Final Report

Queensland Coal Mine Workers' Cancer and Mortality Study

School of Public Health & Preventive Medicine

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1. Summary

1.1 Background

Coal mine workers are exposed to coal mine dust (including silica), diesel engine emissions, solar radiation and other occupational exposures which may affect their mortality and risk of cancer. The extent of exposure differs by job within the industry, era of exposure and type of mine.

Following a health survey of coal mine workers in 1982, mandatory pre-employment and periodic medical examinations were introduced for the Queensland coal mining sector. Coal mine workers now have medicals at least 5-yearly and the data are reported to and collated by Resources Safety and Health Queensland (RSHQ).

The aim of the study was to identify whether mortality and cancer incidence among coal mine workers in Queensland were elevated so that, where necessary, exposure control measures could be targeted to reduce the future burden of cancer and mortality in this population.

1.2 Methods

The medical registration data that have been collected by RSHQ were provided to Monash and were used to form a cohort of Queensland coal mine workers. The cohort data were checked, cleaned and linked to the Australian death and cancer registries held by The Australian Institute of Health and Welfare (AIHW) to identify those diagnosed with cancer and/or were deceased. Death data were nationally complete from 1980 until end of 2020 and the cancer incidence data from 1982 to end of 2016.

The coal mine workers were grouped into four mine Site Types: open cut, underground and coal handling preparation plant (CHPP) and Unknown. They were also grouped by Work Category such as Office (Administration), Production, Maintenance and Construction and more specific Job Groups such as Dragline operators, Diesel fitters or Miners.

To determine whether the rates of death and cancer incidence in this cohort were elevated, the cohort mortality and cancer incidence were compared (i) to the Australian general population rates to obtain age-sex standardised mortality ratios (SMR) and cancer incidence ratios (SIR); (ii) within the cohort giving relative mortality and cancer incidence ratios (RMR and RIR, respectively). The ratios were calculated for overall mortality and cancer incidence as well as for specific causes of mortality and types of cancer. Separate risks were calculated for men and women. Melanoma incidence, overall deaths, all-malignancies, suicide and accidental deaths were also compared to Queensland rates. Results were also reported by Work Categories and Job Groups.

SMRs and SIRs were also calculated by likely duration of employment, by time since first employment and age group. Smoking data were available for more than 99% of the cohort, and were used, together with age, to adjust the calculated RMRs and RIRs.

RSHQ also provided data on respirable crystalline silica, total respirable dust and diesel particulate matter that had been collected in coal mine workplaces for a range of Similar Exposure Groups (SEGs) jobs between 1999 and 2022. These data allowed identification of Job Groups and Work Categories with higher exposure. However, exposure data could not be attributed to individual workers as complete job histories were unavailable. Instead, RMRs and RIRs were calculated for Maintenance, Production and Construction Work Categories as they were likely to be the most exposed workers.

As the National linkage only went until 2016, the cohort were also matched to the Queensland Cancer Registry which was complete to the end of 2020.

The research was granted ethics approval by Human Research Ethics Committees of Monash University, the AIHW and Australian State and Territory Cancer Registries.

1.3 Results

There were 164,622 men and 24,389 women in the cohort with 2,132,340 and 253,567 person-years of follow-up respectively. The cohort was relatively young, with an average age of less than 60 at the end of follow-up, so relatively few cancers and deaths have occurred. The average age at first health assessment was similar for men and women, around 30.

The national linkage identified 4,957 deaths and 5,940 cancers among men and 211 deaths and 427 cancers among women in the cohort. The data do not identify whether or not the cancers or deaths were work-related.

1.3.1 Overall Mortality

There was significantly reduced overall mortality (19% reduction for men and 25% for women) and significantly reduced mortality from all malignancies for male and female coal mine workers compared to expected numbers from the general population with the same age distribution, (Figure 1). Mortality from most causes of death was reduced and, among men, many causes were statistically significantly reduced. No significant excess mortality was observed among women but numbers were small as shown by the wide confidence intervals.

Analysis of mortality by Site Type showed that the SMRs[1] were similar for workers at CHPPs, underground and open cut mines but higher for the male workers where the Site Type was Unknown (often reported as “Various Sites” or “Unknown” in the data).

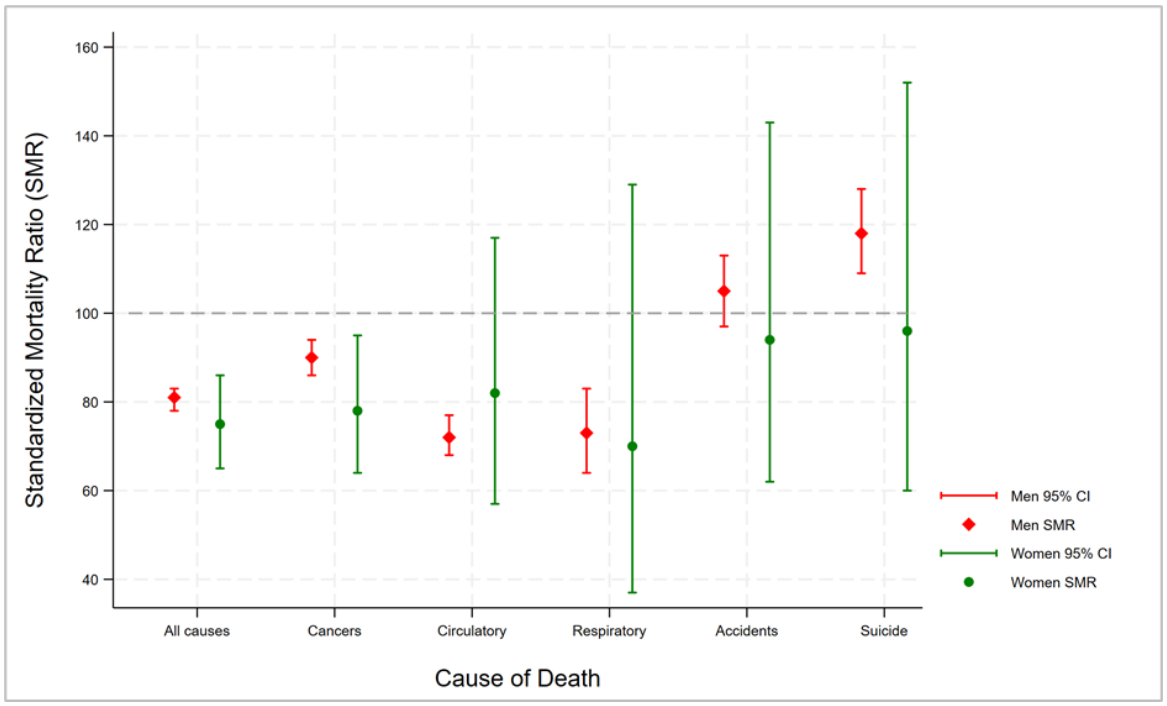


Figure 1: Age Standardised Mortality Ratios (SMRs) for selected causes of death

[1]An SMR or SIR of 100 means that the risk is the same as for the general population, a ratio of more than 100 indicates a greater risk than the general population and a ratio of less than 100 suggests a risk lower than for the general population.

1.3.2 Overall Mortality by Work Category

Figure 2 shows that overall mortality was decreased for men in most Work Categories except Unexposed Non-Office workers, Construction workers and Exploration Drillers where it was the same, or similar to, that of the general population.

The smaller numbers of women gave rise to wide confidence intervals, but mortality was decreased for female Administration and Maintenance workers and likely decreased for Production workers.

When compared with the rest of the male workers in the cohort, after adjustment for age and smoking status, men who had been Administration workers, Occasionally exposed workers or ever Maintenance workers had reduced overall mortality.

When compared to the rest of the female workers in the cohort, after adjustment for age and smoking, the relative mortality was not significantly increased or decreased for women in any Work Category.

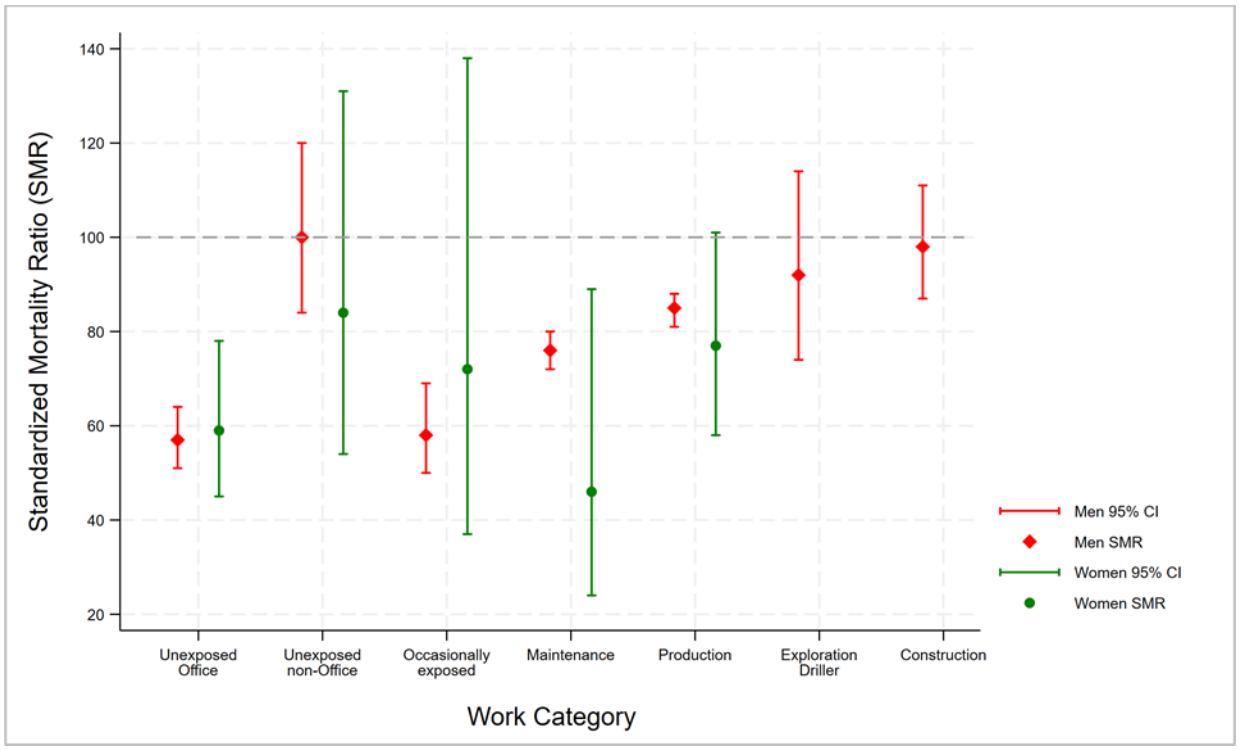


Figure 2: SMRs for all causes of death combined, by sex and Work Category

1.3.3 Mortality by Specific Causes of Death

These data include all deaths, including accidents and suicides, among cohort participants whether they occurred during or outside working hours and before or after retirement/separation from the industry in Queensland.

Figure 3 presents mortality for men in the cohort who worked in the Production, Maintenance and Construction Work Categories by selected causes of death compared to the general population. Production and maintenance workers had reduced risks of death from most causes. Construction workers had somewhat higher risks than Production or Maintenance workers. The risk of death from accidents and suicides were higher than other causes and these are discussed further below.

The Construction Work Category was smaller than the others resulting in wider confidence intervals. For example, risk from respiratory diseases in Construction workers is based on 10 deaths, while there were 66 Maintenance and 86 Production worker deaths.

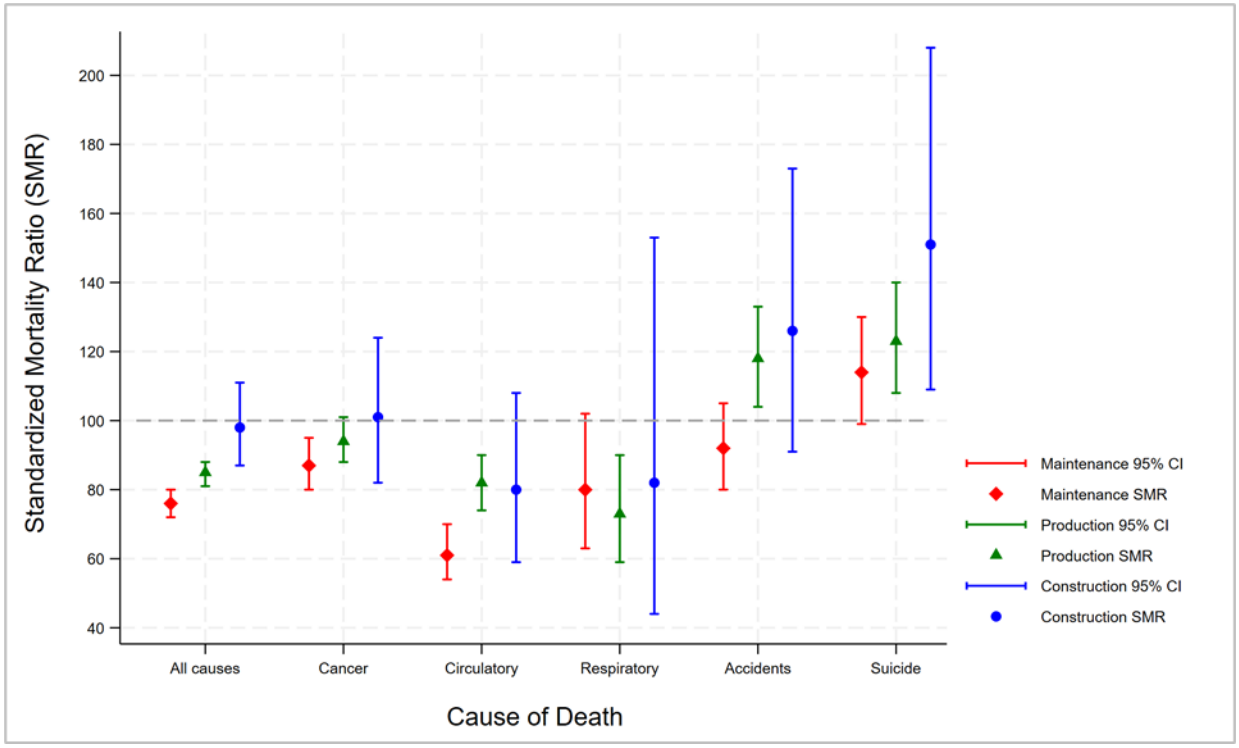


Figure 3: SMRs for selected causes of death for male Maintenance, Production and Construction workers

Some findings on causes of death by Work Categories among men and data on women have been omitted from the Figures in this Summary because numbers were small or they showed no difference to the general population. However, they are reported in full in Section 9.

Figure 4 shows the RMR[2] or relative mortality of the men in three Work Categories when compared to the rest of men in the coal mine worker cohort. The estimates were adjusted for age and smoking.

Cancer mortality did not differ between the Work Categories for men. Maintenance workers have a reduced risk of circulatory disease and accidents and an increased risk of respiratory disease mortality compared to the rest of the cohort. Production workers have an increased risk of death from circulatory disease and accidents. Construction workers have an elevated risk of death from digestive disorders (12/14 deaths were from liver disease), but these are small numbers.

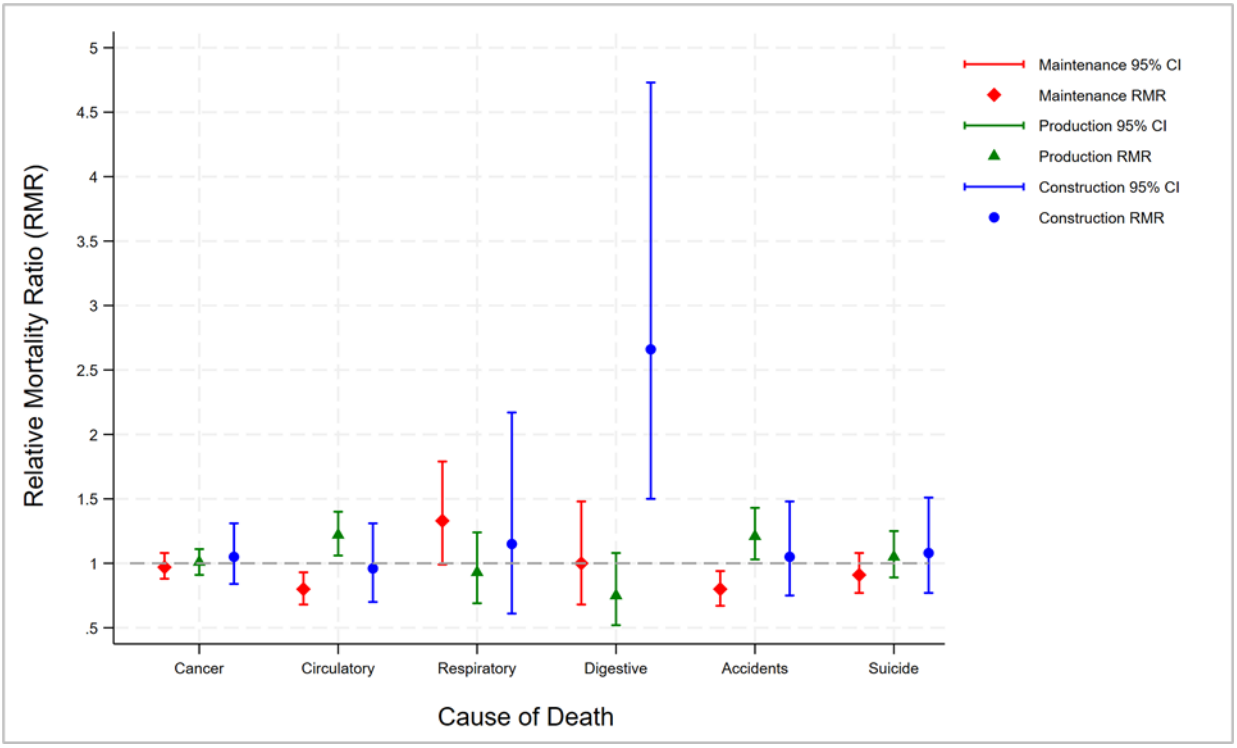


Figure 4: Selected Relative Mortality Ratios for the comparison between male Maintenance, Production and Construction workers and other male cohort members

Suicide

Of the specific causes of death, only suicide was statistically significantly increased among men when compared with the general population (Figure 1) but not significantly increased when compared to the Queensland population SIR 96 (95%CI 89 – 104). AIHW data show that the suicide rate was higher in Queensland than in the general Australian population. Suicide risk is

[2]An RMR or RIR of 100 means that the risk is the same for the specific group within the cohort as for the comparison population within the cohort, a ratio of more than 100 indicates a greater risk than the comparison population and a ratio of less than 100 suggests a risk lower than for the comparison population.

higher for rural and remote areas and this may underlie the difference in State rates and account for at least some of the increases observed in the cohort.

Men under the age of 65 were more at risk of suicide than those over the age of 65, and more at risk soon after their first assessment than five years later, when compared with the general population. Those whose first assessment was after 2010 appeared more at risk than those recruited in previous decades. These rates are compared to era and age standardised rates in the general population, so take account of background changes in the general population.

Compared to the general Australian population, suicides were increased for some Work Categories, notably male Maintenance, Production and Construction workers (Figure 3). When compared to Queensland rates the risks were not increased for Maintenance or Production workers but remained somewhat elevated for Construction workers (SMR 121 (95%CI 87 - 169).

When compared to the Australia population, the suicide risk was increased for female Production workers and for men in many Job Groups including Shutdown Maintenance workers, Boilermakers, Tyre fitters, Operators and Truck Drivers (nec) [3].

Comparisons within the cohort showed that the suicide rate among male Shutdown Maintenance workers was increased in comparison with the rate among other men who ever worked as a Maintenance worker. Female cohort members who ever worked as Production workers had an over three-fold higher risk of suicide compared to other female coal mine workers.

Accidental Deaths

Overall, the rate of accidental deaths in the cohort (for both men and women) was similar to that of the general population (Figure 1) although somewhat increased in male cohort members but the confidence intervals included 100. This increase is not seen when accidental deaths are compared to the Queensland data. Almost 60% of the accidental deaths were from transport accidents and driving distances are often higher in rural areas such as Queensland. This may mean that there is more opportunity for road accidents in this cohort than in the general Australian population.

The data do not identify the reason for travel, e.g. to or from work, at work or during leisure time.

Figure 3 shows that for men, accidental deaths were increased for Production (significantly increased) and Construction workers but probably not for Maintenance workers compared to

[3] nec indicates that the job could not be classified into a specific Work Category e.g. Maintenance or Production.

the Australian population. The rates were also higher for Truck Drivers (nec), Labourers and for male and female Cleaners when compared to the general population.

Figure 4 shows that the accidental death rate was significantly higher among men who had ever been Production Workers when compared to other men in the cohort. Female Production workers had a similar risk of accidental death as other female cohort members. Women who worked as Cleaners (nec) however were three times more likely than other women in the cohort to experience accidental death. Other within-cohort comparisons showed increased accidental deaths for Truck Drivers compared to the rest of the cohort.

When examined by duration of employment, compared to the general population, an increased risk of accidental death was seen for all male coal mine workers with less than 5 years employment but those with more than 15 years employment showed a significant reduction in risk. The decrease in risk with years of employment has a statistically significant trend. A similar pattern was seen for male Production workers.

Respiratory Disease Mortality

Deaths from respiratory diseases were reduced for men and women in the cohort, significantly so for men when compared to the general population (Figure 1). Figure 3 shows similar point estimates for respiratory disease mortality among male Maintenance, Production and Construction workers but the risk was only significantly reduced for Production workers. For male Maintenance and Production workers, the risk was higher for those employed for more than 10 years. Deaths from *Lung Diseases due to Dust*[4] were significantly higher under 65 years, but not in the older group, but numbers were small (n=6).

There were no significant differences in risk from comparisons within the cohort for men or women but numbers were small.

Circulatory Disease Mortality

Deaths from circulatory disease (specifically ischaemic heart disease (IHD)) were overall reduced for men and women in the cohort, significantly so for men (Figure 1) and particularly reduced for male Production and Maintenance workers (Figure 3). However, IHD was significantly increased for men who had worked for 5 or fewer years in the Unexposed Blue Collar Work Category, for male Labourers, male Production Drillers (general) and for Exploration Drillers particularly 15 years or more after their first assessment.

[4] This includes coal workers' pneumoconiosis, asbestosis, silicosis etc. The classification is drawn from the death certificate.

Compared to other cohort members, after adjusting for age and smoking, male Maintenance workers had a reduced risk of circulatory disease but the risk was increased for Production workers. Drillers (general), Unexposed Non-Office workers and Labourers (nec) had an increased risk after adjustment for age and smoking. Within Production, underground miners had a reduced risk of death from circulatory disease.

1.3.4 Overall Cancer Incidence

In this cohort, compared to the Australian population, overall cancer incidence was as expected i.e. the same as that of the general population for women SIR 99 (95% CI 90 - 108) but increased for men SIR 107 (95% CI 104 - 109) (Figure 5). Overall cancer incidence was somewhat higher for all site types except CHPP.

Overall cancer mortality was significantly reduced (Figure 1) for men and women and specifically in male Maintenance workers and probably also for male Production workers (Figure 3).

Cancer incidence includes almost all the cancers that are diagnosed except the common skin cancers. However not all cancers are fatal, and there can be a difference in the fatality rate between populations depending on, for example how early the cancer is identified or the effectiveness of any treatment provided, which may also depend on the general underlying health of the individual.

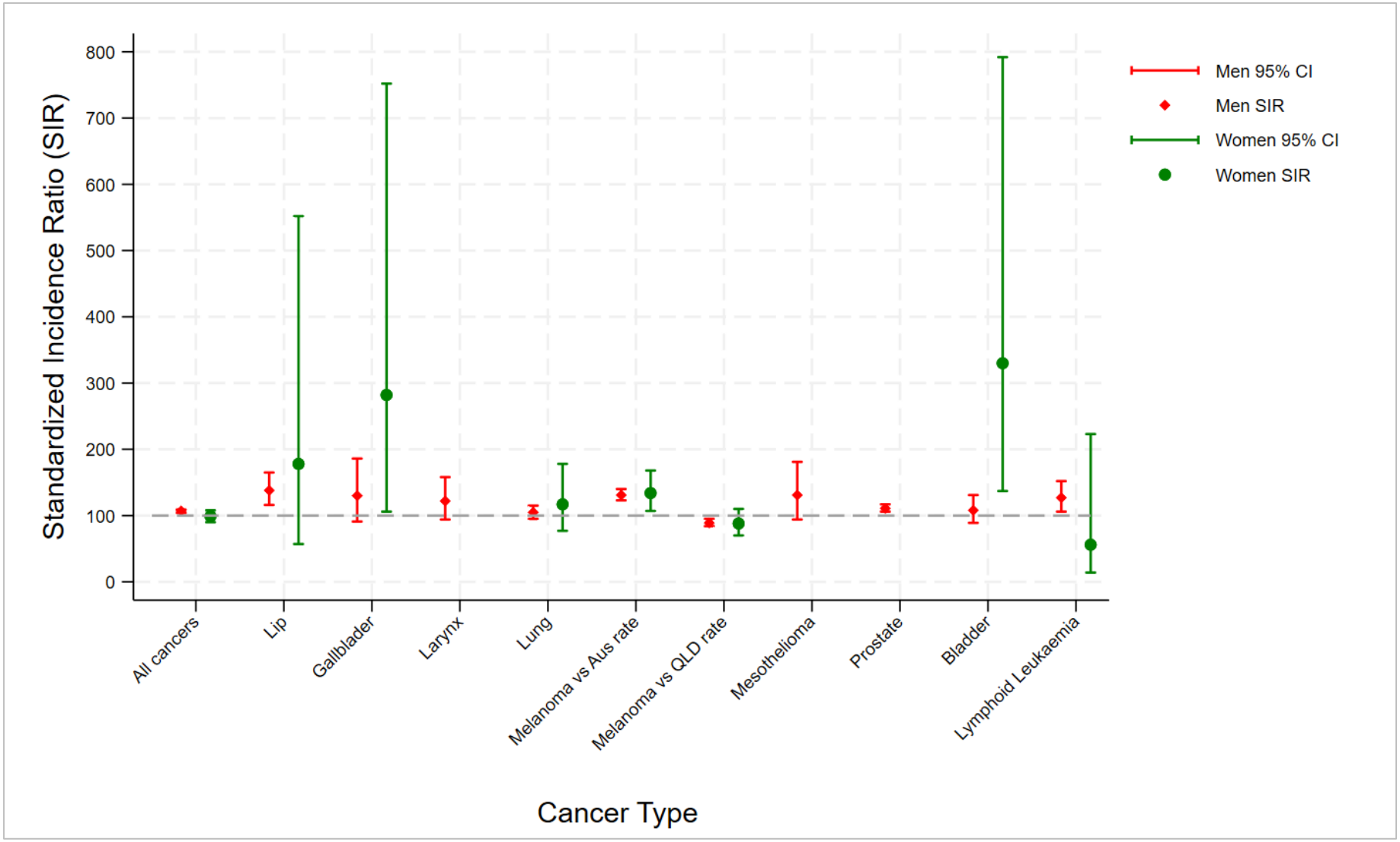


Figure 5: Standardised Incidence Ratios (SIRs) for selected cancers, by sex

1.3.5 Overall Cancer Incidence by Work Category

Figure 6 shows that the SIRs for all cancers combined were as expected for men in the Administration, Occasionally exposed and Construction Work compared to the general population. There was a small but statistically significantly increased risk of overall cancer for male Production Workers compared to the general population. Other Work categories had somewhat elevated overall cancer SIRs.

The all cancer SIR was decreased for female Maintenance workers and Production workers.

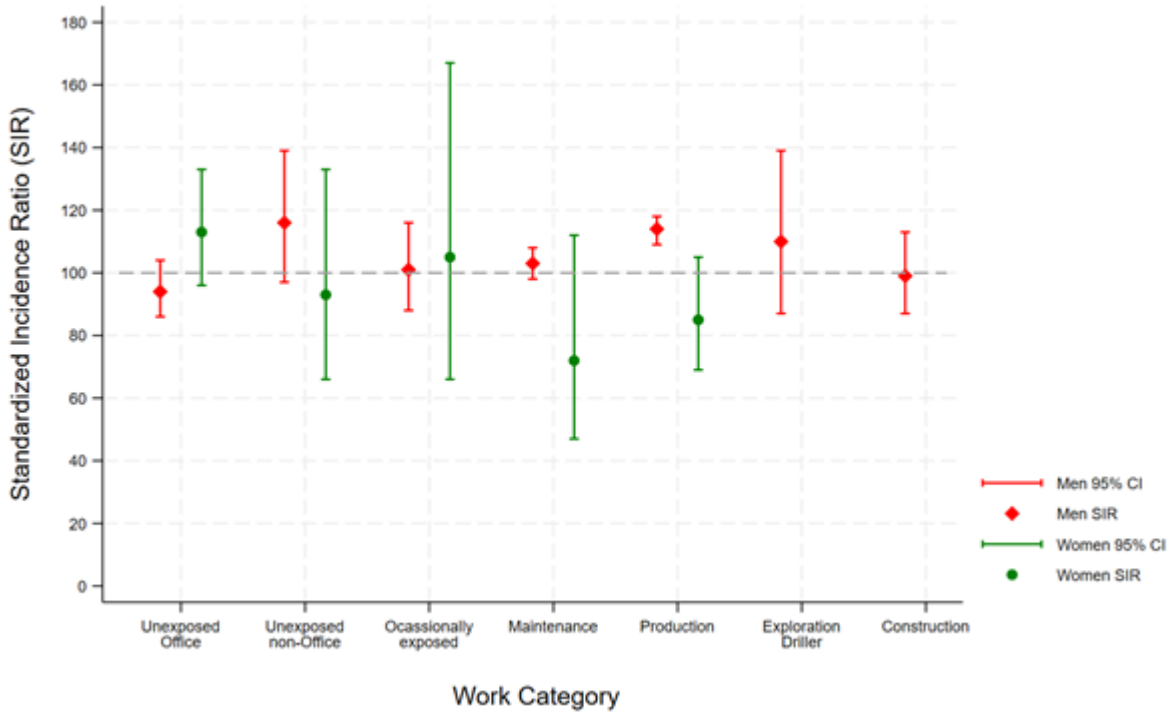


Figure 6: SIRs for all cancers combined, by sex and Work Category

1.3.6 Incidence of Specific Cancers by Work Category

Figure 7 shows the cancers that were elevated (not necessarily statistically significantly so) in male Maintenance (lip, gallbladder, larynx, melanoma, mesothelioma, prostate); Production (lip, larynx, lung, melanoma, prostate, urinary tract, leukaemia); and Construction workers (pharynx, colorectal, gallbladder, larynx, lung, melanoma, mesothelioma).

Compared with the rest of the cohort, male Production workers had increased risk of several cancers but after adjustment for smoking and age, only prostate and the miscellaneous group of Other cancers were significantly increased (Figure 8).

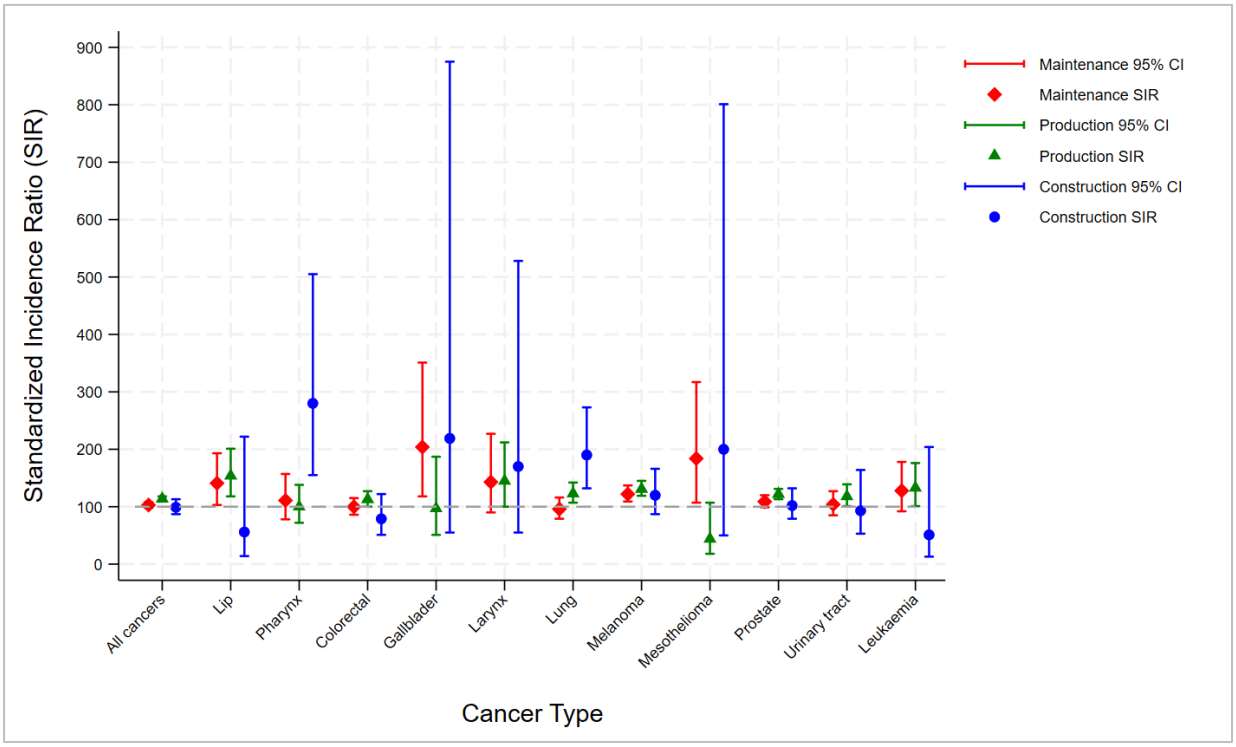


Figure 7: SIRs for selected cancers in male Maintenance, Production and Construction workers

Most cancers were at expected rates among female coal mine workers. However, female Administration workers had an increased risk of overall cancer after adjusting for age and smoking compared to other women in the cohort. Women coal mine workers had an increased risk of gallbladder cancer and this rare cancer was also elevated in men (Figure 5), particularly among male maintenance workers.

There were several cancers showing increased risk in only one group of workers. For example, Labourers and Shutdown Maintenance workers had an increased risk of liver cancer, Supervisors and Dragline operators of testicular cancer, and Dragline operators of urinary tract cancers when compared to other workers. This could be a result of the large number of

comparisons resulting in some chance findings or there could be specific but unexplained risk factors.

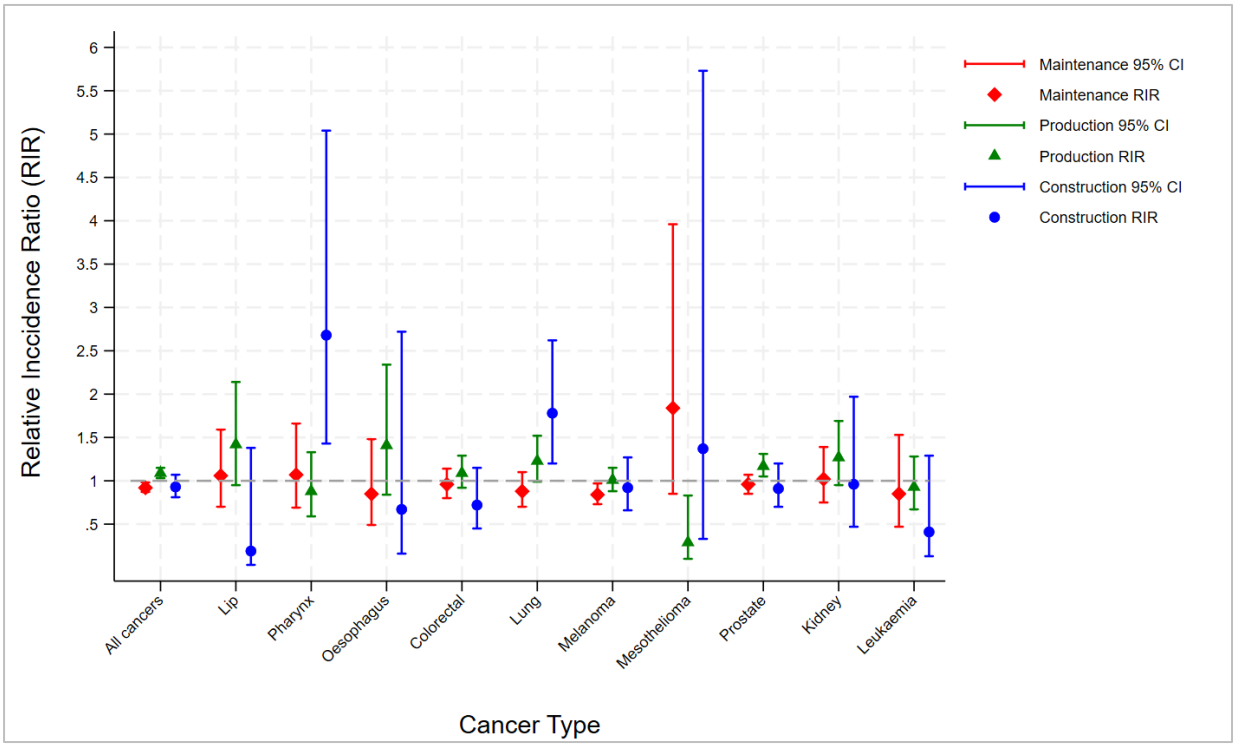


Figure 8: Relative Incidence Ratios (RIRs) for selected cancers for male Maintenance, Production and Construction Work Categories compared with other workers

1.3.7 Specific Types of Cancer

Overall, when compared to the general population, men had significantly increased incidence of cancer of the lip, melanoma, prostate and lymphoid leukaemia (Figure 5). Cancers of the gallbladder, larynx, lung, bladder and mesothelioma were also elevated among men.

In women, cancers of the female reproductive organs were significantly reduced, but melanoma and cancers of the bladder and gallbladder were significantly increased, based on small numbers. Breast cancer incidence was not increased and breast cancer mortality was significantly reduced for women.

Lung Cancer

Lung cancer incidence was significantly increased for male Construction and Production workers (Figure 7). Within Production, lung cancer mortality was higher for those who ever worked as Drillers (general) or Operators compared to the general population.

Lung cancer was also increased for male Construction and Production workers when compared to other members of the cohort after adjusting for smoking and age (Figure 8). When compared with all other maintenance workers, lung cancer was significantly increased for the Shutdown Maintenance Job Group.

Lung cancer mortality, but not incidence, showed a significant trend, increasing with time since first assessment. When split by age, significantly increased lung cancer incidence was observed for men 65 years and above, but not among the younger men.

Laryngeal Cancer

Laryngeal cancer incidence was significantly increased for male Production workers, and specifically for underground Miners and Drillers (general) compared to the general population.

No excess lung or laryngeal cancers were observed among women in internal or external analyses, but numbers were small.

Melanoma

There are regional differences in melanoma (a serious skin cancer) rates in Australia. Rates are higher in Queensland than in some other states. Figure 5 includes the melanoma risk compared to national rates and to Queensland rates.

Melanoma incidence, but not death, was significantly increased among men and women when compared to national rates. However, there was no increase for either men or women when compared to Queensland melanoma incidence (Figure 5). For men and women, the risk was highest within five years of first employment in the industry.

Compared to the national population, melanoma risk was increased for both male and female Administration workers, and men who were Occasionally exposed workers (which includes engineers, geologists and surveyors) and for Maintenance and Production workers (Figure 7), Exploration Drillers, Supervisors and Truck Drivers.

Male Maintenance workers were less likely to have a melanoma diagnosed than other cohort members (Figure 8). Male electricians and Drillers (general) had an increased risk of melanoma compared to other Maintenance and Production workers respectively.

Cancer of the Lip

An increased incidence of cancer of the lip was seen for both men and women (Figure 5). The increase was significant for men who were Maintenance workers, Production workers (Figure 7) and Exploration Drillers compared to the general population.

Internal analyses did not show different risks between Work Categories after adjustment for smoking and age although the risk for Production workers was increased even after adjusting for age and smoking status (Figure 8).

Mesothelioma

Pleural mesothelioma is a rare cancer of the membrane lining the chest wall. No cases of were identified among women. When compared to the general population, mesothelioma incidence was raised for men in the cohort (Figure 5). For Maintenance workers the incidence was significantly raised (Figure 7). Construction workers had a higher point estimate but the increase was not statistically significant, likely reflecting a smaller population.

When compared to the rest of the cohort, mesothelioma incidence was raised but not significantly so for Maintenance and Construction workers (Figure 8). Maintenance (general) are maintenance workers who could not be allocated to a more specific job e.g. fitter. These workers had a threefold increased risk of mesothelioma when compared to the rest of the Maintenance workers.

Cancers of the digestive tract and pharynx

Cancers of the pharynx (throat) were significantly increased among male Construction workers (Figure 7) and in male Dragline operators when compared to the general population and also in internal analyses adjusted for age and smoking (Figure 8).

Male Boilermakers had a threefold increased risk of oesophageal cancer compared to other Maintenance workers.

There was a significant excess of colorectal cancer in workers categorised as Unexposed Non-Office jobs and for male Production workers compared to the general population. When

compared to other Production workers, members of Blast Crews had an increased risk of colorectal cancer. Rectal cancer was increased for female coal mine workers who had worked as Cleaners.

Lymphoid and Haematopoietic (Blood) Cancers

There was a significant excess of lymphoid leukaemia for men but not for women in the cohort when compared to the general population (Figure 5). This increase was seen in the Maintenance and Production Work Categories but not Construction (Figure 7) and was specifically seen among Labourers, Supervisors and Truck drivers.

Compared to other Maintenance workers, Diesel fitters had a nearly four-fold increased risk of Hodgkin Disease and double the expected risk of Non Hodgkin Lymphoma (NHL) but absolute numbers were small.

Prostate cancer

Compared to the general population, prostate cancer incidence was increased for men in the cohort (Figure 5), but mortality was not. The increase was significant for Maintenance workers (Figure 7) and for underground Miners and Dragline operators. There was a statistically significant trend in prostate cancer with increasing years of employment as measured by time between first and last assessment. These risks were age adjusted so are not explained by differences in age between the groups.

Internal analyses showed an increased risk of prostate cancer for Production workers compared to the rest of the cohort even after age and smoking adjustment (Figure 8).

1.3.8 Findings from the Post 2017 Queensland Cancer Registry Match

The cancer incidence data from linkage with the Queensland Register (2017 to 2020) identified 2795 men and 145 women with a cancer diagnosis. When compared to national expected rates, the overall risk of cancer was not raised for men or women. Among men, pharyngeal cancer and melanoma rates were increased, but not lip or prostate cancer. Among women, melanoma, lung and cervical cancer were increased.

The cohort matched to the QCR Registry post 2016 has a different demographic make from that matched between 2016 and 2020 with more young people, more women and fewer older men. Additionally, there was a much shorter follow up for many cohort members. As the underlying cohort is different, findings are not directly comparable to those from the main linkage. Among the considerations are that the Healthy Worker Effect is stronger among the more recently employed, prostate cancer is much more likely in older men and there have been changes in the rates of cancer diagnosed in Australia over time.

1.3.9 Exposure

The data about measured exposure for respirable dust (RD), respirable crystalline silica (RCS) and diesel particulate matter (DPM) covered the period 1999 to 2022. Mean yearly average exposures were below the relevant Workplace Exposure Standards (WES) for most jobs except underground Production workers and Exploration Drillers.

RCS exposure was generally low, less than 0.02 mg/m^3 for most jobs and the levels of exposure were generally constant over the period of the measurements. Maintenance workers showed possible trends of higher RCS exposure before 2005, but average exposure in most years was less than 0.02 mg/m^3. Underground mine workers showed a reduction in exposure over the period with average RCS likely above 0.05 mg/m^3 until around 2000 and then at about 0.02 mg/m^3 until around 2016. Exploration Drillers had very variable exposures which have greatly reduced over the period from over 0.2 mg/m^3 in 2004.

RD exposure was generally low for most jobs other than those underground, averaging less than 0.5 mg/m^3, (typically less than 0.02 mg/m^3). Open cut maintenance workers showed a possible downward trend over the period.

Underground (UG) mine production workers had exposures above the RD WES of 1.5 mg/m^3, averaging more than 2 mg/m^3 in 1999, but halving by 2022. Exposure measurements appeared to be higher between 2013 and 2015, reducing particularly after 2016. The ERZ [5] and underground maintenance workers had similar average RD exposure, falling from about 1.5 mg/m^3 in 1999 to less than 0.5 by 2022. Exploration Drillers had very variable exposures which have greatly reduced over the period from around 4 mg/m^3 in 2004.

Dust exposure data were not available before 1999 but trend lines suggest that exposure would have been higher for underground workers, Exploration Drillers and some maintenance workers.

Fewer exposure data were available for DPM than for coal mine dust. Exposure was likely higher underground than above ground. However, exposure to DPM was typically below the Queensland occupational exposure limit of 0.1 mg/m^3.

[5] An ERZ is underground Explosion risk zone (ERZ) controller who may also be called Mine Deputy

1.4 Discussion

There were several cancers and causes of death that were increased, particularly for men in some specific Work Categories. However, the number of calculated risk estimates was large. For some outcomes, an increased risk was seen in one only group of workers. This could be a result of the large number of comparisons resulting in some chance findings or there could be unexplained risk factors. It is important, therefore, to look at the overall patterns of results, rather than focus on single isolated findings when interpreting the study results.

Male Production workers showed an increased risk in overall cancer and of some specific cancers including prostate and lung cancer in external and internal analyses and of colorectal and laryngeal cancer in external analyses. Construction workers had an increased risk of pharyngeal and lung cancers.

An increased risk with increasing duration of employment (or exposure) would suggest that the risk was employment related. Most of the major categories of cause of death were significantly reduced, no matter for how long the individuals worked.

However, deaths from accidents and suicides both show a monotonic decrease with increasing length of employment (as measured by time between first and last assessment). The risks are not elevated compared to the Queensland population data. Other studies have shown that suicide rates in the Australian mining industry have been increasing since 2011. However, many workers in this study had not worked for a long period (as judged by the time between assessments). Only 5,833 of 61,309 (10%) maintenance workers had worked for more than 15 years.

Male coal mine workers aged under 65 and those over 65 had similar patterns of mortality, with many causes of death significantly reduced. The mortality rates in the older group were somewhat closer to that of the Australian population for some causes of death, but lung cancer and mesothelioma deaths were higher than expected.

Deaths from all cancers were similar to population rates for those with more than 10 years since their first assessment. Although monotonic increases with years since first employed were seen for respiratory and digestive causes of death.

1.4.1 Choice of population reference data

In interpreting the results of this study, it is important to consider the impact of the Healthy Worker Effect, the choice of comparisons and the data limitations.

The choice of the comparison population is important in accurately assessing the risk of cancer and mortality. Australian Bureau of Statistic (ABS) data show that between 1983 and 2002, the

overall male death rates in Queensland for those aged 15 to 85+ were similar to those of the general Australian population. Queensland is a large state which may result in more driving to get from place to place for both occupational and non-occupational reasons. This may result in higher risk of death from motor vehicle accidents and these may not take place at work e.g. they occur when commuting to or from work and/or during leisure time. ABS data show that between 1980 and 2021, the male accidental death rates in Queensland for those aged 15 to 85+ were on average 10% higher than the general Australian population. The accident and suicide rates for men were not in excess in this cohort when compared to Queensland data.

The cancer incidence of the cohort and its subgroups were compared to the Australian population after standardising for age. However for melanoma, Queensland specific rates were also used in the overall melanoma risk estimation as a more appropriate comparison than Australian national rates, because of greater UV exposure in the northern state. When this was done, the overall melanoma rate was no longer in excess for men or women (Figure 5).

1.4.2 Healthy Worker Effect

When the mortality of occupational cohorts is compared with that of the general Australian population, the mortality rate in the occupational cohort is typically lower. This is the well-established “Healthy Worker Effect”.

One cause of the Healthy Worker Effect is the relative social and economic advantage of employed people. Another factor is that people with life-threatening conditions, such as cancer and other chronic illnesses which increase the risk of death, are less likely to enter the workforce after diagnosis, further lowering the mortality rate in the workforce compared with the Australian population. This Healthy Hire Effect may be compounded by the Healthy Survivor Effect whereby those who become ill leave the workforce.

However, there was little difference between the mortality of the whole cohort and the mortality calculated after excluding recently recruited workers. It appears that the low death rates were not solely attributable to the Healthy Worker Effect, however the short follow-up for many workers means that this could not be ruled out.

1.4.3 Strengths of the study

The cohort was compiled from health assessments provided to RSHQ from health providers and from the Rathus and Abrahams survey and are a near complete record of all Queensland coal mine workers employed after 1982, hence the ascertainment bias is small to negligible. There were 24,389 women in the cohort with 253,567 person-years of follow-up. This is much

larger than any other coal mine worker cohort, where few if any women have been included. Unfortunately, for analysis purposes, few women have worked for more than 5 years in the industry.

Smoking is a significant contributor to many causes of death and cancer incidence, so having smoking data was a major asset in this study. Smoking data were captured in all assessment types, and were available from at least one assessment for over 99% of participants in the cohort and used to adjust the internal analyses.

Cancer and death registration is mandatory in all Australian States and Territories, and registration is virtually complete. Matching the cohort names to those in the national death and cancer registries was a probabilistic process. The availability of middle names and dates of last known employment from RSHQ records improved the probability of a correct match to the national registries.

1.4.4 Limitations

The power of this study to determine risk associated with cancer or specific causes of death was limited by the small numbers for the less common causes of death and cancers and the smaller Job Groups. Lack of power could be seen in the wide confidence intervals around some risk estimates, particularly for women, consequently, one death or cancer more or less than expected could have a big effect on the risk estimate.

The cohort was relatively young, with an average age of less than 60 at the end of follow-up, so relatively few cancers and deaths have occurred. The average age at the start of the cohort was similar for men and women, around 30. The average age for those who had died was about 53 for women and 57 for men. The average age for coal mine workers with cancer was 47 for women and 56 for men. Additionally, many workers only entered the cohort recently, with 81% of men and 93% of women having their first assessment in or after 2003, so there was a short follow-up period for many individuals. The majority (91%) of first assessments took place between 2000 and 2019 and 50% of first assessments were between 2010 and 2019.

These limitations mean that it was only possible to identify relatively large increases or decreases in specific cancers or causes of death. The study was sufficiently powered to identify significantly increased risks of most major cancer and death categories for male coal mine workers but not for female coal mine workers.

The precise start and end dates of employment as a coal mine worker in Queensland were not available but were approximated from the dates of their first and last assessments. Another limitation of the study was that data were entered from assessment forms, including from free

text which could have resulted in data entry errors. However, comprehensive data cleaning was conducted.

Job titles were only collected after 1993 which meant that pre-1993 data could not be used in the job specific analyses, which in turn reduced follow-up and thus statistical power. There were 49,490 unique job titles which were grouped into Job Groups and Work Categories and this process may have introduced job misclassification. Steps were taken though to minimise this bias though discussions between the researchers, RSHQ and the Advisory Committee.

As Site Type (i.e. either open cut or underground) was determined using mine names, some names were recorded as “Unknown” or “Various” for around 55% of the health assessments hence the worker/jobs could not be assigned to a specific site type.

Prostate cancer and melanoma incidence were increased, but mortality was not increased. This difference could have resulted from a diagnostic bias, coal mine workers being more likely than the general population to be screened or this could be increased survival as a result of, for example, better general health or earlier access to treatment or access to better treatment.

The study identified some significant differences in cancer and mortality between Work Categories and Job Groups. However, detailed job histories and complete exposure data were unavailable, so that exposure-response relationships could not be calculated on an individual basis.

There were potential confounding factors that could affect the observed risk estimates for some cancers and deaths, and which could not be measured or accounted for in this study design including individual genetic, or lifestyle factors. Aboriginal and Torres Strait Islander status was not recorded and therefore could not be investigated.

1.4.5 Further research

There have been relatively few deaths and cancers so far because the cohort is relatively young and has a high proportion of current employees. As the cohort ages there will be increased precision in the risk estimates with increased numbers of cancer and death events. Future linkages, which could be undertaken in a very cost-effective manner, would be likely to give more robust estimates of cancer and mortality risk.

The risks of cancer and mortality could be further explored when more person-years have accumulated for underground miners and Exploration Drillers in particular, where there is known to have been higher exposure in the past.

The investigation of other important health outcomes, such as reduced lung function or mental health outcomes, would need a different research methodology. Suicide is a very serious problem, but is an inadequate overall measure of mental health problems. Linkage of the cohort with other public health data sets, such as public hospital admissions data, could provide some insight into mental and other health problems which cause important morbidity, but not death.

1.5 Conclusions and main findings

When compared to the general Australian population, the overall mortality and cancer mortality of the cohort was significantly reduced for both men and women. The overall cancer incidence results showed a significant increase in cancer incidence for men but not for women.

Neither mortality nor cancer incidence differed greatly between open cut and underground mine types. Mortality was lower than expected for men and women in Unexposed Office, Occasionally exposed, Production and Maintenance Work Categories and somewhat lower for workers in most other groups except Unexposed Non-Office workers. Circulatory and respiratory causes of death were reduced for male Maintenance and Production workers and likely also for Construction workers.

Suicide and accidental deaths were not higher than expected for men in the cohort when compared to Queensland data but were elevated compared to the general Australian population. Suicide was higher than expected for younger men in the cohort and for those recruited after 2010. It was higher in several job categories including for Maintenance, Production and Construction workers.

Accidental deaths were higher than expected for men in the Production and Construction Work Categories and for Truck Drivers (nec), Labourers and for male and female Cleaners. The risk was higher for male coal mine workers with less than 5 years employment. Those with more than 15 years employment showed a significant reduction in risk.

Melanoma and prostate cancer incidence were higher than expected compared to the general Australian population, but mortality rates were not elevated. This may indicate increased screening and/or treatment in this population. Melanoma rates were not elevated when compared to the Queensland population.

Lung cancer incidence was significantly increased for male Construction and Production workers compared to the general population and within the cohort after adjusting for smoking. Within Production, lung cancer mortality was higher for those who ever worked as Drillers (general) or Operators compared to the general population. These Job Groups are among those with the highest dust exposure.

Gallbladder cancer, although rare, was increased among both men and women. Mesothelioma rates were increased for male Administration, Maintenance and Construction workers.

Lung cancer and mesothelioma rates were higher in the older workers, however only the former was statistically significant. Overall mortality from respiratory disease was reduced but within this group, there were 6 deaths coded by AIHW as *Lung Diseases due to Dust*. The risk was significantly higher in the younger age group, but not in the older group.

The measured data suggests that exposure to RCS and RD has been relatively low for most Jobs over the last 20 years. Exposure before 2000 may have been higher for underground Production workers, some maintenance workers and Exploration Drillers.

The analyses here were based on small numbers for several less common cancers, such as bladder cancer and for most Job Groups. The findings for female coal mine workers often had wide confidence intervals and so the point risk estimates should be interpreted cautiously.

While this study has many strengths, including the large size, especially for male coal mine workers, the smoking data and the ability to access nationally complete death and cancer databases, there were also some limitations. In particular no information being available about other individual lifestyle factors, the use of time between assessments to approximate duration of employment, self-reported job titles and the inability to establish exposure levels for individual workers.

Further follow-up is recommended in five years when the larger number of cancer and death events as the cohort ages will increase the statistical power of the analysis and so provide more precision in the risks of specific causes of death and types of cancer, particularly for the less common cancers.

2. Background to the Study

The mining industry is a major employer in Australia with a large workforce of 43,972 people employed in Queensland in June 2023. Of these 36,570 were employed in open cut or exploration sites and 7,402 in underground mines. [6] The size of the industry has varied over time. The industry includes exploration sites, open cut and underground mines, and Coal Handling Preparation Plants (CHPP) usually co-located with a mine. The workforce may be exposed to many hazardous substances, including respirable coal mine dust (CMD), respirable crystalline silica (RCS), and diesel engine emissions (DEE).

Queensland underground coal mines are thought have a high carbon content (compared to many US mining regions) (Joy, Colinet et al. 2012), but higher silica exposures can occur when mining through rock layers and when drilling or bolting into a stone roof. Open cut mines remove soil and rock before reaching the coal seams, and there is a potential for silica exposure during this process. Data from the USA suggest that workers at open cut mines were exposed to higher RCS concentrations but lower respirable coal mine dust than underground workers. (Rahimi, Shekarian et al. 2023) Australian coal mines are thought to have thicker seams than many US mines so that the rock is less likely to be disturbed leading to lower silica exposure. (Joy, Colinet et al. 2012)

Coal mine workers may also be exposed to physical hazards causing traumatic injury and psychosocial hazards such as remote or isolated work, bullying and harassment which may cause physical or psychological harms. (King, Maheen et al. 2023) The range of hazardous exposures means that mine workers may be vulnerable to chronic respiratory diseases, cancer, cardiovascular disease and psychological impacts, such as anxiety, depression, and in the most severe circumstances, suicide.

A previous cohort study of 23,630 male coal miners from NSW included coal industry workers recruited in or after 1973. This study found that 297 men developed 301 primary cancers in the 20 years of observation. The overall SIR was 182, no specific cancer incidences were significantly increased. (Brown, Christie et al. 1997)

According to the International Agency for Research on Cancer (IARC) (IARC Working Group 2010, IARC Working Group 2012) diesel engine exhaust (e.g. from mine machinery), and silica (e.g. from cutting rock beyond the coal seam and from roof-bolting), are Group 1 Human Carcinogens acting on the lung. Exposure to ultrafine particulates have also been implicated in increased heart disease mortality (Dennekamp, Straney et al. 2015, Wenhua Yu, Yuming Guo et al. 2020, Alexeeff, Liao et al. 2021) including diesel engine particulate. (Thurston, Burnett et

[6] Qld quarterly mine and quarry worker numbers at 30 June 2023 - Qld quarterly mine and quarry safety data - Open Data Portal Queensland Government

al. 2016) The interactions between coal dust, quartz and silicates may lead to a range of pathological changes in the lungs. (Petsonk, Rose et al. 2013, Blanc and Seaton 2016) These incurable but preventable “dust” diseases include the classic fibrotic lung disease coal workers’ pneumoconiosis (CWP) or “Black Lung”, silicosis, mixed dust pneumoconiosis and the more severe progressive massive fibrosis (PMF). (Han, Chen et al. 2018, Newbigin, McBean et al. 2019) Other lung diseases such as chronic obstructive airways disease (COPD), including emphysema and chronic bronchitis have been linked to coal mine dust exposure.(Laney and Weissman, Coggon and Taylor 1998)

The recent re-identification of coal workers’ pneumoconiosis in Queensland (Coal Workers’ Pneumoconiosis Select Committee 2017, Hoy and Brims 2017) is concerning and may have resulted from increased exposure, perhaps from changes in mining technology. (Kizil and Donoghue 2002, Plush, Ren et al. 2012) CWP may also have resulted from higher exposures experienced in the past. The disease may only become recognised years after the exposure, for example in retired workers. (Graham, Vacek et al. 2001) It is possible that other unrecognised occupational diseases may be present among current or former coal mine workers.

Existing Australian data sources on the prevalence of occupational respiratory diseases in coal mine workers are problematic. There were fewer than 5 workers’ compensation claims per million employees for pneumoconioses (excluding asbestosis) from 2000-01 to 2007-08, and no claims from 2008-09 to 2010-11. (Safe Work Australia 2014) However, these conditions may only manifest after retirement, (Graham, Vacek et al. 2001) and may not be recorded on the death certificate. Not all work-related diseases may be recognised as such and may not be claimed for, so there is likely to be significant underreporting in workers’ compensation statistics. Investigation of hospital data admissions from Queensland with the code J60: Coal Workers’ Pneumoconiosis (CWP) showed that the majority of these patients did not in fact have CWP (Monash University and University of Illinois at Chicago 2016). Further most CWP cases are not admitted to hospital. (Monash University and University of Illinois at Chicago 2016).

In 1982, the Queensland Coal Board ordered all current Queensland coal mine employees “engaged in mining or associated operations” to participate in a one-off chest X-ray (CXR) survey (identified in this report as the Survey); retired miners could volunteer to participate. The study identified respiratory abnormalities including 75 cases of pneumoconiosis among 7,784 current and 123 retired employees. (Rathus and Abrahams 1984) At that time, the Board also ordered that all new entrants to the coal industry must undertake CXR and lung function testing as pre-employment medicals.

Then in 1993, a new health scheme was established, overseen by the Queensland Coal Board, requiring both pre-employment medical examinations, and repeat examinations at least once every five years during their employment. Form A was used for the initial (pre-employment medical) and the periodic medical assessments used Form B.

There were changes to the Act and Regulations in 2001, which introduced the current Coal Mine Workers' Health Scheme, with all assessment data submitted to the responsible Queensland Government agency, now called Resources Safety and Health Queensland (RSHQ). This continues to be a requirement under the Coal Mining Safety and Health Regulation 2017 (Qld).[7]

A CXR was required if the worker was deemed to be "at risk from dust exposure" (Monash University and University of Illinois at Chicago 2016) that was extended to all coal mine workers in 2017. The data from these coal mine workers' medicals have been uploaded into a database held by the Health Surveillance Unit (HSU) at RSHQ.

Queensland State regulations allow the use of these identifiable data for research and surveillance purposes. This study was designed to use the data to identify whether rates of cancer and mortality are higher than expected among Queensland coal mine workers, so that occupational exposure control measures can be targeted to reduce the future burden of cancer and mortality in coal mine workers.

The study was funded by the National Health and Medical Research Council (NHMRC) number 1167709 as a Partnership Project between Monash University and RSHQ.

[7] Mining Safety and Health Legislation (Coal Workers' Pneumoconiosis and Other Matters) Amendment Regulation 2016 - Queensland Legislation - Queensland Government

3. Previous findings of mortality, cancer incidence and coal workers' pneumoconiosis in coal mine workers

The scientific literature is briefly summarised here and is discussed in more detail with the relevant outcomes in the Discussion section.

A recent meta-analysis on cancer and mortality in coal mine workers worldwide identified 17 cohort studies, 16 case–control studies and 3 studies of other types. (Alif, Sim et al. 2022) The studies only reported data for male coal mine workers. Most studies described the study population as being coal miners or coal mine workers, (Attfield and Kuempel 2008) while some distinguished between open cut and underground coal miners. (Christie, Brown et al. 1995) Only four papers identified the type of coal being mined, and all four of these identified black coal. (Tomaskova, Jirak et al. 2006, Tomaskova, Jirak et al. 2012, Krech, Selinski et al. 2016, Tomášková, Šplíchalová et al. 2017) There were three studies where the coal miners were selected for the cohort because they had CWP (Swaen, Meijers et al. 1995, Starzyński, Marek et al. 1996, Tomášková, Šplíchalová et al. 2017). The other studies did not identify the CWP status.

The meta-analyses showed that coal mine workers had a decreased all-cause mortality (SMR 0.90, 95% CI 0.83 to 0.98) and decreased all cancer mortality (SMR 0.88, 95% CI 0.80 to 0.97). However, there was an elevated risk of stomach cancer (1.11, 95% CI 0.97 to 1.35) and of mortality from non-malignant respiratory disease (NMRD) (1.26, 95% CI 0.99 to 1.61).

Unsurprisingly, for cohorts of workers **selected** for having coal workers' pneumoconiosis (CWP), risk of all-cause mortality was increased (SMR 1.14, 95% CI 1.00 to 1.30) as was mortality from NMRD (3.59, 95% CI 3.00 to 4.30), however all cancer mortality was not statistically significantly increased (SMR 1.04, 95% CI 0.94 to 1.14).

The meta-analysis (Alif, Sim et al. 2022) did not show an increased risk of lung cancer among coal mine workers with CWP (1.49, 95% CI 0.70 to 3.18) or for coal mine workers of unknown CWP status (1.03, 95% CI 0.91 to 1.18). Lower smoking rates in coal mine workers than in the relevant comparison group could be an explanation for these findings, because case–control studies where smoking was controlled for showed higher risks for lung cancer than were seen in cohort studies where there was no smoking adjustment. (Alif, Sim et al. 2022)

The meta-analysis (Alif, Sim et al. 2022) also showed a decreased risk of prostate cancer and cardiovascular and cerebrovascular mortality among coal mine workers. This may be a result of the Healthy Worker Effect and possibly lower smoking rates, and perhaps also reflect the physically active nature of many jobs in coal mines. (Girschik, Glass et al. 2010, Shephard 2017)

The scientific literature indicates that the overall mortality rate in employed workers is usually lower than that of the general population, but this is probably explained by the Healthy Worker Effect. (Fox and Collier 1976, Choi 2000) This effect is, at least in part, a result of the selection of fit and healthy people to enter the workforce. The Healthy Worker Effect is less likely to operate in respect of cancer incidence, as cancers usually occur in later life, often after retirement.

A Queensland Cancer Council review of the prevalence of coal mine dust lung disease (CMDLD) (Baade, Lu et al. 2021) identified that most studies were from the USA. Among underground miners the prevalence of CWP of any severity was 34.5 cases per 1,000 coal miners (95% CI: 27.7-41.3) (range 20.7 to 55.4 per 1,000 coal miners). From seven USA studies, the overall prevalence of progressive massive fibrosis (PMF) was 3.5 per 1,000 underground coal miners (95% CI: 2.2-4.9).

The report identified CMDLD cases in Queensland from a variety of sources including RSHQ and the Office of Industrial Relations claims data. In the most commonly diagnosed CMDLD were: chronic obstructive pulmonary disease (COPD), CWP, multiple coal mine dust lung diseases, silicosis, and mixed dust pneumoconiosis. All the cases were men, 78% mined only coal but under half had worked only in Queensland. More than half of the cases were diagnosed among former coal mine workers.

Data were sparse, particularly on the date of diagnosis however, the Report estimated that in Queensland on 30 June 2020, there were between 135 and 149 prevalent cases of CMDLD. Of these between 56 and 65 prevalent cases among underground coal miners and between 82 and 95 among surface miners.

The estimate prevalence in 2020 was 2.05 cases per 1,000 coal miners (range 1.94 to 2.14 cases per 1,000 coal miners) and was higher among underground miners (4.3 - 5.0 cases per 1,000 coal miners) than surface miners (1.5 - 1.7 cases per 1,000 coal miners). Data suggest that the prevalence was low <0.2 per 1,000 until 2008 and then yearly case numbers began to rise. (Baade, Lu et al. 2021)

The re-identification of CWP in Queensland coal mine workers parallels that observed in the USA. The National Institute for Occupational Safety and Health (NIOSH) had reported a decline in prevalence of CWP from 6.5% in the 1970s to a low of 2.1% in the 1990s. However, CWP prevalence in the USA subsequently increased to 3.2% in the first decade of this century and was recently reported to be more than 10% nationally for miners with 25 or more years of work and over 20% in some areas. (Blackley, Halldin et al. 2018) The rate of (PMF) in certain coal mining states in the USA has also recently increased to levels observed prior to the introduction of modern dust controls. (Blackley DJ, Halldin CN et al. 2014) A longitudinal analysis by NIOSH

reported a significant decline in CWP deaths in US miners from 1999-2016. (Mazurek, Wood et al. 2018)

Higher rates of CWP have been observed in other countries. For example, coal miners in Chinese state-owned coal mines who commenced work in the 1970s had cumulative rates of CWP of between 4 and 17%. (Blanc and Seaton 2016) In Colombia, the prevalence of CWP in coal miners was recently reported as 36%. (Blanc and Seaton 2016)

The lower prevalence of CWP in Australia, compared to that seen in USA, was thought to be a result of less exposure to quartz, perhaps because there were more open cut mines, thicker coal seams, larger numbers of employees (implying bigger operations with more investment in dust control measures), and more effective use of respiratory protection. (Joy, Colinet et al. 2012, Baade, Lu et al. 2021)

The introduction of new technology may be contributing to the increase in respiratory disease. Longwall mining can give rise to four times as much dust as traditional mining (Kizil and Donoghue 2002), particularly when production rates (machine speeds) are high (Kizil and Donoghue 2002, Plush, Ren et al. 2012). In addition, bi-directional cutting can result in increased exposure to respirable coal mine dust as the air flow is less effective in removing the coal mine dust. (Kizil and Donoghue 2002)

4. Study Aims and Objectives

The specific aims of the study were, where sufficient numbers permitted, to identify whether cancer incidence and mortality among coal mine workers in Queensland are elevated so that occupational exposure control measures can be targeted to reduce the future burden of cancer and mortality in coal mine workers.

The specific aims were to identify whether:

1. cancer incidence and/or mortality by major disease subgroups were elevated in men and/or women who have been employed as coal mine workers in Queensland,
2. the rates of cancer and mortality among Queensland coal mine workers have changed over time, perhaps associated with the introduction of technology such as bi-directional coal cutting,
3. specific types of mines e.g. open cut or underground and/or jobs e.g. drilling and blasting, were more closely associated with an increased risk of cancer and/or mortality,
4. any identified excess risks are associated with specific coal mine exposures, such as coal dust, silica and/or diesel engine emissions,
5. risk estimates based on measured air monitoring and other hygiene data would inform occupational exposure limits and exposure carcinogenicity evaluations, and
6. the findings can be used to estimate the likely future burden of cancer and mortality in the cohort.

The hypotheses were whether any identified increased risks of cancer and/or mortality, in particular chronic lung disease deaths, cardiovascular disease (CVD) deaths, suicides or lung cancer could be associated with:

1. work in mines or jobs with higher occupational exposure to coal dust, silica and/or diesel engine emissions,
2. work in underground mines compared to open cut mines, or coal handling and preparation plants
3. work with certain technology e.g. bi-directional cutting.

5. Study Design

This study was a retrospective cohort study, involving a cohort that was assembled from health assessment records, collated by RSHQ, formerly the Queensland Department of Natural Resources, Mines and Energy (DNRME).

The cohort included current, retired coal mine workers and former coal mine workers i.e. those who are still working, but in jobs outside the coal mining industry. It is especially important to include retired and former coal mine workers, as some may have left the industry as a result of illness. They are likely to have had longer exposure to coal mine dust, be older, and consequently more likely to have developed disease.

Coal mine workers from all coal mining sectors in Queensland are included in the cohort, that is, underground and open cut mines, and CHPPs. Mine workers may have moved from one site type to another, e.g. an open cut miner may previously have worked underground and *vice versa*.

NB a previous study showed that almost 22% of Queensland coal mine workers with CMDLD had also worked in other mine types or quarries, and more than half had worked in mines outside Queensland. (Baade, Lu et al. 2021)

6. Ethics Committee Approvals

Study Protocol was developed by the Study team and submitted to Monash University Human Research Ethics Committee (HREC). The research was granted approval from Monash HREC including for a waiver of individual consent, to access required personal information for coal mine workers. (NHMRC 2001) A waiver of individual consent can be approved by an Ethics Committee where requiring the gaining of individual consent would likely result in flaws in the conduct of the study and where the public interest outweighed any possible infringement of privacy. This would have been the case for this study, where it would not have been possible to track down all of the coal mine workers, for most of whom there would be no current address. In addition, those who had died could not consent and their exclusion would have biased the data set.

Queensland State regulations allow the use of these identifiable data for research and surveillance purposes. RSHQ, formerly DNRME, provided a letter to Monash University indicating the department's agreement to enter a partnership with Monash University and its support of the grant submission to the National Health and Medical Research Council, including provision of data from the coal mine workers' database for the purposes of the study. In addition, the Construction Forestry Mining and Energy Union (CFMEU) and the Australian Workers' Union (AMU) provided letters of support for the study.

The Protocol sets out the steps to ensure data security. A secure ACCESS™ database running on an SQL server is used to store the information about the individuals. Data from RSHQ were sent to the researchers via a secure file transfer system called "CloudStor" [CloudStor is a service run by AARNet (Australia's Academic and Research Network)].[8] The data were uploaded into the database hosted in a critical red-zone, only accessible by a single remote console login. Access is limited to MonCOEH staff working on the study and requires a password login. Data will be regularly backed up.

Ethics committee approval was also granted by the Australian Institute of Health and Welfare (AIHW) HRECs. The AIHW is the custodian of the National Death Index (NDI) and the Australian Cancer Database (ACD), which were used to identify cases of cancer and causes of death in the study. In addition, approval was provided by HRECs from each of the Australian State and Territory Cancer Registries and the State Cancer Registry data custodians and Chief Health Officers (where required).

[8] https://www.aarnet.edu.au/network-and-services/cloud-services/cloudstor/

7. Study Advisory Group

RSHQ in collaboration with Monash, set up an Advisory Group including members from RSHQ, mine operators, the Construction Forestry Mining and Energy Union (CFMEU) and the Australian Workers' Union (AMU).

Members of the Advisory Group were provided with the protocol and have provided advice on the job grouping used in the analysis. The Terms of Reference for the Advisory Group included helping to promote the study.

8. Methods

8.1 Cohort assembly

In March 2021, Monash University was provided with data extracted from the HSU database at RSHQ, including 460,511 records for 209,466 coal mine worker registrations and containing 49,490 unique job titles. This was considered a near complete record, as of 31/12/2019, of Queensland coal mine workers who stated employment after 1982.[9] Assessments after this date were included for coal mine workers who had undergone a first assessment by the end of 2019 and were in the initial cohort.

RSHQ supplied the records assembled onto a password protected spreadsheet sent via secure file transfer services. The AIHW require several personal identifiers, such as full name and date of birth, in order to link the individuals in the cohort with cancer and death registries. The necessary variables are listed in Appendix 1.

The data were uploaded into a secure SQL Server database at Monash and comprehensive data quality checking procedures were applied. These included checking for implausible birth dates and reviewing the allocated sex. Male was the default setting and it was identified that many people with female given names were listed as male. The names were checked across the cohort and there were 1,230 first names recorded as male that were most likely female, and 83 first names recorded as female that may be male. The sex of the worker was checked with RSHQ and corrected where necessary. More details of the data handling and checking procedures are provided in Appendix 2.

After data cleaning, which included removal of duplicates and ineligible workers (see Section 8.3) there were 189,013 individual participants, of whom 164,624 were male and 24,389 were

[9] This assumes that all coal mine workers undertook the required evaluation and that the data were supplied to RSHQ.

female. These individuals contributed 395,861 eligible health assessments. The cohort set up is presented as a flow chart in Figure 11, page 69.

The data held by RSHQ contained information from medical examinations where mine workers was seen by a doctor. Each medical examination generated a heath assessment which was reported to RSHQ. If a mine worker applied to more than one employer within 5 years of an examination, the examination data might be used for more than one health assessment by the different employers. Thus, one examination may be used to complete more than one assessment, generally less than 5 years apart. Some individuals had several assessments and those labelled as “Reviews” in the database, could be close together in time.

The cohort provided by RSHQ includes all workers who commenced employment in the mining industry between 1982 and 2019 and consequently had a mandatory pre-employment assessment, and whose medical records were provided to RSHQ, as required at the time of each assessment. In addition, it includes workers who commenced employment before 1982 who had a five year medical examination in or after 1993.

8.2 Data fields

8.2.1 Sources of data

There were seven types of data entry forms in the dataset which are described in detail in Appendix 2. The eligible health assessments for a cohort participant were those from the following form types: Full Form, Form Summary, Section 4 Only and Survey.

8.2.2 Demographic data

Demographic data were collected from the Full Form, however the variables collected have changed over time with different iterations of the form. Data available included given name(s) and previous name (where known), sex, date of birth. Additional data collected included smoking status at assessment, date of last contact (examination), the type of assessment (first or periodic) the date of each assessment and mine name. Names, date of birth, mine name and smoking history were available from all forms, but other fields changed with the iterations of the forms, as summarised in Table 1.

Data on SEGs (Similar Exposure Groups) were requested on the assessment forms from 2010, however only 30,197 (18%) of workers with post 2010 assessments had recorded SEGs. Some of the other fields in the assessment contained information that conflicted with the SEG (e.g. Mine Style or Position Title) however, where possible, the SEG was used to code the jobs.

The job history was collected on all forms introduced in 1993, except the Periodic form. However, the data were not entered for the Form Summary records and was only available for approximately 30,000 assessments or less than 10% of the total number of assessments. The data were entered as free text, and so could not be easily summarised for an epidemiological study.

Table 1: Comparison of Demographic Data Fields collected on different versions of the health assessment form over time

Variable of interest	Version of form and dates in use					
	1982 survey	Forms 3-8 1983-1992*	Form A Pre-employment 1993-2001	Form B Periodic 1993-2001	Health Assessment Form 2002	Health Assessment Forms 2009-2019
Name(s)	Yes	Yes	Yes	Yes	Yes	Yes
Date of birth	Yes	Yes	Yes	Yes	Yes	Yes
Job Title	No	No†	Yes	Yes	Yes	Yes
Employer	Yes	No	No	No	Yes	Yes
Mine name	Yes	Yes	Yes	Yes	Yes	Yes
SEG	No	No	No	No	No	Yes
Contractor?	No	No	Yes	Yes	No	No
Job history	Yes	Yes	Yes	No	Yes	Yes
Hazardous exposures (Yes/No)	No	No	Yes	No	Yes	Yes
Tobacco smoking history	Yes	Yes	Yes	Yes	Yes	Yes

* Fields identified from the legislation.

†Under occupation Form 4 identifies whether the worker was Face, Underground Non-face and surface

8.2.3 Tobacco smoking data

Smoking data were available from at least one assessment for over 99% of participants in the cohort. Smoking information was missing for only 1,342 workers included in the final analysis set.

Smoking status was reported at each assessment and was used in internal analyses. For these analyses, each worker with smoking data was assigned one of three categories; never smoker, ex-smoker or current smoker based on the most recent assessment data.

Smoking data was incorporated into the analysis based on the following rules:

- Current smoker was assigned to all workers if they stated in their last assessment that they were smokers.
- Never smoked was assigned to all workers if all their assessments stated that they had never smoked.
- Ex-smoker was assigned if the last known smoking status was no smoking, but any earlier examination recorded smoking. This included reviewing the data on the age they stopped smoking.

8.2.4 Job titles

Each of the assessments recorded after 1992 had details on workers' Job Titles. These data were unavailable for assessments conducted prior to this period. Job Titles were entered from free text so there was considerable variation both in the words used in the job description and because of typing errors. The large number of unique job titles (49,490) were coded to a limited number of Job Groups using inclusion and exclusion search terms. The Job Groups and search terms are summarised in Appendix 3 List Job Groups and search terms. The Job Groups are listed by the number of cohort participants in Section 9.1.

The Job Groups were then amalgamated into eight Work Categories: Production, Maintenance, Unexposed Office (Administration), Unexposed Non-Office, Occasionally exposed, Exploration Drillers, Construction and Unknown.

8.2.5 Mine Site Type

Mine Site Type, derived from several sources, was used to categorise workers into either underground mine, open cut mine, CHPP and Other/Unknown. Where the mine name was known, RSHQ provided information about whether the mine was open cut or underground. In

some instances, the type of mine (open cut or underground) was recorded in a separate variable (Mine Style). Where Mine Style was recorded, it was used to determine Mine Site Type.

The mine name was recorded as ”Unknown” or ”Various Mines” for around 55% of the health assessments. The Mine Site Type variable was missing for 139,230 (73.7%) of participants, and 210,317 (53.1%) of assessments. Other fields were therefore interrogated to identify Mine Site Type. These included key words in the individual's job title as indicated in Table 2 and whether the “Working underground” question on the Employer Response form was checked (1993 onwards). Additionally, job titles were reviewed to ensure that the key words had not been inadvertently allocated to the wrong Job Group e.g. wash referring to washroom attendant rather than the Wash Plant. See Section 8.2.4 and Appendix 3 List Job Groups and search terms for more information on Job title allocation. Some jobs could only be associated with a specific Mine Site Type, e.g. ERZ/deputy with Underground, Open Cut Examiner (OCE) and Dragline with Open Cut. All Laboratory jobs were allocated to CHPP.

Table 2: Key words used to identify Mine Site Type within the job title field

Underground Flag	Open Cut Flag	CHPP Flag
UNDERGROUND	O/C	CHPP
UNDER	O\C	PREP
UG	O.C	WASH
U/G	OPEN	SCREENING
U\G	CUT	CPP
U.G	OC_	
OUTBYE	_OC	
UGROUND	_OCE_	
LONGWALL	SURFACE	
LONG WALL		
ROOF BOLT		

8.2.6 Information on mines

In this study, 106 different coal mines were named in the dataset, of which 27 had ceased production activities. Some of the site names were changed however, such as Gordonstone and Kestrel. Some workers gave the mine name as Unknown or Various.

The study included participants from 34 underground mines, 66 open cut and two that had both open cut and underground mining. Four were exploration sites and 34 sites were identified as having CHPPs (some of which were shared with other mines). Of the underground mines, 11 were identified as being longwall mines, the remainder were “bord and pillar” or the type could not be identified.

Table 3: Number of participants by Site Type

Site type (number of mines)*	Cohort Participants at mine		
	Mean	Median	Range at mine
Underground (n=34)	781	166	1-5313
Open cut (n=66)	1714	976	1-8066
Underground and open cut (n=2)	1324		108-2540
Exploration (n=4)	27	14	11-70

* Excludes 158,992 participants where site is unknown/various etc

The coal measures mined are: Rangel n=32 (including 6 jointly with Moranbah, Fort Cooper or Burngrove), Moranbah n=18 (including 7 joint with German Creek), 9 for each of Walloon and German Creek, other n=15, while site data were not available for a further 9 sites.

The coal mined in this study was almost all bituminous. Only 5 of the mines had some semi anthracitic deposits and coal rank was available for 18 sites. In terms of products, 55 sites supplied coking coal, 49 thermal coal and 15 pulverised coal for injection (PCI). Of these sites, 34 supplied more than one type of product.

8.2.7 Exposure Data

Measured exposure data (in mg/m^3) collected by independent specialist hygiene consultants engaged by mining companies between 1999 and 2022, were provided to RSHQ. Data for respirable dust (RD), respirable crystalline silica (RCS) and diesel particulate matter (DPM) to supplied to Monash by RSHQ. Data were identified by the mining company, mine site and specific jobs on multiple dates, SEG code and name, the total sample time (i.e. runtime), length of shift, and measured exposure value (reported as time weighted average). The measurements are conducted in accordance with the published standard methods Australian Standard 2985 Workplace atmospheres – Method for sampling and gravimetric determination of respirable dust and NIOSH standard 5040 for diesel particulate matter. (RSHQ personal communication) RSHQ identified invalid samples and provided estimated values for the samples below the limit of detection.

In order to map the exposure data to job titles in the occupational dataset, the SEGs were allocated to selected Job Groups by Monash and checked with RSHQ to confirm the allocation. The mapping used is summarised in Appendix 4 SEGs allocated to Job Groups.

Not all SEGs were identified as jobs by workers, e.g. no one identified that their job was a dozer push operator but the data were grouped with the most appropriate SEG.

8.3 Cohort eligibility

In order to be included in the cohort, participants had to have a first and surname, a birth date and must have undergone at least one health examination/assessment during or after 1983.

8.3.1 Exclusion criteria

The following exclusion criteria were applied to establish the cohort:

- Those missing birth dates, with incomplete name details or no assessment dates (n=45, before linkage).
- Those whose first health examination/assessment was after 31/12/2019 (n=2,557)
- Those who **only** had a health assessment in the Rathus and Abrahams 1982 Survey and no other examination/assessment, includes those with a place holder record as a follow-up (n=3213 (before linkage) and 20 (excluded post linkage)).
- Those whose **only** health assessment did not include an Assessment Report (n=297 (excluded as this was post data linkage)).
- Those whose health assessment(s) **only** had a job title of Mine Site Visitor (n=4,939), Consultant (n=870), Mine Services Visitor/Consultant (n=20), Vacation Student, Cadet or Intern (n=1,196).
- Those who could not be linked through the AIHW National Linkage Map (NLM) which is based on Medicare card details.[10] This means that workers who were likely temporary migrants, or overseas workers and were not eligible for Medicare or who had chosen not to enrol in Medicare were not included (n=5,151 excluded post linkage). This is about 3% of the final cohort. Of these individuals 49 (0.1%) had died based on the NDI linkage and 60% were born in or after 1970 and had their first examination in or after 2010. Hence it is unlikely that this group would have added many deaths or cancers.
- Duplicate entries identified by Monash and the AIHW (n=1,558 identified before linkage, 574 identified after linkage).

There were cases where individuals may have been excluded for more than one reason e.g. missing birth date and ineligible job so the numbers may differ from those in Figure 11.

[10] The AIHW National Linkage Map (NLM) was created by combining and linking data from the Medicare Consumer Directory (MCD) and the National Death Index (NDI). The National Map covers the majority of the Australian population, as demonstrated by the high linkage rate achieved in linkages to national datasets (for example, residential aged care at 99.5%). Some residents of Australia are known to not be covered, as they are not eligible to, or have not chosen to enrol in Medicare. These may include:

- Temporary migrants, including international students and people on temporary work visas and their families; and
- Young children not enrolled at birth.

8.4 Cohort start and end dates

For the analysis, each cohort member was followed from a start to an end date, and then the total person-years were calculated between these time points; and mortality and cancer incidence were examined within this time period. The cohort 'start date' for each cohort member was the date of their first recorded health examination or the date of the 1982 Survey. For a few participants (approximately 500), the assessment date was before the first examination date due to possible data entry errors, so the earlier date was used as the cohort start date. The cohort 'start date' was when a cohort member began to contribute person-years to the analysis and any deaths or cancers occurring after this date were included in the analyses.

A cohort member ceased to contribute person-years at the date of their death or end of study period (30/11/2020 for mortality and 31/12/2016 for cancer). This is referred to as the cohort `end date'. Therefore total analysis time, referred to as person-years (PY) was calculated as the time between first examination and the end date.

As stated in Section 8.2.4, details on specific jobs held were not available for the full observation period. Therefore, cohort start dates for all analyses relating to specific jobs differed. For these analyses, PY were counted from the first assessment post 1992 for which Job Titles were known. The end dates for mortality and cancer incidence remained the same as mentioned above.

8.5 Data linkage

In order to identify cohort members who died or had a cancer between the cohort start and end dates, the cohort was linked to national records of cancer and mortality held by the Australian Institute of Health and Welfare (AIHW).

The cohort data sent to the AIHW for linkage included: surname, given name(s) and previous name (where known), sex, date of birth and date of last contact. All data and linkage results were sent between Monash and AIHW using a secure file transfer service.

The AIHW databases linked to were the National Death Index, for mortality data, and the Australian Cancer Database, for cancer incidence data. The Australian Cancer Database was linked via the NLM, whereas the cohort was linked directly to the National Death Index.

8.5.1 National Death Index

The National Death Index (NDI) is a dataset developed and maintained by the AIHW. The dataset lists all deaths that have occurred in Australia since 1980.

At the time of linkage in 2022, the NDI was nationally complete from 01/01/1980 until 30/11/2020 for cause of death coding.

The NDI used a probabilistic linkage program to identify likely and possible matches with existing records of the deaths. Each possible match was scored with a weight which indicated the probability of it being a true match. The possible matches were supplied to the Monash researchers for a clerical review. They were independently reviewed by two researchers and difference resolved by discussion before a final decision was made as to which records were to be accepted as true death matches. A small additional number of deaths were obtained as this linkage was repeated using the NLM in order to link to cancer data.

8.5.2 Australian Cancer Database

The Australian Cancer Database (ACD) contains data about all new cases of cancer diagnosed in Australia since 1st January 1982, excluding basal and squamous cell carcinomas of the skin. Cancer is a notifiable disease in all Australian states and territories and the notified cases are entered into the jurisdiction's central cancer registry. These registries then supply data annually to the AIHW, which cleans and standardises the data, and produces the ACD. The ACD was nationally complete from 01/01/1982 to 31/12/2016 at the time of the linkage. Some rare skin cancers (ICD-10 C44) have been included, but data for these are only complete from 2001.

The population data included only primary malignant cancers, excluding secondary tumours spreading from the primary site. Where a cancer had spread, only the site of the original primary

cancer was reported. However, if a person was diagnosed with more than one primary cancer, then all of these primary cancers were included.

The ACD also uses a probabilistic matching program to identify possible matches. This linkage also used the NLM. Like the NDI matching, each possible ACD match was given a score and AIHW clerically reviewed the matches. The probability of false positives and false negatives was then assessed by sampling the cohort and clerically examining the matches. For privacy reasons, the AIHW was not able to release identified individuals for the clerical review to be carried out at Monash University.

The AIHW provided Monash with a de-identified list of cases that were scored as highly certain matches with cohort members i.e. they had a low probability of being an incorrect match or false positive.

8.5.3 Queensland Cancer Register

The Queensland Cancer Register (QCR) includes all new cases of cancer diagnosed in Queensland, excluding skin basal and squamous cell carcinomas. The QCR was complete from 01/01/1982 to 31/12/2020 at the time of the linkage, hence provided four additional years of data beyond what was provided by linkage to the national database. Like the ACD, the QCR uses a probabilistic matching program to identify possible matches. The QCR clerically reviewed the matches and provided Monash with a de-identified list of cases.

8.6 Classification of causes of death and cancer

The mortality and cancer incidence matches identified by the linkages were returned to Monash with cause of death or cancer type recorded as The International Classification of Diseases (ICD) codes. The ICD coding system is an international way of categorising diseases and hence enables comparisons of this study's findings with other studies.

The underlying cause of death for death notifications was coded by the Australian Bureau of Statistics (ABS) according to ICD-9 (World Health Organisation 1977) for records up to the end of 1996, and according to ICD-10 (World Health Organisation 1992) for records from 1997 onwards. Together with the introduction of the ICD-10, the ABS implemented the Automated Coding System (ACS) in 1997 for processing deaths. The ACS provides more consistent coding practices and has enabled more efficient production of statistics for multiple causes of death.

Applicable ICD-9 codes and ICD-10 codes were grouped in similar broad categories such as 'All Malignancies' or 'All Injury and Trauma' which includes all external causes (Table 4). All deaths were counted in the 'All Death Causes Combined' category and every death was assigned to a broad death category classification, including an 'Other' classification which captures all deaths that were not assigned to one of the major groups.

The ICD 10 codes are also used to categorise non-fatal diseases for example ICD F00-F99 Mental and Behavioural diseases. These include dementia, delirium, mental/behavioural disease from use of alcohol, opioids and other drugs, schizophrenia, PTSD, mental retardation and other diseases. Many of these diseases are not fatal so numbers of deaths (apart from dementia) will be small in this category.

The ACD coded all cancer incidence records according to ICD-10, based on ICD-O-3 histology, primary site and behaviour codes (Table 5). Cases were then grouped into broad cancer categories.

Table 4: Cause of death classification in ICD-9 and ICD-10 used in this study

Cause of death	ICD-9 codes (1983-1996)	ICD-10 codes (since 1997)
All malignancies	**140–208, 238.4, 238.6, 238.7, 273.3, 273.8, 273.9**	**C00–C97, D45–D46, D47.1, D47.3, D47.4, D47.5**
Oesophagus	150	C15
Stomach	151	C16
Colorectal	153-154	C18–C21
Liver	155	C22
Pancreas	157	C25
Lung	162	C33-C34
Mesothelioma, pleural	163	C45
Melanoma	172	C43
Breast	174-175	C50
Prostate	185	C61
Bladder	188	C67
Kidney	189	C64
Brain	191-192	C70-C72
All Metabolic	**240-278**	**E00-E99**
Diabetes	250	E10-E14
All Mental and Behavioural	**290-319**	**F00-F99**
Dementia	290.0–290.2, 290.4, 290.8, 290.9	F01, F03
All Nervous System	**320-359**	**G00 - G99**
Alzheimer Disease	331.0	G30
Parkinson Disease	332	G20-G22
All Circulatory	**390 - 459**	**I00 – I99**
Ischaemic Heart Disease (IHD)	410-414	I20-I25
Cerebrovascular	430-438	I60-I69
Other Heart Disease	393-398 ,402, 404, 415, 416, 420-429	I05–I09, I11, I13, I26, I27, I30–I52
All Respiratory	**460 - 519**	**J00 – J99**
COPD	490, 491, 492, 496	J40-J44
Asthma	493	J45,J46
Lung Diseases due to Dust	495, 500-505	J60-J67
All Digestive	**520-579**	**K00-K93**
Liver Disease	570-573	K70-K77
All Urinary	**580-629**	N00 - N99
Kidney Failure	584-586	N17-N19
All Injury and Trauma	**E800-999**	**V01-Y98**
Accidents*	E800-E929	V01-X59, Y85-Y86
Suicide	950-959	X60-X84
All Death Causes Combined**	**000-999**	**A00 - Z99**

* Includes transport accidents

** Will exclude specific male or female causes of death where reported separately e.g. prostate or cervical cancer

Table 5: Cancer classification in ICD-10 used in this study

Cancer Categories	ICD-10 codes
All Malignancies	**C00-C97, D45-D46, D47.1, D47.3-D47.5**
Lip, Oral Cavity and Pharynx	**C00-C14**
Lip	C00
Pharynx	C09-C14
Digestive Organs	**C15-C25**
Oesophagus	C15
Stomach	C16
Colorectal	C18-C21
Colon	C18
Rectum	C19 -C20
Liver	C22
Gallbladder	C23-C24
Pancreas	C25
Respiratory and Intrathoracic Organs	**C30-C38**
Larynx	C32
Lung	C33-C34
Melanoma	**C43**
Mesothelioma	**C45**
Breast	**C50**
Female Reproductive Organs	**C51-C58**
Cervix	C53
Male Reproductive Organs	**C60-C63**
Prostate	C61
Testis	C62
Urinary Tract	**C64-C68**
Kidney	C64
Bladder	C67
Brain and Other CNS	**C70-C72**
Brain	C71
Thyroid and Other Endocrine Glands	**C73-C75**
Thyroid	C73
Unknown Site	**C77-C80, C97**
Lymphoid, Haematopoietic + Related Tissue	**C81-C96, D46**
Hodgkin	C81
Non-Hodgkin Lymphoma	C82- C86
Diffuse Non-Hodgkin Lymphoma	C83
Multiple Myeloma	C90
Leukaemia	C91-C95
Lymphoid Leukaemia	C91
Myeloid Leukaemia	C92
Other Cancers*	C26, C39, C40-41, C44, C46, C47-C49, C69, C76, D45- D47
Myelodysplastic Syndrome (MDS)	D46
Connective tissue	D47-D49

* Includes bone and connective tissue, eye, rare lympho-haematopoetic conditions and cancer of multiple sites. Excludes male and female cancers where reported separately

8.7 Analysis and statistics

Two types of analyses were adopted for this study; the external and internal analyses. All data were conducted in Stata Statistical software (StataCorp. 2021. *Stata Statistical Software: Release 17*. College Station, TX: StataCorp LLC). All analyses were conducted separately for men and women.

8.7.1 External statistical analyses

External analyses are those in which the mortality and cancer incidence rates of the cohort or groups within the cohort are compared to the rates of the Australian population.

The data were analysed by comparing observed (O) the mortality and cancer incidence in the cohort with those expected (E) from the Australian national population, standardised for age and sex. The population reference rates were taken from data published by the AIHW in five year age bands. (Australasian Association of Cancer Registries 2022, Australian Institute of Health and Welfare 2022)

The background rates of melanoma differ nationally as a result of UV exposure from sunlight, so Queensland state melanoma incidence rates were also used as a comparison, in addition to the national data. Additionally, Queensland accident and suicide rates are reportedly higher than national rates hence the cohort rates were also compared to the expected Queensland state rates using data provided by the ABS.

The mortality comparison with the national data was reported as the Standardised Mortality Ratio (SMR), while the Standardised (cancer) Incidence Ratios (SIRs) was used to report the comparison of cancer incidence in the cohort vs the population. Both the SMRs and SIRs were reported together with their 95% confidence intervals. More detail about the methodology is presented in Appendix 4.

In instances where data were analysed split by time, linear trends in SMRs or SIRs over the subgroups were tested using Poisson regression.

QCR linkage outcomes were analysed for the additional four years of data, 2017-2020. The detailed methodology used is outlined in Appendix 10.

8.7.2 Internal statistical analyses

Internal analyses are those in which the mortality and cancer incidence of groups within the cohort are compared to a reference group, which is drawn from the cohort.

These analyses compared groups of cohort members internally against each other, rather than externally to the Australian population. This was done in an effort to reduce the impact of the

Healthy Worker Effect, specifically the “healthy hire” effect, (Fox and Collier 1976) and because these analyses could be adjusted for smoking status. The Relative Mortality Ratio (RMR) for mortality and the Relative Incidence Ratio (RIR) for cancer incidence were calculated within Work Categories and for selected Job Groups.

The RMRs and RIRs were estimated using Stata Statistical software (StataCorp. 2021. *Stata Statistical Software: Release 17*. College Station, TX: StataCorp LLC). More details about the methodology are presented in Appendix 5. The RMRs and RIRs were adjusted for age, era of first examination (i.e. year in which workers had their first examination, regardless of whether their job title was known or unknown at that time point) and smoking status (current, ex-smoker or never smoker). Age is a major factor predicting rates of death and cancer. In addition, they were adjusted for calendar period (i.e. era) because death and cancer rates vary over time.

Different comparison groups were applied to the different worker subgroup analyses. For Work Category comparisons, mortality and cancer rates in each Work Category were combined for the rest of the cohort of the same sex. For example, the RMRs and RIRs for Unexposed Office Work Category were obtained by comparing rates among workers who had only worked in an Office non-exposed role with the rate among those who either had never worked in a job classified as Office non-exposed or may have held other jobs outside this Work Category. A similar approach was used for those who had only worked in a non-Office or an Occasional exposure job. RMRs and RIRs for those who ‘ever’ held a job classified as a Production job were obtained by comparing their mortality and cancer incidence rate with those observed among workers who ‘never’ worked in Production. This approach was also applied to the Maintenance, Construction, Exploration Drillers and Job Groups that could not be assigned to specific Work Categories.

8.7.3 Tests for significance

The formal test of statistical significance is that there is less than a one in 20 probability that it was a chance finding, i.e. was due to random variation. This would be shown by 95% confidence intervals that do not include one in the range between the lower and upper values, associated with the risk ratios (SMR, SIR, RMR or RIR) (see Appendix 5) or a P-value of <0.05 on the trend tests.

The term ‘elevated’ is used in this Report to indicate Ratios greater than 1 but which may not be statistically significantly increased. The term ‘increased’ is used in this Report when the increase is statistically significant.

8.7.4 Groups for statistical analyses

Separate analyses were carried out for men and women.

To preserve confidentiality, the observed and expected numbers were redacted in cells which contained fewer than 6 outcomes leaving only the risk estimate and confidence intervals. In particular this was needed for Job Groups with small numbers of workers and for many analyses of female coal mine workers' health risks.

Mine Site Type

Overall mortality and cancer incidence by Mine Site Type (Underground, Open Cut, CHPP and Unknown), were calculated for all workers (see Section 8.2).

Work Category and Job Group

Analyses by cause of death and type of cancer were carried out by Work Category and then by Job Group (see Section 8.2.4) for all workers **ever** in each category and then for those with 2 or more assessments at least 5 years apart but not necessarily within the same Job Group or Mine Site Type (so any other eligible health assessment).

Job Group was only available for those workers completing an assessment in or after 1993 as that is the date when job titles were first consistently recorded. Of the 11,883 assessments that took place before 1993, only 446 (3.7%) had a job title recorded.

Sub-group analysis for workers with ≥2 assessments

In the second analyses, workers who had all their assessments within 5 years of their first examination date were excluded. This was done as a way of excluding those who may have had assessments but not been subsequently employed or had very short employment as a coal mine worker.

The person-years contributed to these workers only started after their second assessment, as by definition they were alive at that point. These analyses were only conducted for the whole cohort and some Work Categories and Job Groups, where there were at least 20 deaths. The statistical power was too limited analyse data with fewer outcomes.

The reason for the 2+ assessment analyses are:

- The workers were definitely employed;
- It is more likely that job-related ill health would be seen among workers with longer service.
- The health status of short-term employees may differ from that of longer term employees. (Kolstad and Olsen 1999)

Number of assessments (Proxy for duration of employment) for Work Categories and selected Job Groups

Risks were analysed separately for individuals divided by their likely duration of employment: 5 years or less, ≥5 to <10, ≥10 to <15 or ≥15 years, based on the time between their first and last recorded assessments. The assessments did not need to report the same Job Group.

Time since first assessment for Work Categories and selected Job Groups

Risks were analysed separately for individuals divided by time since their first assessment (proxy for employment); 5 years or less, ≥5 to <10, ≥10 to <15 or ≥15 years. If a disease has a long latent period but workers had only recently been employed, there may have been insufficient time for the disease to occur and any diagnosed disease likely resulted from previous exposure.

Risk by age group based on Work Category

Risks were analysed separately for individuals based on their age each year, divided into under 65 or 65 years and older. The aim of these analyses was to identify any heterogeneity in the outcomes which may relate to the latent period of the disease. Diseases such as silicosis may only become apparent after retirement. (Graham, Vacek et al. 2001, Bang, Mazurek et al. 2015)

For some individuals who turned 65 years during follow-up, their person-years before turning 65 years were allocated to the 'under 65s' subgroup whilst the person-years after they turned 65 years were allocated to the older age groups. The death or cancer was attributed to the group in which it occurred.

Risk by Exposure Group

Individuals were to be grouped by technology in use, however most Queensland underground coal mines are now operating longwall mining and the dates of introduction of variations to cutting method, including bi-directional cutting could not be accurately identified. Dust control measures including dust suppression systems, water additives and respiratory protection have varied over time, so these proposed analyses could not be carried out. Analysis by type of coal measure was also not carried out as almost all mines had bituminous coal measures. (RSHQ personal communications)

Many workers had completed more than one health assessment and may have identified different jobs in the different assessments, e.g. been an operator and then a supervisor. For the analyses, individual coal mine workers were allocated to a Job Group based on whether they had **ever** held a job in that category, except for the three less exposed Work Categories, Unexposed Office, Unexposed Non-Office and Occasionally exposed workers which included those who had **only** held a job in this category. This means that workers could appear in more than one Job Category in these analyses.

8.7.5 Sensitivity analyses

Sensitivity analyses were undertaken to investigate the effect that data limitations may have had on the death and cancer rate estimates:

- Mortality of workers after excluding those with only a pre-1993 health assessment (Table 13) i.e. with no Job Group.
- Mortality of workers after excluding those whose first reported assessment was after 2010 (Table 14). This was to investigate whether a large number (66,187 men [40.2%] and 12,882 women [52.8%]) of recently recruited workers were diluting any risk among longer term workers.
- All-cause mortality by Job Group was examined by Site Type. Table 28 includes workers by each Site Type where they had ever worked. In Table 29 workers are allocated to only one Site Type, in likely order of extent of exposure.
- It was not possible to identify whether all men in the Job Group "Miner" had ever worked underground. Table 36 shows mortality results only for male miners who could be identified as underground miners. The mortality of all male miners is presented in Table 35.
- Mortality may differ by employer type, Table 38 and Table 39 compare the mortality of Miners and Dragline operators respectively with that of the general population after grouping by type of employer (direct by the mine, by a large labour hire company or other).
- Exposure has changed over time. In internal analyses for some Job Groups, a time cut point of 2010 was chosen and the risks were calculated for mortality and cancer incidence for workers in selected Job Groups who had worked before that point in time. Workers whose exposure was only after that time point were not included in these sensitivity analyses. The time point of 2010 was chosen as the exposure data suggested that exposure to RD, RCS and or DPM was lower after this period.

9. Results

9.1 Work Category and Job Group

Table 6 lists the Work Categories, and the Job Groups in each Work Category. It shows the number of men and women in each Job Group and the number with at least two assessments (more than 5 years apart), regardless of Job Group. Participants may have been employed in more than one Work Category over their employment period. However, in Table 6, the first three Work Category rows include workers who have ONLY held jobs in that Work Category. Some workers may have worked as production or maintenance and then become administration workers (or *vice versa*). They have not been included in this table under these three categories.

Table 6 shows that 1,735 of the 164,622 male workers, and 257 of the 24,389 women were excluded from the job specific analyses because their job titles were not recorded.

The majority of male and female workers in some Job Groups experienced only one health assessment e.g. in Administration 11% had experienced more than one assessment at least five years after their initial assessment. It is unclear whether these were short term workers or individuals in non-production or non-maintenance jobs who did not routinely receive health assessments or individuals who had short-term jobs on mine sites.

About 40% of male workers who were ever in a Job Group categorised as Maintenance had more than one assessment in Queensland. For female workers the percentage was lower, 22% but this may reflect the shorter employment record for these workers. About 60% of male workers ever in any Job Group categorised as Production had more than one assessment. This rose to 81% for CHPP workers, 86% for ERZ/Deputies (Explosion Risk Zone controller) and 96% for OCE (Open Cut examiner) and Dragline operators. Again, the percentage was lower (31%) for women but the pattern was similar between Job Groups.

Table 6: Numbers of men and women in each Work Category and Job Group

Work Category	Job Group	ALL WORKERS			
		Men		Women	
		Number of workers N=162,887 ^	Number with 2+ assessments (%)* N=53,673	Number of workers N=24,132 ^	Number with 2+ assessments (%)* N=4,204
ONLY Unexposed Office	**Administration**	**12,596**	**1,392 (11.1%)**	**7,538**	**853 (11.3%)**
ONLY Unexposed Non-Office	Blue Collar (Not Exposed)	2,641	178 (6.7%)	1,291	33 (2.6%)
	Control Room	144	12 (8.3%)	69	1 (1.4%)
	Environmental Services	1,709	90 (5.3%)	689	31 (4.5%)
	All combined	**4,494**	**280 (6.2%)**	**2,049**	**65 (3.2%)**
ONLY Occasionally exposed	Engineer	5,964	677 (11.4%)	565	42 (7.4%)
	Mine Services	944	24 (2.5%)	665	7 (1.1%)
	Technical Services (Includes Geologist / Surveyor)	3,806	581 (15.3%)	644	70 (10.9%)
	All combined	**10,714**	**1,282 (12.0%)**	**1,874**	**119 (6.4%)**
EVER Maintenance- all	Maintenance – General	19,250	8,892 (46.2%)	777	188 (24.2%)
	Abrasive, Blast, Sand, Paint	761	304 (39.9%)	6	2 (33.3%)
	Shutdown Maintenance	6,175	2,150 (34.8%)	61	12 (19.7%)
	Belt Splicer	571	279 (48.9%)	2	0
	Boilermaker	8,259	3,280 (39.7%)	39	7 (17.9%)
	Fitter (Nec) **	12,696	6,799 (53.6%)	69	12 (17.4%)
	Diesel Fitter	10,085	5,518 (54.7%)	137	39 (28.5%)
	Tyre Fitter	676	331 (49.0%)	13	3 (23.1%)
	Electrician	11,147	4,158 (37.3%)	264	76 (28.8%)
	Electrician (Auto)	1,139	489 (42.9%)	53	18 (34.0%)
	Industrial Cleaner	811	218 (26.9%)	736	146 (19.8%)
	All combined	**61,309**	**24,017 (39.2%)**	**2,025**	**441 (21.8%)**
EVER Production- all	Production – General	71	41 (57.7%)	7	1 (14.3%)
	Blast Crew	1,857	1,082 (58.3%)	168	62 (36.9%)
	Driller (Blast)	363	251 (69.1%)	34	15 (44.1%)
	Driller (General)	3,827	1,686 (44.1%)	50	21 (42.0%)
	CHPP Plant Operator	1,502	1,210 (80.6%)	95	41 (43.2%)
	Laboratory	910	357 (39.2%)	739	203 (27.5%)
	Driller (Ug, Coal Seam)	261	120 (46.0%)	7	2 (28.6%)
	Explosion risk zone (ERZ) controller/ Deputy	1,039	893 (85.9%)	0	NA
	Open cut Examiner	537	513 (95.5%)	11	7 (63.6%)
	Dragline	1,044	1,003 (96.1%)	10	6 (60.0%)
	Secondary Support	319	147 (46.1%)	14	3 (21.4%)
	Miner	10,471	7,075 (67.6%)	342	154 (45.0%)
	Operator (Inc Mobile Operator, Production Operator, Production Truck Driver)	42,399	22,348 (52.7%)	5,847	1,893 (32.4%)
	Prestrip	429	354 (82.5%)	72	39 (54.2%)
	Scraper	175	75 (42.9%)	1	1 (100.0%)
	Production Support	23	15 (65.2%)	2	1 (50.0%)
	Tunneller	58	20 (34.5%)	0	NA
	All combined	**55,252**	**28,130 (50.9%)**	**6,913**	**2,114 (30.6%)**

Work Category	Job Group	ALL WORKERS			
		Men		Women	
		Number of workers N=162,887 ^	Number with 2+ assessments (%)* N=53,673	Number of workers N=24,132 ^	Number with 2+ assessments (%)* N=4,204
EVER Exploration	**Driller (Exploration)**	**4,970**	**1,206 (24.3%)**	**43**	**6 (14.0%)**
EVER Construction	Civil Works	762	328 (43.0%)	44	21 (47.7%)
	Construction	8,286	1,799 (21.7%)	69	23 (33.3%)
	All combined	**9,034**	**2,117 (23.4%)**	**113**	**44 (38.9%)**
Work Category Unclear	EVER Labourer (nec) **	5,814	1,888 (32.5%)	245	56 (22.9%)
	EVER Cleaner (nec) **	948	244 (25.7%)	2,763	519 (18.8%)
	EVER Supervisor (nec) **	5,575	3,501 (62.8%)	66	31 (47.0%)
	EVER Truck Driver (nec) **	7,701	3,120 (40.5%)	894	327 (36.6%)
	All combined	**19,632**	**8,414 (42.9%)**	**3,893**	**880 (22.8%)**
Missing, no Job Group recorded		1,518	153 (5.1%)	165	14 (8.5%)

* Examination/Assessment 5 years apart independent of Job Group,
** (nec) means Not Elsewhere Classified.

The numbers of coal mine workers in each Job Group are presented by work Site Type in Table 7. Some workers could not be identified by Site Type (typically those who stated that they worked at Unknown or Various mine sites) and these are listed as Site Type Unknown in the table. The Job Group was also unknown for some workers and these are listed as Missing in the table.

To reduce the number of analyses and thus the likelihood of chance findings, the Job Groups were not divided by Site Type in the risk analyses. The decision was based on whether there was a small number of workers in the category e.g. Tunneller (Table 7) and the likelihood that categorisation by the Site Type was appropriate (e.g. exploration is likely less relevant Site Type) and whether Site Type would have affected the exposure e.g. Administration. The Job Groups that were not included in Site Type analyses are identified in Table 7.

Figure 9 illustrates the median age of workers at their first assessment. The figure shows that within the Work Categories, those who had only been in Administration jobs had their first examination at the median age of 41 years, compared with around 30 years among those who only were in Occasionally exposed jobs or those who had ever worked in Maintenance jobs.

Across Job Groups, the median age among those who ever worked as Truck Drivers (41 years) and those who only worked as Blue Collar workers (38 years) were the highest whilst those who ever worked as Scrapers, Auto electricians or Diesel fitters had the lowest median age at first examination.

Like male workers, women who were only in the Blue Collar Job Group were among those with the highest median age at first examination (Figure 10).

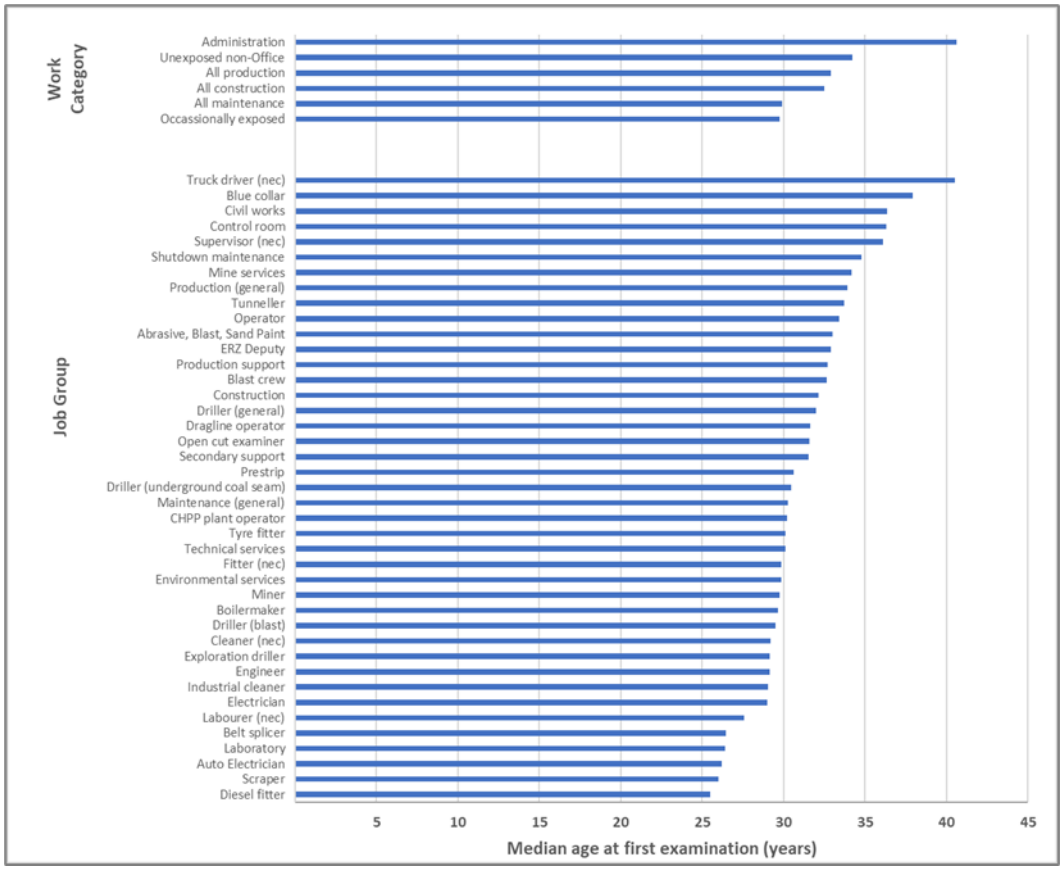


Figure 9: Median age at first examination by Job Group and Work Category among male coal mine workers

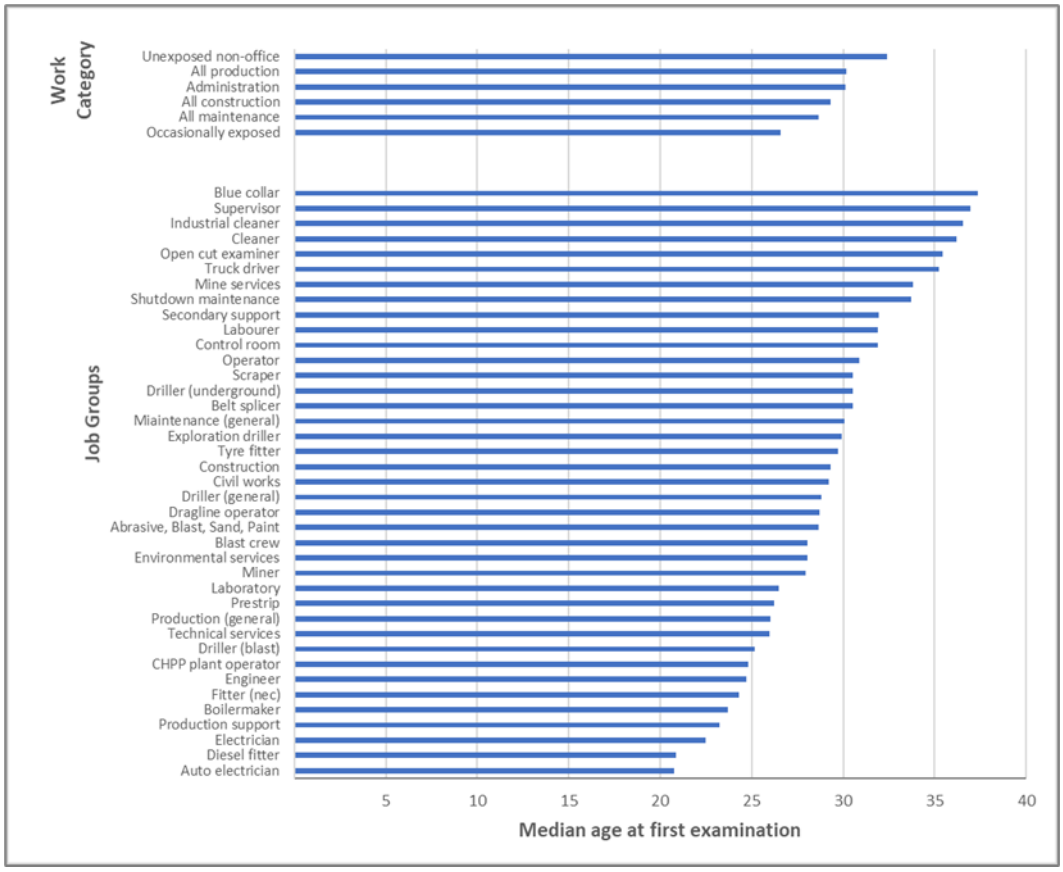


Figure 10: Median age at first examination by Job Group and Work Category among female coal mine workers

Table 7: Numbers of workers by Site Type and whether in Job Group

Job Group Ever	Open Cut		Underground		CHPP		Site Type Unknown for all assessments		Total †
	Men N=69,224	Women N=12,094	Men N=34,079	Women N=2,983	Men N=2,931	Women N=859	Men N=68,389	Women N=9,512	
EVER Unexposed Office									
Administration	8,254	4,484	4,912	1,455	243	26	8,010	3,192	31,836
ONLY Unexposed Office									
Administration	4,161	3,568	2,317	1,234	76	18	6,409	3,014	20,147
EVER Unexposed Non-Office	2,271	1,030	928	254	23	6	3,479	1,467	10,465
Blue Collar (Not Exposed)	1,531	671	508	133	1	1	1,853	943	6,186
Control Room	179	74	147	11	22	5	127	60	765
Environmental Services	563	285	275	111	0	0	1,506	466	3,514
ONLY Unexposed Non-Office	1,262	635	413	165	2	3	2,855	1,265	6,545
Blue Collar (Not Exposed)	891	410	231	88	0	1	1,542	802	3,934
Control Room	38	19	15	2	2	2	91	46	213
Environmental Services	333	206	167	75	0	0	1,222	417	2,398
EVER Occasionally Exposed	5,504	950	3,912	412	20	3	6,470	1,105	19,361
Engineer	3,341	421	2,532	187	17	3	3,202	219	10,115
Mine Services	662	282	206	36	0	0	826	534	2,910
Technical Services	1,593	259	1,237	194	3	1	2,485	356	6,336
ONLY Occasionally Exposed	3,261	663	2,299	297	11	3	5,467	972	12,596
Engineer	1,990	279	1,371	113	9	2	2,785	197	6,535
Mine Services	253	202	97	23	0	0	597	441	1,609
Technical Services	1,018	182	831	161	2	1	2,085	334	4,452
EVER Maintenance	23,257	825	11,533	262	422	5			63,362
Maintenance – General (Nec)	6,273	273	3,054	55	144	4	7,078	336	20,032
Abrasive, Blast, Sand, Paint	142	0	36	0	2	0	465	3	767
Shutdown Maintenance	1,895	15	676	5	2	0	3,153	33	6,238
Belt Splicer	61	0	303	0	1	0	139	2	573
Boilermaker	3,025	15	931	1	26	0	3,869	21	8,300
Fitter (Nec)	4,623	32	2,833	9	103	0	4,040	24	12,771
Diesel Fitter	4,810	96	1,187	16	4	0	3,187	20	10,223
Tyre Fitter	404	9	55	0	0	0	178	1	689
Electrician	4,192	145	3,315	60	147	0	3,833	60	11,423
Electrician (Auto)	586	47	58	2	0	0	427	3	1,192
Industrial Cleaner	185	236	76	118	4	1	418	279	1,547
EVER Production	27,303	4,055	12,745	289	2,384	821			62,206
Production – General (Nec)	36	5	15	1	0	0	15	1	81
Blast Crew	1,128	117	128	6	0	0	433	32	2,025

Job Group Ever	Open Cut		Underground		CHPP		Site Type Unknown for all assessments		Total †
	Men N=69,224	Women N=12,094	Men N=34,079	Women N=2,983	Men N=2,931	Women N=859	Men N=68,389	Women N=9,512	
Driller (Blast)	247	24	10	2	0	0	41	4	397
Driller (General)	1,127	26	643	8	0	0	1,690	15	3,877
CHPP Plant Operator	0	0	0	0	1,504	95	0	0	1,599
Laboratory	0	0	0	0	910	739	0	0	1,649
Driller (Ug, Coal Seam)	0	0	261	7	0	0	0	0	268
ERZ / Deputy	0	0	1,042	0	0	0	0	0	1,042
Open cut Examiner (OC Only)	537	11	0	0	0	0	0	0	548
Dragline (OC Only)	1,044	10	0	0	0	0	0	0	1,054
Secondary Support	0	0	319	14	0	0	0	0	333
Miner	2,161	178	7,700	57	3	0	396	55	10,825
Operator	24,140	3,839	5,456	193	5	1	10,898	1,571	48,267
Prestrip	345	53	4	0	0	0	20	12	501
Scraper	68	0	6	0	0	0	57	0	176
Production Support	0	0	23	2	0	0	0	0	25
Tunneller	0	0	59	0	0	0	0	0	59
EVER Driller (Exploration)	459	5	687	6	0	0	3,181	28	5,013
EVER Construction	2,522	49	1,218	15	5	0			9,149
Civil Works	281	22	54	2	3	0	296	16	806
Construction	2,243	27	1,165	13	2	0	4,278	21	8,357
EVER Unknown									
Labourer (Nec)	1,103	55	912	20	1	0	2,834	127	6,064
Cleaner (Nec)	309	1,099	66	239	0	0	439	1,168	3,711
Supervisor (Nec)	2,153	22	852	7	0	0	1,578	31	5,643
Truck Driver (Nec)	2,306	415	346	27	0	1	3,737	283	8,598
Missing Job Group **	1,177	227	409	20	0	0	1,416	166	3,400

* Number of men/women ever worked in that Site Type.
** All assessments had Job Group unknown.
† Some workers held jobs on more than one Site Type so rows do not add up to column totals

9.1 Cohort structure

Figure 11 shows the structure of the cohort, the number of records provided by RSHQ and the numbers of coal mine workers who were included in the cohort.

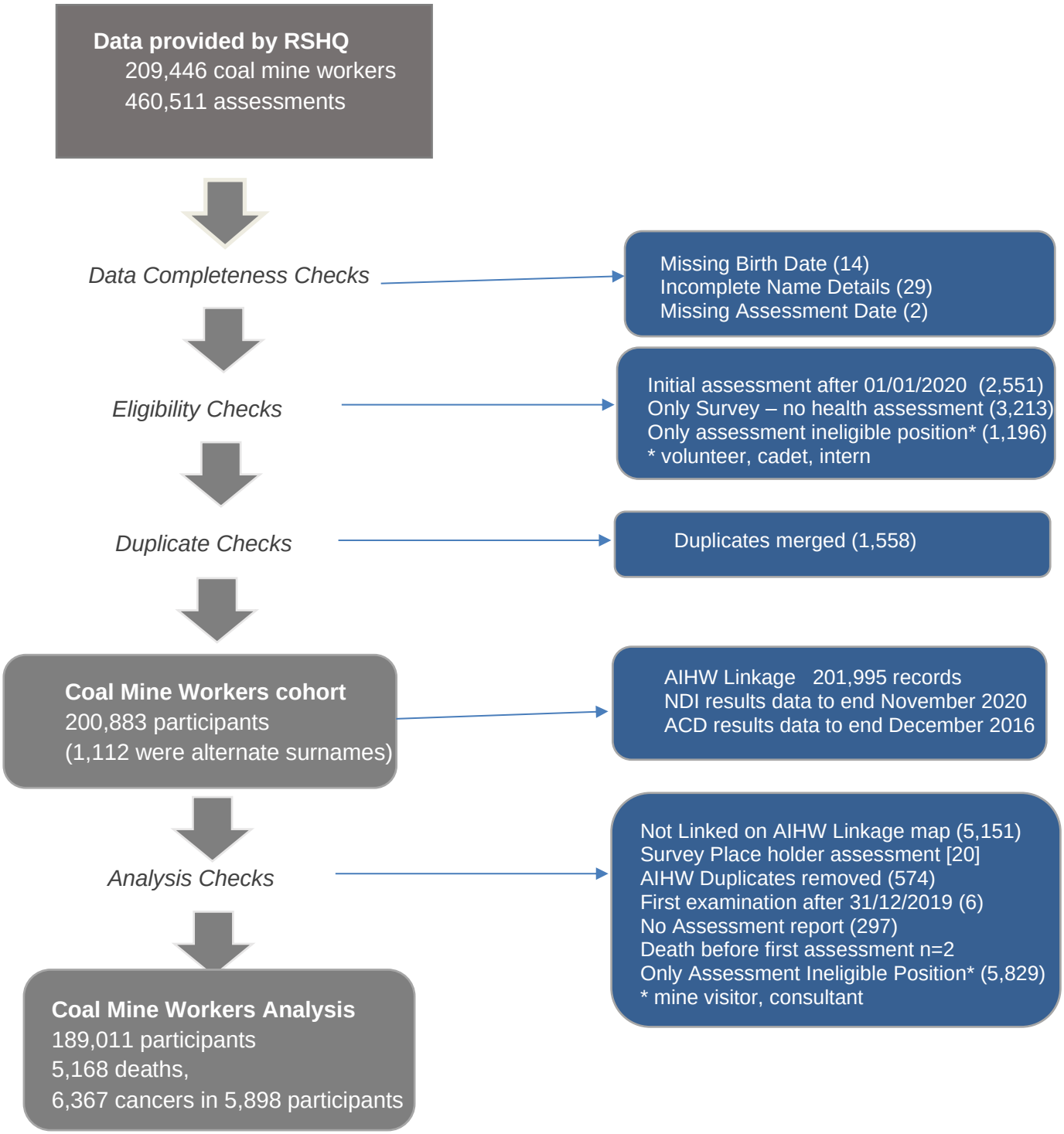


Figure 11: Cohort Structure showing number of coal mine workers and flow of data and exclusions (Individuals may have been excluded for more than one reason)

Two workers were matched to the NDI with high probability but the death dates were before their first assessment date. These were excluded from analyses as there was insufficient information to credit or discredit the match.

The number of eligible health assessments per person is shown in Table 8 this includes the initial survey and the later legislated health assessments. Many individual workers have had more than one assessment. Almost 1000 have had 10 or more assessments. More than one assessment may be generated using the same medical examination (see Section 8.1) and many workers had multiple assessments within a short space of time.

Table 8: Number of Eligible Health Assessments per worker (includes the Rathus & Abrahams as an assessment)

Number of Assessments	Workers n	Workers %
1	102,711	54.34%
2	36,457	19.29%
3	19,697	10.42%
4	12,336	6.53%
5	7636	4.04%
6	4542	2.40%
7	2588	1.37%
8	1322	0.70%
9	785	0.42%
≥10	937	0.50%

In the dataset provided, some assessments were identified as First assessments (likely pre-employment) and others were designated Periodic (likely those required by coal mining safety and health regulations every five years). There was a small proportion of workers (approx. 500) with more than one first assessment, some of these resulted from the identification of duplicates when constructing the cohort. In the data set provided, there were 186,136 workers with a First Assessment, and a further 86,419 workers who had at least one Periodic assessment recorded in the data (Table 9).

Table 9: Breakdown by Health Assessment Type

Health Assessment Type	Number of Health Assessments	Number of Unique Workers*
Rathus & Abrahams Survey	4,838	4,794
First Assessment	188,762	186,136
Periodic Assessment	202,261	86,419

* NB a worker with more than one assessment will appear in counts both for First and Periodic assessments, not all workers were included in the cohort see Figure 11

Figure 12 (men) and Figure 13 (women) illustrates the number of first examinations conducted every year after 1983. The graph shows that the majority of workers had their first examinations after 2000. The boom in coal mining in Queensland in the early years of this century likely explains this increase in first health assessments in those years.

Variations in mortality by era of work were examined by comparing mortality rates by year of first examination. As indicated previously, the majority of workers had their first examinations after 2000.

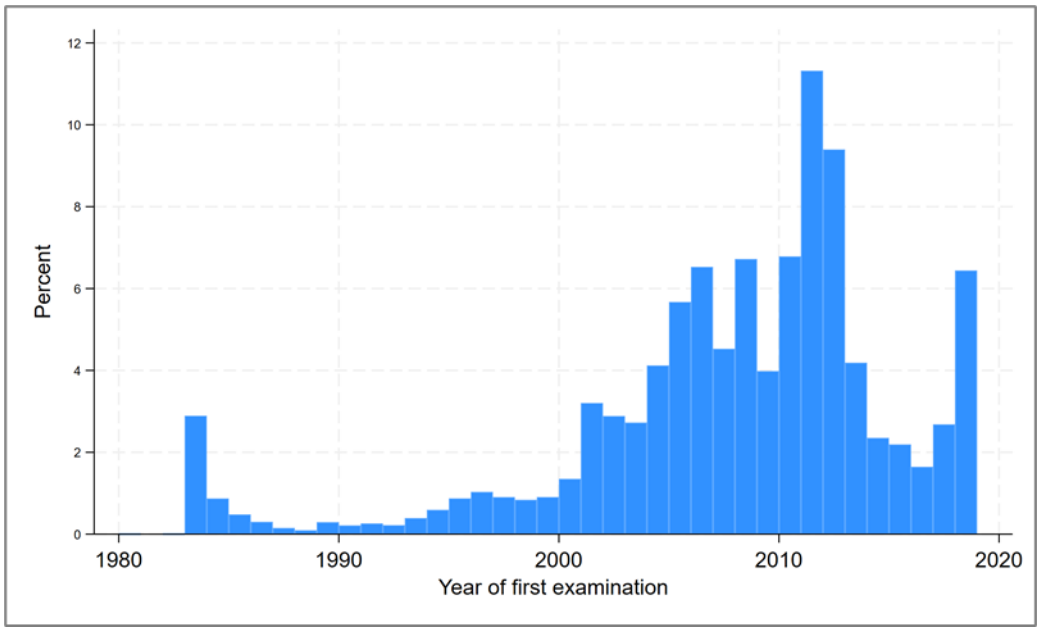


Figure 12: Distribution of year of first examination (excludes survey only workers) Men

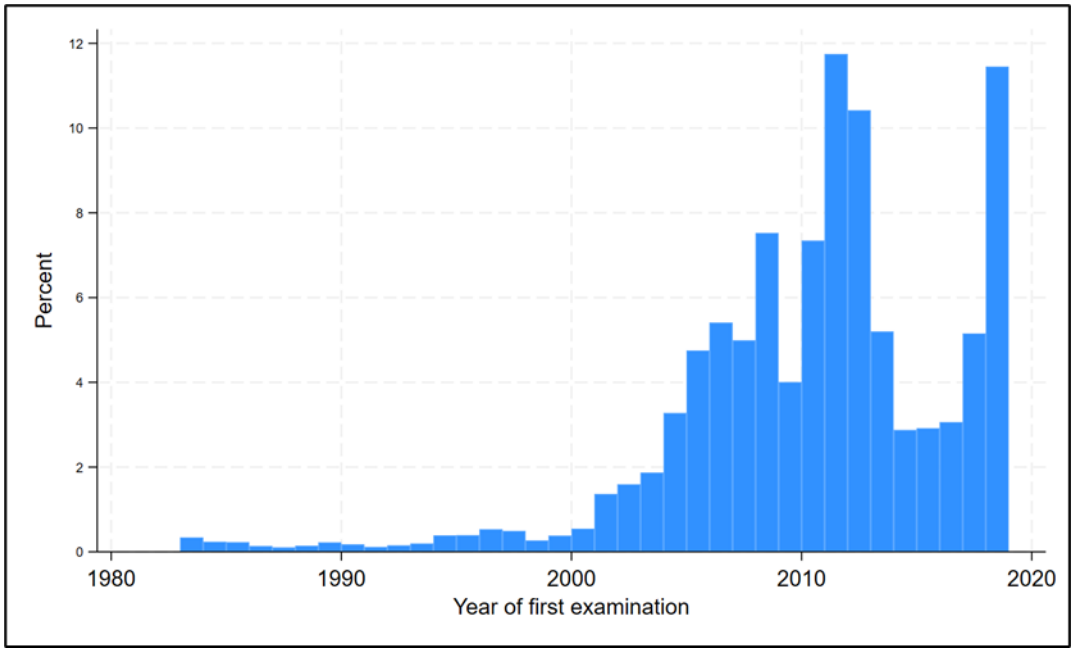


Figure 13: Distribution of year of first examination (excludes survey only workers) Women

The number of health assessments per year by Site Type are shown in Figure 14 and Figure 15.

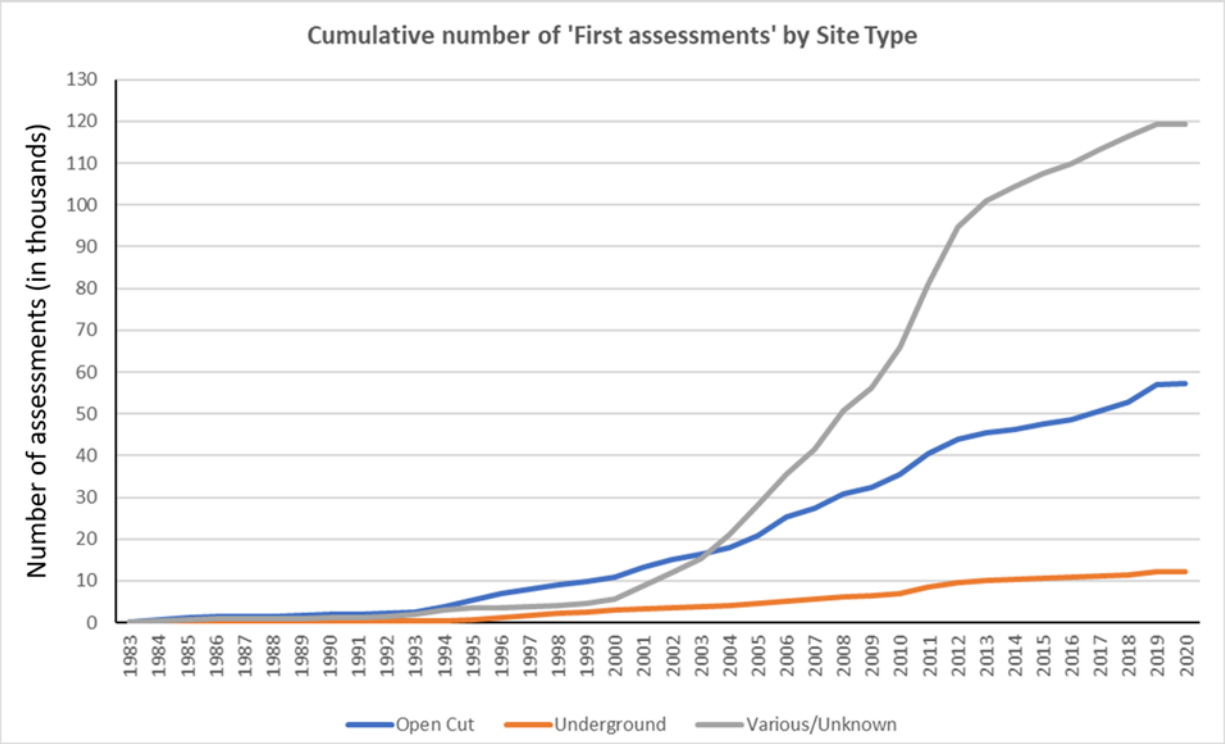


Figure 14: Cumulative number of first assessments by Site Type

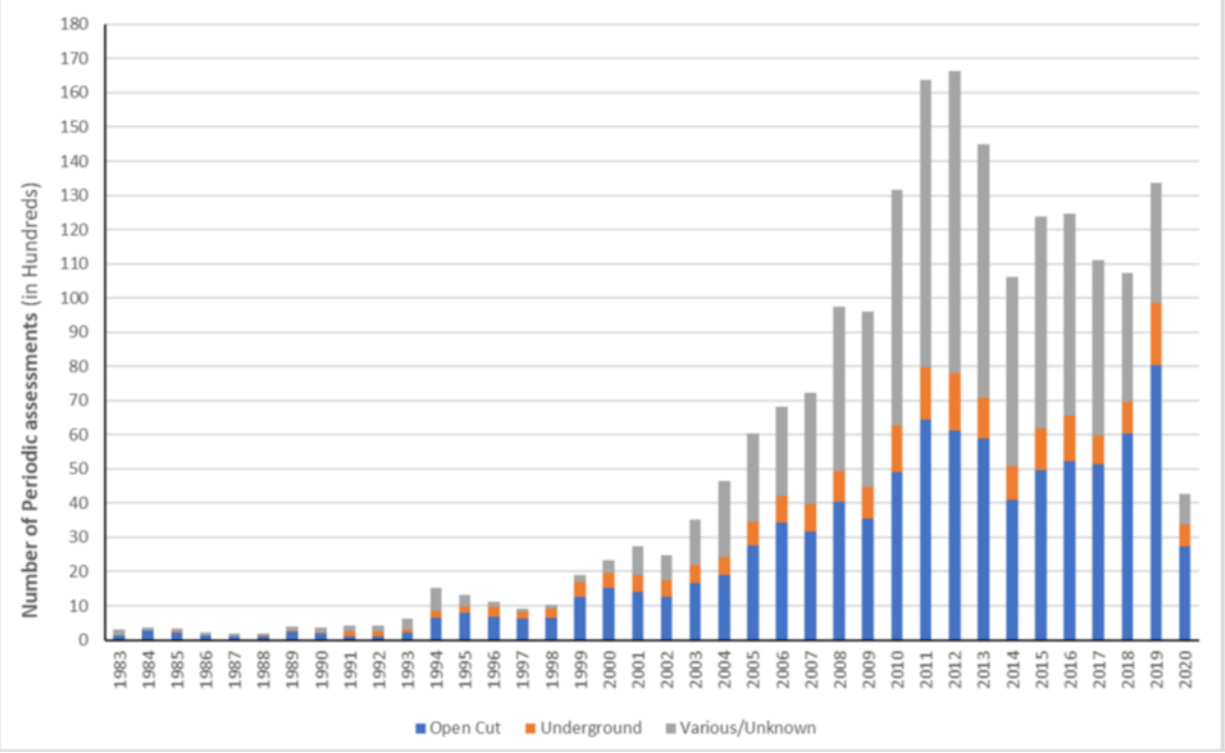


Figure 15: Number of periodic assessments by Site Type

9.1.1 Cohort description

Table 10 presents a description of the cohort including the person-years at risk, numbers of deaths and cancers and ages at various time points.

There were 164,622 men and 24,389 women in the cohort with 2,132,340 and 253,567 person-years of follow-up respectively. The cohort is relatively young, with an average age of less than 60 at the end of follow-up, so relatively few cancers and deaths have occurred. The median age at the start of the cohort was similar for men and women, around 30. The average starting age was similar for those who had only one assessment and those with more than one assessment.

The women who died or had cancer were somewhat younger than the men, although the ranges overlapped. The average age for those who had died was about 53 for women and 57 for men. The average age for coal mine workers with cancer was 47 for women and 56 for men.

Smoking status was recorded for almost all the cohort (>99%) based on data from eligible assessments only. Approximately half the cohort had never smoked, and the remainder were about evenly split between current and ex-smokers. Women were somewhat less likely to be smokers than men ($p<0.001$). Both male and female workers who had more than one assessment were also less likely to be, or to have been, smokers than those with only one assessment (20.8% vs 31.6%, $p<0.001$ among men; 20.1% vs 27.4%, $p<0.001$ among women).

Table 10: Description of the cohort

	Men		Women	
	All	2+ assessments	All	2+ assessments
Total number of coal mine workers (also included in mortality analysis)	164,622	53,762	24,389	4,207
Age at first assessment, median (P_{25} – P_{75})	32.6 (25.1-42.4)	30.7 (23.8-39.2)	30.1 (23.4-41.6)	28.9 (22.0-39.1)
Period of first assessment, n (%)				
Before 1993	9,496 (5.8%)	7,680 (14.3%)	451 (1.8%)	176 (4.2%)
1993 - 2002	21,355 (13.0%)	13,508 (25.1%)	1,503 (6.2%)	570 (13.6%)
2003 onwards	133,771 (81.2%)	32,574 (60.6%)	22,435 (92.0%)	3,461 (82.3%)
Deaths analysis summary (up to 30/11/2020)				
Person-years of follow-up*	2,118,554	980,557	251,476	60,864
Number of deaths n (%)	4,957 (3.0%)	1,665 (3.1%)	211 (0.9%)	28 (0.7%)
Age at death (if deceased before 30/11/2020), median (P_{25} – P_{75})	57.2 (45.7-66.4)	61.4 (52.3-68.9)	52.6 (44.0-60.1)	56.3 (46.8-63.0)
Number alive at 30/11/2020	159,665	52,097	24,178	4,179
Age at 30/11/2020**, median (P_{25} – P_{75})	46.1 (36.8-56.5)	49.2 (39.9-59.0)	41.3 (33.5-52.0)	44.6 (35.9-54.0)
Cancer Incidence analysis (up to 31/12/2016)†,‡				
Number of coal mine workers included in analysis	149,607	53,762	20,340	4,207
Person-years of follow follow-up§	1,514,169	775,287	161,447	44,453
Number of workers with a cancer diagnosis (%)	5,492 (3.7%)	2,693 (5.0%)	406 (2.0%)	84 (2.0%)
Number of people with, n (%)				
1 primary cancer	5,069 (92.3)	2,456 (91.2)	385 (94.8)	80 (95.2)
2 primary cancers	400 (7.3)	226 (8.4)	21 (5.2)	4 (4.8)
3+ primary cancers	23 (0.44)	11 (0.4)	0	0
Age at diagnosis of first cancerǁ, median (P_{25} – P_{75})	56.5 (48.3-63.3)	56.3 (48.1-62.9)	47.2 (39.1-54.4)	45.4 (34.3-53.1)
Smoking data				
Never smoked	75,102 (45.6%)	22,004 (40.9%)	13,068 (53.6%)	2,085 (49.6%)
Current smoker (most recent known status)	45,933 (27.9%)	11,202 (20.8%)	6,311 (25.9%)	844 (20.1%)
Ex-smoker	42,451 (25.8%)	20,438 (38.0%)	4,804 (19.7%)	1,263 (30.0%)
Not recorded	1,136 (0.7%)	118 (0.2%)	206 (0.8%)	15 (0.4%)

* For whole group, person-years are calculated from first examination date to the earliest of date of death or 30/11/2020. For those with 2+ assessments, person-years are calculated from date of a first assessment that occurred ≥5 years post initial examination to the earliest of date of death or 30/11/2020.
** Includes only those alive at end of follow-up.
† Excludes those whose first assessment was after 2016.
‡ 469 cancers occurred in 444 people who had already had a cancer diagnosed outside the follow-up period.
§ This includes time from first examination to the earliest of date of death or 31/12/2016 for all workers and those with 2+ assessments.
ǁ Excludes cancers diagnosed prior to 1st examination/assessment.

9.2 Exposure data

9.2.1 Occupational Exposure Limits

The current Safe Work Australia (SWA) Workplace Exposure Standard (WES)[11] for RCS is 0.05 mg/m^3. Prior to December 2019, the WES was 0.1 mg/m^3. The WES for respirable coal mine dust (containing <5% quartz) is currently 1.5 mg/m^3 reduced from 3 mg/m^3 in October 2022.

In August 2023, SWA proposed a WES for diesel particulate matter (DPM) measured as the respirable elemental carbon (REC) content of the DPM 15 µg REC/m^3. SWA notes that the term DPM refers to the particles within DEE.[12] The Queensland Government made a submission in response to this proposal.[13] Following public consultation a WES of 10 µg REC/m^3 is now proposed by SWA. (RSHQ personal communication)

In November 2018, the Queensland government reduced the occupational exposure limits (OELs) for coal dust from 3.0 mg/m^3 to 2.5 mg/m^3 as an interim measure. Then from September 2020, the OELs for respirable dust and RCS were reduced to 1.5 mg/m^3 and 0.05mg/m^3 respectively.[14] As exposure standards are based on an 8-hour time weighted average, the Coal Mining Safety and Health Regulation includes a provision for shift adjustment when a work shift exceeds 8 hours.[15]

Queensland does not have a legislated exposure limit for DPM for resource industries, however there has been a guideline limit of 0.1 mg/m^3 for coal mines. This was based on the recommendation from the Australian Institute of Occupational Hygienists and recommended maximum workplace exposure for underground environments in New South Wales.[16] The guideline limit for Queensland coal mines has subsequently been reduced to 0.05mg/m^3 from February 2024.

For reference, the Queensland coal mining exposure limits have been added to graphs presented in this section.

[11] https://www.safeworkaustralia.gov.au/sites/default/files/2022-09/workplace_exposure_standards_for_airborne_contaminants_-_1_october_2022.pdf
[12] https://engage.swa.gov.au/consultation-on-a-proposed-workplace-exposure-standard-for-diesel-particulate-matter
[13] S006-Resource_Safety_&_Health_QLD-Redacted.pdf (542 KB) (pdf)
[14] Queensland mines legislation and dust management | Business Queensland
[15] Shift adjustment of the guideline limit for diesel particulate matter | Resources Safety & Health Queensland (rshq.qld.gov.au)
[16] Diesel Particulate Matter and Occupational Health (2017) – AIOH, Guideline for the management of diesel engine pollutants in underground environments (nsw.gov.au)

9.2.2 Occupational Exposure data from RSHQ

Measured exposure data for a range of SEGs was provided by RSHQ. The data came from 49 Companies and over 90 coal mines. There were more than 70,000 RD and RCS measurements and over 12,000 DPM measurements.

Table 11 presents the mean of yearly average exposures to RCS, RD and DPM (UG only) by Job Group mapped to SEGs, that were used for these estimates. Data from SEGs that did not map to Job Groups were not included. A few implausible outliers were removed from the data as noted in Table 11, e.g. 34 mg/m^3 RD, 7.39 mg/m^3 RCS. It was also noted that for certain years, particularly where there were a small number of samples, a few higher results increased the yearly average. The data used by Monash did not take into account the use of respiratory protective equipment (RPE) or shift lengths greater than 8 hours.

Table 11 shows that the mean of yearly RCS measurements for most Job Groups was ≤0.020 mg/m^3. Only Exploration Drillers had an average greater than the current SWA WES, although it was still lower than the previous WES. For RD, majority of the averages were under 0.5 mg/m^3 with the exception of Exploration Drillers, UG miners/maintenance workers and ERZ Deputy. DPM was only reported for a few Job Groups that mapped to SEGs, and the values ranged from 0.001mg/m^3 in CHPP maintenance jobs to 0.054 mg/m^3 in UG miners.

Graphs of the distribution of yearly mean exposures and trend lines for Production and Maintenance workers by Site Type and for other selected Job Groups are presented in Sections 9.2.3 for RCS, 9.2.4 for RD and 9.2.5 for DPM. Further figures for other Job Groups are in Appendix 6. Note the different scales for the three exposures.

The Job Groups that showed the largest changes were Underground Production and Exploration Drillers. Smaller reductions from a lower baseline were seen for ERZ workers and maintenance workers from underground, open cut and CHPP sites. Note that none of the graphs included data from the SEG for Longwall moves (SEG QCU005). The average exposure measurements for RCS over the period for Longwall Production (SEG QCU001) was 0.020 mg/m^3 and for Development Production (SEG QCU002) was 0.028 mg/m^3.

The graphs by year should be interpreted with caution. Where there were few samples in a year but one was higher than usual, this may show as a spike in the graph and this may not be typical of exposure that year or overall. A lognormal distribution is typically observed for occupational hygiene data so occasional high exposures may be seen in large data sets but most measurements are clustered at the lower end of the distribution.

Data sets with few measurements are less likely to capture the uncommon or occasional high exposure. (Rappaport, Spear et al. 1982)

Table 11: Mean of Yearly Average Exposures for Respirable Crystalline Silica, Respirable Dust and Diesel Particulate Matter in mg/m^3 by SEG

SEGs	Job Group/Work Category	Respirable Crystalline Silica		Respirable Dust		Diesel Particulate Matter	
		Mean of Yearly Averages mg/m^3	Number of samples	Mean of Yearly Averages mg/m^3	Number of samples	Mean of Yearly Averages mg/m^3	Number of samples
QCS013, QCU013	Administration	0.009	337	0.107	332		0
QCP001 QCP004	CHPP production	0.010	3443	0.275	3538	0.002	18
QCP002	CHPP maintenance	0.013	1572	0.388	1738	0.001	8
QCP003	CHPP laboratory (excl one 2008 RCS and RD value)	0.012	1451	0.392	1463		0
QCS001 QCS002 QCS004 QCS018	OC production (see below) (excl. one 2002 RD)	0.014	10368	0.191	10645		0
QCS003	OCE (excl. one 2008 RCS value)	0.011	637	0.130	639		0
QCS005 QCS006 QCS011 QCS014 QCS015 QCS016	OC Maintenance	0.020	7989	0.286	7050	0.002	19
QCS008 QCU026	Tech services (engineers, geologists, surveyors) (2021 & 2022)	0.009	867	0.160	955	0.013	23
QCS009	Exploration Drillers	0.060	907	1.192	918		0
QCS007	Blast Crew	0.026	2410	0.354	3137		0
QCS010	Blast Driller	0.031	3123	0.230	2429		0
QCS017	Dragline operators (excl one 2003 RCS and RD value)	0.017	1679	0.157	1696		0
QCS021 QCU010	Control room (UG and OC)	0.006	72	0.061	71		0
QCS033	Shutdown maintenance (2021 & 2022 only)	0.005	115	0.187	115		0
QCU001 QCU002	UG Production (excl one 2002 RCS value)	0.032	12058	1.601	10633	0.054	3635
QCU008	ERZ	0.020	1394	0.936	1615	0.037	847
QCU003 QCU009 QCU011 QCU012	UG maintenance (excl one 2002 RCS value)	0.013	2727	0.790	3050		0
QCU017 QCU023	Driller UG coal seam	0.012	217	0.284	337	0.039	134

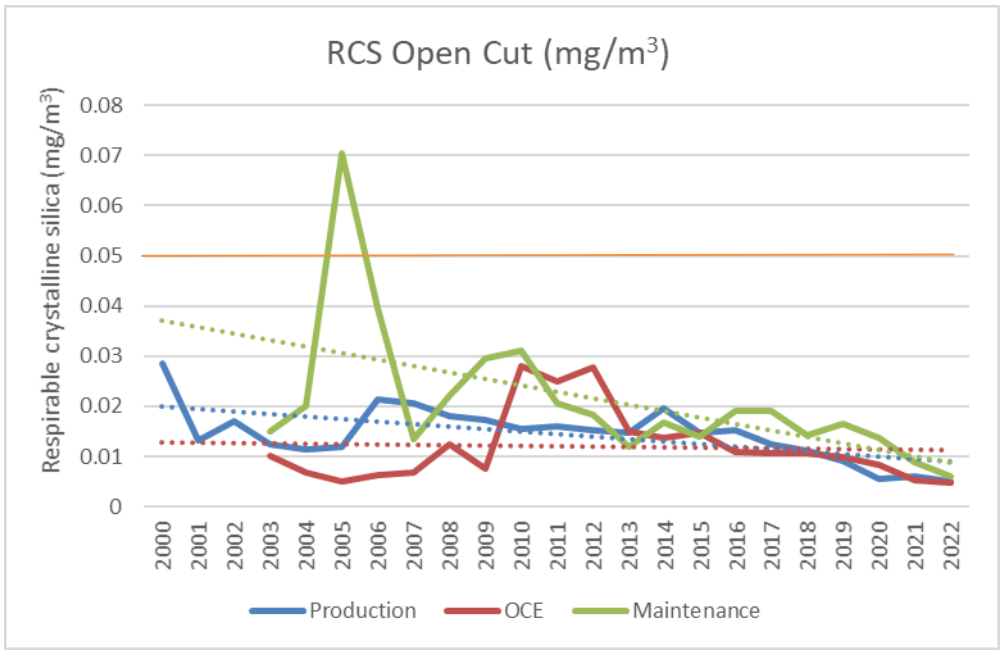
9.2.3 Respirable Crystalline Silica

Respirable crystalline silica (RCS) exposure was generally low, less than 0.02 mg/m^3 for OC Production and OCE (Figure 16), and CHPP Production and Laboratory work (Figure 17). Other low exposed groups include Dragline Operators, UG Drillers, Technical Services, Administration and Control Room workers (see Appendix 6 and Table 11). For these jobs, the levels of exposure were generally constant over the period of the measurements.

CHPP, OC and UG maintenance showed possible trends of higher RCS exposure before 2005 but average exposure in most years was less than 0.02 mg/m^3 (Figure 16 to Figure 18).

Underground mine workers (Figure 18) showed a reduction in exposure over the period. Average RCS was above 0.05 mg/m^3 until around 2010 and at about 0.02 mg/m^3 until around 2016. The ERZ had an average RCS at 0.02 mg/m^3 after 2010.

Exploration Drillers had very variable exposures which have greatly reduced over the period from over 0.2 mg/m^3 in 2004 (Figure 19). Table 11 shows that mean of the yearly average exposure for exploration drillers is 0.06 mg/m^3 (n=907).

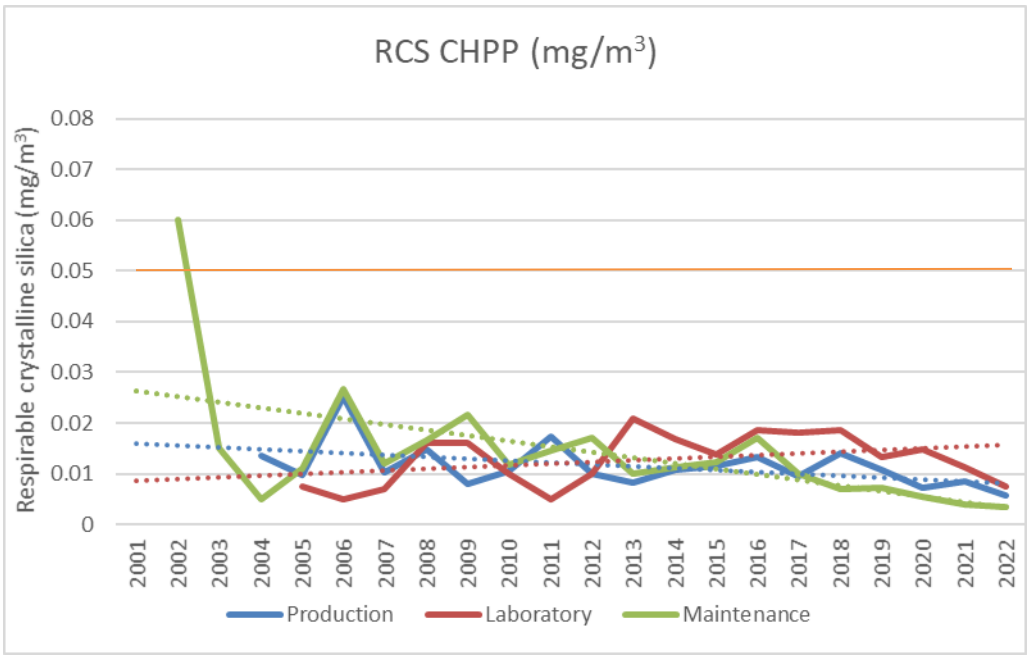


Qld OELs

pre 2018 - 0.1 mg/m^3

2020

Figure 16: Measured Respirable Crystalline Silica dust at Open Cut Mines

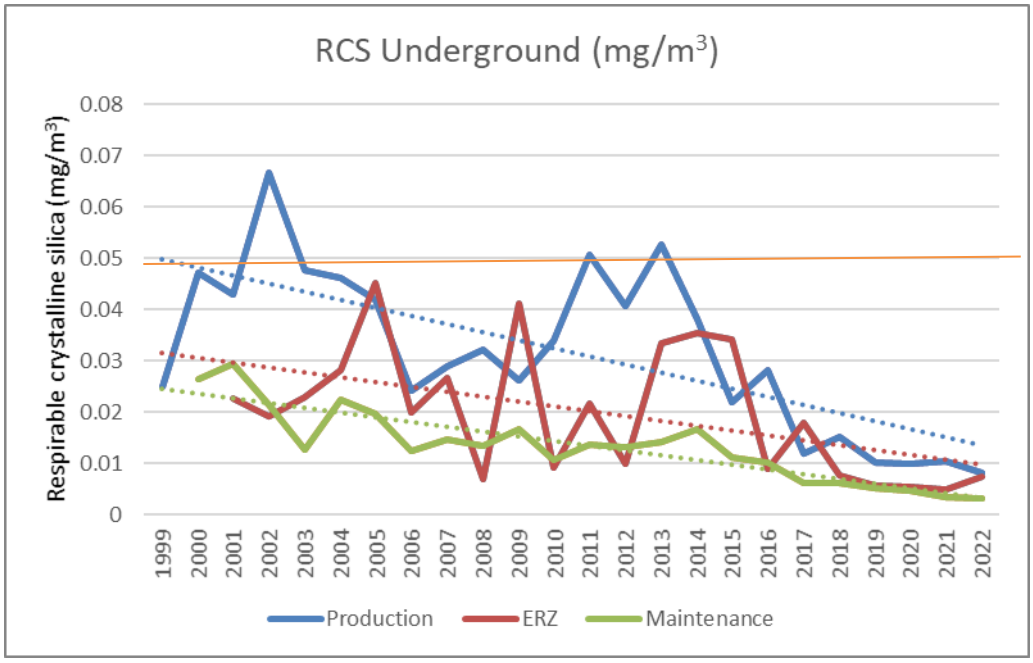


Qld OELs

pre 2018 - 0.1 mg/m³

2020

Figure 17: Measured Respirable Crystalline Silica dust at CHPPs



Qld OELs

pre 2018 - 0.1 mg/m³

2020

Figure 18: Measured Respirable Crystalline Silica dust at Underground Mines

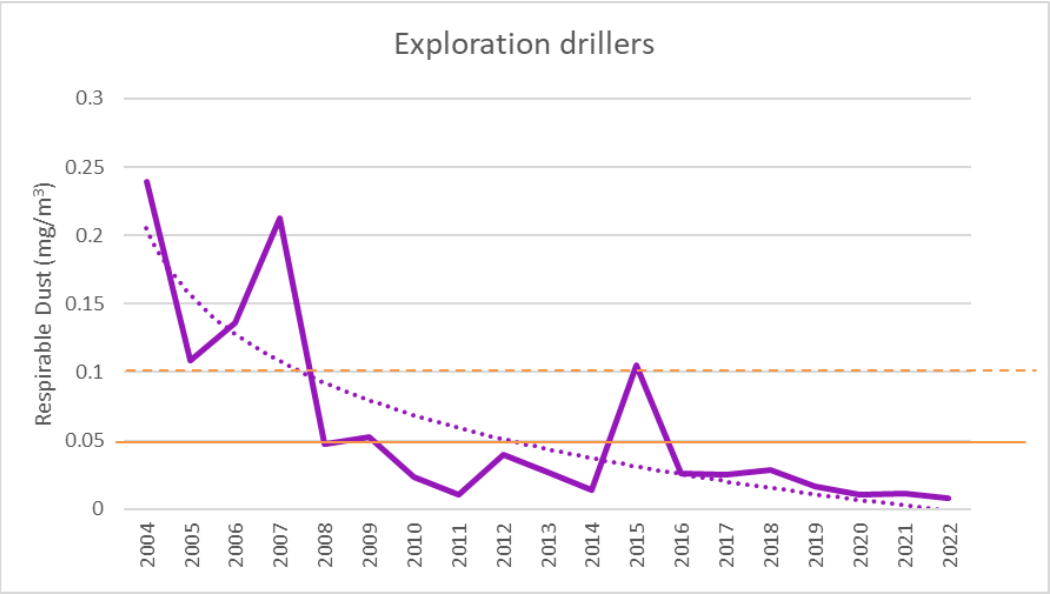


Figure 19: Measured Respirable Crystalline Silica dust for Exploration Drillers

9.2.4 Total Respirable Dust

The exposure results for total respirable dust data, unsurprisingly, reflect those of the RCS data.

RD exposure was generally low for most jobs other than those underground, averaging less than 0.5 mg/m^3, (typically less than 0.2 mg/m^3) for all OC and CHPP workers (Figure 20 and Figure 21), and technical/administrative and UG driller Job Groups (Appendix 6). OC maintenance workers showed a possible downward trend over the period (Figure 20).

Underground mine production workers had exposures above the RD WES of 1.5 mg/m^3, averaging more than 2 mg/m^3 in 1999, but halving by 2022 (Figure 22). Exposure measurements appear to be higher between 2013 and 2015, reducing particularly after 2016. The ERZ had an average RD of about 1.7 mg/m^3 in 2000 falling to 0.05 about 2017 mg/m^3. UG maintenance workers were similar to but somewhat lower than ERZ workers.

Exploration Drillers had very variable exposures which have greatly reduced over the period from around 4 mg/m^3 in 2004 (Figure 23). Table 11 shows that mean of the yearly average exposure for exploration drillers is 1.19 mg/m^3 (n=918).

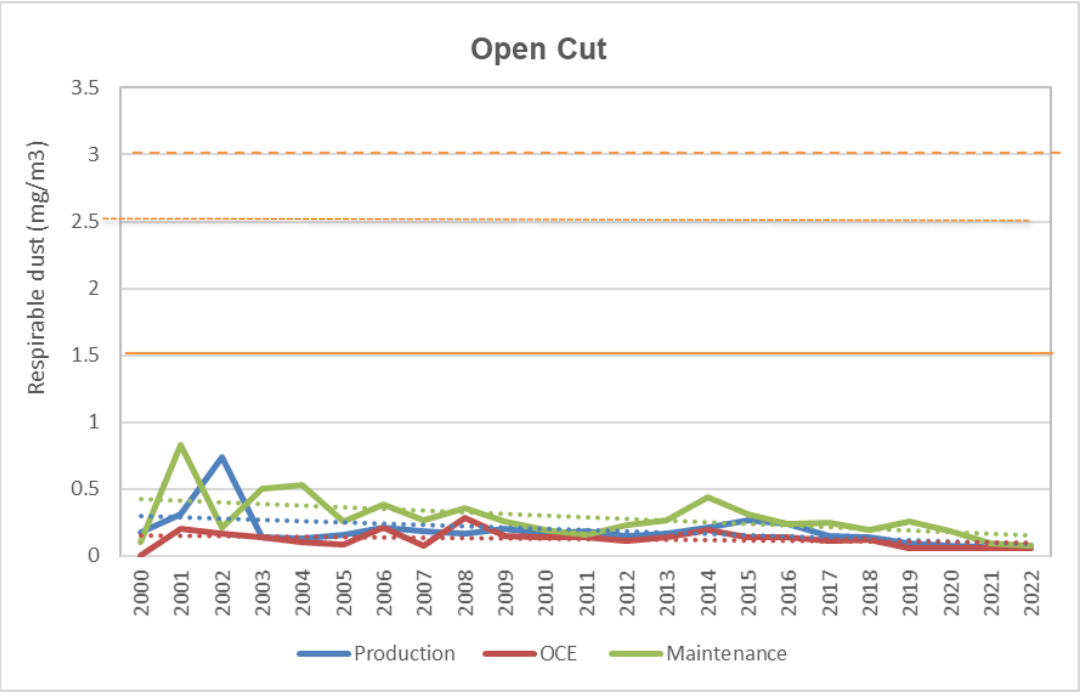


Figure 20: Measured Respirable Dust at Open Cut Mines

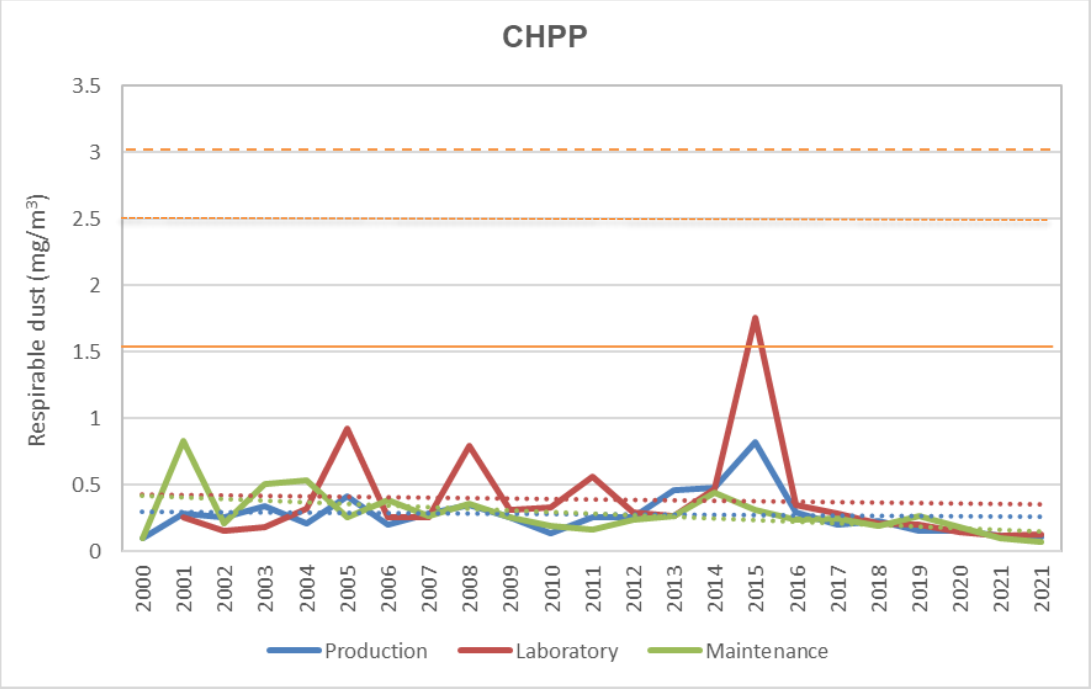


Figure 21: Measured Respirable Dust at CHPPs

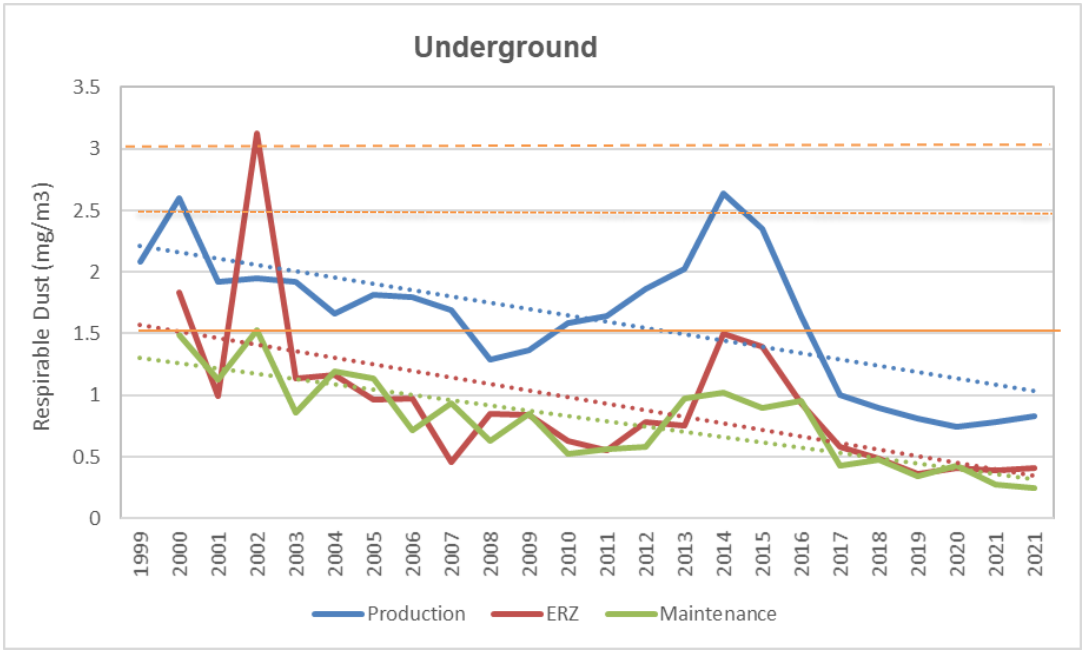


Figure 22: Measured Respirable Dust at Underground Mines

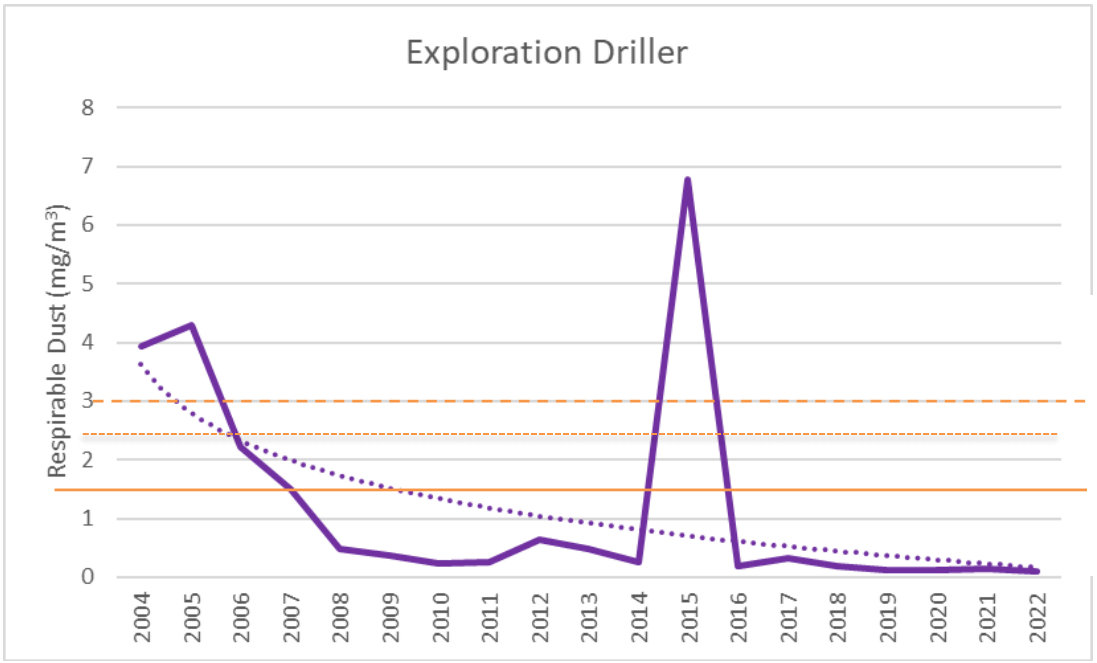


Figure 23: Measured Respirable Dust for Exploration Drillers

9.2.5 Diesel Particulate Matter

Diesel engine emissions, measured as diesel particulate matter (DPM), were most commonly measured underground (Table 11 and Figure 24) and was typically below 0.1 mg/m^3 but this is based on a smaller number of samples and a more limited number of years than for RCS or RD exposure. Exposure was generally higher for Production workers and ERZ than for underground maintenance workers. An occasional high measurement will show as a spike when presented by year. The trend lines show than exposure was typically below the Queensland limit

Table 11 shows that average exposure for CHPP, Laboratory and OC Maintenance was 0.002 mg/m^3 or less, Technical Services had a mean exposure of 0.013 mg/m^3.

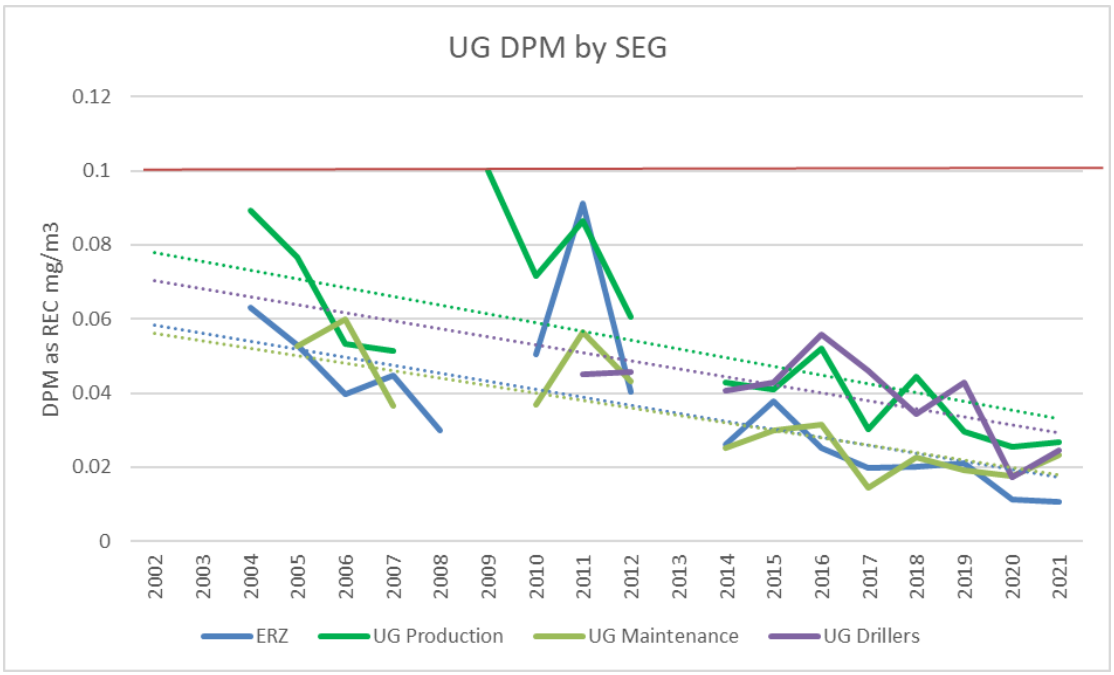


Figure 24: Measured Diesel Particulate Matter at Underground Mines

9.3 Smoking Status

At least one-in-five coal mine workers were smokers at their most recent assessment. About 70% of 'last known smoking status' was recorded at a health assessment within 10 years of each worker's end of follow-up. Figure 25 illustrates the years in which the smoking status was last known.

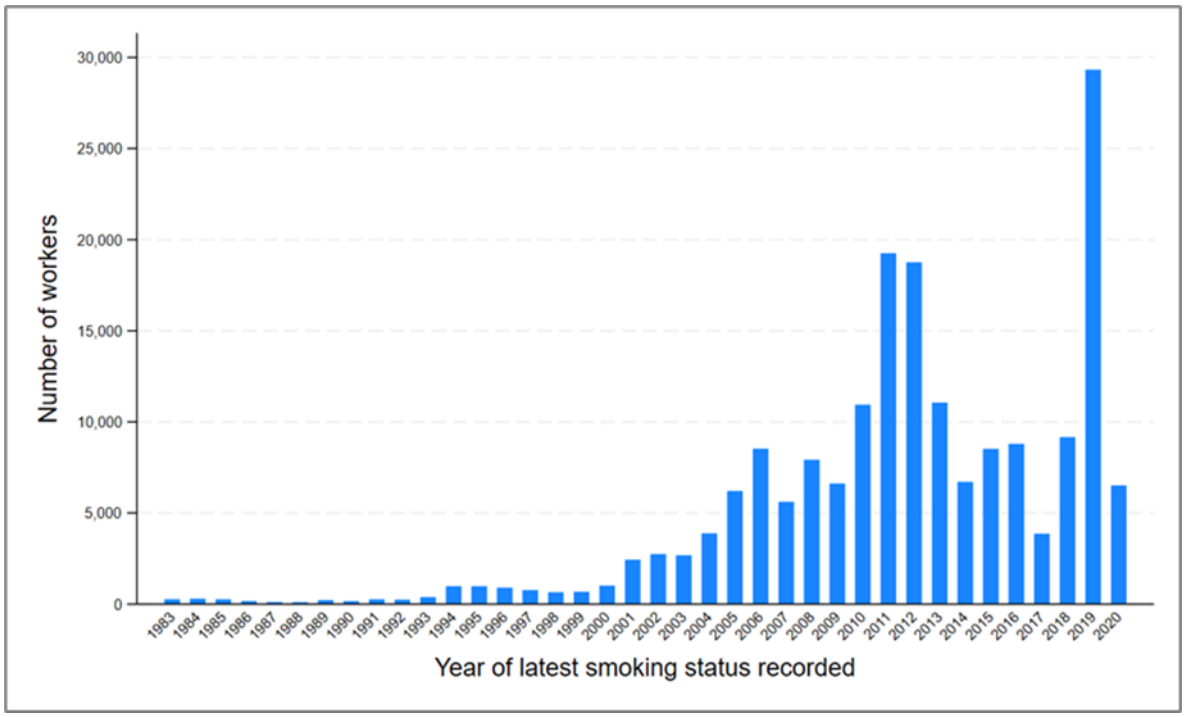


Figure 25: Distribution of year in which smoking status was last reported (men and women combined)

Figure 26 shows the distribution of time between last known smoking status and end of follow-up for each sex by era of first examination. The distribution of workers among those with first examination dates after 2010 was as expected. However, it is also worth noting that even among men whose first examination was in the 1980s or 1990s, a smoking status within 10 years of follow-up was available for 40% of the cohort.

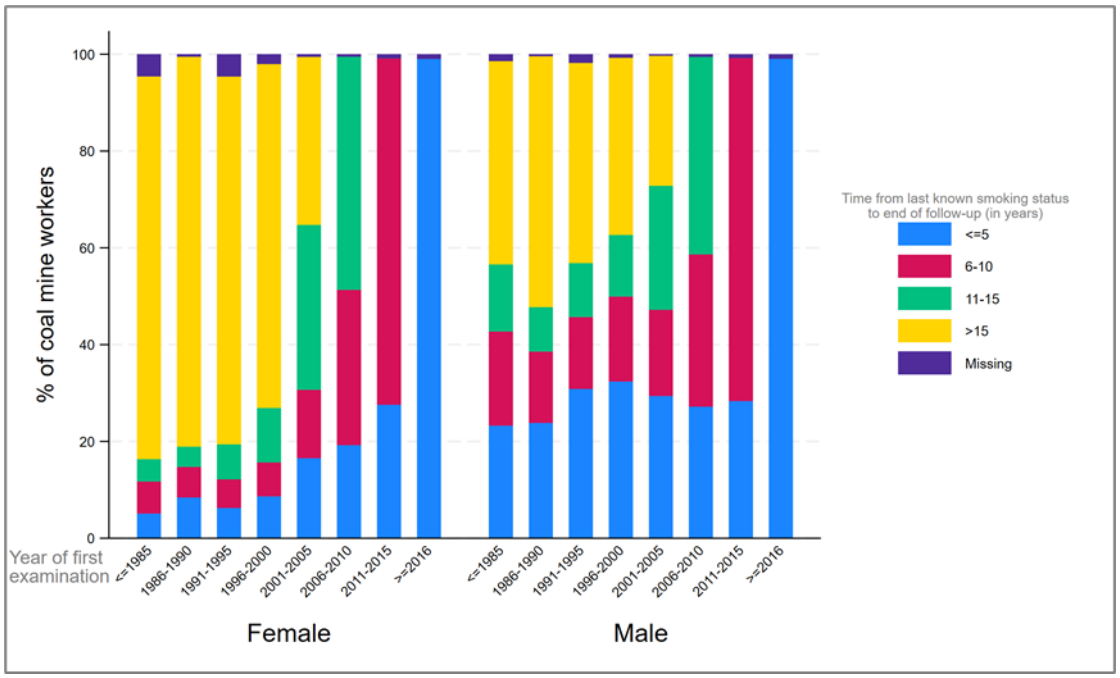


Figure 26: Year in which smoking status was last recorded, split by year of first examination and sex

9.3.1 Smoking status by Work Category and Job Group

Figure 27 shows smoking rates for men while Figure 28 present the data for women. Appendix 7 Smoking status, provides more information on the differences in smoking rates for men and women by Job Group. In both cases smoking rates vary significantly between Work Category and Job Group. In general, men were more likely to smoke than women.

The highest rates for never having smoked were seen in men in the following Job Groups: Occasional exposed (68%) such as Engineers (76%), and in Administration (58%), Auto Electricians (57%) and Electricians (56%). The Job Groups with the highest proportion of current smoking men were Abrasive Sand and Blast (50%), Industrial Cleaners 45%, Scraper and Cleaner (nec) (44%), Labourer (nec) and Belt Splicer (41%), Construction (38%), Shutdown Maintenance (39%), Tyre Fitter and Exploration Driller 37%, Driller (General) and Civil works (36%). Groups of men with the highest percentage of ex-smokers were Dragline (51%) Prestrip (46%) Driller (Blast) (40%) and CHPP (41%).

Among women the Job Groups with the highest proportion of workers who never smoked were: Engineer (88%), Technical Services and Electrician (69%), Administration and Diesel Fitter (62%), Environmental Services (60%) Blast Crew and Laboratory (56%) and Exploration Driller (54%). Mine services, (43%) Cleaner (nec) (41%) had the highest current smoking rates. Groups with the highest percentage of female ex-smokers were: Miner (35%), Operator (26%), Truck Driver (nec) (26%), Blast Crew (25%).

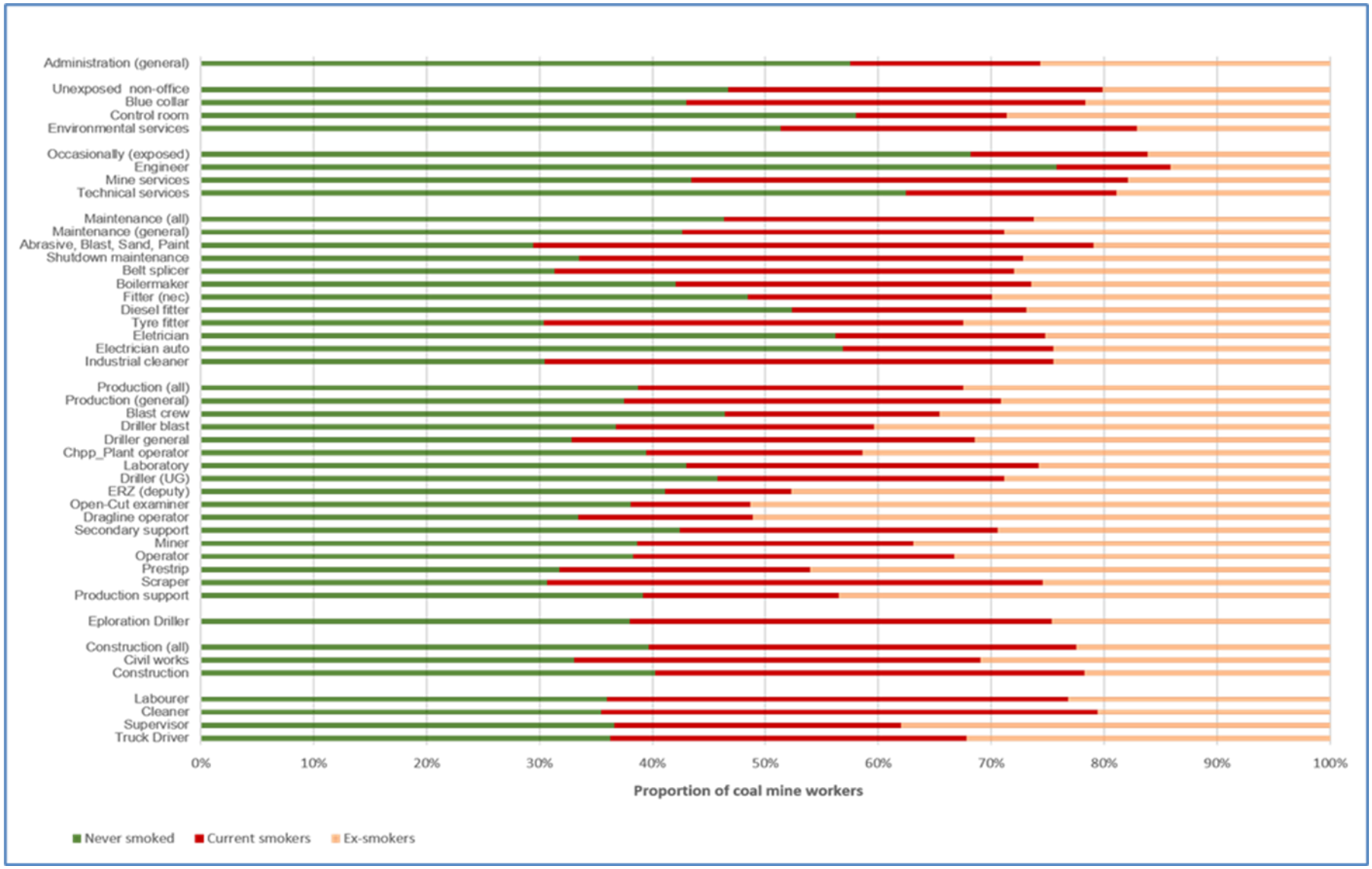


Figure 27: Summary of smoking status among male coal mine workers, by Work Category and Job Group

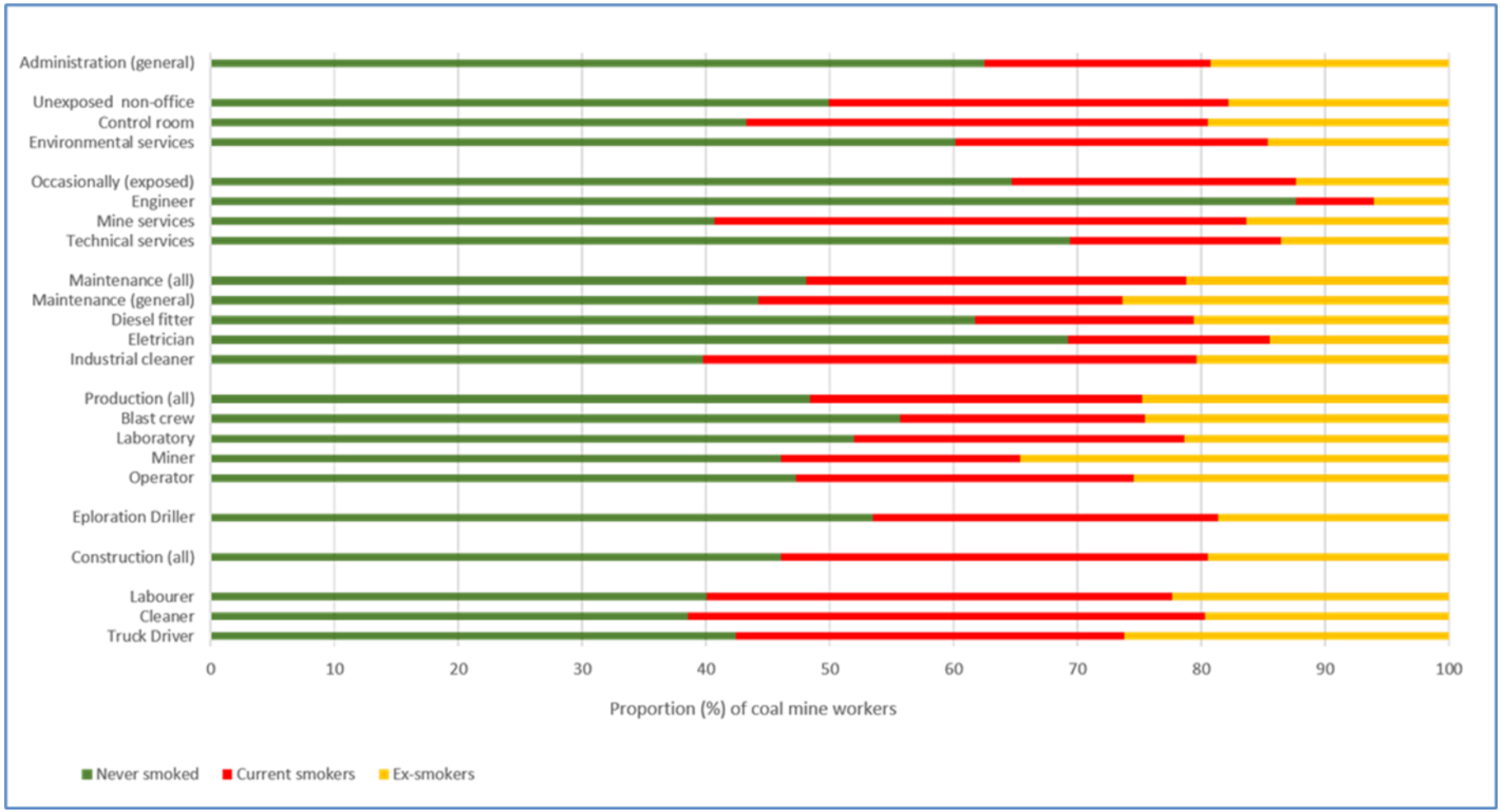


Figure 28: Summary of smoking status among female coal mine workers, by Work Category and Job Group

9.4 Mortality findings compared to the Australian population (External Analyses)

In this section the mortality and cancer incidence for male and female coal mine workers is compared externally to those expected based on the age, sex and era specific rates from the Australian population.

9.4.1 Overall mortality

There were 4,957 (3.0%) deaths among men and 211 (0.9%) deaths among women. Table 12 summarises the SMRs disaggregated by sex, for all workers in the cohort.

Significantly reduced overall mortality and mortality from all malignancies, were seen for male and female coal mine workers compared to expected numbers from the general population with the same age distribution. These SMRs used the general Australian population death rates as a comparison, which should be a valid comparison for nearly all causes of death, the notable exception being for melanoma which may not be the best comparison as Queensland has a higher incidence of melanoma (and hence likely higher mortality) than other states. SIRs for melanoma using Queensland incidence comparison rates are presented in Section 9.5.1.

Mortality from most causes of death were reduced, many were statistically significantly reduced for men. Breast cancer mortality was significantly reduced for women. Of the specific causes of death, suicide was statistically significantly increased among men: SMR 118 (95 % CI 109 - 128). Overall for both men and women, there were no other statistically significant increased risks of mortality. Of the 674 deaths caused by accidents, more than half were from traffic accidents (n=395; 59%), whilst almost 20% were as result of accidental poisoning by exposure to a noxious substance (e.g. alcohol, carbon monoxide, narcotics, etc) (n=129, 19%).

Only workers who had an assessment after 1993 could be included in the analyses by Work Category or Job Group because the job title was not consistently collected prior to 1993. Those workers whose assessments were only before 1993 (n=1,992) did not provide a job title and could not be included in the analyses by Work Category or Job Group.

As a sensitivity analysis, Table 13 provides the SMRs disaggregated by sex after excluding workers with only a pre-1993 assessment. There were 4,629 (2.8%) deaths among men and 202 (0.8%) deaths among women, so that 328 deaths among men and 9 among women were excluded. Unsurprisingly, there was very little change in overall death rates or in deaths from specific causes.

Table 12: Standardised Mortality Ratios (SMR) and 95% confidence intervals (CI) for all male and female coal mine workers compared to the Australian population (Observed (O), Expected (E))

Cause of death categories †	All Men *N=164,622 PY=2,118,553*			All Women *N=24,389; PY=251,476*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	4957	6143	81 (78 - 83)	211	282	75 (65 - 86)
All Malignancies	1888	2093	90 (86 - 94)	99	127	78 (64 - 95)
Oesophagus	79	96	82 (66 – 102)	--**	--	140 (35 - 561)
Stomach	59	71	83 (64 - 107)	--	--	68 (17 - 272)
Colorectal	196	218	90 (78 - 103)	6	12	52 (23 - 115)
Liver	100	127	79 (65 - 96)	--	--	27 (4 - 189)
Pancreas	119	132	90 (75 - 108)	--	--	79 (33 - 190)
Lung	434	428	101 (92 - 111)	23	20	115 (76 - 173)
Mesothelioma, pleural	36	34	105 (76 - 146)	0		
Melanoma	90	99	91 (74 - 112)	--	--	94 (35 - 251)
Prostate	122	115	107 (89 - 127)	-		
Breast	0 ‡			16	30	53 (33 - 87)
Bladder	24	33	72 (48 - 107)	--	--	285 (71 - 1141)
Kidney	52	59	88 (67 - 116)	0		
Brain	111	121	92 (76 - 110)	--	--	62 (23 - 166)
All Metabolic	123	228	54 (45 - 64)	6	10	57 (26 - 128)
Diabetes	89	154	58 (47 - 71)	--	--	81 (34 - 194)
All Mental and Behavioural	37	100	37 (27 - 51)	--	--	32 (5 - 228)
Dementia	19	36	52 (33 - 82)	0		
All Nervous System	93	209	44 (36 - 55)	6	11	53 (24 - 118)
Alzheimer Disease	12	18	67 (38 - 118)	0		
Parkinson Disease	11	22	50 (28 - 90)	0		
All Circulatory	944	1306	72 (68 - 77)	30	37	82 (57 - 117)
IHD	597	777	77 (71 - 83)	11	13	86 (48 - 155)
Cerebrovascular	113	185	61 (51 - 73)	7	10	72 (35 - 152)
Other Heart Disease	172	263	65 (56 - 76)	9	11	83 (43 - 160)
All Respiratory	221	304	73 (64 - 83)	10	14	70 (37 - 129)
COPD	137	161	85 (72 - 101)	--	--	28 (7 - 112)
Asthma	8	18	45 (23 - 90)	--	--	236 (89 - 629)
Lung Diseases due to Dust	6	4	155 (70 - 346)	0		
All Digestive	136	291	47 (40 - 55)	8	12	66 (33 - 131)
Liver Disease	87	207	42 (34 - 52)	8	8	95 (48 - 190)
All Urinary	26	53	50 (34 - 73)	--	--	78 (20 - 312)
Kidney Failure	19	34	56 (36 - 88)	--	--	69 (10 - 489)
All Injury and Trauma	**1336**	**1261**	**106 (100 - 112)**	45	47	96 (72 - 128)
Accidents	674	643	105 (97 - 113)	22	23	94 (62 - 143)
Suicide	**614**	**520**	**118 (109 - 128)**	18	19	96 (60 - 152)
All Other Causes	144	299	48 (41 - 57)	--	--	18 (7 - 47)

* Statistically significantly increased SMR results are in red, statistically significantly reduced SMR results are in blue

** Cell sizes of less than 6 are not reported to preserve privacy, the symbol -- has been used

† Specific cause of death for 9 male workers.

‡ 0 means no instances were identified

NB More detail about how the risk ratios are calculated is presented in Appendix 4. Discussion of the interpretation of risk ratios and confidence intervals is in Section 10.10 Statistical significance.

Table 13: SMRs* for male and female coal mine workers, who were in employment after 1993, compared to the Australian population

Cause of death categories †	All Men *N=162,887 PY=1,972,946*			All Women *N=24,132; PY=240,802*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	4629	5679	82 (79 - 84)	202	268	75 (66 - 86)
All Malignancies	1776	1953	91 (87 - 95)	95	121	78 (64 - 96)
Oesophagus	75	91	83 (66 – 103)	--**	--	147 (37 - 589)
Stomach	56	66	85 (65 - 110)	--	--	71 (18 - 285)
Colorectal	183	203	90 (78 - 104)	6	11	54 (24 - 121)
Liver	95	121	79 (64 - 96)	--	--	28 (4 - 197)
Pancreas	115	125	92 (76 - 110)	--	--	83 (35 - 200)
Lung	407	399	102 (93 - 112)	23	19	120 (80 - 181)
Mesothelioma, pleural	32	32	100 (71 - 142)	0		
Melanoma	86	91	95 (77 - 117)	--	--	99 (37 - 265)
Prostate	112	106	106 (88 - 127)	NA		
Breast	0			14	28	49 (29 - 83)
Bladder	23	31	74 (49 - 112)	--	--	152 (21 - 1076)
Kidney	51	55	93 (70 - 122)	0		
Brain	103	114	91 (75 - 110)	--	--	65 (25 - 174)
All Metabolic	114	214	53 (44 - 64)	6	10	60 (27 - 133)
Diabetes	82	145	57 (46 - 70)	--	--	85 (35 - 203)
All Mental and Behavioural	32	86	37 (26 - 52)	--	--	35 (5 - 249)
Dementia	18	32	56 (35 - 88)	0		
All Nervous System	83	195	42 (34 - 53)	6	11	56 (25 - 124)
Alzheimer Disease	11	16	69 (38 - 124)	0		
Parkinson Disease	8	20	40 (20 - 79)	0		
All Circulatory	877	1195	73 (69 - 78)	28	35	80 (56 - 116)
IHD	560	708	79 (73 - 86)	11	12	91 (50 - 164)
Cerebrovascular	107	169	63 (52 - 77)	6	9	66 (29 - 146)
Other Heart Disease	153	244	63 (54 - 74)	8	10	78 (39 - 156)
All Respiratory	198	280	71 (61 - 81)	10	14	73 (39 - 136)
COPD	122	150	82 (68 - 97)	--	--	29 (7 - 117)
Asthma	8	16	52 (26 - 103)	--	--	255 (96 - 679)
Lung Diseases due to Dust	6	4	171 (77 - 380)	0		
All Digestive	123	271	45 (38 - 54)	8	12	69 (34 - 137)
Liver Disease	80	194	41 (33 - 51)	8	8	99 (50 - 199)
All Urinary	20	48	41 (27 - 64)	--	--	82 (21 - 329)
Kidney Failure	15	31	48 (29 - 80)	--	--	72 (10 - 514)
All Injury and Trauma	**1262**	**1159**	**109 (103 - 115)**	43	45	96 (71 - 130)
Accidents	629	587	107 (99 - 116)	21	22	95 (62 - 145)
Suicide	**590**	**482**	**122 (113 - 133)**	17	18	94 (59 - 152)
All Other Causes	136	275	49 (42 - 58)	--	--	14 (4 - 43)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

**Cell sizes of less than 6 are not reported to preserve privacy

† Specific cause of death for 8 male workers.

There were large numbers of recently recruited workers who would be likely to have a relatively low risk of death so we carried out a sensitivity analysis excluding those workers whose first reported assessment was after 2010 (Table 14). There were 4,113 deaths among men, 4.7% of the cohort and 152 deaths among women 1.6% of the cohort. This analysis excluded 844 deaths among men and 59 among women from the analysis in Table 12. Unsurprisingly, most of the deaths were in those workers recruited before 2010 who were likely older. The results show that the SMRs (which are age-adjusted) reported for the pre-2010 coal mine workers are very similar to those reported for the cohort as a whole. The only new statistically-significant increase was the SMR for bladder cancer although this was based on a small number of deaths (<6).

Table 15 presents the SMRs by year of first examination grouped by decade. This includes the individuals who took part in the Rathus and Abrahams survey and subsequently had another health assessment. The SMRs are reduced in all groups and there is little difference in the SMRs between the decades. For the very small group of women whose first examination was before 2000, the SMRs were not statistically significantly reduced. The large number of deaths in those whose first assessment was 2001 – 2010, merely reflects the large number of workers recruited in that period.

Table 14: SMRs* for male and female coal mine workers, excluding workers with first assessment 2010 onwards, compared to the Australian population

Cause of death categories †	All Men *N=87,268 PY=1,557,381*			All Women *N=9,716; PY=154,231*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	4113	5000	82 (80 - 85)	152	187	81 (69 - 95)
All Malignancies	1632	1749	93 (89 - 98)	73	86	85 (68 - 107)
Oesophagus	73	80	88 (69 – 111)	--	--	206 (52 - 823)
Stomach	43	59	73 (54 - 98)	--	--	102 (25 - 407)
Colorectal	166	181	92 (79 - 107)	--	--	39 (13 - 121)
Liver	81	102	79 (64 - 99)	--	--	41 (6 - 293)
Pancreas	97	109	89 (73 - 108)	--	--	94 (35 - 251)
Lung	386	362	107 (96 - 118)	17	14	124 (77 - 200)
Mesothelioma, pleural	32	30	106 (75 - 150)	0		
Melanoma	76	83	92 (74 - 115)	--	--	34 (5 - 242)
Prostate	112	100	111 (93 - 134)	NA		
Breast	0			13	20	65 (37 - 111)
Bladder	21	29	73 (47 - 111)	--	--	**411 (103 - 1643)**
Kidney	49	49	100 (76 - 132)	0		
Brain	92	97	95 (78 - 117)	--	--	72 (23 - 222)
All Metabolic	108	185	58 (48 - 70)	--	--	59 (22 - 157)
Diabetes	77	127	61 (49 - 76)	--	--	74 (24 - 230)
All Mental and Behavioural	34	87	39 (28 - 55)	--	--	44 (6 - 312)
Dementia	19	33	58 (37 - 90)	0		
All Nervous System	83	170	49 (39 - 60)	--	--	40 (13 - 124)
Alzheimer Disease	12	16	74 (42 - 131)	0		
Parkinson Disease	11	20	56 (31 - 100)	0		
All Circulatory	798	1092	73 (68 - 78)	25	25	100 (68 - 148)
IHD	505	654	77 (71 - 84)	8	9	90 (45 - 181)
Cerebrovascular	89	157	57 (46 - 70)	7	7	106 (50 - 222)
Other Heart Disease	150	214	70 (60 - 82)	7	7	97 (46 - 204)
All Respiratory	208	257	81 (71 - 93)	8	10	82 (41 - 163)
COPD	134	137	98 (83 - 116)	--	--	20 (3 - 145)
Asthma	6	14	43 (19 - 95)	--	--	259 (84 - 804)
Lung Diseases due to Dust	--**	--	114 (43 - 304)	0		
All Digestive	119	235	51 (42 - 61)	--	--	63 (26 - 150)
Liver Disease	75	166	45 (36 - 57)	--	--	92 (38 - 221)
All Urinary	26	44	58 (40 - 86)	--	--	114 (28 - 454)
Kidney Failure	19	29	66 (42 - 104)	--	--	100 (14 - 708)
All Injury and Trauma	980	944	104 (97 - 110)	28	29	95 (66 - 138)
Accidents	527	488	108 (99 - 118)	17	15	114 (71 - 184)
Suicide	**420**	**381**	**110 (100 - 121)**	8	11	71 (36 - 142)
All Other Causes	119	237	50 (42 - 60)	--	--	20 (6 - 62)

† Specific cause of death for 6 male workers.

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

** Cell sizes of less than 6 are not reported to preserve privacy

Table 15: All-cause mortality SMRs* for male and female coal mine workers, by year of first examination**, compared to the Australian population

Decade of first examination	All Men *N=164,622 PY=2,118,553*				All Women *N=24,389 PY=251,476*			
	N	O	E	SMR (95%	N	O	E	SMR (95% CI)
In or before 1990	8,708	1143	1475	77 (73 – 82)	386	14	21	67 (40 – 113)
1991 – 2000	12,122	820	945	87 (81 – 93)	846	22	26	85 (56 – 129)
2001 – 2010	77,605	2336	2830	83 (79 – 86)	10,275	127	158	80 (68 – 96)
After 2010	66,187	658	894	74 (68 – 79)	12,882	48	77	62 (47 – 82)

***** Statistically significantly reduced SMR results are in **blue**

** Includes Survey-only people where the Rathus and Abrahams survey is regarded as their first assessment

9.4.1.1 Comparison to Queensland death rates

When compared to Queensland rates the SMR for men and women for all causes of death and all malignancies did not greatly change (Table 16). However, the accidental death SMR and suicide SMRs for all men in the cohort did not differ from the state rates even though they were higher than Australian rates. The rates for women were slightly lower than when compared to the Australian national data.

Table 16: SMR and 95% confidence intervals (CI) for all male and female coal mine workers compared to the Queensland population

Cause of death categories	Men		Women	
	E	SMR (95% CI)	E	SMR (95% CI)
ALL CAUSES OF DEATH	6369	78 (76 – 80)	291	73 (63 – 83)
All Malignancies	2185	86 (83 – 90)	129	77 (63 – 93)
All Injury and Trauma	1418	94 (89 – 99)	50	90 (67 – 120)
Accidents	699	96 (89 – 104)	25	90 (59 – 136)
Suicide	640	96 (89 – 104)	21	85 (53 – 134)

The risks of all causes of death and all malignancies by Work Category were somewhat lower when compared to Queensland reference date than when compared to Australian data for both men (Table 25) and women (Table 26). The biggest changes were seen for external causes which are discussed below.

For ease of reading, the remaining Tables in this section are in Appendix 8 starting on Page 204.

9.4.2 Mortality rates for male coal mine workers

9.4.2.1 All-cause mortality by Work Category and Job Group

Table 27 presents all-cause mortality by Work Category (bold) and Job Group for all male coal mine workers. Compared with the general Australian population, all-cause mortality was significantly reduced among those in the Occasionally Exposed, Maintenance and Production Work Categories. Additionally, when compared with the SMR for the *(Only)* Unexposed Office, all Work Categories had significantly higher SMRs ($p<0.001$) with the exception of the *(Only)* Occasionally Exposed Work Category ($p=0.831$). The estimated SMRs for the following Work Categories: *(Only)* Unexposed Non-Office ($p=0.061$) and *(Ever)* Exploration Driller ($p=0.468$) were similar to that observed in the *(Ever)* Production Work Category.

When analysed by Job Group, most SMRs were significantly reduced, and a similar reduction was seen for most Job Groups when the analyses were restricted to those with at least 2 assessments at least 5 years apart.

Scraper operators had significantly increased risk of mortality for all men and for those with 2+ assessments even though the number of workers was small (n=175).

9.4.2.2 Overall mortality by Site Type

All-cause mortality by Job Group was examined by Site Type (Table 28). If a person worked in more than one Site Type, they were included in the analyses for each Site Type where they had ever worked. Note that workers can therefore appear in more than one column. Some Job Groups were excluded from some Site Types by definition e.g. CHPP workers could only be at CHPP sites, Dragline operators could only be at Open Cut sites. Excluded combinations are marked in the table as NA. For some workers, their Site Type was either missing or listed as various or unknown, and these have been included in the "Unknown" column. Almost two-thirds (63.3%) of workers in this group either had only one assessment or had all their assessments within 5 years of the initial assessment.

SMRs were significantly reduced for many Job Groups at most Site Types. Numbers were small for many Job Groups particularly for CHPP workers where there were no workers in several of the Job Groups, and few deaths identified for many Job Groups where numbers of workers were small. The small numbers limited the precision of some SMRs.

The SMR for industrial cleaners at CHPP plants was significantly increased. For workers at the Site Type unknown, the SMRs were significantly increased for Scraper Operators. In both of these cases the numbers were small.

Table 29 also examined mortality by Work Category and Job Group, but individuals were allocated to only one Site Type. The column with "Open Cut" workers excluded anyone who had ever worked underground, or in a CHPP plant. The underground group excluded anyone who had ever worked in a CHPP plant. This means that workers in the "Site Type Unknown" column **only** worked at an unknown Site Type. Of these 67,875 workers, only 7,990 (11.8%) had at least one assessment more than five years after their initial examination/assessment.

These two analyses show little differences in risks for most causes of death at most Site Types. The SMRs were usually higher for the workers where the Site Type was Unknown (often reported as "Various" in the data) than for workers in the three specific Site Types, open cut, underground and CHPP. The SMRs were significantly increased for Tyre Fitters, Ever Production (including specifically for General Drillers and Scraper) and for Labourers.

9.4.2.3 Mortality of all male coal mine workers by Work Category and Job Group

This section presents the SMRs by Work Category and where possible for Job Groups within the Work Category. When the cohort was divided into Job Groups, the number of workers and events in many Job Groups were very small and analysis by specific causes of death became uninformative. Even for some larger groups, examination of SMRs for those with more than two assessments was uninformative. SMRs by specific causes of death have not been presented for Job Groups where there were fewer than 20 deaths.

9.4.2.3.1 Unexposed Office Work Category

Table 30 examined the mortality by specific diseases among individuals who had only worked in Administration. The SMRs for most specific disease categories were significantly reduced, none were significantly raised. Mortality from specific cancers were similar to the population rates although mortality from all malignancies was significantly reduced. In many cases the SMRs for specific disease categories were very low, under 40, but the upper confidence limits were usually over 70.

The SMRs were similar for all Administration workers and Administration workers with more than two assessments except, as expected, much wider confidence intervals. However, these latter analyses removed 88.9% of workers so these results have not been presented.

9.4.2.3.2 Unexposed non-Office Work Category

Table 31 presents the SMRs for all workers who only worked in Job Groups categorised into the Unexposed Non-Office Work Category which included unexposed blue-collar jobs such as Peggy and Environmental services jobs (see Appendix 3 for a more complete identification of the jobs in these Job Groups). Overall mortality was the same as that expected from population rates. Significant increases were seen in the Work Category for deaths from

colorectal cancer and for Ischaemic Heart Disease (IHD), but these were based on small numbers. A significant increase in melanoma deaths was seen for the Environmental Services Job Group, was also based on small numbers.

Analyses for those with 2+ assessments are not presented as these removed 93.8% of individual coal mine workers in this Work Category.

9.4.2.3.3 Occasionally Exposed Work Category

Table 32 presents the SMRs for workers who only worked in Job Groups categorised as occasionally exposed e.g. Engineers, (Table 6). Most specific causes of death were not significantly increased except for stomach cancer among Engineers, and mesothelioma for the Mining and Technical Services groups.

Workers with more than one assessment made up only 12% of all workers in this Work Category and these data, again, are not presented.

9.4.2.3.4 Maintenance Work Category

Table 33 presents the SMRs for workers who worked in Job Groups that were categorised as ever maintenance workers. There were a large number of maintenance workers in this Work Category; about 40% of these workers had had more than 2 assessments at least five years apart. Some Job Groups within the Maintenance Work Category were also large enough to allow meaningful analyses for those with 2+ assessments.

Mortality from most non-malignant causes was significantly reduced for the Maintenance Work Category as a whole (Table 33A), but deaths from mesothelioma were significantly increased. Suicide rates were elevated compared to national rates but not when compared to Queensland rates (Table 25).

The findings were similar for all maintenance workers, maintenance workers who could not be allocated to a particular trade and for those maintenance workers with two or more assessments.

For other maintenance worker Job Groups, most causes of death were at population rates. The rate of suicide was significantly raised for Shutdown Maintenance workers (Table 33B), Boilermakers (Table 33B) and Tyre fitters (Table 33D). Deaths from liver cancer was significantly raised for Shutdown Maintenance workers and from oesophageal cancer in Boilermakers (Table 33B). Deaths from prostate cancer were higher than expected for fitters, and from mesothelioma for diesel fitters with more than 2 assessments (Table 33C). Deaths from melanoma were increased for Tyre fitters (Table 33D).

9.4.2.3.5 Production Work Category

Table 34A-D present mortality for Job Groups within the Production Work Category. For the Work Category as a whole, the death rates for most major disease groups are significantly reduced, including from Metabolic, Mental and Behavioural, Nervous System, Circulatory, Respiratory, Digestive and Urinary diseases. Deaths from lung cancer, accidents and suicide were significantly increased compared to national rates. Patterns were similar for workers with more than one assessment. Accident and suicide rates were attenuated when compared to Queensland rates (Table 25) so that suicide was no longer increased but accidents were elevated.

Within the Production Category, the mortality of Drillers, was not reduced in any category. Mortality was significantly increased for overall cancer deaths, and specifically for lung, melanoma and bladder cancer deaths. Circulatory system deaths were significantly raised, as a result of increased rates of deaths from IHD and cerebrovascular causes.

Within the Production Work Category, the mortality of Blast Crew, CHPP operators, ERZ/Deputies and Open cut examiners was similar to that of the general population but numbers were small. Those who were ever categorised as Operators had an increased risk of lung cancer and suicide (Table 34B). Patterns were similar for Operators with more than one assessment. Laboratory workers (Table 34C) had an increased risk of death from Mental and Behavioural diseases but not from suicide but again, numbers were small.

9.4.2.3.6 Selected Job Groups within the Production Work Category

Mortality was further explored for production workers who had been categorised into one of three Job Groups, Miner, Dragline and Exploration Driller within the Production Work Category.

Job Group: Miner

Table 35 shows that men who had ever worked as a miner (this includes underground and open cut miners) are at similar or reduced risk of death from most major causes. This remained true for miners with more than one assessment although the numbers were smaller.

A similar pattern was seen for those miners who had ever worked underground (Table 36).

Job Group: Dragline Operator

Table 37 examines the mortality of all Dragline Operators with that of the general population. All-cause mortality was significantly reduced. There were no significantly decreased or increased SMRs for individual causes of death, but numbers were small and confidence intervals were wide.

It is noteworthy that of 1,044 Dragline Operators, 1,003 had had more than two assessments five years apart. A much higher proportion than in most of the Job Groups investigated.

9.4.2.3.7 Selected Production Job Groups by Employer type

The employers of the Miners and Dragline operators were examined and categorised into one of three employer types:

1. Directly employed by the mine (or where only the mine name was supplied),
2. By a large labour hire company (>50 employees in at least one of the Job Groups),
3. Other.

The risks by type of employer among miners and dragline operators were evaluated. There were too few Exploration Drillers to investigate in this way.

Table 38 compares the mortality of miners with that of the general population after grouping by type of employer, (direct by the mine, by a large labour hire company or other). Some employees were employed directly by a mine and also with a large contractor. Approximately 20% were only employed in one employer type i.e. the 3 groupings are not mutually exclusive.

The accident rate was significantly increased for the miners who were not directly employed or were not employed by a large labour hire company. Suicides were lower than expected among those directly employed by mine companies in comparison to national rates.

Table 39 compares the mortality of Dragline Operators with that of the general population after grouping by type of employer, (direct by the mine, by a large labour hire company or other). NB Dragline Operators may have had more than one type of employer i.e. the groupings are not mutually exclusive. Deaths from circulatory diseases and injury/trauma were significantly reduced for the Dragline Operators directly employed by the mines.

9.4.2.3.8 Construction Work Category

Lung cancer deaths and suicides were significantly increased for those classified as ever being a construction worker (Table 40). Within this group, those classified as Civil Works and the other construction workers had similar findings.

Overall, only a quarter of the construction workers had more than one assessment and for these workers the excess in lung cancer deaths was maintained, but suicide deaths were not elevated. Construction workers have an elevated risk of death from digestive disorders (12/14 deaths were from liver disease) only 9 were expected, but these are small numbers.

Accident rates were elevated and suicides significantly increased compared to national rates. Compared to Queensland rates (Table 25) both were attenuated but remained elevated.

There were no significantly reduced causes of death for construction workers

9.4.2.3.9 Exploration Driller Work Category

Table 41 examines the mortality of all Exploration Drillers. There were no significantly decreased SMRs but numbers were small and confidence intervals were very wide.

Injury and trauma rates were significantly increased compared to national rates but neither accidents nor suicide had a statistically significant increase, likely because of small numbers. When compared to Queensland rates both were attenuated and suicide was no longer elevated.

9.4.2.3.10 Unclear Work Category

Over 5,500 workers indicated that they were supervisors but they could not be categorised into the type of work they supervised e.g. administration, maintenance, or production (Table

41: SMRs* for male coal mine workers who EVER were Drillers (Exploration)

Cause of death categories	Ever Exploration Driller *N= 4,970; PY= 54,690*		
	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	80	87	92 (74 – 114)
All Malignancies	19	22	88 (56 - 137)
Oesophagus	0		
Stomach	---	---	122 (17 - 866)
Colorectal	0		
Liver	0		
Pancreas	---	---	147 (37 - 589)
Lung	---	---	107 (40 - 285)
Mesothelioma, pleural	0		
Melanoma	---	---	162 (40 - 647)
Prostate	0		
Bladder	---	---	393 (55 - 2790)
Kidney	0		
Brain	---	---	107 (27 - 430)
All Metabolic	---	---	34 (5 - 244)
Diabetes	---	---	57 (8 - 405)
All Mental and Behavioural	0		
All Nervous System	0		
All Circulatory	14	15	92 (55 - 156)
IHD	10	9	116 (62 - 216)
Cerebrovascular	---	---	51 (7 - 364)
Other Heart Disease	---	---	84 (27 - 259)
All Respiratory	---	---	35 (5 - 249)
COPD	0		
All Digestive	0		
All Urinary	0		
All Injury and Trauma	**43**	**32**	**136 (101 - 184)**
Accidents	23	16	146 (97 - 219)
Suicide	15	13	112 (67 - 185)
All Other Causes	---	---	21 (3 - 150)

***** Statistically significantly increased SMR results are in **red**

Table 42). No significant excess causes of death were identified for this group.

Significant reductions were observed for deaths overall and from most major causes. A similar pattern was seen for those with more than one assessment (n = 3,501).

There were 7,701 truck drivers in the cohort who could not be allocated to production or maintenance work on the basis of their job title. They may include on-site drivers, drivers delivering fuel or other materials to the site or taking coal away from the site (Table 43). Overall deaths and cancer deaths were at general population rates. Significant increases were seen in risk of death from brain cancer, accidents and suicides compared to national data. Both rates were attenuated when compared to Queensland data and suicide was no longer significantly increased (Table 25).

Less than half of these drivers had more than one assessment and these showed the same pattern as the larger group, except they did not have an elevated suicide risk and their overall death rate was significantly lower than expected.

There were 5,814 labourers and 948 cleaners in the cohort who could not be allocated to production or maintenance work on the basis of their job title. They may include cleaners and labourers who work at the mine site or in mine accommodation sites (Table 44). Overall deaths and cancer deaths were at general population rates. Significant increases were seen in risk of death from bladder cancer among cleaners and for accidents in both groups compared to national data. Compared to Queensland data risk of accidental death attenuated but remained significantly high for Cleaners and was still elevated for Labourers (Table 25).

9.4.2.4 Mortality by time between first and last assessments for Work Categories and selected Job Groups

Table 45 shows that most workers had their first health assessment at around 30 years of age and the group who had had more than one assessment were slightly but significantly younger than those with only one assessment.

There was a significant difference between the ages of the groups at the end of follow-up. Those who had only one assessment were about 45 years old at the end of follow-up. Those who had more than 15 years between first and last assessment were, on average, aged 57 years at the end of follow-up.

The dates of first and last health assessment approximate to duration of employment. This metric is used because specific dates of first and last employment were not available for this

cohort. Further, some workers such as those employed via labour hire companies, may not have experienced continuous employment as coal mine workers.

In the tables presented in this section, the person-years for each individual are attributed to the relevant period, so that those who worked for more than 15 years will contribute person-years to each group, as they accumulate employment time. The section only presents results for Work Categories and a few selected Job Groups.

Table 46 shows that for all male coal mine workers, the overall mortality and most of the major categories of death were significantly reduced, compared to the expected rate for the general population, irrespective of how long the individuals worked. Significant increases were found for accidental death and suicides within the first five years group.

There was a monotonic and significant decrease in the risk of accidental death with increasing years of employment. There were significant trends in decreased mortality from liver cancer, mesothelioma, bladder cancer, IHD and cerebrovascular causes with increasing period of work.

Table 47 for Administration workers shows the same overall pattern of reduced mortality for most causes of death as seen in Table 46. However, of 12,596 Administration workers, only a small proportion, 1,388, had worked for more than five years and 506 had worked for more than ten years.

Table 48 shows the analyses for Unexposed Non-Office workers and Table 49 for the Occasionally Exposed Work Category. Again, very few workers had been in these categories for more than five years making any trends difficult to identify. Table 50 shows the data for maintenance workers. Many workers did not have more than 5 years employment: of 61,309 only 5,833 had worked for more than 15 years. This limits the utility of these analyses. Significant increases were for suicides within the first five years after the first assessment. Mesothelioma deaths were higher than expected for workers in all employment periods.

There was a similar pattern for Production workers (Table 51) going from 55,252 employed for five or fewer years to 8,527 employed for more than 15 years. Accidental deaths and suicides were high in the shortest period but there was no trend by years of service.

In Table 52 for underground miners, and Table 53 Exploration Drillers (very small numbers), no trends of mortality by employment length were discernible but numbers of deaths were small, suggesting that these are young workers.

In Table 54 Construction Work Category, numbers were again small but deaths from lung cancer showed an increase with years of employment and accidental death was raised in the shortest time category.

In Table 55 Labourers were shown to have a significantly higher overall death rate, likely influenced by high accidental deaths and suicides for those with less than five years employment which decreased with length of employment. Table 56 Supervisors (nec) shows a decrease in overall mortality for all periods. No trends were identified as numbers were small.

Table 57 for Truck Drivers (nec), another small group, shows high accidental deaths and suicides for those with less than five years employment compared to national data. The SMR for accidents decreased with length of employment. The SMR for suicide was increased among workers in the less than five years group, but not for those with longer periods of work.

9.4.2.5 Mortality by time since first assessment for Work Categories and selected Job Groups

Table 58 shows the SMRs for all male coal mine workers by the time since their first assessment. This approximates to years since they were first employed as a coal mine worker. There were 164,622 men in the cohort, however, only 49,283 had more than 15 years after their first assessment. The person-years for each individual are attributed to the relevant period, so that those who were first employed more than 15 years ago contributed person-years to each shorter time period. There is a significant decrease in overall mortality for workers in all groups.

Most major causes of death were significantly reduced for all time periods since first assessment. Deaths from all cancers, however, show a significantly increasing trend from significantly less than that of the general population to a rate similar to population rates for those with more than 10 years since their first assessment. Deaths from accidents are significantly increased for those with less than five years. There is a significant trend of reduction across the groups. Suicides are significantly increased for those with less than 10 years since first employment and again there is a monotonic reduction by the years of work groups, but the trend is not significant. Monotonic increases and a significant trend with years since first employed are seen for diabetes, respiratory and digestive diseases.

Mortality by Work Category and years since the first assessment are presented in Table 59 (Administration Job Groups only), Table 61 (Occasionally exposed only), Table 62 (ever Maintenance) Table 63 (ever Production), Table 68 (Supervisor nec). The overall death rates are significantly reduced for all employment groups. Most individual causes of death were not statistically different to the population rates but numbers are small.

Table 60 shows that for those who had only worked in Job Groups classified as Unexposed Non-Office, numbers were very small. Unlike other Job Groups, no causes of death were significantly reduced.

Table 62 (ever Maintenance worker) additionally showed a monotonic decease in suicide from a significant excess for those with less than five years to a decrease in those whose first assessment was more than 15 years ago. No other patterns were identified. Table 63 (ever Production worker) also showed a monotonic decease in accidental deaths from a significant excess in the most recent group to rates similar to the population rate for the 15+ group. There was also a monotonic increase in lung cancer mortality with time since first assessment. No other patterns were identified.

Cause of death by time since first assessment are presented in Table 64 (ever Underground Miner), Table 65 (ever Exploration Driller), Table 66 (ever Construction work), Table 67 (ever labourer), Table 68 (ever Supervisor nec), Table 69 (ever Truck Driver nec). No patterns were seen although some causes of death groups were significantly increased within the analyses.

9.4.2.6 Mortality by age group and Work Category

This section compares cohort mortality with population mortality split at age 65 years, such that results for under 65 years are separated from those 65 years or older. Table 70 shows that coal mine workers aged under 65 and those over 65 had significantly reduced mortality compared with the general population for many causes of death. Deaths from lung cancer were also higher in the older age group. Deaths from *Lung Diseases due to Dust* and suicide were significantly higher in the younger age group but not in the older group.

Table 71 shows a similar pattern for workers who were ever Production and accidental deaths were significantly in excess in the younger but not the older age group.

Table 72 shows similar results for those workers who were ever Maintenance workers. The older age group have a significantly increased risk of death from mesothelioma. Neither group have increases in accidental death but the younger group does show an increase in suicide.

There are no significantly increased risks of death for Administration workers by age group, most major causes of death are significantly reduced (Table 73).

Analyses for Unexposed Non-Office workers showed death rates for major causes of death were as expected except for the younger group who showed increases in colorectal cancer deaths SMR 312 (95% CI 162 - 599) (n=9) and deaths from pancreatic cancer SMR 295 (95% CI 123 - 708) (n<6). (Table 74).

Workers in the occasionally exposed Work Category showed no significantly increased risk of death. In the younger group overall deaths, and deaths from cancer, circulatory and digestive diseases, injury and trauma were all significantly reduced. (Table 75).

There were too few data for analysis for Exploration Drillers to be meaningful.

Ever construction worker over 65 but not under 65 show an increase in lung cancer deaths, SMR 207 (95% CI 117 - 364) (n=12) and younger construction workers showed an increased risk of suicide SMR 151 (95% CI 109 - 209) (n=36). Other causes of death were not different from those in the general population (Table 76).

9.4.2.1 Mortality from external causes

9.4.2.1.1 Suicide among male coal mine workers

Suicide rates were elevated for men compared to the Australian population rates but not when compared to Queensland rates (Section 9.4.1.1 and Figure 29). However, the rate appears higher than Australian and Queensland Rates since about 2014 and the overall trend is significant for the comparison to the Australian rates. NB The larger number of deaths is against a background of an increasing number of coal mine workers. The comparison data was provided by the ABS.

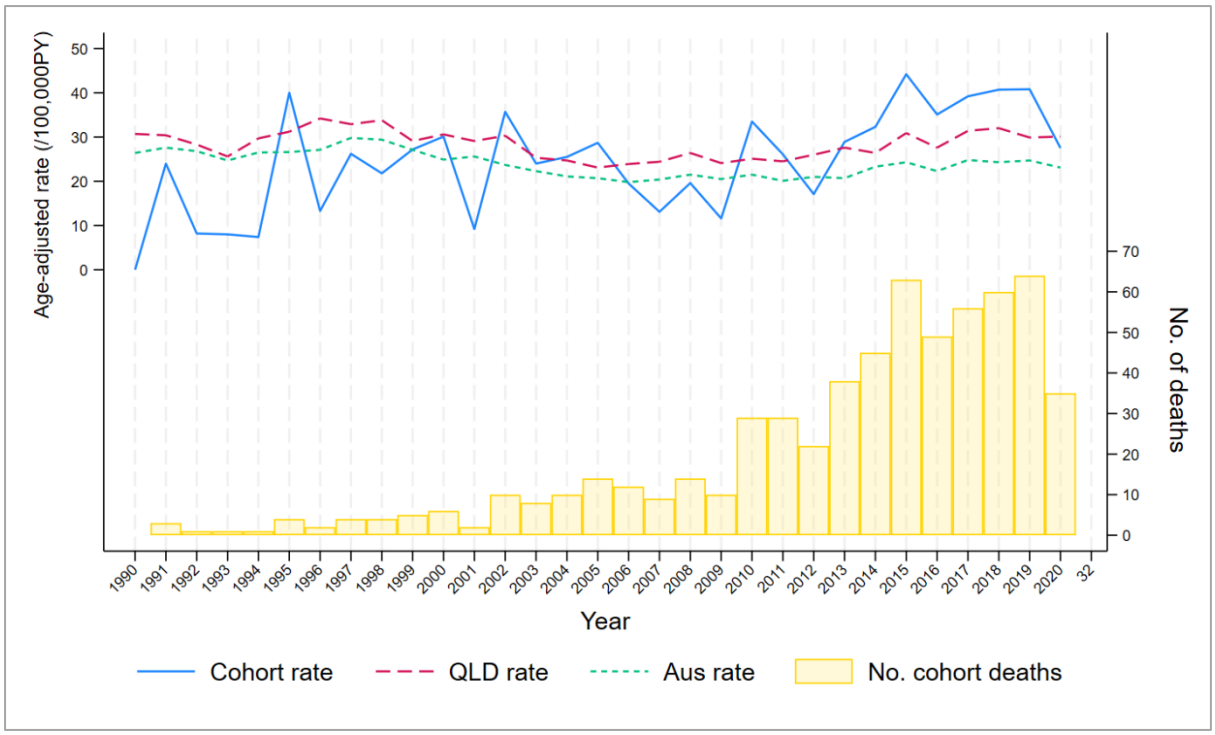


Figure 29: Age-standardised suicide rates for male coal miners, Queensland and Australian general population from 1990-2020

[TREND: Coal miners β= 0.76/100,000/year, p<0.001; Australian population β= -0.18/100,000/year, p=0.001; QLD population β= -0.07/100,000/year, p=0.257]

Table 77 shows that compared to the Australian population there was a significant increase in suicides from 2001 to 2015 but the increase did not reach statistical significance when compared to State rates.

Table 78 shows that the suicide rate was reduced in the late 1980s but has increased since then. Since 2011 the rate has been statistically significantly higher than that of the general population and above the Queensland rates. Further analyses show that the risk after 2011 is elevated for all age groups and statistically significantly increased for men in the <25 age group and 25 – 34, 35 – 44, and 45 – 54 age groups but not for those in the 55 – 64 or 65+ age groups (data not shown).

In order to investigate whether increased rate of suicide was explained by age of the coal mine workers, the time between the first assessment and death was evaluated. Figure 30 shows that the age distribution of workers who had committed suicide, most were under 40 years.

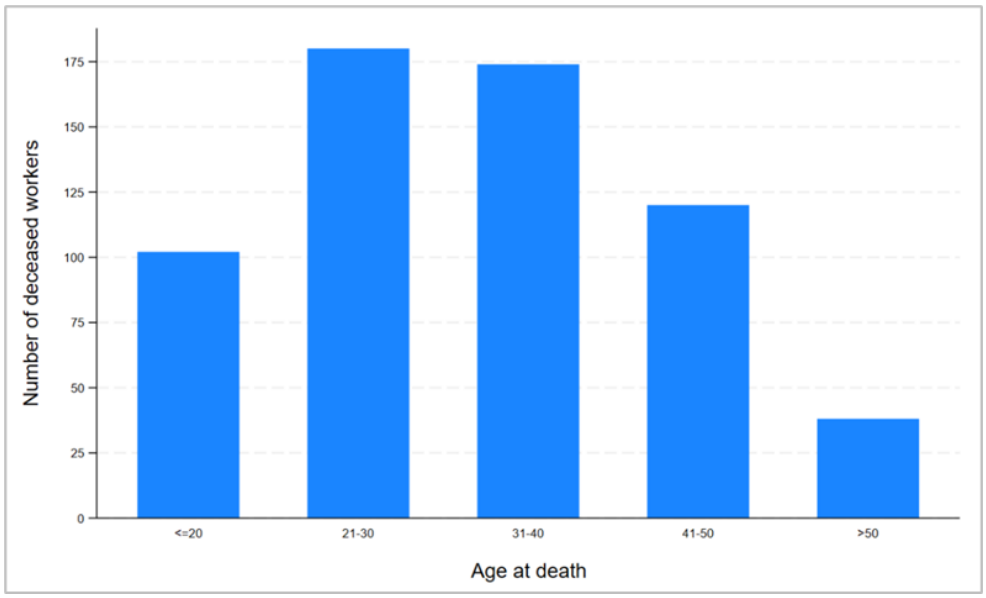


Figure 30: Summary of age at suicide among men *[Average= 42 years; SD=12]*

Table 79 shows suicide rates by age at first examination. Suicide is elevated (compared to the expected rates from the general population) in most age groups except those who are in the 55 to 64 age group when they had their first assessment. Figure 31 shows the time between when the first examination took place when and when they committed suicide. Most suicides occur within 10 years of the first assessment.

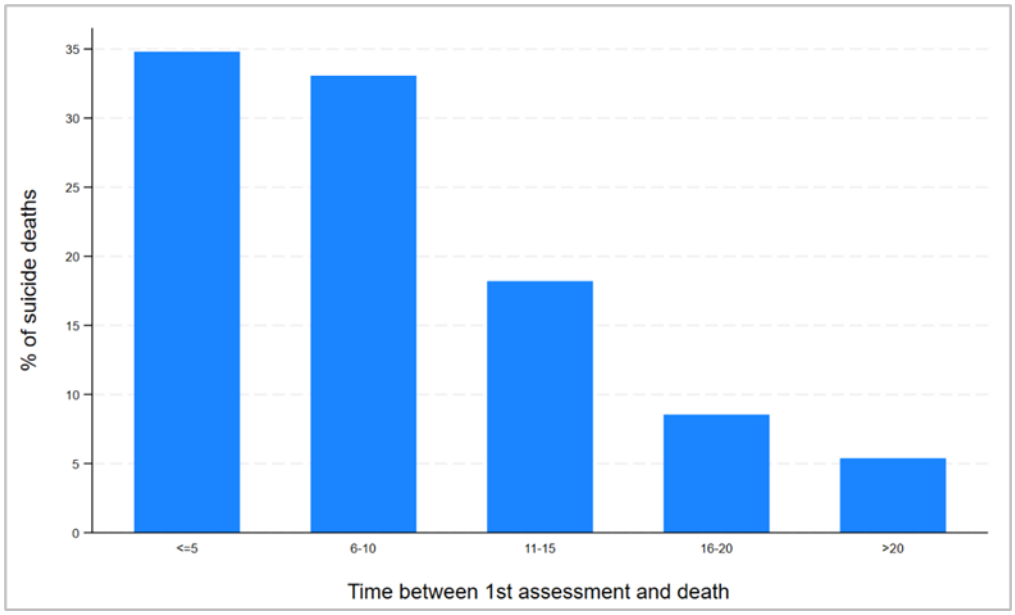


Figure 31: Years between 1st examination and suicide

Table 80 shows that suicide is higher than expected for men under 44 within five years of their first assessment. The increase is statistically significant for those under 25 and those between 35 and 44 years of age. Rates are also significantly raised for those between 45 and 54 more than five years after their first assessment. Note however, that the rates are also elevated for all age groups except for men over 55. Younger men may be at risk of suicide soon after employment but there is still elevated risk more than five years after the first assessment.

The increased risk of suicide seen in several Work Categories when compared to Australian national population rates were attenuated for men (Table 25) when compared to the Queensland population rates.

9.4.2.1.2 Accidental deaths among male coal mine workers

Accidental death rates were elevated for men compared to the Australian population rates but not when compared to Queensland rates (Section 9.4.1.1 and Figure 32). However the rate is lower than Australian and Queensland Rates since about 2014 and the overall decreasing trend is significant when to the Australian and Queensland rates.

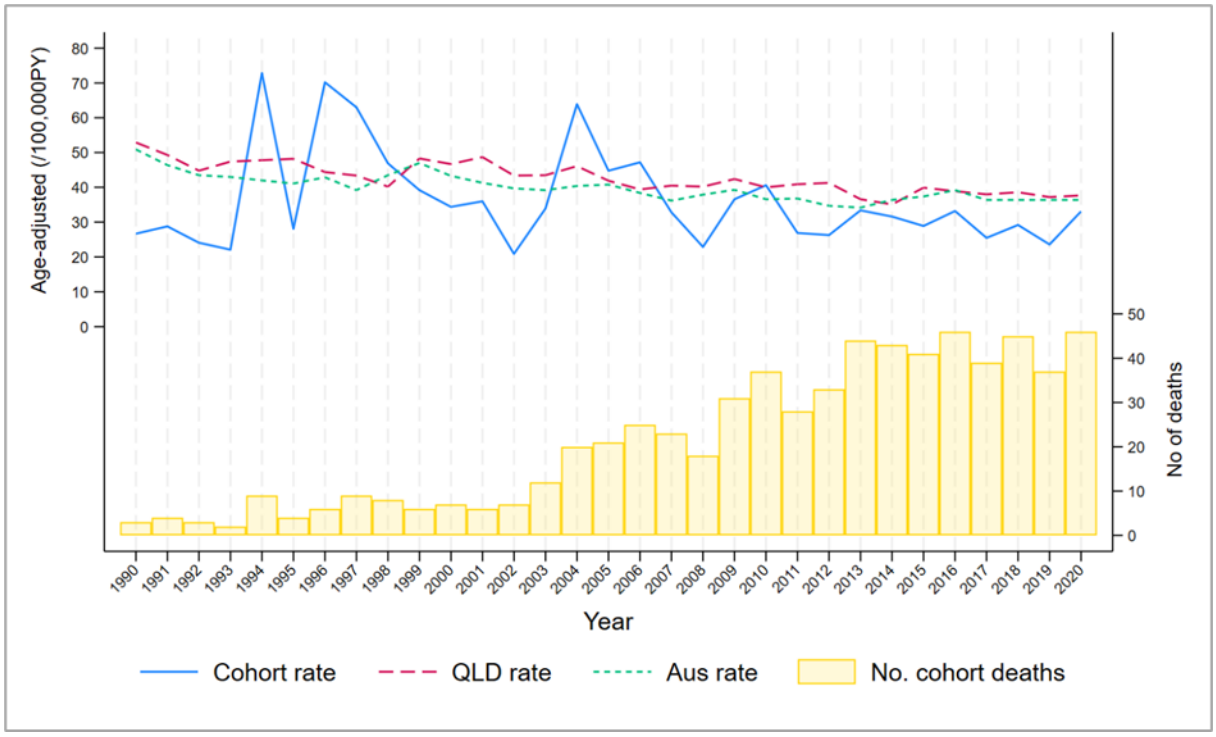


Figure 32: Age-standardised accident rates for male coal miners, Queensland and Australian general population from 1990-2020

[TREND: Coal miners β= -0.44/100,000/year, p=0.125; Australian population β= -0.35/100,000/year, p<0.001; QLD population β= -0.41/100,000/year, p<0.001]

Table 81 shows an increased risk of accidental death compared to Queensland and national rates for those whose first assessment was between 1986 and 1990, the risk decreases for those whose first assessment was about 2000 when it begins to increase again. Table 82 shows that era of follow up does not strongly predict risk.

Figure 33 shows that the age distribution of workers who experienced an accidental death, most were under 40 years. Figure 34 shows the distribution of time between when the first examination took place when and the accidental death, most occurred within 10 years of the first assessment.

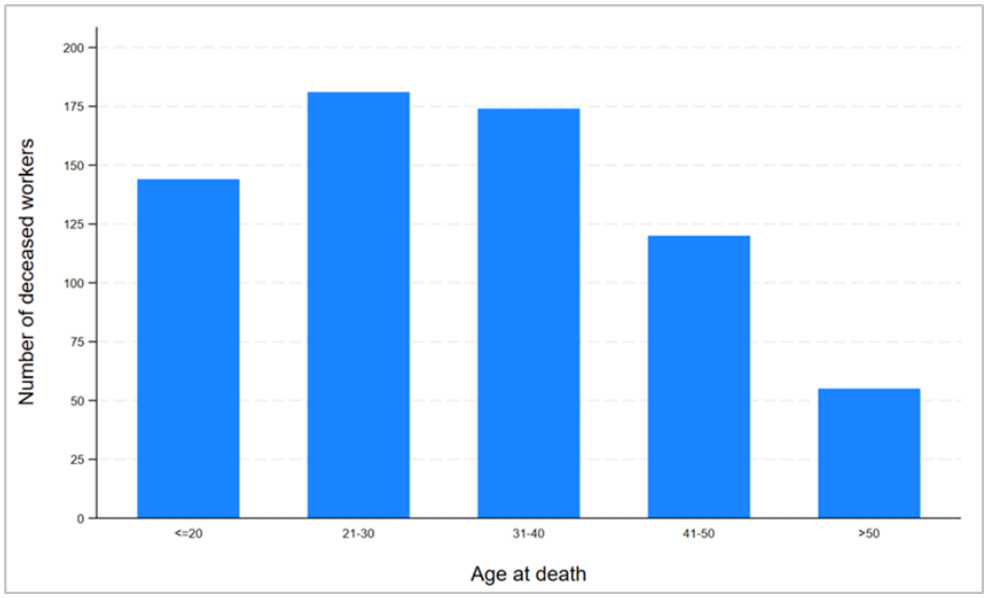


Figure 33: Summary of age at accident among men *[Average= 42 years; SD=13]*

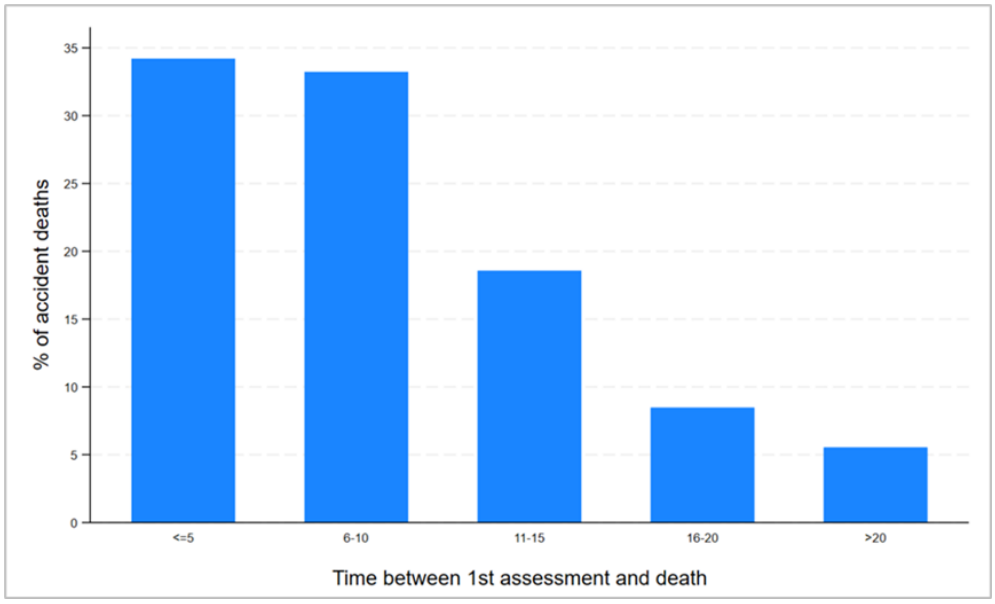


Figure 34: Summary of time between first assessment and accidental deaths among men

Table 83 shows that almost 60% of the accidental deaths relate to transport accidents, a further 21% are accidental poisonings.

The increased risk of mortality from accidents seen in several Work Categories when compared to Australian national population rates was attenuated for men (Table 25) when compared to Queensland rates.

9.4.3 Mortality for female coal mine workers

Among women, there were 211 deaths from the NDI, linked to cohort members however 9 of these did not have assessments after 1993 so cannot be included in the Job Group or Work Category analyses. The small number of deaths limit the analyses which can be undertaken.

9.4.3.1 All-cause mortality by Work Category and Job Group

Table 84 shows the number of women in each Work Category (bold) and Job Group. Most Job Groups are small, with fewer than 1,000 women and so there are few deaths in each Job Group. No Job Group had statistically significantly increased mortality. Administration, Industrial Cleaners and Truck Drivers had significantly reduced mortality compared to that expected from age matched female rates in the general population.

9.4.3.2 Overall mortality by Site Type and Work Category

Table 85 shows overall mortality by Site Type. Many women had worked at more than one Site Type and they are included in each Site Type in this table.

The majority of women in the cohort worked in jobs where the Site Type could not be classified (n=14,173). Many others were identified as having worked at open cut mines at some time (n=11,912). Only 2,971 were categorised as ever working underground, and 859 were ever CHPP workers.

Mortality was decreased for women from all Site Types. There was a higher than expected mortality for women who had only held Unexposed Non-Office jobs at open cut sites and reduced mortality for female Operators at open cut sites.

Table 86 shows that 9,448 women had only worked at unknown Site Types. When the female coal mine workers were classified into exclusive Site Types, the increased SMR for Unexposed Non-Office workers was no longer statistically significant. The smaller number of women in the open cut group widened the confidence intervals as fewer deaths were expected.

9.4.3.3 Specific causes of mortality among women coal mine workers by selected Work Category and Job Groups

There were very small numbers of women once they were categorised by Work Category and Job Group. Overall mortality was reduced for most Work Categories, and only that for the Maintenance Category was statistically significantly reduced. No major causes of death were increased for Administration (Table 87) Unexposed Non-Office (Table 88) or Maintenance workers (Table 89).

Women Production workers (Table 90) had an increased risk of suicide compared to Australian population. The risk attenuated when compared to the Queensland population SMR 177 (95% CI 95 - 329 (Table 26).

Table 91 shows that women Cleaners had elevated risk of suicide and accidental death compared to national rates which were both attenuated when compared to Queensland rates but accidental deaths remained significantly elevated (Table 26).

9.4.3.4 Mortality by time between first and last assessments

Table 92 shows that although 20,182 women have had an initial assessment only 2,795 (14%) had a second assessment, at least five years later, and only 2% have had an assessment at least 15 years after their first assessment. The median ages of the groups of female coal mine workers at follow-up are between 40 and 50. This cohort is young and of course most deaths and cancers occur in later life.

The low number of person-years, particularly for the longer serving workers is seen in Table 93, and the very few deaths observed is unsurprising. Most causes of death are as expected. For the shortest serving group, the overall death rate is low, as are overall cancer deaths and deaths from breast cancer.

Table 94 again shows that there has only been a short period of follow-up since most workers' first assessment. There are few women whose employment was more than 10 years (as measured by time between first and last assessment). For those whose assessment was less than five years ago, the overall death rate is low and not significantly reduced for any Work Category.

9.4.3.5 Mortality by time since first assessment

No patterns of specific causes of death were discernible by time since first assessment (Table 95) nor for all-cause mortality by Work Category (Table 96).

9.4.3.6 Mortality by age group

Few women in the cohort had reached the age of 65 (n=937). Table 97 and Table 98 show that few deaths have occurred. There is a significant reduction in over all deaths and deaths from cancer in the younger group. For the older group the deaths are as expected from population data.

In terms of Work Category, the significantly reduced death rates seen for Administration, ever Maintenance and ever Production (Table 98) for those aged <65 years are not seen in the older workers where the rates are as expected.

9.5 Cancer incidence findings compared to the Australian population (External Analyses)

9.5.1 Overall cancer incidence

A total of 149,607 men and 20,340 women were included in the cancer incidence analyses. These numbers differ from those in the mortality analyses because, at the time of these analyses, the Australian Cancer Database was only updated until the end of 2016, hence any coal mine workers recruited 2017 onwards were excluded (15,015 men and 4,049 women).

There were 5,492 men with 5,940 cancers and 406 women with 427 cancers as matched to the ACD. Of the workers with at least one cancer, 444 had two or more cancers. The number of women, and hence cancers identified was small, providing little power to investigate cancer incidence among most subgroups of women. Only a few subgroup results are presented in Section 9.5.3.

Note: that not all of the individuals with cancer will have died, some cancers are treated or are non-fatal, or participants can have cancer and die from a different cause, so the numbers will not match with those of the cancer mortality data reported in Section 9.1.

Among men, cancer incidence was significantly increased overall and significantly increased for cancer of the lip, melanoma, prostate and lymphoid leukaemia (Table 17). Rates of stomach cancer, liver cancer and lymphomas were significantly reduced compared to the general Australian population.

Among women, melanoma and cancers of the bladder and gallbladder were significantly increased (but numbers were small), cancer of the female reproductive organs were significantly reduced and the overall cancer rate was not increased.

Analyses by year of recruitment (Table 18) suggest that, among men, those recruited before 2000 were at higher risk of cancer than those recruited later where there has been a shorter follow-up time.

9.5.1.1 Melanoma compared to Queensland rates

The expected cancer rates have been derived from age adjusted Australian general population data. However, because melanoma rates in Queensland are higher than national rates, we also compared the observed melanoma rate in the coal mine worker cohort to the Queensland melanoma rates. In this analysis, the expected melanoma rates for men (n=1,108) and women (n=87) were higher, resulting in an SIR=89 (95% CI 84 - 95) for men and SIR=88 (95% CI 70 - 110) for women. That is the risk of melanoma amongst coal mine workers was not significantly increased compared to Queensland data.

Table 17: Cancer Standardised Incidence Ratios (SIRs)* and 95% confidence intervals (CI) for all male and female coal mine workers compared to the Australian population

Cancer categories	All Men *N=149,607; PY= 1,514,169*			All Women *N=20,339; PY=161,447*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	**5,940**	**5,568**	**107 (104 – 109)**	427	433	99 (90 – 108)
Lip, Oral Cavity and Pharynx	329	297	111 (99 - 123)	8	8	98 (49 - 196)
Lip	**125**	**90**	**138 (116 - 165)**	---	---	178 (57 - 552)
Pharynx	100	93	107 (88 - 131)	---	---	116 (29 - 463)
Digestive Organs	1,046	1,079	97 (91 - 103)	51	51	101 (77 – 133)
Oesophagus	71	74	96 (76 - 121)	0		
Stomach	80	104	77 (62 - 96)	---	---	104 (39 - 277)
Colorectal	661	631	105 (97 - 113)	36	35	102 (74 - 142)
Colon	370	349	106 (96 - 117)	18	21	84 (53 - 134)
Rectum	284	265	107 (96 - 121)	16	12	134 (82 - 219)
Liver	83	114	73 (59 - 91)	0		
Gallbladder	30	23	130 (91 - 186)	**---**	**---**	**282 (106 - 752)**
Pancreas	89	104	86 (70 - 106)	---	---	102 (42 - 245)
Respiratory and Intrathoracic Organs	491	463	106 (97 - 115)	23	20	114 (76 - 171)
Larynx	56	46	122 (94 - 158)	0		
Lung	416	397	105 (95 - 115)	22	19	117 (77 - 178)
Melanoma	**987**	**752**	**131 (123 - 140)**	**76**	**57**	**134 (107 - 168)**
Mesothelioma	36	28	131 (94 - 181)	0		
Breast	9	10	91 (47 – 174)	150	156	96 (82 - 113)
Female Reproductive Organs	NA			34	48	71 (50 – 99)
Cervix	NA			11	15	71 (39 - 129)
Male Reproductive Organs	**1,729**	**1,594**	**108 (103 - 114)**	NA		
Prostate	**1,577**	**1,422**	**111 (106 - 117)**	NA		
Testis	144	161	89 (76 - 105)	NA		
Urinary Tract	320	314	102 (91 - 114)	9	10	92 (48 - 177)
Kidney	201	205	98 (85 - 113)	---	---	38 (12 - 118)
Bladder	103	95	108 (89 - 131)	**---**	**---**	**330 (137 - 792)**
Brain and Other CNS	126	115	109 (92 - 130)	---	---	45 (15 - 141)
Brain	124	111	112 (94 - 134)	---	---	49 (16 - 152)
Thyroid and Other Endocrine	99	97	102 (83 - 124)	30	31	98 (69 - 140)
Thyroid	94	90	104 (85 - 127)	28	30	93 (65 - 135)
Unknown Site	83	81	102 (83 - 127)	---	---	146 (61 - 350)
Lymphoid, Haematopoietic + Related Tissue	490	545	90 (82 - 98)	31	31	101 (71 – 143)
Hodgkin Lymphoma	30	48	63 (44 - 90)	8	5	168 (84 - 337)
Non-Hodgkin Lymphoma	201	239	84 (73 - 97)	13	13	101 (58 - 173)
Diffuse Non-Hodgkin	94	117	80 (66 - 98)	---	---	73 (28 - 196)
Multiple Myeloma	72	70	102 (81 - 129)	---	---	125 (47 - 332)
Leukaemia	182	171	106 (92 - 123)	6	9	69 (31 - 154)
Lymphoid Leukaemia	**120**	**94**	**127 (106 - 152)**	---	---	56 (14 - 223)
Myeloid Leukaemia	47	63	75 (56 - 100)	---	---	91 (34 - 243)
Other Cancers	195	202	96 (84 - 111)	7	12	60 (28 - 125)
Myelodysplastic Syndrome	22	27	82 (54 - 125)	0		
Connective tissue	40	45	89 (65 - 121)	---	---	27 (4 - 189)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 18: All malignancies SIRs* for male and female coal mine workers, by year of first examination,** compared to the Australian population

Decade of first examination	All Men *N=149,607*				All Women *N=20,340*			
	PY	O	E	SIR (95% CI)	PY	O	E	SIR (95% CI)
In or before 1990	271,478	**1,600**	**1,471**	**109 (104 – 114)**	11,362	38	36	106 (76 – 145)
1991 – 2000	234,859	**1,071**	**938**	**114 (108 – 121)**	16,594	44	45	99 (73 – 132)
2001 – 2010	794,793	**2,728**	**2,612**	**104 (101 – 109)**	98,794	249	264	94 (83 – 107)
After 2010	213,040	541	547	99 (91 – 108)	34,696	96	88	109 (89 – 133)

***** Statistically significantly increased SIR results are in **red**

** Includes Survey-only people where the Rathus and Abrahams survey is regarded as their first assessment

Very similar SIR results were seen whose first assessment was on or after 1993 (Table 19) compared to the whole cohort. Similar results were also seen when those whose first assessment was after 2010 were removed, (i.e. those who had been more recently recruited and were likely younger (Table 20)). This analysis removed only 6% of cancers in men and 7% in women.

Table 19: Cancer SIR* for male and female coal mine workers, commencing follow-up at first assessment on/after 01/01/1993, compared to the Australian population

Cancer categories	All Men *N=147,837; PY= 1,374,213*			All Women *N=20,081; PY=153,403*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	**5,568**	**5,180**	**108 (105 - 110)**	396	409	97 (88 - 107)
Lip, Oral Cavity and Pharynx	290	274	106 (94 - 119)	8	8	104 (52 - 207)
Lip	**103**	**81**	**127 (105 - 154)**	---	---	192 (62 - 594)
Pharynx	93	87	107 (87 - 131)	---	---	123 (31 - 490)
Digestive Organs	983	1003	98 (92 - 103)	49	48	102 (77 - 136)
Oesophagus	67	69	97 (76 - 123)	0		
Stomach	75	96	78 (63 - 98)	---	---	110 (41 - 294)
Colorectal	617	584	106 (98 - 114)	34	33	102 (73 – 143)
Colon	341	322	106 (95 - 118)	16	20	79 (49 - 130)
Rectum	269	246	109 (97 - 123)	16	11	142 (87 - 231)
Liver	79	108	73 (59 - 91)	0		
Gallbladder	29	21	136 (95 - 196)	**---**	**---**	**300 (112 - 798)**
Pancreas	84	97	87 (70 - 107)	---	---	107 (45 - 258)
Respiratory and Intrathoracic Organs	458	425	108 (98 - 118)	23	19	121 (80 - 181)
Larynx	54	42	129 (99 - 168)	0		
Lung	386	364	106 (96 - 117)	22	18	124 (82 - 188)
Melanoma	**913**	**691**	**132 (124 - 141)**	**70**	**53**	**132 (105 - 167)**
Mesothelioma	31	25	124 (87 - 176)	0		
Breast	8	9	87 (43 - 173)	137	147	93 (79 - 110)
Female Reproductive	NA			32	45	71 (50 - 100)
Cervix	NA			10	14	69 (37 - 129)
Male Reproductive Organs	**1648**	**1508**	**109 (104 - 115)**	NA		
Prostate	**1510**	**1349**	**112 (106 - 118)**	NA		
Testis	130	149	87 (73 - 104)	NA		
Urinary Tract	304	292	104 (93 - 116)	8	9	87 (43 - 173)
Kidney	194	193	100 (87 - 116)	---	---	40 (13 - 125)
Bladder	96	86	111 (91 - 136)	**---**	**---**	**282 (106 - 752)**
Brain and Other CNS	117	106	110 (92 - 132)	---	---	48 (16 - 150)
Brain	115	102	113 (94 - 136)	---	---	52 (17 - 162)
Thyroid and Other	92	92	100 (81 - 122)	28	29	96 (66 - 139)
Thyroid	87	86	101 (82 - 125)	26	29	91 (62 - 133)
Unknown Site	78	73	107 (86 - 134)	---	---	157 (66 - 378)
Lymphoid, Haematopoietic + Related Tissue	462	505	91 (83 – 100)	27	29	93 (64 - 135)
Hodgkin	27	44	61 (42 - 89)	7	5	154 (74 - 324)
Non-Hodgkin Lymphoma	192	221	87 (75 - 100)	11	12	90 (50 - 163)
Diffuse Non-Hodgkin	89	109	82 (66 - 101)	---	---	39 (10 - 156)
Multiple Myeloma	68	66	103 (81 - 131)	---	---	99 (32 - 306)
Leukaemia	170	159	107 (92 - 125)	6	8	73 (33 - 163)
Lymphoid Leukaemia	**112**	**88**	**127 (106 - 153)**	---	---	59 (15 - 236)
Myeloid Leukaemia	44	58	76 (57 - 103)	---	---	97 (36 - 258)
Other Cancers	184	186	99 (86 - 114)	6	11	54 (24 - 120)
Myelodysplastic Syndrome	21	25	84 (55 - 129)	0		
Connective tissue	38	42	91 (66 - 126)	---	---	28 (4 - 200)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 20: Cancer SIR* for male and female coal mine workers, excluding workers with first assessment 2010 onwards, compared to the Australian population

Cancer categories	All Men *N=87,268; PY= 1,229,210*			All Women *N=9,716; PY=116,672*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	**5,204**	**4,826**	**108 (105 - 111)**	297	318	93 (83 - 105)
Lip, Oral Cavity & Pharynx	**290**	**255**	**114 (101 - 128)**	7	6	116 (56 - 244)
Lip	**119**	**79**	**152 (127 - 181)**	---	---	155 (39 - 620)
Pharynx	85	79	108 (87 - 133)	---	---	158 (39 - 631)
Digestive Organs	912	936	97 (91 - 104)	36	37	97 (70 - 135)
Oesophagus	64	65	98 (77 - 125)	0		
Stomach	67	91	74 (58 - 93)	---	---	140 (52 - 372)
Colorectal	584	549	106 (98 - 115)	24	26	93 (62 - 139)
Colon	329	304	108 (97 - 121)	13	16	83 (48 - 144)
Rectum	250	231	108 (96 - 123)	10	9	114 (61 - 211)
Liver	65	96	68 (53 - 86)	0		
Gallbladder	28	20	139 (96 - 201)	**---**	**---**	**380 (143 - 1013)**
Pancreas	77	90	86 (68 - 107)	---	---	84 (27 - 259)
Respiratory and Intrathoracic Organs	446	411	109 (99 - 119)	16	15	106 (65 - 173)
Larynx	49	41	120 (90 - 158)	0		
Lung	384	353	109 (98 - 120)	16	14	114 (70 - 186)
Melanoma	**833**	**646**	**129 (121 - 138)**	**56**	**42**	**134 (103 - 174)**
Mesothelioma	32	25	127 (90 - 179)	0		
Breast	8	9	92 (46 - 185)	110	115	96 (79 - 115)
Female Reproductive	NA			23	35	65 (43 - 98)
Cervix	NA			9	11	80 (41 - 153)
Male Reproductive	**1,537**	**1,395**	**110 (105 - 116)**	NA		
Prostate	**1,425**	**1,259**	**113 (107 - 119)**	NA		
Testis	107	126	85 (70 - 102)	NA		
Urinary Tract	280	271	103 (92 - 116)	6	7	84 (38 - 187)
Kidney	172	173	99 (85 - 115)	0		
Bladder	93	85	110 (89 - 134)	**---**	**---**	**435 (181 - 1046)**
Brain and Other CNS	107	98	110 (91 - 133)	---	---	21 (3 - 146)
Brain	106	93	113 (94 - 137)	---	---	22 (3 - 158)
Thyroid and Other	85	79	108 (87 - 133)	15	22	69 (42 - 115)
Thyroid	80	73	110 (88 - 136)	13	21	61 (36 - 105)
Unknown Site	73	73	101 (80 - 126)	---	---	113 (36 - 349)
Lymphoid, Haematopoietic + Related	431	465	93 (84 - 102)	19	22	85 (54 - 133)
Hodgkin	22	38	58 (38 - 88)	---	---	152 (63 - 366)
Non-Hodgkin Lymphoma	179	206	87 (75 - 101)	7	10	73 (35 - 154)
Diffuse Non-Hodgkin	84	101	83 (67 - 103)	---	---	49 (12 - 197)
Multiple Myeloma	63	61	103 (81 - 132)	---	---	85 (21 - 338)
Leukaemia	163	146	112 (96 - 130)	---	---	79 (33 - 189)
Lymphoid Leukaemia	**107**	**81**	**132 (109 - 160)**	---	---	76 (19 - 302)
Myeloid Leukaemia	41	53	77 (57 - 105)	---	---	93 (30 - 290)
Other Cancers	170	174	98 (84 - 114)	---	---	59 (24 - 141)
Myelodysplastic	19	24	80 (51 - 125)	0		
Connective tissue	33	38	87 (62 - 123)	---	---	37 (5 - 259)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

--- Cell sizes of less than 6 are not reported to preserve privacy

For ease of reading, the remaining Tables in this section are in Appendix 9 starting on page 274.

9.5.2 Cancer incidence for male coal mine workers

9.5.2.1 Overall cancer incidence by Work Category and Job Group

For most Job Groups, cancer incidence was at the expected rates (Table 99). Overall cancer risk was significantly increased for male workers in the Production Work Category and specifically was significantly increased for General Production workers, Operators, Miners and for the Blast Crew, Drillers (Blast and General) and Dragline operators.

9.5.2.2 Overall cancer incidence by Site Type

Table 100 shows that the overall risk of cancer was significantly increased for workers who had only worked in open cut (OC) sites or at underground (UG) sites. The increase in risk of overall cancer was similar for open cut and underground production workers but not for CHPP production workers.

For those who had ever worked in the Production Work Category there were increases in cancer incidence for OC workers, UG workers and operators from unknown site type. Within the Production Work Category, increased risks of cancer were seen for: Blast Crew, Dragline, and Operators from OC mines; general Production, Driller, and Operators from UG mines, and Drillers from unknown site types. There were some other increased risks seen within different combinations of Job Group and site type, particularly for CHPP workers and those where the site type was unknown, but all of these had small numbers.

9.5.2.3 Specific Cancer incidence among all male coal mine workers by Work Category and selected Job Groups

The following analyses examine the cancer incidence for those who have **only** worked as administration, blue collar unexposed workers and those who were occasionally exposed e.g. engineers.

Among all Job Groups except Production, cancer rates are broadly as would be expected when compared to the general population. Melanoma and mesothelioma were significantly increased for those working in Administration (Table 101), Unexposed Non-Office jobs (Table 102) occasionally exposed jobs (Table 103), and among Maintenance workers (Table 104). Prostate cancer in Maintenance workers was elevated but not statistically significantly so. In

addition, there were isolated increases in various solid and blood cancers in the different Job Groups.

The remainder of the analyses in this section include men who have ever held a job in the relevant Work Category or Job Group. This meant, for example, that a person who worked as an underground miner, a dragline operator and a supervisor at different times would be included in all three of these tables.

In those who had ever worked in Maintenance, there were statistically significant increases in the risks of lip and gallbladder cancer and melanoma and mesothelioma (Table 104). Those who had ever been Production workers (Table 105) had significantly increased risks of overall malignancies and cancers at several specific sites: cancers of the lip, colorectum, larynx, lung, prostate, kidney and bladder as well as melanoma and lymphoid leukaemia. The same overall pattern was seen for those classified as Operators within the Production Work Category (Table 106), although oesophageal cancers were raised but not significantly so for Production Operators.

Drillers (general) had an increased risk of all malignancies and specifically for cancers of the oesophagus, larynx, lung and of melanoma (Table 107).

The next set of analyses examine the incidence of specific cancers by site type and job category. Underground miners had an overall significantly increased risk of cancer, and of some specific cancers. The risk of laryngeal cancer, prostate cancer and lymphoid leukaemia was increased (Table 108).

Table 109 shows an increased risk of cancer and specifically of pharyngeal, prostate and testicular cancers among Dragline operators.

Table 110 shows no overall increase in cancer for Construction workers although significant increases were seen for pharyngeal and lung cancer.

Workers who had held exploration drilling jobs had increased risk of melanoma, lip cancer and of Myelodysplastic syndrome (MDS) (Table 111).

Overall, there was no significant increase in expected cancers for labourers (Table 112) but there were significantly increased risks for liver cancer (four-fold risk) and for lymphoid tumours, again based on small numbers.

Table 113 shows that supervisors had an increased risk of melanoma and lymphoid leukaemia, but no overall increase in cancer. Truck drivers had a similar pattern to that of supervisors.

9.5.2.4 Cancer incidence by time between first and last assessments

As discussed in the mortality results, few members of the cohort have worked for more than 15 years since their last assessment.

Overall risk of cancer does not show an increase with increasing employment duration in the industry, as measured by the time between first and last assessments (Table 114). There is a monotonic increase in risk of prostate cancer with a significant trend from an SIR of 105 (95% CI 98- 112) within 5 years to an SIR of 124 (95% CI 112 - 139) after 25 years. These risks were age adjusted so this was not a reflection of increasing disease with increasing age.

It is notable that mesotheliomas are increased for those who have worked for less than 10 years in the Queensland Coal mine industry, but not for those with longer job duration, as indicated by time between first and last assessments. The risk of mesothelioma shows a significant trend reducing over time.

Liver cancer also shows a significant decrease with increasing time.

9.5.2.5 Cancer incidence by time since first assessment

Table 115 shows the SIRs for all male coal mine workers by the time since their first assessment. This approximates to years since they were first employed as a coal mine worker. The person-years for each individual are attributed to the relevant period, so that those who were first employed more than 15 years ago would contribute person-years to each shorter time period. The overall cancer risk is highest for those within the first 5 years of employment, although comparable with estimates for other lengths of follow-up.

The SIRs for the majority of cancers are similar to the population background rates for all time periods since first assessment. Mesothelioma, which has a long latent period, while in excess compared to the general population, was lowest after 15 years since first employment and highest within the first 5 years of employment but the trend was not statistically significant (p=0.119 for trend).

Prostate cancer is in excess in all time periods, but there was no trend with time since first employment. There was an excess of melanoma, but the trend significantly reduced with time since first employment. No other trends were obvious.

9.5.2.1 Cancer incidence by age group

Table 116 presents the age adjusted SIRs for men when they were 65 or under (n = 149,131) and when they were over 65 years of age (n = 9,208). Men can appear in both the 65 or under group and the over 65 years of age if they turned 65 years during the follow-up period. Note the lower number of older workers indicates less power to identify real differences.

When compared to the general population, the risks are significantly increased for the younger group of men but not older group for lip cancer and melanoma, both sun-related cancers. Risks are significantly increased for older but not younger men for lung cancer, mesothelioma and lymphoid leukaemia.

The significantly reduced risks for stomach, liver and overall LH cancers seen in younger men were no longer evident in older men, where the rates were as expected.

9.5.3 Cancer Incidence for female coal mine workers

9.5.3.1 Overall cancer incidence by Work Category and Job Group

Table 117 provides the SIRs for female coal mine workers by Work Category and Job Group for those groups with more than 100 workers and more than 10 cancers. There were no increased or decreased cancer risks.

9.5.3.2 Overall cancer incidence by Site Type

When divided by Site Type, numbers of cancers in women were small and no differences in risk by Site Type were obvious (Table 118). Cancer risk for Exploration Drillers was significantly increased but the numbers were very small as can be seen from the very wide confidence intervals.

9.5.3.3 Cancer incidence among all female coal mine workers by Work Category and Job Group

Table 119 shows cancer risk for female Administration workers. The risk for melanoma was significantly increased while all other risks were similar to those of the general population.

Cancer risks for several other Work Categories were examined but the number of women in the groups were too small to be informative (Table 120 to Table 125).

9.5.3.4 Cancer incidence by time between first and last assessments

Women were grouped into those who had been employed for less than five years and those who had had another assessment after at least five years (Table 126).

There was limited power to discriminate between the groups and most cancer risks were similar to those expected. All cancers had lower point estimates for those with the longer employment. Melanoma was increased among the women with one assessment compared to national rates but not for those with more than one. The explanation for this is unknown, but the number of women with more than one assessment was small.

9.5.3.5 Cancer incidence by time since first assessment

Cancers among women were analysed by time since first employed, and then grouped into those who had been employed for less than five years and more than five years (Table 127).

There was limited power to discriminate between the groups and most cancer risks were similar to that expected. Overall cancer, melanoma and Hodgkin disease risks were

significantly increased within five years of first employment, but not for the longer period. No risks were higher for the longer time since the first assessment. The explanation for this is unknown.

9.5.3.6 Cancer incidence by age group

There were very few women over the age of 65 in this cohort. In so far as conclusions can be drawn, the overall cancer rate is the same as the general population for the younger women and the melanoma rate is higher (Table 128).

9.5.4 Queensland Cancer Registry Matches post 2016

By the end of 2016 there were 161,460 men and 24,270 women in the cohort who subsequently contributed an extra 626,276 and 94,789 person years between 2017 and 2020.

There were 2795 men with a cancer diagnosis between 2017 and 2020. Of these 2636 men had one primary cancer, 145 had two and 14 had three or more primary cancers. Among women, there were 312 individuals with cancer, 12 of whom had 2 primary cancers.

About 11% of the cancers found on the ACD for overlapping years (1983-2016) were not diagnosed in Queensland. This is likely because a proportion of the cohort lives outside Queensland. Consequently, in comparing the cohort cancer incidence rates for the period 2017-2020 with the expected population rates, the observed numbers were adjusted by a similar proportion to account for the incident cancers from non-Queensland residents (see Appendix 10 for methodology).

When compared to national rates the overall risk of cancer was not raised for men (Table 21) or women (Table 22). Among men, pharyngeal cancer and melanoma rates were increased, but not lip or prostate cancer. Among women, melanoma, lung and cervical cancer were increased.

Table 21: Cancer incidence for male coal mine workers 2017-2020 compared to the Australian population, using Queensland Cancer Registry data

Cancer categories	*N=161,460; PY= 617,517*			
	O	$O_{Adjusted}$	E	SIR* (95% CI)
All Malignancies	2,973	3,329	3,458	96 (93 - 100)
Lip, Oral Cavity and Pharynx	165	188	165	114 (98 - 131)
Lip	25	28	31	92 (61 - 132)
Pharynx	69	**79**	**61**	**130 (103 - 162)**
Digestive Organs	563	632	672	94 (87 - 102)
Oesophagus	31	37	47	78 (55 - 108)
Stomach	54	56	62	90 (68 - 117)
Colorectal	339	378	366	103 (93 - 114)
Respiratory and Intrathoracic Organs	255	290	290	100 (89 - 112)
Lung	221	253	256	99 (87 - 112)
Melanoma	498	**531**	**437**	**121 (111 - 132)**
Mesothelioma	11	14	16	88 (48 - 148)
Male Reproductive Organs	799	904	1033	87 (82 - 93)
Prostate	746	840	958	88 (82 - 94)
Urinary Tract	177	203	213	95 (83 - 109)
Bladder	55	67	63	106 (82 - 134)
Brain and Other CNS	42	49	57	87 (64 - 115)
Thyroid and Other Endocrine Glands	62	67	69	97 (75 - 123)
Lymphoid, Haematopoietic + Related Tissue	271	291	362	80 (71 - 90)

Abbreviations: O = number of cancers from QCR; $O_{Adjusted}$ allowing for non-Queensland population
***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results in **blue**

Table 22: Cancer incidence for female coal mine workers 2017-2020 compared to the Australian population, using Queensland Cancer Registry data

Cancer categories	*N=24,270; PY= 90,377*			
	O	$O_{Adjusted}$	E	SIR (95% CI)
All Malignancies	324	363	342	106 (96 – 118)
Lip, Oral Cavity and Pharynx	---	---	---	76 (23 – 184)
Digestive Organs	26	26	46	57 (37 - 83)
Colorectal	11	11	30	36 (18 - 64)
Respiratory and Intrathoracic Organs	23	28	21	133 (88 – 192)
Lung	23	**30**	**20**	**149 (100 – 213)**
Melanoma	62	**70**	**40**	**176 (137 – 222)**
Mesothelioma	0	0		
Breast	92	101	121	84 (68 – 102)
Female Reproductive Organs	30	38	37	102 (72 – 140)
Cervix	14	**19**	**10**	**193 (116 – 300)**
Urinary Tract	8	8	9	94 (47 - 188)
Thyroid and Other Endocrine Glands	29	32	23	140 (96 – 198)
Lymphoid, Haematopoietic + Related Tissue	28	33	26	128 (89 – 180)

Abbreviations: O cancers identified in the QCR Registry; $O_{Adjusted}$ allowing for non-Queensland population ******
Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in blue
--- Cell sizes of less than 6 are not reported to preserve privacy

9.6 Internal analyses within the cohort groups

Relative risk is used to examine whether members of a subgroup such as specific Work Categories, have more or less risk of death or cancer than other cohort members. Relative Mortality Ratio (RMR) compares the mortality rates for groups of coal mine workers with a comparison group from the cohort. The Relative Incidence Ratio (RIR) compares the cancer incidence rates for groups of coal mine workers with the other cohort members. Where there were fewer than 6 events in a major death or cancer incidence category, the category was omitted from the analyses.

These analyses were adjusted for smoking which is potentially an important confounder.

For ease of reading, the Tables are in Appendix 11 starting on page 303.

9.6.1 Internal comparisons for mortality among male workers

9.6.1.1 Comparison of mortality rates by Work Category

When overall mortality for each Work Category was compared to workers who had never been in that Work Category (i.e. the rest of the cohort), Unexposed Non-Office workers and Production workers had increased mortality (Table 131). However, these increased risks were no longer evident when the risks were adjusted for era of first examination, age and smoking status. Office workers, Occasionally exposed workers and those who were ever Maintenance workers had significantly reduced RMR for all-cause mortality after adjustment.

In a sensitivity analysis those whose first examination date was after 2010 were removed from the All-Cause RMR (Table 132). The remaining workers, particularly those in Production jobs, could have experienced higher dust exposures. Adjusted risks are increased for Unexposed Non-Office workers but not for other Work Categories. This suggests no large effect from increased dust exposure at the level of Work Category. Age is unlikely to explain the differences as the analyses are age adjusted.

Table 133 to Table 138 compare specific causes of death for Work Categories with the rest of the cohort. Table 133 shows that Unexposed Office Workers, when compared to the rest of the cohort, had a reduced risk of circulatory and accidental deaths after adjustment for age, smoking etc. The risk of death from all cancers was the same as that of the rest of the cohort after adjustment.

Unexposed Non-Office Workers had an increased risk of circulatory disease after adjustment (Table 134) whilst those in Occasionally Exposed group had significantly reduced accidental deaths (Table 135) compared to the rest of the cohort. There were other causes of mortality that were increased but none were statistically significant, and there were small numbers of deaths (<6) in many of the categories.

Table 136 shows that Maintenance Workers, when compared to the rest of the cohort, had reduced risks for several causes of death but the reduction was smaller after adjustment. Deaths from respiratory causes, specifically COPD were elevated. Deaths from external causes, specifically accidental death, were significantly reduced. Deaths from mesothelioma were significantly increased.

When those maintenance workers with first examination date before 2010 were excluded, there was little change in findings for most causes of mortality (Table 136).

Table 137 shows that Production Workers, when compared to the rest of the cohort, had increased risk of lung cancer which was no longer statistically significant after adjustment suggesting that the excess deaths were likely related to age and/or smoking rates. Circulatory and accidental deaths were increased after adjustment. Mesothelioma deaths were significantly reduced for these workers compared to the rest of the cohort.

When the mortality of workers whose first assessment was before 2010 was examined, the accident rate was no longer significantly increased but there was little change in other causes of death after adjustment for smoking and age.

Table 138 showed that for Construction Workers, when compared to the rest of the cohort, there were higher lung cancer and digestive disease mortality rates before and after adjustment. There were no significantly reduced cases of death in the group.

9.6.1.2 Comparison of mortality rates by Job Group

Where numbers allowed, and there were more than 20 deaths in a Job Group, the mortality of specific Jobs Groups were compared to that of other workers in the same Work Category to identify risks specific to that Job Group.

Maintenance workers

Within the Maintenance Work Category, Shutdown Maintenance workers had an increased risk of death even after adjustment for age and smoking. Diesel fitters and Electricians showed a reduced mortality even after adjusting for age and smoking (Table 139). Excluding workers who started after 2010 showed little difference (Table 140).

Table 141 shows that Shutdown Maintenance workers had higher risk of death than other maintenance workers from metabolic disease and external causes after adjustment. All the specific mortality rates reduced after adjusting for age and smoking. In particular deaths from lung cancer, metabolic and circulatory disease, COPD and accidents and suicides were no longer significantly increased after adjustment. Several of these causes of death are known to be smoking related.

Diesel fitters showed reduced risk for several causes of death compared to other Maintenance workers, all of these except the reduction for accidental death disappeared when adjusted for age and smoking (Table 142). Boilermakers, fitters and electricians showed few differences in risk, none were statistically significant, when compared to other workers in the Maintenance Work Category either before or after adjustment (data not shown).

Production workers

Compared to Production workers as a whole, male CHPP operators, ERZ/Deputy, OCE and Miners showed a reduced mortality, after adjusting for age and smoking (Table 143).

The mortality of miners whose first assessment was before 2010 (Table 144) was very similar to that of the whole Production Work Category.

Table 145 shows that Drillers had higher risk of death than other Production workers from lung cancer, melanoma and circulatory disease after adjustment. Melanoma was more than 3 times as common in Drillers than other Production workers. Mesothelioma deaths were elevated but numbers were small (<6).

Table 146 for Underground miners showed little differences in risk when compared to other Production Workers. Circulatory disease risk was low both before and after adjustment. Operators had a similar risk compared to other Production workers (data not shown).

Job Groups in the Unknown Work Category

Within the Unknown Work Category (Table 147), Truck drivers and Labourers had increased risk of mortality after adjustment for age and smoking, but Supervisors had reduced mortality, when compared to all other coal mine workers in the cohort.

Labourers had an increased risk of circulatory disease and accidental death although the latter was not statistically significant (Table 148). Several causes of death were elevated for Truck Drivers (nec) but only accidental death was increased after adjusting for smoking and age

(Table 149). Compared to other workers, the death rate for circulatory disease and external causes were significantly reduced for supervisors (data not shown).

9.6.1.1 Comparison of mortality rates by site type among male workers

Table 150 shows little difference in mortality between workers by site type after adjustment for smoking and age. The all-cause death rate is lower for underground and particularly so for CHPP workers compared to open cut workers. CHPP workers have a reduced risk of death from Injury and Trauma.

9.6.2 Internal comparisons for mortality among female workers

9.6.2.1 Comparison of mortality rates by Work Category and Job Groups

There were only a small number of deaths among female coal mine workers so the power to examine risk by specific Job Groups was limited.

Between Work Categories those who had ever been a Cleaner (nec) were at increased risk of mortality compared to all other female mine workers but the excess was attenuated when adjusted for age and smoking (Table 151).

Unexposed Office workers were significantly less likely than other female coal mine workers to die in accidents (Table 152). Production female workers were over three times more likely than other female coal mine workers to commit suicide (Table 153). Cleaners (nec) were three times more likely to have an accidental death than other female coal mine workers. Deaths from cancer and other causes were also higher in this group than for other workers before accounting for age and smoking effects but these increases were no longer significant after adjusting for age and smoking (Table 154).

There were few significant differences in mortality between Job Groups, although this may be attributable to the small numbers for many Jobs. The number of deaths observed among women working in Unexposed Non-Office jobs, Occasionally exposed jobs, Maintenance jobs or as Operators were small and hence uninformative, so results on specific causes of death have not been presented here. For the same reasons, comparisons of rates by Site Types have not been presented.

9.7 Internal comparisons for cancer incidence

For ease of reading, the Tables are Appendix 12 starting on page 306.

9.7.1 Cancer incidence internal comparisons among male workers

9.7.1.1 Comparison of cancer incidence rates by Work Category in male workers

When risk of cancer in each Work Category for men was compared to the rest of the male cohort and adjusted for age and smoking, a significantly reduced risk of overall cancer was seen for those who had worked only as Office workers (Table 155). After adjustment, the only other statistically significant results were an increase for those who had ever worked in Production and a decrease for those who had ever worked in Maintenance. The findings did not change when workers whose first assessment was after 2010 were excluded (Table 156).

In Work Category analyses for specific cancers, there were no statistically significant increases for Unexposed Office after adjustment (Table 157). Unexposed Non-Office workers had increased adjusted risks of pancreatic and testicular cancer (Table 158). For those who had ever worked in Maintenance, there were no increased risks (Table 159) but the adjusted risk of melanoma was reduced by nearly 20% in both all workers and in those workers with their first examination before 2010.

Risks of many types of cancer were increased for ever Production workers in unadjusted analyses but all types except prostate cancer were no longer significantly increased after adjustment for age and smoking (Table 160). Lung cancer risk remained high but no longer reached statistical significance. Adjusted mesothelioma risk was significantly reduced but numbers were small. When Production workers whose first assessment was after 2010 were excluded, adjusted risks for lip cancer, lung cancer, melanoma, and prostate cancer were statistically significantly raised.

Risks of pharyngeal and lung cancer were increased for ever construction workers with and without adjustment (Table 161). Lympho-haematopoetic (LH) cancers were significantly reduced but numbers were small.

Non Hodgkin lymphoma (NHL) was significantly increased for those in Occasionally Exposed jobs after adjustment for age and smoking (data not shown). No other cancers were increased or decreased for these workers.

9.7.1.1 Internal comparisons of cancer incidence rates by Job Group among male workers

Maintenance workers

Table 162 and Table 163 compare the cancer incidence for workers who were ever in selected Job Groups within the Maintenance Work Category with those observed for the rest of the Maintenance workers. In the adjusted results, there were no statistically significant changes for all cancers combined (Table 162) even when restricted to those workers employed before 2010 (Table 163). The Table shows that even though the unadjusted RIR for men who ever worked a Shutdown Maintenance job indicated an increased cancer risk in this group, the differences between the groups were no longer statistically significant after adjusting for age and smoking.

The RIRs for specific cancers were examined for the Job Groups of ever Maintenance (general group) and ever Shutdown Maintenance. For general maintenance (Table 164), there was a threefold increased risk of mesothelioma, although not statistically significant, and only a small number of cancers were observed (n=6). For Shutdown Maintenance workers there were increases in the adjusted risks of liver cancer and lung cancer, and reduced risks of non-Hodgkin lymphoma (Table 165).

Compared to other Maintenance workers, Diesel fitters had an increased risk of Hodgkin Disease adjusted RIR 3.87 (95% CI 1.00 - 15.00), but there were small numbers (n<6). They also had an increased risk of NHL, adjusted RIR 2.14 (95% CI 1.16 - 3.96) (n=14). In this Job Group, no other cancers were significantly increased or reduced after adjustment (data not shown).

Compared to other maintenance workers, Boilermakers had a threefold increased risk of oesophageal cancer, adjusted RIR 3.14 (95% CI 1.15 - 8.59) (n=6) and a significantly reduced risk of melanoma adjusted RIR 0.65 (95% CI 0.44 - 0.97) (n=27). No other cancers were signifcantly increased or reduced after adjustment (data not shown).

In similar analyses Electricians had an increased risk of melanoma, adjusted RIR 1.46 (95% CI 1.11 - 1.92). No other cancers were signifcantly increased or reduced after adjustment (data not shown).

There were no increased or decreased risks for specifc types of cancer among those who had ever worked as Fitters when compared to other Maintenance workers (data not shown).

Production workers

Table 166 and Table 167 compare the cancer incidence for selected Job Groups within the Production Work Category. After adjustment, there were no statistically significant increases for all cancers combined but there was a reduction in risk for CHPP Operators (Table 166). Risks did not change when workers whose first assessment was after 2010 were excluded (Table 167).

Dragline operators had increased adjusted RIRs for pharyngeal and testicular cancers (Table 168). Compared to other Production workers, after adjustment for age and smoking, Blast Crew workers had an increased risk of colorectal cancer RIR 2.15 (95% CI 1.23 - 3.75) (n=13) and bladder cancer 3.30 (95% CI 1.01 - 10.8) (n<6). After adjustment for age and smoking, men who had ever worked as a Driller (General) had an increased risk of melanoma RIR 1.94 (95% CI 1.38 - 2.71) and cancers of Unknown Site RIR 3.06 (95% CI 1.08 - 8.68). No other cancers were significantly increased or reduced (data not shown). CHPP operators were a small group and no cancers were significantly increased after adjustment (data not shown) however, respiratory cancers were significantly reduced RIR 0.32 (95% CI 0.10 - 0.99) (n<6). There were no significant increases or decreases in adjusted rates of specific cancer type for men who had ever held an Open Cut Examiners,ERZ/Deputy, Miner or Operator position (data not shown).

Workers in the Unknown Work Category

Table 169 presents the RIR for male workers in unknown Work Categories compared to all other coal mine workers. The table shows that male Cleaners (nec) were at reduced risk of overall cancer compared to all other male coal mine workers, but numbers were small (n=14).

Truck drivers (Table 170) had no statistically significant increases in risk after adjustment for age and smoking.

Labourers had an increased risk of liver cancer, adjusted 5.91 (95% CI 2.86 - 12.22) (n=9). There were no other significantly increased nor reduced RIRs after adjustment (data not shown).

Supervisors had an increased RIR for testicular cancer; adjusted 2.08 (95% CI 1.09 - 3.96) (n=11). There were no other significantly increased or reduced RIRs (data not shown).

9.7.1.1 Comparison of cancer incidence rates across site types among male workers

Table 171 shows comparisons of cancer incidence rates between Underground or CHPP workers with Open Cut workers. The table shows little difference in RIRs by site type after adjusting for age and smoking. No cancers were significantly in excess in the analyses.

9.7.2 Cancer incidence internal comparisons among female workers

There were too few deaths among women for meaningful comparisons of cancer rates by Site Type or Job Group for most jobs.

9.7.2.1 Comparison of cancer incidence rates by Work Category in women

Table 172 shows little difference in overall malignancies between Work Categories. Office workers had an increased risk of cancer after adjustment for age and smoking.

9.7.2.1 Comparison of cancer incidence rates by selected Job Groups in women

Women who had only worked in offices had statistically significant adjusted increased risks of melanoma (Table 173). After adjustment, no significantly increased or decreased risks of specific cancers were seen for women who worked in Production jobs (Table 174). Numbers were too small to be informative for other Job Groups including Blue Collar Unexposed workers and Cleaners (nec).

10. Discussion

10.1 Cohort mortality

When the mortality of coal mine workers was compared to rates expected from an age and sex matched sample of the general population, the overall mortality of both male and female coal mine workers was significantly reduced.

The rates of mortality (specific causes and all causes combined) varied by Work Categories, Job Groups and time since the date of their first examination. However, it is important to note that these results need to be interpreted with caution as the cohort includes many young people, there are small numbers in some subgroups, (compounded with a short follow-up) resulting in small numbers of observed deaths and hence wide confidence intervals. Additionally, given the many analyses conducted for this report, some of the findings of excess or reduced mortality may be chance findings (see Section 10.10). Therefore, it is the trends or patterns that are important.

The overall mortality rates were significantly lower by 19% for men and 25% for women, compared with the general population. The findings were robust to sensitivity analyses that excluded those with first examination dates before 1993 or those with first examination dates post 2009. These reduced rates are common in industrial cohorts because of the Healthy Worker Effect (that is workers are healthier than the general Australian population) see Section 10.11.6. As a comparison, the Health Watch cohort of petroleum industry workers had a similar overall SMR for men of 72 (95% CI 69 - 75).(Wood, Glass et al. 2013)

There were significant trends in decreased mortality from accidental death, suicides, liver cancer, mesothelioma, bladder cancer, IHD and cerebrovascular causes with increasing period of employment, measured as the time between first and last assessments. This may be that younger and/or more inexperienced workers may be more at risk for accidents and suicides. It is difficult to explain for the other diseases listed here except perhaps as a manifestation of the Healthy Worker Effect (see section 10.11.6) or exposure in previous jobs.

A majority of ill health usually appears in later life, however, male coal mine workers aged over 65 had significantly reduced mortality compared with the general population (with the same age profile) for many causes of death. Lung cancer and mesothelioma were increased in the older male age group, only the former was statistically significant however *Lung Diseases due to Dust* and suicide were both significantly higher in the male younger age group but not in the older group. The comparisons by age group for women were limited by the very small numbers of older women.

Internal mortality analyses show a reduced RMR for all-cause mortality for male Office workers, Occasionally exposed workers and those who were ever Maintenance workers compared to the rest of the male cohort. In the case of Office workers, the risk decreased after adjustment which suggests that some of their mortality reduction was likely a result of lower smoking rates (Appendix 7 Smoking status) and/or more younger workers than in the rest of the cohort. This shows the importance of adjusting for these important confounders. Mortality in this cohort was lower than general population, but these three groups appear to have particularly low mortality when compared to the rest of the cohort.

When Maintenance and Occasionally exposed workers were compared to the rest of the cohort, mortality risks increased after adjustment (but were still significantly reduced) suggesting more younger workers and/or lower smoking rates for Maintenance workers

When the Administration workers were compared to the rest of the cohort, mortality risks decreased after adjustment suggesting more older workers and/or higher smoking rates for Occasionally exposed workers.

Some risks did not greatly change when adjusted for age and smoking e.g. Construction workers, who were more likely than the rest of the cohort to die from lung cancer.

Construction workers had an elevated risk of death from digestive diseases, most of which were liver disease.

10.1.1 Mortality by specific causes of death

10.1.1.1 Suicide

Overall suicide rates were significantly increased for men but not for women when compared with the general population. The rate was not increased overall when compared to Queensland State data (Figure 35). Analyses by era showed that the suicide rate among male coal mine workers was reduced or similar to the Queensland rates between 1980 and 2010. Between 2011 and 2015, the $SMR_{Queensland}$ was 103, 95%CI 90–119 (n=197) and between 2016 – 2020 $SMR_{Queensland}$ it was 108, 95%CI 96–122 (n=264).

AIHW data (Figure 35) shows that between 1981 and 2021, the suicide rate was higher in Queensland than in the rest of the Australian general population. This may be partially explained by the higher rate of suicides in regional and remote areas (Figure 36). This increase in suicide with remoteness has been attributed to lower rates of diagnosis and treatment of mental disorders, particularly in men. (Fitzpatrick, Handley et al. 2021)

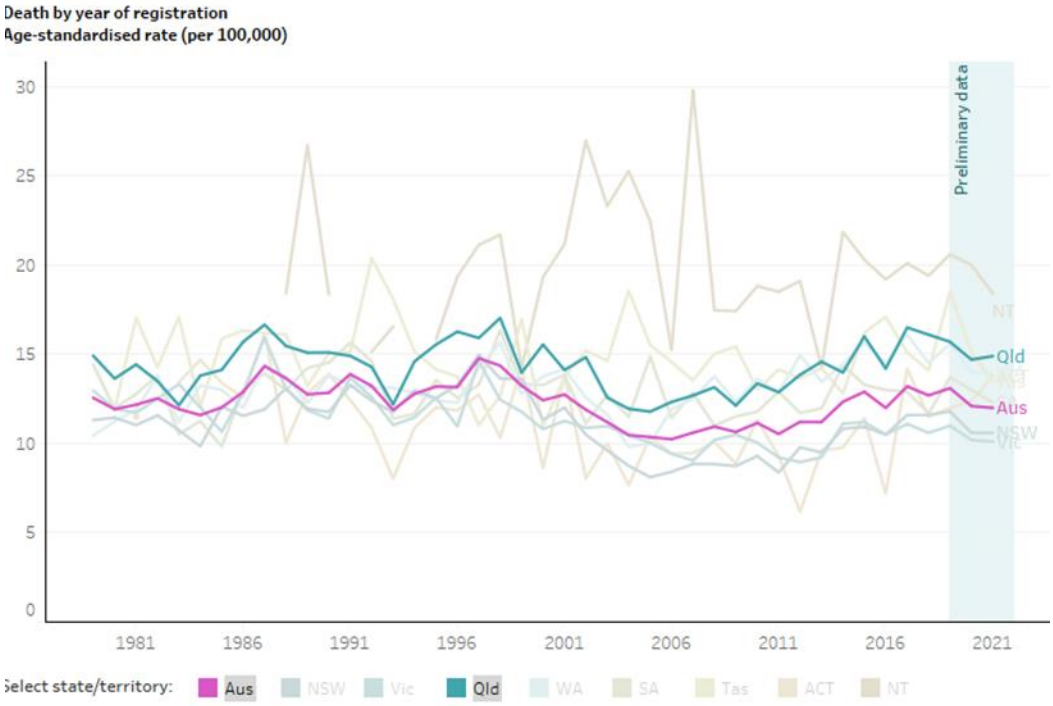


Figure 35: Suicide deaths for men and women by States and Territories, 1980 to 2021[17]

There were, however, intra-cohort differences in suicide rates which may identify those at risk and so where interventions may be most effective. Suicide rates are highest for those aged under 25 and between 35 and 44 at recruitment. Comparing between age groups, suicide

[17] https://www.aihw.gov.au/suicide-self-harm-monitoring/data/deaths-by-suicide-in-australia/suicide-deaths-by-state-territories

rates are somewhat higher for younger men within five years of their first health assessment and were higher among those most recently recruited.

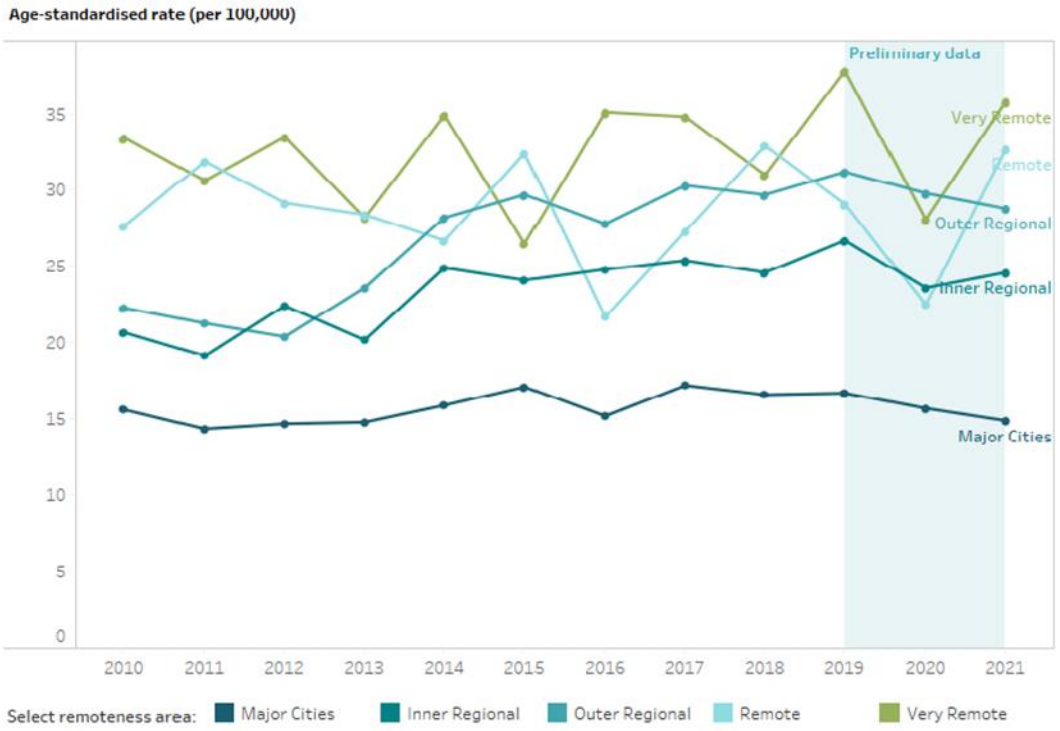


Figure 36: Suicide deaths for men by remoteness area 2010 to 2021[18]

In the Healthwise Aluminium worker cohort study, suicide was significantly decreased for all Smelter workers (includes production, maintenance and office workers) SMR 55 (95% 31 to 89) but for those who had worked for less than 20 years (the shortest duration analyses) the risk was higher, SMR 153 (95% 99 to 227). In Health Watch, a mature petroleum industry cohort set up in 1980, the suicide rate up to the end 2015, was significantly reduced SMR 65 (95%CI 50 - 82). However, 68% of these workers were retired. Data on suicides within 5 years of employment were not available for comparison from these cohorts. There is some evidence that in Australia, compared to construction workers, suicide rates are higher in the mining industry and higher than among other employed people. (Considine, Tynan et al. 2017) Based on coronial data, the suicide rate for male mining workers in Australia was estimated to be between 11 and 25 per 100,000 (likely closer to 25 per 100,000) over the period of 2001 to 2019 and that the rate among mining workers has been increasing from 2011. (King, Maheen et al. 2023) This is also shown in this study. An earlier study did not identify a higher suicide risk for miners in Queensland. (McPhedran 2015)

Many mine workers have a Fly In Fly Out (FIFO) work arrangement. It is known that FIFO workers are at greater risk of poor mental health and suicide, particularly men aged 25 - 34

[18] https://www.aihw.gov.au/suicide-self-harm-monitoring/data/geography/suicide-by-remoteness-areas.

years (compared to those aged 55 years or older). (Centre for Transformative Work Design 2018). In many settings, higher rates of suicide have been observed among lower-skilled and blue-collar workers both in Australia and internationally. Further, shift-work or atypical hours, low job control and perceived job insecurity are a known risk factors for poorer mental health (King, Maheen et al. 2023) FIFO workers may be at greater risk of suicide, compared to the general population perhaps because they are reluctant to seek help when in distress as a result of a culture of traditional masculine norms and/or there may be a culture of alcohol and drug use (King, Maheen et al. 2023) However, FIFO status of the workers in this cohort was not identified and so could not be investigated further.

Other factors that affect risk of suicide risk by type industry include high job demand, low autonomy and physical danger (https://www.saxinstitute.org.au/publications/evidence-check-library/suicide-prevention-in-high-risk-occupations/).

Precarious employment is thought to impact mental health (Min, Park et al. 2015) and result in increased risk of suicide compared with other workers. (Kreshpaj, Orellana et al. 2020) In this cohort, suicide rates were higher than expected among men within 5 years of their first assessment (median age of 34 years) than for older, longer serving employees. This may indicate that the suicide risk was higher among more mobile workers who remained in the same jobs for short periods of time, or who changed roles or employers frequently or this may be an age-related effect.

Compared to Australian (but not Queensland) rates, suicides were increased for some Work Categories, notably, increased for male and female Production workers, male Truck Drivers and Construction workers. When compared to Queensland rates, suicides were only elevated but not statistically significantly increased for male Construction workers and female Production workers. Compared to Australian rates, significant excesses of suicide were seen amongst men in many Job Groups including Shutdown Maintenance workers, Boilermakers, Tyre fitters, Operators and Truck Drivers (nec). This is in line with recent Australian literature which identified that some occupations are at greater risk of suicide, particularly “workers in construction industry, labourers, cleaners, machine operators and skilled trades, such as electricians and builders”. (Centre for Transformative Work Design 2018) Suicide was not elevated for male administration workers.

Analyses comparing sub-groups of workers showed that compared to other Maintenance workers, Diesel fitters and Electricians, were less likely to commit suicide. Male Shutdown Maintenance workers were at more risk. For women in Production jobs the risk was over three-fold compared to other female coal mine workers.

10.1.1.2 Accidental death

The rate of accidental death in male coal mine workers was higher than in the Australian population but not when compared to Queensland rates (see Section 9.4.2.1.2). In recent years, post 2014, the rates appear lower than both the national and the Queensland rates. The accidents are mainly from transport accidents (59%) so may not take place during work time. They may occur when commuting to or from work or during leisure time. Driving distances are often higher in rural areas, which encompass much of as Queensland. This may mean that there is more opportunity for road accidents in this cohort than in the general Australian population.

Compared to the Australian population, the rate of accidental deaths differed by Work Category and Job Group. Accidental deaths were elevated among men who had ever been Production Workers, Truck Drivers (nec) and Labourers and for male and female Cleaners when compared to the general population. Subgroup analyses also showed increased accidental deaths for male Truck Drivers and Production workers when compared with other workers in the cohort. Women who worked as Cleaners (nec) were three times more likely than other women in the cohort to experience accidental death. The internal analyses also show that male Occasionally Exposed workers and Maintenance workers and male and female Office workers were less likely to experience accidental death than other workers in the cohort.

Few of the cohort's 696 accidental deaths would have been a result of workplace accidents, although this could not be definitively ascertained in this study. A recent Safe Work Australia report identified 10 fatalities in mining in Queensland between 2017 and 2021, (Safe Work Australia 2021) and ten between 2013 and 2017. (Safe Work Australia 2017) Not all of these deaths would have been in coal mining. It is possible that some Job Groups have higher accidental deaths from work related causes such as explosions or mine collapses (Noraishah Ismail, Ramli et al. 2021). A Finnish study among underground mine workers found higher rates of accidental death among Production workers. (Onder and Adiguzel 2010)

When examined by length of employment, an increased risk of accidental death was seen for all male coal mine workers with less than 5 years employment but those with more than 15 years employment showed a significant reduction in risk. The decrease in risk with years of employment has a statistically significant trend. A similar pattern was seen for male Production workers.

Accidental deaths were not elevated for male coal mine workers employed directly by the mine or employed by a large contractor but they were increased for those employed by other company types. This may reflect more time spent driving between sites for these workers.

10.1.1.3 Respiratory disease mortality

Deaths from respiratory diseases were reduced for men and women in the cohort, significantly so for men when compared to the general population.

For male Maintenance and Production workers, the risk of respiratory disease mortality was higher for those employed for more than 10 years. The internal comparisons did not show significant differences within the cohort for men or women but numbers were small. However, within cohort comparisons showed that the risk of non-malignant respiratory disease specifically COPD was raised for Maintenance workers and Truck Drivers even after adjusting for smoking. An increased risk of non-malignant respiratory disease was seen in the meta analysis. (Alif, Sim et al. 2022)

There were six deaths from *Lung Diseases due to Dust* and the rate was significantly higher in those under 65 years but not elevated in the older group. This may be a survivor effect in the smaller, older group or may relate to older miners having experienced less dust that those who worked more recently. These six deaths include CWP, asbestosis and other fibrotic lung diseases.

The prevalence of CWP in Queensland increased from 2008 (Baade, Lu et al. 2021), which could suggest that there would be increased mortality from NMRD (Coal Workers' Pneumoconiosis Select Committee 2017, Hoy and Brims 2017). The study could not identify and include those diagnosed with the disease who had not died, or those who died with the disease but the diagnosis was not recorded on the death certificate. There is no current national CWP registration scheme. The disease takes time to develop and tends to be diagnosed later in life, for example after retirement (Graham, Vacek et al. 2001) and many workers in the cohort are young. An increase in CWP prevalence was seen in the USA in the first decade of this century (Blackley, Halldin et al. 2018), but NIOSH reported a significant decline in CWP deaths among US miners from 1999-2016 (Mazurek, Wood et al. 2018). Cohen et al suggest that it is the exposure to quartz that is responsible for this increase in cases, based on post mortem examination of the lungs. (Cohen, Rose et al. 2022)

10.1.1.4 Heart disease mortality

Deaths from Ischaemic Heart Disease (IHD) were overall reduced for men and women in the cohort, significantly so for men. However, IHD was significantly increased for men who had worked for 5 or fewer years in the Unexposed Non-Office Work Category.

The within-cohort comparisons suggested that male Office Workers and Maintenance workers had a reduced risk of death from circulatory disease but Production (notably Drillers), Unexposed Non-Office workers and Labourers (nec) had a significantly increased risk, even after adjustments for age and smoking status. Within Production, underground miners had a reduced risk of death from circulatory disease. The numbers were too small to identify significant increases or decreases for female coal mine workers.

It is generally accepted that exposure to fine particulate increases the risk of cardiovascular mortality, (Alexeeff, Liao et al. 2021) and Production workers, notably drillers, had a higher risk than workers, and were the most likely to be exposed to fine particulate. However, Production workers who had ever worked as underground miners did not have an increased risk over that of other Production workers, despite their likely higher exposure. There were too few Exploration Drillers (who were also likely to have greater dust exposure) to be included in these analyses.

Other studies of coal miners conducted in the USA have also shown elevated cardiovascular/heart disease mortality, although none of the studies specified the jobs or Work Categories included in their studies. (Landen, Wassell et al. 2011, Arif and Adeyemi 2020) This may be related to higher rates of high blood pressure and obesity among miners in the USA (Casey, Fedan et al. 2017).

An excess risk of IHD mortality among underground coal mine workers has been attributed to dust exposure (Landen, Wassell et al. 2011) with increased risk associated with higher exposure, and also with coal rank. In another study the analyses could not distinguish whether the risk was more strongly associated with average exposure intensity of RD or RCS. Median average RCS exposure in the study was 0.12 mg/m^3 and for RD 1.69 mg/m^3 (Costello, Attfield et al. 2018). These were higher RCS exposures than recent measurements for underground workers in Queensland (Table 11) where the mean average exposure to RCS was 0.034 mg/m^3 and to RD was 1.60 mg/m^3 after 2000 but were likely higher in earlier years.

10.2 Cohort cancer incidence and mortality

In this cohort, compared to the Australian population, the overall incidence of cancer was significantly increased in men but not in women. However, cancer mortality was significantly reduced for both men and women. There were few cancers in women, which limits interpretation of these results.

Overall cancer incidence among male workers was comparable to the general population across all Work Categories except Production. In internal analyses, when comparing cancer risk for male Production workers with the rest of the cohort, several cancers were increased but after adjustment for smoking and age, only prostate and the miscellaneous group of other cancers were increased. Male CHPP workers had a reduced risk of cancer when compared to other Production workers.

Male Office and Maintenance workers had a significantly reduced risk of cancer compared to other men in the cohort after adjusting for age and smoking. Compared to other women in the cohort, female office workers, however, had an increased risk of cancer after adjusting for age and smoking. These were mainly breast cancers and melanomas.

Some Job Groups eg Truck drivers and Shutdown Maintenance workers showed increased risks for several specific cancers compared to other cohort workers before adjusting for age and smoking status. However, many of these significant associations disappeared after adjusting for age and smoking. Some assocations remained, for example, Labourers and Shutdown Maintenance workers had increased risk of liver cancer while risk of testicular cancer was increased in Supervisors and Dragline operators, when compared to other workers.

Among women, breast cancer was significantly reduced for Production workers compared to the general population. Many risk factors influence the likelihood of breast cancer including genetic risk factors, breast density, parity, age at menarche and time breast feeding and none of these factors could be examined in this study. (https://www.bcna.org.au/breast-health-awareness/risk-factors). Of these risk factors, it is possible that coal mine workers may not have the same rates of parity and length of breast feeding, as women in the general population. Having many children and a long period of breast feeding are thought to be protective against breast cancer.

A number of cancers now have a good response to treatment so incidence is a better measure of disease than is cancer mortality. However, most previous cohort studies of coal mine workers studied rates of cancer mortality rather than incidence. The meta-analyses of six studies of coal mine workers suggested that the risk of overall cancer mortality was

approximately 10% lower than expected (Alif, Sim et al. 2022). No specific cancer categories showed statistically significant increases in this meta-analysis.

10.2.1 Incidence and mortality of specific cancers

10.2.1.1 Lung and laryngeal cancers

It might be expected that lung and laryngeal cancers would be elevated among coal mine workers who have exposure to agents classified by IARC as carcinogenic, notably diesel engine exhaust and silica (https://monographs.iarc.who.int/list-of-classifications). However, lung and laryngeal cancer incidence and mortality were not significantly raised for the cohort as a whole when compared to the general population.

Lung cancer mortality, but not incidence, showed a significant trend, increasing with time since first assessment but did not show a statistically significant increase for any group specific Work Category or Job Group compared to the general population. Laryngeal cancer incidence was elevated (but not statistically significant) for men with between five and 15 years since first assessment compared to the general population.

When split by age, significantly excess lung cancer incidence and mortality were observed for men 65 years and above, but not among the younger men when compared to the general population.

Laryngeal cancer incidence, lung cancer incidence and lung cancer mortality were significantly increased for male Production workers. Within Production, lung cancer mortality was highest for those who ever worked as Drillers (general) or Operators when compared to the general population. Among underground Miners compared to the general population, the increase in lung cancer was not statistically significant but laryngeal cancer was significantly increased.

In internal analyses, after adjusting for smoking, lung cancer incidence and mortality were elevated for Production workers compared to other workers in the cohort although not statistically significantly so. Lung cancer mortality was higher in Drillers (general) compared with other Production workers. No significant excesses in lung or laryngeal cancer incidence were observed in any other subgroups of Production workers.

When compared with all other maintenance workers, lung cancer was significantly increased for the Shutdown Maintenance Job Group, and significantly reduced for Electricians compared with all other Maintenance workers.

Compared to the general population, lung cancer and laryngeal cancer incidence and mortality were increased for Construction workers but only the former was significantly increased.

Internal analyses also showed that lung cancer incidence and mortality were significantly increased in Construction workers compared to other Work Categories.

No excess lung or laryngeal cancers were observed among women in external analyses. However, in smoking-adjusted internal analyses, women who had only worked in offices had increased risks of lung cancer compared to other female coal mine workers. Numbers were too small to be informative about laryngeal cancer. The recent meta-analysis (Alif, Sim et al. 2022) found no significant increases in lung cancer among in coal miners.

Overall, Construction, Shutdown Maintenance and Production workers, mainly Drillers and Operators, appear to have an increased risk of lung cancer.

Several studies have noted that coal miners have a reduced risk of lung cancer mortality and it has been suggested that this is a result of the Healthy Worker Effect and/or coal miners not being able to smoke underground. (Stayner and Graber 2011) A study from Scotland, which took into account smoking status, showed that lung cancer mortality showed a small but statistically significantly increased relative risk for respirable quartz exposure.(Miller and MacCalman 2010)

Brown et al did not identify increased incidences of lung cancer SIR 0.74 (95% CI 0.50 - 1.06) or laryngeal cancer SIR 1.02 (95% CI 0.37 - 2.21) in a cohort of NSW coal miners. (Brown, Christie et al. 1997)

Most previous studies have only presented data on underground coal miners without identifying specific jobs. The exposure measurements in this study clearly indicate variations in exposure by Site Type and Work Category. While it was not possible to directly attribute exposure to individual workers, it is worth noting that statistically significant excess lung cancer incidence and mortality were observed in the Production group which includes underground workers with historically higher exposures to RCS and RD and likely DPM exposure. Further, higher SMRs and SIRs for lung cancer were seen in older workers.

10.2.1.2 Melanoma

Melanoma incidence, but not mortality was significantly increased among men and women when compared to national rates. When compared to Queensland incidence rates, this effect disappeared suggesting that the risk for both men and women was similar to that of other people living in Queensland.

Internal analysis, adjusted for smoking and age, showed that when compared within the rest of the cohort, male Maintenance workers and female Office workers had an increased risk of melanoma. Male electricians and Drillers (general) had an increased risk of melanoma

compared to other Maintenance and Production workers, respectively. Boilermakers had a reduced risk of melanoma compared to other Maintenance workers.

When examined by time between first and last assessment, melanoma incidence was significantly raised in men for all except those with more than 15 years between their first and last assessment, but the trend was not significant. A similar pattern was seen for women.

For men and women there was an increased risk within five years of first employment in the industry as measured by the initial assessment. For men there was a significant reduction in risk over time since first assessment, the reason for this is unclear, one possibility is the relatively recent increased awareness of the need for sun protection at work and during leisure activities. Sun exposure in adulthood is a risk factor for melanoma but sun exposure in childhood is a strong determinant of risk. (Whiteman, Whiteman et al. 2001) The Cancer Council of Australia "Slip, Slap , Slop" campaign which started in 1981 and the primary school Sunsmart program started in 1994 thought to have contributed to a reduction in melanomas in those under 40 seen in 2016. (Walker, Maitland et al. 2022)

Melanoma showed a monotonic increase with years of employment for Administration workers but the increase was not statistically significant.

Brown et al found an overall SIR for malignant melanoma in the NSW coal miner cohort of 113 (95% CI 90 - 139) but for those workers who started in an open cut mine the SIR was significantly increased at 202 (95% CI 131 - 298). (Brown, Christie et al. 1997)

Together these data do not suggest a strong relationship between working as a coal mine worker and increased melanoma incidence or mortality. However, there was an increased risk of melanoma for workers in Job Groups possibly working off site such as surveyors, geologists, environmental services, truck drivers, exploration and general drillers.

10.2.1.3 Cancer of the lip

An increased incidence of cancer of the lip was seen for both men and women although only the former was significantly increased. The increase was significant for men who were Maintenance workers, Production workers and Exploration drillers compared to the general population. Internal analyses did not show significantly different risks between Job Groups after adjustment for smoking and age.

Brown et al did not find an increased risk of cancer of the lip in NSW coal miners. (Brown, Christie et al. 1997) Cancer of the lip has been linked to outdoor work in Denmark, probably from sun exposure. (Kenborg, Jørgensen et al. 2010). There was an excess for men with less than 10 years employment but not for those with longer employment and there was no trend

across the employment categories. The increase may therefore relate to being Queensland based rather than being specific to working at a mine.

Other risk factors for lip cancer include age and male gender, poorer socio-economic circumstances, smoking and alcohol, sunlight exposure early in life and cumulatively, viral infections and immunosuppression.(Perea-Milla López, Miñarro-Del Moral et al. 2003)

10.2.1.4 Mesothelioma

Mesothelioma occurs as a result of exposure to asbestos. New use of asbestos was completely banned in Australia from the end of 2003, however there is still a large amount of asbestos in existing structures and asbestos *in situ* may be disturbed by maintenance work. (Australian Institute of Health and Welfare 2019) The most common job carried out by those diagnosed with mesothelioma in Australia, between 2010 and 2018, was maintenance work including building trades, electricians and fitters (Australian Institute of Health and Welfare 2019)

In this study, there were no cases of mesothelioma, a relatively rare cancer, among women. The following findings relate to men. Compared to the general population, Administration, Occasionally exposed workers (engineers, geologists and surveyors) and Maintenance workers showed a significant excess of mesothelioma but numbers were small. An increased risk for Maintenance workers is a common finding. Mesotheliomas were higher in workers who had worked for less than 10 years in mining, which suggests that the asbestos exposure could have predated their mining employment. The increased risk for Administration and Occasionally exposed workers is difficult to explain unless there had been asbestos exposure in previous jobs.

When compared to the rest of the cohort in internal analyses, mesotheliomas were significantly reduced in male Production workers and raised but not significantly so for male Maintenance and Construction workers. Male Maintenance (general) workers had a three-fold increased risk of mesothelioma when compared to the rest of the Maintenance workers but there were only a small number of cases (n=6).

Mesothelioma has a very long latent period of over 30 years. (Tossavainen 1997). It is notable that mesotheliomas were increased for those who have worked for less than 10 years in the Queensland coal mine industry but not for those with longer job duration (as indicated by time between first and last assessments). Some of these workers will have been employed elsewhere before joining the coal industry and may have been exposed to asbestos in other settings. Mesothelioma in this cohort was lower after 15 years since first assessment and

higher within the first 5 years of their first assessment. We are unclear as to how to interpret this finding.

10.2.1.5 Cancers of the digestive tract

Cancers of the pharynx were significantly increased in male Dragline operators, and male Construction workers but not in other Job Groups or Work Categories when compared to the general population. Internal analyses also showed an increased RIR for pharyngeal cancer in male Construction workers compared to the rest of the cohort and in Dragline workers compared to other Production workers. Known risk factors for pharyngeal cancer are: smoking tobacco, excessive alcohol consumption, infection with Human Papilloma Virus or Epstein-Barr Virus, a poor diet or a family history of cancer. (https://www.cancer.org.au/cancer-information/types-of-cancer/throat-cancer)

Male Boilermakers had a threefold increased risk of oesophageal cancer compared to other Maintenance workers. A Swedish national case-control study found an increased risk of oesophageal cancer for ”Non-metallic mineral production” 2.3 (0.5–10.1) but this is based on only three cases. Mining was not mentioned in the article (Jansson, Plato et al. 2006)

There was a significant excess of colorectal cancer in workers categorised as Unexposed Non-Office jobs and for male Production workers compared to the general population. Rectal cancer was increased for female coal mine workers who had worked as Cleaners. When compared to other Production workers, members of Blast Crews had an increased risk of colorectal cancer.

No clear pattern emerged from these data although Construction and Production workers appear more at risk of digestive system cancers than other groups. An increased risk of stomach cancer was seen in the meta analysis (Alif, Sim et al. 2022)

A study from Scotland, which took into account smoking status, showed no increased risk of stomach cancer with increasing dust or quartz exposure.(Miller and MacCalman 2010) Brown et al did not find an increased risk of cancers of the digestive system in NSW coal miners. (Brown, Christie et al. 1997)

10.2.1.6 Lympho-Haematopoetic (LH) Cancers

There was a significant excess of lymphoid leukaemia for men who were Production workers, Labourers, Supervisors and Truck drivers when compared to the general population. Significantly reduced incidence rates for men were found for Hodgkin Disease in Maintenance

workers, myeloid leukaemia in Production workers, and Diffuse Non-Hodgkin Lymphoma in Operators, and NHL in Construction workers (see Table 5 for LH cancer classification).

Within the cohort, no particular patterns emerge with RIRs, but numbers are small. Compared to the rest of the cohort LH cancers were significantly reduced in construction workers. NHL was significantly increased for those in Occasionally Exposed jobs. When compared to other Maintenance workers, Diesel fitters had an increased risk of Hodgkin Disease and NHL. Women who had only worked in offices had an increased risk of NHL.

Brown et al did not find an increased risk of LH cancers in NSW coal miners despite concern about an NHL cluster in a specific coal mine. (Brown, Christie et al. 1997) Gilman et al (Gilman, Ames et al. 1985) identified an increased odds ratio for leukaemia associated with more than 25 years working as an underground miner (as a proxy for higher electromagnetic field exposure). No other studies were identified that examined this outcome.

Chronic lymphocytic leukaemias, the largest group of lymphoid leukaemias, are now grouped with NHLs. (Jaffe, Harris et al. 2001) About 98% of the Lymphoid Leukaemias in this study were Chronic Lymphocytic Leukaemias. Large case control studies of NHL in Canada (Mao, Hu et al. 2000) and USA (Schenk, Purdue et al. 2009) have not identified an association with work as a miner.

10.2.1.7 Prostate cancer

Prostate cancer incidence was increased among men, but mortality was not. One explanation might be that coal mine workers were more likely be screened for prostate cancer, identifying cases which were unlikely to be fatal and/or identifying cases for treatment at an earlier (curative) stage.

The increased SIR was significant among Production workers and specifically for underground Miners and Dragline operators. It was close to significant for Maintenance workers. There appears to be an increased risk with increasing years of employment as measured by time between first and last assessment and the trend was significant. These risks are age adjusted so this was not a reflection of increasing age over the groups.

Internal adjusted analyses showed an increased risk of prostate cancer among Production workers compared to the rest of the cohort. Prostate cancer risk was higher for OCE and Dragline operators than other Production workers but was elevated but not statistically significantly so after adjustment for age and smoking. This reduction in observed risk may reflect the age profile of the workers in these groups compared to other Production workers, i.e. after adjusting for age the risk ratio decreased.

The previous literature has reported both a reduced risk of prostate cancer incidence and mortality. Brown et al identified a significantly reduced risk of prostate cancer incidence in NSW coal miners. (Brown, Christie et al. 1997) The meta-analysis of three studies (Alif, Sim et al. 2022) showed a significantly decreased mortality from prostate cancer, as did a meta-analysis of mine workers who were not specifically coal miners. (Girschik, Glass et al. 2010).

10.2.1.8 Gallbladder cancer

This is a rare cancer usually occurring in older people (over 80). It is more common in women and in the current study, it was significantly increased in female coal mine workers although there were few cases. However, there was also a non-significant increase among all male coal mine workers which was significantly increased, men within the first 10 years of employment and for those employed for 5 years or less. The increase was also significant for male Maintenance workers. Numbers were too small for internal analyses.

There is little information on occupationally related gallbladder cancer. A recent systematic review identified possible associations of cholangiocarcinoma (the main type of gallbladder cancer) with the solvent 1,2-dichloropropane, asbestos, endocrine-disrupting compounds and rotating shift work.(Seeherunwong, Chaiear et al. 2022) Exposures that have been linked to increased risk include smoking, x-rays and alcohol. [19]

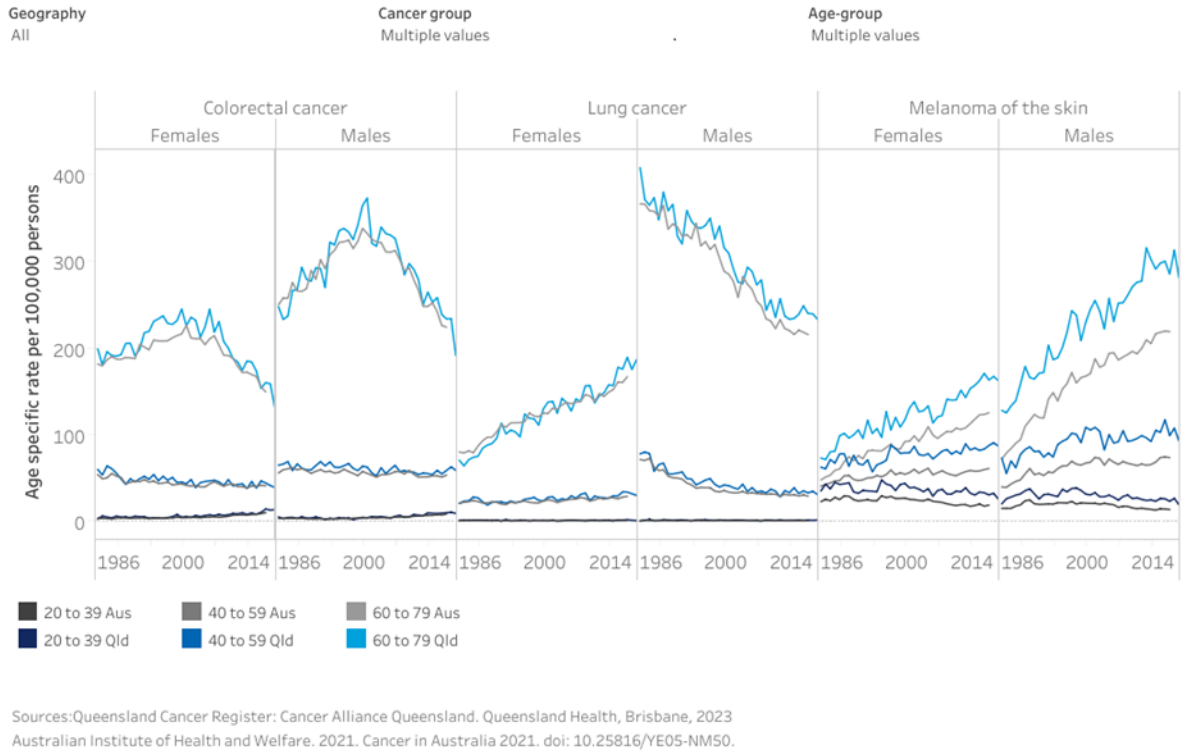
10.3 Cancer risk post 2016

Undertaking an additional linkage to the QCR was intended to provide more up to date (2017-2020) information on the cohort's cancer risk. The risks were compared to the national reference data as were the pre-2017 findings. However, it is important to note that the demographics of the cohort changed markedly before and after 2010 because many individuals were newly recruited into the sector in the period after 2010 (Figure 14). The cohort matched to the QCR Registry pre 2016 has a different demographic make than that matched between 2016 and 2020 with more young people, more women and fewer older men.

Importantly also, there have been changes in the rates of cancer diagnosed in Australia over time. Figure 37 shows lung cancer rates have been falling in Australia (and Queensland) for men aged 60-75 but rising for women in the same age group.

Consequently, the findings from the QCR linkage are not directly comparable to those from the main linkage.

[19] https://www.cancerresearchuk.org/about-cancer/gallbladder-cancer/risks-causes



Sources:Queensland Cancer Register: Cancer Alliance Queensland. Queensland Health, Brisbane, 2023
Australian Institute of Health and Welfare. 2021. Cancer in Australia 2021. doi: 10.25816/YE05-NM50.

Figure 37: Selected trends in Australia and Queensland cancer incidence by age and sex [20]

The overall cancer SIR is lower in the post 2016 matches and this could be that the Healthy Worker Effect is stronger among the more recently employed workers (ill people are not recruited to coalmining and only a short time has elapsed for some of them to have become ill). Among men, melanoma and pharyngeal cancer risks were increased but lip and prostate cancer were not increased. Among women, melanoma, lung and cervical cancer were increased. The national cervical cancer screening program starts at the age of 25 and for 2023 the AIHW project[21] that there will be 2.3 cervical cancer cases per 100,000 women aged 25-29. For women aged 40-44 the rate is 17.4 per 100,000 and for 50-54 women the rate is 8.7 per 100,000. This means that the number of cases can change greatly if the age distribution of the population changes.

[20] https://www.choreport.health.qld.gov.au/our-health/cancer/cancer-incidence
[21] https://www.aihw.gov.au/reports/cancer/cancer-data-in-australia/contents/summary-dashboard

10.4 Work Category and Job Group cancer and mortality findings

Job titles for those workers whose only assessments were before 1993 were unavailable so they could not be included in the analyses by Work Category or Job Group. Only those continuing to work would have a second assessment providing a job title. Individuals could have left employment before 1993 and hence have no job title; or they could be deceased or have emigrated. If they had died, this could introduce a survivor bias into the analyses by Work Category or Job Group.

Mortality by Job Group differed little by Site Type. The SMRs were significantly increased for Tyre Fitters, Ever Production (including specifically for General Drillers, Operators and Prestrip) and for Labourers whose Site Type was unknown.

Overall cancer incidence was higher for Production workers (underground miners, Dragline operators, OC operators and operators from unknown site type as well as labourers from open cut and underground Site Types). It was also increased for various categories of drillers (Blast crew (open cut), Blast Drillers (underground), Exploration drillers (OC and UG) and general drillers (site type unknown). For most categories of drillers the numbers were too small to identify the specific types of cancer that were increased.

The risks associated with some SEGs could not be evaluated as there were too few workers with that Job Title e.g. longwall movers.

Internal analyses between Job Groups within Work Categories showed differences in risk between Job Groups. For example, when compared to Maintenance workers as a whole, Shutdown Maintenance workers had an increased risk of mortality but Diesel fitters and Electricians showed a reduced adjusted mortality.

10.5 Adjustments to Internal Analyses

Groups of workers differed in their age profile and smoking rates. Male Scrapers, Auto electricians and Diesel fitters had the lowest median age at first examination. Male Administration[22] and Truck Drivers and male and female Blue Collar workers had the highest average age at first examination (Section 9.1).

The highest rates of never smoking were seen in Occasionally exposed workers such as Engineers (male 76%, female 88%); the highest rates of current smokers were seen among male Abrasive Sand and Blast (50%), Industrial Cleaner 45%, Scraper and Cleaner (nec) (44%). The highest female current smoking rates were seen in Mine services, (43%) Cleaner (nec (41%) (Section 9.3.1).

Age and smoking strongly predict the risk of death and cancer, and community rates of cancer have changed over time. In order to make a meaningful comparison between groups for the RMR and RIR, the internal analyses took into account any variations by age, smoking and era that may exist between compared groups.

Shutdown Maintenance workers had higher risk of death than other maintenance workers from lung cancer, circulatory disease, and COPD before adjustment for age and smoking. After adjustment none of these causes of death were significantly increased, although rates of lung cancer and COPD remained elevated. These causes of death are known to be associated with cigarette smoking. A similar reduction in lung cancer risk among Production workers was seen after adjustment for smoking. For Construction workers however, the significantly increased RMR for lung cancer changed little after adjustment.

[22] This maybe because they were only more recently included in the Health assessment scheme rather than reflecting the age at which they entered the industry,

10.6 Number of assessments cancer and mortality findings

An increased risk with increasing length of employment (or exposure) would suggest that the risk was employment related. In this cohort however, it was possible that workers may have had a pre-employment medical examination but not subsequently been employed. In addition, those who had only one medical would have worked for 5 or fewer years. Short-term workers are known to have a higher mortality than longer term workers and this is thought to relate to a less healthy lifestyle e.g. more smoking and perhaps a poorer diet.(Kolstad and Olsen 1999)

Number of assessments is a proxy for length of employment. We anticipated analysing mortality for those with more than one assessment. However only 33% (53,762 of 164,622) men and 17% (4,207 of 24,389) women had 2 or more assessments at least 5 years apart. Further 81% of men and 93% of women had their first assessment in or after 2003. Removing individuals who had only one health assessment reduced the power of the study and the results were similar to the mortality by Job Group for all workers.

Most of the major categories of cause of death were significantly reduced compared with the general population, no matter how long the individuals worked for. There was a statistically significant trend of decreasing risk of accidental death and suicides with increasing years of employment.

A small proportion of maintenance workers had experienced a long duration of employment, only 5,833 of 61,309 (10%) had worked for more than 15 years. Deaths from accidents and suicides both show a monotonic decrease with increasing length of employment (as measured by time between first and last assessment. Mesotheliomas were higher than expected for workers in all employment periods.

In the Construction Work Category, deaths from lung cancer showed an increase with years of employment. Deaths among Truck Drivers (nec) from respiratory disease increases monotonically across the years of employment groups but the numbers are small and the increases are not statistically significant.

10.7 Cancer and mortality findings by age group

Male coal mine workers aged under 65 and those over 65 had similar patterns of mortality, with many causes of death significantly reduced. The mortality of the older group was somewhat closer to that of the Australian population for some causes of death but lung cancer and mesothelioma deaths were higher than expected. In industrial cohorts, the initially low mortality becomes closer to that of the general population over time. (Gordon and Finch 2007)

The proportion of workers in the older age group was small which limited the precision of the risk estimates.

In terms of cancer incidence, the risks were higher for younger than older men for lip cancer and melanoma, both sun-related cancers. Risks are higher for older than younger men for lung cancer, mesothelioma and lymphoid leukaemia.

There were too few older women to be informative about mortality or cancer incidence by age.

10.8 Latent period

It is generally considered that there is a latent period between first exposure and diagnosis of disease. The latent period can be relatively short e.g. perhaps 10 years for leukaemia, (Finkelstein 2000) around 10-15 years for many solid tumours (Guidotti 2007) but can be 30-40 years for mesotheliomas.(Tossavainen 1997) There is a latent period of about 20 years for the development of CWP (Attfield and Castellan 1992).

For half the cohort whose first assessment was in or after 2010, exposure only started recently. It is probably too early for potential work-related cancers to have been diagnosed and this emphasises the need to continue to monitor the cancers occurring in this cohort into the future.

Most major causes of death were significantly reduced for all time periods since first assessment. Deaths from all cancers, however, were similar to population rates for those with more than 10 years since their first assessment. Monotonic increases with years since first employed were seen for respiratory and digestive diseases but these were not statistically significant increases.

10.9 Exposure data

10.9.1 Exposure metrics

It was hoped to group the coal mine workers by exposure to investigate the risks of mortality and cancer incidence associated with exposure to measured airborne contaminants or changes in technology which might be associated with changes in exposure.

Measured exposure data for RD, RCS and DPM were provided by RSHQ for the period 1999 to 2022. Reporting data to RSHQ only became mandatory for RCD and RCS in 2017. Prior to this data was provided voluntarily following request by RSHQ Coal Hygiene team. Reporting of DPM is still voluntary but has 100% participation from all underground coal mines. (RSHQ personal communication)

The data from all sites were amalgamated which assumes that exposure did not differ by mine site. For many SEGs and years there were too few data to analyse attribute to workers from the different companies/mine sites. Further, the mine name was recorded as Unknown or Various Mines for around 55% of the health assessments.

The data amalgamation should have reduced any variation that may have occurred between different consulting companies who performed the monitoring.

It was not possible in this study to group individuals by when longwalls or bidirectional cutting were introduced, so analysis of the effect of these on risk was not possible. Information on direction of cut and airflow could not be factored in to this study.

10.9.2 Differences in risk with era of exposure

It was not possible to construct exposure profiles on an individual basis for workers in the study because Job Titles from the health assessments were not available before 1993 and the job titles on health assessments do not always align with the SEGs recorded for personal monitoring and employment dates for individuals were not available. There were insufficient data to calculate yearly exposure by mine and extrapolation of data from 2000-2022 to the 1980s would be too speculative. Where exposure had not changed significantly, analyses would not be informative beyond the use of Job Groups. Instead, sensitivity analyses were carried out for excluding workers who commenced after the earlier, possibly higher exposure period. It was not justifiable to identify separate cut points for the three different exposure measures so the same cut point of 2010 was used. There was a large influx of both male and female workers after 2010 (Figure 12 and Figure 13).

There were no changes in mortality or cancer incidence for Maintenance workers when this time cut point was used. Production workers overall had a somewhat lower accident rate, but no changes to disease mortality. However, when Production workers whose first assessment was after 2010 were excluded, adjusted risks for lip cancer, lung cancer, and melanoma became statistically significantly increased although there was only a small absolute change in risk. It is possible that these higher rates result from higher dust and/or ultraviolet light exposure among Production workers in earlier years but the evidence is not strong. UG production workers are unlikely to be exposed to significant UV at work and many OC production workers are in enclosed cabs. (RSHQ personal communication) The reduction could also result from a general improvement in sun safety behaviour see Section 10.2.1.2.

Because of the 20 year latent period (Attfield and Castellan 1992), cases of CWP identified circa 2015 would likely have been exposed before 2000, the period before exposure data are available. In a study of British coal miners who worked for 40 years, the risk of progressive massive fibrosis was estimated to be 0.8% after exposure to 1.5 mg/m^3 RD, rising to about 5% at 6 mg/m^3 and Category 2 CWP, 1.5 % at 1.5 mg/m^3 and 9 % at 6 mg/m^3. Over a 15 year period, the risk for Category 2 silicosis was estimated to be 1% at 0.02 mg/m^3, 2.5% at 0.1 mg/m^3, and 30% at 0.3 mg/m^3. (Soutar, Hurley et al. 2004) These data show the significant changes in exposures over the past century, where risk of silicosis related to extent of exposure in the coal mine industry.

Cliff et al (2020) summarised data from three studies showing that for bituminous coal ranks, estimated CWP rates varied between 28 and 116 cases per 1,000 workers exposed to 1 mg/m^3 for 40 years. The risk was between 65 and 282 per 1,000 with exposure to 2 mg/m^3. (Cliff, LaBranche et al. 2020)

Both of these predictions are based on working for 40 years and few of the workers in this cohort fulfil that criterion. Further, the cases would need to be identified by CXR or CT scans. Deaths from NMRD do not capture CWP prevalence as many cases may be unrecognised and undiagnosed, particularly those cases which develop after retirement and in smokers (Monash University and University of Illinois at Chicago 2016)

10.9.3 Makeup of coal mine dust

As discussed by Cliff, the majority of "coal dust" is not actually coal. There may be a large portion of alumina silicates and some silica present. (Cliff, LaBranche et al. 2020) Queensland coal however is generally upper rank metallurgical coal (RSHQ personal communication).

Queensland underground coal mines are thought to contain less than 5% silica, lower than many mines in the USA, and this is thought to have reduced the likelihood of CWP (Joy 2012). In addition, the coal rank of the majority of coal mines was bituminous rather than anthracitic. Exposure to anthracitic, rather than bituminous, coal dust is thought to be associated with increased risk of pneumoconiosis (Attfield and Castellan 1992, Gamble JF, Reger RB et al. 2012). The risk of CWP might therefore be expected to be lower in Queensland coal mines than in those in the USA.

Other authors consider that coal rank and silica content is less important than the bioavailable iron in the coal dust (Huang, Li et al. 2005). No data were available on this risk factor.

10.9.4 Exposure to RD in Queensland and elsewhere

For many Job Groups/Work Categories there was little change in exposure to RD between 1999 and 2022 as can be seen in the trend lines in the RSHQ data in Section 9.1 and Appendix 6 Graphs of RSHQ Exposure Data. See for example the graphs for Production at open cut mines including Dragline and OCE, CHPP work, Administration and Control room workers. Exposure was likely higher for underground workers and Exploration Drillers, particularly before 2010.

Mean yearly average exposures to RD before 2013 were probably higher than the current WES (1.5 mg/m^3) in underground mining but below the WES applicable at that time (3 mg/m^3). It is difficult to predict exposure before 1999 but it could have been higher than that.

These data are similar to that reported in the literature for other Australian mines. Average exposure data for four underground mining jobs from New South Wales between 1985 -1999 ranged from 1.67 to 2.12 mg/m^3 and in two data sets from Queensland ranged from 1.94 to 2.53 mg/m^3 between 1995-2000 and from 1.83 to 2.86 mg/m^3 between 1999-2001 (Joy 2012).

Other investigators report that between 2012 and 2014 in Queensland, the estimated mean respirable dust concentration for workers in longwall production was below 3 mg/m^3, but periodically this level peaked above 6 mg/m^3. They suggest that exceedances of the OELs occurred particularly during 2014, and that this is consistent with progressive mechanization and the dust control equipment and processes implemented varied from mine to mine. (Perret, Plush et al. 2017) The exceedances may also correlate with the increased use of methane drainage underground (which removes moisture from the coal making it dustier) and to lesser extent the introduction of top coal caving technology at two mines (RSHQ personal communication). This increase in 2014 is suggested in the RSHQ data in Figure 22 for underground miners.

Cliff et al (2020) reported RD data from Queensland supplied by RSHQ for two periods 1992-1994 and 1996-2001 (Table 23 and Table 24) (Cliff, LaBranche et al. 2020). The exposures vary by mine and by year. The higher levels found in Mine B in 1994 were thought to be due to the thinning coal seam. Exposures are similar but possibly lower after 1994 but between mine differences appear somewhat larger.

Table 23: Average personal respirable dust exposure after (Cliff, LaBranche et al. 2020)

Mine	Average RD Exposure (mg/m^3)		
	1992	1993	1994
A	2.6	-	2.4
B	1.05	-	3.5
C	1.8	1.5	1.3
D	-	1.6	2.2
AM	1.8	1.5	2.4

Table 24: Average 8 hour TWA personal respirable dust exposure for Queensland longwall mines 1996 - 2001 after (Cliff, LaBranche et al. 2020)

Mine	RD (mg/m^3)	Number of Samples
1	1.66	25
2	1.81	51
3	1.81	92
4	1.83	73
5	2.44	50
6	1.84	58
7	1.83	69
8	2.98	219
9	1.64	58
10	3.24	80
11	1.59	38
QLD Average	2.06	813
NSW Average	1.51	11829

A study from South Africa, of dust measurements in a Bord and Pillar mine suggested that average RD exposure was between 1.7 and 5.9 mg/m^3 depending on the direction of the cut and the airflow (Grové, Van Dyk et al. 2014). These exposures are rather higher than the exposure data from Queensland coal mines, although covering a similar period.

Data from underground coal mines in USA included 681,497 respirable dust samples collected by inspectors from the Mine Safety and Health Administration (MSHA) between 1982 and 2017. The overall geometric mean concentration for RD was 0.55 mg/m^3 and 5.5% of the samples exceeded 2.0 mg/m^3. There was a decline over time in the percent of respirable dust

samples exceeding 2.0 mg/m^3.(Doney, Blackley et al. 2020) (These data are not strictly comparable with the Australian data as they are geometric rather than arithmetic means and the geometric mean is likely to be lower if the data have the typical lognormal distribution.)

Data from Colombian underground bituminous coal mines in 2014 had average concentrations of RD of just over 3 mg/m^3 (Rey, Pinilla et al. 2015), The South African, US and Colombian exposures appear to be higher than those from Queensland. For the period, 1999 – 2022, the mean yearly average for underground miners and operators from RSHQ data was 1.6 mg/m^3. Trend lines for the graphed data suggest that exposure would have been somewhat higher before 2000.

10.9.5 Exposure to RCS in Queensland and elsewhere

Mean yearly average exposures were below the current WESs of 0.5 mg/m^3 for RCS for most SEGs in the RSHQ data. Underground Production jobs had higher mean exposures but some of these were influenced by a small number of higher values. There is always variability in occupational hygiene exposure data, depending on for example the work rate, ventilation, number of workers, their distance from the source etc. This may explain the typical log normal distribution of measurements

The data provided by RSHQ suggests that exposure to RCS in underground mining before 2004 was probably below the WES applicable at that time (0.1 mg/m^3) but higher than the current WES (0.05 mg/m^3). According to the RSHQ data, RCS exposure has fallen over the last 20 years for OC, UG and (probably) CHPP maintenance workers. A larger fall in RCS was seen for Exploration Drillers and UG production workers.

Australian data suggest that there was variation in exposure between jobs with continuous miners, longwall workers and roof bolters having higher RCS exposures. (Cliff, LaBranche et al. 2020) This was seen in this study too. Open cut workers having lower exposure than underground workers.

NSW data for RCS exposure in open cut mining suggest that exposure was over 0.11 mg/m^3 in 2006 mg/m^3 and fell to <0.04 mg/m^3 by 2009. The majority of jobs between 2002-2016 averaged <0.05 mg/m^3 RCS. General open cut workers, On shot and Transport drivers had the highest average exposures of over 0.25 mg/m^3.(Cliff, LaBranche et al. 2020)

South African data from Bord and Pillar mines suggested that average RCS exposure was between 0.005 and 0.55 mg/m^3 depending on the direction of the cut and the airflow. (Grové, Van Dyk et al. 2014)

The USA MHSA data calculated that the overall respirable quartz geometric mean concentration for 210,944 samples between 1982 and 2017 was 0.038 mg/m^3.(Doney, Blackley et al. 2020) MSHA data for West Virginia mines suggest that exposure was over 0.1 mg/m^3 until 1993 when it plateaued to around 0.06 mg/m^3 until 2006 when it fell gradually to about 0.02 mg/m^3 by 2016.

The data provided by RSHQ, suggests that RCS exposure in Queensland mines is similar to that from most jobs in open cut mines in NSW, and the more recent data from MSHA for the USA and at the lower end of the data from South African bord and pillar mines.

10.9.6 Exposure to DPM in Queensland and elsewhere

There was a smaller data set for DPM than for RCD or RCS, most of the data related to underground workers. The exposure for fewer Job Groups could be examined (see Table 11). The exposure appears to have fallen on average over the period and for most Job Groups to have usually been below the Queensland recommended eight hour exposure limit over the period of the measurements.

Air monitoring surveys were conducted between 1998 and 2001 at seven USA non-coal, non-metal mining facilities to assess exposure to REC from diesel engine exhaust. The average REC exposure levels for underground jobs ranged from 31 to 58 µg/m^3 [0.031 - 0.058 mg/m^3] at the facility with the lowest average exposure levels and from 313 to 488 µg/m^3 [0.313 – 0.488 mg/m^3] at the facility with the highest average exposure levels. The average REC exposure levels for surface workers ranged from 2 to 6 µg/m^3 [0.002 – 0.006 mg/m^3] across the seven facilities.(Coble, Stewart et al. 2010)

EC measurements, reported in the mid 1990s, were collected at a USA potash mine. Underground production jobs ranged from 162 - 345 µg/m^3 [0.162 – 0.345 mg/m^3] and surface jobs 12 – 31 µg/m^3 [0.012 – 0.031 mg/m^3]. (Stanevich RS, Hintz P et al. 1997)

The USA measurements were collected in non-coal mines. It is possible that samples collected in coal mines include fine coal dust and would (if anything) overestimate the extent of DPM exposure. The use of cyclone samples should mitigate this risk. However, the Queensland data are generally lower than the USA data. The USA data was collected some years before the Queensland data and changes have taken place to diesel engines over this period that are thought to have reduced emissions.

10.10 Statistical significance

As noted in Section 8.7.3, the formal test for statistical significance in this report was that the 95% confidence intervals do not include one. This implies that there was less than a one in 20 probability that the finding is due to chance i.e. was due to random variation. However when more than 20 risk estimates are made, it becomes more likely that one or more of these may be a chance finding. (Savitz and Olshan 1995)

The number of calculated risk estimates was large in this study. For example, for external analyses, there were ten major categories of cause of death, and an overall risk estimate, for both male and female group. There were 14 major cancer categories including an overall cancer risk estimate, for each of the six groups.

Where there are small numbers of deaths or cancers, the confidence intervals can be large. One event more or less can have a big effect on the point estimate. Confidence intervals help to show the certainty around a point estimate.

The 95% CI is a useful rule of thumb but increased or decreased risk estimates which do not reach statistical significance are also informative. (Valentin Amrhein, Sander Greenland et al. 2019)

It is important, therefore, to look at the overall patterns of results, rather than focus on single isolated findings when interpreting the study results. For example, there was an increased risk of Hodgkin Disease among Diesel fitters compared to other Maintenance workers, but would appear to be an isolated finding. On the other hand, the increased risk of gallbladder cancer in female coal mine workers was unexpected and an increase in this rare cancer was also seen in male maintenance workers. This makes it somewhat more likely that there could be an occupationally related cause that could warrant further investigation.

10.11 Strengths of the study

10.11.1 Completeness of the cohort

The cohort was compiled from health assessments provided to RSHQ from health providers and from the Rathus and Abrahams survey. After 1982, all coal mine workers needed a pre-employment medical and after 1993, a medical every five years. This should therefore be a near complete record of all Queensland coal mine workers employed after 1982. However, it is possible that not all coal mine workers had health assessments and that RSHQ and its predecessors did not receive every completed health assessment since that time. Those whose first examination was after 2019 (n=2,557) were excluded but they would add little to the person-years at risk because they would be alive and most likely healthy in 2020. Coal mine workers from underground, open cut and CHPP sites were included, although the type of site at which they worked predominantly could not always be determined.

There were 24,389 women in the cohort with 253,567 person-years of follow-up. This is much larger than any other coal mine worker cohort where few if any women have been included. Unfortunately, however, few of these women had worked for more than 5 years in the industry.

The presence of assessments for many visitors and consultants suggest that the records are comprehensive, and include individuals who do not usually work at a mine site. This suggests that those who work there on a more permanent basis are unlikely to have been missed.

There were only 300 people with health assessments with missing information who could not be included in the cohort. These were mainly from after 2016 and as these were recent, they are unlikely to have significantly affected the findings.

10.11.2 Smoking data

The availability of smoking data for the majority of cohort members is a major asset in this study. Smoking data were captured in all assessment types, and are available from at least one assessment for over 99% of participants in the cohort. These data were used to adjust the relative mortality and cancer analyses so that the potential confounding effect was reduced.

However, measurement error cannot be ruled out, for example, a good intention on the morning of the examination might record the individual as ex-smoker but they subsequently continue to smoke. The presence of several assessments for some workers should limit this potential problem.

10.11.3 Choice of population reference data

The choice of the comparison population is important in accurately assessing the risk of cancer and mortality. ABS data show that between 1983 and 2002, the overall male death rates in Queensland for those aged 15 to 85 + are similar to those of the general Australian population.

The risks of major causes of death were somewhat lower when compared to Queensland reference date than when compared to Australian data for both men and women. The biggest changes were seen for external causes accidents and suicides.

Queensland is a large state and jobs may require more driving to get from place to place. This may result in higher risk of death from motor vehicle accidents when driving as part of employment, e.g. Truck Driver; the accidents may not be during work time however, they may occur when commuting to or from work or during leisure time. ABS data show that between 1983 and 2002, the male accidental death rates in Queensland for those aged 15 to 85 + are on average 10% higher than the general Australian population. Similar data show that the suicide rate is higher in Queensland than in the rest of the Australian general population.[23] Hence accidental deaths and suicides were also compared to the expected numbers from age standardised Queensland data.

The cancer incidence of the cohort and its subgroups were compared to the Australian population after standardising for age. However, some cancer rates vary by state, notably melanoma (MacKie, Hauschild et al. 2009, Baade, Meng et al. 2012) and in that case, Queensland rates were used as a more appropriate comparison than Australian national rates.

10.11.4 Identification of deaths and cancer cases

The death and cancer registrations held by the AIHW are a reliable source of information (Kelman 2000) on occurrence and cause of death and cancer incidence for the whole of Australia. Cancer and death registration is mandatory in all Australian States and Territories, and registration, including for cancer, is virtually complete (Burton 2002). Approximately 10% of cancers were diagnosed in states other than Queensland.

Non-melanotic skin cancers (NMSCs) are not reportable, so data on basal and squamous cell skin cancers (ICD-10 C44) are not collected routinely. However, the ACD does contain all cases of rare NMSCs which have been registered since 1982 but the collection is not considered complete until 2001 onwards. These cancers were identified in the cohort and

[23] https://www.aihw.gov.au/suicide-self-harm-monitoring/data/deaths-by-suicide-in-australia/suicide-deaths-by-state-territories

comparison data are available in the general population data so these have been included in the All Cancer analyses presented here.

Matching the cohort names to those in the NDI and ACD was a probabilistic process. The availability of middle names and dates of last known employment from RSHQ records improve the probability of a correct match of the Australian cohort members to the mortality and cancer data held in the NDI and ACD.

Some deaths and cancer cases may be missed e.g. where names were spelled incorrectly or dates of birth were wrong, either in the data supplied by the agencies or in the cancer and death registries, or both. The linkage process included similarly spelled names and common shortenings, so few cases should be missed because of this. However, it was also possible that matches have been made with people who were not in the cohort but who had similar names and dates of birth i.e. there may be deaths/cancer cases in the analyses that should not have been included. We carried out a thorough clerical review of the possible death matches and are confident that good quality matches were included. The clerical review of possible matches for cancer cases was done by the AIHW, using well-established protocols, so again, this factor was likely to have only a small impact on the validity of the findings.

It is possible that individuals changed their name after completing the assessment and could not be linked to the new name. Only a small proportion of the cohort were women and their previous name was captured for some. Other women may not have changed their surname. The linkage uses the given names and date of birth so that such changes were checked and individuals may have been identified.

Previous validation studies of the NDI have found good sensitivity and specificity of the matching process, with sensitivity (chance of finding a true match) between 88% (Kelman 2000) and 95% (Powers J 2000) and specificity (chance of rejecting a false match) of about 98%. (Kelman 2000, Powers J 2000) This cohort did not have postcodes available, which may have decreased the sensitivity and specificity.

Some workers from the 1982 Rathus and Abrahams Survey were not matched because they had not had a subsequent examination/assessment (n = 3,213). They may have worked after this date but left before 1994 when periodic assessments were required.

Cancers diagnosed overseas and not treated in Australia would not be reported to the ACD and so were not included. In addition, approximately 5,000 workers were not included in the cohort as they could not be matched on the AIHW NLM. They were likely temporary migrants or overseas workers and so were not eligible for, or may have chosen not to enrol in Medicare. Their health status could not be determined. This should not introduce a bias but there would be a small loss of power.

10.11.5 Possible ascertainment bias

Ascertainment bias is where individuals have left the industry, perhaps because they had died or contracted cancer and so were not included in future health assessments. This would result in an underestimate of the true mortality and cancer incidence in the cohort and would contribute to a healthy worker survivor effect. RSHQ is thought to have near complete capture of all coal mine workers newly employed in Queensland since 1982, so there should be little or no ascertainment bias.

10.11.6 Healthy Worker Effect

When the mortality of occupational cohorts is compared with that of the general population, the mortality rate in the occupational cohort is typically lower. This is the well-established Healthy Worker Effect.(Fox and Collier 1976, McMichael 1976, Choi 2000) This effect has been shown in other cohorts in respect of mortality. (Musk, Monson et al. 1978, Aronson, Tomlinson et al. 1994, Tornling, Gustavsson et al. 1994, Ma, Fleming et al. 2005, Wagner, Berger et al. 2006)

One cause of the Healthy Worker Effect is the relative social and economic advantage of employed people (Ross and Mirowsky 1995). Another factor is that people with life-threatening conditions, such as cancer and other chronic illnesses which increase the risk of death, are less likely to enter the workforce after diagnosis, further lowering the mortality rate in the workforce compared with the Australian population. For physically active jobs such as that of coal mine workers, individuals with metabolic disorders such as diabetes, or with asthma would be less likely to be recruited and the SMRs for these diseases are particularly low.

The Healthy Hire Effect may be compounded by the Healthy Survivor Effect whereby those who become ill leave the workforce. (Fox and Collier 1976) Those coal mine workers who become ill, e.g. with dementia or diabetes may leave the workforce early as they can no longer carry out physically and/or mentally demanding jobs. It is very possible when workers are on short term contracts such as with labour hire contactors they would not be rehired if they become ill. However, there is capture of all new entrants since 1983, so even if individuals had developed an illness and left the industry, they should still have been included in the cohort.

There was, however, little difference between the SMRs in Table 12 (all cohort members N=164,622 men and 24,389 women) and those in Table 13 where the first assessment was

in or after 1993 (N=162,887 men and 24,132 women) and Table 14 which excluded workers whose first assessment was in or after 2010 (N=87,268 men and 9,716 women). If there was a large Healthy Worker Effect it might be expected that standardised death rates in Table 13 (most recent workers) would be lower those in Table 14 which excluded recently recruited workers. It appears that the low death rates are not solely attributable to the Healthy Worker Effect, however the short follow-up for many workers means that this cannot be ruled out.

In the analyses by age group, most SMRs for the younger group of coal mine workers were low compared to the Australian population. For the older group, many SMRs increase somewhat with deaths from all cancers, respiratory disease, urinary diseases becoming indistinguishable from those of the Australian population. This indicates some attenuation of the Healthy Worker Effect with age which would be as expected.

Internal analyses comparing the mortality and cancer incidence between groups of coal mine workers are a way to limit the impact of the Healthy Worker Effect. That is comparing the risks of those who have worked for less time or have had fewer exposures with those who have worked for a longer time or who were known to have experienced more exposures. In these analyses, the groups being compared would have been selected for employment/service in the same way as the reference group and therefore the Healthy Worker Effect should have been minimised.

10.12 Limitations

10.12.1 Cancer data only until 2016

Death data were nationally complete from 1980 until the end of 2020 but the cancer incidence data were only complete to the end of 2016. This limitation should not be a bias in the study. A separate analysis was carried out for cancers identified in Queensland between 2017 and 2020. The number of cancers observed were adjusted to take account of the fact that a proportion of the cohort (likely about 11%) were not based in Queensland so would not contribute cancers to the QCR. As a result of the large recent recruitment to the cohorts and changes to cancer rates over time the findings of the two analyses should not be compared.

10.12.2 Statistical power of the study

The power of this study to determine risk associated with cancer or specific causes of death was limited by the small numbers for the less common causes of death and cancers.

The cohort is relatively young, with an average age of less than 60 at the end of follow-up, so relatively few cancers and deaths have occurred. The average age at the start of the cohort was similar for men and women, around 30. The average age for those who had died was about 53 for women and 57 for men. The average age for coal mine workers with cancer was 47 for women and 56 for men.

Many workers entered the cohort recently so there has been a short follow-up period. 81% of men and 93% of women had their first assessment in or after 2003. 91% of first assessments took place between 2000 and 2019 and 50% of first assessments were between 2010 and 2019.

These limitations mean that it was only possible to identify relatively large statistically significant increases or decreases in specific cancers or causes of death. The study was sufficiently powered to have identified significantly increased or decreased risks of most major cancer and death categories for male coal mine workers but not for female coal mine workers.

10.12.3 Start and end dates of employment were estimated

The start and end dates of employment as a coal mine worker in Queensland were not available but were approximated from the dates of their first and last assessments. Health examinations could give rise to different health assessment reports and these could have different dates to that of the health examination. Employment as another type of miner would not be captured nor would employment as a coal miner in other states or overseas. A previous study showed that almost 22% of Queensland coal mine workers with CMDLD had also worked in other mine types, and more than half had worked in mines outside Queensland. (Baade, Lu et al. 2021) Breaks in employment as a Queensland coal mine worker were not captured.

10.12.4 Lack of Job Titles data prior to 1993

Additionally, lack of Job Titles data prior to 1993 limited the ability to assess job-specific effects using data from this time period. This limitation may have resulted in an underestimate of SMRs and SIRs when analyses were conducted by Work Category or Job Group, as older workers (i.e. those without assessments post 1992) or outcomes occurring prior to 1993 may have been excluded.

There will also have been a reduction in statistical power as individuals could not be included in the Work Category and Job Group analyses.

10.12.5 Complexities of the dataset

10.12.5.1 Data entry

In the early years, health assessments were entered from handwritten forms. There were several versions of the forms that changed over time and several types of form, the data from which needed to be consolidated.

The names, job titles, employers and mine sites were entered from free text so that some fields were difficult to interpret, for example where the job title was entered as a date. There were also variations in spelling. Male sex was the default and names were checked for likely sex. Some individuals allocated as male were changed to female (n=1310) and female to male (n=40). Some individuals were duplicated, and these records were merged. Details about the full data cleaning procedures are provided in Appendix 2.

10.12.5.2 Accuracy of job title grouping

Job title was only collected after 1993. The data were entered as free text, and there were 49,490 unique job titles which were grouped into Job Groups and Work Categories by using computerised search strings and then manually checking where possible (see Appendix 3). The proposed Job Groups were discussed with RSHQ and the Advisory Group. There may, however, be some residual misclassification.

However only 1,735 of 164,622 male workers and 257 out of the 24,389 women were excluded from job specific analyses because their job titles were unknown. In many analyses, Production and Maintenance workers were analysed on the basis of ever having worked in that group. If an individual's Job Group was known for any assessment, they were included in the analyses.

Where possible, mine site visitors were excluded e.g. consultants, vending machine workers, students. The presence of assessments for many visitors and consultants suggest that the records include individuals who did not usually work at the mine site. This may result in misclassification, particularly for administration and technical occupational groups.

10.12.5.3 Accuracy of type of mine

The mine name was recorded as Unknown or Various MINES for around 55% of the health assessments. The Mine Site Type variable was missing for 139,230 (73.7%) of participants, and 210,317 (53.1%) of assessments. Other fields were interrogated to identify whether individuals worked at underground, open cut or CHPP sites. For the analyses, however Administration workers were grouped without consideration of site and some Job Groups were automatically allocated to a site type e.g. ERZ to underground and Dragline operators to open cut.

10.12.5.4 Accuracy of smoking data

While the majority of workers had smoking data recorded in at least one assessment, there were some implausible or unreliable values e.g. the variable with 'age started smoking' had values ranging from 0 years to 2,014. Other examples include 196 workers who had an 'age started smoking' greater than their supposed age at the time of that assessment.

The combination of these inaccuracies and unknown job start dates hindered calculation of exact smoking patterns (for example if a worker started smoking, then stopped, and then resumed smoking). The current analyses assume that if the variable with 'age stopped smoking' is not missing, then that worker is deemed to have stopped smoking at some point in the past, even though the exact date is unknown.

However, the researchers are confident about the current smoker and never smoking classifications, and that differential misclassification is unlikely as misclassification would be uniform across work groups with minimum effect on the findings.

10.12.6 Diagnostic Bias

There could have been diagnostic bias in terms of respiratory diseases because of increased health screening for coal mine workers, however few fatal non malignant respiratory deaths were identified in the cohort.

In recent years prostate cancer has been diagnosed more often because of the availability of screening tests. Prostate cancer incidence was increased, but mortality was not increased. This difference could have resulted from a diagnostic bias, coal mine workers could have been more likely than the general population to be screened, and hence more cases were identified, but at an earlier stage at which effective treatment could be provided, reducing the attributable mortality. An alternative explanation of the increased survival is that these men had better general health and/or better access to treatment than the general population.

Melanoma is another cancer for which screening and treatment is available. When compared to national rates melanoma incidence was significantly increased among men and women. However, deaths from melanoma were not significantly increased.

10.12.7 Possible confounding factors

There were potential confounding factors that could affect the observed risk estimates for some cancers and deaths, and which could not be measured or accounted for in this study design. The study could not take into account individual genetic, or lifestyle factors such as ethnicity, alcohol consumption, diet, or non-occupational job exposures experienced, for example, in previous jobs. Smoking data could not be used in the external comparisons.

Ethnic origin was not identified in the health records and, in particular, Aboriginal and Torres Strait Islander status was not recorded and therefore could not be investigated. Genetic factors play a part in the risk of some diseases. For example prostate cancer is more common among African Americans than Caucasian Americans (Farrell, Petrovics et al.) and those with paler skin who do not tan easily (Armstrong, Kricker et al.) are more susceptible to melanoma. For melanoma, solar UV exposure during leisure and at work is an important risk factor, but no information was available on this or on the extent of use of sun protection measures on an individual basis for the cohort members.

10.1 Further research

Now that the cohort has been assembled and a database constructed for linkage to the NDI and the ACD, future linkages can be undertaken in a very cost-effective manner. There have been relatively few deaths and cancers so far, because the cohort is relatively young, with a high proportion of current employees and the length of follow up is short for majority of the workers. Latent periods (i.e. time that lapses between initial exposure and disease diagnosis) for many cancers are long, for example over 30 years for mesothelioma (Tossavainen 1997). As the cohort ages, more cancers and deaths will accumulate and this will increase precision of the risk estimates. Future linkages are therefore likely to give more robust estimates of cancer and mortality risk particularly for women. In addition, more Job Groups will have accumulated sufficient person-years to make analyses feasible.

The NDI linkage was carried out to 30/11/2020 to identify causes of death. The national cancer linkage was only completed to 31/12/2016. Following the cohort for five years into the future, and rematching to the NDI and ACD would result in an increased number of deaths and cancers, which would increase the power to detect further increases in risk, in particular for rarer cancer types and smaller Job Groups.

An extra five years for mortality and seven or more years for cancer incidence (AIHW has already updated the ACD data to 2020) will provide approximately an extra 789,510 and 1,088,537 person-years respectively, which equate to an expected 3,497 deaths and 6,650 cancers among men, assuming the cohort mortality and cancer incidence is similar to the general population. This would almost double the 4,957 deaths and 5,940 cancers currently identified for men in the cohort.

These numbers will provide over 90% study power for SMRs or SIRs of 110 and above. However, for specific cancers with smaller incidence rates such as that for lung cancer, the extra years will provide approximately 85% study power (with estimated 945 lung cancers expected over the 5 years) as opposed to 50% study power for the current sample size. The

additional years will also increase the expected number of deaths and cancer for the smaller groups of workers such as Exploration Drillers and Underground miners.

DEE and RCS are carcinogenic but the extent of exposure giving rise to an increased risk of lung cancer is not well established, especially among coal mine workers. Understanding the extent of exposure to RD, RCS and DPM prior to 2000, could provide insights into the exposure-disease relationships and any trends in risk. This cohort would be better placed to investigate this relationship than many other cohorts because it has individualised smoking data. If these earlier exposure data are not available then following the cohort for five more years would increase the proportion of workers whose working period is covered by the exposure data.

An investigation of the incidence of gallbladder cancers, examining the exposures of cases and randomly selected controls from the cohort might be of interest although numbers are small, 30 in men and less than 6 in women.

The investigation of other important health outcomes, such as reduced lung function or mental health outcomes, would need a different research methodology. Suicide is a very serious problem, but can only partially measure extent of mental health conditions such as anxiety and depression.(Fitzpatrick, Handley et al. 2021) Linkage of the cohort with other public health data sets, could provide some insight into mental and other health conditions which cause morbidity, but not death.

A mental health and suicide prevention program, MATES in Mining[24] was piloted in Australia about five years ago. It will be important to explore the uptake of this program and its long-term effects on suicide rates among coal mine workers. (Tynan, James et al. 2018)

The internal analyses indicated significantly higher mortality and cancer incidence for Production workers, Construction workers, Labourers, Cleaners and Truck Drivers. The exposures for these groups may require further investigations to ensure that the higher morbidity is mitigated.

In summary, given the retrospective nature of the current study, future research that includes work history and exposure data covering a greater proportion of the work period would be of interest. This may involve study designs such as case-control design for cancer incidence and or prospective cohort studies for both mortality and cancer incidence. Examples of similar studies conducted by the Monash team are the Healthwise[25]. Health Surveillance Study of aluminium industry workers and the Health Watch[26]. Study of petroleum industry workers.

[24] https://mates.org.au/mining/
[25] https://www.monash.edu/medicine/sphpm/coeh/research/healthwise
[26] https://www.monash.edu/medicine/sphpm/coeh/research/healthwatch

11. Conclusions

11.1 Completion of Study Aims

1. Cancer incidence and/or mortality by major disease subgroups were not elevated in men and/or women who were employed as coal mine workers in Queensland:

When compared to the general Australian population, the overall mortality and cancer mortality of the cohort was significantly reduced for both men and women. The overall cancer incidence results show a significant increase in cancer incidence for men but not for women.

2. The rates of cancer and mortality among Queensland coal mine workers have changed over time, perhaps associated with the introduction of technology such as bi-directional coal cutting.

It had been hoped to be able to group individuals by technology in use but these analyses proved impossible. Most Queensland underground coal mines are now operating longwall mining and the dates of introduction of bi-directional cutting could not be accurately identified. Dust control measures including respiratory protection have varied over time and likely by mine site.

Rates of lung cancer and mesothelioma were higher among older workers. Deaths from *Lung Diseases due to Dust* were significantly higher in the younger age group (under 65) and not in the older group but numbers were small.

It was not possible to construct exposure profiles on an individual basis for workers in the study. There were insufficient data to calculate yearly exposure by mine and extrapolation of data from 2000-2022 to the 1980s would be too speculative. Instead, sensitivity analyses were carried out excluding men who commenced after 2010, because exposure levels in this period were much lower than in the earlier years. This did not suggest a large difference in risk.

Based on within cohort comparisons, there were no changes in mortality or cancer incidence for Maintenance workers when this time cut point was used. Production workers overall had a somewhat lower accident rate, but no changes to disease mortality. Risks for lip cancer, lung cancer, and melanoma were significantly increased (but only a small absolute change in risk). It is possible that these higher rates result from more dust and/or ultraviolet light exposure among Production workers in earlier years.

3. Specific types of mines e.g. open cut or underground and/or jobs e.g. drilling and blasting, were more closely associated with an increased risk of cancer and/or mortality.

Job titles were only available from 1993 and onwards, limiting the ability to investigate by Job Group, so workers whose only assessments were before 1993 had to be excluded from the job specific analyses. Further, a high proportion of miners worked at unidentified or multiple mine sites so could have worked at more than one mine site types.

Compared to age and sex matched population rates, mortality was lower than expected for men and women in Office, Occasionally exposed, Production and Maintenance Work Categories and somewhat lower for workers in most other groups except Unexposed Non-Office workers. Circulatory and respiratory causes of death were reduced amongst male Maintenance and Production workers and likely also for Construction workers.

The overall suicide rate was not higher than expected when comparing to Queensland rates. However, when compared to the Australian general population data, suicide rates were higher than expected in the cohort, particularly for younger men and especially among those recruited after 2010. Suicide rates were higher in several Job Groups amongst Maintenance Production and Construction workers.

Compared to National Australian rates, accidental deaths were higher than expected for men in the Production and Construction Work Categories and for Truck Drivers (nec), Labourers and for male and female Cleaners. The risk is higher for male coal mine workers with less than 5 years employment. Those with more than 15 years employment showed a significant reduction in risk. Overall however, the accident rates were similar to that of the general Queensland population except for male Truck Drivers.

Melanoma was not increased compared to the Queensland population. Further, melanoma and prostate cancer incidence were higher than expected but mortality was not increased. This may indicate increased screening /detection at earlier stages in this population.

Lung cancer incidence and mortality were significantly increased for male Construction and Production workers compared to the general population and within the cohort after adjusting for smoking. Within Production, lung cancer mortality was higher for those who ever worked as Drillers (general) or Operators compared to the general population. It is likely that these workers were more highly exposed to dust than were Office or Maintenance workers.

Mesothelioma rates were increased for Administration, Maintenance and Construction workers.

Gallbladder cancer was increased among both men and women.

4. Any identified excess risks are associated with specific coal mine exposures, such as coal dust, silica and/or diesel particulate matter,
5. Risk estimates based on measured air monitoring and other hygiene data would inform occupational exposure limits and exposure carcinogenicity evaluations.

It was not possible to construct individual exposure profiles for coal mine workers in the study and hence to identify specific levels of exposure associated risks. However, the measured data suggests that exposure to RCS and RD has been relatively low for most jobs over the last 20 years. Exposure before 2000 may have been higher, particularly for underground Production workers, some Maintenance workers and Exploration Drillers.

6. The findings can be used to estimate the likely future burden of cancer and mortality in the cohort.

The large influx of miners in recent years would make this a useful exercise, but assumptions about change or lack of change in exposure would have to be made. Further the small size of many Job Groups would limit the precision of these calculations.

While the RCS and RD exposure levels for most jobs have reduced in recent years, many coal mine workers were employed pre-2010 when the levels were higher, however there has been insufficient lag time to diagnose cancers and diseases with longer latency periods. Therefore, some of the patterns observed in this study (e.g. lung cancer incidence and mesotheliomas in the Construction Work Category) may still become evident in the future.

11.2 Study interpretation

The analyses here were based on small numbers for a number of the less common cancers, such as bladder cancer and for most Job Groups. The analyses for female coal mine workers in particular, often had wide confidence intervals and so the point risk estimates should be interpreted cautiously.

While this study has some strengths, including the large size, especially for male coal mine workers, availability of smoking data and the ability to access nationally complete death and cancer databases, there were some limitations. These include lack of job titles and worksite information for some participants, the use of time between assessments to approximate for duration of employment and the self-reported job titles. There was also no information available about other individual lifestyle factors,

Further follow-up is recommended in five years when the larger number of cancer and death events as the cohort ages will increase the statistical power of the study and so provide more precision in the risks of causes of death and types of cancer, particularly for the less common cancers.

Glossary

From: Goddard, D. (2002) *Glossary of Terms Relating to Occupational Health & Epidemiology.* Department of Epidemiology and Preventive Medicine, Monash University, Melbourne.

Association (in epidemiology)
A finding of co-existence between exposure to an agent and a changed (usually increased) incidence of disease brought about because (1) the exposure causes the disease, or (2) the disease brings about the exposure, or (3) there is confounding. Causation is a sub-set of association; they are not identical. It is the extent to which the occurrence of two or more characteristics are linked either through a causal or non-causal relationship.

Bias
A non-random error in an epidemiological study that leads to a distorted result.

Case
A person with a disease of interest.

Cohort
A group of persons who share a common attribute, such as birth in a particular year, residence in a particular town or exposure to a particular agent, and who are observed over a period.

Cohort study
An observational study in which subjects are sampled based on the presence (exposed) or absence (unexposed) of a risk factor of interest. All cohort studies proceed forward in time from exposure (or not) to health outcome, although the exposure status may be decided either from historical record or determined after the study commences.

Confidence interval
A range of values, calculated from the sample observations that are believed, with a particular probability, to contain the true parameter value. A 95% confidence interval, for example, implies that, were the estimation process repeated again and again, then 95% of the calculated intervals would be expected to contain the true parameter value. Other confidence intervals often used are 90% and 99%.

Confounding
An association between an exposure of interest and a disease which is not directly causal but where both exposure and disease are linked by their association with a third factor. It has the potential to bring an error in the interpretation of the results of a study.

Correlation
Describes the direction and strength of a straight-line relationship between two variables.

Dose-response relationship
A relationship in which a change in amount, intensity or duration of exposure is associated with a change in the risk or severity of a specified outcome.

Epidemiology
The study of the distribution and determinants of disease in groups of people i.e. who suffers what and why.

Exposure
The presence of a noise, substance or form of radiation in the environment of a person or animal. A measurement of this presence.

External analysis
Where a cohort is compared to the general population (i.e. a population external to the cohort)

Frequency
In statistics – frequency is the recorded or expected number of occurrences of a particular type during a specified time period.

Incidence
The proportion of new cases of interest in a study population in a given period.

Internal analysis
Where subgroups within a cohort are compared with each other (i.e. the comparisons are internal to the cohort).

Mortality
Death. Usually the cause (specific disease, condition, or injury) is stated.

Person-years
Describes the accumulated amount of time that study participants were being followed up. So, if five people were followed up for ten years each, this would be equivalent to 50 person-years of follow-up. Sometimes the rate of an event in a study is given per person year rather than as a simple proportion of people affected, to take into account the fact that different people in the study may have been followed up for different lengths of time.

Population
The total set of persons, things or events under investigation or relevant to a study. If a population is large, a sample may be drawn from it and the characteristics of the population then inferred from the characteristics of the sample through use of statistics.

Power (in epidemiology and statistics)
Power is the ability of an epidemiological study to detect a true effect (or difference) of a specified size.

Prevalence
The proportion of people that have a given disease or condition at a specified point in time. Prevalence is not a rate; it is not simply a count of incident cases over a period.

P-value
The probability that an observed difference has arisen by chance alone. By convention, a P-value of 0.05 or less is usually considered statistically significant because the difference it relates to would occur by chance alone only one in twenty times or less often.

Rate
A proportion that takes the additional dimension of time, e.g. 6 new cases per thousand of population per year. Incidence is an example of a rate.

Ratio
A comparison of two numbers - the number of observations with a characteristic of interest compared with or divided by the number without that characteristic.

Relative Incidence Ratio (RIR)
Compares the cancer incidence rates for groups of coal mine workers

Relative Mortality Ratio (RMR)
Compares the mortality rates for groups of coal mine workers with the earliest, lowest or shortest duration group. This is calculated by dividing the number of deaths in that group with the number of person-years in the same group.

Risk (in statistics & epidemiology)
The probability that an event, e.g. the occurrence of a specific disease, will happen during the study period. [This is the way that the term risk is used in 'relative risk' which refers to association but not necessarily causation. However, in most situations where the term risk is used in preventive medicine, there is an implication of causation - the probability that harm will occur. Hence, risk factors.]

Sample
A relatively small set of observations or individuals drawn from a larger universe of potential observations or individuals. The sample is usually assumed to have all the essential characteristics of the larger population from which it is drawn, but this does not always happen in practice.

Significance level
This refers to the probability that chance is the explanation of a difference between means, proportions or counts; it provides the means of decision-making once a statistical test of significance is underway. It is simply an arbitrary level of probability, usually 0.05, below which chance is rejected as the explanation of difference, i.e. it is the level at which the null hypothesis is rejected in favour of the alternative hypothesis.

Standardise
Alter in a way that enables fair and ready comparison with a recognised model.

Standardisation
A change to findings to make them more readily comparable with others that refer to similar things.

Standardised Incidence Ratio (SIR)
Compares the cohort data with the Australian population.

Standardised Mortality Ratio (SMR)
Compares the actual number of deaths from a particular cause in the cohort with the expected number of deaths in the cohort if the death rate in the cohort was the same as that of the Australian population.

Statistically significant
'Not likely to happen just by chance'. The phrase 'not likely' is made more exact by setting a level of probability below which we reject chance as the explanation. This arbitrary level is designated 'a'; it is most commonly set at 0.05. This means that if:
- the P-value is less than 0.05, or
- the 95% [1] confidence interval of a ratio does not include the value 1, or
- the 95% confidence interval of a difference does not include 0, then chance can be rejected as the explanation of why one group differs from another.

Tertile
A group derived by ranking the population according to specified criteria and dividing it into three equal parts

Trend
A long-term movement or change in frequency, usually upwards or downwards.

Abbreviations

95% CI	95% Confidence Interval
ABS	Australian Bureau of Statistics
ACS	Automated Coding System used by ABS to code deaths
AIHW	Australian Institute of Health and Welfare
AMU	Australian Workers' Union
CFMEU	Construction Forestry Mining and Energy Union
CHPP	Coal Handling and Preparation Plant
CI	Confidence Interval
CMDLD	Coal Mine Dust Lung Disease
COPD	Chronic Obstructive Lung Disease
DEE	Diesel Engine Emissions (Exhaust)
DNRME	Department of Natural Resources, Mines and Energy
DPM	Diesel Particulate Matter
E	Expected
ERZ	Explosion Risk Zone controller
HR	Human resources
HREC	Human Research Ethics Committees
HSU	Health Surveillance Unit, within RSHQ
HWE	Healthy Worker Effect
IARC	International Agency for Research on Cancer
ICD-10	International Classification of Disease Version 10
ICD-9	International Classification of Disease Version 9
IHD	Ischaemic heart disease
LH	Lympho-haematopoetic
MCD	Medicare Consumer Directory
MDS	Myelodysplastic Syndrome
MM	Multiple myeloma
MonCOEH	Monash University Centre for Occupational and Environmental Health
MSHA	Mine Safety and Health Administration
MUHREC	Monash University Human Research Ethics Committee
nec	Not elsewhere classified
NHL	Non-Hodgkin lymphoma
NHMRC	National Health and Medical Research Council
NLM	AIHW National Linkage Map
NMRD	Non-malignant respiratory disease
NMSC	Non-melanotic skin cancer
O	Observed
OC	Open cut
OCE	Open Cut Examiner
PAHs	Polycyclic Aromatic Hydrocarbons
PIN	person identification number
PY	Person-years
REC	Respirable elemental carbon
RCS	Respirable Crystalline silica
RD	Respirable Dust
RIR	Relative Incidence Ratio
RMR	Relative Mortality Ratio
RPE	Respiratory protective equipment includes air supplied BA & filtering face masks
RSHQ	Resources, Safety and Health Queensland
SEG	Similar Exposure Group
SIR	Standardised Incidence Ratio
SMR	Standardised Mortality Ratio
SWA	Safe Work Australia
UG	Underground
WES	Workplace Exposure Standard

Appendix 1 Data Items Available from Health Records

The following data items were obtained for each health assessment

A data set containing personal information including (where available):

- Coal Mine Worker registration number
- Surname
- First name
- Middle name (if available)
- Preferred name (if available)
- Date of birth
- Sex
- Smoking status

Appendix 2 Data Handling and Cleaning Processes

The data were loaded into a study database which has two components, the front end and back end. The back end contains all the data which was stored in an SQL Server database on a secure Monash University server. A comprehensive data dictionary was prepared and stored with this database. Identifiers such as names and dates of birth were kept separate from the de-identified data set, which contains details of causes of death and cancer diagnoses. The records were linked by a common study-specific identification number (Coal mine worker ID). Analysis was undertaken on a de-identified data set.

The front end was written in Microsoft Access and access to the data was limited only to MonCOEH staff working on the study and constituted a password login with user access and data modification rights controlled by the MonCOEH data manager.

The data were checked for completeness by the research team before being collated and passed to the AIHW for linkage.

The date of last contact for individual cohort members was the date when of the last examination as assessments could be delayed for some time after the examination.

Each original data set was archived unchanged and a copy was loaded into the study database and the following cleaning procedures carried out to produce the final data set. At each step, clarification was sought from the agency where there was missing or conflicting information.

- Duplicates were merged
- Missing or implausible birth dates or other missing data were followed up with the RSHQ, checked and confirmed.
- Sex change: male sex was the default and a number of individuals were recoded from male to female, based on their names. A much smaller number were recoded from female to male. The frequency of names by sex were confirmed using online resources such as: https://www.gpeters.com/names/baby-names.php https://www.popular-babynames.com/name/ (gives percentage by each country). The frequency of names by sex in the general population had to be weighed up against most of the coal mine cohort being male. e.g. ASHEIGH with a male middle name is male, ASHLEIGH with a female middle name is female, ASHLEIGH with no middle name is assumed to be male because the proportion of men to women in the cohort is very high.

Types of Data Form

There were seven types of data entry forms in the dataset as follows.

- Full Form – the data identified as ‘Full Form’ were drawn from the completed mine health assessment form and all the health assessment data variables were entered into the RSHQ database.
- Form Summary – only data for selected variables from the completed health assessment form electronically captured.
- Review - these were additional assessments to the usual five-yearly health surveillance assessment process, following up findings from the initial ‘full’ health assessment. These are known as subsequent assessments under the current Coal Mine Workers’ Health Scheme.
- Review Summary – only data for selected variables from the completed review were electronically captured.
- Health Assessment Report (‘Section 4') Only – This data captures only the Section 4 from the health assessment forms in cases where the full assessment was not provided to RSHQ. The health assessment report contains the medical decision about whether the individual was fit for work and identified any restrictions on activities, as well as any diagnosis of a disease prescribed under the Coal Mining Safety and Health Regulation 2017.
- Approx. 300 health assessments had missing information that resulted in limited data being captured. Those individuals with only a Return form were not included in the cohort, and a Return did not count as a health assessment for those already in the cohort.
- Survey – assessments from the Rathus and Abrahams 1982 Survey which were included in the cohort.

Appendix 3 List Job Groups and search terms

This appendix presents the Work Categories (underlined and bold in Column 1), the search terms used on the free text job titles in CAPS below. Column 2 lists the jobs which have been included in these groups and those that have been excluded are in red.

JOB GROUP SEARCH TERMS	**Definitions and exclusions**
ABRASIVE, BLAST, SAND, PAINT	After shutdown, maintenance is undertaken by abrasive blasting, painting, sanding and spray painting, includes industrial painter
ABRA	If allied with cement or concrete jobs go to CONSTRUCTION
SAND	
PAINT	Excludes other types of painting, plastering, floor spraying, decoration painting, weed spraying including just paint
SPRAY	
BELT SPLICER	BELT SPLICING Job Group should only be used the word “splice” is present.
SPLICE	All other “belt” jobs such as technicians, maintenance, man should be assigned to MAINTENANCE – GENERAL
BLAST CREW	Shot firer and blast crew jobs into BLAST CREW category, includes bench jobs, MMU and MPU if associated terms
SHOT	
BLAST	Drillers go to Driller (Blast Crew)
BENCH	Ground crew are involved in blasting, but excluded groundsmen and groundskeeping who are doing gardening
EXPLOSIVES PLANT	
MPU	Hydro and water blasters to INDUSTRIAL CLEANER.
DIP	Abrasive blasters go to ABRASAIVE, BLAST, SAND, PAINT
BOILERMAKER	BOILERMAKERS and welders should be assigned to the BOILERMAKER Job Group. Includes steel fabrication, welding, oxycutting.
BOIL	
SHEET METAL	Poly welder or poly pipe welder is mine services not a boilermaker
FABRICA,	
WELD	
OXY	
CHPP PLANT OPERATOR	CHPP Plant Operators, can include dozer, truck & loader operations, but must include the words CHPP/CPP/Coal Handling/Coal Processing/mineral processing/Wash/Prep(aration) and the word operator.
PLANT & OPERATOR+CHPP / WASH /CPP	CHPP maintenance tasks are under maintenance but with a CHPP flag to identify them
CHPP & OPERATOR	
WASH & OPERATOR	Combined jobs with dozers, truck drivers, etc are not included
CPP & OPERATOR	PLANT OPERATOR can be used as a general term for an employee as well. does not include general production, mobile plant, operator
PROCESSING	
FIXED PLANT	
STATIONARY PLANT	
CIVIL WORKS	Road making, grading jobs, grader, Earthmoving road work, small crushers to make road stone, and dam jobs
CRUSH	
DAM	
EARTH	
GRADER	
KERBY	
RECL	
ROAD	
ROLLER	
CLEANING	This is an exclusion category for Cleaners where it cannot be determined whether they are domestic OR Industrial Cleaners. Most are likely to be domestic rather than industrial

CLEANE	
CLEANING	domestic cleaners and utility cleaners go under BLUE COLLAR (UNEXPOSED) if there are any terms such as machines, trades assistant, etc these go under INDUSTRIAL CLEANING.
CONSTRUCTION	Form work, agitators, concrete, carpenters, labourer (inc with truck driving), builders, brick layers.
AGI	
BATCH	All construction work goes into construction (overwriting Miner, Labourer,
BOBCAT	Fitter, Maintenance) with these key words (to the left).
BRICK	
BUILD	Removed construction visitors doing short-term installations including terms
CARPENT	such as:
CIVIL	FENCE,
CONCRET	FLOOR
CONSTRUCT	WINDOW
DEMOL	GLAZIER
FORM	PLASTER
MOXY	TILE
PLUM	GLAZ
STEEL	
CONTROL ROOM	CONTROL ROOM jobs may also use the terms DISPATCHER, CRO (Control Room Operator), or IROC.
CRO	
DISPATCHER	Control system jobs may be IT workers and are assigned to ADMIN
IROC	
RADIO	
DRAGLINE OPERATOR	DRAGLINE OPERATORS.
DRAG	Other engineers, industrial cleaners and maintenance workers with similar job titles are assigned to appropriate Job Groups.
DRILLER (EXPLORATION)	There are four types of DRILL category, Driller (Exploration), Driller (Blast),
EXP & DRILL	Driller (U/G, Coal SeamGas,), Driller (General).
DRILL & ASS	
DRILL & OFF	Exploration Drillers will have the words Exploration, Ass(istant) or Off(sider),
EXPLORATION	derrick associated with them. May be exploration alone and roughneck.
DERRIK	
LEASEHAND	Blast drillers are open cut and involved in the Drill-Load-Blast process on
CHAIN	the benches, anywhere says Drill and Blast
ROUGH	Overburden drilling refers to blast hole in open cut mines.
DRILLER (BLAST)	Underground drillers are usually drillers for the coal gas seam and will have
BLAST & DRILL	words associated with seam, UG, U/G, underground, etc . Directional drilling also for coal seam gas. Also included drill, direct, steering and gas
DRILLER (U/G, COAL SEAM)	(unless Grasstree or Moranbah gas plant)
UG & DRILL	Other Drillers are General drillers and include Bore Hole and Shaft
U/G & DRILL	
UNDER & DRILL	Excluded those are drilling concrete, wood, etc which are building jobs and
SEAM & DRILL	belong under CONSTRUCTION.
STEER	
GAS (unless drainer)	
DRILLER (GENERAL)	
BORE HOLE	
SHAFT	

ELECTRICIAN	All electric fitters are ELECTRICIANS
ELECTRICIAN (AUTO)	Auto (car, truck) electricians have their own category
ENGINEER	The ENGINEER job title is a mainly office job, although many will have some time on site ENGINEERING jobs are not engineers unless the job title suggests otherwise, but tradesman, fitters, servicemen etc in engineering are not engineers. (Electrical engineering may be electrician). Engineers that do not typically do work in the mine include acoustic, computer, IT, accounting, costs, biomed, surveying (inc geo tech surveyors), environmental engineer, automation engineer planning, sale, these are assigned to ADMIN.
ENVIRONMENTAL SERVICES	All field work and survey work. Including ecologist, Field assistant or officer, soil testing, Aboriginal/cultural/artefacts if field work
BOT CULT ECO ENV FAUNA FIELD (not all WILD) MARINE SOIL	Jobs which are maintenance, fitter, electrician go into the appropriate categories.
ERZ / DEPUTY	The Explosion Risk Zone (ERZ) controller previously known as a DEPUTY jobs grouped with underground supervisor.
EXAM (OCE)	Open Cut examiner jobs. These are the open cut mine equivalent of ERZ/Deputy jobs Exclude other types of “examiner”
FITTER	The FITTER category refers to mine jobs as a maintenance fitter. There are various types of FITTER:
TYRE FITTER	Any positions titles with DIESEL was coded as DIESEL FITTER; with TYRE coded as TYRE FITTER.
DIESEL FITTER	Other job titles with DIESEL or TYRE were reviewed manually, to identify where they should be assigned. Electric fitters are ELECTRICIANS. Those FITTERS associated with gas, pipe, auto, school, town, refrigeration, access, aircon, fire, hose, radio, sprinkler belong to MAINTENANCE – GENERAL Those FITTERs associated with glazier, floor, patio, glass, carpet, door, etc belong in CONSTRUCTION or MINE SITE VISITOR.
GEOLOGIST	Geology jobs these were scored as a separate category but will be combined with Technical Services
INDUSTRIAL CLEANER	Industrial cleaners clean machinery and production areas. Includes any cleaning work as a crew, industrial production, CHPP, Plant, Machinery, Maintenance, Equipment, Trades Assistant
CLEANE CLEANING HYDRO WATER	Industrial cleaner if also operator/cleaner combination. Some include Water or hydro blasting
LABORATORY	All laboratory jobs, including coal analyst and coal sampler, samplers may be more highly exposed than other lab jobs
LAB ASS LABORAT SAMPLE ANALYST	Some analysts are Administrations, e.g. cost analyst Also excluded soil sampler and soil testing.

LABOURER	Exclusion category for Labourers who cannot be categorised into other categories definitively. Likely most will be CONSTRUCTION
LABOUR	Labourers who are Trades, Trades Assistant go into MAINTENANCE-GENERAL Labourers who are Construction jobs (brick, roof, fence, carpenter, concrete, etc) go into CONSTRUCTION Labourers who are gardeners, field, site etc go into BLUE COLLAR
MINE SERVICES	Group providing services to the mine and mine workers including: Dredging, dewatering, gas drainage (except drillers)
DEWATER DREDG GAS DRAIN PIT POLY PIPE in welding PUMP CREW MINE SERVICES UTILITIES WATER SEWERAGE	Utilities (water and sewerage) (not cleaning) (sewerage and water), Outbye indicates ug mine services job Exclude those doing surveys, e.g. wildlife, fauna, environment, they are likely ENVIRONMENTAL SERVICES. Excluded power plant workers
MINER	General category for miner, includes Miner, roof bolters, CM is continuous driver (ug) Mine technicians, coal tech, development production, LongWall
MINE TECH BOLT CM	Category for those who are general Mine Tech, Production Tech etc These all appear to be underground jobs Remove where another job identified e.g. Fitter at a Mine.
MOBILE OPERATOR	Mobile Operator category, operators who use dozers, excavators, backhoes, mogo and tracks (unless maintenance)
DOZER BULLDOZER EXCAVATOR (EXC) HME MOBILE PLANT MACHINE & OPERATOR MULTI & OPERATOR TRACK	These are production operators but different from CHPP Plant Operator.
OPERATOR	All generic operator jobs which cannot be confidentially coded Includes mine worker, mining operator and operator/maintainer
PRESTRIP	PRE STRIP workers removing overburden before mining
PRESTRIP	
PRODUCTION OPERATOR	Production operator jobs, includes the words Production/Underground and the words Operator/Employee.
PRODUCTION OPERATOR UNDER & OPERATOR PROD & EMPLOY TRAINEE OPERATOR PROD & OPER	includes Production Worker. Seems to be overlap between Miner and Operator Only categorised here if the words are similar to these. If there are other terms the position might belong in a more specific category.
PRODUCTION SUPPORT	Bull gang do some coal getting, some maintenance between shifts v dusty UG job
BULLG/BULL G SUPPORT (PROD)	
PRODUCTION TRUCK DRIVER	Truck drivers that are DUMP, HAUL, SHOVEL excluding DOZER and EXCAVATOR. Amalgamate in analyses with mobile operator
DUMP & TRUCK HAUL & TRUCK SHOVEL & TRUCK WATER & TRUCK	Must have the word TRUCK or DRIVER and one of the other key words. can have the word OPERATOR instead of, or as well as TRUCK e.g. SHOVEL TRUCK or SHOVEL OPERATOR. SIDE TIPPER

SCRAPER	Scrapers may remove overburden or mine coal
SCRAPE	
SECONDARY SUPPORT	These are workers who help support the structure of the mine, all underground
SHOTCRE	including shotcreters, grouter, Ventilation control device (VCD) installers
GROUT	(not ventilation officers)
OUTBYE	Check for ug concrete
VCD	
SHUTDOWN MAINTENANCE	All crane, riggers and scaffolders go to the SHUTDOWN MAINTENANCE group. This is when large machinery is shutdown and dismantled for maintenance.
CRANE	Doggers or dogmen follow the crane to help direct it
DOG	
EWP	Exclude if job specifies it is some other sort of work, e.g. telecommunications, construction, etc
RIGG	
SCAFF	
SUPERVISOR	General supervisor category where cannot otherwise be determined from other words in job title.
TECH SERVICES	Surveyors, Geotech engineers and geo physicist and geo technical staff Includes Ventilation officers, NDT, non destructive testing, various other
SURVEY	testing, thermographer, Vibration (vibe), metallurgist
GEO TECH	
GEO PHY	Outbye indicates ug mine services job
NDT	
TEST	Exclude those doing surveys, e.g. wildlife, fauna, environment.
THERM	
VENT	
VIB	
TRUCK DRIVER	This is an exclusion category, for all those who cannot be ruled out as being a Production Truck Driver
TRUCK	
DRIVER	Excludes UNEXPOSED BLUE COLLAR drivers such as bus, coach, rail, train, B double, forklift or CONSTRUCTION, e.g. excavator and dozer
TUNNELER	Tunnel boring including development, drivage, header
DRIFT	
HEADER	
TUNNEL	
ADMINISTRATION – GENERAL	Administration term overrides other terms that may be exposed
	HR refers to human services, note that HR can also be a type of truck so
ADMIN	these need to be separated and coded
ACCOUNT	Managers are assumed to be administration.
BUSINESS	Also other terms like, Aboriginal relations, analyst (if not coal), community,
CLERICAL	computer, cost, document, drug, executive, finance, GM (general
CLERK	manager), I.T. (information technology), learning, medical, network,
COMMERCIAL	personal, personnel, physiotherapist, reception, recruitment, sales,
CUSTOMER	secretary, supply, software, staff, systems, trainers (in house), management
HR	(but may refer to other areas that are not office), H&S, rescue if FT, fleet &
HUMAN RESOURCE	parts (unless maintenance), boats, and marine
IT (starting with IT followed by space)	
MANAGER	
OFFICE	
PURCHASING	
SALES	
SCHEDULER	

BLUE COLLAR NOT EXPOSED ACCESS BAR CAMP, CHEF CLEAN (IF DOMESTIC) COOK CRIB FORKLIFT GROUNDS IRRIG KITCHEN LANDSCAPE LAWN PARTS PEGGY (inc TA peggy) SECURITY STORE TRAFFIC WAREHOUSE YARD	Blue collar jobs which have been included in Admin (if direct employ not visitors where identifiable). Some low level exposure for outdoor jobs e.g. access control, accommodation, inc bar chefs cooks etc, firemen (ERT), first aid, irrigation, landscape, laundry, lawn, grounds (groundsman), house (keeping), office and utility cleaners, peggy, security, crib and lamp room, parts
MAINTENANCE – GENERAL APPRENT (nec) HYDRAUL HYDRO, (some visitors) HOSE INSTRU LINESMAN MAINT MECHANIC MTCE PUMP RELIAB SERVICE SOIL TA TRADE WIRELINE WORKSHOP	General maintenance jobs include apprentices (unless otherwise specified), instrument, trades, maintenance, service, workshop, mechanic, TA Wireline (loggers prob visitors) and linesmen, hydro, hose are mobile maint. Calib tech, Equipment, power plant Soil sampling and testing, pumper jobs if maintenance or reliability These are all remaining maintenance jobs, which has not been coded to specific jobs, so exclude (FITTER, ELECTRICIAN, BOILERMAKER Inc etc.) which already have categories. Exclude jobs which are 1. Construction such as carpenter, plumber, planner, civil, build, concrete, 2, Shutdown maintenance crane, rigger, scaffolder 3. Production jobs: drillers, blast 4. Refrigeration, A/C, air con 5. Admin: communication 6. Blue collar: access, , emergency, employment. 7. Mine service visitors include camp, floor, window, carpet, door, fire, hose, radio install, sprinkler, paint (some), roof
PRODUCTION GENERAL	Production jobs that could not be assigned to a more specific job, likely to be grouped with operator, mobile operator and production operator in analyses.
VISITORS AIR CON REFRIDG CABLE (ROPES) GIS GPS	This includes the following groups: air con/refridg, cable inspection and repair (not bolting), GPS and GIS installation, coaches (people, not buses), arborist, accessory, boat, cabinet, camera, courier, catering, delivery, ergonomist, exercise, fauna, spotter, wildlife, film, first aid (unless direct employ), fire alarm, journalist, mail, pest, photocopy, research, retail, sales, installer, sign, tax, telephone, tagging (tag), test, tree, trainer if not coal co., vendor, vending, visiting, weed, weld inspectors xerox. Fuel and other delivery trucks, driver trainers and assessors
CONSULTANTS	All jobs stating consultant, even if production or maintenance
UNKNOWN	All blanks assessments, or those with dates, numbers, generic terms like a mine name or “medical” instead of a position title. specific terms: Tank, piling

Appendix 4 SEGs allocated to Job Groups

Job Groups mapped to SEGs by Site Type

Job Group	SEG		
	OC	UG	CHPP
ADMINISTRATION	QCS013,	QCU013	
BLUE COLLAR (NOT EXPOSED)	QCS013 QCS012	QCU013, QCU029	
CONTROL ROOM	QCS021	QCU010	
ENVIRONMENTAL SERVICES	QCS~~U~~008	QC~~U~~008 (surface) QCU026 (UG)	
ENGINEER	QCS~~U~~008	QCU026	
MINE SERVICES	QCS006, QCS015 QCS014	QCU003, QCU009	QCP002
TECHNICAL SERVICES inc GEOLOGIST & SURVEYOR	QCS008	QCU026	
MAINTENANCE – GENERAL (nec)*	QCS006, QCS015, QCS014	QCU003, QCU009	QCP002
ABRASIVE, BLAST, SAND, PAINT	QCS033	QCU003	QCP008
SHUTDOWN MAINTENANCE	QCS033	QCU003	QCP008
BELT SPLICER	QCS011	QCU011	QCP005
BOILERMAKER	QCS005	QCU012	
FITTER (nec)*	QCS006	QCU003	QCP002
DIESEL FITTER	QCS006	QCU003	QCP002
TYRE FITTER	QCS016	QCU003	
ELECTRICIAN	QCS006	QCU003 also separate	QCP002
INDUSTRIAL CLEANER	QCS030 or QCS031	QCU028	QCP008
PRODUCTION – GENERAL (nec)*	QCS001, QCS002	QCU001, QCU002	QCP004
BLAST CREW	QCS007		
DRILLER (BLAST)	QCS010		
DRILLER (GENERAL)		QCU024	
CHPP PLANT OPERATOR			QCP001, QCP004
LABORATORY			QCP003
DRILLER (UG, Coal Seam)		QCU017, QCU023	
ERZ / DEPUTY		QCU008	
OPEN CUT EXAMINER (OC only)	QCS003		
DRAGLINE (OC only)	QCS017		
SECONDARY SUPPORT		QCU006, QCU020	
MINER	QCS001, QCS002, QCS018, QCS004	QCU001, QCU002	
OPERATOR inc MOBILE OPERATOR, OPERATOR, PRODUCTION OPERATOR and PRODUCTION TRUCK DRIVER	QCS001, QCS002, QCS018, QCS004	QCU001, QCU002	QCP001, QCP004
PRESTRIP	QCS001		
PRODUCTION SUPPORT		QCU019	
TUNNELLER		QCU015	
DRILLER (EXPLORATION)	QCS009		
CIVIL WORKS	QCS004, QCS026		
CONSTRUCTION	QCS026		QCS026
LABOURER (nec)*	QCS006, QCS015, QCS014	QCU003, QCU009	QCP002
CLEANER (nec)*	QCS030		
SUPERVISOR (nec)*	QCS003	QCU018	
TRUCK DRIVER (nec)**		QCU001, QCU002	

* (nec) means Not Elsewhere Classified so unclear what work they were doing, may be able to classify by site type but a lot were “various” sites

** ELECTRICIAN (AUTO) could not be assigned to a SEG

Appendix 5 Analysis Methodology

External Analyses

There are two ways to analyse the cohort data compared to the general population, these are summarised below (Breslow and Day 1987):

1. The Standardised Mortality Ratio (SMR) and
2. Standardised Incidence Ratio (SIR) which compared the cohort data with the Australian population.

The SMR is a measure of the death rate occurring in the cohort compared with the death rate occurring in the national population. This ratio can be measured for the whole cohort or any subset of workers, for any particular cause of death, or for all causes.

The SMR tabulations show the number of deaths observed among the coal mine workers and the calculated expected number which would arise in a group of the same age and sex in the Australian national population.

To find the expected number of deaths, the numbers of person-years were calculated in the cohort grouped by age group and calendar time, and then the Australian general population death rates were projected to this cohort.

The actual number of deaths was divided by the expected number of deaths to calculate the SMR. If the death rate in the cohort is the same as that of the Australian population, the SMR is equal to 1 (sometimes reported as a percentage i.e. 100). If the SMR is greater than 1 then the death rate in the cohort is greater than that of the Australian population. If the SMR is less than 1.0 then deaths in the cohort are occurring less frequently than they do in the national population. Thus, the SMR forms a measure of the risk of mortality in the cohort compared to the Australian population as a whole, with age and sex taken into account.

When measuring the risk of developing cancer, the standardised incidence ratio (SIR) is calculated. Incidence measures cancer as it arises, as opposed to when it causes death. All cases of cancer except non-melanoma skin cancers are reported to the relevant state cancer registries by the treating medical specialist. Providing that cancer registration is reliable, as it is in Australia, cancer incidence is a more valid indicator of cancer risk than is cancer mortality. The SIR is calculated in a similar way to the SMR. To calculate SIRs, calculation of expected numbers from national cancer incidence is required. The national data are derived from the ACD.

Both SMRs and SIRs are age-standardised because death and cancer rates vary strongly with age. They also vary with sex so rates are calculated separately for men and women.

Internal Analyses

Internal comparisons have also been used to look at the health effects of working in the coal mining industry. Relative risk is used to examine whether members of a subgroup such as specific Work Categories, have more or less risk of death or cancer than the group as a whole.

Relative Mortality Ratio (RMR) compares the mortality rates for groups of coal mine workers with the rest of the cohort. The cohort as a whole is represented as having a risk of 1.0. Risks for Work Categories or specific Job Groups are then calculated for risk in comparison with the rest of the cohort. This is calculated by dividing the number of deaths in that group with the number of person-years in the same group. The rate ratio for each of the groups is calculated as the rate for the group divided by the rate in the comparison group, that is in the rest of the cohort. A rate ratio of 1 indicates that the exposed group has the same rate of death as the comparison group. Similar calculations have been made for incident cancers.

The Relative Incidence Ratio (RIR) compares the cancer incidence rates for groups of coal mine workers. Such internal comparisons can only be done where there are sufficient numbers in the groups being compared. The two big advantages of doing internal comparisons are:

- is that it helps to overcome the Healthy Worker Effect and
- smoking rates can be adjusted for as they are known for this population.

The SMR and SIR are accompanied by 95% confidence intervals. If the confidence intervals do not include one, the risk would be considered statistically significantly increased or decreased.

Confidence Intervals and Risk Estimates

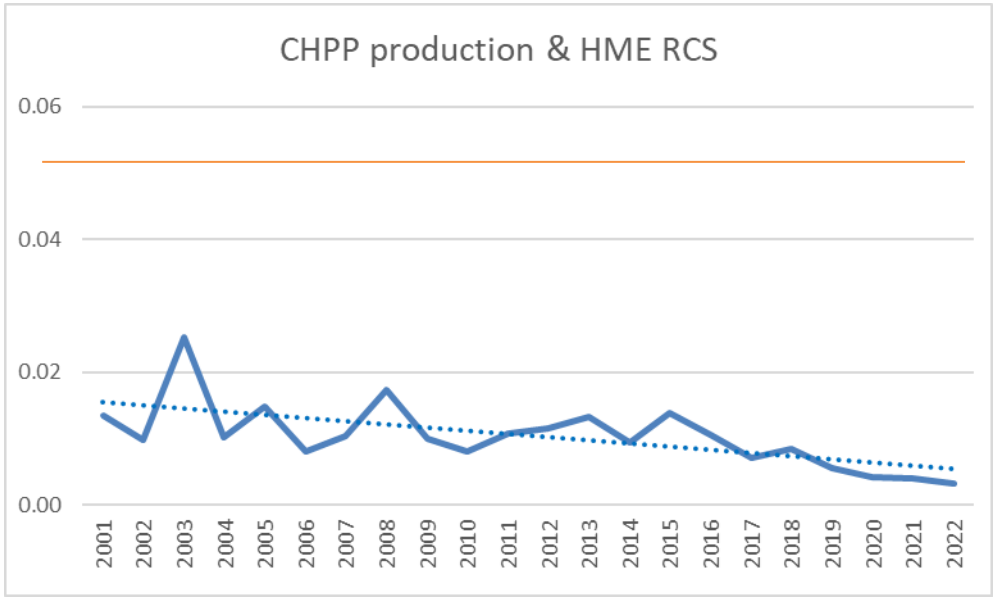
The rate ratios, SMR, SIR, RMR and RIR, are accompanied by 95% confidence intervals (95% C.I.). The value attributed to the ratio is actually a statistical estimate of the true ratio, however, the true ratio cannot be known exactly. The spread of estimates of the ratios within which it is 95% certain that the true figure will lie can be calculated. This spread is called the confidence interval.

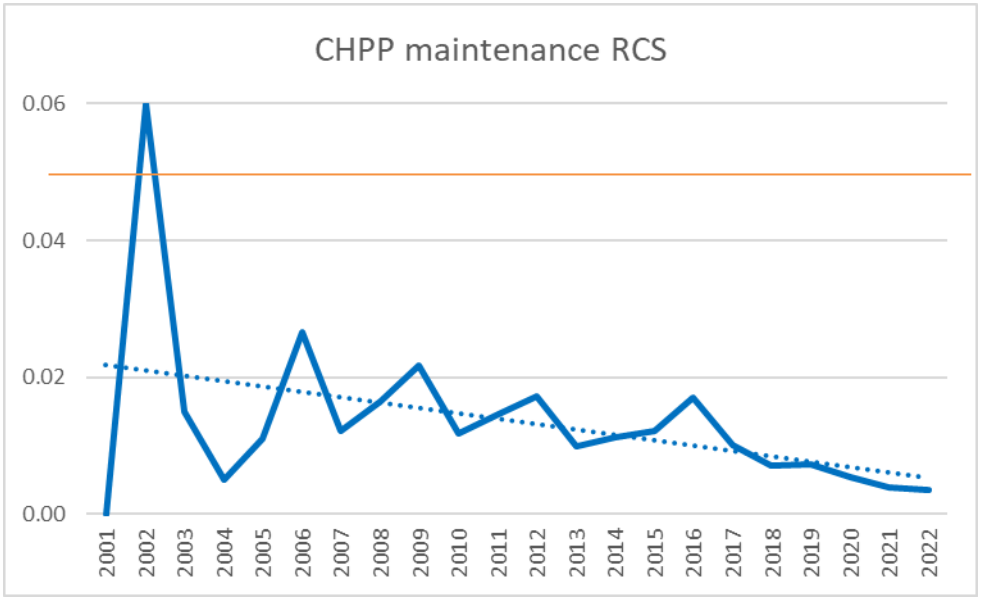
The choice of 95% confidence intervals is commonly used in health studies, and simply means that the certainty of the result is such that the odds of the true figure lying outside the confidence interval are about 5% or 1 in 20.

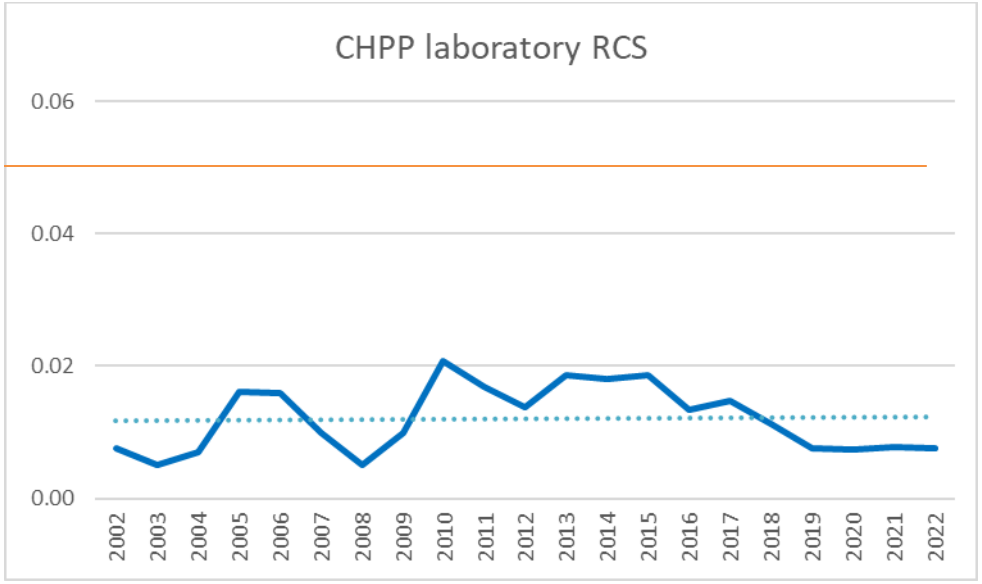
Confidence intervals are influenced by the size of the group however. Two groups may have the same point estimate of risk, but the larger group will have narrower confidence intervals. This may mean that larger groups such as from Work Categories have statistically significant results but the same point estimates for smaller groups such as Drillers that may not be statistically significant.

The importance of this lies in the interpretation of the ratios in terms of risk appraisal. Where a ratio is higher than 1.0 then a risk may be present, but if the lower end of the confidence interval extends below 1.0, then it is possible that the real ratio is 1.0 or less and no risk is present. However, when the lower end of a confidence interval is above 1.0 then we can say with some certainty that an increased risk does exist. This is often described as being a statistically significant result. If both confidence intervals are below 1 then the risk is said to be statistically significantly lower than that of the reference group.

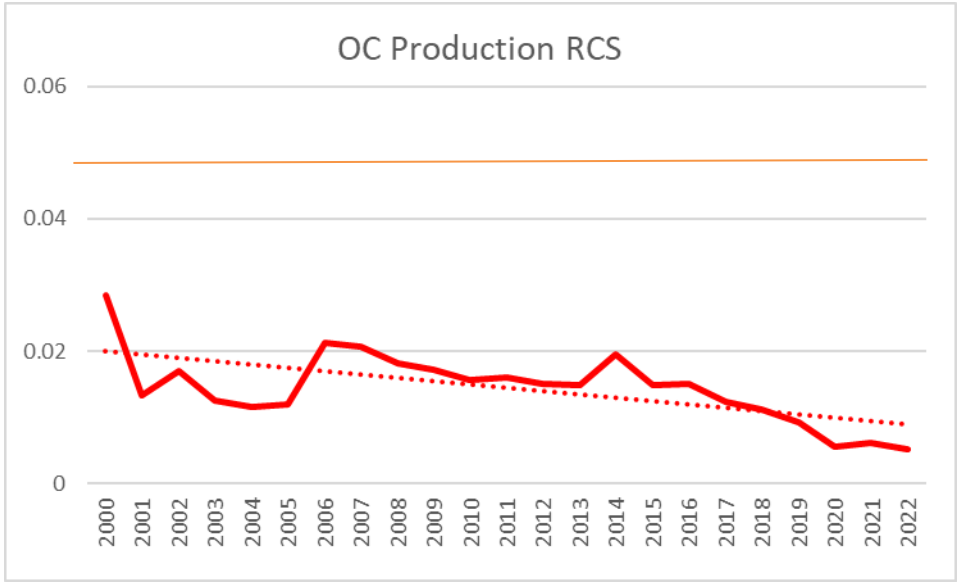
Appendix 6 Graphs of RSHQ Exposure Data







Key Qld OEL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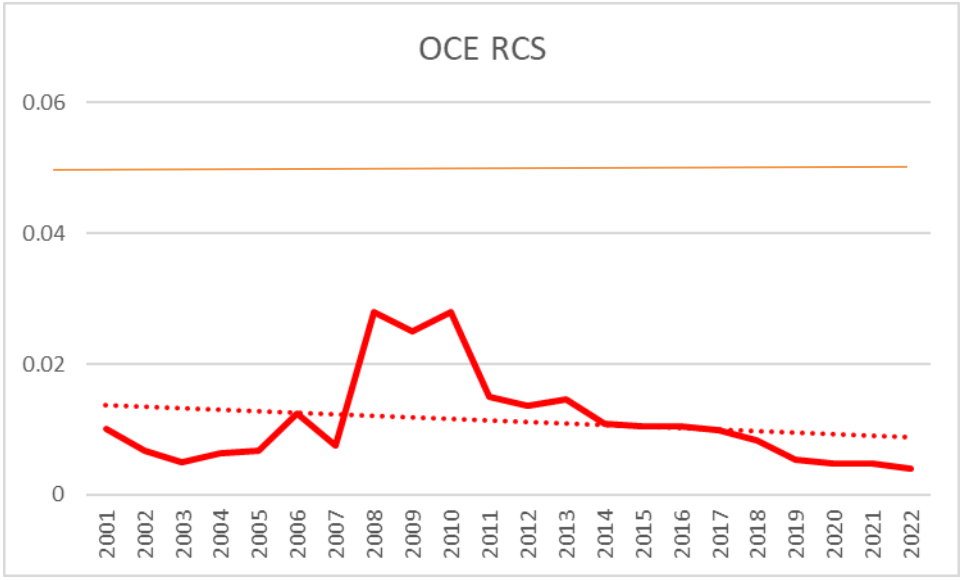
0.02
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


OCE RCS
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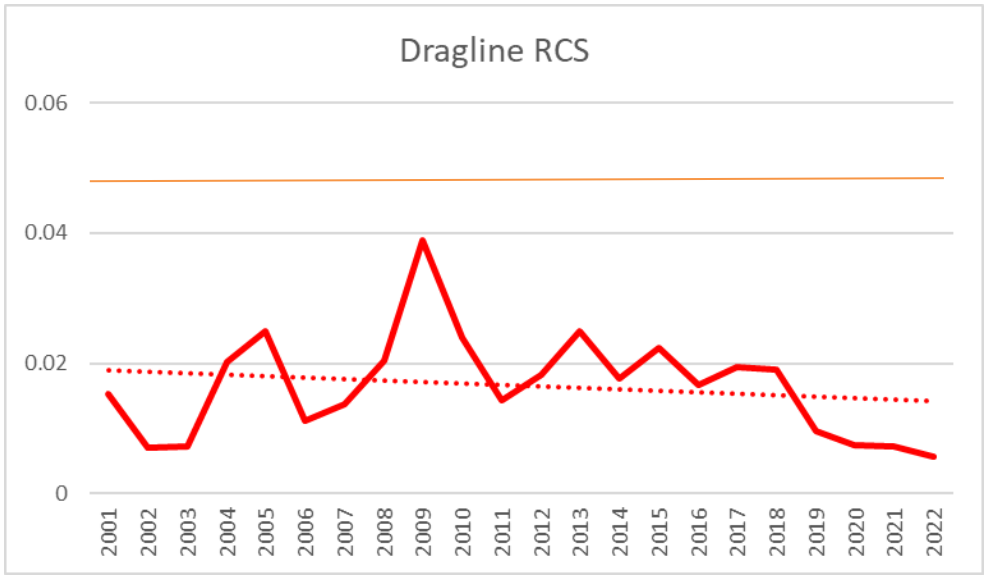
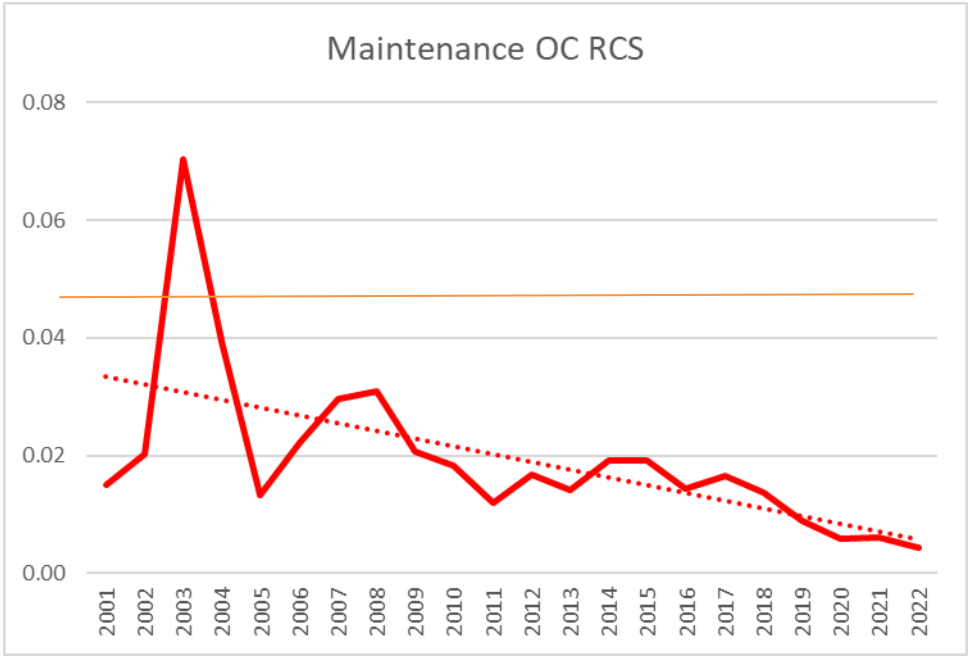
0.04
0.02
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Dragline RCS
0.06
0.04
0.02
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Maintenance OC RCS
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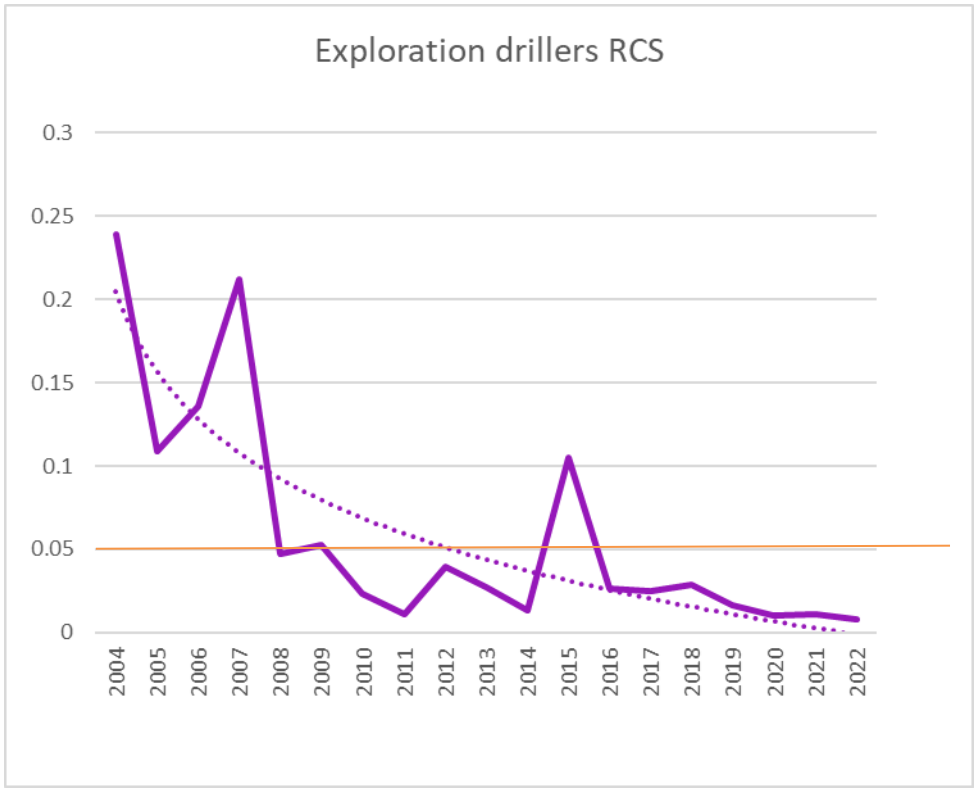
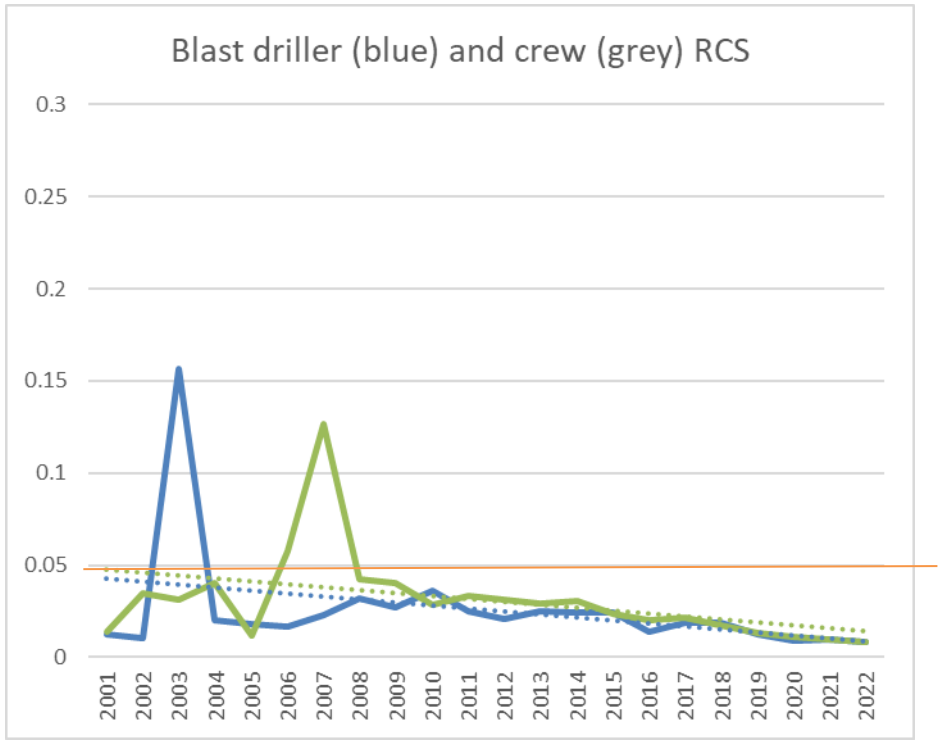
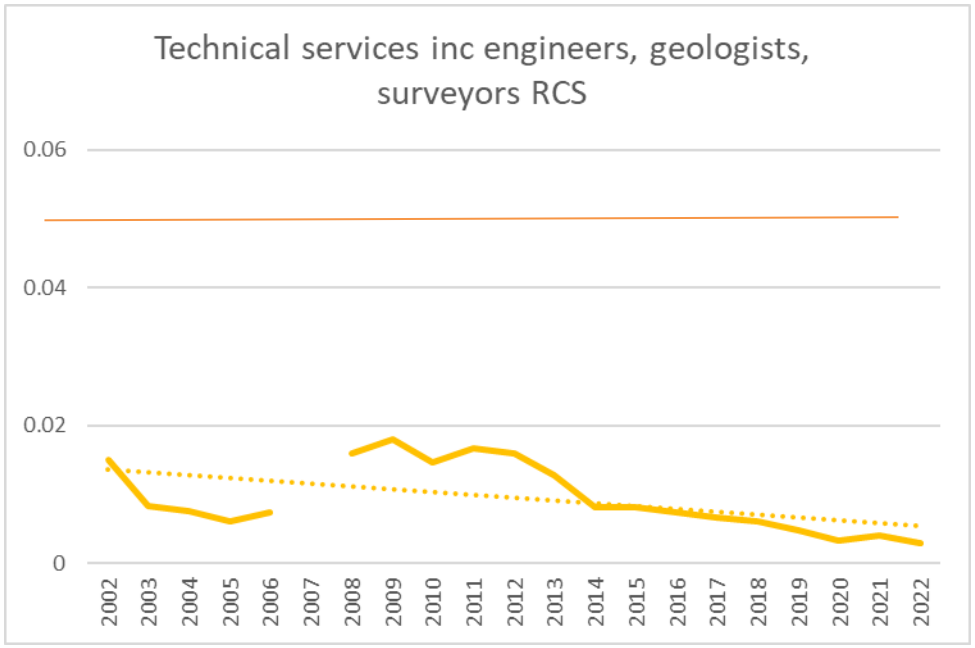
0.06
0.04
0.02
0.00
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

Note change of Scale






Technical services inc engineers, geologists, surveyors RCS
0.06
0.04
0.02
0
2002
2003
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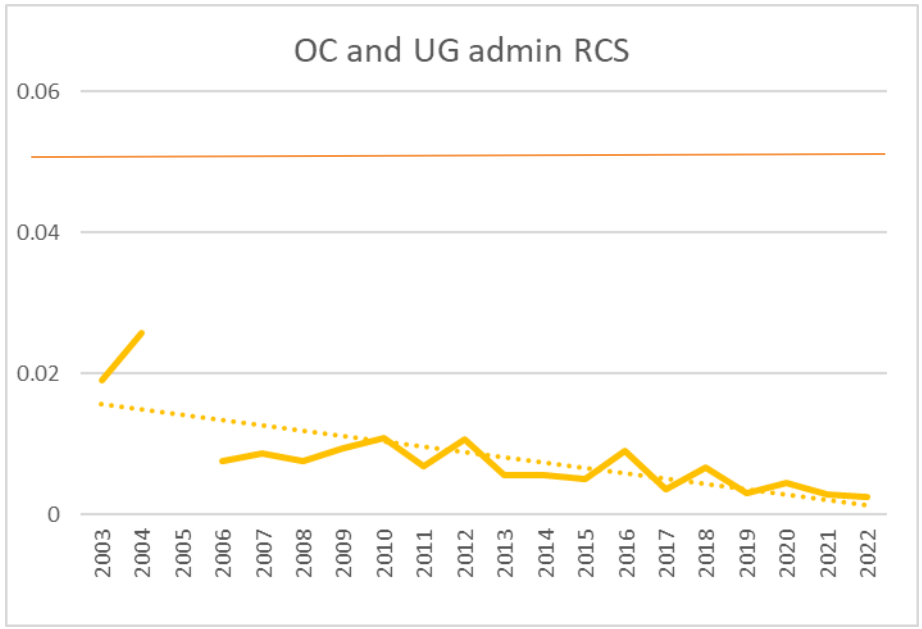
2020
2021
2022


OC and UG admin RCS
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0.04
0.02
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
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2016
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2018
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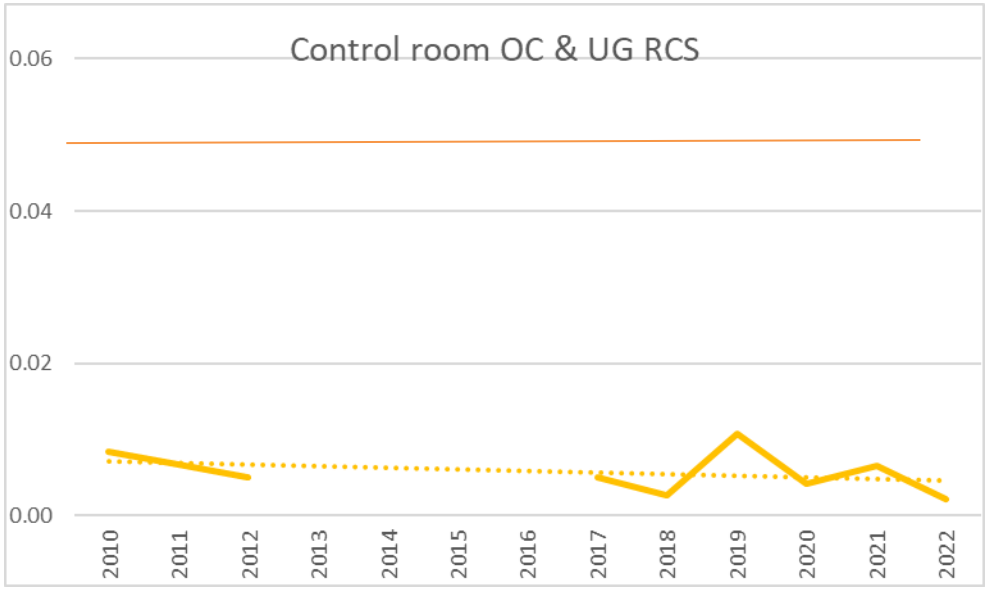
2020
2021
2022


Control room OC & UG RCS
0.06
0.04
0.02
0.00
2010
2011
2012
2013
2014
2015
2016
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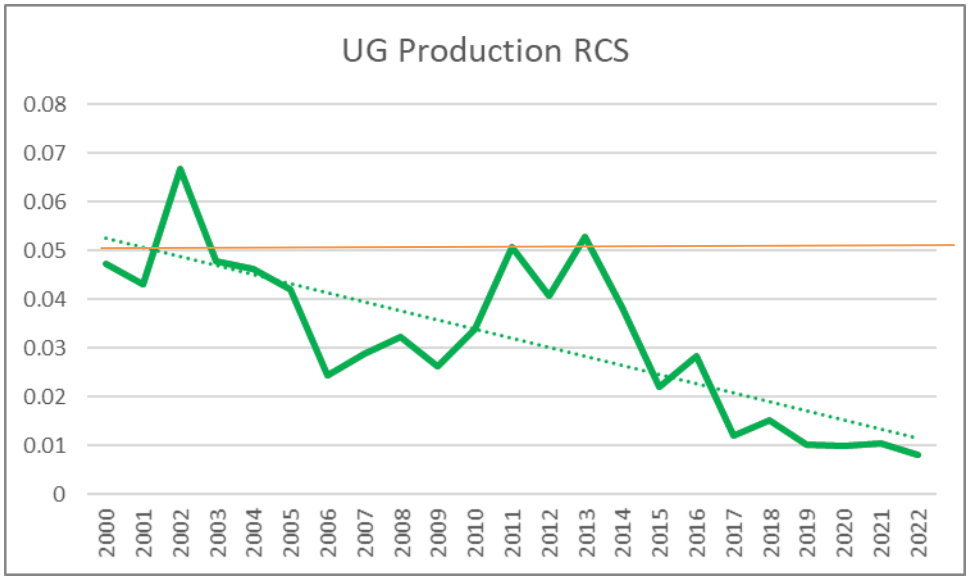
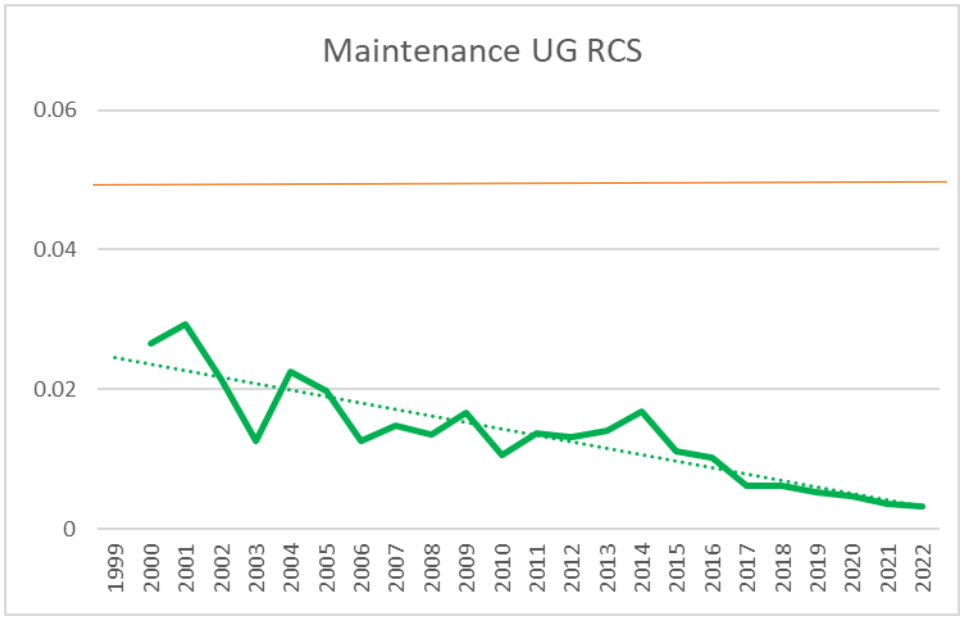
2021
2022


UG Production RCS
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Maintenance UG RCS
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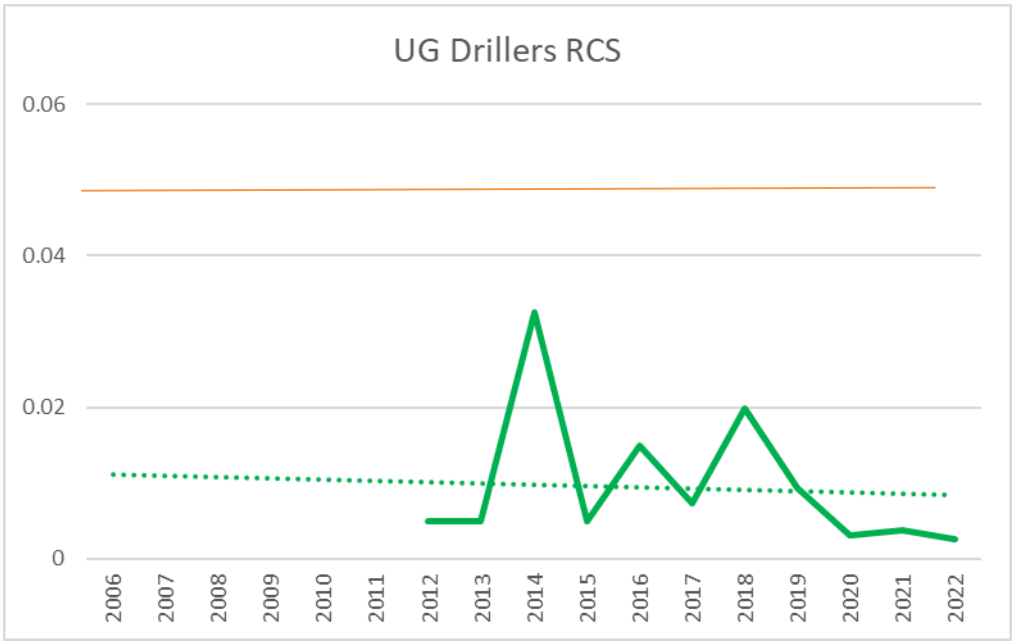
0.02
0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


UG Drillers RCS
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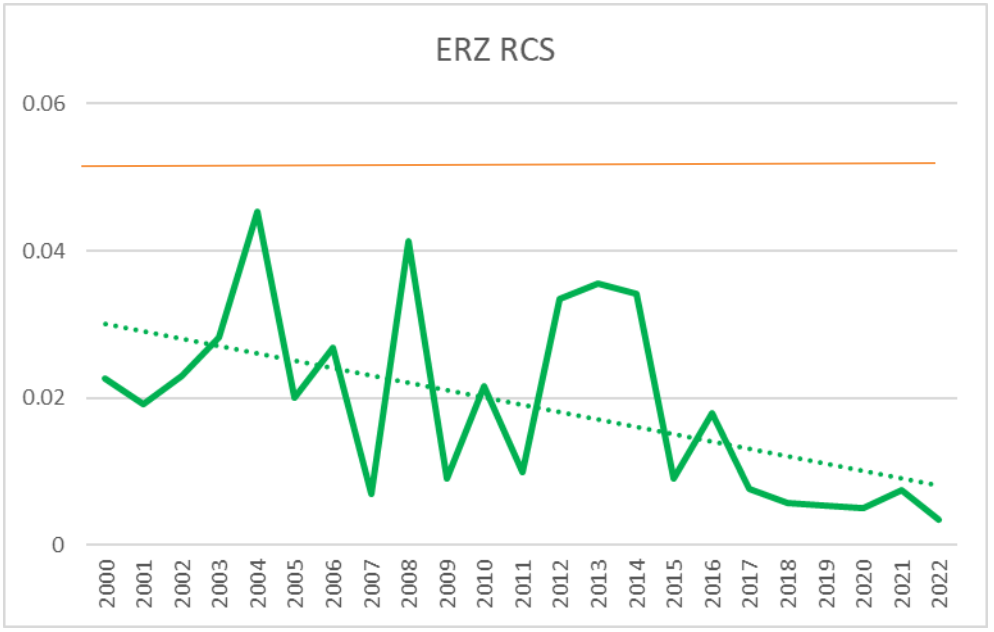
2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


ERZ RCS
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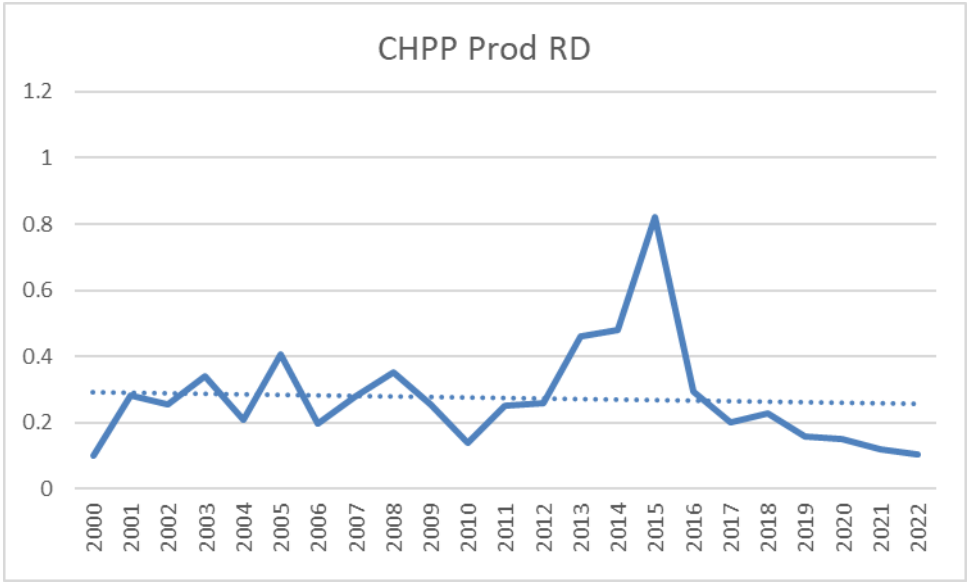
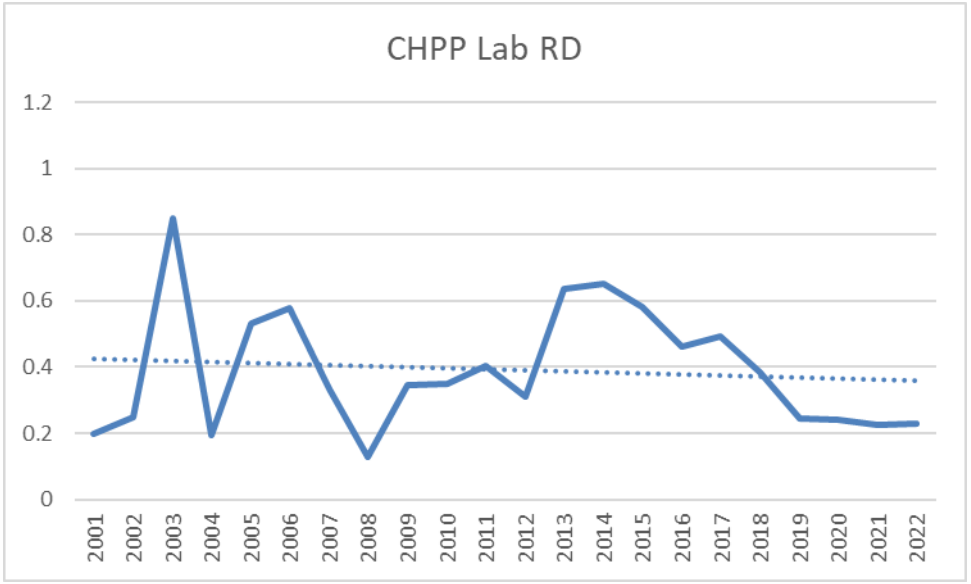
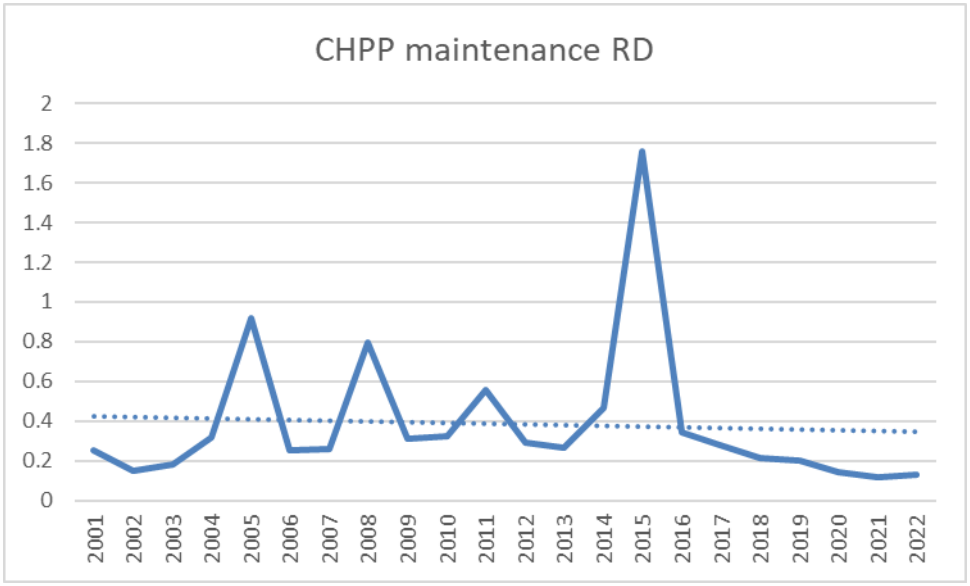
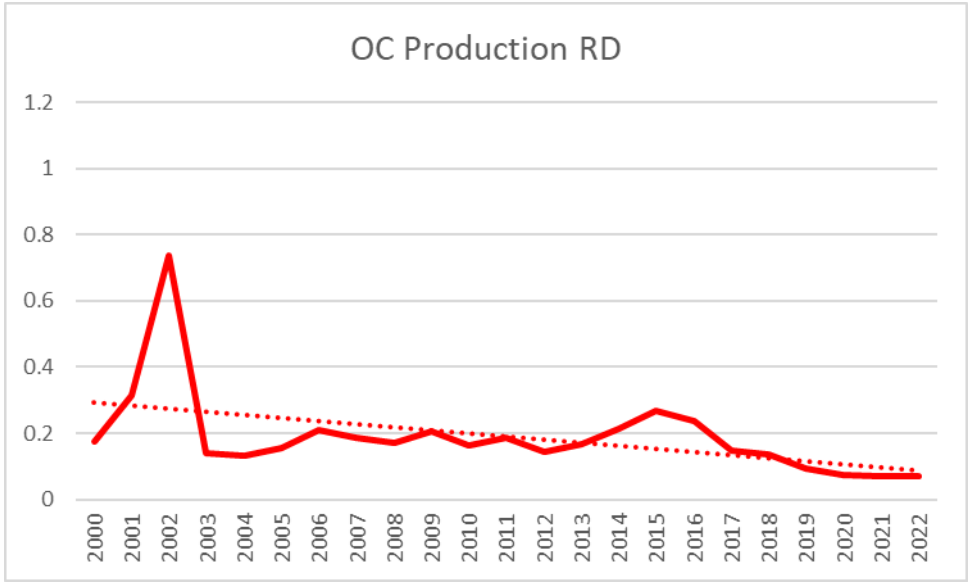




Note change of Scale



Queensland OEL 2020 1.5 mg/m^3


OC Production RD
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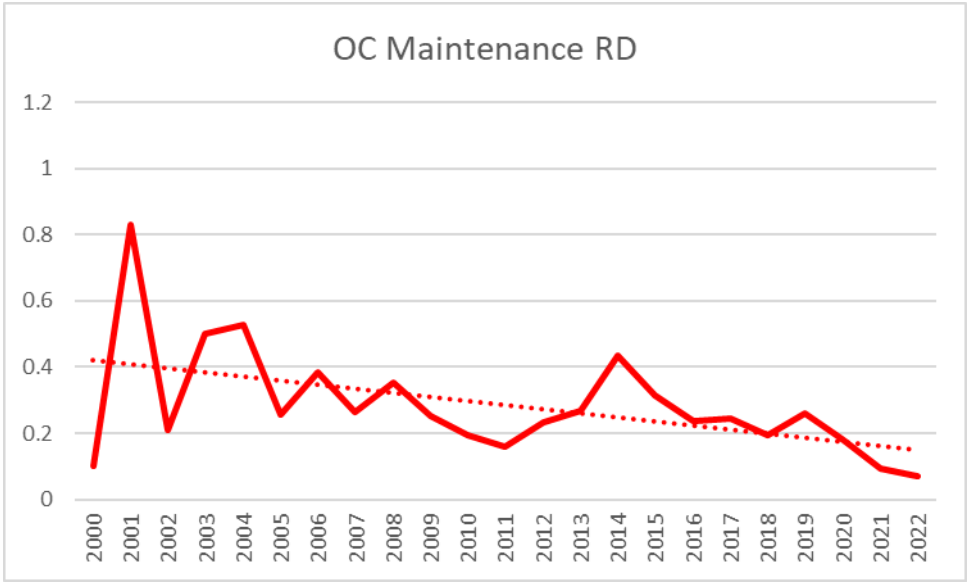
1
0.8
0.6
0.4
0.2
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


OC Maintenance RD
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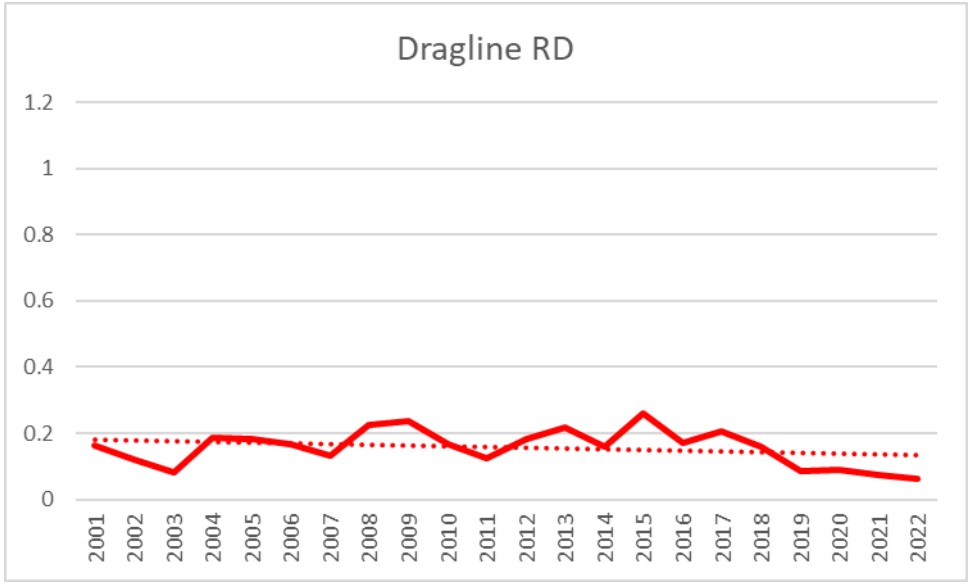
Dragline RD
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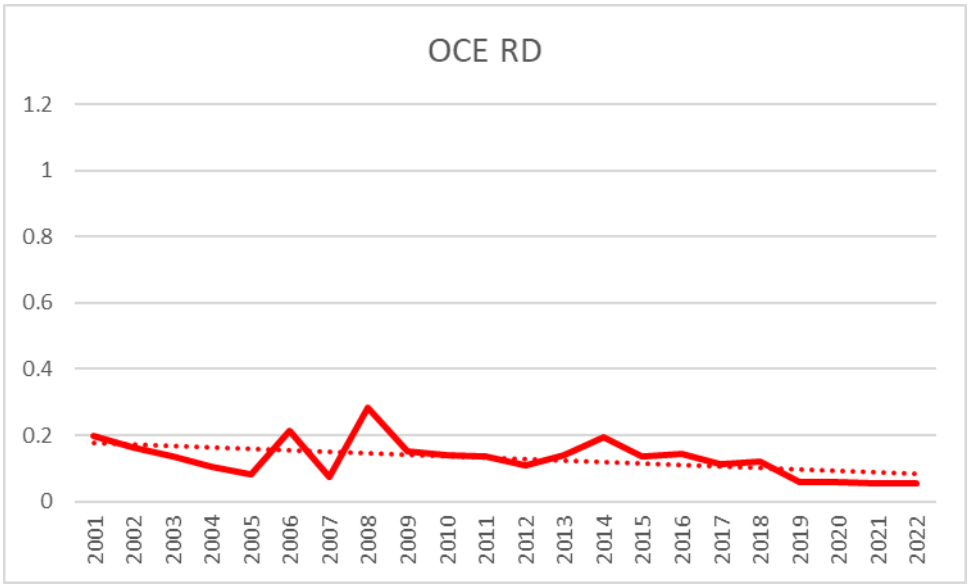
1
0.8
0.6
0.4
0.2
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


OCE RD
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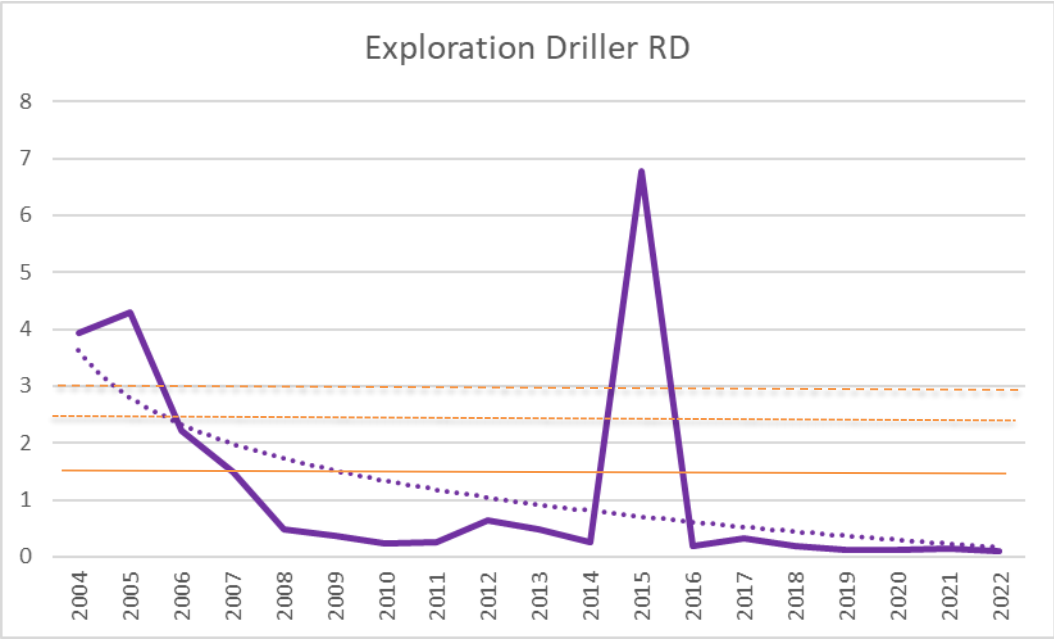
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

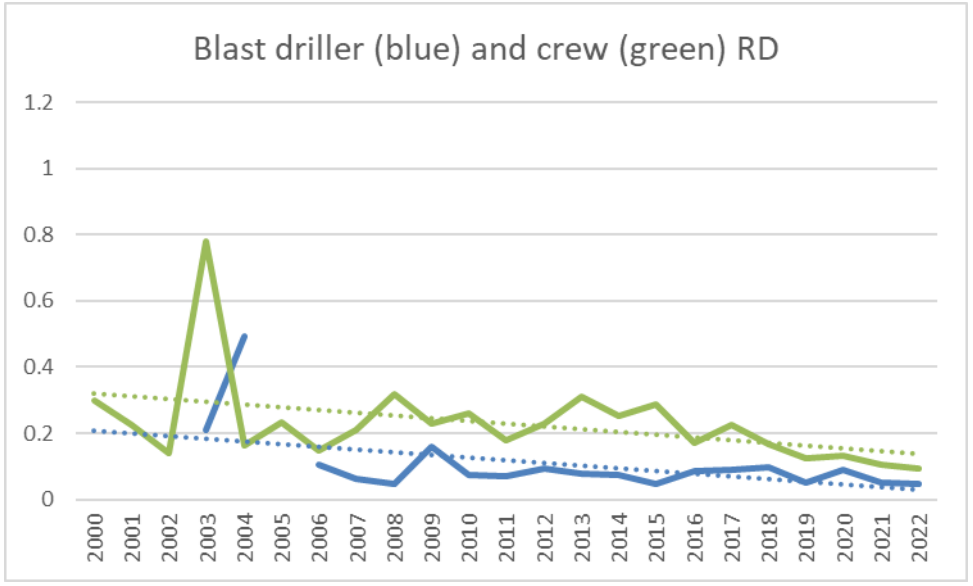
Note change of Scale



Qld OEL for RDs

pre 2018
2018

2020


Blast driller (blue) and crew (green) RD
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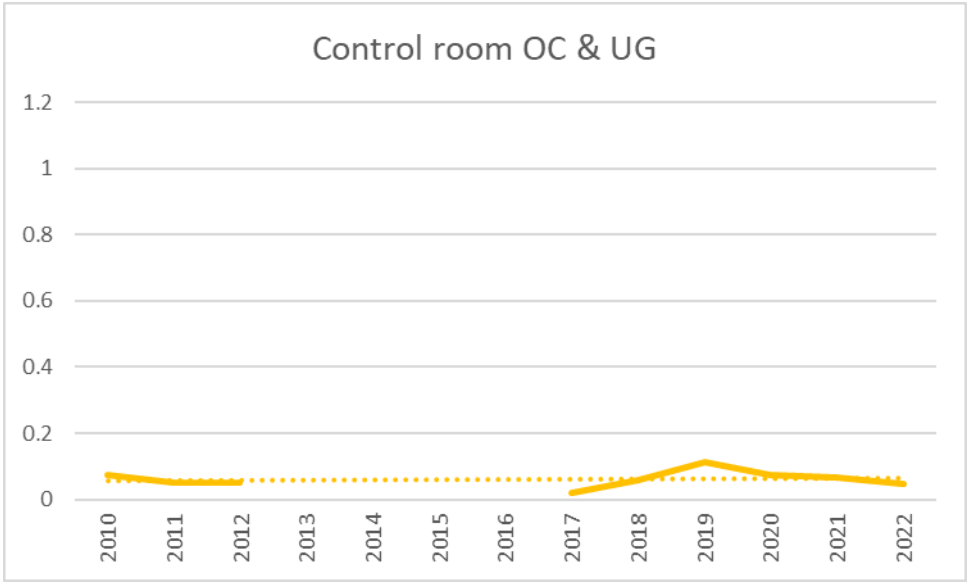
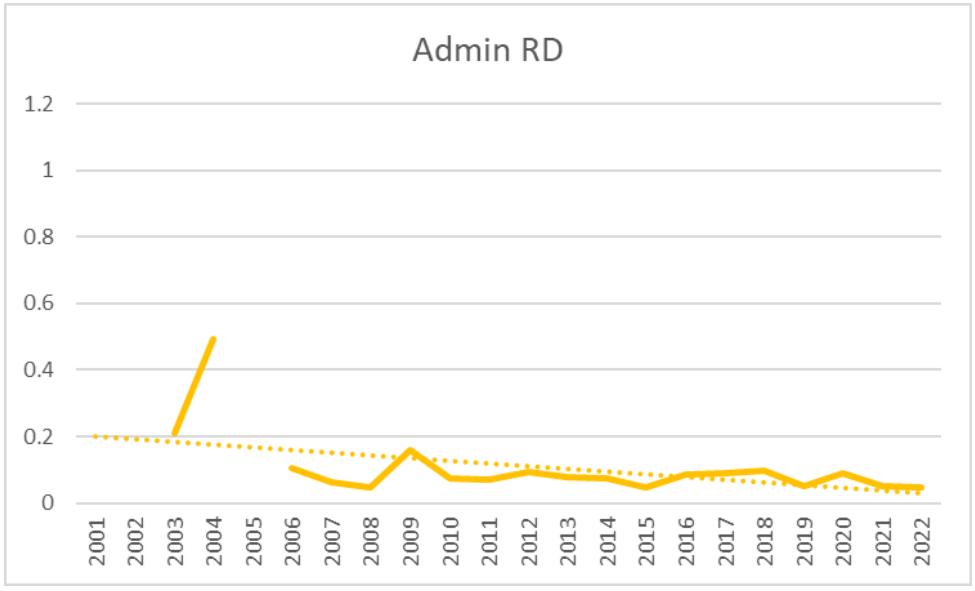
1
0.8
0.6
0.4
0.2
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Control room OC & UG
1.2
1
0.8
0.6
0.4
0.2
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Admin RD
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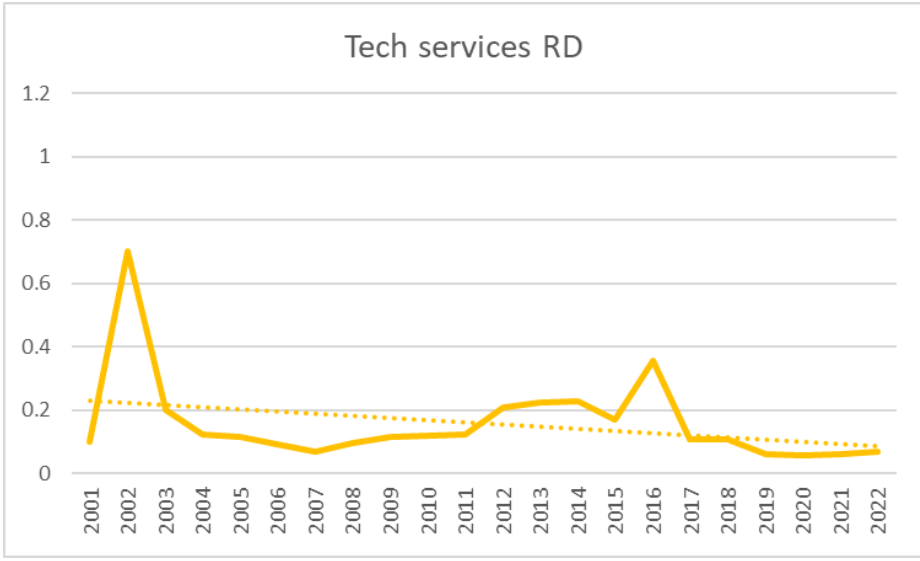
0.8
0.6
0.4
0.2
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Tech services RD
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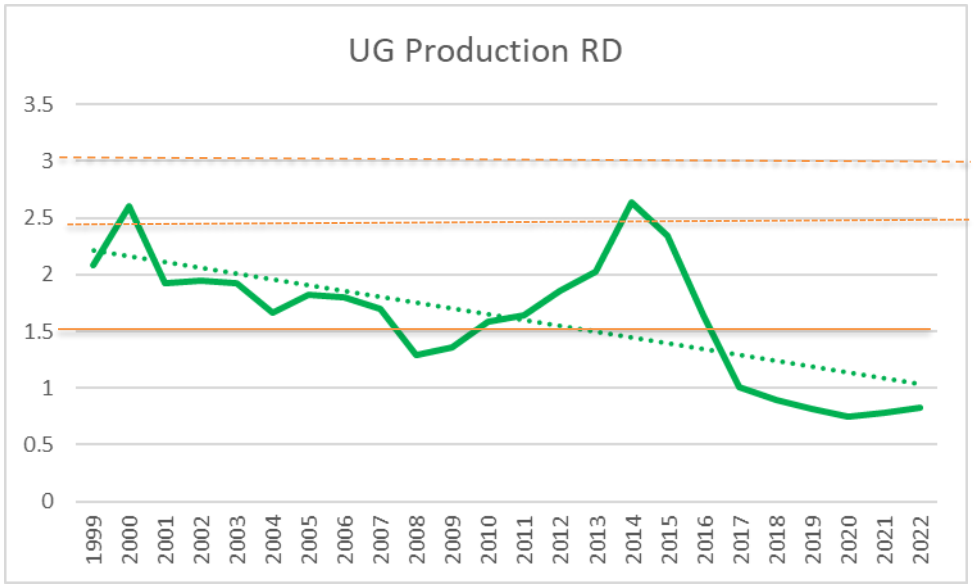
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022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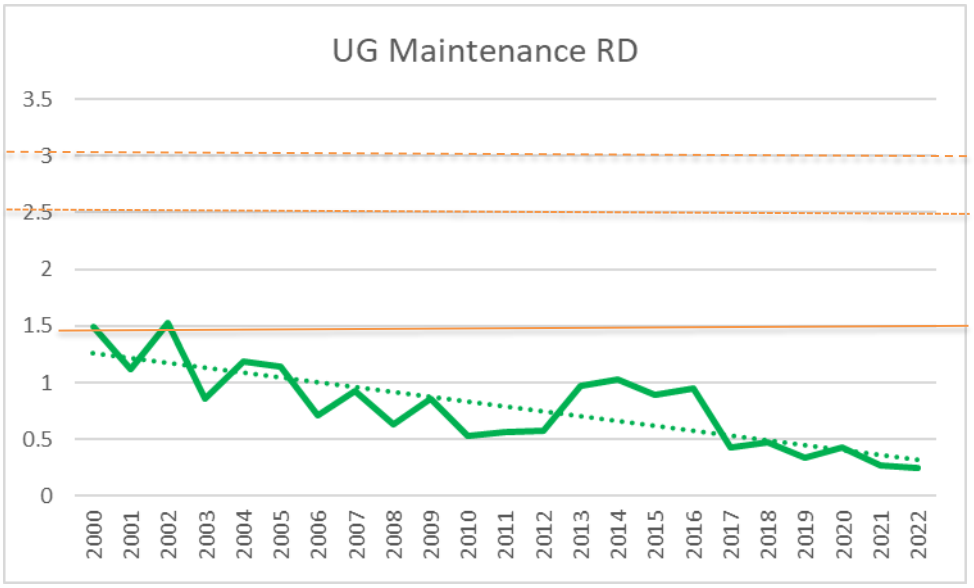
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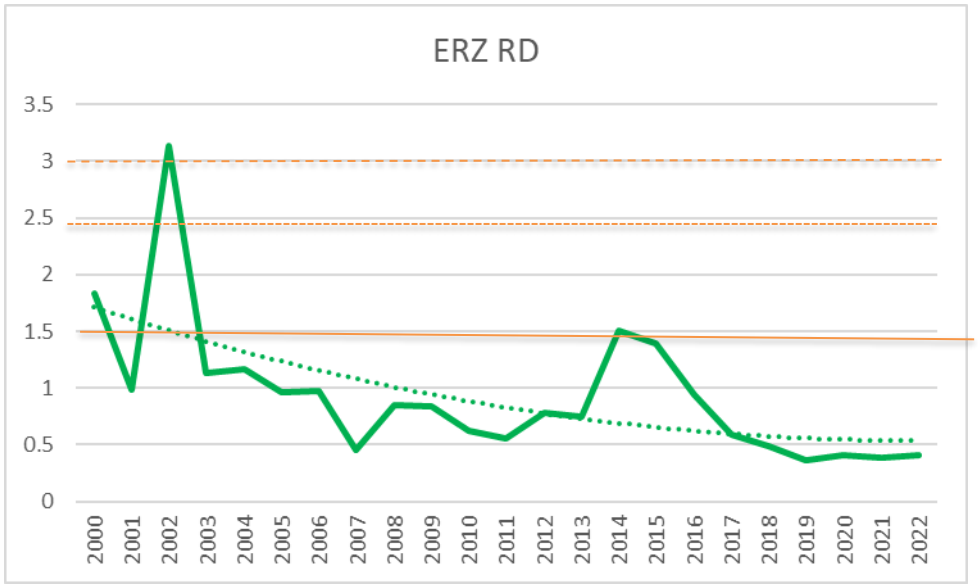
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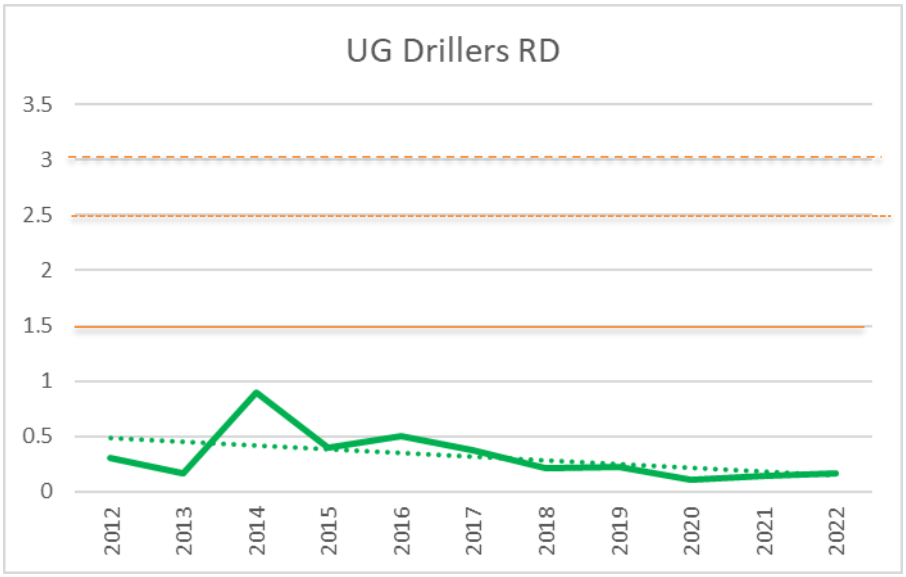
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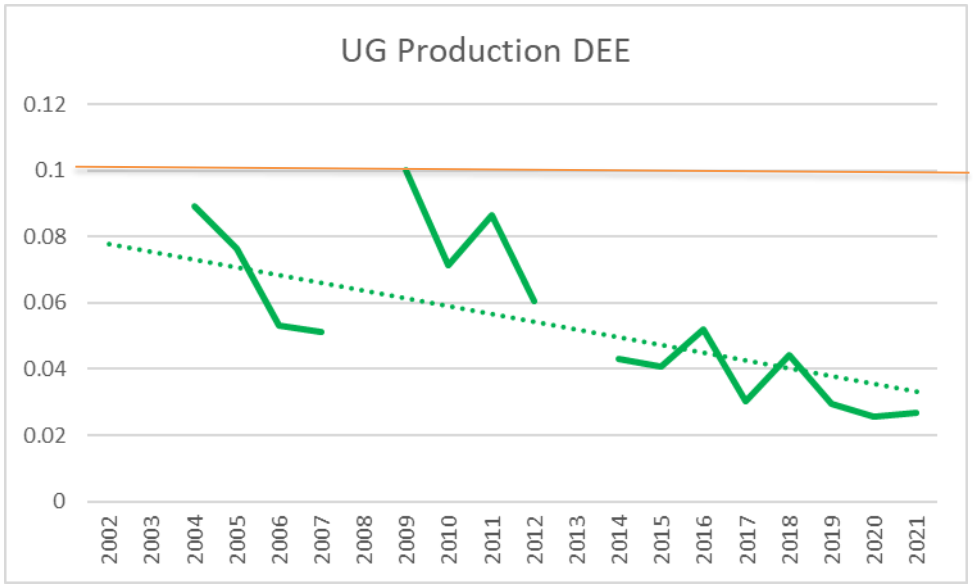

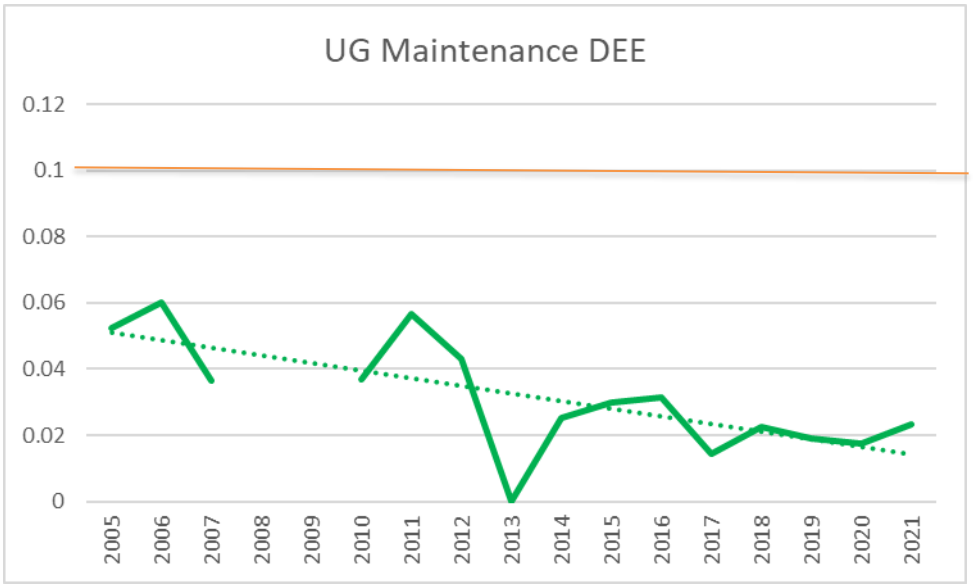

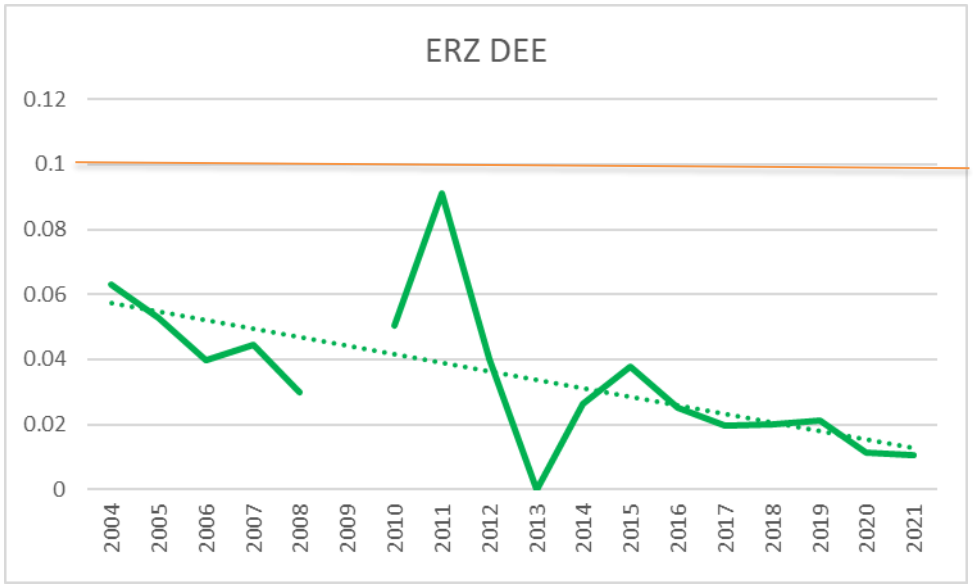

Queensland DPM OEL

Appendix 7 Smoking status

Smoking status for Men by Work Category and Job Group

Work Category/Job Group	Last Known Smoking status			Comparison between current group and all other coal mine workers
	Never smoked	Current smoker	Ex-smoker	
	n (row %)	n (row %)	n (row %)	p-value
ONLY Unexposed Office				
Administration	**7202 (57.5)**	**2110 (16.8)**	**3213 (25.7)**	<0.001
All other coal mine workers	67900 (45.0)	43823 (29.0)	39238 (26.0)	
ONLY Unexposed Non-Office	**2079 (46.7)**	**1477 (33.2)**	**899 (20.2)**	<0.001
All other coal mine workers	73023 (45.9)	44456 (28.0)	41552 (26.1)	
Blue Collar (Not Exposed)	1127 (43.0)	924 (35.3)	568 (21.7)	<0.001
All other coal mine workers	73975 (46.0)	45009 (28.0)	41883 (26.0)	
Control Room	83 (58.0)	19 (13.3)	41 (28.7)	<0.001
All other coal mine workers	75019 (45.9)	45914 (28.1)	42410 (26.0)	
Environmental Services	869 (51.3)	534 (31.5)	290 (17.1)	<0.001
All other coal mine workers	74233 (45.9)	45399 (28.1)	42161 (26.1)	
ONLY Occasionally Exposed	**7259 (68.2)**	**1667 (15.7)**	**1717 (16.1)**	<0.001
All other coal mine workers	67843 (44.4)	44266 (29.0)	40734 (26.7)	
Engineer	4490 (75.8)	598 (10.1)	835 (14.1)	<0.001
All other coal mine workers	70612 (44.8)	45335 (28.8)	41616 (26.4)	
Mine Services	406 (43.5)	361 (38.7)	167 (17.9)	<0.001
All other coal mine workers	74696 (46.0)	45572 (28.0)	42284 (26.0)	
Technical Services	2363 (62.4)	708 (18.7)	715 (18.9)	<0.001
All other coal mine workers	72739 (45.5)	45225 (28.3)	41736 (26.1)	
EVER Maintenance - All	**28240 (46.3)**	**16752 (27.5)**	**15993 (26.2)**	<0.001
All other coal mine workers	46862 (45.7)	29181 (28.5)	26458 (25.8)	
Maintenance – General (Nec)	8166 (42.6)	5460 (28.5)	5527 (28.9)	<0.001
All other coal mine workers	66936 (46.4)	40473 (28.0)	36924 (25.6)	
Abrasive, Blast, Sand, Paint	222 (29.4)	374 (49.6)	158 (21)	<0.001
All other coal mine workers	74880 (46.0)	45559 (28.0)	42293 (26.0)	
Shutdown Maintenance	2059 (33.5)	2417 (39.3)	1671 (27.2)	<0.001
All other coal mine workers	73043 (46.4)	43516 (27.7)	40780 (25.9)	
Belt Splicer	177 (31.3)	230 (40.7)	158 (28)	<0.001
All other coal mine workers	74925 (46.0)	45703 (28.1)	42293 (26.0)	
Boilermaker	3454 (42.1)	2584 (31.5)	2176 (26.5)	<0.001
All other coal mine workers	71648 (46.1)	43349 (27.9)	40275 (25.9)	
Fitter (Nec)	6124 (48.4)	2733 (21.6)	3789 (30.0)	<0.001
All other coal mine workers	68978 (45.7)	43200 (28.6)	38662 (25.6)	
Diesel Fitter	5255 (52.3)	2086 (20.8)	2702 (26.9)	<0.001
All other coal mine workers	69847 (45.5)	43847 (28.6)	39749 (25.9)	
Tyre Fitter	204 (30.4)	249 (37.1)	218 (32.5)	<0.001
All other coal mine workers	74898 (46.0)	45684 (28.1)	42233 (25.9)	
Electrician	6238 (56.2)	2061 (18.6)	2797 (25.2)	<0.001
All other coal mine workers	68864 (45.2)	43872 (28.8)	39654 (26.0)	
Electrician (Auto)	645 (56.9)	211 (18.6)	278 (24.5)	<0.001
All other coal mine workers	74457 (45.9)	45722 (28.2)	42173 (26.0)	
Industrial Cleaner	246 (30.4)	364 (45.0)	198 (24.5)	<0.001
All other coal mine workers	74856 (46.0)	45569 (28.0)	42253 (26.0)	
EVER Production - All	**21295 (38.8)**	**15801 (28.8)**	**17850 (32.5)**	<0.001
All other coal mine workers	53807 (49.6)	30132 (27.8)	24601 (22.7)	
Blast Crew	858 (46.4)	351 (19.0)	640 (34.6)	0.349
All other coal mine workers	74244 (45.9)	45582 (28.2)	41811 (25.9)	
Driller (Blast)	132 (36.8)	82 (22.8)	145 (40.4)	<0.001

Work Category/Job Group	Last Known Smoking status			Comparison between current group and all other coal mine workers
	Never smoked	Current smoker	Ex-smoker	
	n (row %)	n (row %)	n (row %)	p-value
All other coal mine workers	74970 (46.0)	45851 (28.1)	42306 (25.9)	
Driller (General)	1252 (32.9)	1359 (35.7)	1197 (31.4)	<0.001
All other coal mine workers	73850 (46.2)	44574 (27.9)	41254 (25.8)	
CHPP Plant Operator	590 (39.4)	287 (19.2)	620 (41.4)	<0.001
All other coal mine workers	74512 (46.0)	45646 (28.2)	41831 (25.8)	
Laboratory	390 (43.0)	283 (31.2)	234 (25.8)	<0.001
All other coal mine workers	74712 (46.0)	45650 (28.1)	42217 (26.0)	
Driller (Ug, Coal Seam)	119 (45.8)	66 (25.4)	75 (28.8)	0.088
All other coal mine workers	74983 (45.9)	45867 (28.1)	42376 (26.0)	
ERZ / Deputy	427 (41.1)	116 (11.2)	495 (47.7)	<0.001
All other coal mine workers	87743 (47.0)	52128 (27.9)	46760 (25.1)	
Open cut Examiner (OC Only)	204 (38.1)	57 (10.6)	275 (51.3)	<0.001
All other coal mine workers	74898 (46)	45876 (28.2)	42176 (25.9)	
Dragline (OC Only)	348 (33.5)	160 (15.4)	532 (51.2)	<0.001
All other coal mine workers	74754 (46.0)	45773 (28.2)	41919 (25.8)	
Secondary Support	134 (42.4)	89 (28.2)	93 (29.4)	0.313
All other coal mine workers	74968 (45.9)	45844 (28.1)	42358 (26)	
Miner	4035 (38.7)	2552 (24.4)	3851 (36.9)	<0.001
All other coal mine workers	71067 (46.4)	43381 (28.3)	38600 (25.2)	
Operator	16132 (38.3)	12003 (28.5)	14029 (33.3)	<0.001
All other coal mine workers	58970 (48.6)	33930 (28)	28422 (23.4)	
Prestrip	136 (31.8)	95 (22.2)	197 (46.0)	<0.001
All other coal mine workers	74966 (46.0)	45838 (28.1)	42254 (25.9)	
Scraper	53 (30.6)	76 (43.9)	44 (25.4)	<0.001
All other coal mine workers	75049 (46.0)	45857 (28.1)	42407 (26.0)	
EVER Driller (Exploration)	**1877 (38.0)**	**1845 (37.3)**	**1219 (24.7)**	<0.001
All other coal mine workers	73225 (46.2)	44088 (27.8)	41232 (26.0)	
EVER Construction	**3561 (39.7)**	**3399 (37.9)**	**2019 (22.5)**	<0.001
All other coal mine workers	71541 (46.3)	42534 (27.5)	40432 (26.2)	
Civil Works	250 (33.1)	272 (36.0)	234 (31.0)	0.313
All other coal mine workers	74852 (46.0)	45661 (28.1)	42217 (25.9)	
Construction	3315 (40.2)	3131 (38.0)	1791 (21.7)	<0.001
All other coal mine workers	71787 (46.2)	42802 (27.6)	40660 (26.2)	
EVER Unclear Work Category				
Labourer (Nec)	2083 (36.0)	2363 (40.8)	1344 (23.2)	<0.001
All other coal mine workers	73019 (46.3)	43570 (27.6)	41107 (26.1)	
Cleaner (Nec)	333 (35.5)	413 (44.0)	193 (20.6)	<0.001
All other coal mine workers	74769 (46.0)	45520 (28.0)	42258 (26.0)	
Supervisor (Nec)	2033 (36.6)	1409 (25.4)	2110 (38.0)	<0.001
All other coal mine workers	73069 (46.3)	44524 (28.2)	40341 (25.5)	
Truck Driver (Nec)	2773 (36.2)	2419 (31.6)	2462 (32.2)	<0.001
All other coal mine workers	72329 (46.4)	43514 (27.9)	39989 (25.7)	

Smoking status for Women by Work Category and Job Group

Work Category/Job Group	Smoking status			Comparison between current group and other coal mine workers
	Never smoked n(row %)	Current smoker n(row %)	Ex-smoker n(row %)	p-value
ONLY Unexposed Office				
Administration	4674 (62.5)	1366 (18.3)	1438 (19.2)	<0.001
All other coal mine workers	8394 (50.2)	4945 (29.6)	3366 (20.1)	
ONLY Unexposed Non-Office	**1015 (49.9)**	**657 (32.3)**	**362 (17.8)**	<0.001
All other coal mine workers	12053 (54.4)	5654 (25.5)	4442 (20.1)	
Blue Collar (Not Exposed)	554 (43.2)	478 (37.3)	250 (19.5)	<0.001
All other coal mine workers	12514 (54.6)	5833 (25.5)	4554 (19.9)	
Environmental Services	411 (60.2)	172 (25.2)	100 (14.6)	0.001
All other coal mine workers	12657 (53.9)	6139 (26.1)	4704 (20.0)	
ONLY Occasionally Exposed	**1201 (64.7)**	**427 (23.0)**	**229 (12.3)**	<0.001
All other coal mine workers	11867 (53.2)	5884 (26.4)	4575 (20.5)	
Engineer	489 (87.6)	35 (6.3)	34 (6.1)	<0.001
All other coal mine workers	12579 (53.2)	6276 (26.6)	4770 (20.2)	
Mine Services	268 (40.7)	283 (42.9)	108 (16.4)	<0.001
All other coal mine workers	12800 (54.4)	6028 (25.6)	4696 (20)	
Technical Services	444 (69.4)	109 (17.0)	87 (13.6)	<0.001
All other coal mine workers	12624 (53.6)	6202 (26.3)	4717 (20.0)	
EVER Maintenance - All	**965 (48.1)**	**616 (30.7)**	**426 (21.2)**	<0.001
All other coal mine workers	12103 (54.6)	5695 (25.7)	4378 (19.7)	
Maintenance – General (Nec)	339 (44.3)	225 (29.4)	202 (26.4)	<0.001
All other coal mine workers	12729 (54.4)	6086 (26.0)	4602 (19.7)	
Diesel Fitter	84 (61.8)	24 (17.6)	28 (20.6)	0.071
All other coal mine workers	12984 (54.0)	6287 (26.1)	4776 (19.9)	
Electrician	182 (69.2)	43 (16.3)	38 (14.4)	<0.001
All other coal mine workers	12886 (53.9)	6268 (26.2)	4766 (19.9)	
Industrial Cleaner	291 (39.8)	292 (39.9)	149 (20.4)	<0.001
All other coal mine workers	12777 (54.5)	6019 (25.7)	4655 (19.8)	
EVER Production - All	**3322 (48.4)**	**1842 (26.8)**	**1701 (24.8)**	<0.001
All other coal mine workers	9746 (56.3)	4469 (25.8)	3103 (17.9)	
Blast Crew	93 (55.7)	33 (19.8)	41 (24.6)	0.104
All other coal mine workers	12975 (54.0)	6278 (26.1)	4763 (19.8)	
Laboratory	382 (52.0)	196 (26.7)	157 (21.4)	0.462
All other coal mine workers	12686 (54.1)	6115 (26.1)	4647 (19.8)	
Miner	157 (46.0)	66 (19.4)	118 (34.6)	<0.001
All other coal mine workers	12911 (54.2)	6245 (26.2)	4686 (19.7)	
Operator	2746 (47.3)	1581 (27.2)	1479 (25.5)	<0.001
All other coal mine workers	10322 (56.2)	4730 (25.7)	3325 (18.1)	
EVER Driller (Exploration)	**23 (53.5)**	**12 (27.9)**	**8 (18.6)**	0.956
All other coal mine workers	13045 (54.0)	6299 (26.1)	4796 (19.9)	
EVER Construction	**52 (46.0)**	**39 (34.5)**	**22 (19.5)**	
All other coal mine workers	13016 (54.1)	6272 (26.1)	4782 (19.9)	0.108
EVER Unclear Work Category				
Labourer (Nec)	97 (40.1)	91 (37.6)	54 (22.3)	<0.001
All other coal mine workers	12971 (54.2)	6220 (26.0)	4750 (19.8)	
Cleaner (Nec)	1057 (38.5)	1146 (41.8)	540 (19.7)	<0.001
All other coal mine workers	12011 (56.0)	5165 (24.1)	4264 (19.9)	
Truck Driver (Nec)	377 (42.4)	279 (31.4)	233 (26.2)	<0.001
All other coal mine workers	12691 (54.5)	6032 (25.9)	4571 (19.6)	

Appendix 8 Standardised Mortality Tables

Table 25: Standardized Mortality Ratios (SMR) for male coal mine workers by Work Category compared to the Australian and Queensland populations

Cause of death categories	Observed	Comparison rate			
		Australia		Queensland	
		E	SMR* (95% CI)	E	SMR* (95% CI)
Administration Only Administration *N=12,596; PY=132,633*					
All Causes	295	515	57 (51 – 64)	530	56 (50 - 62)
All Malignancies	140	192	73 (62 - 86)	201	70 (59 - 82)
All Injury and Trauma	44	79	56 (42 - 75)	87	50 (38 - 68)
Accidents	17	40	43 (27 - 69)	43	40 (25 - 64)
Suicide	25	33	77 (52 - 113)	40	62 (42 - 92)
Unexposed non-Office Only Unexposed Non-office *N=4,494; PY=41,033*					
All Causes	122	122	100 (84 – 120)	127	96 (81 - 115)
All Malignancies	45	42	107 (80 - 143)	44	102 (76 - 137)
All Injury and Trauma	22	24	92 (61 - 140)	27	81 (54 - 124)
Accidents	12	12	100 (57 - 176)	13	92 (52 - 162)
Suicide	10	10	100 (54 - 185)	13	79 (43 - 148)
Occasionally exposed Only Occasionally Exposed *N=10,714; PY= 111,574*					
All Causes	144	247	58 (50 – 69)	259	56 (47 - 65)
All Malignancies	62	77	81 (63 - 103)	80	77 (60 - 99)
All Injury and Trauma	41	65	63 (47 - 86)	74	55 (41 - 75)
Accidents	16	33	49 (30 - 80)	36	45 (28 - 73)
Suicide	24	27	88 (59 - 131)	34	70 (47 - 104)
Maintenance *N=61,309; PY= 758,949*					
All Causes	1391	1836	76 (72 – 80)	1915	73 (69 - 77)
All Malignancies	514	592	87 (80 - 95)	618	83 (76 - 91)
All Injury and Trauma	434	445	98 (89 - 107)	502	86 (79 - 95)
Accidents	207	225	92 (80 - 105)	245	84 (74 - 97)
Suicide	211	185	114 (99 - 130)	230	92 (80 - 105)
Production *N=55,252; PY=753,893*					
All Causes	1979	2339	85 (81 – 88)	2422	82 (78 - 85)
All Malignancies	771	821	94 (88 - 101)	858	90 (84 - 96)
All Injury and Trauma	509	**447**	**114 (104 - 124)**	500	102 (93 - 111)
Accidents	267	**227**	**118 (104 - 133)**	246	109 (96 - 122)
Suicide	228	**185**	**123 (108 - 140)**	227	101 (88 - 115)
Construction *N= 9,034; PY= 100,766*					
All Causes	254	259	98 (87 - 111)	270	94 (83 - 106)
All Malignancies	87	86	101 (82 - 124)	90	97 (78 - 119)
All Injury and Trauma	77	**59**	**132 (105 - 164)**	66	116 (93 - 145)
Accidents	37	29	126 (91 - 173)	32	116 (84 - 159)
Suicide	37	**25**	**151 (109 - 208)**	31	121 (87 - 169)
Exploration Driller *N= 4,970; PY= 54,690*					
All Causes	80	87	92 (74 – 114)	93	86 (69 - 107)
All Malignancies	19	22	88 (56 - 137)	23	84 (54 - 132)
All Injury and Trauma	43	**32**	**136 (101 - 184)**	36	119 (88 - 160)
Accidents	23	16	146 (97 - 219)	17	133 (88 - 199)
Suicide	15	13	112 (67 - 185)	17	88 (53 - 146)
Labourer *N=5,814; PY=69,441*					
All Causes	138	124	111 (94 – 131)	131	105 (89 - 124)
All Malignancies	35	34	102 (73 - 142)	36	98 (70 - 136)
All Injury and Trauma	56	**40**	**140 (108 - 182)**	46	123 (94 - 159)
Accidents	30	**20**	**148 (104 - 212)**	22	135 (95 - 193)
Suicide	22	17	132 (87 - 200)	21	104 (69 - 159)
Cleaner *N=948; PY=10,112*					
All Causes	21	26	79 (52 – 122)	28	76 (50 - 117)
All Malignancies	6	9	67 (30 - 149)	9	64 (29 - 142)
All Injury and Trauma	9	6	158 (82 - 303)	7	139 (72 - 266)
Accidents	7	**3**	**242 (115 - 507)**	**3**	**221 (106 - 464)**
Suicide	---	---	84 (21 - 334)	---	67 (17 - 266)

Supervisor *N=5,575; PY=85,840*					
All Causes	163	293	56 (48 - 65)	302	54 (46 - 63)
All Malignancies	83	105	79 (64 - 98)	110	75 (61 - 94)
All Injury and Trauma	35	52	68 (49 - 94)	57	61 (44 - 85)
Accidents	14	26	54 (32 - 90)	28	50 (29 - 84)
Suicide	21	21	98 (64 - 151)	26	81 (53 - 125)
Truck Driver *N=7,701; PY=96,203*					
All Causes	336	369	91 (82 – 101)	380	88 (79 - 98)
All Malignancies	133	139	96 (81 - 113)	145	92 (77 - 109)
All Injury and Trauma	80	**57**	**141 (113 - 176)**	**63**	**128 (103 - 159)**
Accidents	46	**29**	**161 (120 - 214)**	**31**	**149 (112 - 199)**
Suicide	33	**23**	**141 (101 - 199)**	28	116 (83 - 164)

Table 26: Standardized Mortality Ratios (SMR) for female coal mine workers by Work Category compared to the Australian and Queensland populations

Cause of death categories	Observed	Comparison rate			
		Australia		Queensland	
		E	SMR* (95% CI)	E	SMR* (95% CI)
Administration *N=7,538; PY=79,488*					
All Causes	50	85	59 (45 - 78)	88	57 (43 - 75)
All Malignancies	30	38	79 (55 - 113)	38	78 (55 - 112)
All Injury and Trauma	<6		14 (3 - 54)		13 (3 - 51)
Accidents	<6		14 (2 - 97)		13 (2 - 92)
Suicide	0				
Unexposed non-Office *N=2,049; PY=18,448*					
All Causes	20	24	84 (54 - 131)	24	82 (53 - 127)
All Malignancies	8	11	72 (36 - 144)	11	71 (36 - 142)
All Injury and Trauma	<6		145 (60 - 348)		137 (57 - 329)
Accidents	<6		116 (29 - 464)		111 (28 - 445)
Suicide	<6		144 (36 - 575)		128 (32 - 511)
Maintenance *N=2,025; PY= 17,909*					
All Causes	9	19	46 (24 - 89)	20	45 (23 - 86)
All Malignancies	<6		47 (18 - 126)		47 (17 - 124)
All Injury and Trauma	<6		61 (15 - 242)		57 (14 - 226)
Accidents	<6		121 (30 - 486)		117 (29 - 466)
Suicide	0				
Production *N=6,913; PY=66,047*					
All Causes	51	66	77 (58 - 101)	69	74 (56 - 98)
All Malignancies	22	29	75 (49 - 114)	30	74 (49 - 112)
All Injury and Trauma	16	12	131 (80 - 214)	13	122 (75 - 200)
Accidents	6	6	100 (45 - 222)	6	95 (43 - 212)
Suicide	10	**5**	**201 (108 - 374)**	6	177 (95 - 329)
Cleaner *N=2,763; PY=30,034*					
All Causes	48	45	107 (81 - 142)	46	105 (79 - 139)
All Malignancies	21	22	97 (63 - 149)	22	96 (63 - 148)
All Injury and Trauma	15	**6**	**261 (157 - 433)**	**6**	**247 (149 - 409)**
Accidents	8	**3**	**276 (138 - 552)**	**3**	**263 (132 - 526)**
Suicide	<6		177 (66 - 471)	3	156 (59 - 417)

Table 27: All-Cause Mortality SMR by Job Groups – all Site Types combined – Men only

Job Group	All Men *N=162,887 PY=1,972,946*			Only those with 2+assessments *N=53,673 PY=547,042*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ONLY Unexposed Office						
Administration	295	515	57 (51 - 64)	47	79	59 (45 - 79)
ONLY Unexposed Non-Office	**122**	**122**	**100 (84 – 120)**	**20**	**23**	**89 (57 – 137)**
Blue Collar (Not Exposed)	86	88	98 (79 – 121)	17	20	84 (52 – 136)
Control Room	---	---	80 (26 – 247)	---	---	167 (42 – 666)
Environmental Services	33	30	108 (77 - 153)	---	---	84 (12 – 593)
ONLY Occasionally Exposed	**144**	**247**	**58 (50 - 69)**	**12**	**31**	**39 (22 - 68)**
Engineer	63	134	47 (37 - 60)	7	14	51 (24 – 107)
Mine Services	22	20	110 (72 – 166)	0		
Technical Services	59	92	64 (49 - 82)	5	16	31 (13 - 75)
EVER Maintenance - All	**1391**	**1836**	**76 (72 - 80)**	**527**	**758**	**70 (64 - 76)**
Maintenance – General (Nec)	470	626	75 (69 - 82)	208	296	70 (61 - 81)
Abrasive, Blast, Sand, Paint	21	21	100 (65 - 153)	---	---	76 (32 - 182)
Shutdown Maintenance	207	210	99 (86 - 113)	86	78	110 (89 - 136)
Belt Splicer	9	13	72 (37 - 138)	---	---	81 (31 - 217)
Boilermaker	203	267	76 (66 - 87)	71	121	59 (47 - 74)
Fitter (Nec)	280	435	64 (57 - 72)	141	219	64 (55 - 76)
Diesel Fitter	116	208	56 (46 - 67)	57	99	57 (44 - 74)
Tyre Fitter	22	18	120 (79 - 183)	11	11	100 (56 - 181)
Electrician	191	330	58 (50 - 67)	55	130	42 (32 - 55)
Electrician (Auto)	11	22	50 (28 - 91)	6	10	62 (28 - 138)
Industrial Cleaner	13	18	72 (42 - 125)	---	---	80 (33 - 193)
EVER Production - All	**1979**	**2339**	**85 (81 - 88)**	**1017**	**1264**	**80 (76 - 86)**
Production – General (Nec)	---**	---	141 (58 - 338)	---	---	58 (8 - 414)
Blast Crew	40	61	66 (48 - 89)	21	33	63 (41 - 97)
Driller (Blast)	9	11	83 (43 - 160)	7	7	106 (51 - 223)
Driller (General)	128	120	106 (89 - 127)	57	54	105 (81 - 136)
CHPP Plant Operator	46	92	50 (37 - 67)	39	75	52 (38 - 71)
Laboratory	22	30	74 (49 - 112)	11	15	71 (39 - 128)
Driller (Ug, Coal Seam)	---	---	75 (31 - 180)	---	---	92 (23 - 367)
ERZ / Deputy	46	88	52 (39 - 70)	34	67	50 (36 - 71)
Open cut Examiner (OC Only)	25	57	44 (30 - 65)	23	53	43 (29 - 65)
Dragline (OC Only)	77	105	73 (58 - 91)	72	94	77 (61 - 96)
Secondary Support	6	7	81 (37 - 181)	---	---	37 (5 - 264)
Miner	368	504	73 (66 - 81)	250	342	73 (65 - 83)
Operator	1472	1775	83 (79 - 87)	751	952	79 (73 - 85)
Prestrip	6	17	35 (16 - 77)	---	---	40 (17 - 96)
Scraper	**9**	**3**	**330 (172 - 634)**	**---**	**---**	**338 (109 - 1048)**
Production Support	---	---	233 (33 - 1652)	0		
Tunneller	---	---	155 (65 - 373)	---	---	156 (39 - 624)
EVER Driller (Exploration)	**80**	**87**	**92 (74 - 114)**	**17**	**16**	**106 (66 - 170)**
EVER Construction	**254**	**259**	**98 (87 - 111)**	**43**	**55**	**78 (58 - 105)**
Civil Works	22	33	66 (44 - 101)	10	13	77 (41 - 143)
Construction	232	227	102 (90 - 116)	33	42	78 (55 - 109)
EVER Unclear Work Category						
Labourer (Nec)	138	124	111 (94 - 131)	31	32	97 (68 – 138)
Cleaner (Nec)	21	26	79 (52 - 122)	---	---	62 (26 - 149)
Supervisor (Nec)	163	293	56 (48 - 65)	83	158	52 (42 - 65)
Truck Driver (Nec)	336	369	91 (82 - 101)	107	134	80 (66 - 97)
Missing Job Group †	74	70	105 (84 – 132)	---	---	28 (9 – 86)
ALL MALE WORKERS	4629	5679	82 (79 - 84)	1647	2719	61 (58 – 64)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

**-- No workers in this category; † All assessments had Job Group as Unknown.

Table 28: All-cause mortality SMR for male coal mine workers in each Work Category and Job Group, by Site Types where workers had EVER worked

Job Group	Ever Open Cut *N=68,282; PY=940,963*			Ever Underground *N=33,790; PY=449,687*			Ever CHPP *N=2,929; PY=47,217*			Ever Unknown Site Type *N=112,191; PY=1,370,528*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
All Workers	2198	2934	75 (72 – 78)	768	1124	68 (64 – 73)	78	149	52 (42 – 65)	2865	3701	77 (75 – 80)
Only ever Unexposed Office												
Administration – General only	97	195	50 (41 - 61)	63	100	63 (49 - 81)	---	---	24 (3 - 171)	159	300	53 (45 - 62)
Only ever Unexposed Non-Office	48	47	102 (77 - 136)	9	12	76 (39 - 145)	NA			70	74	94 (75 - 119)
Blue Collar (Not Exposed)	34	37	92 (66 - 128)	---	---	61 (25 - 147)	NA			50	51	98 (74 - 129)
Control Room	---**	---	113 (28 - 453)	---	---	130 (18 - 921)	NA			0		
Environmental Services	12	8	148 (84 - 261)	---	---	102 (33 - 315)	NA			20	22	93 (60 - 143)
Only ever Occasionally Exposed	48	85	56 (42 - 75)	23	51	45 (30 - 68)	---	---	112 (16 - 797)	85	150	57 (46 - 70)
Engineer	25	48	52 (35 - 77)	10	30	34 (18 - 63)	---	---	117 (17 - 834)	34	75	45 (32 - 63)
Mine Services	7	6	112 (53 - 235)	---	---	55 (8 - 389)	NA			14	14	102 (60 - 172)
Technical Services	16	31	51 (31 - 84)	12	19	62 (35 - 108)	0			37	61	60 (44 - 83)
Ever Maintenance - All	570	847	67 (62 - 73)	210	320	66 (57 - 75)	6	21	28 (13 - 63)	854	1161	74 (69 - 79)
Maintenance – General (Nec)	176	260	68 (58 - 78)	67	90	75 (59 - 95)	NA			261	332	79 (70 - 89)
Abrasive, Blast, Sand, Paint	7	6	124 (59 - 260)	---	---	190 (48 - 761)	NA			17	16	104 (64 - 167)
Shutdown Maintenance	75	84	89 (71 - 112)	21	20	107 (70 - 164)	NA			152	154	99 (84 - 116)
Belt Splicer	---	---	233 (87 - 620)	3	7	44 (14 - 138)	NA			---	---	31 (8 - 122)
Boilermaker	84	126	67 (54 - 83)	16	24	66 (40 - 107)	NA			125	171	73 (61 - 87)
Fitter (Nec)	115	195	59 (49 - 71)	55	91	61 (47 - 79)	---	---	60 (23 - 160)	144	238	60 (51 - 71)
Diesel Fitter	55	109	51 (39 - 66)	13	24	53 (31 - 92)	NA			70	131	54 (42 - 68)
Tyre Fitter	14	13	111 (66 - 188)	0			NA			12	9	134 (76 - 235)
Electrician	81	152	53 (43 - 66)	39	91	43 (31 - 59)	---	---	17 (2 - 121)	103	185	56 (46 - 67)
Electrician (Auto)	---	---	39 (16 - 94)	NA			NA			9	14	63 (33 - 120)
Industrial Cleaner	6	7	81 (36 - 181)	---	---	77 (11 - 547)	**---**	**---**	**725 (102 - 5144)**	7	10	72 (34 - 151)
Ever Production - All	1079	1354	80 (75 - 85)	363	483	75 (68 - 83)	68	121	56 (44 - 71)	916	1089	84 (79 - 90)
Production – General (Nec)	---	---	132 (43 - 410)	---	---	129 (18 - 914)	NA			---	---	195 (27 - 1382)
Blast Crew	23	39	59 (39 - 89)	---	---	53 (17 - 164)	NA			16	30	54 (33 - 88)
Driller (Blast)	---	---	65 (27 - 156)	---	---	323 (45 - 2293)	NA			---	---	112 (42 - 297)
Driller (General)	59	52	113 (88 - 146)	7	17	42 (20 - 88)	NA			76	72	105 (84 - 132)
CHPP Plant Operator	NA‡			NA			46	92	50 (37 - 67)	NA		
Laboratory	NA			NA			22	30	74 (49 - 112)	NA		
Driller (Ug, Coal Seam)	NA			---	---	75 (31 - 180)	NA			NA		
ERZ / Deputy	NA			46	88	52 (39 - 70)	NA			NA		
Open Cut Examiner (OC Only)	25	57	44 (30 - 65)	NA			NA			NA		
Dragline (OC Only)	77	105	73 (58 - 91)	NA			NA			NA		
Secondary Support	NA			6	7	81 (37 - 181)	NA			NA		
Miner	111	170	65 (54 - 79)	229	297	77 (68 - 88)	NA			67	82	82 (64 - 104)

Job Group	Ever Open Cut *N=68,282; PY=940,963*			Ever Underground *N=33,790; PY=449,687*			Ever CHPP *N=2,929; PY=47,217*			Ever Unknown Site Type *N=112,191; PY=1,370,528*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
Operator	905	1160	78 (73 - 83)	109	175	62 (52 - 75)	NA			766	932	82 (77 - 88)
Prestrip	---	---	20 (6 - 62)	0			NA			---	---	119 (38 - 369)
Scraper	---	---	229 (74 - 711)	0			NA			**6**	**1**	**417 (188 - 929)**
Production Support	NA			---	---	233 (33 - 1652)	NA			NA		
Tunneller	NA			---	---	155 (65 - 373)	NA			0		
Ever Driller (Exploration)	10	11	91 (49 - 169)	7	10	68 (32 - 142)	NA			64	70	92 (72 - 117)
Construction - All	93	92	101 (83 - 124)	25	29	86 (58 - 127)	NA			159	165	96 (83 - 113)
Civil Works	8	15	53 (26 - 106)	---	---	97 (24 - 386)	NA			13	17	76 (44 - 131)
Construction	85	77	111 (90 - 137)	23	27	85 (57 - 128)	NA			146	148	99 (84 - 116)
Unclear Work Category												
Ever Labourer (Nec)	32	26	124 (88 - 176)	17	17	101 (63 - 162)	NA			92	86	107 (88 - 132)
Ever Cleaner (Nec)	12	11	111 (63 - 196)	---	---	57 (8 - 401)	NA			9	15	59 (31 - 113)
Ever Supervisor (Nec)	68	133	51 (40 - 65)	23	40	58 (38 - 87)	NA			85	147	58 (47 - 72)
Ever Truck Driver (Nec)	114	124	92 (77 - 111)	13	14	94 (54 - 161)	NA			224	254	88 (77 - 100)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

** -- Observed value <6.

‡ NA No worker in that Job Group within that Site Type.

Table 29: All-cause mortality SMR for male coal mine workers in each Work Category and Job Group, by Site Type (mutually exclusive groupings)

Job Group	Only worked in Open Cut (excludes CHPP, Underground) *N=58,799; PY=779,630*			Ever Underground (excludes CHPP) *N=33,284; PY=440,467*			Ever CHPP *N=2,929; PY=47,217*			Only Unknown *N=67,875; PY=705,632*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
All Workers	1985	2504	79 (76 – 83)	756	1103	69 (64 – 74)	78	149	52 (42 – 65)	1810	1923	94 (90 – 99)
Only ever Unexposed Office												
Administration – General only	91	179	51 (41 - 62)	63	99	63 (50 - 81)	---	---	24 (3 - 171)	140	233	60 (51 - 71)
Only ever Unexposed Non-Office	47	45	104 (78 - 138)	9	12	76 (39 - 145)	NA			66	65	102 (80 - 130)
Blue Collar (Not Exposed)	34	36	95 (68 - 133)	---	---	61 (25 - 147)	NA			47	44	107 (81 - 143)
Control Room	---	---	116 (29 - 463)	---	---	130 (18 - 921)	NA			0		
Environmental Services	11	8	142 (79 - 256)	---	---	102 (33 - 315)	NA			19	20	96 (61 - 151)
Only ever Occasionally Exposed	43	78	55 (41 - 75)	23	51	45 (30 - 68)	---	---	112 (16 - 797)	77	117	66 (53 - 82)
Engineer	22	43	51 (34 - 77)	10	30	34 (18 - 63)	---	---	117 (17 - 834)	30	61	49 (35 - 71)
Mine Services	7	6	115 (55 - 240)	---	---	55 (8 - 389)	NA			14	12	115 (68 - 195)
Technical Services	14	28	49 (29 - 83)	12	19	62 (35 - 108)	0			33	44	74 (53 - 104)
Ever Maintenance - All	513	711	72 (66 - 79)	207	311	67 (58 - 76)	6	21	28 (13 - 63)	568	619	92 (84 - 100)
Maintenance – General (Nec)	160	222	72 (62 - 84)	64	87	73 (57 - 94)	NA			179	184	97 (84 - 113)
Abrasive, Blast, Sand, Paint	7	5	135 (64 - 283)	---	---	196 (49 - 783)	NA			12	11	111 (63 - 195)
Shutdown Maintenance	68	76	90 (71 - 114)	21	19	109 (71 - 167)	NA			97	86	113 (93 - 138)
Belt Splicer	---	---	233 (75 - 723)	---	---	45 (14 - 139)	NA			---	---	40 (6 - 287)
Boilermaker	78	110	71 (57 - 89)	16	24	67 (41 - 110)	NA			94	101	93 (76 - 114)
Fitter (Nec)	99	158	63 (51 - 76)	55	88	62 (48 - 81)	---	---	60 (23 - 160)	89	115	77 (63 - 95)
Diesel Fitter	49	94	52 (39 - 69)	13	24	54 (31 - 92)	NA			35	52	68 (49 - 94)
Tyre Fitter	13	11	116 (67 - 199)	0			NA			**7**	**3**	**225 (107 - 472)**
Electrician	72	117	61 (49 - 77)	39	88	44 (32 - 61)	---	---	17 (2 - 121)	69	95	72 (57 - 92)
Electrician (Auto)	---	---	42 (18 - 101)	0			NA			---	---	72 (30 - 174)
Industrial Cleaner	---	---	73 (30 - 176)	---	---	77 (11 - 547)	**---**	**---**	**725 (102 - 5144)**	---	---	63 (24 - 167)
Ever Production - All	983	1181	83 (78 - 89)	357	473	75 (68 - 84)	68	121	56 (44 - 71)	**479**	**429**	**112 (102 - 122)**
Production – General (Nec)	---	---	103 (26 - 413)	---	---	129 (18 - 914)	NA			---	---	295 (42 - 2092)
Blast Crew	23	35	66 (44 - 99)	---	---	53 (17 - 165)	NA			11	11	103 (57 - 186)
Driller (Blast)	---	---	62 (23 - 164)	---	---	323 (45 - 2293)	NA			---	---	255 (64 - 1018)
Driller (General)	58	47	123 (95 - 160)	7	17	42 (20 - 89)	NA			**56**	**41**	**138 (106 - 179)**
CHPP Plant Operator	NA			NA			46	92	50 (37 - 67)	NA		
Laboratory	NA			NA			22	30	74 (49 - 112)	NA		
Driller (Ug, Coal Seam)	NA			5	7	75 (31 - 180)	NA			NA		
ERZ / Deputy	NA			46	87	53 (40 - 71)	NA			NA		
Open Cut Examiner (OC Only)	24	49	49 (33 - 74)	NA			NA			NA		
Dragline (OC Only)	72	101	72 (57 - 90)	NA			NA			NA		

Job Group	Only worked in Open Cut (excludes CHPP, Underground) *N=58,799; PY=779,630*			Ever Underground (excludes CHPP) *N=33,284; PY=440,467*			Ever CHPP *N=2,929; PY=47,217*			Only Unknown *N=67,875; PY=705,632*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
Secondary Support	NA			6	7	84 (38 - 187)	NA			NA		
Miner	89	135	66 (54 - 81)	224	292	77 (67 - 88)	NA			22	24	92 (61 - 140)
Operator	833	1021	82 (76 - 87)	108	169	64 (53 - 77)	NA			388	358	108 (98 - 120)
Prestrip	---	---	22 (7 - 70)	0			NA			0		
Scraper	---	---	258 (83 - 799)	0			NA			---	---	**661 (275 - 1587)**
Production Support	NA			---	---	244 (34 - 1729)	NA			NA		
Tunneller	NA			---	---	126 (47 - 335)	NA			NA		
Ever Driller (Exploration)	10	10	103 (55 - 191)	7	10	68 (32 - 142)	NA			54	53	103 (79 - 134)
Construction - All	90	84	108 (87 - 132)	25	29	86 (58 - 128)	NA			118	117	101 (84 - 121)
Civil Works	7	14	50 (24 - 104)	---	---	97 (24 - 386)	NA			7	10	71 (34 - 148)
Construction	83	70	119 (96 - 148)	23	27	85 (57 - 129)	NA			111	107	103 (86 - 125)
Unclear Work Category												
Ever Labourer (Nec)	29	23	124 (86 - 178)	17	17	102 (64 - 165)	NA			**73**	**57**	**129 (102 - 162)**
Ever Cleaner (Nec)	12	10	119 (67 - 209)	---	---	57 (8 - 403)	NA			8	11	76 (38 - 152)
Ever Supervisor (Nec)	59	115	51 (40 - 66)	21	39	54 (35 - 82)	NA			55	72	77 (59 - 100)
Ever Truck Driver (Nec)	109	116	94 (78 - 114)	13	14	94 (54 - 162)	NA			176	167	105 (91 - 122)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

** -- Observed value <6.

† All assessments had Site Type Unknown or Various (excludes workers where Job Group was unknown)

‡ NA No worker in that Job Group within that Site Type.

Table 30: SMRs* for male coal mine workers who ONLY worked in Administration categorised as Unexposed Office

Cause of death categories	Only Administration – General All workers *N=12,596; PY=132,633*		
	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	295	515	57 (51 – 64)
All Malignancies	140	192	73 (62 - 86)
Oesophagus	6	9	66 (30 – 148)
Stomach	---	---	31 (8 - 125)
Colorectal	15	20	77 (46 - 127)
Liver	8	12	65 (33 - 131)
Pancreas	8	13	64 (32 - 127)
Lung	30	40	75 (52 - 107)
Mesothelioma, pleural	---	---	123 (46 - 328)
Melanoma	10	8	119 (64 - 222)
Prostate	8	11	70 (35 - 140)
Bladder	---	---	31 (4 - 223)
Kidney	6	5	112 (50 - 249)
Brain	---	---	39 (15 - 104)
All Metabolic	10	21	48 (26 - 90)
Diabetes	6	14	42 (19 - 93)
All Mental and Behavioural	---	---	12 (2 - 88)
All Nervous System	6	18	33 (15 - 73)
All Circulatory	53	114	46 (35 - 61)
IHD	35	68	52 (37 - 72)
Cerebrovascular	---	---	24 (9 - 65)
Other Heart Disease	9	23	39 (20 - 75)
All Respiratory	18	28	63 (40 - 100)
COPD	6	16	38 (17 - 84)
All Digestive	10	25	39 (21 - 73)
Liver Disease	9	18	50 (26 - 96)
All Urinary	---	---	41 (10 - 163)
All Injury and Trauma	44	79	56 (42 - 75)
Accidents	17	40	43 (27 - 69)
Suicide	25	33	77 (52 - 113)
All Other Causes	10	24	41 (22 - 76)

***** Statistically significantly reduced SMR results are in **blue**

Table 31: SMRs* for male coal mine workers who ONLY worked in Job Groups categorised as Unexposed Non-Office

Cause of death categories	Only Unexposed Non-Office [ALL] All workers *N=4,494; PY=41,033*			Only Blue Collar (Not Exposed) All workers *N=2,641; PY=24,243*			Only Environmental Services All workers *N= 1,709; PY= 15,670*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	122	122	100 (84 – 120)	86	88	98 (79 – 121)	33	30	108 (77 – 153)
All Malignancies	45	42	107 (80 - 143)	34	32	106 (76 - 148)	10	9	115 (62 - 214)
Oesophagus	0			0			0		
Stomach	---	---	71 (10 - 505)	0			0		
Colorectal	**10**	**4**	**229 (123 - 426)**	**10**	**3**	**304 (163 - 565)**	0		
Liver	---	---	77 (19 - 307)	---	---	102 (25 - 407)	0		
Pancreas	---	---	185 (77 - 445)	**---**	**---**	**242 (101 - 581)**	0		
Lung	---	---	58 (24 - 139)	---	---	45 (14 - 138)	---	---	123 (31 - 490)
Mesothelioma, pleural	---	---	143 (20 - 1015)	---	---	177 (25 - 1260)	0		
Melanoma	---	---	162 (52 - 502)	---	---	73 (10 - 520)	---	---	**462 (116 - 1848)**
Prostate	---	---	159 (60 - 424)	---	---	197 (74 - 526)	0		
Bladder	0			0			0		
Kidney	---	---	87 (12 - 617)	---	---	115 (16 - 814)	0		
Brain	---	---	85 (21 - 339)	---	---	60 (8 - 424)	---	---	162 (23 - 1153)
All Metabolic	---	---	63 (20 - 196)	---	---	57 (14 - 228)	---	---	92 (13 – 651)
Diabetes	---	---	93 (30 - 288)	---	---	82 (21 - 329)	---	---	144 (20 - 1022)
All Mental and Behavioural	0			0			0		
All Nervous System	---	---	46 (12 - 184)	---	---	63 (16 - 253)	0		
All Circulatory	32	26	124 (88 - 175)	22	19	114 (75 - 173)	9	6	159 (83 – 305)
IHD	**23**	**15**	**153 (102 - 230)**	16	11	141 (87 - 231)	6	3	187 (84 - 415)
Cerebrovascular	---	---	53 (13 - 212)	0			---	---	255 (64 - 1021)
Other Heart Disease	---	---	93 (39 - 223)	---	---	128 (53 - 307)	0		
All Respiratory	6	6	93 (42 - 207)	---	---	101 (42 - 242)	---	---	79 (11 – 558)
COPD	---	---	85 (28 - 265)	---	---	108 (35 - 335)	0		
All Digestive	---	---	88 (37 - 211)	---	---	97 (36 - 258)	---	---	72 (10 – 513)
Liver Disease	---	---	76 (24 - 235)	---	---	71 (18 - 282)	---	---	100 (14 - 710)
All Urinary	0			0			0		
All Injury and Trauma	22	24	92 (61 - 140)	13	14	92 (53 - 158)	9	9	100 (52 – 192)
Accidents	12	12	100 (57 - 176)	8	7	112 (56 - 223)	---	---	89 (33 - 236)
Suicide	10	10	100 (54 - 185)	---	---	85 (35 - 204)	---	---	130 (54 - 311)
All Other Causes	6	6	103 (46 - 229)	---	---	74 (24 - 228)	---	---	127 (32 – 508)

***** Statistically significantly increased SMR results are in **red**

Table 32: SMRs* for male coal mine workers who ONLY worked in Job Groups categorised as Occasionally Exposed

Cause of death categories	Occasionally Exposed [ALL] All workers *N=10,714; PY= 111,574*			Engineer All workers *N=5,964; PY=63,141*			Mine Services All workers *N=944; PY=7,790*			Technical Services All workers *N=3,806; PY=40,642*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	144	247	58 (50 – 69)	63	134	47 (37 – 60)	22	20	110 (72 – 166)	59	92	64 (49 – 82)
All Malignancies	62	77	81 (63 - 103)	27	41	66 (45 - 96)	7	7	103 (49 - 217)	28	29	96 (66 - 139)
Oesophagus	---	---	85 (27 - 262)	---	---	107 (27 - 428)	0			---	---	74 (10 - 526)
Stomach	**6**	**3**	**227 (102 - 505)**	**---**	**---**	**284 (107 - 758)**	0			---	---	199 (50 - 795)
Colorectal	---	---	49 (18 - 131)	---	---	92 (35 - 246)	0			0		
Liver	---	---	41 (10 - 164)	---	---	39 (6 - 279)	0			---	---	54 (8 - 383)
Pancreas	---	---	41 (10 - 162)	---	---	38 (5 - 273)	---	---	221 (31 - 1570)	0		
Lung	14	15	93 (55 - 157)	---	---	63 (26 - 151)	---	---	74 (10 - 523)	8	6	140 (70 - 279)
Mesothelioma, pleural	---	---	261 (84 - 810)	0			**---**	**---**	**1030 (145 – 7316)**	**---**	**---**	**460 (115 - 1840)**
Melanoma	---	---	81 (26 - 250)	---	---	50 (7 - 354)	0			---	---	142 (36 - 568)
Prostate	---	---	105 (39 - 279)	---	---	98 (25 - 392)	0			---	---	138 (34 - 551)
Bladder	0			0			0			0		
Kidney	0			0			0			0		
Brain	8	5	160 (80 - 320)	---	---	74 (19 - 296)	---	---	237 (33 - 1684)	**---**	**---**	**267 (111 - 641)**
All Metabolic	---	---	11 (2 - 79)	0			0			---	---	29 (4 - 209)
Diabetes	---	---	17 (2 - 120)	0			0			---	---	45 (6 - 319)
All Mental and Behavioural	---	---	30 (4 - 211)	0			0			---	---	79 (11 - 560)
All Nervous System	---	---	47 (18 - 126)	---	---	22 (3 - 154)	0			---	---	95 (31 - 294)
All Circulatory	25	48	52 (35 - 78)	10	26	39 (21 - 73)	7	4	174 (83 - 364)	8	18	44 (22 - 88)
IHD	14	28	51 (30 - 86)	9	15	61 (32 - 118)	---	---	42 (6 - 300)	---	---	38 (14 - 101)
Cerebrovascular	6	7	91 (41 - 202)	---	---	28 (4 - 200)	---	---	366 (92 - 1464)	---	---	119 (39 - 370)
Other Heart Disease	---	---	38 (14 - 102)	0			**---**	**---**	**466 (175 - 1243)**	0		
All Respiratory	---	---	18 (5 - 73)	0			---	---	107 (15 - 758)	---	---	24 (3 - 171)
COPD	---	---	18 (3 - 126)	0			---	---	199 (28 - 1409)	0		
All Digestive	---	---	27 (9 - 82)	---	---	17 (2 - 118)	0			---	---	47 (12 - 186)
Liver Disease	---	---	12 (2 - 87)	---	---	23 (3 - 164)	0			0		
All Urinary	0			0			0			0		
All Injury and Trauma	41	65	63 (47 - 86)	20	37	54 (35 - 84)	7	4	157 (75 - 329)	14	23	60 (35 - 101)
Accidents	16	33	49 (30 - 80)	8	19	43 (22 - 86)	---	---	225 (94 - 542)	---	---	25 (8 - 79)
Suicide	24	27	88 (59 - 131)	11	15	71 (39 - 128)	---	---	104 (26 - 418)	11	10	111 (61 - 200)
All Other Causes	---	---	32 (12 - 86)	---	---	45 (14 - 138)	0			---	---	22 (3 - 154)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 33A: SMRs* for male coal mine workers who EVER worked in Job Groups categorised as Maintenance

Cause of death categories	Ever Maintenance (ALL)						Ever Maintenance – General (nec)					
	All workers *N=61,309; PY= 758,949*			2+assessments *N= 24,017; PY= 236,348*			All workers *N=19,250; PY=251,075*			2+assessments *N= 8,892; PY= 91,029*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	1391	1836	76 (72 – 80)	527	758	70 (64 – 76)	470	626	75 (69 – 82)	208	296	70 (61 – 81)
All Malignancies	514	592	87 (80 - 95)	230	268	86 (75 - 98)	171	204	84 (72 - 97)	87	105	83 (67 - 102)
Oesophagus	23	28	83 (55 – 126)	8	13	64 (32 - 127)	--	--	52 (22 - 126)	---	---	60 (19 - 186)
Stomach	17	20	83 (52 - 134)	6	9	66 (30 - 146)	6	7	85 (38 - 189)	---	---	56 (14 - 222)
Colorectal	51	62	82 (62 - 108)	25	28	89 (60 - 132)	17	21	80 (49 - 128)	9	11	82 (43 - 157)
Liver	31	37	83 (59 - 118)	12	17	72 (41 - 127)	8	13	62 (31 - 124)	---	---	60 (22 - 159)
Pancreas	39	38	103 (75 - 141)	14	17	81 (48 - 136)	14	13	107 (63 - 181)	7	7	102 (49 - 214)
Lung	106	118	90 (75 - 109)	49	55	89 (67 - 117)	37	41	91 (66 - 126)	18	22	83 (52 - 132)
Mesothelioma, pleural	**15**	**9**	**168 (101 - 278)**	**9**	**4**	**205 (107 - 394)**	**7**	**3**	**227 (108 - 476)**	---	---	237 (89 - 630)
Melanoma	28	29	97 (67 - 140)	12	12	97 (55 - 172)	7	10	70 (33 - 147)	---	---	41 (10 - 165)
Prostate	32	29	111 (79 - 157)	16	14	111 (68 - 181)	8	10	82 (41 - 164)	6	5	109 (49 - 243)
Bladder	7	9	79 (38 - 166)	---	---	71 (23 - 220)	0			0		
Kidney	16	17	95 (58 - 155)	7	8	92 (44 - 193)	8	6	136 (68 - 273)	---	---	166 (69 - 398)
Brain	31	37	83 (58 - 118)	12	15	78 (44 - 137)	12	13	93 (53 - 165)	6	6	98 (44 - 218)
All Metabolic	28	67	42 (29 - 61)	9	29	31 (16 - 59)	---	---	22 (9 - 53)	---	---	18 (4 - 70)
Diabetes	20	44	45 (29 - 70)	6	20	30 (14 - 67)	---	---	20 (6 - 62)	---	---	13 (2 - 92)
All Mental and Behavioural	11	27	41 (23 - 74)	---	---	35 (13 - 92)	---	---	33 (11 - 101)	---	---	45 (11 - 182)
All Nervous System	22	62	35 (23 - 54)	10	26	39 (21 - 72)	9	21	43 (22 - 82)	---	---	50 (21 - 121)
All Circulatory	227	369	61 (54 - 70)	90	164	55 (45 - 68)	85	127	67 (54 - 83)	36	64	56 (41 - 78)
IHD	139	218	64 (54 - 75)	48	98	49 (37 - 65)	48	75	64 (48 - 84)	20	38	52 (34 - 81)
Cerebrovascular	31	51	61 (43 - 87)	16	23	70 (43 - 114)	13	17	75 (43 - 129)	6	9	68 (30 - 150)
Other Heart Disease	41	77	53 (39 - 72)	19	33	58 (37 - 91)	14	26	53 (32 - 90)	---	---	39 (16 - 94)
All Respiratory	66	82	80 (63 - 102)	35	38	92 (66 - 128)	27	28	96 (66 - 141)	15	15	102 (62 - 170)
COPD	42	42	99 (74 - 135)	22	21	107 (70 - 162)	17	14	118 (73 - 190)	8	8	101 (51 - 202)
All Digestive	39	87	45 (33 - 61)	15	37	40 (24 - 67)	11	30	37 (20 - 66)	---	---	34 (14 - 81)
Liver Disease	25	63	40 (27 - 59)	9	27	34 (17 - 64)	7	22	32 (15 - 67)	---	---	28 (9 - 86)
All Urinary	6	14	42 (19 - 94)	---	---	62 (23 - 164)	---	---	21 (3 - 147)	0		
All Injury and Trauma	434	445	98 (89 - 107)	112	140	80 (66 - 96)	141	148	95 (81 - 112)	48	54	89 (67 - 118)
Accidents	207	225	92 (80 - 105)	58	70	82 (64 - 107)	71	75	95 (75 - 120)	25	27	92 (62 - 137)
Suicide	211	185	114 (99 - 130)	52	59	88 (67 - 116)	63	62	102 (80 - 131)	22	23	97 (64 - 147)
All Other Causes	43	92	47 (35 - 63)	18	37	49 (31 - 77)	16	31	51 (31 - 83)	8	15	55 (27 - 110)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 33B: SMRs* for male coal mine workers who EVER worked in Job Groups categorised as Maintenance

Cause of death categories	Ever Shutdown Maintenance						Ever Boilermaker					
	All workers *N=6,175; PY= 73,843*			2+assessments *N= 2,150; PY= 19,814*			All workers *N=8,259; PY=105,548*			2+assessments *N= 3,280; PY= 33,898*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	207	210	99 (86 – 113)	86	78	110 (89 – 136)	203	267	76 (66 – 87)	71	121	59 (47 – 74)
All Malignancies	81	72	113 (91 - 140)	**42**	**30**	**142 (105 - 192)**	71	87	82 (65 - 103)	31	44	71 (50 - 101)
Oesophagus	---	---	88 (28 - 272)	---	---	142 (35 – 566)	**8**	**4**	**201 (101 – 403)**	---	---	100 (25 – 399)
Stomach	---	---	81 (20 - 323)	---	---	102 (14 - 722)	---	---	34 (5 - 239)	0		
Colorectal	12	7	160 (91 - 282)	6	3	199 (89 - 442)	---	---	55 (23 - 132)	---	---	44 (11 - 175)
Liver	**9**	**5**	**194 (101 - 372)**	---	---	157 (51 - 487)	---	---	57 (18 - 178)	---	---	39 (6 - 278)
Pancreas	---	---	86 (32 - 228)	---	---	205 (77 - 546)	---	---	55 (18 - 170)	---	---	36 (5 - 255)
Lung	21	15	144 (94 - 221)	10	6	161 (87 - 299)	15	17	86 (52 - 143)	7	9	77 (36 - 160)
Mesothelioma, pleural	---	---	182 (45 - 726)	---	---	202 (28 - 1431)	---	---	144 (36 - 576)	---	---	256 (64 - 1024)
Melanoma	---	---	117 (44 - 312)	---	---	155 (39 - 620)	---	---	96 (36 - 255)	0		
Prostate	6	4	169 (76 - 377)	---	---	180 (58 - 559)	---	---	87 (33 - 232)	---	---	76 (19 - 304)
Bladder	---	---	185 (46 - 738)	---	---	212 (30 - 1503)	---	---	73 (10 - 520)	---	---	135 (19 - 961)
Kidney	---	---	48 (7 - 343)	0			---	---	123 (40 - 381)	0		
Brain	---	---	69 (22 - 213)	---	---	63 (9 - 445)	---	---	38 (9 - 151)	---	---	42 (6 - 301)
All Metabolic	8	8	101 (51 - 202)	---	---	96 (31 - 298)	7	10	72 (34 - 151)	---	---	85 (32 - 227)
Diabetes	---	---	95 (39 - 227)	---	---	93 (23 - 370)	---	---	77 (32 - 185)	---	---	93 (30 - 287)
All Mental and Behavioural	---	---	68 (17 - 271)	0			---	---	97 (36 - 258)	---	---	99 (25 - 397)
All Nervous System	---	---	43 (14 - 132)	---	---	37 (5 - 264)	---	---	33 (11 - 101)	---	---	48 (12 - 190)
All Circulatory	31	44	70 (49 - 100)	13	17	75 (44 - 130)	24	55	44 (29 - 66)	9	27	34 (17 - 65)
IHD	17	26	65 (40 - 104)	---	---	29 (9 - 90)	15	32	47 (28 - 78)	---	---	31 (13 - 75)
Cerebrovascular	6	6	99 (45 - 221)	---	---	123 (40 - 381)	---	---	26 (6 - 104)	---	---	26 (4 - 182)
Other Heart Disease	7	9	78 (37 - 164)	6	3	176 (79 - 392)	7	11	62 (29 - 129)	---	---	57 (18 - 176)
All Respiratory	9	10	91 (48 - 176)	---	---	72 (23 - 222)	10	13	80 (43 - 148)	6	7	92 (41 - 205)
COPD	8	5	154 (77 - 308)	---	---	127 (41 - 395)	6	6	92 (41 - 206)	6	4	168 (76 - 374)
All Digestive	7	10	67 (32 - 140)	---	---	102 (38 - 271)	---	---	24 (8 - 75)	0		
Liver Disease	---	---	65 (27 - 157)	---	---	71 (18 - 285)	---	---	11 (2 - 80)	0		
All Urinary	0			0			---	---	91 (23 - 363)	---	---	178 (45 - 713)
All Injury and Trauma	**61**	**44**	**140 (109 - 180)**	18	12	154 (97 - 245)	73	62	118 (94 - 148)	13	20	65 (38 - 111)
Accidents	28	22	128 (88 - 185)	9	6	153 (80 - 295)	31	31	99 (69 - 140)	7	10	69 (33 - 144)
Suicide	**30**	**18**	**165 (115 - 236)**	9	5	185 (96 - 356)	**37**	**26**	**144 (104 - 198)**	---	---	60 (25 - 143)
All Other Causes	---	---	48 (20 - 115)	---	---	54 (13 - 214)	6	13	46 (21 - 102)	---	---	35 (9 - 141)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 33C: SMRs* for male coal mine workers who EVER worked in Job Groups categorised as Maintenance

Cause of death categories	Ever Fitter (nec)						Ever Diesel fitter					
	All workers *N=12,696; PY= 175,943*			2+assessments *N= 6,799; PY= 71,001*			All workers *N=10,085; PY=127,681*			2+assessments *N= 5,518; PY= 49,465*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	280	435	64 (57 – 72)	141	219	64 (55 – 76)	116	208	56 (46 – 67)	57	99	57 (44 – 74)
All Malignancies	105	140	75 (62 - 91)	54	76	71 (54 - 92)	32	53	60 (43 - 85)	19	28	68 (43 - 106)
Oesophagus	---	---	46 (15 – 142)	0			---	---	42 (6 – 297)	0		
Stomach	---	---	41 (10 - 164)	---	---	38 (5 - 271)	0			0		
Colorectal	15	15	102 (61 - 169)	9	8	113 (59 - 216)	---	---	69 (26 - 184)	---	---	65 (16 - 259)
Liver	9	9	101 (53 - 195)	6	5	125 (56 - 277)	0			0		
Pancreas	12	9	134 (76 - 236)	---	---	20 (3 - 144)	---	---	31 (4 - 217)	0		
Lung	21	28	75 (49 - 116)	12	16	77 (44 - 136)	8	9	85 (43 - 170)	7	5	135 (65 - 284)
Mesothelioma, pleural	---	---	95 (24 - 380)	---	---	166 (41 - 663)	---	---	329 (82 - 1317)	**---**	**---**	**612 (153 - 2449)**
Melanoma	---	---	58 (22 - 154)	---	---	28 (4 - 199)	---	---	67 (17 - 269)	---	---	134 (33 - 535)
Prostate	**12**	**7**	**180 (102 - 316)**	**8**	**4**	**204 (102 - 408)**	---	---	56 (8 - 396)	0		
Bladder	---	---	48 (7 - 342)	0			0			0		
Kidney	---	---	50 (12 - 198)	---	---	92 (23 - 366)	0			0		
Brain	6	9	67 (30 - 150)	---	---	22 (3 - 157)	---	---	117 (49 - 282)	---	---	93 (23 - 372)
All Metabolic	6	16	38 (17 - 85)	---	---	36 (12 - 111)	---	---	44 (14 - 138)	---	---	57 (14 - 229)
Diabetes	---	---	48 (20 - 116)	---	---	35 (9 - 142)	---	---	24 (3 - 172)	---	---	45 (6 - 323)
All Mental and Behavioural	---	---	15 (2 - 109)	---	---	30 (4 - 212)	0			0		
All Nervous System	7	15	48 (23 - 101)	---	---	54 (20 - 145)	---	---	29 (7 - 116)	---	---	31 (4 - 222)
All Circulatory	52	88	59 (45 - 78)	28	47	60 (41 - 86)	19	36	53 (34 - 83)	9	19	48 (25 - 92)
IHD	34	52	65 (47 - 91)	19	28	68 (43 - 106)	15	21	73 (44 - 121)	6	11	55 (25 - 122)
Cerebrovascular	8	12	67 (33 - 133)	---	---	61 (23 - 163)	---	---	21 (3 - 151)	---	---	40 (6 - 287)
Other Heart Disease	6	18	33 (15 - 73)	---	---	42 (16 - 113)	---	---	24 (6 - 96)	---	---	24 (3 - 170)
All Respiratory	11	19	57 (32 - 103)	8	11	75 (38 - 150)	7	7	99 (47 - 208)	6	4	162 (73 - 361)
COPD	7	10	71 (34 - 149)	---	---	88 (37 - 212)	---	---	98 (32 - 304)	---	---	175 (56 - 542)
All Digestive	10	21	48 (26 - 89)	6	11	55 (25 - 122)	---	---	33 (11 - 102)	---	---	20 (3 - 145)
Liver Disease	8	15	53 (26 - 105)	---	---	50 (19 - 134)	---	---	15 (2 - 104)	0		
All Urinary	---	---	30 (4 - 213)	---	---	55 (8 - 390)	---	---	79 (11 - 560)	---	---	152 (21 - 1080)
All Injury and Trauma	79	104	76 (61 - 94)	32	42	75 (53 - 107)	47	74	63 (47 - 84)	16	30	54 (33 - 88)
Accidents	39	53	74 (54 - 101)	17	21	80 (50 - 129)	18	38	48 (30 - 76)	7	15	48 (23 - 100)
Suicide	38	43	88 (64 - 120)	14	18	78 (46 - 133)	29	31	93 (65 - 134)	9	13	71 (37 - 137)
All Other Causes	8	22	37 (18 - 73)	4	11	37 (14 - 98)	---	---	18 (4 - 72)	---	---	37 (9 - 147)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 33D: SMRs* for male coal mine workers who EVER worked in Job Groups categorised as Maintenance

Cause of death categories	Ever Tyre Fitter *N= 676; PY= 8,136*		
	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	22	18	120 (79 – 183)
All Malignancies	9	6	161 (84 - 310)
Oesophagus	0		
Stomach	0		
Colorectal	0		
Liver	---	---	294 (41 - 2086)
Pancreas	0		
Lung	---	---	185 (46 - 741)
Mesothelioma, pleural	0		
Melanoma	**---**	**---**	**1052 (339 – 3260)**
Prostate	0		
Bladder	0		
Kidney	0		
Brain	0		
All Metabolic	0		
All Mental and Behavioural	0		
All Nervous System	0		
All Circulatory	---	---	110 (41 - 293)
IHD	---	---	93 (23 - 372)
Cerebrovascular	0		
Other Heart Disease	---	---	261 (65 - 1043)
All Respiratory	0		
All Digestive	0		
All Urinary	0		
All Injury and Trauma	9	5	188 (98 - 361)
Accidents	---	---	41 (6 - 294)
Suicide	**7**	**2**	**349 (166 - 731)**
All Other Causes	0		

***** Statistically significantly increased SMR results are in **red**

Table 34A: SMRs* for male coal mine workers who EVER worked in Job Groups categorised as Production

Cause of death categories	Ever Production (ALL)						Ever Driller (General)					
	All workers *N=55,252; PY=753,893*			2+assessments *N= 28,130; PY= 309,176*			All workers *N= 3,827; PY= 49,243*			2+assessments *N=1,686; PY= 15,639*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
AL CAUSES OF DEATH	1979	2339	85 (81 – 88)	1017	1264	80 (76 – 86)	128	120	106 (89 – 127)	57	54	105 (81 – 136)
All Malignancies	771	821	94 (88 - 101)	441	478	92 (84 - 101)	**54**	**39**	**140 (107 - 183)**	28	20	142 (98 - 206)
Oesophagus	30	38	79 (55 – 113)	20	22	90 (58 – 140)	---	---	112 (28 - 448)	---	---	216 (54 – 862)
Stomach	24	28	87 (58 - 129)	11	16	69 (38 - 125)	---	---	149 (37 - 595)	0		
Colorectal	77	85	90 (72 - 113)	39	49	79 (58 - 108)	---	---	73 (24 - 227)	---	---	97 (24 - 387)
Liver	36	50	73 (52 - 101)	19	28	67 (43 - 105)	---	---	127 (41 - 393)	---	---	165 (41 - 658)
Pancreas	47	52	90 (68 - 120)	32	31	104 (74 - 148)	---	---	41 (6 - 290)	---	---	78 (11 - 556)
Lung	**194**	**169**	**115 (100 - 132)**	120	101	118 (99 - 141)	**16**	**8**	**210 (128 - 342)**	8	4	195 (98 - 390)
Mesothelioma, pleural	---	---	36 (15 - 87)	---	---	23 (6 - 92)	---	---	171 (24 - 1214)	0		
Melanoma	41	38	107 (79 - 146)	20	21	95 (61 - 148)	**7**	**2**	**366 (175 - 768)**	**---**	**---**	**449 (169 - 1197)**
Prostate	52	45	115 (87 - 150)	36	29	124 (90 - 172)	---	---	108 (27 - 432)	---	---	93 (13 - 658)
Bladder	12	13	91 (52 - 160)	---	---	37 (12 - 115)	**---**	**---**	**521 (168 - 1616)**	---	---	319 (45 - 2266)
Kidney	26	23	112 (76 - 165)	19	13	143 (91 - 224)	---	---	181 (45 - 725)	---	---	358 (89 - 1431)
Brain	44	47	94 (70 - 127)	24	25	97 (65 - 144)	---	---	81 (20 - 323)	0		
All Metabolic	46	88	52 (39 - 70)	28	50	56 (39 - 81)	---	---	46 (11 - 183)	---	---	47 (7 - 335)
Diabetes	34	60	57 (40 - 79)	22	35	63 (42 - 96)	---	---	35 (5 - 247)	0		
All Mental and Behavioural	16	37	43 (26 - 70)	11	20	54 (30 - 97)	---	---	58 (8 - 411)	---	---	125 (18 - 891)
All Nervous System	34	80	42 (30 - 59)	20	44	45 (29 - 70)	---	---	50 (12 - 198)	---	---	109 (27 - 436)
All Circulatory	411	503	82 (74 - 90)	214	286	75 (65 - 85)	**35**	**24**	**143 (103 - 199)**	17	12	143 (89 - 230)
IHD	263	301	87 (78 - 99)	135	172	79 (66 - 93)	**23**	**14**	**159 (106 - 240)**	10	7	140 (75 - 260)
Cerebrovascular	46	71	65 (48 - 86)	22	41	53 (35 - 81)	7	3	209 (99 - 438)	---	---	120 (30 - 479)
Other Heart Disease	75	100	75 (60 - 94)	42	55	76 (56 - 103)	---	---	98 (41 - 235)	---	---	213 (89 - 511)
All Respiratory	86	118	73 (59 - 90)	54	70	77 (59 - 101)	---	---	37 (9 - 149)	---	---	36 (5 - 256)
COPD	54	63	86 (66 - 112)	30	39	76 (53 - 109)	---	---	37 (5 - 261)	0		
All Digestive	46	112	41 (31 - 55)	31	61	51 (36 - 72)	0			0		
Liver Disease	28	80	35 (24 - 51)	17	43	40 (25 - 64)	0			0		
All Urinary	8	20	40 (20 - 79)	7	12	59 (28 - 123)	0			0		
All Injury and Trauma	**509**	**447**	**114 (104 - 124)**	179	183	98 (85 - 113)	29	29	100 (69 - 143)	6	9	65 (29 - 145)
Accidents	**267**	**227**	**118 (104 - 133)**	96	93	103 (85 - 126)	14	15	95 (56 - 161)	---	---	65 (21 - 201)
Suicide	**228**	**185**	**123 (108 - 140)**	79	76	105 (84 - 130)	12	12	99 (56 - 174)	---	---	52 (13 - 206)
All Other Causes	50	112	45 (34 - 59)	30	58	51 (36 - 73)	---	---	50 (16 - 155)	---	---	38 (5 - 273)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 34B: SMRs* for male coal mine workers who EVER worked in Job Groups categorised as Production

Cause of death categories	Ever Operator						Ever Blast crew			Ever CHPP Plant operator		
	All workers *N=42,399; PY=571,551*			2+assessments *N=22,348; PY=239,140*			All workers *N=1,857; PY=24,326*			All workers *N=1,502; PY=26,464*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	1472	1775	83 (79 – 87)	751	952	79 (73 – 85)	40	61	66 (48 – 89)	46	92	50 (37 – 67)
All Malignancies	589	626	94 (87 - 102)	335	360	93 (84 - 104)	17	19	89 (55 - 143)	15	33	45 (27 - 75)
Oesophagus	25	29	85 (58 - 126)	16	17	95 (58 – 155)	---	---	113 (16 - 799)	0		
Stomach	19	21	90 (57 - 141)	8	12	67 (33 - 134)	0			---	---	90 (13 - 637)
Colorectal	58	65	89 (69 - 116)	28	37	75 (52 - 109)	---	---	147 (47 - 456)	---	---	29 (4 - 207)
Liver	30	39	78 (54 - 111)	15	22	69 (41 - 114)	---	---	83 (12 - 591)	0		
Pancreas	34	40	85 (60 - 118)	23	23	99 (66 - 149)	0			---	---	144 (46 - 446)
Lung	**153**	**129**	**118 (101 - 139)**	92	76	121 (99 - 148)	---	---	54 (13 - 214)	---	---	15 (2 - 103)
Mesothelioma, pleural	---	---	38 (14 - 102)	---	---	31 (8 - 126)	0			0		
Melanoma	26	29	89 (61 - 131)	13	16	82 (48 - 141)	0			---	---	193 (62 - 600)
Prostate	41	34	121 (89 - 165)	29	21	138 (96 - 198)	---	---	224 (56 - 897)	---	---	53 (7 - 374)
Bladder	8	10	81 (40 - 161)	---	---	34 (8 - 135)	0	0		0		
Kidney	22	18	124 (81 - 188)	16	10	159 (97 - 259)	---	---	180 (25 - 1274)	0		
Brain	35	36	98 (70 - 136)	20	19	105 (68 - 163)	---	---	79 (11 - 564)	0		
All Metabolic	35	67	52 (37 - 73)	21	38	56 (36 - 86)	0			0		
Diabetes	25	46	55 (37 - 81)	17	26	65 (40 - 105)	0			0		
All Mental and Behavioural	11	27	40 (22 - 73)	7	15	47 (22 - 98)	0			---	---	60 (9 - 429)
All Nervous System	24	60	40 (27 - 59)	13	33	40 (23 - 68)	---	---	98 (25 - 392)	0		
All Circulatory	307	381	81 (72 - 90)	159	214	74 (64 - 87)	8	13	63 (32 - 127)	15	20	73 (44 - 122)
IHD	192	228	84 (73 - 97)	96	129	75 (61 - 91)	6	7	80 (36 - 179)	7	12	57 (27 - 119)
Cerebrovascular	34	53	64 (45 - 89)	21	31	69 (45 - 105)	0			---	---	102 (33 - 316)
Other Heart Disease	60	76	79 (61 - 102)	31	41	75 (53 - 106)	---	---	38 (5 - 270)	---	---	51 (13 - 202)
All Respiratory	61	88	69 (54 - 89)	37	52	71 (52 - 99)	---	---	111 (36 - 345)	---	---	63 (20 - 195)
COPD	39	47	82 (60 - 112)	21	29	73 (47 - 111)	---	---	75 (11 - 532)	---	---	117 (38 - 362)
All Digestive	29	86	34 (23 - 48)	20	47	43 (28 - 66)	---	---	66 (17 - 265)	---	---	68 (22 - 209)
Liver Disease	20	62	32 (21 - 50)	12	33	36 (21 - 64)	---	---	45 (6 - 321)	---	---	32 (4 - 225)
All Urinary	8	15	53 (26 - 106)	7	9	80 (38 - 168)	0	0		0		
All Injury and Trauma	**375**	**338**	**111 (100 - 123)**	132	141	93 (79 - 111)	7	15	48 (23 - 100)	6	16	38 (17 - 84)
Accidents	189	171	110 (96 - 127)	68	71	95 (75 - 121)	---	---	68 (28 - 163)	---	---	25 (6 - 99)
Suicide	**177**	**140**	**126 (109 - 147)**	63	59	108 (84 - 138)	---	---	33 (8 - 131)	---	---	61 (23 - 163)
All Other Causes	32	86	37 (26 - 53)	19	45	43 (27 - 67)	---	---	32 (5 - 228)	---	---	68 (22 - 212)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 34C: SMRs* for male coal mine workers who EVER worked in Job Groups categorised as Production

Cause of death categories	Ever Laboratory All workers *N=910; PY= 12,091*			Ever ERZ Deputy All workers *N=1,039; PY= 21,359*			Ever Open cut examiner All workers *N= 537; PY= 11,885*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	22	30	74 (49 – 112)	46	88	52 (39 – 70)	25	57	73 (58 – 91)
All Malignancies	7	10	73 (35 - 153)	24	33	73 (49 - 108)	11	23	49 (27 - 88)
Oesophagus	0			0			0		
Stomach	---	---	306 (43 - 2171)	0			0		
Colorectal	0			---	---	148 (61 - 354)	---	---	43 (6 - 308)
Liver	0			---	---	53 (7 - 374)	---	---	79 (11 - 558)
Pancreas	0			---	---	96 (24 - 384)	---	---	71 (10 - 501)
Lung	---	---	155 (50 - 481)	6	7	86 (38 - 190)	---	---	41 (10 - 165)
Mesothelioma, pleural	0			0			0		
Melanoma	0			---	---	201 (65 - 622)	0		
Prostate	---	---	189 (27 - 1338)	---	---	50 (7 - 352)	0		
Bladder	0			---	---	177 (25 - 1257)	0		
Kidney	0			---	---	108 (15 - 766)	0		
Brain	0			---	---	59 (8 - 419)	---	---	91 (13 - 647)
All Metabolic	0			0			---	---	45 (6 - 317)
Diabetes	0			0			---	---	63 (9 - 448)
All Mental and Behavioural	---	---	**407 (102 - 1627)**	0			---	---	195 (49 - 779)
All Nervous System	0			---	---	66 (16 - 264)	---	---	50 (7 - 357)
All Circulatory	---	---	65 (24 - 173)	10	20	50 (27 - 93)	---	---	23 (7 - 70)
IHD	---	---	111 (42 - 295)	---	---	41 (17 - 100)	---	---	12 (2 - 88)
Cerebrovascular	0			0			---	---	51 (7 - 364)
Other Heart Disease	0			---	---	132 (55 - 318)	---	---	40 (6 - 287)
All Respiratory	---	---	70 (10 - 497)	0			---	---	91 (29 - 283)
COPD	0			0			---	---	108 (27 - 432)
All Digestive	0			---	---	24 (3 - 170)	---	---	37 (5 - 261)
Liver Disease	0			---	---	34 (5 - 244)	0		
All Urinary	0			0			0		
All Injury and Trauma	7	7	100 (48 - 210)	9	13	70 (36 - 134)	---	---	29 (7 - 114)
Accidents	---	---	141 (59 - 338)	---	---	75 (31 - 181)	---	---	55 (14 - 220)
Suicide	---	---	69 (17 - 275)	---	---	76 (29 - 202)	0		
All Other Causes	---	---	69 (10 - 489)	0			---	---	39 (6 - 279)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 35: SMRs* for male coal mine workers who EVER worked as a Miner, regardless of Site Type

Cause of death categories	Ever Miner					
	All miners *N=10,471; PY= 175,629*			Miners with 2+ assessments *N= 7,075; PY= 93,465*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	368	504	73 (66 - 81)	250	342	73 (65 – 83)
All Malignancies	143	170	84 (72 - 99)	110	125	88 (73 - 106)
Oesophagus	8	8	103 (51 - 206)	8	6	138 (69 - 275)
Stomach	---	---	86 (36 - 206)	---	---	119 (49 - 285)
Colorectal	13	18	73 (42 - 126)	9	13	69 (36 - 133)
Liver	---	---	30 (10 - 93)	---	---	40 (13 - 125)
Pancreas	12	11	113 (64 - 199)	8	8	100 (50 - 201)
Lung	32	35	93 (66 - 131)	27	26	103 (71 - 150)
Mesothelioma, pleural	0			0		
Melanoma	7	8	85 (40 - 178)	---	---	87 (36 - 209)
Prostate	11	9	122 (67 - 220)	9	7	126 (66 - 243)
Bladder	---	---	74 (19 - 296)	0		
Kidney	---	---	104 (43 - 249)	---	---	141 (59 - 339)
Brain	8	10	80 (40 - 160)	---	---	73 (30 - 176)
All Metabolic	10	18	54 (29 - 101)	7	13	53 (25 - 111)
Diabetes	9	12	73 (38 - 140)	6	9	66 (30 - 147)
All Mental and Behavioural	---	---	11 (2 - 81)	---	---	18 (3 - 126)
All Nervous System	7	17	41 (20 - 86)	---	---	43 (18 - 103)
All Circulatory	63	107	59 (46 - 75)	42	77	55 (41 - 74)
IHD	39	64	61 (44 - 83)	28	46	61 (42 - 88)
Cerebrovascular	7	15	46 (22 - 97)	---	---	18 (5 - 73)
Other Heart Disease	12	21	56 (32 - 99)	9	15	61 (32 - 117)
All Respiratory	14	24	58 (34 - 98)	10	18	56 (30 - 104)
COPD	9	13	72 (37 - 137)	---	---	51 (21 - 123)
All Digestive	11	24	46 (25 - 83)	9	17	54 (28 - 103)
Liver Disease	---	---	29 (12 - 70)	---	---	42 (17 - 101)
All Urinary	---	---	24 (3 - 169)	---	---	32 (5 - 231)
All Injury and Trauma	104	106	98 (81 - 119)	55	56	98 (76 - 128)
Accidents	57	54	105 (81 - 137)	29	28	103 (71 - 148)
Suicide	45	44	102 (76 - 137)	24	23	104 (69 - 154)
All Other Causes	13	25	53 (31 - 91)	9	16	55 (29 - 106)

***** Statistically significantly reduced SMR results are in **blue**

Table 36: SMRs* for male coal mine workers who EVER worked as an underground Miner

Cause of death categories	Ever an UNDERGROUND Miner					
	All underground miners *N=7,696; PY= 125,277*			Miners with 2+ assessments *N= 4,989; PY= 92,781*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	229	297	77 (68 - 88)	136	222	61 (52 - 73)
All Malignancies	82	92	89 (72 - 111)	58	69	85 (65 - 109)
Oesophagus	--	--	117 (49 - 282)	--	--	157 (65 - 376)
Stomach	--	--	123 (46 - 327)	--	--	164 (61 - 437)
Colorectal	9	10	93 (48 - 178)	--	--	69 (29 - 166)
Liver	--	--	35 (9 - 141)	--	--	47 (12 - 188)
Pancreas	6	6	104 (47 - 231)	--	--	93 (35 - 248)
Lung	16	18	90 (55 - 146)	11	13	82 (46 - 149)
Mesothelioma, pleural	0			0		
Melanoma	--	--	63 (20 - 194)	--	--	28 (4 - 196)
Prostate	6	4	148 (67 - 330)	--	--	169 (70 - 406)
Bladder	--	--	76 (11 - 536)	0		
Kidney	--	--	149 (56 - 397)	--	--	198 (74 - 528)
Brain	--	--	82 (34 - 196)	--	--	65 (21 - 203)
All Metabolic	7	10	67 (32 - 141)	--	--	65 (27 - 156)
Diabetes	7	7	103 (49 - 217)	--	--	100 (42 - 240)
All Mental and Behavioural	0			0		
All Nervous System	--	--	41 (15 - 109)	--	--	42 (13 - 129)
All Circulatory	32	60	54 (38 - 76)	17	45	38 (24 - 61)
IHD	19	36	53 (34 - 84)	11	27	41 (23 - 74)
Cerebrovascular	6	8	74 (33 - 165)	--	--	33 (8 - 133)
Other Heart Disease	6	12	49 (22 - 108)	--	--	44 (16 - 117)
All Respiratory	7	12	57 (27 - 119)	--	--	44 (16 - 117)
COPD	--	--	66 (25 - 176)	--	--	22 (3 - 160)
All Digestive	6	14	42 (19 - 93)	--	--	47 (19 - 112)
Liver Disease	--	--	28 (9 - 88)	--	--	38 (12 - 117)
All Urinary	0			0		
All Injury and Trauma	83	76	109 (88 - 135)	39	57	69 (50 - 94)
Accidents	43	39	112 (83 - 150)	19	29	66 (42 - 103)
Suicide	38	32	120 (87 - 165)	18	24	76 (48 - 121)
All Other Causes	7	15	46 (22 - 96)	--	--	35 (13 - 93)

***** Statistically significantly reduced SMR results are in **blue**

Table 37: SMRs* for male coal mine workers who EVER worked as Dragline operators (all employer types)

Cause of death categories	Ever Dragline All workers *N=1,044; PY= 22,786*			Ever Dragline 2+ assessments *N= 1,003; PY= 18,366*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	77	105	73 (58 – 91)	72	94	77 (61 – 96)
All Malignancies	35	41	84 (61 - 118)	34	38	90 (64 - 125)
Oesophagus	---	---	105 (26 - 419)	---	---	113 (28 - 454)
Stomach	---	---	74 (10 - 527)	---	---	81 (11 - 578)
Colorectal	---	---	94 (35 - 250)	---	---	103 (39 - 274)
Liver	---	---	44 (6 - 316)	---	---	48 (7 - 339)
Pancreas	---	---	154 (58 - 410)	---	---	166 (62 - 443)
Lung	7	9	78 (37 - 163)	7	8	85 (40 - 177)
Mesothelioma, pleural	0			0		
Melanoma	---	---	109 (27 - 435)	---	---	121 (30 - 484)
Prostate	---	---	152 (57 - 405)	---	---	166 (62 - 442)
Bladder	0			0		
Kidney	0			0		
Brain	---	---	49 (7 - 350)	---	---	55 (8 - 389)
All Metabolic	---	---	49 (12 - 195)	---	---	54 (13 - 214)
Diabetes	---	---	69 (17 - 275)	---	---	75 (19 - 301)
All Mental and Behavioural	---	---	55 (8 - 388)	---	---	65 (9 - 458)
All Nervous System	---	---	83 (27 - 256)	---	---	92 (30 - 286)
All Circulatory	16	24	65 (40 - 107)	14	22	63 (38 - 107)
IHD	13	15	87 (51 - 150)	11	13	82 (45 - 148)
Cerebrovascular	---	---	56 (14 - 225)	---	---	63 (16 - 250)
Other Heart Disease	---	---	22 (3 - 157)	---	---	25 (3 - 175)
All Respiratory	---	---	83 (35 - 200)	---	---	91 (38 - 219)
COPD	---	---	59 (15 - 235)	---	---	64 (16 - 256)
All Digestive	---	---	41 (10 - 163)	---	---	22 (3 - 160)
Liver Disease	---	---	30 (4 - 210)	---	---	33 (5 - 231)
All Urinary	0			0		
All Injury and Trauma	9	13	67 (35 - 129)	9	11	85 (44 - 163)
Accidents	6	7	86 (39 - 191)	6	5	109 (49 - 243)
Suicide	---	---	55 (18 - 172)	---	---	70 (23 - 218)
All Other Causes	---	---	87 (33 - 231)	---	---	74 (24 - 228)

***** Statistically significantly reduced SMR results are in **blue**

Table 38: SMRs* for male coal mine workers who EVER worked as Miners, by employer type

Cause of death categories	Ever Miner as Direct Mine Employee *N=4,030; PY=71,108*			Ever Miner employed by a Large Contractor *N= 3,091; PY= 39,167*			Ever Miner with any Other Employer Type *N= 4,015; PY= 76,203*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	94	179	52 (43 - 64)	38	67	57 (42 - 79)	244	276	88 (78 - 100)
All Malignancies	34	57	60 (43 - 84)	10	17	59 (32 - 110)	100	100	100 (82 - 121)
Oesophagus	---	---	76 (19 - 305)	0			6	5	131 (59 - 292)
Stomach	0			---	---	157 (22 - 1117)	---	---	120 (45 - 319)
Colorectal	---	---	84 (35 - 201)	---	---	160 (52 - 496)	6	10	58 (26 - 129)
Liver	0			0			---	---	53 (17 - 164)
Pancreas	---	---	140 (58 - 337)	---	---	189 (47 - 757)	---	---	80 (33 - 192)
Lung	---	---	36 (13 - 95)	---	---	34 (5 - 241)	27	21	128 (88 - 187)
Mesothelioma, pleural	0			0			0		
Melanoma	---	---	103 (33 - 320)	0			---	---	86 (32 - 230)
Prostate	---	---	151 (57 - 402)	---	---	202 (29 - 1437)	6	6	100 (45 - 223)
Bladder	0			---	---	498 (70 - 3534)	---	---	59 (8 - 418)
Kidney	---	---	61 (9 - 430)	0			---	---	143 (54 - 381)
Brain	---	---	82 (26 - 254)	0			---	---	94 (39 - 226)
All Metabolic	---	---	47 (15 - 147)	0			7	10	67 (32 - 141)
Diabetes	---	---	48 (12 - 192)	0			7	7	97 (46 - 204)
All Mental and Behavioural	---	---	32 (5 - 229)	0			0		
All Nervous System	---	---	34 (8 - 135)	---	---	46 (7 - 330)	---	---	42 (16 - 113)
All Circulatory	17	37	46 (29 - 74)	---	---	26 (8 - 79)	44	62	71 (53 - 96)
IHD	11	22	50 (28 - 90)	---	---	15 (2 - 105)	27	37	73 (50 - 106)
Cerebrovascular	---	---	20 (3 - 141)	---	---	66 (9 - 469)	6	9	67 (30 - 150)
Other Heart Disease	---	---	40 (13 - 124)	---	---	37 (5 - 262)	8	12	68 (34 - 136)
All Respiratory	---	---	13 (2 - 91)	---	---	91 (23 - 365)	11	15	75 (42 - 136)
COPD	0			---	---	218 (55 - 872)	7	8	88 (42 - 184)
All Digestive	6	9	69 (31 - 155)	---	---	32 (5 - 228)	---	---	39 (16 - 93)
Liver Disease	---	---	47 (15 - 147)	---	---	42 (6 - 302)	---	---	22 (6 - 88)
All Urinary	---	---	73 (10 - 516)	0			0		
All Injury and Trauma	27	43	62 (43 - 91)	20	23	86 (55 - 133)	**62**	**46**	**134 (105 - 172)**
Accidents	14	22	63 (38 - 107)	6	12	51 (23 - 114)	**39**	**24**	**165 (120 - 225)**
Suicide	12	18	67 (38 - 118)	13	10	133 (77 - 230)	23	19	122 (81 - 183)
All Other Causes	---	---	22 (5 - 87)	---	---	28 (4 - 196)	10	13	78 (42 - 145)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 39: SMRs* for male coal mine workers who EVER worked as Dragline operators, by employer type

Cause of death categories	Ever Dragline [Direct mine employee] *N=848; PY= 18,462*			Ever Dragline [Big labour hires] *N= 57; PY= 1,242*			Ever Dragline any Other Employer Type *N= 174; PY= 3,864*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	44	77	57 (42 - 76)	---	---	83 (21 – 221)	30	26	113 (79 - 162)
All Malignancies	22	30	74 (49 - 112)	---	---	164 (53 – 508)	11	11	99 (55 - 179)
Oesophagus	---	---	72 (10 - 513)	0			---	---	202 (28 - 1433)
Stomach	---	---	102 (14 - 726)	0			0		
Colorectal	---	---	33 (5 - 231)	0			---	---	263 (85 - 814)
Liver	---	---	60 (8 - 427)	0			0		
Pancreas	---	---	159 (51 - 494)	0			---	---	146 (21 - 1039)
Lung	---	---	78 (33 - 188)	0			---	---	81 (20 - 322)
Mesothelioma, pleural	0			0			0		
Melanoma	---	---	74 (10 - 525)	---	---	**1152 (162 – 8179)**	0		
Prostate	---	---	111 (28 - 446)	0			---	---	248 (62 - 991)
Bladder	0			0			0		
Kidney	0			0			0		
Brain	---	---	66 (9 - 467)	0			0		
All Metabolic	---	---	34 (5 - 239)	0			---	---	93 (13 - 661)
Diabetes	---	---	48 (7 - 341)	0			---	---	128 (18 - 906)
All Mental and Behavioural	---	---	75 (11 - 534)	0			0		
All Nervous System	---	---	114 (37 - 353)	0			0		
All Circulatory	9	18	51 (27 - 98)	---	---	92 (13 – 655)	6	6	93 (42 - 207)
IHD	8	11	74 (37 - 148)	---	---	150 (21 – 1062)	---	---	102 (38 - 272)
Cerebrovascular	0			0			---	---	203 (51 - 813)
Other Heart Disease	---	---	30 (4 - 215)	0			0		
All Respiratory	---	---	71 (23 - 220)	0			---	---	116 (29 - 465)
COPD	0			0			---	---	199 (50 - 797)
All Digestive	0			0			---	---	173 (43 - 693)
Liver Disease	0			0			---	---	134 (19 - 948)
All Urinary	0			0			0		
All Injury and Trauma	---	---	36 (14 - 97)	0			---	---	228 (95 - 548)
Accidents	---	---	70 (26 - 188)	0			---	---	169 (42 - 676)
Suicide	0			0			---	---	**356 (115 - 1103)**
All Other Causes	---	---	29 (4 - 204)	0			---	---	287 (93 - 890)

* Statistically significantly increased SMR results are in red, statistically significantly reduced SMR results are in blue

Table 40: SMRs* for male coal mine workers who EVER worked in construction

Cause of death categories	Ever Construction						Ever Civil works			Ever Construction (other)		
	All workers *N= 9,034; PY= 100,766*			2+assessments *N= 2,117; PY= 16,559*			All workers *N=762; PY=9,656*			All assessments *N= 8,286; PY= 91,293*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	254	259	98 (87 - 111)	43	55	78 (58 - 105)	22	33	66 (44 – 101)	232	227	102 (90 - 116)
All Malignancies	87	86	101 (82 - 124)	21	20	105 (69 - 162)	12	12	98 (56 - 173)	75	74	101 (81 - 127)
Oesophagus	---	---	99 (37 - 263)	0			0			---	---	115 (43 - 306)
Stomach	---	---	102 (33 - 315)	0			---	---	246 (35 - 1744)	---	---	78 (20 - 314)
Colorectal	9	9	100 (52 - 192)	0			0			9	8	116 (60 - 223)
Liver	---	---	90 (37 - 216)	0			0			---	---	104 (43 - 250)
Pancreas	---	---	72 (27 - 191)	---	---	151 (38 - 605)	---	---	251 (63 - 1002)	---	---	42 (10 - 166)
Lung	**30**	**17**	**173 (121 - 248)**	**10**	**4**	**243 (131 - 452)**	---	---	195 (81 - 468)	**25**	**15**	**169 (114 - 250)**
Mesothelioma, pleural	---	---	228 (73 - 706)	0			---	---	476 (67 - 3382)	---	---	180 (45 - 720)
Melanoma	---	---	49 (12 - 196)	0			0			---	---	57 (14 - 226)
Prostate	---	---	115 (48 - 276)	---	---	283 (91 - 879)	0			---	---	136 (57 - 327)
Bladder	---	---	77 (11 - 545)	0			0			---	---	90 (13 - 639)
Kidney	---	---	82 (20 - 327)	---	---	178 (25 - 1261)	0			---	---	95 (24 - 380)
Brain	---	---	75 (28 - 201)	0			0			---	---	86 (32 - 229)
All Metabolic	7	10	72 (34 - 151)	---	---	46 (6 - 325)	0			7	8	83 (40 - 174)
Diabetes	---	---	77 (32 - 186)	---	---	67 (9 - 477)	0			---	---	90 (37 - 215)
All Mental and Behavioural	---	---	84 (27 - 259)	---	---	132 (19 - 937)	---	---	204 (29 - 1449)	---	---	64 (16 - 257)
All Nervous System	---	---	56 (23 - 136)	---	---	53 (7 - 378)	0			---	---	65 (27 - 155)
All Circulatory	42	53	80 (59 - 108)	6	12	51 (23 - 113)	---	---	42 (13 - 129)	39	46	85 (62 - 117)
IHD	26	31	84 (57 - 123)	---	---	57 (21 - 151)	---	---	70 (22 - 216)	23	27	86 (57 - 129)
Cerebrovascular	---	---	55 (21 - 146)	0			0			---	---	63 (24 - 169)
Other Heart Disease	8	11	72 (36 - 144)	0			0			8	10	83 (41 - 165)
All Respiratory	10	12	82 (44 - 153)	---	---	36 (5 - 254)	---	---	58 (8 - 410)	9	10	86 (45 - 166)
COPD	8	6	126 (63 - 251)	---	---	65 (9 - 460)	---	---	104 (15 - 741)	7	5	129 (62 - 271)
All Digestive	14	12	112 (66 - 189)	---	---	108 (35 - 335)	0			14	11	128 (76 - 217)
Liver Disease	12	9	133 (75 - 234)	---	---	150 (48 - 465)	0			12	8	152 (86 - 268)
All Urinary	---	---	95 (24 - 382)	0			0			---	---	110 (28 - 442)
All Injury and Trauma	**77**	**59**	**132 (105 - 164)**	9	10	92 (48 - 177)	---	---	88 (37 - 212)	**72**	**53**	**136 (108 - 171)**
Accidents	37	29	126 (91 - 173)	6	5	123 (55 - 274)	---	---	139 (52 - 371)	33	27	124 (88 - 174)
Suicide	**37**	**25**	**151 (109 - 208)**	---	---	73 (23 - 225)	---	---	43 (6 - 303)	**36**	**22**	**162 (117 - 224)**
All Other Causes	6	13	47 (21 - 104)	0			0			6	11	53 (24 - 118)

***** Statistically significantly increased SMR results are in **red**

Table 41: SMRs* for male coal mine workers who EVER were Drillers (Exploration)

Cause of death categories	Ever Exploration Driller *N= 4,970; PY= 54,690* O	E	SMR (95% CI)
ALL CAUSES OF DEATH	80	87	92 (74 – 114)
All Malignancies	19	22	88 (56 - 137)
Oesophagus	0		
Stomach	---	---	122 (17 - 866)
Colorectal	0		
Liver	0		
Pancreas	---	---	147 (37 - 589)
Lung	---	---	107 (40 - 285)
Mesothelioma, pleural	0		
Melanoma	---	---	162 (40 - 647)
Prostate	0		
Bladder	---	---	393 (55 - 2790)
Kidney	0		
Brain	---	---	107 (27 - 430)
All Metabolic	---	---	34 (5 - 244)
Diabetes	---	---	57 (8 - 405)
All Mental and Behavioural	0		
All Nervous System	0		
All Circulatory	14	15	92 (55 - 156)
IHD	10	9	116 (62 - 216)
Cerebrovascular	---	---	51 (7 - 364)
Other Heart Disease	---	---	84 (27 - 259)
All Respiratory	---	---	35 (5 - 249)
COPD	0		
All Digestive	0		
All Urinary	0		
All Injury and Trauma	**43**	**32**	**136 (101 - 184)**
Accidents	23	16	146 (97 - 219)
Suicide	15	13	112 (67 - 185)
All Other Causes	---	---	21 (3 - 150)

***** Statistically significantly increased SMR results are in **red**

Table 42: SMRs* for male coal mine workers who EVER held a job as Supervisor (unclear Work Category)

Cause of death categories	Ever Supervisor					
	All workers *N=5,575; PY=85,840*			2+assessments *N=3,501; PY=42,064*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	163	293	56 (48 - 65)	83	158	52 (42 - 65)
All Malignancies	83	105	79 (64 - 98)	44	59	75 (56 - 101)
Oesophagus	6	5	120 (54 – 267)	---	---	106 (34 – 329)
Stomach	---	---	56 (14 - 224)	---	---	50 (7 - 356)
Colorectal	8	11	74 (37 - 149)	---	---	83 (34 - 199)
Liver	---	---	60 (22 - 160)	---	---	26 (4 - 186)
Pancreas	---	---	59 (22 - 156)	---	---	52 (13 - 207)
Lung	22	22	101 (67 - 154)	14	12	114 (68 - 193)
Mesothelioma, pleural	---	---	58 (8 - 413)	---	---	105 (15 - 744)
Melanoma	---	---	41 (10 - 162)	---	---	37 (5 - 265)
Prostate	6	6	107 (48 - 237)	---	---	160 (67 - 385)
Bladder	---	---	60 (8 - 428)	0		
Kidney	---	---	66 (17 - 265)	---	---	59 (8 - 419)
Brain	---	---	67 (25 - 178)	---	---	61 (15 - 243)
All Metabolic	---	---	18 (4 - 71)	---	---	16 (2 - 114)
Diabetes	---	---	26 (7 - 105)	---	---	23 (3 - 166)
All Mental and Behavioural	---	---	43 (11 - 172)	---	---	42 (6 - 297)
All Nervous System	---	---	20 (5 - 80)	0		
All Circulatory	28	64	44 (30 - 64)	14	35	40 (24 - 67)
IHD	14	38	37 (22 - 62)	7	21	33 (16 - 69)
Cerebrovascular	---	---	56 (23 - 135)	---	---	21 (3 - 146)
Other Heart Disease	6	13	48 (21 - 106)	---	---	58 (22 - 155)
All Respiratory	6	15	41 (18 - 91)	---	---	37 (12 - 115)
COPD	---	---	25 (6 - 101)	0		
All Digestive	---	---	14 (3 - 55)	---	---	25 (6 - 98)
Liver Disease	---	---	19 (5 - 76)	---	---	34 (8 - 135)
All Urinary	---	---	79 (20 - 315)	---	---	146 (36 - 582)
All Injury and Trauma	35	52	68 (49 - 94)	16	25	64 (39 - 104)
Accidents	14	26	54 (32 - 90)	8	13	64 (32 - 128)
Suicide	21	21	98 (64 - 151)	8	10	77 (38 - 153)
All Other Causes	---	---	7 (1 - 50)	0		

***** Statistically significantly reduced SMR results are in **blue**

Table 43: SMRs* for male coal mine workers who EVER held a job as Truck Driver (Unclear Work Category)

Cause of death categories	Ever Truck driver					
	All workers *N=7,701; PY=96,203*			2+assessments *N=3,120; PY=29,291*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATHS	336	369	91 (82 – 101)	107	134	80 (66 – 97)
All Malignancies	133	139	96 (81 - 113)	44	52	85 (63 - 114)
Oesophagus	9	7	136 (71 – 261)	---	---	163 (61 – 435)
Stomach	---	---	43 (11 - 173)	0		
Colorectal	13	14	92 (54 - 159)	---	---	94 (39 - 226)
Liver	---	---	56 (23 - 134)	---	---	31 (4 - 218)
Pancreas	12	9	132 (75 - 232)	---	---	147 (61 - 352)
Lung	31	29	106 (75 - 151)	11	11	99 (55 - 179)
Mesothelioma, pleural	---	---	43 (6 - 303)	0		
Melanoma	0			0		
Prostate	9	8	114 (59 - 219)	---	---	63 (16 - 250)
Bladder	0			0		
Kidney	---	---	102 (38 - 271)	---	---	208 (67 - 645)
Brain	**13**	**7**	**174 (101 - 300)**	---	---	152 (57 - 404)
All Metabolic	10	15	68 (37 - 127)	---	---	73 (28 - 195)
Diabetes	9	10	89 (46 - 171)	---	---	104 (39 - 278)
All Mental and Behavioural	0			0		
All Nervous System	6	13	47 (21 - 104)	---	---	42 (11 - 170)
All Circulatory	74	81	91 (72 - 114)	26	30	86 (58 - 126)
IHD	46	49	94 (71 - 126)	16	18	88 (54 - 144)
Cerebrovascular	13	12	113 (65 - 194)	---	---	68 (22 - 212)
Other Heart Disease	11	16	68 (38 - 124)	---	---	85 (35 - 203)
All Respiratory	19	20	96 (61 - 150)	10	8	130 (70 - 242)
COPD	12	11	109 (62 - 191)	---	---	91 (34 - 243)
All Digestive	6	18	33 (15 - 72)	---	---	61 (23 - 162)
Liver Disease	---	---	30 (11 - 81)	---	---	44 (11 - 174)
All Urinary	---	---	60 (15 - 238)	---	---	77 (11 - 550)
All Injury and Trauma	**80**	**57**	**141 (113 - 176)**	15	17	87 (52 - 144)
Accidents	**46**	**29**	**161 (120 - 214)**	11	9	126 (70 - 227)
Suicide	**33**	**23**	**141 (101 - 199)**	---	---	56 (21 - 150)
All Other Causes	6	17	34 (15 - 76)	---	---	16 (2 - 115)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 44: SMRs* for male coal mine workers who EVER held a Job as labourer or cleaner (Unclear Work Category)

Cause of death categories	Labourer All workers *N=5,814; PY=69,441*			Cleaner All workers *N=948; PY=10,112*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	138	124	111 (94 – 131)	21	26	79 (52 – 122)
All Malignancies	35	34	102 (73 - 142)	6	9	67 (30 - 149)
Oesophagus	0			0		
Stomach	---	---	81 (11 - 579)	0		
Colorectal	---	---	81 (26 - 251)	---	---	108 (15 - 766)
Liver	---	---	225 (93 - 540)	0		
Pancreas	---	---	46 (7 - 328)	0		
Lung	10	6	158 (85 - 293)	---	---	54 (8 - 385)
Mesothelioma, pleural	0			0		
Melanoma	---	---	55 (8 - 392)	0		
Prostate	---	---	75 (11 - 534)	0		
Bladder	0			**---**	**---**	**1381 (345 - 5523)**
Kidney	0			0		
Brain	---	---	39 (6 - 278)	---	---	194 (27 - 1380)
All Metabolic	---	---	71 (23 - 219)	---	---	100 (14 - 710)
Diabetes	---	---	75 (19 - 302)	0		
All Mental and Behavioural	0			0		
All Nervous System	---	---	72 (23 - 223)	0		
All Circulatory	28	22	125 (86 - 181)	---	---	19 (3 - 132)
IHD	18	13	140 (88 - 222)	---	---	32 (4 - 226)
Cerebrovascular	6	3	202 (91 - 449)	0		
Other Heart Disease	---	---	59 (19 - 183)	0		
All Respiratory	---	---	43 (11 - 172)	---	---	150 (37 - 599)
COPD	---	---	46 (7 - 328)	---	---	276 (69 - 1105)
All Digestive	---	---	71 (27 - 189)	0		
Liver Disease	---	---	72 (23 - 223)	0		
All Urinary	0			0		
All Injury and Trauma	**56**	**40**	**140 (108 - 182)**	9	6	158 (82 - 303)
Accidents	**30**	**20**	**148 (104 - 212)**	**7**	**3**	**242 (115 - 507)**
Suicide	22	17	132 (87 - 200)	---	---	84 (21 - 334)
All Other Causes	7	6	108 (52 - 227)	---	---	159 (40 - 635)

***** Statistically significantly increased SMR results are in **red**

Table 45: Age at first and last examination/assessment by time between first and last assessment, male coal mine workers in

Time between 1st and last assessment	N	Age at 1st examination or assessment	Age at last examination or assessment	Age at end of follow-up
		Median (P^{25}, P^{75})	Median (P^{25}, P^{75})	Median (P^{25}, P^{75})
<5 years	110,860	33.7 (25.7, 44.2)	34.3 (26.4, 44.8)	44.6 (35.6, 55.3)
5 - 10 years	24,567	31.7 (24.1, 41.5)	39.0 (31.5, 48.8)	45.3 (36.8, 55.5)
10 - 15 years	15,446	31.3 (23.9, 39.8)	43.5 (36.2, 52.1)	48.6 (40.2, 58.5)
≥ 15 years	13,749	29.1 (23.1, 35.2)	51.9 (44.6, 58.1)	57.0 (48.7, 64.9)
Comparison between time categories (p-value)		p <0.001	p <0.001	p <0.001

Table 46: SMRs* for all male coal mine workers by time between first and last assessment (all jobs included)

Cause of death categories	≤5 years *N=164,622; PY=1,380,035*			>5-10 years *N=53,762; PY=362,291*			>10 – 15 years *N=29,195; PY=199,497*			>15 years *N=13,749; PY=176,730*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH #	3292	3587	92 (89 - 95)	597	918	65 (60 - 70)	581	779	75 (69 - 81)	487	859	57 (52 - 62)
All Malignancies #	1147	1175	98 (92 - 103)	226	294	77 (67 - 87)	254	282	90 (80 - 102)	261	342	76 (68 - 86)
Oesophagus	47	54	87 (65 - 116)	10	13	74 (40 - 138)	10	12	81 (43 - 150)	12	16	74 (42 - 130)
Stomach	39	40	97 (71 - 133)	---	---	49 (20 - 117)	6	9	63 (29 - 141)	9	11	80 (42 - 154)
Colorectal	116	122	95 (79 - 114)	27	31	87 (59 - 126)	26	30	87 (59 - 127)	27	35	78 (53 - 113)
Liver #	68	73	93 (74 - 119)	10	18	56 (30 - 104)	13	15	86 (50 - 148)	9	21	43 (22 - 83)
Pancreas	72	75	97 (77 - 122)	18	18	98 (62 - 156)	14	17	81 (48 - 137)	15	22	67 (41 - 112)
Lung	251	236	106 (94 - 120)	50	59	85 (65 - 113)	72	60	121 (96 - 152)	61	73	83 (65 - 107)
Mesothelioma, pleural #	25	18	137 (92 - 202)	6	4	138 (62 - 306)	---	---	38 (9 - 152)	---	---	48 (15 - 149)
Melanoma	56	56	100 (77 - 129)	10	15	67 (36 - 125)	12	13	95 (54 - 168)	12	15	81 (46 - 142)
Prostate	65	62	105 (82 - 134)	16	14	115 (70 - 187)	21	18	115 (75 - 176)	20	20	98 (63 - 153)
Bladder #	19	18	103 (66 - 162)	---	---	23 (3 - 161)	---	---	59 (19 - 184)	---	---	18 (2 - 125)
Kidney	25	33	76 (51 - 112)	12	8	142 (81 - 250)	6	8	79 (35 - 175)	9	10	93 (48 - 178)
Brain	70	71	99 (78 - 125)	12	19	64 (37 - 114)	15	14	104 (63 - 172)	14	17	81 (48 - 136)
All Metabolic	81	131	62 (50 - 77)	14	32	43 (26 - 73)	17	30	57 (35 - 91)	11	35	32 (18 - 57)
Diabetes	57	87	65 (50 - 84)	10	21	47 (25 - 87)	11	21	52 (29 - 95)	11	24	45 (25 - 82)
All Mental and Behavioural	22	56	39 (26 - 59)	---	---	27 (10 - 72)	8	15	53 (27 - 106)	---	---	22 (7 - 70)
All Nervous System	61	122	50 (39 - 64)	15	30	50 (30 - 83)	6	27	22 (10 - 49)	11	30	37 (21 - 67)
All Circulatory #	614	739	83 (77 - 90)	121	190	64 (53 - 76)	114	180	63 (53 - 76)	95	198	48 (39 - 59)
IHD #	393	436	90 (82 - 100)	72	114	63 (50 - 80)	68	107	63 (50 - 80)	64	121	53 (42 - 68)
Cerebrovascular #	76	104	73 (58 - 91)	14	26	54 (32 - 91)	12	27	45 (25 - 78)	11	28	39 (22 - 70)
Other Heart Disease	108	153	71 (59 - 86)	25	38	65 (44 - 96)	26	35	75 (51 - 111)	13	37	35 (20 - 60)
All Respiratory	130	170	76 (64 - 91)	20	41	49 (32 - 76)	47	44	107 (80 - 142)	24	48	50 (33 - 74)
COPD	84	89	95 (76 - 117)	13	21	63 (37 - 109)	30	24	124 (87 - 178)	10	27	36 (20 - 68)
All Digestive	81	168	48 (39 - 60)	24	44	55 (37 - 82)	19	36	53 (34 - 83)	12	43	28 (16 - 49)
Liver Disease	56	120	47 (36 - 60)	13	32	41 (24 - 70)	9	24	37 (19 - 71)	9	30	30 (15 - 57)
All Urinary	14	30	47 (28 - 80)	---	---	43 (14 - 132)	---	---	52 (20 - 139)	---	---	62 (26 - 148)
All Injury and Trauma #	**1040**	**819**	**127 (119 - 135)**	155	218	71 (61 - 83)	92	121	76 (62 - 93)	49	103	48 (36 - 63)
Accidents #	**511**	**419**	**122 (112 - 133)**	94	111	85 (69 - 104)	47	61	76 (57 - 102)	22	53	42 (28 - 64)
Suicide #	**488**	**338**	**145 (132 - 158)**	59	91	65 (50 - 84)	42	50	84 (62 - 114)	25	42	59 (40 - 88)
All Other Causes	95	176	54 (44 - 66)	13	47	28 (16 - 48)	20	36	55 (35 - 85)	16	39	41 (25 - 67)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**;

Test for trend across subgroups shows a significant increase or reduction (p <0.005)

Table 47: SMRs* for male coal mine workers by time between first and last assessment among those who ONLY worked in Administration (Unexposed Office Work Category)

Cause of death categories	≤5 years *N= 12,596; PY= 117,543*			>5-10 years *N= 1,388; PY= 10,126*			> 10 years *N= 506; PY= 4,963*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	252	430	59 (52 - 66)	21	46	45 (29 - 69)	22	39	57 (37 - 86)
All Malignancies	114	158	72 (60 - 87)	12	18	66 (38 - 117)	14	16	88 (52 - 148)
Oesophagus	---	---	54 (20 - 143)	0			---	---	277 (69 - 1110)
Stomach	---	---	19 (3 - 134)	0			---	---	204 (29 - 1446)
Colorectal	12	16	74 (42 - 131)	---	---	108 (27 - 432)	---	---	65 (9 - 460)
Liver	8	10	78 (39 - 157)	0			0		
Pancreas	8	10	77 (39 - 154)	0			0		
Lung	25	33	76 (52 - 113)	---	---	26 (4 - 184)	---	---	115 (43 - 307)
Mesothelioma, pleural	---	---	154 (58 - 411)	0			0		
Melanoma	8	7	115 (57 - 229)	---	---	129 (18 - 915)	---	---	161 (23 - 1142)
Prostate	7	9	77 (37 - 162)	---	---	91 (13 - 644)	0		
Bladder	---	---	39 (5 - 277)	0			0		
Kidney	---	---	112 (47 - 270)	---	---	196 (28 - 1394)	0		
Brain	---	---	12 (2 - 82)	---	---	218 (54 - 870)	---	---	153 (22 - 1085)
All Metabolic	8	17	47 (23 - 93)	---	---	53 (7 - 378)	---	---	60 (8 - 426)
Diabetes	---	---	42 (18 - 102)	---	---	76 (11 - 539)	0		
All Mental and Behavioural	---	---	15 (2 - 108)	0			0		
All Nervous System	6	15	40 (18 - 88)	0			0		
All Circulatory	48	94	51 (38 - 67)	---	---	28 (9 - 87)	---	---	22 (5 - 87)
IHD	33	56	59 (42 - 83)	---	---	16 (2 - 111)	---	---	19 (3 - 135)
Cerebrovascular	---	---	22 (7 - 69)	---	---	65 (9 - 460)	0		
Other Heart Disease	7	19	37 (18 - 77)	---	---	49 (7 - 345)	---	---	54 (8 - 387)
All Respiratory	16	23	69 (42 - 113)	---	---	75 (19 - 301)	0		
COPD	6	13	47 (21 - 105)	0			0		
All Digestive	7	21	33 (16 - 68)	0			---	---	174 (56 - 540)
Liver Disease	7	15	46 (22 - 96)	0			---	---	185 (46 - 741)
All Urinary	---	---	50 (13 - 201)	0			0		
All Injury and Trauma	40	70	57 (42 - 78)	---	---	34 (8 - 134)	---	---	67 (17 - 268)
Accidents	15	35	43 (26 - 71)	0			---	---	124 (31 - 497)
Suicide	23	29	79 (53 - 119)	---	---	82 (20 - 328)	0		
All Other Causes	9	21	43 (23 - 83)	---	---	47 (7 - 335)	0		

***** Statistically significantly reduced SMR results are in **blue**

Table 48: SMRs* for male coal mine workers by time between first and last assessment among those who ONLY worked in the Unexposed Non-Office Work Category

Cause of death categories	≤5 years *N= 4,494; PY= 38,106*			>5-10 years *N= 277; PY= 1,834*			>10 years *N= 101; PY= 1,093*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	105	100	105 (87 - 127)	8	7	108 (54 - 216)	9	14	63 (33 - 120)
All Malignancies	36	33	108 (78 - 149)	---	---	142 (53 - 378)	---	---	86 (36 - 208)
Oesophagus	0			0			0		
Stomach	0			0			---	---	591 (83 - 4194)
Colorectal	7	4	200 (95 - 419)	---	---	319 (45 - 2268)	---	---	364 (91 - 1457)
Liver	---	---	46 (6 - 325)	0			---	---	363 (51 - 2579)
Pancreas	---	---	183 (69 - 489)	0			---	---	288 (41 - 2041)
Lung	---	---	74 (31 - 178)	0			0		
Mesothelioma, pleural	---	---	198 (28 - 1405)	0			0		
Melanoma	---	---	197 (64 - 611)	0			0		
Prostate	---	---	173 (56 - 535)	---	---	562 (79 - 3993)	0		
Bladder	0			0			0		
Kidney	0			**---**	**---**	**1304 (184 - 9260)**	0		
Brain	---	---	98 (25 - 393)	0			0		
All Metabolic	---	---	78 (25 - 243)	0			0		
Diabetes	---	---	118 (38 - 365)	0			0		
All Mental and Behavioural	0			0			0		
All Nervous System	---	---	58 (14 - 232)	0			0		
All Circulatory	**30**	**20**	**147 (103 - 210)**	---	---	57 (8 - 404)	---	---	28 (4 - 196)
IHD	**22**	**12**	**184 (121 - 279)**	---	---	93 (13 - 658)	0		
Cerebrovascular	---	---	70 (18 - 280)	0			0		
Other Heart Disease	---	---	93 (35 - 246)	0			---	---	135 (19 - 956)
All Respiratory	---	---	62 (20 - 193)	---	---	239 (34 - 1699)	---	---	165 (41 - 660)
COPD	---	---	39 (5 - 275)	---	---	421 (59 - 2990)	---	---	144 (20 - 1023)
All Digestive	---	---	62 (20 - 193)	**---**	**---**	**592 (148 - 2368)**	0		
Liver Disease	---	---	58 (14 - 232)	---	---	433 (61 - 3072)	0		
All Urinary	0			0			0		
All Injury and Trauma	22	22	100 (66 - 151)	0			0		
Accidents	12	11	109 (62 - 192)	0			0		
Suicide	10	9	107 (57 - 198)	0			0		
All Other Causes	---	---	101 (42 - 241)	0			---	---	183 (26 - 1299)

***** Statistically significantly increased SMR results are in **red**

Table 49: SMRs* for male coal mine workers by time between first and last assessment among those who ONLY worked in the Occasionally Exposed Work Category

Cause of death categories	≤5 years *N= 10,714; PY= 98,924*			>5-10 years *N= 1,282; PY= 9,594*			>10 years *N= 380; PY= 3,056*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	132	211	62 (53 - 74)	8	22	37 (19 - 74)	---	---	29 (11 - 76)
All Malignancies	56	65	86 (66 - 112)	---	---	60 (22 - 159)	---	---	38 (9 - 151)
Oesophagus	---	---	100 (32 - 311)	0			0		
Stomach	---	---	223 (93 - 537)	0			---	---	590 (83 - 4191)
Colorectal	---	---	58 (22 - 155)	0			0		
Liver	---	---	49 (12 - 195)	0			0		
Pancreas	---	---	48 (12 - 193)	0			0		
Lung	14	13	111 (66 - 187)	0			0		
Mesothelioma, pleural	---	---	**313 (101 - 972)**	0			0		
Melanoma	---	---	63 (16 - 253)	---	---	299 (42 - 2124)	0		
Prostate	---	---	127 (47 - 337)	0			0		
Bladder	0			0			0		
Kidney	0			0			0		
Brain	6	4	140 (63 - 312)	---	---	219 (31 - 1557)	---	---	383 (54 - 2718)
All Metabolic	---	---	13 (2 - 93)	0			0		
Diabetes	---	---	20 (3 - 143)	0			0		
All Mental and Behavioural	---	---	35 (5 - 250)	0			0		
All Nervous System	---	---	55 (21 - 148)	0			0		
All Circulatory	21	40	52 (34 - 80)	---	---	47 (12 - 189)	---	---	64 (16 - 256)
IHD	12	23	51 (29 - 91)	---	---	40 (6 - 285)	---	---	55 (80 - 393)
Cerebrovascular	---	---	90 (37 - 216)	---	---	176 (25 - 1251)	0		
Other Heart Disease	---	---	45 (17 - 120)	0			0		
All Respiratory	---	---	22 (5 - 87)	0			0		
COPD	---	---	21 (3 - 151)	0			0		
All Digestive	---	---	31 (10 - 97)	0			0		
Liver Disease	---	---	14 (2 - 102)	0			0		
All Urinary	0			0			0		
All Injury and Trauma	39	57	68 (50 - 93)	---	---	36 (9 - 142)	0		
Accidents	14	29	49 (29 - 82)	---	---	71 (18 - 284)	0		
Suicide	24	24	99 (67 - 148)	0			0		
All Other Causes	---	---	38 (14 - 100)	0			0		

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 50: SMRs* for male coal mine workers by time between first and last assessment among those who EVER worked in the Maintenance Work Category

Cause of death categories	≤5 years *N= 61,309; PY= 473,964*			>5-10 years *N= 23,996; PY= 158,010*			>10 – 15 years *N= 13,068; PY= 81,333*			>15 years *N= 5,833; PY= 45,643*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	878	101	87 (81 - 93)	229	351	65 (57 - 74)	186	264	70 (61 - 81)	98	207	47 (39 - 58)
All Malignancies	287	309	93 (83 - 104)	88	109	81 (66 - 100)	80	93	86 (69 - 107)	59	81	73 (57 - 94)
Oesophagus	16	14	112 (69 - 183)	---	---	40 (10 - 159)	---	---	116 (48 - 278)	0		
Stomach	11	11	102 (57 - 184)	---	---	52 (13 - 208)	---	---	64 (16 - 255)	---	---	75 (19 - 300)
Colorectal	26	33	80 (54 - 117)	10	12	85 (46 - 158)	10	10	103 (56 - 192)	---	---	62 (26 - 150)
Liver	19	19	98 (62 - 154)	6	7	91 (41 - 202)	---	---	90 (37 - 216)	---	---	18 (3 - 126)
Pancreas	25	19	128 (87 - 190)	7	7	103 (49 - 216)	---	---	83 (35 - 200)	---	---	36 (9 - 145)
Lung	58	60	96 (75 - 125)	18	21	85 (53 - 134)	12	19	62 (35 - 110)	18	17	106 (67 - 168)
Mesothelioma, pleural	6	4	135 (61 - 300)	---	---	**316 (131 - 758)**	---	---	124 (31 - 498)	---	---	152 (38 - 610)
Melanoma	16	16	103 (63 - 168)	---	---	71 (27 - 189)	---	---	116 (48 - 278)	---	---	90 (29 - 279)
Prostate	17	14	121 (75 - 195)	6	5	129 (58 - 288)	---	---	37 (9 - 147)	7	5	149 (71 - 312)
Bladder	---	---	90 (34 - 240)	---	---	65 (9 - 462)	---	---	127 (32 - 509)	0		
Kidney	9	9	102 (53 - 196)	---	---	63 (16 - 251)	---	---	115 (37 - 356)	---	---	88 (22 - 353)
Brain	19	21	93 (59 - 145)	---	---	41 (13 - 126)	6	5	114 (51 - 255)	---	---	71 (23 - 219)
All Metabolic	19	36	53 (34 - 84)	---	---	33 (12 - 87)	---	---	39 (15 - 104)	---	---	12 (2 - 82)
Diabetes	14	23	61 (36 - 103)	---	---	25 (6 - 100)	---	---	43 (14 - 134)	---	---	16 (2 - 117)
All Mental and	7	15	47 (22 - 99)	---	---	63 (20 - 194)	0			---	---	34 (5 - 239)
All Nervous System	12	34	35 (20 - 62)	6	11	53 (24 - 118)	---	---	32 (10 - 100)	---	---	13 (2 - 95)
All Circulatory	141	196	72 (61 - 85)	38	70	54 (39 - 74)	32	57	56 (39 - 79)	16	46	35 (21 - 57)
IHD	95	115	82 (67 - 101)	20	42	48 (31 - 74)	14	34	41 (25 - 70)	10	27	37 (20 - 69)
Cerebrovascular	15	27	56 (34 - 93)	7	9	75 (36 - 157)	6	8	72 (32 - 160)	---	---	46 (15 - 143)
Other Heart Disease	22	42	53 (35 - 80)	9	14	62 (32 - 120)	8	12	68 (34 - 137)	---	---	22 (5 - 86)
All Respiratory	31	42	73 (51 - 104)	9	14	63 (33 - 121)	19	14	138 (88 - 216)	---	---	59 (28 - 124)
COPD	20	21	95 (61 - 147)	8	7	115 (57 - 229)	11	7	149 (83 - 269)	---	---	44 (14 - 136)
All Digestive	24	47	51 (34 - 77)	9	17	54 (28 - 103)	---	---	39 (16 - 94)	---	---	9 (1 - 67)
Liver Disease	16	34	47 (29 - 76)	6	12	48 (22 - 108)	---	---	22 (6 - 88)	---	---	13 (2 - 94)
All Urinary	---	---	41 (13 - 126)	---	---	40 (6 - 285)	---	---	82 (20 - 326)	0		
All Injury and Trauma	**327**	**276**	**118 (106 - 132)**	67	93	72 (57 - 92)	32	48	66 (47 - 94)	8	27	29 (15 - 58)
Accidents	152	140	108 (92 - 127)	36	47	77 (56 - 107)	17	24	70 (43 - 112)	---	---	15 (4 - 58)
Suicide	**161**	**115**	**140 (120 - 163)**	30	39	77 (54 - 110)	14	20	70 (41 - 118)	6	11	53 (24 - 118)
All Other Causes	26	52	50 (34 - 74)	---	---	23 (9 - 61)	9	13	72 (37 - 138)	---	---	40 (15 - 106)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 51: SMRs* for male coal mine workers by time between first and last assessment among those who EVER worked in the Production Work Category

Cause of death categories	≤5 years *N= 55,252; PY= 398,849*			>5-10 years *N= 28,077; PY= 179,153*			>10 – 15 years *N= 16,997; PY= 104,848*			>15 years *N= 8,527; PY= 71,043*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	100	101	99 (93 - 106)	370	485	76 (69 - 84)	347	440	79 (71 - 88)	256	402	64 (56 - 72)
All Malignancies	344	328	105 (94 - 117)	142	163	87 (74 - 102)	152	166	92 (78 - 107)	133	164	81 (69 - 96)
Oesophagus	10	15	66 (36 - 123)	9	8	118 (61 - 227)	7	8	93 (44 - 194)	---	---	51 (19 - 136)
Stomach	13	11	114 (66 - 196)	---	---	70 (26 - 186)	---	---	56 (18 - 172)	---	---	77 (29 - 204)
Colorectal	40	35	115 (85 - 157)	17	18	96 (60 - 154)	8	17	47 (24 - 94)	12	16	75 (43 - 133)
Liver	17	20	86 (53 - 138)	---	---	52 (22 - 126)	8	9	86 (43 - 171)	6	11	55 (25 - 123)
Pancreas	16	21	78 (48 - 127)	10	10	98 (53 - 182)	10	11	95 (51 - 176)	11	11	100 (55 - 180)
Lung	77	66	117 (94 - 146)	34	33	102 (73 - 143)	**51**	**35**	**145 (110 - 191)**	32	35	91 (65 - 129)
Mesothelioma, pleural	---	---	59 (19 - 183)	---	---	38 (5 - 269)	0			---	---	34 (5 - 240)
Melanoma	21	16	129 (84 - 199)	7	8	86 (41 - 181)	6	7	82 (37 - 182)	7	7	107 (51 - 224)
Prostate	17	16	106 (66 - 170)	8	8	105 (53 - 210)	16	11	146 (89 - 238)	11	11	103 (57 - 185)
Bladder	9	5	181 (94 - 347)	0			---	---	66 (16 - 264)	---	---	36 (5 - 254)
Kidney	7	9	75 (36 - 157)	**10**	**5**	**208 (112 - 386)**	---	---	88 (33 - 236)	---	---	112 (46 - 268)
Brain	22	20	108 (71 - 164)	10	10	98 (53 - 182)	7	8	85 (40 - 178)	---	---	64 (27 - 154)
All Metabolic	18	36	50 (31 - 79)	8	18	45 (23 - 91)	12	17	69 (39 - 121)	8	17	47 (23 - 94)
Diabetes	12	24	50 (28 - 88)	6	12	51 (23 - 114)	8	12	65 (33 - 131)	8	12	66 (33 - 131)
All Mental and Behavioural	---	---	30 (13 - 73)	---	---	15 (2 - 104)	7	8	93 (44 - 195)	---	---	48 (15 - 148)
All Nervous System	14	34	42 (25 - 70)	10	16	64 (35 - 120)	---	---	19 (6 - 58)	7	15	47 (22 - 98)
All Circulatory	213	209	102 (89 - 117)	79	104	76 (61 - 95)	64	101	64 (50 - 81)	55	90	61 (47 - 79)
IHD	142	125	114 (96 - 134)	51	64	80 (61 - 105)	36	59	61 (44 - 84)	34	53	64 (46 - 90)
Cerebrovascular	24	29	83 (56 - 124)	6	14	43 (19 - 96)	8	15	53 (26 - 105)	8	13	60 (30 - 120)
Other Heart Disease	34	42	80 (57 - 113)	19	20	94 (60 - 148)	14	20	71 (42 - 120)	8	18	44 (22 - 88)
All Respiratory	34	45	75 (54 - 105)	13	21	61 (35 - 104)	28	26	109 (76 - 159)	11	25	44 (24 - 79)
COPD	25	23	108 (73 - 159)	8	11	73 (36 - 146)	17	14	121 (75 - 194)	4	15	27 (10 - 72)
All Digestive	17	48	36 (22 - 57)	11	24	46 (26 - 84)	11	21	53 (29 - 95)	7	20	36 (17 - 75)
Liver Disease	12	35	34 (20 - 61)	---	---	23 (9 - 61)	6	14	42 (19 - 94)	6	14	44 (20 - 99)
All Urinary	---	---	13 (2 - 90)	---	---	55 (14 - 219)	---	---	22 (3 - 155)	---	---	97 (36 - 258)
All Injury and Trauma	**340**	**237**	**143 (129 - 160)**	92	105	87 (71 - 107)	58	62	93 (72 - 120)	19	42	45 (29 - 71)
Accidents	**178**	**120**	**148 (128 - 171)**	50	53	94 (71 - 124)	30	32	94 (66 - 135)	9	22	42 (22 - 80)
Suicide	**151**	**98**	**153 (131 - 180)**	40	44	91 (67 - 124)	27	25	107 (73 - 156)	10	17	59 (32 - 109)
All Other Causes	20	51	40 (26 - 61)	10	23	43 (23 - 80)	11	20	56 (31 - 101)	9	18	49 (25 - 94)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 52: SMRs* for male coal mine workers by time between first and last assessment among those who EVER worked as an Underground Miner

Cause of death categories	≤5 years *N= 7,696; PY= 54,993*			>5-10 years *N= 4,985; PY= 31,738*			>10 – 15 years *N= 3,438; PY= 21,139*			>15 years *N= 1,995; PY= 17,407*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	97	106	91 (75 - 111)	47	62	75 (57 - 100)	47	61	78 (58 - 103)	38	68	56 (41 - 77)
All Malignancies	27	29	94 (65 - 137)	18	17	104 (65 - 165)	19	20	93 (59 - 146)	18	25	71 (45 - 112)
Oesophagus	0			---	---	255 (64 - 1021)	---	---	105 (15 - 743)	---	---	159 (40 - 635)
Stomach	0			---	---	311 (78 - 1242)	---	---	141 (20 - 1004)	---	---	114 (16 - 811)
Colorectal	---	---	130 (49 - 346)	0			---	---	187 (70 - 499)	---	---	39 (5 - 274)
Liver	0			0			---	---	166 (41 - 662)	0		
Pancreas	---	---	117 (29 - 470)	---	---	97 (14 - 686)	---	---	77 (11 - 548)	---	---	115 (29 - 459)
Lung	6	5	113 (51 - 251)	---	---	93 (30 - 289)	6	4	147 (66 - 326)	---	---	19 (3 - 135)
Mesothelioma, pleural	0			0			0			0		
Melanoma	---	---	123 (31 - 492)	---	---	98 (14 - 694)	0			0		
Prostate	---	---	172 (43 - 689)	---	---	**500 (161 - 1550)**	---	---	96 (14 - 682)	0		
Bladder	---	---	252 (35 - 1789)	0			0			0		
Kidney	0			---	---	190 (27 - 1347)	---	---	169 (24 - 1200)	---	---	269 (67 - 1077)
Brain	---	---	96 (24 - 383)	---	---	75 (11 - 535)	0			---	---	136 (34 - 543)
All Metabolic	---	---	59 (15 - 238)	---	---	49 (7 - 351)	---	---	90 (22 - 359)	---	---	72 (18 - 288)
Diabetes	---	---	94 (24 - 377)	---	---	79 (11 - 560)	---	---	134 (34 - 537)	---	---	106 (26 - 422)
All Mental and	0			0			0			0		
All Nervous System	---	---	29 (4 - 207)	---	---	103 (26 - 411)	---	---	49 (7 - 347)	0		
All Circulatory	16	20	81 (50 - 133)	---	---	33 (12 - 88)	---	---	23 (7 - 72)	9	15	61 (32 - 116)
IHD	9	12	77 (40 - 149)	---	---	14 (2 - 97)	---	---	26 (6 - 103)	7	9	79 (38 - 165)
Cerebrovascular	---	---	149 (56 - 398)	---	---	64 (9 - 452)	0			---	---	50 (7 - 353)
Other Heart Disease	---	---	48 (12 - 190)	---	---	80 (20 - 320)	---	---	38 (5 - 271)	---	---	33 (5 - 237)
All Respiratory	---	---	77 (25 - 238)	---	---	46 (6 - 324)	---	---	106 (34 - 327)	0		
COPD	---	---	170 (55 - 528)	0			---	---	69 (10 - 493)	0		
All Digestive	---	---	22 (3 - 153)	---	---	34 (5 - 242)	---	---	66 (17 - 264)	---	---	54 (13 - 215)
Liver Disease	0			---	---	45 (6 - 320)	---	---	46 (6 - 323)	---	---	36 (5 - 259)
All Urinary	0			0			0			0		
All Injury and Trauma	44	34	130 (97 - 174)	15	19	78 (47 - 130)	17	13	135 (84 - 217)	7	10	67 (32 - 140)
Accidents	24	17	138 (93 - 206)	6	10	62 (28 - 138)	9	6	143 (74 - 274)	---	---	78 (29 - 207)
Suicide	20	14	143 (92 - 222)	8	8	100 (50 - 200)	7	5	134 (64 - 281)	---	---	68 (22 - 210)
All Other Causes	---	---	53 (17 - 164)	---	---	123 (46 - 328)	0			0		

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 53: SMRs* for male coal mine workers by time between first and last assessment among those who EVER worked as an Exploration Driller

Cause of death categories	≤5 years *N= 4,970; PY= 43,418*			>5-10 years *N= 1,205; PY= 8,124*			>10 years *N= 465; PY= 3,148*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	64	67	96 (75 - 123)	11	14	77 (43 - 139)	---	---	76 (32 - 184)
All Malignancies	16	16	100 (61 - 163)	---	---	53 (13 - 212)	---	---	54 (8 - 380)
Oesophagus	0			0			0		
Stomach	0			---	---	708 (100 - 5024)	0		
Colorectal	0			0			0		
Liver	0			0			0		
Pancreas	---	---	202 (50 - 807)	0			0		
Lung	---	---	147 (55 - 391)	0			0		
Mesothelioma, pleural	0			0			0		
Melanoma	---	---	107 (15 - 761)	---	---	477 (67 - 3389)	0		
Prostate	0			0			0		
Bladder	---	---	538 (76 - 3821)	0			0		
Kidney	0			0			0		
Brain	---	---	142 (36 - 570)	0			0		
All Metabolic	---	---	46 (6 - 326)	0			0		
Diabetes	---	---	77 (11 - 547)	0			0		
All Mental and Behavioural	0			0			0		
All Nervous System	0			0			0		
All Circulatory	8	11	71 (35 - 141)	---	---	154 (58 - 411)	---	---	160 (40 - 640)
IHD	6	6	94 (42 - 209)	---	---	202 (65 - 626)	---	---	138 (19 – 977)
Cerebrovascular	---	---	69 (10 - 489)	0			0		
Other Heart Disease	---	---	37 (5 - 262)	---	---	167 (23 - 1184)	---	---	354 (50 - 2512)
All Respiratory	---	---	47 (7 - 336)	0			0		
COPD	0			0			0		
All Digestive	0			0			0		
All Urinary	0			0			0		
All Injury and Trauma	**36**	**25**	**144 (104 - 200)**	---	---	105 (44 - 252)	---	---	105 (26 - 421)
Accidents	18	12	144 (91 - 229)	---	---	169 (64 - 451)	---	---	107 (15 - 762)
Suicide	14	11	132 (78 - 224)	---	---	49 (7 - 349)	0		
All Other Causes	---	---	28 (4 - 196)	0			0		

***** Statistically significantly increased SMR results are in **red**

Table 54: SMRs* for male coal mine workers by time between first and last assessment among those who EVER worked in a Job Group in the Construction Work Category

Cause of death categories	≤5 years *N= 9,034; PY= 78,622*			>5-10 years *N= 2,115; PY= 14,314*			≥10 years *N= 947; PY= 7,830*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	212	194	109 (95 - 125)	24	36	67 (45 - 100)	18	29	61 (39 - 97)
All Malignancies	66	64	104 (82 - 132)	7	12	60 (29 - 126)	**12**	**7**	**182 (103 - 320)**
Oesophagus	---	---	135 (51 - 359)	0			0		
Stomach	---	---	138 (44 - 428)	0			0		
Colorectal	9	7	136 (71 - 261)	0			0		
Liver	---	---	123 (51 - 295)	0			0		
Pancreas	---	---	49 (12 - 195)	0			---	---	228 (32 - 1622)
Lung	**20**	**13**	**157 (102 - 244)**	---	---	172 (65 - 460)	**6**	**1**	**441 (198 - 982)**
Mesothelioma, pleural	**---**	**---**	**310 (100 - 960)**	0			0		
Melanoma	---	---	66 (17 - 264)	0			0		
Prostate	---	---	62 (16 - 249)	---	---	393 (98 - 1571)	---	---	287 (40 - 2038)
Bladder	---	---	104 (15 - 737)	0			0		
Kidney	---	---	56 (8 - 395)	0			0		
Brain	---	---	101 (38 - 270)	0			0		
All Metabolic	6	7	83 (37 - 185)	---	---	76 (11 - 542)	0		
Diabetes	---	---	84 (31 - 223)	---	---	116 (16 - 827)	0		
All Mental and Behavioural	---	---	74 (18 - 295)	0			---	---	396 (56 - 2812)
All Nervous System	---	---	60 (23 - 160)	---	---	86 (12 - 610)	0		
All Circulatory	36	39	92 (66 - 128)	---	---	55 (21 - 146)	0		
IHD	22	23	96 (63 - 146)	---	---	69 (22 - 214)	0		
Cerebrovascular	---	---	74 (28 - 197)	0			0		
Other Heart Disease	8	8	97 (48 - 193)	0			0		
All Respiratory	9	9	100 (52 - 192)	---	---	65 (9 - 464)	0		
COPD	7	5	149 (71 - 313)	---	---	129 (18 - 916)	0		
All Digestive	12	9	130 (74 - 229)	---	---	112 (28 - 447)	0		
Liver Disease	10	7	150 (81 - 279)	---	---	151 (38 - 604)	0		
All Urinary	---	---	128 (32 - 511)	0			0		
All Injury and Trauma	**68**	**45**	**149 (118 - 190)**	8	8	96 (48 - 191)	---	---	30 (4 - 210)
Accidents	31	23	135 (95 - 192)	---	---	120 (50 - 288)	---	---	59 (8 - 421)
Suicide	**34**	**19**	**178 (127 - 249)**	---	---	85 (27 - 263)	0		
All Other Causes	6	10	62 (28 - 139)	0			0		

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 55: SMRs* for male coal mine workers by time between first and last assessment among those who EVER worked as a Labourer (not elsewhere classified)

Cause of death categories	≤5 years *N= 5,814; PY= 49,672*			>5-10 years *N= 1,888; PY= 12,713*			>10 – 15 years *N= 942; PY= 5,550*			>15 years *N= 269; PY= 1,506*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	**107**	**86**	**125 (103 - 151)**	21	23	93 (61 - 143)	8	11	73 (36 - 146)	---	---	40 (10 - 162)
All Malignancies	26	23	112 (76 - 164)	---	---	48 (16 - 150)	6	3	192 (86 - 428)	0		
Oesophagus	0			0			0			0		
Stomach	---	---	121 (17 - 859)	0			0			0		
Colorectal	---	---	120 (39 - 373)	0			0			0		
Liver	**---**	**---**	**269 (101 - 717)**	0			---	---	468 (66 - 3320)	0		
Pancreas	---	---	69 (10 - 490)	0			0			0		
Lung	---	---	117 (49 - 281)	---	---	176 (44 - 705)	**---**	**---**	**525 (169 - 1629)**	0		
Mesothelioma, pleural	0			0			0			0		
Melanoma	0			0			---	---	633 (89 - 4490)	0		
Prostate	---	---	109 (15 - 776)	0			0			0		
Bladder	0			0			0			0		
Kidney	0			0			0			0		
Brain	---	---	58 (8 - 410)	0			0			0		
All Metabolic	---	---	105 (34 - 324)	0			0			0		
Diabetes	---	---	112 (28 - 447)	0			0			0		
All Mental and	0			0			0			0		
All Nervous System	---	---	69 (17 - 275)	---	---	135 (19 - 961)	0			0		
All Circulatory	20	15	131 (85 - 204)	---	---	147 (66 - 327)	---	---	49 (7 - 345)	---	---	97 (14 - 685)
IHD	12	9	138 (78 - 242)	**---**	**---**	**254 (114 - 566)**	0			0		
Cerebrovascular	6	2	295 (132 - 656)	0			0			0		
Other Heart Disease	---	---	58 (14 - 230)	0			---	---	215 (30 - 1523)	0		
All Respiratory	---	---	31 (4 - 223)	---	---	123 (17 - 877)	0			0		
COPD	---	---	68 (10 - 485)	0			0			0		
All Digestive	---	---	79 (26 - 245)	---	---	95 (13 - 678)	0			0		
Liver Disease	---	---	72 (18 - 286)	---	---	127 (18 - 905)	0			0		
All Urinary	0			0			0			0		
All Injury and Trauma	**45**	**28**	**158 (118 - 212)**	9	7	123 (64 - 236)	---	---	30 (4 - 215)	---	---	109 (15 - 773)
Accidents	**23**	**14**	**159 (106 - 240)**	6	4	163 (73 - 364)	0			---	---	219 (31 - 1554)
Suicide	**19**	**12**	**161 (103 - 252)**	---	---	65 (16 - 259)	---	---	70 (10 - 497)	0		
All Other Causes	7	4	157 (75 - 330)	0			0			0		

***** Statistically significantly increased SMR results are in **red**

Table 56: SMRs* for male coal mine workers by time between first and last assessment among those who EVER worked as Supervisor (not elsewhere classified)

Cause of death categories	≤5 years *N= 5.575; PY= 38.030*			>5-10 years *N= 3.497; PY= 22.434*			>10 – 15 years *N= 2.362; PY= 14.306*			>15 years *N= 1.347; PY= 11.070*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	83	124	67 (54 - 83)	29	64	46 (32 - 66)	30	50	60 (42 - 86)	21	55	38 (25 - 59)
All Malignancies	42	43	97 (72 - 131)	14	22	65 (38 - 109)	15	18	82 (50 - 137)	12	22	55 (31 - 96)
Oesophagus	---	---	149 (48 - 461)	---	---	97 (14 - 687)	---	---	230 (58 - 919)	0		
Stomach	---	---	68 (10 - 485)	0			0			---	---	139 (20 - 984)
Colorectal	---	---	68 (22 - 210)	---	---	88 (22 - 351)	---	---	160 (51 - 495)	0		
Liver	---	---	114 (37 - 353)	0			---	---	88 (12 - 625)	0		
Pancreas	---	---	72 (18 - 290)	---	---	72 (10 - 514)	0			---	---	67 (9 - 472)
Lung	10	9	112 (60 - 209)	---	---	114 (47 - 274)	---	---	106 (40 - 283)	---	---	65 (21 - 201)
Mesothelioma, pleural	0			---	---	299 (42 - 2125)	0			0		
Melanoma	---	---	49 (7 - 344)	0			---	---	116 (16 - 824)	0		
Prostate	---	---	83 (21 - 330)	---	---	102 (14 - 727)	---	---	209 (52 - 834)	---	---	79 (11 - 560)
Bladder	---	---	142 (20 - 1011)	0			0			0		
Kidney	---	---	81 (11 - 577)	0			---	---	190 (27 - 1348)	0		
Brain	---	---	82 (20 - 326)	---	---	73 (10 - 521)	0			---	---	88 (12 - 627)
All Metabolic	---	---	22 (3 - 154)	0			0			---	---	43 (6 - 305)
Diabetes	---	---	32 (4 - 225)	0			0			---	---	61 (9 - 435)
All Mental and	---	---	45 (6 - 320)	0			---	---	138 (19 - 980)	0		
All Nervous System	---	---	47 (12 - 188)	0			0			0		
All Circulatory	14	27	52 (31 - 88)	6	14	44 (20 - 98)	---	---	36 (14 - 96)	---	---	33 (12 - 87)
IHD	7	16	44 (21 - 92)	---	---	36 (12 - 112)	---	---	15 (2 - 106)	---	---	41 (13 - 128)
Cerebrovascular	---	---	105 (39 - 280)	0			---	---	64 (9 - 457)	0		
Other Heart Disease	---	---	38 (9 - 151)	---	---	75 (19 - 300)	---	---	46 (6 - 325)	---	---	41 (6 - 289)
All Respiratory	---	---	48 (15 - 149)	0			---	---	80 (20 - 318)	---	---	32 (4 - 224)
COPD	---	---	60 (15 - 240)	0			0			0		
All Digestive	0			---	---	31 (4 - 219)	---	---	39 (5 - 274)	0		
Liver Disease	0			---	---	42 (6 - 295)	---	---	53 (7 - 378)	0		
All Urinary	0			**---**	**---**	**411 (103 - 1642)**	0			0		
All Injury and Trauma	19	23	82 (52 - 128)	6	13	45 (20 - 100)	7	9	82 (39 - 172)	---	---	46 (15 - 142)
Accidents	6	12	51 (23 - 113)	---	---	74 (31 - 178)	---	---	70 (23 - 218)	0		
Suicide	13	10	137 (79 - 235)	---	---	18 (3 - 128)	---	---	113 (43 - 302)	---	---	110 (36 - 342)
All Other Causes	---	---	17 (2 - 117)	0			0			0		

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 57: SMRs* for male coal mine workers by time between first and last assessment among those who EVER worked as a Truck Driver not elsewhere classified)

Cause of death categories	≤5 years *N= 7.701; PY= 60.392*			>5-10 years *N= 3.117; PY= 20.578*			>10 – 15 years *N= 1.695; PY= 10.186*			>15 years *N= 664; PY= 5.047*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	230	221	104 (91 - 118)	5	69	72 (55 - 95)	32	4	72 (51 - 102)	24	34	71 (48 - 106)
All Malignancies	90	83	109 (89 - 134)	1	25	71 (45 - 112)	14	1	83 (49 - 140)	11	14	78 (43 - 141)
Oesophagus	---	---	127 (53 - 305)	---	---	244 (79 - 758)	---	---	126 (18 - 896)	0		
Stomach	---	---	73 (18 - 290)	0			0			0		
Colorectal	8	8	96 (48 - 191)	0			---	---	58 (8 - 410)	---	---	**296 (111 - 787)**
Liver	---	---	75 (28 - 200)	---	---	60 (9 - 429)	0			0		
Pancreas	8	5	148 (74 - 295)	---	---	120 (30 - 481)	---	---	91 (13 - 642)	---	---	107 (15 - 757)
Lung	20	17	116 (75 - 179)	---	---	57 (18 - 176)	---	---	140 (58 - 337)	---	---	99 (32 - 306)
Mesothelioma, pleural	---	---	73 (10 - 517)	0			0			0		
Melanoma	0			0			0			0		
Prostate	7	5	153 (73 - 321)	0			---	---	95 (13 - 676)	---	---	99 (14 - 705)
Bladder	0			0			0			0		
Kidney	---	---	43 (6 - 302)	---	---	**403 (130 - 1249)**	0			0		
Brain	**9**	**4**	**200 (104 - 385)**	---	---	136 (34 - 543)	---	---	231 (58 - 923)	0		
All Metabolic	6	9	69 (31 - 154)	---	---	75 (19 - 298)	---	---	55 (8 - 392)	---	---	69 (10 - 487)
Diabetes	---	---	84 (35 - 201)	---	---	110 (27 - 439)	---	---	79 (11 - 563)	---	---	95 (13 - 674)
All Mental and	0			0			0			0		
All Nervous System	---	---	52 (20 - 139)	---	---	87 (22 - 349)	0			0		
All Circulatory	48	48	99 (75 - 131)	1	15	92 (54 - 155)	---	---	49 (20 - 118)	7	8	92 (44 - 192)
IHD	30	29	103 (72 - 148)	9	9	97 (51 - 187)	---	---	17 (2 - 118)	6	4	135 (61 - 301)
Cerebrovascular	10	7	147 (79 - 273)	---	---	49 (7 - 345)	---	---	134 (33 - 535)	0		
Other Heart Disease	6	10	63 (28 - 139)	---	---	102 (33 - 315)	---	---	100 (25 - 399)	0		
All Respiratory	9	12	77 (40 - 149)	---	---	147 (61 - 354)	---	---	197 (82 - 474)	0		
COPD	8	6	124 (62 - 248)	---	---	163 (52 - 504)	---	---	71 (10 - 505)	0		
All Digestive	---	---	18 (5 - 72)	0			---	---	45 (6 - 321)	---	---	190 (61 - 590)
Liver Disease	---	---	25 (6 - 101)	0			0			---	---	192 (48 - 767)
All Urinary	---	---	51 (7 - 361)	0			0			---	---	268 (38 - 1902)
All Injury and Trauma	**65**	**36**	**183 (143 - 233)**	9	12	75 (39 - 144)	---	---	82 (34 - 198)	---	---	34 (5 - 238)
Accidents	**35**	**18**	**195 (140 - 271)**	7	6	116 (55 - 244)	---	---	98 (31 - 303)	---	---	64 (9 - 456)
Suicide	**29**	**15**	**198 (138 - 285)**	---	---	40 (10 - 159)	---	---	80 (20 - 320)	0		
All Other Causes	---	---	47 (20 - 113)	0			---	---	48 (7 - 343)	0		

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 58: SMRs* for all male coal mine workers by time since first assessment (all jobs included)

Cause of death categories	≤5 years *N=164,622; PY=705,788*			>5-10 years *N=145,727; PY=668,699*			>10 – 15 years *N=96,204; PY=385,942*			>15 years *N=49,283; PY=358,124*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	1035	1265	82 (77 - 87)	1223	1584	77 (73 - 82)	1034	1233	84 (79 - 89)	1665	2061	81 (77 - 85)
All Malignancies #	249	344	72 (64 - 82)	438	503	87 (79 - 96)	430	431	100 (91 - 110)	771	815	95 (88 - 101)
Oesophagus	12	16	77 (44 - 136)	18	23	77 (48 - 122)	17	20	85 (53 - 136)	32	37	86 (61 - 122)
Stomach	9	13	71 (37 - 137)	21	18	118 (77 - 182)	11	15	75 (41 - 135)	18	26	69 (44 - 110)
Colorectal	26	37	70 (47 - 102)	45	54	84 (62 - 112)	42	46	92 (68 - 125)	83	82	102 (82 - 126)
Liver	10	20	51 (28 - 95)	32	32	101 (71 - 142)	26	28	94 (64 - 139)	32	48	67 (47 - 95)
Pancreas	22	20	110 (73 - 167)	27	32	85 (58 - 124)	24	28	86 (57 - 128)	46	53	87 (65 - 117)
Lung #	51	65	79 (60 - 104)	89	100	89 (73 - 110)	99	88	112 (92 - 136)	195	175	111 (97 - 128)
Mesothelioma, pleural #	8	5	177 (88 - 354)	10	7	143 (77 - 266)	8	7	120 (60 - 240)	10	16	63 (34 - 116)
Melanoma	16	21	77 (47 - 125)	25	25	99 (67 - 146)	18	19	93 (59 - 148)	31	33	94 (66 - 133)
Prostate	7	11	63 (30 - 132)	18	22	84 (53 - 133)	30	23	131 (92 - 188)	67	59	114 (89 - 144)
Bladder	---	---	65 (21 - 202)	7	7	98 (47 - 205)	---	---	76 (32 - 183)	9	15	59 (31 - 114)
Kidney	---	---	39 (15 - 103)	15	15	102 (62 - 170)	12	12	100 (57 - 176)	21	22	96 (63 - 148)
Brain	17	26	67 (41 - 107)	29	33	87 (61 - 126)	31	25	123 (86 - 174)	34	37	91 (65 - 128)
All Metabolic #	12	38	32 (18 - 56)	22	56	39 (26 - 60)	32	48	67 (47 - 94)	57	86	66 (51 - 86)
Diabetes #	7	23	30 (14 - 63)	15	37	41 (25 - 68)	20	32	62 (40 - 95)	47	62	76 (57 - 101)
All Mental and Behavioural	---	---	26 (11 - 62)	---	---	18 (7 - 48)	11	19	58 (32 - 104)	17	39	44 (27 - 71)
All Nervous System	10	39	26 (14 - 48)	22	50	44 (29 - 66)	25	41	60 (41 - 89)	36	78	46 (33 - 64)
All Circulatory	191	237	80 (70 - 93)	221	321	69 (60 - 79)	189	265	71 (62 - 82)	343	483	71 (64 - 79)
IHD	126	144	88 (74 - 104)	148	192	77 (66 - 91)	123	158	78 (65 - 93)	200	283	71 (61 - 81)
Cerebrovascular	21	30	69 (45 - 106)	29	43	68 (47 - 98)	21	37	56 (37 - 87)	42	75	56 (41 - 76)
Other Heart Disease	34	49	70 (50 - 98)	31	66	47 (33 - 67)	32	54	60 (42 - 85)	75	95	79 (63 - 99)
All Respiratory #	15	42	36 (22 - 59)	34	67	51 (36 - 71)	48	62	77 (58 - 103)	124	133	93 (78 - 111)
COPD #	---	---	23 (9 - 62)	19	33	57 (36 - 89)	36	34	106 (77 - 147)	78	77	102 (82 - 127)
All Digestive #	18	57	32 (20 - 50)	30	77	39 (27 - 56)	31	61	51 (36 - 72)	57	96	59 (46 - 77)
Liver Disease	14	43	33 (19 - 55)	20	57	35 (23 - 54)	25	44	57 (38 - 84)	28	63	44 (31 - 64)
All Urinary #	0			---	---	35 (13 - 93)	---	---	29 (9 - 91)	19	23	82 (52 - 128)
All Injury and Trauma #	**507**	**417**	**122 (111 - 133)**	411	396	104 (94 - 114)	237	232	102 (90 - 116)	181	215	84 (73 - 97)
Accidents #	**278**	**217**	**128 (114 - 144)**	191	199	96 (83 - 111)	115	116	99 (83 - 119)	90	112	80 (65 - 99)
Suicide	**210**	**169**	**124 (109 - 143)**	**204**	**167**	**122 (106 - 140)**	114	99	116 (96 - 139)	86	86	101 (81 - 124)
All Other Causes #	27	64	42 (29 - 62)	32	80	40 (28 - 56)	26	62	42 (28 - 61)	59	92	64 (50 - 83)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**;

Test for trend across subgroups shows a significant increase or reduction (p<0.005)

Table 59: SMRs* for male coal mine workers by time since first assessment among those who ONLY worked in Administration

Cause of death categories	≤5 years *N= 12,602; PY= 53,779*			>5-10 years *N= 10,937; PY= 48,260*			>10 – 15 years *N= 5,819; PY= 21,194*			>15 years *N= 2,290; PY= 12,469*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	71	142	50 (40 - 63)	104	178	59 (48 - 71)	65	112	58 (46 - 74)	55	84	66 (50 - 86)
All Malignancies	38	48	79 (58 - 109)	41	66	62 (46 - 85)	35	44	79 (57 - 110)	26	34	77 (52 - 113)
Oesophagus	0			---	---	63 (16 - 252)	---	---	96 (24 - 383)	---	---	134 (34 - 536)
Stomach	0			0			---	---	71 (10 - 501)	---	---	98 (14 - 694)
Colorectal	---	---	97 (40 - 233)	---	---	73 (31 - 176)	---	---	46 (11 - 182)	---	---	95 (31 - 295)
Liver	---	---	35 (5 - 245)	---	---	92 (34 - 245)	---	---	103 (33 - 320)	0		
Pancreas	---	---	101 (33 - 313)	---	---	69 (22 - 212)	0			---	---	89 (22 - 357)
Lung	---	---	51 (21 - 123)	9	14	66 (34 - 126)	8	9	85 (42 - 169)	8	7	112 (56 - 224)
Mesothelioma, pleural	---	---	281 (70 - 1123)	---	---	192 (48 - 768)	0			0		
Melanoma	---	---	118 (38 - 367)	---	---	70 (17 - 279)	---	---	172 (55 - 534)	---	---	163 (41 - 652)
Prostate	---	---	154 (50 - 476)	---	---	28 (4 - 201)	---	---	101 (32 - 312)	---	---	34 (5 - 240)
Bladder	0			---	---	97 (14 - 690)	0			0		
Kidney	---	---	137 (34 - 547)	---	---	53 (7 - 378)	---	---	168 (42 - 674)	---	---	119 (17 - 846)
Brain	0			---	---	27 (4 - 192)	---	---	94 (23 - 374)	---	---	75 (11 - 536)
All Metabolic	---	---	40 (10 - 161)	---	---	42 (14 - 130)	---	---	42 (10 - 167)	---	---	80 (26 - 247)
Diabetes	0			---	---	61 (20 - 190)	---	---	29 (4 - 208)	---	---	72 (18 - 289)
All Mental and Behavioural	0			0			---	---	55 (8 - 394)	0		
All Nervous System	0			---	---	50 (16 - 154)	---	---	24 (3 - 169)	---	---	53 (13 - 213)
All Circulatory	14	31	46 (27 - 77)	19	39	49 (31 - 76)	11	25	44 (24 - 79)	9	19	46 (24 - 89)
IHD	10	19	53 (29 - 99)	12	23	52 (29 - 91)	7	15	48 (23 - 100)	6	11	56 (25 - 125)
Cerebrovascular	0			---	---	37 (9 - 147)	---	---	53 (13 - 210)	0		
Other Heart Disease	---	---	17 (2 - 120)	---	---	52 (19 - 138)	---	---	20 (3 - 140)	---	---	71 (23 - 221)
All Respiratory	---	---	17 (2 - 121)	8	9	86 (43 - 172)	---	---	71 (30 - 172)	---	---	63 (24 - 168)
COPD	0			---	---	58 (19 - 180)	---	---	73 (24 - 227)	0		
All Digestive	---	---	27 (7 - 109)	---	---	44 (16 - 117)	---	---	37 (9 - 147)	---	---	55 (14 - 221)
Liver Disease	---	---	36 (9 - 145)	---	---	61 (23 - 162)	---	---	54 (13 - 216)	---	---	46 (7 - 329)
All Urinary	0			---	---	129 (32 - 517)	0			0		
All Injury and Trauma	11	31	35 (19 - 63)	20	29	70 (45 - 108)	6	13	47 (21 - 106)	7	6	115 (55 - 240)
Accidents	6	16	38 (17 - 85)	6	14	42 (19 - 94)	---	---	47 (15 - 144)	---	---	60 (15 - 239)
Suicide	---	---	38 (16 - 91)	12	12	99 (56 - 175)	---	---	58 (19 - 181)	---	---	224 (93 - 537)
All Other Causes	---	---	43 (14 - 134)	---	---	35 (11 - 109)	---	---	38 (10 - 152)	---	---	53 (13 - 212)

***** Statistically significantly reduced SMR results are in **blue**

Table 60: SMRs* for male coal mine workers by time since first assessment among those who ONLY worked in Job Groups within the Unexposed-Non Office Work Category

Cause of death categories	≤5 years *N= 4,495; PY= 18,702*			>5-10 years *N= 3,683; PY= 15,520*			>10 – 15 years *N= 1,433; PY= 4,899*			>15 years *N= 445; PY= 2,835*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	37	38	97 (70 - 134)	47	43	109 (82 - 145)	27	21	127 (87 - 185)	11	19	58 (32 - 104)
All Malignancies	10	12	86 (46 - 159)	19	15	128 (82 - 201)	12	8	149 (84 - 262)	---	---	54 (20 - 143)
Oesophagus	0			0			0			0		
Stomach	0			0			---	---	386 (54 - 2739)	0		
Colorectal	---	---	78 (11 - 553)	**6**	**2**	**380 (171 - 845)**	---	---	246 (61 - 982)	---	---	145 (20 - 1032)
Liver	0			---	---	102 (14 - 723)	0			---	---	250 (35 - 1772)
Pancreas	**---**	**---**	**420 (135 - 1302)**	0			---	---	374 (94 - 1497)	0		
Lung	---	---	43 (6 - 307)	---	---	33 (5 - 235)	---	---	175 (56 - 542)	0		
Mesothelioma, pleural	0			0			---	---	684 (96 - 4856)	0		
Melanoma	---	---	161 (23 - 1144)	---	---	311 (78 - 1244)	0			0		
Prostate	0			---	---	263 (66 - 1054)	0			---	---	267 (67 - 1067)
Bladder	0			0			0			0		
Kidney	0			0			---	---	475 (67 - 3375)	0		
Brain	---	---	124 (18 - 883)	---	---	111 (16 - 791)	0			0		
All Metabolic	---	---	77 (11 - 547)	---	---	59 (8 - 418)	---	---	112 (16 - 793)	0		
Diabetes	---	---	122 (17 - 865)	---	---	88 (12 - 623)	---	---	158 (22 - 1123)	0		
All Mental and Behavioural	0			0			0			0		
All Nervous System	0			---	---	138 (34 - 551)	0			0		
All Circulatory	**14**	**8**	**185 (110 - 313)**	10	9	112 (60 - 208)	6	5	127 (57 - 282)	---	---	44 (11 - 175)
IHD	**10**	**5**	**220 (118 - 409)**	9	5	170 (89 - 327)	---	---	146 (55 - 388)	0		
Cerebrovascular	---	---	103 (14 - 729)	0			0			---	---	119 (17 - 846)
Other Heart Disease	---	---	129 (32 - 515)	---	---	54 (8 - 383)	---	---	104 (15 - 739)	---	---	99 (14 - 703)
All Respiratory	---	---	68 (10 - 484)	---	---	48 (7 - 338)	---	---	231 (74 - 716)	---	---	63 (9 - 448)
COPD	0			0			---	---	268 (67 - 1071)	---	---	109 (15 - 777)
All Digestive	---	---	55 (8 - 390)	---	---	94 (24 - 377)	---	---	101 (14 - 717)	---	---	132 (19 - 939)
Liver Disease	---	---	74 (10 - 522)	---	---	65 (9 - 463)	0			---	---	250 (35 - 1773)
All Urinary	0			0			0			0		
All Injury and Trauma	8	11	76 (38 - 152)	10	9	111 (59 - 205)	---	---	137 (51 - 365)	0		
Accidents	---	---	95 (39 - 227)	6	4	134 (60 - 298)	---	---	67 (9 - 478)	0		
Suicide	---	---	67 (22 - 208)	---	---	102 (38 - 273)	---	---	249 (80 - 773)	0		
All Other Causes	---	---	53 (7 - 378)	---	---	94 (23 - 374)	0			**---**	**---**	**370 (119 - 1148)**

***** Statistically significantly increased SMR results are in **red**

Table 61: SMRs* for male coal mine workers by time since first assessment among those who ONLY worked in Job Groups within the Occasionally Exposed Work Category

Cause of death categories	≤5 years *N= 10,722; PY= 45,489*			>5-10 years *N= 9,279; PY= 40,980*			>10 – 15 years *N= 4,992; PY= 18,038*			>15 years *N= 1,870; PY= 8,219*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	46	73	63 (47 - 84)	45	87	52 (39 - 70)	38	54	71 (51 - 97)	15	33	45 (27 - 75)
All Malignancies	13	20	66 (39 - 114)	20	27	75 (49 - 117)	19	19	103 (65 - 161)	10	12	81 (44 - 151)
Oesophagus	0			---	---	81 (11 - 575)	---	---	116 (16 - 821)	---	---	176 (25 - 1249)
Stomach	---	---	144 (20 - 1019)	---	---	216 (54 - 864)	---	---	321 (80 - 1285)	---	---	250 (35 - 1777)
Colorectal	---	---	94 (24 - 376)	---	---	35 (5 - 247)	---	---	52 (7 - 370)	0		
Liver	---	---	88 (12 - 625)	---	---	59 (8 - 417)	0			0		
Pancreas	---	---	87 (12 - 619)	---	---	59 (8 - 417)	0			0		
Lung	---	---	27 (4 - 195)	---	---	97 (40 - 233)	---	---	134 (56 - 322)	---	---	119 (38 - 367)
Mesothelioma, pleural	---	---	380 (54 - 2697)	---	---	265 (37 - 1885)	---	---	342 (48 - 2430)	0		
Melanoma	---	---	174 (44 - 698)	0			0			---	---	208 (29 - 1478)
Prostate	---	---	145 (20 - 1027)	---	---	165 (41 - 659)	---	---	95 (13 - 677)	0		
Bladder	0			0			0			0		
Kidney	0			0			0			0		
Brain	0			---	---	166 (54 - 516)	---	---	272 (88 - 844)	---	---	322 (81 - 1289)
All Metabolic	0			0			---	---	46 (7 - 329)	0		
Diabetes	0			0			---	---	68 (10 - 486)	0		
All Mental and Behavioural	---	---	104 (15 - 740)	0			0			0		
All Nervous System	---	---	43 (6 - 302)	0			---	---	157 (51 - 487)	0		
All Circulatory	7	13	54 (26 - 113)	10	17	61 (33 - 112)	6	11	54 (24 - 121)	---	---	28 (7 - 111)
IHD	---	---	26 (7 - 105)	6	10	63 (28 - 139)	---	---	79 (33 - 189)	---	---	25 (3 - 174)
Cerebrovascular	---	---	121 (30 - 484)	---	---	134 (43 - 415)	0			---	---	89 (13 - 633)
Other Heart Disease	---	---	105 (34 - 327)	---	---	28 (4 - 196)	0			0		
All Respiratory	---	---	41 (6 - 288)	---	---	27 (4 - 193)	0			0		
COPD	0			---	---	54 (8 - 383)	0			0		
All Digestive	---	---	32 (5 - 230)	---	---	25 (4 - 177)	0			---	---	62 (9 - 444)
Liver Disease	0			---	---	34 (5 - 243)	0			0		
All Urinary	0			0			0			0		
All Injury and Trauma	19	26	74 (47 - 116)	12	24	51 (29 - 89)	8	11	74 (37 - 148)	---	---	44 (11 - 176)
Accidents	9	13	69 (36 - 132)	---	---	34 (13 - 90)	---	---	55 (18 - 172)	0		
Suicide	10	11	94 (51 - 174)	7	10	69 (33 - 144)	---	---	109 (45 - 262)	---	---	108 (27 - 430)
All Other Causes	---	---	83 (27 - 256)	0			---	---	37 (5 - 260)	0		

***** Statistically significantly reduced SMR results are in **blue**

Table 62: SMRs* for male coal mine workers by time since first assessment among those who EVER worked in Maintenance

Cause of death categories	≤5 years *N= 61,337; PY= 262,736*			>5-10 years *N= 54,166; PY= 249,268*			>10 – 15 years *N= 37,419; PY= 152,190*			>15 years *N= 19,362; PY= 129,148*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	305	415	73 (66 - 82)	387	515	75 (68 - 83)	361	438	82 (74 - 91)	338	467	72 (65 - 80)
All Malignancies	64	104	61 (48 - 78)	139	156	89 (76 - 105)	147	151	97 (83 - 115)	164	181	91 (78 - 106)
Oesophagus	6	5	130 (58 - 288)	---	---	69 (29 - 165)	9	7	126 (65 - 241)	---	---	35 (11 - 110)
Stomach	---	---	104 (39 - 277)	6	6	107 (48 - 239)	---	---	58 (19 - 180)	---	---	69 (26 - 183)
Colorectal	---	---	9 (1 - 62)	13	17	77 (44 - 132)	22	16	139 (91 - 211)	15	18	84 (51 - 140)
Liver	---	---	53 (17 - 163)	11	10	114 (63 - 205)	8	10	82 (41 - 163)	9	12	75 (39 - 144)
Pancreas	**11**	**6**	**188 (104 - 339)**	8	10	82 (41 - 165)	9	10	90 (47 - 174)	11	12	90 (50 - 162)
Lung	15	19	80 (48 - 132)	24	30	79 (53 - 119)	30	31	98 (69 - 140)	37	38	98 (71 - 135)
Mesothelioma, pleural	---	---	226 (73 - 701)	---	---	140 (45 - 434)	---	---	174 (65 - 465)	---	---	157 (65 - 377)
Melanoma	---	---	76 (32 - 183)	11	8	134 (74 - 241)	---	---	58 (22 - 154)	8	7	112 (56 - 224)
Prostate	---	---	67 (17 - 267)	7	6	115 (55 - 242)	10	8	132 (71 - 244)	13	12	107 (62 - 185)
Bladder	0			---	---	93 (23 - 373)	---	---	88 (22 - 351)	---	---	97 (31 - 300)
Kidney	---	---	32 (4 - 226)	---	---	108 (45 - 260)	---	---	117 (49 - 281)	---	---	103 (43 - 248)
Brain	---	---	48 (18 - 129)	11	11	100 (56 - 181)	10	9	109 (58 - 202)	6	9	67 (30 - 149)
All Metabolic	---	---	34 (13 - 89)	---	---	28 (12 - 67)	8	17	47 (24 - 94)	11	20	55 (30 - 99)
Diabetes	---	---	42 (14 - 131)	---	---	26 (9 - 82)	---	---	44 (18 - 106)	9	14	63 (33 - 122)
All Mental and Behavioural	0			---	---	46 (15 - 142)	---	---	86 (36 - 207)	---	---	39 (12 - 120)
All Nervous System	---	---	8 (1 - 55)	---	---	24 (9 - 65)	11	15	75 (41 - 135)	6	18	33 (15 - 74)
All Circulatory	41	73	56 (41 - 76)	68	101	67 (53 - 86)	55	92	60 (46 - 78)	63	103	61 (48 - 78)
IHD	33	44	75 (53 - 105)	45	60	75 (56 - 100)	30	54	55 (39 - 79)	31	59	52 (37 - 74)
Cerebrovascular	---	---	21 (5 - 86)	8	13	61 (30 - 122)	8	13	63 (32 - 126)	13	16	83 (48 - 143)
Other Heart Disease	---	---	32 (13 - 77)	10	21	47 (26 - 88)	14	19	74 (44 - 125)	12	22	56 (32 - 98)
All Respiratory	8	12	65 (32 - 129)	10	20	50 (27 - 93)	20	21	95 (61 - 148)	28	29	97 (67 - 140)
COPD	---	---	43 (11 - 171)	---	---	53 (22 - 127)	14	11	125 (74 - 211)	21	17	124 (81 - 191)
All Digestive	---	---	23 (9 - 60)	7	25	28 (14 - 60)	16	22	73 (45 - 119)	12	23	53 (30 - 93)
Liver Disease	---	---	30 (11 - 80)	---	---	27 (11 - 65)	13	16	81 (47 - 140)	---	---	19 (6 - 60)
All Urinary	---	---	43 (6 - 308)	---	---	29 (4 - 204)	---	---	28 (4 - 198)	---	---	61 (20 - 190)
All Injury and Trauma	175	152	115 (99 - 133)	134	144	93 (78 - 110)	87	90	97 (79 - 120)	38	58	65 (47 - 89)
Accidents	87	78	111 (90 - 137)	61	72	84 (66 - 109)	41	45	92 (68 - 125)	18	30	61 (38 - 96)
Suicide	**80**	**62**	**129 (103 - 160)**	68	61	111 (88 - 141)	43	38	113 (84 - 152)	20	24	84 (54 - 129)
All Other Causes	7	22	32 (15 - 68)	15	26	58 (35 - 97)	11	22	50 (28 - 91)	10	23	44 (24 - 82)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 63: SMRs* for male coal mine workers by time since first assessment among those who EVER worked in Production

Cause of death categories	≤5 years *N= 55,293; PY= 239,028*			>5-10 years *N= 49,853; PY= 235,869*			>10 – 15 years *N= 37,150; PY= 154,717*			>15 years *N= 21,887; PY= 176,856*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	360	443	81 (73 - 90)	486	577	84 (77 - 92)	441	520	85 (77 - 93)	692	799	87 (80 - 93)
All Malignancies	85	121	70 (57 - 87)	176	188	94 (81 - 109)	196	190	103 (90 - 119)	314	322	97 (87 - 109)
Oesophagus	---	---	37 (9 - 148)	7	9	79 (38 - 166)	12	9	132 (75 - 233)	9	15	61 (32 - 117)
Stomach	---	---	44 (11 - 176)	**12**	**7**	**179 (102 - 315)**	6	6	93 (42 - 208)	---	---	40 (15 - 106)
Colorectal	13	14	96 (55 - 164)	23	21	111 (74 - 167)	12	20	60 (34 - 106)	29	31	94 (65 - 135)
Liver	---	---	31 (8 - 126)	7	11	63 (30 - 131)	11	12	94 (52 - 170)	16	20	79 (48 - 128)
Pancreas	---	---	44 (14 - 137)	12	12	103 (58 - 181)	9	12	73 (38 - 139)	23	21	107 (71 - 161)
Lung	17	23	74 (46 - 119)	39	38	104 (76 - 142)	50	40	125 (95 - 165)	**88**	**69**	**128 (104 - 157)**
Mesothelioma, pleural	---	---	61 (9 - 434)	---	---	36 (5 - 253)	---	---	64 (16 - 257)	---	---	16 (2 - 113)
Melanoma	---	---	67 (28 - 161)	10	10	104 (56 - 193)	12	9	138 (79 - 244)	14	13	112 (66 - 189)
Prostate	---	---	56 (14 - 222)	6	8	78 (35 - 174)	13	10	131 (76 - 226)	31	24	128 (90 - 182)
Bladder	---	---	126 (32 - 504)	---	---	113 (37 - 351)	---	---	100 (32 - 311)	---	---	67 (25 - 178)
Kidney	---	---	27 (4 - 192)	7	6	124 (59 - 261)	6	5	111 (50 - 247)	12	8	142 (81 - 250)
Brain	8	9	88 (44 - 176)	10	12	80 (43 - 149)	**18**	**11**	**166 (105 -**	8	14	56 (28 - 112)
All Metabolic	---	---	8 (1 - 55)	6	20	29 (13 - 65)	11	20	55 (30 - 99)	28	35	81 (56 - 117)
Diabetes	0			---	---	23 (7 - 70)	8	14	58 (29 - 117)	23	25	92 (61 - 138)
All Mental and	---	---	25 (6 - 101)	---	---	26 (7 - 106)	---	---	15 (2 - 105)	11	15	74 (41 - 134)
All Nervous System	---	---	23 (7 - 71)	8	18	45 (22 - 90)	8	17	47 (24 - 95)	15	32	46 (28 - 77)
All Circulatory	84	86	97 (79 - 121)	95	121	78 (64 - 96)	85	115	74 (60 - 92)	147	181	81 (69 - 95)
IHD	59	53	110 (86 - 142)	66	74	89 (70 - 113)	62	69	89 (70 - 115)	76	104	73 (59 - 92)
Cerebrovascular	8	11	73 (37 - 146)	11	16	70 (39 - 126)	---	---	25 (10 - 68)	23	29	80 (53 - 120)
Other Heart Disease	14	17	83 (49 - 140)	11	24	47 (26 - 84)	14	22	63 (37 - 107)	36	38	96 (69 - 133)
All Respiratory	---	---	29 (11 - 77)	7	24	30 (14 - 62)	20	26	78 (50 - 121)	55	54	101 (78 - 132)
COPD	---	---	36 (9 - 143)	---	---	43 (18 - 104)	11	14	80 (44 - 144)	36	32	112 (81 - 155)
All Digestive	6	20	30 (13 - 66)	8	29	28 (14 - 56)	10	26	38 (20 - 70)	22	37	60 (39 - 91)
Liver Disease	---	---	26 (10 - 69)	---	---	19 (7 - 50)	6	19	31 (14 - 70)	14	24	58 (35 - 99)
All Urinary	0			---	---	25 (4 - 177)	---	---	46 (11 - 183)	---	---	54 (22 - 129)
All Injury and Trauma	**168**	**142**	**118 (102 - 138)**	**174**	**138**	**126 (109 - 146)**	100	90	111 (91 - 135)	67	77	87 (69 - 111)
Accidents	**99**	**72**	**137 (112 - 166)**	78	69	113 (90 - 141)	51	45	113 (86 - 149)	39	40	97 (71 - 133)
Suicide	65	58	111 (87 - 142)	**90**	**58**	**155 (126 - 190)**	46	38	121 (91 - 162)	27	30	89 (61 - 130)
All Other Causes	7	23	30 (14 - 64)	8	28	29 (14 - 57)	8	25	32 (16 - 65)	27	36	74 (51 - 108)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 64: SMRs* for male coal mine workers by time since first assessment among those who EVER worked as an Underground Miner

Cause of death categories	≤5 years *N= 7,700; PY= 34,094*			>5-10 years *N= 7,354; PY= 35,857*			>10 – 15 years *N= 6,191; PY= 27,282*			>15 years *N= 4,177; PY= 35,174*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	34	48	71 (51 - 100)	43	61	70 (52 - 94)	50	64	79 (60 - 104)	102	124	82 (68 - 100)
All Malignancies	--	--	54 (23 - 130)	13	16	84 (49 - 144)	13	20	66 (38 - 113)	51	47	108 (82 - 142)
Oesophagus	0			--	--	290 (73 - 1161)	--	--	106 (15 - 751)	--	--	88 (22 - 352)
Stomach	0			--	--	167 (23 - 1182)	--	--	277 (69 - 1109)	--	--	63 (9 - 449)
Colorectal	--	--	98 (14 - 695)	0			--	--	46 (6 - 327)	7	5	147 (70 - 309)
Liver	0			0			0			--	--	62 (15 - 246)
Pancreas	0			--	--	227 (57 - 907)	0			--	--	125 (47 - 332)
Lung	--	--	70 (10 - 499)	--	--	36 (5 - 259)	--	--	26 (4 - 185)	13	10	132 (76 - 227)
Mesothelioma, pleural	0			0			0			0		
Melanoma	0			--	--	99 (14 - 706)	--	--	93 (13 - 660)	--	--	50 (7 - 357)
Prostate	--	--	643 (91 – 4563)	0			--	--	279 (70 - 1115)	--	--	108 (35 - 335)
Bladder	0			--	--	542 (76 - 3849)	0			0		
Kidney	0			--	--	206 (29 - 1462)	0			--	--	226 (73 - 700)
Brain	--	--	113 (16 - 804)	0			--	--	143 (36 - 573)	--	--	79 (20 - 317)
All Metabolic	0			--	--	54 (8 - 380)	--	--	90 (23 - 361)	--	--	77 (29 - 205)
Diabetes	0			--	--	89 (13 - 631)	--	--	141 (35 - 565)	--	--	111 (42 - 295)
All Mental and	0			0			0			0		
All Nervous System	0			--	--	54 (8 - 384)	--	--	51 (7 - 363)	--	--	44 (11 - 177)
All Circulatory	7	7	94 (45 - 197)	--	--	43 (18 - 104)	--	--	30 (11 - 81)	16	27	58 (36 - 95)
IHD	--	--	90 (34 - 240)	--	--	14 (2 - 102)	--	--	37 (12 - 116)	11	16	68 (38 - 123)
Cerebrovascular	**--**	**--**	**313 (101 - 971)**	0			--	--	58 (8 - 414)	--	--	50 (13 - 201)
Other Heart Disease	0			--	--	125 (40 - 387)	0			--	--	53 (17 - 166)
All Respiratory	0			0			--	--	125 (40 - 387)	--	--	57 (21 - 151)
COPD	0			0			--	--	184 (46 - 735)	--	--	50 (12 - 199)
All Digestive	0			0			--	--	60 (15 - 241)	--	--	62 (23 - 166)
Liver Disease	0			0			--	--	40 (6 - 282)	--	--	44 (11 - 176)
All Urinary	0			0			0			0		
All Injury and Trauma	22	21	103 (68 - 156)	20	21	93 (60 - 144)	23	16	142 (95 - 214)	18	17	105 (66 - 167)
Accidents	15	11	135 (81 - 224)	6	11	55 (25 - 123)	10	8	125 (67 - 232)	12	9	140 (80 - 247)
Suicide	7	9	81 (38 - 169)	13	9	144 (84 - 248)	**12**	**7**	**176 (100 - 310)**	6	7	84 (38 - 188)
All Other Causes	0			--	--	62 (16 - 248)	--	--	62 (15 - 247)	--	--	49 (16 - 152)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 65: SMRs* for male coal mine workers by time since first assessment among those who EVER worked as an Exploration Driller

Cause of death categories	≤5 years *N= 4,970: PY= 21,617*			>5-10 years *N= 4,559: PY= 21,446*			>10 – 15 years *N= 2,710: PY= 9,157*			>15 years *N= 835: PY= 2,669*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	26	26	100 (68 - 147)	23	33	69 (46 - 104)	22	2	111 (73 - 169)	9	8	110 (57 - 211)
All Malignancies	---	---	100 (42 - 241)	6	8	74 (33 - 165)	---	---	86 (36 - 207)	---	---	107 (34 - 330)
Oesophagus	0			0			0			0		
Stomach	0			0			---	---	467 (66 - 3312)	0		
Colorectal	0			0			0			0		
Liver	0			0			0			0		
Pancreas	---	---	386 (54 - 2737)	0			---	---	254 (36 - 1801)	0		
Lung	---	---	135 (19 - 958)	---	---	74 (10 - 524)	0			---	---	359 (90 - 1435)
Mesothelioma, pleural	0			0			0			0		
Melanoma	0			---	---	215 (30 - 1525)	---	---	361 (51 - 2560)	0		
Prostate	0			0			0			0		
Bladder	0			0			**---**	**---**	**1379 (194 - 9788)**	0		
Kidney	0			0			0			0		
Brain	---	---	195 (27 - 1384)	---	---	136 (19 - 967)	0			0		
All Metabolic	---	---	146 (21 - 1038)	0			0			0		
Diabetes	---	---	270 (38 - 1919)	0			0			0		
All Mental and	0			0			0			0		
All Nervous System	0			0			0			0		
All Circulatory	---	---	78 (25 - 241)	---	---	69 (26 - 185)	---	---	52 (13 - 209)	**---**	**---**	**294 (123 - 707)**
IHD	---	---	93 (23 - 373)	---	---	92 (30 - 284)	---	---	90 (23 - 361)	---	---	305 (98 - 946)
Cerebrovascular	---	---	212 (30 - 1507)	0			0			0		
Other Heart Disease	0			---	---	73 (10 - 515)	0			**---**	**---**	**538 (134 - 2150)**
All Respiratory	0			0			0			---	---	242 (34 - 1716)
COPD	0			0			0			0		
All Digestive	0			0			0			0		
Liver Disease	0			0			0			0		
All Urinary	0			0			0			0		
All Injury and Trauma	17	12	140 (87 - 225)	12	12	97 (55 - 170)	**14**	**5**	**255 (151 - 431)**	0		
Accidents	10	6	161 (87 - 300)	---	---	82 (34 - 196)	**8**	**3**	**298 (149 - 595)**	0		
Suicide	---	---	81 (30 - 215)	6	5	111 (50 - 247)	---	---	209 (87 - 501)	0		
All Other Causes	0			---	---	57 (8 - 402)	0			0		

***** Statistically significantly increased SMR results are in **red**

Table 66: SMRs* for male coal mine workers by time since first assessment among those who EVER worked in a Construction Work Category

Cause of death categories	≤5 years *N= 9,036; PY= 39,222*			>5-10 years *N= 8,296; PY= 37,155*			>10 – 15 years *N= 4,537; PY= 17,586*			>15 years *N= 1,999; PY= 8,082*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	68	69	98 (77 - 124)	85	89	95 (77 - 118)	65	62	105 (82 - 134)	36	39	93 (67 - 129)
All Malignancies	14	19	72 (43 - 122)	32	29	110 (78 - 156)	24	23	106 (71 - 158)	17	15	112 (69 - 180)
Oesophagus	---	---	224 (56 - 895)	---	---	145 (36 - 580)	0			0		
Stomach	0			---	---	197 (49 - 787)	---	---	134 (19 - 950)	0		
Colorectal	---	---	94 (24 - 377)	---	---	97 (31 - 301)	---	---	130 (42 - 402)	---	---	68 (10 - 484)
Liver	---	---	177 (44 - 709)	---	---	106 (26 - 423)	0			---	---	98 (14 - 694)
Pancreas	0			0			---	---	197 (63 - 610)	---	---	95 (13 - 677)
Lung	---	---	136 (57 - 327)	**11**	**6**	**191 (106 - 345)**	**10**	**5**	**214 (115 - 398)**	---	---	125 (47 - 333)
Mesothelioma, pleural	0			**---**	**---**	**487 (122 - 1947)**	---	---	274 (39 - 1946)	0		
Melanoma	0			---	---	71 (10 - 507)	---	---	105 (15 - 748)	0		
Prostate	0			---	---	77 (11 - 549)	---	---	154 (38 - 615)	---	---	181 (45 - 722)
Bladder	---	---	379 (53 - 2691)	0			0			0		
Kidney	0			---	---	119 (17 - 843)	0			---	---	254 (36 - 1802)
Brain	---	---	69 (10 - 493)	---	---	158 (51 - 491)	0			0		
All Metabolic	---	---	46 (7 - 328)	---	---	61 (15 - 242)	---	---	118 (38 - 366)	---	---	59 (8 - 416)
Diabetes	0			---	---	93 (23 - 370)	---	---	115 (29 - 459)	---	---	82 (11 - 579)
All Mental and	0			0			---	---	228 (57 - 910)	---	---	148 (21 - 1050)
All Nervous System	---	---	46 (6 - 326)	---	---	34 (5 - 244)	---	---	91 (23 - 363)	---	---	64 (9 - 455)
All Circulatory	8	13	61 (31 - 122)	17	18	95 (59 - 152)	9	13	68 (35 - 131)	8	9	94 (47 - 188)
IHD	---	---	25 (6 - 102)	12	11	113 (64 - 199)	6	8	78 (35 - 173)	6	5	124 (56 - 276)
Cerebrovascular	---	---	120 (30 - 481)	---	---	41 (6 - 294)	---	---	53 (7 - 374)	0		
Other Heart Disease	---	---	110 (35 - 340)	---	---	79 (26 - 246)	---	---	36 (5 - 259)	---	---	55 (8 - 390)
All Respiratory	---	---	86 (22 - 344)	---	---	52 (13 - 206)	6	3	177 (80 - 395)	0		
COPD	---	---	103 (14 - 730)	---	---	101 (25 - 405)	**---**	**---**	**262 (109 - 630)**	0		
All Digestive	---	---	126 (47 - 335)	---	---	68 (22 - 211)	---	---	163 (68 - 391)	---	---	109 (27 - 437)
Liver Disease	---	---	125 (40 - 388)	---	---	62 (15 - 247)	---	---	229 (96 - 551)	---	---	165 (41 - 661)
All Urinary	0			---	---	148 (21 - 1053)	0			---	---	231 (33 - 1638)
All Injury and Trauma	**37**	**22**	**166 (120 - 229)**	26	22	121 (82 - 177)	9	11	86 (45 - 165)	---	---	119 (49 - 285)
Accidents	17	11	150 (93 - 241)	14	11	131 (78 - 221)	---	---	76 (29 - 203)	---	---	92 (23 - 369)
Suicide	**17**	**9**	**185 (115 - 297)**	12	9	130 (74 - 229)	---	---	113 (47 - 270)	---	---	177 (57 - 549)
All Other Causes	---	---	29 (4 - 205)	---	---	23 (3 - 160)	---	---	132 (49 - 351)	0		

***** Statistically significantly increased SMR results are in **red**

Table 67: SMRs* for male coal mine workers by time since first assessment among those who EVER worked as a Labourer (not elsewhere classified)

Cause of death categories	≤5 years *N= 5,819; PY= 25,293*			>5-10 years *N= 5,326; PY= 24,484*			>10 – 15 years *N= 3,596; PY= 14,755*			>15 years *N= 1,664; PY= 5,700*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	41	34	122 (90 - 166)	48	42	115 (87 - 152)	30	34	89 (62 - 127)	19	15	127 (81 - 198)
All Malignancies	---	---	67 (28 - 162)	13	11	115 (67 - 197)	9	10	86 (45 - 165)	8	5	158 (79 - 315)
Oesophagus	0			0			0			0		
Stomach	0			---	---	242 (34 - 1718)	0			0		
Colorectal	---	---	126 (18 - 896)	---	---	81 (11 - 573)	---	---	88 (12 - 625)	0		
Liver	---	---	242 (34 - 1721)	---	---	273 (68 - 1091)	---	---	277 (69 - 1109)	0		
Pancreas	0			0			---	---	142 (20 - 1012)	0		
Lung	---	---	159 (40 - 637)	0			**---**	**---**	**250 (104 - 600)**	---	---	300 (97 - 930)
Mesothelioma, pleural	0			0			0			0		
Melanoma	0			0			0			---	---	478 (67 - 3397)
Prostate	---	---	524 (74 - 3718)	0			0			0		
Bladder	0			0			0			0		
Kidney	0			0			0			0		
Brain	0			---	---	114 (16 - 813)	0			0		
All Metabolic	---	---	110 (16 - 783)	0			---	---	76 (11 - 541)	---	---	161 (23 - 1140)
Diabetes	---	---	193 (27 - 1372)	0			0			---	---	238 (33 - 1687)
All Mental and	0			0			0			0		
All Nervous System	---	---	179 (45 - 717)	---	---	73 (10 - 519)	0			0		
All Circulatory	---	---	132 (63 - 277)	11	7	147 (81 - 266)	---	---	76 (32 - 183)	---	---	164 (68 - 393)
IHD	---	---	164 (68 - 394)	6	4	139 (63 - 310)	---	---	80 (26 - 247)	---	---	227 (85 - 605)
Cerebrovascular	---	---	149 (21 - 1055)	**---**	**---**	**412 (155 - 1097)**	---	---	111 (16 - 789)	0		
Other Heart Disease	---	---	81 (11 - 575)	---	---	59 (8 - 415)	---	---	68 (10 - 482)	0		
All Respiratory	0			0			---	---	133 (33 - 530)	0		
COPD	0			0			---	---	129 (18 - 913)	0		
All Digestive	---	---	77 (11 - 547)	---	---	105 (26 - 420)	---	---	60 (8 - 426)	0		
Liver Disease	0			---	---	141 (35 - 563)	---	---	82 (12 - 584)	0		
All Urinary	0			0			0			0		
All Injury and Trauma	**22**	**14**	**154 (101 - 234)**	19	14	137 (87 - 214)	11	9	126 (70 - 228)	---	---	131 (49 - 349)
Accidents	**17**	**7**	**228 (142 - 367)**	6	7	87 (39 - 193)	6	4	139 (63 - 310)	---	---	66 (9 - 468)
Suicide	---	---	70 (26 - 187)	10	6	169 (91 - 314)	---	---	132 (55 - 317)	---	---	230 (74 - 713)
All Other Causes	---	---	174 (56 - 541)	---	---	94 (23 - 375)	---	---	57 (8 - 403)	---	---	117 (16 - 829)

***** Statistically significantly increased SMR results are in **red**

Table 68: SMRs* for male coal mine workers by time since first assessment among those who EVER worked as Supervisor (not elsewhere classified)

Cause of death categories	≤5 years *N= 5,577; PY= 24,844*			>5-10 years *N= 5,412; PY= 25,792*			>10 – 15 years *N= 4,317; PY= 18,854*			>15 years *N= 2,888; PY= 22,794*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	25	55	46 (31 - 67)	43	74	58 (43 - 78)	49	71	69 (52 - 92)	46	93	50 (37 - 66)
All Malignancies	10	16	61 (33 - 114)	24	26	94 (63 - 140)	23	26	88 (58 - 132)	26	37	70 (48 - 103)
Oesophagus	---	---	265 (66 - 1058)	---	---	82 (12 - 582)	---	---	159 (40 - 635)	---	---	57 (8 - 403)
Stomach	0			---	---	111 (16 - 791)	0			---	---	84 (12 - 597)
Colorectal	0			---	---	148 (56 - 395)	---	---	37 (5 - 264)	---	---	83 (27 - 258)
Liver	---	---	114 (16 - 808)	---	---	64 (9 - 455)	---	---	118 (30 - 472)	0		
Pancreas	0			---	---	124 (31 - 494)	---	---	58 (8 - 410)	---	---	39 (6 - 280)
Lung	---	---	94 (30 - 293)	7	5	135 (64 - 282)	---	---	73 (27 - 195)	8	8	102 (51 - 204)
Mesothelioma, pleural	0			0			---	---	232 (33 - 1647)	0		
Melanoma	0			---	---	77 (11 - 546)	---	---	84 (12 - 597)	0		
Prostate	---	---	177 (25 - 1259)	---	---	87 (12 - 615)	---	---	141 (35 - 564)	---	---	80 (20 - 321)
Bladder	0			0			---	---	239 (34 - 1695)	0		
Kidney	0			---	---	130 (18 - 926)	---	---	133 (19 - 944)	0		
Brain	0			---	---	63 (9 - 446)	---	---	137 (34 - 548)	---	---	56 (8 - 399)
All Metabolic	0			---	---	37 (5 - 263)	0			---	---	25 (4 - 176)
Diabetes	0			---	---	56 (8 - 395)	0			---	---	35 (5 - 248)
All Mental and	0			0			---	---	99 (14 - 703)	---	---	65 (9 - 459)
All Nervous System	0			---	---	84 (21 - 338)	0			0		
All Circulatory	8	11	71 (36 - 142)	6	16	37 (17 - 83)	8	16	51 (26 - 102)	6	21	29 (13 - 64)
IHD	---	---	57 (21 - 152)	---	---	41 (15 - 109)	---	---	21 (5 - 85)	---	---	33 (12 - 89)
Cerebrovascular	---	---	207 (67 - 643)	0			---	---	91 (23 - 365)	0		
Other Heart Disease	---	---	47 (7 - 334)	---	---	32 (5 - 228)	---	---	65 (16 - 260)	---	---	47 (12 - 186)
All Respiratory	0			0			---	---	81 (26 - 252)	---	---	51 (17 - 159)
COPD	0			0			---	---	99 (25 - 395)	0		
All Digestive	0			0			---	---	55 (14 - 220)	0		
Liver Disease	0			0			---	---	76 (19 - 305)	0		
All Urinary	0			---	---	174 (25 - 1236)	0			---	---	101 (14 - 717)
All Injury and Trauma	7	15	46 (22 - 96)	9	15	59 (30 - 113)	11	11	99 (55 - 178)	8	10	81 (40 - 161)
Accidents	---	---	26 (6 - 103)	---	---	39 (13 - 121)	---	---	89 (37 - 215)	---	---	79 (30 - 211)
Suicide	---	---	80 (33 - 191)	6	6	94 (42 - 209)	6	5	129 (58 - 288)	---	---	99 (37 - 265)
All Other Causes	0			0			---	---	30 (4 - 211)	0		

***** Statistically significantly reduced SMR results are in **blue**

Table 69: SMRs* for male coal mine workers by time since first assessment among those who EVER worked as a Truck Driver (not elsewhere classified)

Cause of death categories	≤5 years *N= 7,704; PY= 33,463*			>5-10 years *N= 7,021; PY= 32,615*			>10 – 15 years *N= 5,070; PY= 20,179*			>15 years *N= 2,363; PY= 14,151*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	79	89	89 (71 - 111)	92	115	80 (65 - 98)	90	93	97 (79 - 119)	75	72	104 (83 - 130)
All Malignancies	23	30	77 (51 - 115)	37	43	86 (62 - 119)	41	36	113 (83 - 153)	32	30	108 (76 - 153)
Oesophagus	---	---	69 (10 - 491)	---	---	144 (46 - 445)	---	---	173 (56 - 536)	---	---	148 (37 - 590)
Stomach	---	---	93 (13 - 663)	0			---	---	85 (12 - 603)	0		
Colorectal	---	---	63 (16 - 250)	---	---	90 (34 - 240)	---	---	55 (14 - 220)	---	---	177 (74 - 426)
Liver	0			---	---	71 (18 - 282)	---	---	82 (21 - 329)	---	---	53 (7 - 375)
Pancreas	---	---	163 (52 - 504)	---	---	71 (18 - 283)	---	---	81 (20 - 325)	**---**	**---**	**251 (105 - 603)**
Lung	7	6	114 (55 - 240)	9	9	100 (52 - 192)	9	8	117 (61 - 225)	6	6	95 (43 - 211)
Mesothelioma, pleural	---	---	222 (31 - 1578)	0			0			0		
Melanoma	0			0			0			0		
Prostate	0			---	---	92 (23 - 369)	---	---	89 (22 - 357)	---	---	217 (90 - 520)
Bladder	0			0			0			0		
Kidney	0			---	---	159 (40 - 635)	---	---	101 (14 - 718)	---	---	131 (18 - 931)
Brain	---	---	105 (26 - 421)	---	---	204 (85 - 491)	**6**	**2**	**324 (146 - 722)**	0		
All Metabolic	0			---	---	67 (22 - 207)	---	---	128 (53 - 307)	---	---	62 (16 - 250)
Diabetes	0			---	---	98 (32 - 304)	---	---	146 (55 - 388)	---	---	86 (21 - 343)
All Mental and	0			0			0			0		
All Nervous System	0			---	---	105 (39 - 280)	---	---	59 (15 - 237)	0		
All Circulatory	18	19	94 (59 - 149)	19	25	75 (48 - 118)	21	21	102 (67 - 156)	16	16	98 (60 - 159)
IHD	12	12	100 (57 - 177)	13	15	85 (49 - 146)	11	12	91 (50 - 164)	10	9	107 (58 - 200)
Cerebrovascular	---	---	40 (6 - 287)	---	---	116 (44 - 310)	6	3	201 (90 - 447)	---	---	76 (19 - 304)
Other Heart Disease	---	---	83 (27 - 259)	---	---	41 (10 - 163)	---	---	97 (36 - 258)	---	---	58 (15 - 233)
All Respiratory	0			6	6	104 (47 - 231)	7	5	129 (61 - 270)	6	5	118 (53 - 263)
COPD	0			---	---	157 (65 - 377)	---	---	158 (66 - 380)	---	---	66 (17 - 264)
All Digestive	---	---	22 (3 - 155)	---	---	17 (2 - 119)	0			---	---	122 (46 - 325)
Liver Disease	---	---	29 (4 - 205)	---	---	23 (3 - 163)	0			---	---	96 (24 - 383)
All Urinary	0			0			0			---	---	229 (57 - 915)
All Injury and Trauma	**34**	**20**	**174 (124 - 244)**	21	19	111 (72 - 170)	12	12	101 (57 - 177)	**13**	**6**	**211 (123 - 363)**
Accidents	**19**	**10**	**192 (123 - 301)**	15	10	158 (95 - 262)	---	---	83 (35 - 200)	**7**	**3**	**215 (103 - 452)**
Suicide	**14**	**8**	**174 (103 - 294)**	6	8	75 (34 - 168)	7	5	142 (68 - 297)	**6**	**2**	**252 (113 - 561)**
All Other Causes	---	---	69 (22 - 214)	---	---	18 (3 - 130)	---	---	46 (11 - 183)	0		

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 70: SMRs* for all male coal mine workers by Age Group

Cause of death categories	< 65 N=164,067; PY=2,021,570			65+ N=17,255; PY=96,983		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	3539	4513	78 (76 - 81)	1418	1631	87 (83 - 92)
All Malignancies	1155	1386	83 (79 - 88)	733	707	104 (96 - 111)
Oesophagus	54	67	64 (48 - 87)	25	29	86 (58 - 127)
Stomach	43	51	84 (63 - 114)	16	20	79 (49 - 129)
Colorectal	127	153	83 (70 - 99)	69	65	106 (83 - 134)
Liver	70	91	77 (61 - 98)	30	36	83 (58 - 119)
Pancreas	78	88	89 (71 - 111)	41	45	92 (67 - 124)
Lung	242	269	90 (79 - 102)	**192**	**158**	**121 (105 - 140)**
Mesothelioma, pleural	14	17	85 (50 - 143)	22	18	125 (82 - 190)
Melanoma	69	74	93 (74 - 118)	21	25	86 (56 - 131)
Prostate	49	43	113 (85 - 149)	73	71	103 (82 - 129)
Bladder	15	18	84 (51 - 140)	9	16	57 (30 - 110)
Kidney	34	43	80 (57 - 112)	18	16	111 (70 - 177)
Brain	96	99	97 (79 - 118)	15	22	68 (41 - 113)
All Metabolic	83	154	54 (44 - 67)	40	74	54 (39 - 73)
Diabetes	57	97	58 (45 - 76)	32	57	56 (40 - 80)
All Mental and Behavioural	18	62	29 (18 - 46)	19	38	51 (32 - 79)
All Nervous System	51	135	38 (29 - 50)	42	74	57 (42 - 77)
All Circulatory	656	915	72 (66 - 77)	288	391	74 (66 - 83)
IHD	437	562	78 (71 - 85)	160	215	74 (64 - 87)
Cerebrovascular	66	115	57 (45 - 73)	47	70	67 (50 - 89)
Other Heart Disease	114	183	62 (52 - 75)	58	79	73 (56 - 94)
All Respiratory	78	162	48 (39 - 60)	143	142	101 (86 - 119)
COPD	41	75	55 (40 - 75)	96	86	111 (91 - 136)
Asthma	7	16	44 (21 - 93)	---	---	50 (7 - 356)
Lung Diseases due to Dust	**---**	**---**	**394 (127 - 1222)**	---	---	97 (31 - 300)
All Digestive	99	232	43 (35 - 52)	37	59	63 (46 - 87)
Liver Disease	69	178	39 (31 - 49)	18	30	61 (38 - 97)
All Urinary	6	28	21 (9 - 47)	20	24	83 (54 - 129)
All Injury and Trauma	**1283**	**1200**	**107 (101 - 113)**	53	61	86 (66 - 113)
Accidents	638	604	106 (98 - 114)	36	40	91 (65 - 126)
Suicide	**597**	**503**	**119 (110 - 129)**	17	17	99 (62 - 160)
All Other Causes	102	238	43 (35 - 52)	42	61	69 (51 - 93)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 71: SMRs* for male coal mine workers by Age Group – Ever Production

Cause of death categories	Ever Production					
	< 65 N=55,141; PY=714,906			65+ N=6,785; PY=38,987		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	1397	1695	82 (78 – 87)	582	644	90 (83 – 98)
All Malignancies	476	539	88 (81 - 97)	295	282	105 (93 - 117)
Oesophagus	21	26	80 (52 - 122)	9	12	77 (40 - 147)
Stomach	19	20	96 (61 - 151)	---	---	62 (26 - 150)
Colorectal	51	59	86 (65 - 113)	26	26	100 (68 - 147)
Liver	20	35	57 (37 - 88)	16	14	111 (68 - 181)
Pancreas	30	34	87 (61 - 125)	17	18	95 (59 - 152)
Lung	109	106	103 (85 - 124)	**85**	**63**	**134 (108 - 166)**
Mesothelioma, pleural	---	---	44 (14 - 138)	---	---	28 (7 - 113)
Melanoma	30	28	106 (74 - 151)	11	10	112 (62 - 202)
Prostate	22	17	126 (83 - 192)	30	28	107 (75 - 153)
Bladder	8	7	113 (57 - 227)	---	---	65 (24 - 172)
Kidney	17	17	102 (63 - 164)	9	6	139 (72 - 267)
Brain	36	38	95 (69 - 132)	8	9	90 (45 - 180)
All Metabolic	27	59	46 (31 - 67)	19	29	64 (41 - 101)
Diabetes	19	38	51 (32 - 79)	15	22	67 (40 - 111)
All Mental and Behavioural	6	23	26 (12 - 58)	10	14	70 (38 - 130)
All Nervous System	17	51	33 (21 - 54)	17	29	58 (36 - 94)
All Circulatory	291	351	83 (74 - 93)	120	152	79 (66 - 94)
IHD	201	217	93 (81 - 106)	62	84	74 (58 - 95)
Cerebrovascular	24	44	54 (37 - 81)	22	27	81 (53 - 123)
Other Heart Disease	47	69	68 (51 - 90)	28	31	90 (62 - 131)
All Respiratory	31	62	50 (35 - 71)	55	56	99 (76 - 129)
COPD	19	29	65 (42 - 103)	35	34	103 (74 - 143)
All Digestive	29	89	33 (23 - 47)	17	23	73 (46 - 118)
Liver Disease	18	68	26 (17 - 42)	10	12	84 (45 - 157)
All Urinary	---	---	27 (9 - 85)	---	---	54 (22 - 129)
All Injury and Trauma	**484**	**423**	**115 (105 - 125)**	25	24	103 (70 - 152)
Accidents	**249**	**211**	**118 (104 - 133)**	18	16	115 (73 - 183)
Suicide	**221**	**178**	**124 (109 - 142)**	7	7	102 (49 - 215)
All Other Causes	32	88	36 (26 - 51)	18	24	75 (47 - 119)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 72: SMRs* for male coal mine workers by Age Group– Ever Maintenance

Cause of death categories	Ever Maintenance					
	< 65 N=61,200; PY=734,697			65+ N=4,680; PY=24,252		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	1050	1457	72 (68 - 77)	341	379	90 (81 - 100)
All Malignancies	326	424	77 (69 - 86)	188	168	112 (97 - 129)
Oesophagus	19	20	93 (59 - 146)	---	---	56 (21 - 150)
Stomach	14	16	90 (53 - 151)	3	5	63 (20 - 194)
Colorectal	30	47	64 (45 - 92)	21	15	136 (89 - 209)
Liver	25	28	88 (60 - 131)	6	9	67 (30 - 150)
Pancreas	25	27	93 (63 - 137)	14	11	129 (76 - 218)
Lung	63	80	79 (62 - 101)	43	38	114 (84 - 153)
Mesothelioma, pleural	---	---	104 (43 - 251)	**10**	**4**	**240 (129 - 446)**
Melanoma	22	23	96 (63 - 145)	6	6	103 (46 - 229)
Prostate	13	13	103 (60 - 178)	19	16	117 (75 - 184)
Bladder	---	---	76 (28 - 201)	---	---	85 (27 - 262)
Kidney	10	13	77 (41 - 143)	6	4	155 (70 - 344)
Brain	27	32	85 (58 - 123)	---	---	74 (28 - 196)
All Metabolic	19	49	39 (25 - 60)	9	17	52 (27 - 99)
Diabetes	13	31	42 (25 - 73)	7	13	53 (25 - 111)
All Mental and Behavioural	6	19	32 (14 - 71)	---	---	63 (26 - 152)
All Nervous System	15	45	33 (20 - 55)	7	17	41 (20 - 86)
All Circulatory	164	281	58 (50 - 68)	63	88	71 (56 - 91)
IHD	106	169	63 (52 - 76)	33	49	67 (48 - 95)
Cerebrovascular	18	35	51 (32 - 81)	13	16	84 (49 - 144)
Other Heart Disease	31	59	52 (37 - 74)	10	18	55 (30 - 103)
All Respiratory	30	50	60 (42 - 86)	36	32	111 (80 - 154)
COPD	14	22	63 (37 - 106)	28	20	140 (97 - 203)
All Digestive	28	73	38 (26 - 55)	11	14	79 (44 - 143)
Liver Disease	21	56	38 (25 - 58)	---	---	54 (20 - 145)
All Urinary	---	---	33 (11 - 104)	---	---	57 (18 - 176)
All Injury and Trauma	422	430	98 (89 - 108)	12	15	82 (47 - 145)
Accidents	200	216	93 (81 - 107)	7	9	75 (36 - 158)
Suicide	206	181	114 (99 - 130)	---	---	118 (49 - 283)
All Other Causes	36	77	47 (34 - 64)	7	14	49 (23 - 102)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

Table 73: SMRs* for male coal mine workers by Age Group – Only Administration

Cause of death categories	Only Administration					
	< 65 N=12,476; PY=122,452			65+ N=1,882; PY=10,181		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	182	346	53 (45 - 61)	113	169	67 (56 - 80)
All Malignancies	78	119	66 (53 - 82)	62	73	85 (66 - 109)
Oesophagus	---	---	67 (25 - 178)	---	---	66 (16 - 263)
Stomach	---	---	23 (3 - 165)	---	---	48 (7 - 341)
Colorectal	10	13	78 (42 - 145)	---	---	74 (31 - 179)
Liver	---	---	59 (25 - 142)	---	---	79 (25 - 245)
Pancreas	---	---	63 (26 - 152)	---	---	64 (21 - 199)
Lung	11	24	46 (26 - 84)	19	16	116 (74 - 183)
Mesothelioma, pleural	---	---	70 (10 - 496)	---	---	165 (53 - 511)
Melanoma	7	6	120 (57 - 252)	---	---	118 (38 - 366)
Prostate	---	---	123 (51 - 295)	---	---	41 (13 - 127)
Bladder	---	---	63 (9 - 450)	0		
Kidney	---	---	81 (26 - 252)	---	---	179 (58 - 555)
Brain	---	---	50 (19 - 134)	0		
All Metabolic	9	13	70 (36 - 134)	---	---	13 (2 - 91)
Diabetes	---	---	59 (25 - 143)	---	---	17 (2 - 120)
All Mental and Behavioural	0			---	---	25 (4 - 180)
All Nervous System	---	---	19 (5 - 76)	---	---	52 (19 - 138)
All Circulatory	30	74	41 (28 - 58)	23	40	57 (38 - 86)
IHD	22	46	48 (32 - 73)	13	22	59 (34 - 102)
Cerebrovascular	---	---	11 (2 - 76)	---	---	42 (13 - 129)
Other Heart Disease	---	---	27 (10 - 73)	---	---	60 (25 - 145)
All Respiratory	6	14	43 (20 - 97)	12	15	82 (46 - 144)
COPD	---	---	14 (2 - 102)	---	---	56 (23 - 135)
All Digestive	9	19	46 (24 - 89)	---	---	16 (2 - 116)
Liver Disease	8	15	54 (27 - 108)	---	---	32 (5 - 229)
All Urinary	0			---	---	80 (20 - 319)
All Injury and Trauma	39	72	54 (39 - 74)	---	---	78 (32 - 186)
Accidents	12	36	34 (19 - 59)	---	---	120 (50 - 289)
Suicide	25	31	81 (55 - 120)	0		
All Other Causes	8	18	44 (22 - 89)	---	---	31 (8 - 124)

***** Statistically significantly reduced SMR results are in **blue**

Table 74: SMRs* for male coal mine workers by Age Group – Only Unexposed Office

Cause of death categories	Only Unexposed Office					
	< 65 N=4,468; PY=38,922			65+ N=378; PY=2,111		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	89	84	106 (86 - 130)	33	38	88 (62 - 123)
All Malignancies	31	26	119 (84 - 170)	14	16	87 (52 - 147)
Oesophagus	0			0		
Stomach	0			---	---	219 (31 -
Colorectal	**9**	**3**	**312 (162 - 599)**	---	---	68 (10 - 479)
Liver	---	---	55 (8 - 394)	---	---	125 (18 - 888)
Pancreas	**---**	**---**	**295 (123 - 708)**	0		
Lung	---	---	40 (10 - 158)	---	---	84 (27 - 260)
Mesothelioma, pleural	0			---	---	248 (35 -
Melanoma	---	---	231 (74 - 716)	0		
Prostate	---	---	119 (17 - 842)	---	---	180 (58 - 557)
Bladder	0			0		
Kidney	0			---	---	275 (39 -
Brain	---	---	107 (27 - 427)	0		
All Metabolic	---	---	66 (17 - 265)	---	---	58 (8 - 412)
Diabetes	---	---	104 (26 - 417)	---	---	76 (11 - 541)
All Mental and Behavioural	0			0		
All Nervous System	---	---	77 (19 - 308)	0		
All Circulatory	23	17	138 (92 - 208)	9	9	98 (51 - 189)
IHD	16	10	159 (98 - 260)	7	5	140 (67 - 295)
Cerebrovascular	---	---	95 (24 - 382)	0		
Other Heart Disease	---	---	114 (43 - 305)	---	---	53 (7 - 377)
All Respiratory	---	---	32 (5 - 228)	---	---	150 (62 - 359)
COPD	0			---	---	149 (48 - 463)
All Digestive	---	---	92 (35 - 245)	---	---	75 (11 - 532)
Liver Disease	---	---	60 (15 - 242)	---	---	155 (22 -
All Urinary	0			0		
All Injury and Trauma	22	22	98 (64 - 149)	0		
Accidents	12	11	108 (61 - 190)	0		
Suicide	10	10	103 (56 - 192)	0		
All Other Causes	---	---	68 (22 - 210)	---	---	214 (69 - 663)

***** Statistically significantly increased SMR results are in **red**

Table 75: SMRs* for male coal mine workers by Age Group – Only Occasional Exposure

Cause of death categories	Only Occasional Exposure					
	< 65 N=10,656; PY=108,130			65+ N=681; PY=3,444		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	105	194	54 (45 - 66)	39	53	73 (54 - 100)
All Malignancies	37	53	69 (50 - 96)	25	24	106 (72 - 157)
Oesophagus	0			---	---	300 (97 - 929)
Stomach	---	---	203 (76 - 540)	---	---	298 (74 - 1191)
Colorectal	---	---	50 (16 - 156)	---	---	46 (7 - 329)
Liver	---	---	56 (14 - 222)	0		
Pancreas	---	---	29 (4 - 209)	---	---	65 (9 - 463)
Lung	8	10	82 (41 - 164)	6	5	114 (51 - 253)
Mesothelioma, pleural	---	---	351 (88 - 1405)	---	---	173 (24 - 1225)
Melanoma	---	---	103 (33 - 320)	0		
Prostate	---	---	64 (9 - 457)	---	---	133 (43 - 411)
Bladder	0			0		
Kidney	0			0		
Brain	8	4	189 (95 - 378)	0		
All Metabolic	---	---	15 (2 - 108)	0		
Diabetes	---	---	25 (3 - 176)	0		
All Mental and Behavioural	---	---	44 (6 - 313)	0		
All Nervous System	---	---	33 (8 - 132)	---	---	84 (21 - 335)
All Circulatory	17	35	48 (30 - 77)	8	12	65 (32 - 130)
IHD	8	21	38 (19 - 77)	6	7	88 (40 - 196)
Cerebrovascular	---	---	90 (34 - 240)	---	---	93 (23 - 371)
Other Heart Disease	---	---	51 (19 - 135)	0		
All Respiratory	---	---	15 (2 - 110)	---	---	22 (3 - 157)
COPD	---	---	35 (5 - 250)	0		
All Digestive	---	---	21 (5 - 86)	---	---	51 (7 - 362)
Liver Disease	0			---	---	96 (14 - 681)
All Urinary	0			0		
All Injury and Trauma	41	63	65 (48 - 89)	0		
Accidents	16	31	51 (31 - 83)	0		
Suicide	24	27	90 (60 - 134)	0		
All Other Causes	---	---	19 (5 - 77)	---	---	98 (25 - 393)

***** Statistically significantly reduced SMR results are in **blue**

Table 76: SMRs* for male coal mine workers by Age Group– Ever Construction

Cause of death categories	Ever Construction					
	< 65 N=9,003; PY = 97,000			65+ N=728; PY = 3,766		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	194	201	97 (84 - 111)	60	58	103 (80 - 132)
All Malignancies	52	60	86 (66 - 113)	35	26	135 (97 - 189)
Oesophagus	---	---	68 (17 - 271)	---	---	182 (46 - 730)
Stomach	---	---	135 (44 - 420)	0		
Colorectal	---	---	60 (23 - 161)	---	---	211 (88 - 508)
Liver	---	---	96 (36 - 255)	---	---	72 (10 - 514)
Pancreas	---	---	51 (13 - 204)	---	---	119 (30 - 476)
Lung	18	12	156 (99 - 248)	**12**	**6**	**207 (117 - 364)**
Mesothelioma, pleural	---	---	147 (21 - 1045)	---	---	314 (78 - 1254)
Melanoma	---	---	63 (16 - 252)	0		
Prostate	---	---	161 (52 - 499)	---	---	80 (20 - 322)
Bladder	---	---	131 (18 - 932)	0		
Kidney	---	---	108 (27 - 433)	0		
Brain	---	---	67 (22 - 208)	---	---	119 (17 - 842)
All Metabolic	7	7	100 (48 - 209)	0		
Diabetes	---	---	113 (47 - 272)	0		
All Mental and Behavioural	---	---	42 (6 - 301)	---	---	163 (41 - 651)
All Nervous System	---	---	48 (16 - 149)	---	---	76 (19 - 305)
All Circulatory	33	39	84 (60 - 118)	9	14	66 (34 - 127)
IHD	19	24	81 (51 - 127)	7	7	93 (45 - 196)
Cerebrovascular	---	---	81 (31 - 217)	0		
Other Heart Disease	7	8	84 (40 - 177)	---	---	36 (5 - 255)
All Respiratory	---	---	70 (29 - 168)	---	---	100 (42 - 241)
COPD	---	---	91 (29 - 282)	---	---	163 (68 - 392)
All Digestive	13	10	126 (73 - 217)	---	---	46 (7 - 330)
Liver Disease	12	8	152 (86 - 268)	0		
All Urinary	0			---	---	245 (61 - 981)
All Injury and Trauma	**75**	**56**	**133 (106 - 167)**	---	---	88 (22 - 353)
Accidents	36	28	129 (93 - 178)	---	---	69 (10 - 493)
Suicide	**36**	**24**	**151 (109 - 209)**	---	---	152 (21 - 1076)
All Other Causes	---	---	38 (14 - 100)	---	---	90 (22 - 359)

***** Statistically significantly increased SMR results are in **red**

Table 77: Suicide SMRs* for male coal mine workers by era of first assessment

Era of first examination	Number of workers	Number of deaths observed	Compared with Australian rates		Compared with Queensland rates	
			E	SMR (95% CI)	E	SMR (95% CI)
1980 - 1985	6,987	46	59	77 (58 – 103)	69	67 (50 – 90)
1986 - 1990	1,721	12	14	84 (48 – 148)	17	73 (41 – 128)
1991 - 1995	3,844	22	26	86 (57 – 130)	30	73 (48 – 110)
1996 - 2000	8,278	47	46	102 (77 – 136)	55	85 (64 – 113)
2001 - 2005	30,626	154	**124**	**124 (106 – 145)**	152	101 (86 – 118)
2006 - 2010	46,979	188	**140**	**135 (117 – 155)**	175	108 (93 – 124)
2011 - 2015	48,468	129	**99**	**130 (109 – 154)**	127	102 (86 – 118)
2016 - 2020	17,719	16	12	139 (85 – 227)	15	106 (65 – 172)

* Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in blue

Table 78: Suicide SMRs* for male coal mine workers by era of follow-up

Era	Number of workers	Number of death observed	Compared with Australian rates		Compared with Queensland rates	
			E	SMR (95% CI)	E	SMR (95% CI)
1980 - 1985	6,987	---	---	30 (4 – 216)	---	27 (4 – 188)
1986 - 1990	8,704	---	---	**29 (9 – 89)**	**---**	**24 (8 – 75)**
1991 - 1995	12,516	10	14	73 (39 – 135)	15	67 (36 – 124)
1996 - 2000	20,728	21	24	87 (57 – 134)	28	74 (48 – 114)
2001 - 2005	51,194	44	41	107 (80 – 144)	48	92 (69 – 124)
2006 - 2010	97,832	74	84	88 (70 – 111)	98	75 (60 – 94)
2011 - 2015	145,530	197	**153**	**129 (112 – 148)**	190	103 (90 – 119)
2016 - 2020	161,847	264	**191**	**138 (123 – 156)**	244	108 (96 – 122)

* Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in blue

Table 79: Suicide SMRs* for male coal mine workers by age at first examination compared to Australian rates

Age group	O	E	SMR (95% CI)
< 25	**158**	**129**	**123 (105 - 143)**
25 -34	198	180	110 (96 - 127)
35 - 44	**160**	**131**	**122 (105 - 143)**
45 - 54	**86**	**64**	**134 (108 - 165)**
55 -64	11	16	69 (38 - 125)
65+	---	---	114 (16 - 809)

***** Statistically significantly increased SMR results are in **red**

Table 80: Suicide SMRs* for male coal mine workers by combinations of age at first examination and time since first assessment compared to Australian rates

Time since first examination	Age group	O	E	SMR (95% CI)
< 5 years	< 25	**52**	**36**	**143 (109 – 187)**
	25 - 34	63	56	113 (88 – 144)
	35 - 44	**58**	**44**	**131 (101 – 170)**
	45 - 54	31	25	124 (87 – 177)
	55 - 64	6	7	89 (40 – 199)
	65+	0		
≥ 5 years	< 25	106	92	115 (95 – 139)
	25 - 34	135	124	109 (92 – 129)
	35 - 44	102	86	118 (97 – 143)
	45 - 54	**55**	**39**	**140 (107 – 182)**
	55 - 64	---	---	55 (23 – 131)
	65+	---	---	204 (29 - 1451)

***** Statistically significantly increased SMR results are in **red**

Table 81: Accidental deaths SMRs* for male coal mine workers by era of first assessment

Era of first examination	Number of workers	Number of death observed	Compared with Australian rates		Compared with Queensland rates	
			E	SMR (95% CI)	E	SMR (95% CI)
1980 - 1985	6,987	54	86	63 (48 – 82)	94	58 (44 – 75)
1986 - 1990	1,721	32	**19**	**171 (121 – 242)**	**20**	**160 (113 - 227)**
1991 - 1995	3,844	43	32	133 (99 – 179)	35	124 (92 – 167)
1996 - 2000	8,278	59	59	101 (78 – 130)	63	94 (73 – 121)
2001 - 2005	30,626	183	**157**	**116 (101 – 135)**	171	107 (93 – 124)
2006 - 2010	46,979	184	167	110 (95 – 127)	183	101 (87 – 116)
2011 - 2015	48,468	104	111	93 (77 – 113)	121	86 (71 – 104)
2016 - 2020	17,719	15	12	123 (74 – 204)	13	114 (69 – 189)

* Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in blue

Table 82: Accidental deaths SMRs* for male coal mine workers by era of follow-up

Era	Number of workers	Number of death observed	Compared with Australian rates		Compared with Queensland rates	
			E	SMR (95% CI)	E	SMR (95% CI)
1980 - 1985	6,987	---	---	28 (9 – 110)	---	23 (6 – 92)
1986 - 1990	8,704	12	18	66 (37 – 116)	19	62 (35 – 110)
1991 - 1995	12,516	22	17	129 (85 – 196)	20	112 (74 – 170)
1996 - 2000	20,728	36	29	126 (91 – 175)	29	124 (89 – 172)
2001 - 2005	51,194	66	55	120 (94 – 152)	62	107 (84 – 136)
2006 - 2010	97,832	134	112	**120 (101 – 142)**	122	110 (92 – 130)
2011 - 2015	145,530	189	181	104 (91 – 120)	203	93 (81 – 108)
2016 - 2020	161,847	213	225	95 (83 – 108)	236	90 (79 – 103)

* Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in blue

Table 83: Descriptions of ICD codes for accidental deaths

Description	n (%)
Transport accidents	396 (58.8)
Accidental poisoning by and exposure to noxious substance	139 (20.6)
Slipping/Tripping/Falling	32 (4.8)
Exposure to electrical current	8 (1.2)
Exposure to smoke/fire/flames	10 (1.5)
Struck by thrown, projected or falling object	9 (1.3)
Caught, crushed, jammed or pinched in or between objects	14 (2.1)
Other	66 (9.8)

Table 84: All Cause Mortality by Work Category and Job Groups – all SITE Types - Women only

Work Category and Job Group	O	E	SMR (95% CI)
ONLY ever Unexposed Office			
Administration	50	85	59 (45 - 78)
ONLY ever Unexposed Non-Office	**20**	**24**	**84 (54 - 131)**
Blue Collar (Not Exposed)	16	18	90 (55 - 146)
Control Room	0		
Environmental Services	---	---	71 (27 - 188)
ONLY ever Occasionally exposed	**9**	**13**	**72 (37 - 138)**
Engineer	0		
Mine Services	8	6	145 (73 - 291)
Technical Services	---	---	24 (3 - 171)
EVER Maintenance - all	**9**	**19**	**46 (24 - 89)**
Maintenance – General (Nec)	---	---	39 (13 - 120)
Shutdown Maintenance	0		
Diesel Fitter	---	---	216 (30 - 1532)
Electrician	---	---	77 (11 - 543)
Electrician (Auto)	0		
Industrial Cleaner	---	---	32 (10 - 98)
EVER Production – all	**51**	**66**	**77 (58 - 101)**
Blast Crew	---	---	92 (13 - 652)
CHPP Plant Operator	0		
Laboratory	6	8	74 (33 - 165)
Miner	0		
Operator	45	56	80 (60 - 108)
Prestrip	0		
EVER Construction	**---**	**---**	**149 (37 - 597)**
Civil Works	---	---	158 (22 - 1123)
Construction	---	---	141 (20 - 1004)
Unclear Work Category			
EVER Labourer (Nec)	---	---	136 (51 - 363)
EVER Cleaner (Nec)	48	45	107 (81 - 142)
EVER Supervisor (Nec)	0		
EVER Truck Driver (Nec)	6	13	45 (20 - 99)
Missing Job Group **	6	3	191 (86 – 426)
ALL FEMALE WORKERS	202	268	75 (66 – 86)

***** Statistically significantly reduced SMR results are in **blue**
** All assessments had a Job Group unknown
-- Fewer than 6 deaths in the category

Table 85: All-cause mortality SMR for female coal mine workers by Site Type and Work Category compared to the Australian population

Job Group	Ever Open Cut *N=11,912; PY=125,477*			Ever Underground *N=2,971; PY=31,077*			Ever CHPP *N=859; PY=9,978*			Ever Unknown Site Type *N=14,173; PY=144,090*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
All Workers	103	136	76 (63 – 92)	8	30	27 (13 – 54)	6	9	64 (29 – 143)	123	164	75 (63 – 89)
Only ever Unexposed Office												
Administration – General only	27	43	63 (43 - 92)	--	--	15 (4 - 59)	0			27	43	62 (43 - 91)
Only ever Unexposed Non-Office	**13**	**8**	**171 (100 - 295)**	0			0			10	16	62 (33 - 115)
Only ever Occasionally Exposed	--	--	48 (12 - 193)	0			0			7	8	86 (41 - 180)
Ever Maintenance - All	--	--	63 (26 - 152)	0			0			--	--	35 (13 - 94)
Ever Production - All	23	37	62 (41 - 93)	--	--	43 (6 - 304)	6	9	67 (30 - 150)	28	36	77 (53 - 111)
Operator	23	36	64 (43 - 97)	--	--	61 (9 - 431)	0			27	35	78 (54 - 114)
Ever Construction - All	--	--	311 (78 - 1244)	0			NA‡			--	--	154 (22 - 1093)
Unclear Work Category												
Ever Cleaner (Nec)	19	20	96 (61 - 150)	--	--	84 (27 - 261)	NA			27	25	109 (75 - 158)
Missing Job Group **	--	--	285 (92 – 885)	0			NA			--	--	174 (65 – 463)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**
** All assessments had a Job Group unknown
-- Observed value < 6.
‡ NA No worker in that Job Group within that Site Type.

Table 86: All-cause mortality SMR for female coal mine workers by Site Type and Work Category (mutually exclusive groupings)

Job Group	Only worked in Open Cut (excludes CHPP, Underground and unknown) *N=10,908; PY=112,434*			Ever Underground (excludes CHPP and unknown) *N=2,917; PY=30,420*			Ever CHPP *N=659; PY=7,460*			ONLY Unknown Site Type *N=9,448; PY=87,970*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
All Workers	100	125	80 (66 – 98)	8	29	27 (14 – 55)	---	---	57 (21 – 153)	88	105	84 (68 – 103)
Only ever Unexposed Office												
Administration – General only	27	39	69 (47 - 100)	--	--	15 (4 - 59)	0			21	32	67 (43 - 102)
Only ever Unexposed Non-Office	**13**	**7**	**178 (104 - 307)**	0			0			7	15	47 (23 - 100)
Only ever Occasionally Exposed	---	---	53 (13 - 213)	0			0			7	7	103 (49 - 215)
Ever Maintenance - All	---	---	69 (29 - 165)	0			0			--	--	40 (13 - 123)
Ever Production - All	21	35	61 (39 - 93)	--	--	44 (6 - 309)	---	---	60 (23 – 160)	19	17	113 (72 - 178)
Operator	21	33	63 (41 - 96)	--	--	61 (9 - 435)	0			18	16	116 (73 - 183)
Ever Construction - All	---	---	328 (82 - 1311)	0			NA			0		
Unclear Work Category												
Ever Cleaner (Nec)	19	19	100 (64 - 157)	--	--	86 (28 - 266)	NA			25	18	139 (94 - 206)
Missing Job Group **	---	---	285 (92 – 885)	0			NA			--	--	154 (50 – 477)

***** Statistically significantly reduced SMR results are in **blue**** All assessments had a Job Group unknown .

Table 87: SMRs* for female coal mine workers who ONLY worked in administration categorised as Unexposed Office

Cause of death categories	Only Administration – General *N=7,538; PY=79,488*		
	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	50	85	59 (45 - 78)
All Malignancies	30	38	79 (55 - 113)
Lung	7	6	120 (57 - 252)
Breast	--	--	45 (17 - 119)
All Circulatory	9	11	83 (43 - 159)
All Respiratory	--	--	24 (3 - 168)
All Injury and Trauma	--	--	14 (3 - 54)
Accidents	--	--	14 (2 - 97)
Suicide	0		

***** Statistically significantly reduced SMR results are in **blue**

Table 88: SMRs* for female coal mine workers who ONLY worked in Job Groups categorised as Unexposed Non-Office

Cause of death categories	Only Unexposed Non-Office [ALL] *N=2,049; PY=18,448*		
	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	20	24	84 (54 - 131)
All Malignancies	8	11	72 (36 - 144)
Lung	--	--	106 (27 - 426)
Breast	0		
All Circulatory	--	--	65 (16 - 258)
All Respiratory	--	--	77 (11 - 545)
All Injury and Trauma	--	--	145 (60 - 348)
Accidents	--	--	116 (29 - 464)
Suicide	--	--	144 (36 - 575)

Table 89: SMRs* for female coal mine workers who EVER worked in Job Groups categorised as Maintenance

Cause of death categories	Ever Maintenance (ALL) *N=2,025; PY= 17,909*		
	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	9	19	46 (24 - 89)
All Malignancies	---	---	47 (18 - 126)
Lung	--	--	76 (11 - 539)
Breast	0		
All Circulatory	--	--	75 (19 - 299)
All Respiratory	0		
All Injury and Trauma	--	--	61 (15 - 242)
Accidents	--	--	121 (30 - 486)
Suicide	0		

***** Statistically significantly reduced SMR results are in **blue**

Table 90: SMRs* for female coal mine workers who EVER worked in Job Groups categorised as Production

Cause of death categories	Ever Production (ALL) *N=6,913; PY=66,048*		
	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	51	66	77 (58 - 101)
All Malignancies	22	29	75 (49 - 114)
Lung	6	4	138 (62 - 307)
Breast	--	--	56 (21 - 148)
All Circulatory	7	8	83 (40 - 175)
All Respiratory	0		
All Injury and Trauma	16	12	131 (80 - 214)
Accidents	6	6	100 (45 - 222)
Suicide	**10**	**5**	**201 (108 - 374)**

***** Statistically significantly increased SMR results are in **red**

Table 91: SMRs* for female coal mine workers who EVER held a Job as a Cleaner (Unclear Work Category)

Cause of death categories	All workers *N=2,763 PY=30,034*		
	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	48	45	107 (81 - 142)
All Malignancies	21	22	97 (63 - 149)
Lung	6	4	161 (72 - 357)
Breast	--	--	41 (10 - 163)
All Circulatory	--	--	50 (16 - 155)
All Respiratory	--	--	200 (83 - 479)
All Injury and Trauma	**15**	**6**	**261 (157 - 433)**
Accidents	**8**	**3**	**276 (138 - 552)**
Suicide	--	--	177 (66 - 471)

***** Statistically significantly increased SMR results are in **red**

Table 92: Age of female coal mine workers at first and last examination/assessment by time between first and last assessment

Time between first and last assessment	N	Age at first examination/assessment	Age at last examination/ assessment	Age at end of follow-up
		Median (P^{25}, P^{75})	Median (P^{25}, P^{75})	Median (P^{25}, P^{75})
<5 years	20,182	30.4 (23.7, 42.1)	30.9 (24.2, 42.7)	40.8 (33.0, 51.9)
5 - 10 years	2,795	29.3 (22.2, 40.2)	36.2 (29.3, 47.7)	42.4 (34.4, 53.3)
10 - 15 years	1,051	29.6 (22.2, 37.9)	41.7 (34.2, 50.1)	46.3 (37.9, 54.7)
≥ 15 years	361	24.9 (19.8, 31.7)	45.9 (39.8, 51.0)	50.1 (44.4, 56.3)
Comparison between time categories (p-value)		p <0.001	p <0.001	p <0.001

Table 93: SMRs* for female coal mine workers by time between first and last assessment

Cause of death categories	≤5 years *N= 24,389; PY= 209,503*			>5-10 years *N=4,207; PY= 29,679*			>10-15 years *N=1,412; PY= 8,838*			≥ 15 years *N= 361; PY= 3,454*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	183	229	80 (69 - 93)	15	35	43 (26 - 71)	8	13	62 (31 - 123)	--	--	93 (39 - 225)
All Malignancies	82	103	80 (64 - 99)	8	16	50 (25 - 100)	6	6	98 (44 - 219)	--	--	116 (37 - 360)
Lung	16	16	99 (61 - 162)	--	--	118 (38 - 367)	--	--	303 (98 - 939)	--	--	246 (35 - 1749)
Breast	13	24	54 (31 - 93)	0			--	--	71 (10 - 501)	--	--	308 (77 - 1231)
All Circulatory	28	30	95 (65 - 137)	--	--	43 (11 - 172)	0			0		
All Respiratory	7	12	61 (29 - 127)	--	--	55 (8 - 388)	--	--	276 (69 - 1103)	0		
All Injury and Trauma	41	39	105 (78 - 143)	--	--	53 (17 - 165)	0			--	--	141 (20 - 999)
Accidents	20	19	103 (67 - 160)	--	--	36 (5 - 254)	0			--	--	282 (40 - 2000)
Suicide	16	16	103 (63 - 168)	--	--	89 (22 - 354)	0			0		

***** Statistically significantly reduced SMR results are in **blue**

Table 94: SMRs* for all-cause mortality by job type among female coal mine workers by time between first and last assessment

Job Group	≤5 years			>5-10 years			>10-15 years			≥ 15 years		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ONLY Unexposed Office												
Administration – General	45	73	62 (46 - 82)	--	--	13 (2 - 94)	--	--	63 (16 - 253)	--	--	200 (50 - 800)
ONLY Unexposed Non-Office	18	23	79 (50 - 126)	0			**--**	**--**	**1326 (332 - 5301)**	NA **		
ONLY Occasionally Exposed	9	12	77 (40 - 148)	0			0			0		
EVER Maintenance – All	8	15	54 (27 - 108)	--	--	32 (4 - 225)	0			0		
Maintenance – General (Nec)	--	--	52 (17 - 163)	0			0			0		
EVER Production – All	38	46	83 (61 - 114)	9	14	63 (33 - 120)	--	--	38 (10 - 152)	--	--	159 (40 - 637)
Operator	33	38	88 (62 - 123)	9	13	70 (36 - 134)	--	--	22 (3 - 158)	--	--	208 (52 - 831)
EVER Construction	--	--	259 (65 - 1034)	0	0		0			0		
EVER Unclear Work Category												
Cleaner (Nec)	44	37	120 (89 - 161)	--	--	64 (24 - 172)	0			0		

***** Statistically significantly increased SMR results are in **red**

** NA No workers in this category

Table 95: SMRs* for female coal mine workers by time since first assessment

Cause of death categories	≤5 years *N= 24,389; PY= 100,629*			>5-10 years *N=19,500; PY= 86,976*			>10-15 years *N=11,277; PY= 41,504*			≥ 15 years *N= 4,207; PY= 22,367*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	64	82	78 (61 - 99)	70	96	73 (58 - 92)	42	59	71 (53 - 96)	35	45	78 (56 - 108)
All Malignancies	25	35	72 (49 - 106)	38	43	88 (64 - 121)	21	28	76 (50 - 116)	15	22	69 (42 - 115)
Lung	--	--	103 (43 - 247)	--	--	73 (31 - 176)	8	5	174 (87 - 347)	--	--	132 (55 - 318)
Breast	--	--	23 (6 - 92)	--	--	39 (15 - 105)	--	--	80 (33 - 192)	--	--	104 (43 - 250)
All Circulatory	7	10	70 (33 - 147)	8	12	66 (33 - 131)	10	8	127 (68 - 236)	--	--	76 (32 - 183)
All Respiratory	--	--	87 (28 - 270)	--	--	21 (3 - 149)	--	--	90 (29 - 279)	--	--	106 (34 - 330)
All Injury and Trauma	23	18	128 (85 - 193)	13	16	80 (47 - 138)	--	--	37 (12 - 115)	6	5	129 (58 - 286)
Accidents	12	9	135 (77 - 237)	--	--	62 (26 - 150)	--	--	49 (12 - 196)	--	--	124 (40 - 384)
Suicide	10	7	141 (76 - 261)	--	--	75 (31 - 181)	--	--	31 (4 - 217)	--	--	113 (28 - 453)

***** Statistically significantly reduced SMR results are in **blue**

Table 96: SMRs* for all-cause mortality among female coal mine workers by time since first assessment and Work Category

Job Group	≤5 years			>5-10 years			>10-15 years			≥ 15 years		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ONLY Unexposed Office												
Administration	15	25	59 (36 - 98)	16	30	54 (33 - 88)	10	17	57 (31 - 106)	9	12	73 (38 - 141)
ONLY Unexposed Non-Office				7	10	71 (34 - 150)	--	--	123 (51 - 295)	--	--	86 (12 - 613)
ONLY Occasionally Exposed	--	--	54 (8 - 380)	--	--	81 (30 - 215)	0			**0**		
EVER Maintenance - All	0			--	--	61 (23 - 163)	--	--	76 (24 - 235)	**0**		
Maintenance – General (Nec)	--	--	33 (8 - 132)	--	--	75 (19 - 299)	--	--	58 (8 - 415)	0		
EVER Production - All	12	21	59 (33 - 103)	18	23	77 (48 - 122)	12	16	74 (42 - 131)	9	6	141 (73 - 271)
Operator	11	18	63 (35 - 113)	16	20	80 (49 - 131)	10	14	73 (39 - 136)	8	5	167 (83 - 334)
EVER Construction	--	--	**490 (123 - 1961)**	0			0			**0**		
EVER Unclear Work Category												
Cleaner (Nec)	15	13	117 (70 - 194)	18	16	110 (69 - 174)	11	11	96 (53 - 174)	--	--	96 (36 - 256)

***** Statistically significantly increased SMR results are in **red**, statistically significantly reduced SMR results are in **blue**

.

Table 97: SMRs* for female coal mine workers by Age

Cause of death categories	< 65 N=24,379; PY=248,039			65+ N=937; PY = 3,436		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ALL CAUSES OF DEATH	186	253	73 (64 - 85)	25	29	87 (58 - 128)
All Malignancies	85	113	75 (61 - 93)	14	14	100 (59 - 168)
Lung	19	17	112 (71 - 176)	--	--	129 (49 - 345)
Breast	14	28	50 (30 - 85)	--	--	97 (24 - 388)
All Circulatory	26	32	82 (56 - 120)	--	--	82 (31 - 217)
All Respiratory	7	12	61 (29 - 128)	--	--	105 (34 - 326)
All Injury and Trauma	45	46	98 (73 - 131)	0		
Accidents	22	23	96 (63 - 146)	0		
Suicide	18	19	97 (61 - 154)	0		

***** Statistically significantly reduced SMR results are in **blue**

Table 98: SMRs* for female coal mine workers by Age and Work Category

Cause of death categories	< 65 N=24,379; PY=248,039			65+ N=937; PY = 3,436		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
ONLY Unexposed Office						
Administration	42	77	55 (40 - 74)	8	8	100 (50 - 200)
ONLY Unexposed Non-	16	21	77 (47 - 126)	--	--	133 (50 - 353)
ONLY Occasionally	8	12	69 (35 - 138)	--	--	104 (15 - 737)
EVER Maintenance - All	7	17	41 (20 - 87)	--	--	78 (20 - 312)
Maintenance – General	--	--	28 (7 - 114)	--	--	141 (20 - 999)
EVER Production - All	47	63	74 (56 - 99)	--	--	121 (45 - 321)
Operator	42	53	79 (58 - 106)	--	--	118 (38 - 365)
EVER Construction	--	--	161 (40 - 645)	0		
EVER Unclear Work						
Cleaner (Nec)	47	39	121 (91 - 162)	--	--	17 (2 - 117)

***** Statistically significantly reduced SMR results are in **blue**

Appendix 9 Standardised Cancer Incidence Tables

Table 99: All Malignancies SIRs* by Work Category and Job Groups – all Site Types combined – Men only

Job Group	*N=147,839 PY=1,374,156*		
	O	E	SIR (95% CI)
ONLY Unexposed Office			
Administration	438	465	94 (86 - 104)
ONLY Unexposed Non-Office	116	100	116 (97 - 139)
Blue Collar (Not Exposed)	84	74	113 (91 - 140)
Control Room	---	---	33 (5 - 233)
Environmental Services	31	22	138 (97 - 196)
ONLY Occasionally Exposed	205	202	101 (88 - 116)
Engineer	101	109	92 (76 - 112)
Mine Services	17	16	107 (67 - 173)
Technical Services	87	77	112 (91 - 139)
EVER Maintenance - All	1680	1633	103 (98 - 108)
Maintenance – General (Nec)	600	569	105 (97 - 114)
Abrasive, Blast, Sand, Paint	16	18	89 (54 - 145)
Shutdown Maintenance	211	194	109 (95 - 125)
Belt Splicer	9	10	89 (47 - 172)
Boilermaker	233	238	98 (86 - 111)
Fitter (Nec)	372	393	95 (85 - 105)
Diesel Fitter	157	162	97 (83 - 113)
Tyre Fitter	17	16	107 (67 - 172)
Electrician	293	291	101 (90 - 113)
Electrician (Auto)	23	18	130 (86 - 195)
Industrial Cleaner	15	15	99 (60 - 165)
EVER Production - All	**2522**	**2220**	**114 (109 - 118)**
Production – General (Nec)	**9**	**4**	**239 (124 - 460)**
Blast Crew	**72**	**53**	**135 (107 - 170)**
Driller (Blast)	**18**	**9**	**190 (120 - 301)**
Driller (General)	**143**	**108**	**132 (112 - 156)**
CHPP Plant Operator	80	91	88 (71 - 110)
Laboratory	26	26	98 (67 - 144)
Driller (Ug, Coal Seam)	---	---	54 (18 - 168)
ERZ / Deputy	90	89	101 (82 - 124)
Open cut Examiner (OC Only)	64	61	106 (83 - 135)
Dragline (OC Only)	**136**	**114**	**120 (101 - 142)**
Secondary Support	---	---	50 (16 - 156)
Miner	**541**	**480**	**113 (104 - 123)**
Operator	**1923**	**1693**	**114 (109 - 119)**
Prestrip	15	16	95 (57 - 157)
Scraper	---	---	54 (8 - 383)
Production Support	0		
Tunneller	---	---	77 (19 - 307)
EVER Driller (Exploration)	71	65	110 (87 - 139)
EVER Construction	227	229	99 (87 - 113)
Civil Works	34	32	106 (76 - 148)
Construction	193	197	98 (85 - 113)
EVER Unclear Work Category			
Labourer (Nec)	112	100	112 (93 - 135)
Cleaner (Nec)	15	23	65 (39 - 108)
Supervisor (Nec)	291	283	103 (92 - 115)
Truck Driver (Nec)	380	354	107 (97 - 119)

***** Statistically significantly increased SIR results are in **red**

Table 100: All Malignancies SIRs* for male coal mine workers for each Work Category and Job Group, by Site Type (mutually exclusive groupings)

Job Group	Only worked in Open Cut (excludes CHPP, Underground and only unknown) *N=52,521; PY=566,684*			Ever Underground (excludes CHPP and only unknown) *N=30,858; PY=317,168*			Ever CHPP (excludes unknown) *N=2,784; PY=36,264*			All Other workers (unknown site type only) † *N=61,676; PY=454,039*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Workers	**2655**	**2392**	**111 (107 – 115)**	**1056**	**983**	**107 (101 – 114)**	125	144	87 (73 – 104)	**1731**	**1660**	**104 (100 – 109)**
Only ever Unexposed Office												
Administration – General only	161	168	96 (82 - 112)	88	89	99 (80 - 122)	---	---	25 (4 - 180)	188	203	93 (80 - 107)
Only ever Unexposed Non-Office	38	40	96 (70 - 132)	12	10	116 (66 - 204)	0			**66**	**50**	**132 (104 - 168)**
Blue Collar (Not Exposed)	29	32	90 (63 - 129)	11	7	152 (84 - 275)	NA‡			44	35	126 (94 - 169)
Control Room	---	---	71 (10 - 504)	0			0			0		
Environmental Services	8	6	135 (67 - 269)	---	---	43 (6 - 304)	NA			**22**	**14**	**155 (102 - 236)**
Only ever Occasionally Exposed	69	67	103 (81 - 130)	43	41	104 (77 - 140)	0			93	93	100 (82 - 123)
Engineer	40	36	112 (82 - 152)	21	24	88 (58 - 135)	0			40	49	82 (60 - 112)
Mine Services	6	5	114 (51 - 253)	---	---	224 (72 - 695)	NA			8	9	87 (43 - 174)
Technical Services	23	26	88 (59 - 133)	19	16	117 (74 - 183)	0			45	35	129 (96 - 172)
Ever Maintenance - All	703	662	106 (99 - 114)	267	265	101 (89 - 114)	15	21	72 (44 - 120)	535	526	102 (93 - 111)
Maintenance – General (Nec)	225	213	106 (93 - 120)	84	76	111 (89 - 137)	---	---	32 (8 - 129)	162	159	102 (87 - 119)
Abrasive, Blast, Sand, Paint	---	---	21 (3 - 147)	---	---	220 (55 - 878)	---	---	**1243 (175 - 8821)**	11	9	125 (69 - 226)
Shutdown Maintenance	85	74	114 (92 - 141)	20	17	119 (77 - 184)	0			75	75	100 (80 - 125)
Belt Splicer	---	---	80 (11 - 566)	---	---	58 (19 - 178)	NA			---	---	110 (28 - 441)
Boilermaker	107	103	103 (86 - 125)	16	19	82 (50 - 134)	NA			88	85	104 (84 - 128)
Fitter (Nec)	148	149	99 (85 - 117)	72	77	94 (74 - 118)	6	7	86 (39 - 193)	95	102	93 (76 - 114)
Diesel Fitter	71	75	95 (75 - 119)	24	18	130 (87 - 194)	---	---	**1023 (144 - 7259)**	35	38	92 (66 - 128)
Tyre Fitter	10	10	99 (53 - 183)	---	---	150 (21 - 1067)	NA			---	---	80 (20 - 319)
Electrician	122	109	112 (94 - 133)	61	74	82 (64 - 106)	---	---	74 (28 – 196)	88	81	109 (89 - 135)
Electrician (Auto)	14	10	139 (82 - 235)	0			NA			8	5	150 (75 - 301)
Industrial Cleaner	6	6	94 (42 - 208)	---	---	196 (49 - 784)	---	---	**724 (102 – 5143)**	0		
Ever Production - All	**1348**	**1160**	**116 (110 - 123)**	**492**	**433**	**114 (104 - 124)**	105	116	90 (75 - 110)	**431**	**383**	**113 (102 - 124)**
Production – General (Nec)	---	---	237 (98 - 568)	---	---	**346 (112 - 1074)**	NA			0		
Blast Crew	**43**	**31**	**140 (103 - 188)**	7	5	135 (64 - 282)	NA			13	9	150 (87 - 258)
Driller (Blast)	9	6	160 (83 - 307)	---	---	**700 (175 - 2799)**	NA			---	---	310 (78 - 1239)
Driller (General)	60	47	127 (99 - 164)	19	14	137 (88 - 216)	NA			**48**	**33**	**145 (109 - 192)**
CHPP Plant Operator	NA			NA			80	91	88 (71 - 110)	NA		
Laboratory	NA			NA			26	26	98 (67 - 144)	NA		

Job Group	Only worked in Open Cut (excludes CHPP, Underground and only unknown) *N=52,521; PY=566,684*			Ever Underground (excludes CHPP and only unknown) *N=30,858; PY=317,168*			Ever CHPP (excludes unknown) *N=2,784; PY=36,264*			All Other workers (unknown site type only) † *N=61,676; PY=454,039*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)
Driller (Ug, Coal Seam)	NA			---	---	54 (18 - 168)	NA			NA		
ERZ / Deputy	NA			90	88	102 (83 - 125)	NA			NA		
Open cut Examiner (OC Only)	54	52	104 (80 - 136)	NA			NA			NA		
Dragline (OC Only)	**133**	**108**	**123 (104 - 145)**	NA			NA			NA		
Secondary Support	NA			---	---	52 (17 - 161)	NA			NA		
Miner	156	137	114 (97 - 133)	**297**	**266**	**112 (100 - 125)**	---	---	269 (38 - 1912)	26	23	114 (78 - 167)
Operator	**1161**	**1002**	**116 (109 - 123)**	171	148	115 (99 - 134)	0			352	323	109 (98 - 121)
Prestrip	12	13	95 (54 - 168)	0			NA			---	---	207 (29 - 1473)
Scraper	0			0			NA			---	---	201 (28 - 1424)
Production Support	NA			0			NA			NA		
Tunneller	NA			---	---	78 (19 - 310)	NA			NA		
Ever Driller (Exploration)	**15**	**8**	**182 (110 - 301)**	**14**	**7**	**199 (118 - 336)**	NA			35	38	92 (66 - 129)
Ever Construction - All	85	79	107 (87 - 132)	24	24	102 (68 - 152)	0			95	99	96 (78 - 117)
Civil Works	11	14	77 (43 - 139)	---	---	104 (26 - 415)	0			10	9	113 (61 - 210)
Construction	74	65	114 (90 - 143)	22	22	102 (67 - 154)	0			85	91	94 (76 - 116)
Unclear Work Category												
Ever Labourer (Nec)	**32**	**19**	**164 (116 - 232)**	**24**	**12**	**196 (132 - 293)**	0			38	45	84 (61 - 116)
Ever Cleaner (Nec)	7	9	75 (36 - 156)	0			NA			6	9	69 (31 - 153)
Ever Supervisor (Nec)	119	115	104 (87 - 124)	32	37	87 (62 - 123)	NA			70	67	104 (82 - 131)
Ever Truck Driver (Nec)	128	114	112 (94 - 133)	19	13	147 (94 - 231)	NA			163	155	105 (90 - 122)

***** Statistically significantly increased SIR results are in **red**

--- Observed value < 6.

† All assessments had Site Type Unknown or Various (excludes workers where Job Group was unknown)

‡ NA No worker in that Job Group within that Site Type

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Table 101: Cancer SIR* for male coal mine workers who ONLY worked in Administration, compared to the Australian population

Cancer Categories	*N=11,339; PY= 86,254*		
	O	E	SIR (95% CI)
All Malignancies	438	465	94 (86 - 104)
Lip, Oral Cavity and Pharynx	14	24	59 (35 - 100)
Lip	---	---	31 (8 - 125)
Pharynx	7	8	89 (42 - 187)
Digestive Organs	75	92	81 (65 - 102)
Oesophagus	---	---	61 (23 - 163)
Stomach	---	---	34 (11 - 106)
Colorectal	49	53	92 (70 - 123)
Colon	26	29	89 (61 - 131)
Rectum	22	22	99 (65 - 151)
Liver	7	10	68 (32 - 142)
Gallbladder	---	---	149 (48 - 460)
Pancreas	7	9	76 (36 - 160)
Respiratory and Intrathoracic Organs	34	40	85 (61 - 119)
Larynx	---	---	26 (4 - 184)
Lung	33	35	95 (68 - 134)
Melanoma	**78**	**58**	**135 (108 - 169)**
Mesothelioma	**6**	**2**	**252 (113 - 561)**
Breast	0		
Male Reproductive Organs	140	141	99 (84 - 117)
Prostate	129	132	97 (82 - 116)
Testis	11	8	137 (76 - 248)
Urinary Tract	23	27	86 (57 - 129)
Kidney	16	17	92 (57 - 151)
Bladder	7	8	85 (40 - 178)
Brain and Other CNS	7	8	83 (40 - 175)
Brain	6	8	74 (33 - 166)
Thyroid and Other Endocrine Glands	11	7	152 (84 - 274)
Thyroid	11	7	162 (90 - 292)
Unknown Site	8	7	122 (61 - 244)
Lymphoid, Haematopoietic + Related Tissue	31	43	73 (51 - 103)
Hodgkin	---	---	37 (5 - 265)
Non-Hodgkin Lymphoma	11	19	58 (32 - 105)
Diffuse Non-Hodgkin Lymphoma	6	9	64 (29 - 142)
Multiple Myeloma	6	6	96 (43 - 214)
Leukaemia	13	14	96 (56 - 166)
Lymphoid Leukaemia	8	8	102 (51 - 204)
Myeloid Leukaemia	4	5	88 (33 - 235)
Other Cancers	11	16	69 (38 - 124)
Myelodysplastic Syndrome (MDS)	---	---	41 (6 - 291)
Connective tissue	---	---	30 (4 - 215)

***** Statistically significantly increased SIR results are in **red**
--- Cell sizes of less than 6 are not reported to preserve privacy

Table 102: Cancer SIRs* for male coal mine workers who ONLY worked in Unexposed Non-Office jobs, compared to the Australian population

Cancer Categories	*N=3,834; PY= 24,833*		
	O	E	SIR (95% CI)
All Malignancies	116	100	116 (97 - 139)
Lip, Oral Cavity and Pharynx	6	5	119 (54 - 265)
Lip	---	---	211 (68 - 653)
Pharynx	---	---	123 (31 - 493)
Digestive Organs	**30**	**20**	**152 (107 - 218)**
Oesophagus	0		
Stomach	---	---	107 (27 - 428)
Colorectal	**20**	**11**	**174 (113 - 270)**
Colon	11	6	171 (95 - 309)
Rectum	9	5	190 (99 - 365)
Liver	---	---	95 (24 - 378)
Gallbladder	0		
Pancreas	---	---	**259 (108 - 621)**
Respiratory and Intrathoracic Organs	---	---	59 (24 - 141)
Larynx	---	---	125 (18 - 886)
Lung	---	---	41 (13 - 126)
Melanoma	16	13	125 (77 - 205)
Mesothelioma	0		
Breast	---	---	561 (79 - 3984)
Male Reproductive Organs	30	30	101 (71 - 144)
Prostate	24	27	90 (60 - 134)
Testis	6	3	219 (98 - 487)
Urinary Tract	8	6	140 (70 - 279)
Kidney	6	4	162 (73 - 361)
Bladder	---	---	113 (28 - 453)
Brain and Other CNS	---	---	153 (49 - 474)
Brain	---	---	159 (51 - 493)
Thyroid and Other Endocrine Glands	---	---	114 (29 - 456)
Thyroid	---	---	122 (31 - 489)
Unknown Site	---	---	142 (36 - 568)
Lymphoid, Haematopoietic + Related Tissue	9	10	93 (49 - 179)
Hodgkin	0		
Non-Hodgkin Lymphoma	---	---	48 (12 - 192)
Diffuse Non-Hodgkin Lymphoma	---	---	48 (7 - 343)
Multiple Myeloma	---	---	**307 (115 - 818)**
Leukaemia	---	---	98 (32 - 305)
Lymphoid Leukaemia	---	---	117 (29 - 468)
Myeloid Leukaemia	---	---	93 (13 - 657)
Other Cancers	---	---	111 (42 – 296)
Myelodysplastic Syndrome (MDS)	0		
Connective tissue	---	---	256 (64 - 1023)

***** Statistically significantly increased SIR results are in **red**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 103: Cancer SIRs* for male coal mine workers who ONLY worked in Occasionally Exposed jobs, compared to the Australian population

Cancer Categories	*N=9,522; PY= 72,038*		
	O	E	SIR (95% CI)
All Malignancies	205	202	101 (88 - 116)
Lip, Oral Cavity and Pharynx	6	11	56 (25 - 124)
Lip	---	---	60 (15 - 241)
Pharynx	---	---	60 (15 - 239)
Digestive Organs	34	38	90 (64 - 125)
Oesophagus	0		
Stomach	---	---	112 (42 - 298)
Colorectal	20	22	90 (58 - 139)
Colon	14	12	113 (67 - 192)
Rectum	6	9	64 (29 - 143)
Liver	---	---	121 (51 - 292)
Gallbladder	---	---	256 (64 - 1022)
Pancreas	---	---	83 (27 - 257)
Respiratory and Intrathoracic Organs	10	15	66 (36 - 123)
Larynx	---	---	137 (34 - 549)
Lung	8	13	62 (31 - 124)
Melanoma	**49**	**29**	**172 (130 - 228)**
Mesothelioma	**---**	**---**	**359 (116 - 1112)**
Breast	0		
Male Reproductive Organs	50	58	87 (66 - 114)
Prostate	43	48	89 (66 - 120)
Testis	7	9	78 (37 - 163)
Urinary Tract	12	11	107 (61 - 189)
Kidney	7	8	91 (44 - 191)
Bladder	---	---	164 (68 - 394)
Brain and Other CNS	8	5	171 (86 - 343)
Brain	8	4	179 (89 - 358)
Thyroid and Other Endocrine Glands	---	---	68 (22 - 212)
Thyroid	---	---	74 (24 - 228)
Unknown Site	---	---	117 (38 - 364)
Lymphoid, Haematopoietic + Related Tissue	21	21	100 (65 - 153)
Hodgkin	---	---	83 (21 - 330)
Non-Hodgkin Lymphoma	13	9	146 (85 - 251)
Diffuse Non-Hodgkin Lymphoma	8	4	183 (92 - 365)
Multiple Myeloma	---	---	163 (61 - 434)
Leukaemia	---	---	31 (8 - 123)
Lymphoid Leukaemia	---	---	29 (4 - 204)
Myeloid Leukaemia	---	---	39 (6 - 280)
Other Cancers	6	8	79 (35 - 175)
Myelodysplastic Syndrome (MDS)	0		
Connective tissue	**---**	**---**	**271 (113 - 650)**

***** Statistically significantly increased SIR results are in **red**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 104: Cancer SIRs* for male coal mine workers who EVER worked in Maintenance jobs, compared to the Australian population

Cancer Categories	*N=55,505; PY=532,772*		
	O	E	SIR (95% CI)
All Malignancies	1680	1633	103 (98 - 108)
Lip, Oral Cavity and Pharynx	100	90	112 (92 - 136)
Lip	**39**	**28**	**141 (103 - 193)**
Pharynx	31	28	111 (78 - 157)
Digestive Organs	299	310	96 (86 - 108)
Oesophagus	18	21	86 (54 - 136)
Stomach	27	30	91 (63 - 133)
Colorectal	181	181	100 (86 - 115)
Colon	98	100	98 (81 - 120)
Rectum	81	77	106 (85 - 131)
Liver	24	34	71 (48 - 106)
Gallbladder	**13**	**6**	**204 (118 - 351)**
Pancreas	26	30	88 (60 - 129)
Respiratory and Intrathoracic Organs	130	126	103 (87 - 122)
Larynx	18	13	143 (90 - 227)
Lung	103	107	96 (79 - 116)
Melanoma	**281**	**230**	**122 (109 - 137)**
Mesothelioma	**13**	**7**	**184 (107 - 317)**
Breast	---	---	141 (53 - 376)
Male Reproductive Organs	473	460	103 (94 - 113)
Prostate	430	395	109 (99 - 120)
Testis	42	61	69 (51 - 93)
Urinary Tract	94	91	103 (84 - 126)
Kidney	63	62	102 (79 - 130)
Bladder	25	25	99 (67 - 146)
Brain and Other CNS	34	37	93 (67 - 130)
Brain	34	35	97 (70 - 136)
Thyroid and Other Endocrine Glands	28	33	85 (59 - 124)
Thyroid	27	30	89 (61 - 129)
Unknown Site	21	22	95 (62 - 146)
Lymphoid, Haematopoietic + Related Tissue	153	167	92 (78 - 107)
Hodgkin	8	17	46 (23 - 92)
Non-Hodgkin Lymphoma	72	72	100 (79 - 126)
Diffuse Non-Hodgkin Lymphoma	32	35	90 (64 - 128)
Multiple Myeloma	14	20	70 (41 - 118)
Leukaemia	58	52	112 (86 - 145)
Lymphoid Leukaemia	36	28	128 (92 - 178)
Myeloid Leukaemia	16	20	81 (49 - 132)
Other Cancers	50	61	82 (62 - 109)
Myelodysplastic Syndrome (MDS)	---	---	55 (21 - 148)
Connective tissue	11	14	76 (42 - 138)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 105: Cancer SIRs* for male coal mine workers who EVER worked in Production jobs, compared to the Australian population

Cancer Categories	*N=50,918; PY=550,726*		
	O	E	SIR (95% CI)
All Malignancies	**2522**	**2220**	**114 (109 - 118)**
Lip, Oral Cavity and Pharynx	130	117	111 (93 - 132)
Lip	**54**	**35**	**154 (118 - 201)**
Pharynx	37	37	100 (72 - 138)
Digestive Organs	434	432	100 (91 – 110)
Oesophagus	35	30	116 (84 - 162)
Stomach	30	42	72 (51 - 103)
Colorectal	**285**	**253**	**113 (100 - 127)**
Colon	159	139	114 (98 - 133)
Rectum	122	107	114 (96 - 137)
Liver	24	45	53 (35 - 79)
Gallbladder	9	9	97 (51 - 187)
Pancreas	34	42	82 (58 - 114)
Respiratory and Intrathoracic Organs	**229**	**186**	**123 (108 - 140)**
Larynx	**27**	**19**	**145 (100 – 212)**
Lung	**197**	**160**	**123 (107 - 142)**
Melanoma	**387**	**295**	**131 (119 - 145)**
Mesothelioma	**---**	**---**	44 (18 - 107)
Breast	**---**	**---**	50 (13 - 200)
Male Reproductive Organs	**770**	**646**	**119 (111 - 128)**
Prostate	**712**	**584**	**122 (113 - 131)**
Testis	54	58	94 (72 - 123)
Urinary Tract	**148**	**125**	**118 (101 - 139)**
Kidney	95	82	116 (95 - 142)
Bladder	46	38	121 (91 - 162)
Brain and Other CNS	52	45	117 (89 - 153)
Brain	51	43	119 (91 - 157)
Thyroid and Other Endocrine Glands	41	38	109 (80 - 148)
Thyroid	39	35	112 (82 - 153)
Unknown Site	36	32	111 (80 - 154)
Lymphoid, Haematopoietic + Related Tissue	194	214	91 (79 - 105)
Hodgkin	13	17	75 (44 - 130)
Non-Hodgkin Lymphoma	80	94	85 (68 - 106)
Diffuse Non-Hodgkin Lymphoma	34	46	73 (52 - 102)
Multiple Myeloma	28	28	99 (68 - 143)
Leukaemia	70	67	104 (82 - 132)
Lymphoid Leukaemia	**50**	**38**	**133 (101 - 176)**
Myeloid Leukaemia	14	24	58 (34 - 98)
Other Cancers	94	79	119 (97 - 146)
Myelodysplastic Syndrome (MDS)	13	11	120 (70 - 207)
Connective tissue	17	17	98 (61 - 158)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 106: Cancer SIRs* for male coal mine workers who EVER worked in Production jobs as Operators, compared to the Australian population

Cancer Categories	*N=38,977; PY=415,485*		
	O	E	SIR (95% CI)
All Malignancies	**1923**	**1693**	**114 (109 - 119)**
Lip, Oral Cavity and Pharynx	108	90	120 (99 - 145)
Lip	**45**	**27**	**169 (126 - 226)**
Pharynx	31	29	108 (76 - 154)
Digestive Organs	337	329	102 (92 - 114)
Oesophagus	30	23	130 (91 - 186)
Stomach	23	32	73 (48 - 110)
Colorectal	**219**	**192**	**114 (100 – 130)**
Colon	120	105	115 (95 - 136)
Rectum	96	81	118 (97 - 144)
Liver	21	35	60 (39 - 91)
Gallbladder	9	7	128 (67 - 246)
Pancreas	22	32	69 (46 - 105)
Respiratory and Intrathoracic Organs	**179**	**141**	**127 (110 - 147)**
Larynx	18	14	127 (80 - 202)
Lung	**157**	**121**	**130 (111 - 152)**
Melanoma	**279**	**225**	**124 (110 - 139)**
Mesothelioma	**---**	**---**	48 (18 - 127)
Breast	0		
Male Reproductive Organs	**595**	**494**	**120 (111 - 130)**
Prostate	**547**	**448**	**122 (112 - 133)**
Testis	44	43	102 (76 - 137)
Urinary Tract	110	96	115 (95 - 139)
Kidney	75	63	119 (95 - 150)
Bladder	30	29	105 (73 - 150)
Brain and Other CNS	41	34	121 (89 - 164)
Brain	40	33	123 (90 - 168)
Thyroid and Other Endocrine Glands	34	29	118 (85 - 166)
Thyroid	32	27	120 (85 - 170)
Unknown Site	23	24	94 (63 - 142)
Lymphoid, Haematopoietic + Related Tissue	138	163	85 (72 – 100)
Hodgkin	9	13	69 (36 - 133)
Non-Hodgkin Lymphoma	58	72	81 (62 - 104)
Diffuse Non-Hodgkin Lymphoma	22	35	62 (41 - 94)
Multiple Myeloma	15	22	69 (42 - 115)
Leukaemia	53	51	104 (79 - 136)
Lymphoid Leukaemia	37	29	129 (94 - 178)
Myeloid Leukaemia	11	18	60 (33 - 108)
Other Cancers	**75**	**60**	**125 (100 - 157)**
Myelodysplastic Syndrome (MDS)	9	8	112 (58 - 215)
Connective tissue	16	13	121 (74 - 198)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 107: Cancer SIRs* for male coal mine workers who EVER worked in Driller (general) jobs, compared to the Australian population

Cancer Categories	*N=3,649; PY= 34,989*		
	O	E	SIR (95% CI)
All Malignancies	**143**	**108**	**132 (112 - 156)**
Lip, Oral Cavity and Pharynx	---	---	67 (25 - 178)
Lip	---	---	159 (51 - 494)
Pharynx	0		
Digestive Organs	18	21	87 (55 - 138)
Oesophagus	**---**	**---**	**289 (108 - 769)**
Stomach	---	---	152 (49 - 472)
Colorectal	8	12	66 (33 - 132)
Colon	---	---	75 (31 - 180)
Rectum	---	---	58 (19 - 181)
Liver	0		
Gallbladder	0		
Pancreas	---	---	51 (7 - 363)
Respiratory and Intrathoracic Organs	**16**	**8**	**191 (117 - 312)**
Larynx	**---**	**---**	**358 (116 - 1111)**
Lung	**13**	**7**	**183 (106 - 315)**
Melanoma	**38**	**15**	**246 (179 - 338)**
Mesothelioma	---	---	211 (30 - 1499)
Breast	0		
Male Reproductive Organs	35	30	117 (84 - 163)
Prostate	32	26	125 (88 - 176)
Testis	---	---	49 (12 - 196)
Urinary Tract	9	6	148 (77 - 284)
Kidney	---	---	120 (50 - 289)
Bladder	---	---	238 (89 - 633)
Brain and Other CNS	---	---	41 (6 - 291)
Brain	---	---	43 (6 - 304)
Thyroid and Other Endocrine Glands	---	---	136 (44 - 420)
Thyroid	---	---	146 (47 - 452)
Unknown Site	**---**	**---**	**270 (101 - 720)**
Lymphoid, Haematopoietic + Related Tissue	9	11	81 (42 - 156)
Hodgkin	---	---	89 (13 - 632)
Non-Hodgkin Lymphoma	---	---	83 (31 - 221)
Diffuse Non-Hodgkin Lymphoma	---	---	127 (41 - 395)
Multiple Myeloma	---	---	150 (38 - 601)
Leukaemia	---	---	58 (15 - 232)
Lymphoid Leukaemia	---	---	54 (8 - 383)
Myeloid Leukaemia	---	---	75 (11 - 535)
Other Cancers	---	---	124 (52 - 298)
Myelodysplastic Syndrome (MDS)	---	---	210 (30 - 1493)
Connective tissue	0		

***** Statistically significantly increased SIR results are in **red**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 108: Cancer SIRs* for male coal mine workers who EVER worked in Production jobs as Underground Miners, compared to the Australian population

Cancer Categories	*N=7,421; PY=96,341*		
	O	E	SIR (95% CI)
All Malignancies	**304**	**270**	**112 (100 - 126)**
Lip, Oral Cavity and Pharynx	17	16	107 (67 - 172)
Lip	7	5	132 (63 - 278)
Pharynx	6	5	125 (56 - 278)
Digestive Organs	47	51	92 (69 - 123)
Oesophagus	---	---	88 (28 - 272)
Stomach	---	---	81 (30 - 216)
Colorectal	32	30	107 (76 - 151)
Colon	20	16	123 (79 - 191)
Rectum	11	13	86 (48 - 156)
Liver	---	---	37 (9 - 147)
Gallbladder	0		
Pancreas	---	---	105 (44 - 252)
Respiratory and Intrathoracic Organs	25	20	123 (83 - 182)
Larynx	**6**	**2**	**288 (129 - 641)**
Lung	18	17	106 (66 - 167)
Melanoma	53	41	129 (98 - 169)
Mesothelioma	0		
Breast	0		
Male Reproductive Organs	**93**	**71**	**131 (107 - 160)**
Prostate	**81**	**59**	**136 (110 - 169)**
Testis	12	11	108 (61 - 190)
Urinary Tract	18	15	119 (75 - 189)
Kidney	13	10	124 (72 - 214)
Bladder	---	---	99 (37 - 263)
Brain and Other CNS	6	6	93 (42 - 207)
Brain	6	6	97 (44 - 217)
Thyroid and Other Endocrine Glands	---	---	87 (36 - 210)
Thyroid	---	---	94 (39 - 226)
Unknown Site	---	---	131 (55 - 316)
Lymphoid, Haematopoietic + Related Tissue	25	28	88 (59 - 130)
Hodgkin	---	---	33 (5 - 235)
Non-Hodgkin Lymphoma	10	13	80 (43 - 148)
Diffuse Non-Hodgkin Lymphoma	---	---	66 (25 - 175)
Multiple Myeloma	---	---	123 (46 - 327)
Leukaemia	10	9	114 (61 - 212)
Lymphoid Leukaemia	**9**	**5**	**194 (101 - 373)**
Myeloid Leukaemia	---	---	28 (4 - 202)
Other Cancers	10	10	96 (52 - 179)
Myelodysplastic Syndrome (MDS)	---	---	91 (13 - 647)
Connective tissue	---	---	79 (20 - 316)

***** Statistically significantly increased SIR results are in **red**,
--- Cell sizes of less than 6 are not reported to preserve privacy

Table 109: Cancer SIRs* for male coal mine workers who EVER worked in Production jobs as Dragline Operators, compared to the Australian population

Cancer Categories	*N=1,040; PY=18,946*		
	O	E	SIR (95% CI)
All Malignancies	**136**	**114**	**120 (101 - 142)**
Lip, Oral Cavity and Pharynx	9	6	162 (84 - 312)
Lip	---	---	62 (9 - 442)
Pharynx	**6**	**2**	**344 (155 - 766)**
Digestive Organs	21	22	93 (61 - 143)
Oesophagus	---	---	122 (31 - 489)
Stomach	---	---	46 (6 - 324)
Colorectal	13	13	98 (57 - 169)
Colon	---	---	68 (28 - 163)
Rectum	8	6	143 (72 - 287)
Liver	---	---	47 (7 - 334)
Gallbladder	0		
Pancreas	---	---	46 (6 - 324)
Respiratory and Intrathoracic Organs	9	11	86 (45 - 165)
Larynx	0		
Lung	9	9	99 (52 - 190)
Melanoma	13	14	93 (54 - 161)
Mesothelioma	0		
Breast	0		
Male Reproductive Organs	**57**	**35**	**163 (125 - 211)**
Prostate	**51**	**33**	**153 (116 - 202)**
Testis	**6**	**2**	**389 (175 - 866)**
Urinary Tract	8	6	126 (63 - 253)
Kidney	---	---	104 (39 - 276)
Bladder	---	---	186 (70 - 495)
Brain and Other CNS	0		
Brain	0		
Thyroid and Other Endocrine Glands	---	---	216 (70 - 670)
Thyroid	---	---	233 (75 - 724)
Unknown Site	---	---	55 (8 - 390)
Lymphoid, Haematopoietic + Related Tissue	10	10	99 (53 - 184)
Hodgkin	---	---	180 (25 - 1279)
Non-Hodgkin Lymphoma	---	---	88 (33 - 234)
Diffuse Non-Hodgkin Lymphoma	---	---	44 (6 - 315)
Multiple Myeloma	0		
Leukaemia	---	---	155 (64 - 372)
Lymphoid Leukaemia	---	---	159 (51 - 493)
Myeloid Leukaemia	---	---	94 (13 - 666)
Other Cancers	---	---	132 (55 - 318)
Myelodysplastic Syndrome (MDS)	---	---	165 (23 - 1172)
Connective tissue	0		

***** Statistically significantly increased SIR results are in **red**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 110: Cancer SIRs* for male coal mine workers who EVER worked in Construction jobs, compared to the Australian population

Cancer Categories	*N=8,435; PY=67,179*		
	O	E	SIR (95% CI)
All Malignancies	227	229	99 (87 - 113)
Lip, Oral Cavity and Pharynx	16	12	130 (80 - 213)
Lip	---	---	56 (14 - 222)
Pharynx	**11**	**4**	**280 (155 - 505)**
Digestive Organs	37	44	84 (61 - 116)
Oesophagus	---	---	100 (32 - 311)
Stomach	---	---	72 (23 - 224)
Colorectal	20	25	78 (51 - 122)
Colon	12	14	86 (49 - 151)
Rectum	8	11	74 (37 - 149)
Liver	6	5	123 (55 - 273)
Gallbladder	---	---	219 (55 - 875)
Pancreas	---	---	47 (12 - 188)
Respiratory and Intrathoracic Organs	**32**	**18**	**178 (126 - 252)**
Larynx	---	---	170 (55 - 528)
Lung	**29**	**15**	**189 (131 - 272)**
Melanoma	37	31	119 (86 - 165)
Mesothelioma	---	---	200 (50 - 800)
Breast	---	---	250 (35 - 1771)
Male Reproductive Organs	67	66	101 (79 - 128)
Prostate	59	58	101 (79 - 131)
Testis	8	8	104 (52 - 209)
Urinary Tract	12	13	93 (53 - 164)
Kidney	8	9	91 (46 - 183)
Bladder	---	---	83 (27 - 258)
Brain and Other CNS	---	---	41 (10 - 164)
Brain	---	---	43 (11 - 171)
Thyroid and Other Endocrine Glands	---	---	22 (3 - 159)
Thyroid	---	---	24 (3 - 170)
Unknown Site	---	---	66 (17 - 264)
Lymphoid, Haematopoietic + Related Tissue	10	23	44 (24 - 82)
Hodgkin	---	---	91 (23 - 362)
Non-Hodgkin Lymphoma	---	---	30 (10 - 94)
Diffuse Non-Hodgkin Lymphoma	---	---	41 (10 - 165)
Multiple Myeloma	---	---	69 (17 - 277)
Leukaemia	---	---	42 (14 - 131)
Lymphoid Leukaemia	---	---	51 (13 - 204)
Myeloid Leukaemia	0		
Other Cancers	8	8	96 (48 - 192)
Myelodysplastic Syndrome (MDS)	0		
Connective tissue	---	---	104 (26 - 415)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 111: Cancer SIRs* for male coal mine workers who EVER worked in Exploration Driller jobs, compared to the Australian population

Cancer Categories	*N=4,621; PY=36,068*		
	O	E	SIR (95% CI)
All Malignancies	71	65	110 (87 - 139)
Lip, Oral Cavity and Pharynx	**9**	**4**	**228 (119 - 439)**
Lip	**---**	**---**	**366 (153 - 884)**
Pharynx	---	---	170 (43 - 681)
Digestive Organs	---	---	17 (4 - 69)
Oesophagus	0		
Stomach	---	---	92 (13 - 651)
Colorectal	0		
Colon	0		
Rectum	0		
Liver	0		
Gallbladder	0		
Pancreas	---	---	96 (14 - 681)
Respiratory and Intrathoracic Organs	---	---	52 (13 - 206)
Larynx	0		
Lung	---	---	32 (4 - 224)
Melanoma	**23**	**11**	**213 (142 - 321)**
Mesothelioma	0		
Breast	0		
Male Reproductive Organs	19	15	123 (78 - 192)
Prostate	15	11	142 (85 - 233)
Testis	---	---	85 (32 - 225)
Urinary Tract	---	---	84 (27 - 261)
Kidney	---	---	37 (5 - 262)
Bladder	---	---	271 (68 - 1082)
Brain and Other CNS	---	---	105 (26 - 418)
Brain	---	---	110 (27 - 438)
Thyroid and Other Endocrine Glands	---	---	152 (49 - 471)
Thyroid	---	---	109 (27 - 436)
Unknown Site	---	---	139 (20 - 987)
Lymphoid, Haematopoietic + Related Tissue	---	---	38 (12 - 119)
Hodgkin	0		
Non-Hodgkin Lymphoma	---	---	62 (16 - 248)
Diffuse Non-Hodgkin Lymphoma	0		
Multiple Myeloma	---	---	142 (20 - 1009)
Leukaemia	0		
Lymphoid Leukaemia	0		
Myeloid Leukaemia	0		
Other Cancers	---	---	145 (54 - 387)
Myelodysplastic Syndrome (MDS)	**---**	**---**	**939 (235 - 3754)**
Connective tissue	0		

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

--- Cell sizes of less than 6 are not reported to preserve privacy

Table 112: Cancer SIRs* for male coal mine workers who EVER worked as Labourers, compared to the Australian population

Cancer Categories	Labourers *N=5,445; PY=47,754*		
	O	E	SIR (95% CI)
All Malignancies	112	100	112 (93 - 135)
Lip, Oral Cavity and Pharynx	8	6	140 (70 - 280)
Lip	---	---	160 (52 - 497)
Pharynx	---	---	58 (8 - 410)
Digestive Organs	23	18	127 (84 - 191)
Oesophagus	---	---	87 (12 - 619)
Stomach	---	---	59 (8 - 417)
Colorectal	7	11	65 (31 - 137)
Colon	---	---	85 (35 - 204)
Rectum	---	---	44 (11 - 177)
Liver	**9**	**2**	**449 (234 - 864)**
Gallbladder	---	---	288 (41 - 2042)
Pancreas	---	---	60 (8 - 424)
Respiratory and Intrathoracic Organs	10	7	150 (81 - 278)
Larynx	0		
Lung	9	6	162 (84 - 311)
Melanoma	16	15	104 (64 - 170)
Mesothelioma	---	---	308 (43 - 2184)
Breast	0		
Male Reproductive Organs	32	26	122 (86 - 172)
Prostate	28	20	139 (96 - 202)
Testis	---	---	67 (25 - 178)
Urinary Tract	---	---	37 (9 - 147)
Kidney	---	---	51 (13 – 204)
Bladder	0		
Brain and Other CNS	---	---	76 (19 - 303)
Brain	---	---	79 (20 - 317)
Thyroid and Other Endocrine Glands	---	---	39 (5 - 276)
Thyroid	---	---	42 (6 - 298)
Unknown Site	---	---	169 (42 - 677)
Lymphoid, Haematopoietic + Related Tissue	12	11	106 (60 - 187)
Hodgkin	---	---	121 (30 - 485)
Non-Hodgkin Lymphoma	---	---	64 (21 - 198)
Diffuse Non-Hodgkin Lymphoma	0		
Multiple Myeloma	---	---	176 (44 - 705)
Leukaemia	---	---	144 (60 - 345)
Lymphoid Leukaemia	---	---	**281 (117 - 676)**
Myeloid Leukaemia	0		
Other Cancers	---	---	74 (24 - 231)
Myelodysplastic Syndrome (MDS)	---	---	260 (37 - 1843)
Connective tissue	---	---	94 (13 - 670)

***** Statistically significantly increased SIR results are in **red**,
--- Cell sizes of less than 6 are not reported to preserve privacy

Table 113: Cancer SIRs* for male coal mine workers who EVER worked as Supervisors or Truck Drivers (Unclear Work Category), compared to the Australian population

Cancer Categories	Supervisor *N=5,447; PY=64,670*			Truck Driver *N=7,209; PY=67,813*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	291	283	103 (92 - 115)	380	354	107 (97 - 119)
Lip, Oral Cavity and Pharynx	18	15	117 (74 - 186)	24	18	131 (88 - 195)
Lip	6	4	133 (60 - 297)	9	5	180 (94 - 347)
Pharynx	6	5	121 (54 - 269)	---	---	82 (34 - 198)
Digestive Organs	45	55	82 (61 - 109)	65	70	93 (73 - 119)
Oesophagus	---	---	103 (39 - 273)	7	5	141 (67 - 295)
Stomach	---	---	57 (18 - 176)	8	7	121 (60 - 242)
Colorectal	30	32	94 (66 - 135)	40	40	100 (73 – 137)
Colon	17	17	98 (61 - 158)	20	22	91 (59 - 142)
Rectum	12	14	89 (50 - 156)	20	17	118 (76 - 183)
Liver	---	---	82 (34 - 196)	---	---	25 (6 - 102)
Gallbladder	0			---	---	132 (33 - 529)
Pancreas	---	---	37 (9 - 149)	---	---	73 (30 - 175)
Respiratory and Intrathoracic Organs	15	23	64 (39 - 107)	31	30	103 (72 - 146)
Larynx	---	---	42 (6 - 301)	---	---	134 (50 - 357)
Lung	13	20	65 (38 - 112)	27	26	104 (71 - 151)
Melanoma	**52**	**38**	**137 (105 - 180)**	**61**	**44**	**138 (107 - 177)**
Mesothelioma	---	---	148 (37 - 593)	0		
Breast	0			0		
Male Reproductive Organs	98	82	119 (98 - 145)	122	108	113 (95 - 135)
Prostate	87	76	115 (93 - 142)	116	101	115 (96 - 138)
Testis	11	6	172 (95 - 311)	---	---	64 (24 - 171)
Urinary Tract	14	16	87 (52 - 146)	13	20	64 (37 - 111)
Kidney	7	11	65 (31 - 137)	12	13	91 (52 - 161)
Bladder	7	5	148 (71 - 310)	0		
Brain and Other CNS	---	---	36 (9 - 143)	8	6	124 (62 - 248)
Brain	---	---	37 (9 - 149)	8	6	129 (65 - 258)
Thyroid and Other Endocrine	---	---	84 (32 - 224)	---	---	55 (18 - 170)
Thyroid	---	---	90 (34 - 240)	---	---	59 (19 - 182)
Unknown Site	---	---	99 (37 - 263)	---	---	60 (19 - 186)
Lymphoid, Haematopoietic + Related Tissue	29	27	108 (75 - 155)	35	33	108 (77 - 150)
Hodgkin	---	---	51 (7 - 363)	---	---	47 (7 - 337)
Non-Hodgkin Lymphoma	9	12	75 (39 - 144)	11	14	76 (42 - 137)
Diffuse Non-Hodgkin Lymphoma	---	---	17 (2 - 120)	7	7	97 (46 - 204)
Multiple Myeloma	---	---	136 (57 - 327)	---	---	106 (44 - 256)
Leukaemia	13	8	154 (90 - 265)	**18**	**10**	**175 (110 - 278)**
Lymphoid Leukaemia	**11**	**5**	**231 (128 - 416)**	**11**	**6**	**185 (102 - 334)**
Myeloid Leukaemia	---	---	33 (5 - 236)	6	3	173 (78 - 385)
Other Cancers	8	10	80 (40 - 161)	15	12	125 (75 - 207)
Myelodysplastic Syndrome (MDS)	---	---	75 (11 - 535)	---	---	114 (28 - 455)
Connective tissue	---	---	92 (23 - 368)	---	---	79 (20 - 317)

***** Statistically significantly increased SIR results are in **red**,
--- Cell sizes of less than 6 are not reported to preserve privacy

Table 114: Cancer SIRs* for male coal mine workers by time between first and last assessment

Cancer Categories	≤5 years *N= 149,607; PY= 979,581*			>5-10 years *N= 51,047; PY= 267,100*			>10 – 15 years *N= 26,230; PY= 141,368*			>15 years *N= 11,781; PY= 126,123*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	**3373**	**3151**	**107 (104 - 111)**	877	830	106 (99 - 113)	**800**	**715**	**112 (104 - 120)**	890	872	102 (96 - 109)
Lip, Oral Cavity and Pharynx	186	170	109 (95 - 126)	**66**	**47**	**139 (109 - 177)**	40	36	111 (82 - 152)	37	44	84 (61 - 116)
Lip	**66**	**52**	**127 (100 - 161)**	**33**	**15**	**214 (152 - 300)**	14	11	125 (74 - 211)	12	12	103 (58 - 181)
Pharynx	64	53	121 (94 - 154)	14	14	97 (57 - 163)	10	11	92 (49 - 170)	12	15	82 (47 - 145)
Digestive Organs	618	602	103 (95 - 111)	128	158	81 (68 - 96)	158	144	110 (94 - 128)	142	174	82 (69 - 96)
Oesophagus	43	41	105 (78 - 142)	10	11	94 (50 - 174)	7	10	71 (34 - 148)	11	13	86 (48 - 155)
Stomach	49	58	85 (64 - 112)	7	16	45 (22 - 95)	12	14	84 (48 - 149)	12	17	72 (41 - 126)
Colorectal	374	351	106 (96 - 118)	87	93	94 (76 - 115)	**107**	**86**	**124 (103 - 150)**	93	100	92 (75 - 113)
Colon	209	194	108 (94 - 123)	45	51	88 (66 - 118)	61	49	126 (98 - 161)	55	55	100 (77 - 130)
Rectum	159	147	108 (92 - 126)	42	39	107 (79 - 145)	45	35	127 (95 - 171)	38	43	89 (65 - 122)
Liver #	60	65	92 (72 - 119)	---	---	30 (12 - 72)	12	13	90 (51 - 159)	6	19	32 (15 - 72)
Gallbladder	**20**	**13**	**158 (102 - 245)**	---	---	152 (63 - 366)	---	---	31 (4 - 220)	---	---	103 (39 - 274)
Pancreas	56	58	97 (75 - 126)	12	15	80 (46 - 142)	12	14	87 (49 - 152)	9	17	52 (27 - 100)
Respiratory and Intrathoracic Organs	268	252	106 (94 - 120)	72	66	109 (87 - 138)	80	67	119 (96 - 148)	71	79	90 (72 - 114)
Larynx	27	25	109 (75 - 159)	**12**	**7**	**178 (101 – 313)**	8	7	122 (61 - 244)	9	8	112 (59 - 216)
Lung	231	215	108 (95 - 122)	53	56	95 (73 - 124)	71	58	122 (97 - 154)	61	68	90 (70 - 115)
Melanoma	**586**	**435**	**135 (124 - 146)**	**159**	**121**	**132 (113 - 154)**	**122**	**91**	**134 (112 - 160)**	120	105	114 (95 - 137)
Mesothelioma #	**26**	**14**	**181 (123 - 266)**	6	4	162 (73 - 361)	---	---	22 (3 - 156)	---	---	61 (20 - 188)
Breast	8	6	145 (72 - 290)	0			0			---	---	61 (9 - 432)
Male Reproductive Organs #	920	894	103 (96 - 110)	243	224	108 (96 - 123)	**233**	**204**	**114 (100 - 130)**	**333**	**271**	**123 (110 - 137)**
Prostate #	816	779	105 (98 - 112)	212	193	110 (96 - 136)	**224**	**190**	**118 (104 - 135)**	**325**	**261**	**124 (112 - 139)**
Testis	100	109	91 (75 - 111)	27	30	90 (62 - 131)	9	13	67 (35 - 130)	8	9	92 (46 - 183)
Urinary Tract	175	177	99 (85 - 115)	52	47	112 (85 - 146)	44	41	107 (80 - 144)	49	50	99 (75 - 131)
Kidney	107	117	91 (75 - 110)	36	31	115 (83 - 159)	25	25	101 (68 - 150)	33	31	106 (75 - 148)
Bladder	59	52	114 (89 - 148)	14	13	104 (62 - 176)	17	14	120 (75 - 193)	13	16	81 (47 - 140)
Brain and Other CNS	80	68	117 (94 - 146)	21	19	111 (72 - 170)	13	13	98 (57 - 169)	12	15	81 (46 - 143)
Brain	79	65	121 (97 - 150)	21	18	116 (76 - 178)	13	13	102 (59 - 176)	11	14	77 (43 - 139)
Thyroid and Other Endocrine Glands	58	60	96 (75 - 125)	19	16	117 (75 - 184)	13	10	130 (76 - 224)	9	11	81 (42 - 155)

Cancer Categories	≤5 years *N= 149,607; PY= 979,581*			>5-10 years *N= 51,047; PY= 267,100*			>10 – 15 years *N= 26,230; PY= 141,368*			>15 years *N= 11,781; PY= 126,123*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)
Thyroid	57	56	102 (79 - 132)	18	15	120 (76 - 191)	11	9	119 (66 - 215)	8	10	77 (38 - 154)
Unknown Site	48	44	109 (82 - 145)	12	12	100 (57 - 177)	12	12	100 (57 - 177)	11	13	83 (46 - 150)
Lymphoid, Haematopoietic + Related Tissue	284	317	90 (80 – 101)	68	85	80 (63 - 102)	62	66	94 (74 - 120)	76	77	99 (79 - 124)
Hodgkin	22	32	69 (46 - 105)	---	---	49 (18 - 129)	---	---	72 (23 - 225)	---	---	28 (4 - 195)
Non-Hodgkin Lymphoma	112	137	82 (68 - 98)	26	37	69 (47 - 102)	26	30	87 (60 - 128)	37	35	106 (77 - 147)
Diffuse Non-Hodgkin	54	67	80 (62 - 105)	12	18	67 (38 - 117)	13	15	89 (52 - 153)	15	17	87 (53 - 144)
Multiple Myeloma	44	39	112 (84 - 151)	13	10	128 (74 - 220)	7	9	75 (36 - 158)	8	12	68 (34 - 136)
Leukaemia	103	99	104 (86 - 126)	25	26	96 (65 - 142)	24	21	114 (76 - 170)	30	25	122 (86 - 175)
Lymphoid Leukaemia	67	54	124 (98 - 158)	17	14	121 (75 - 195)	17	12	143 (89 - 231)	19	15	130 (83 - 204)
Myeloid Leukaemia	26	37	70 (47 - 102)	8	10	79 (40 - 158)	6	7	82 (37 - 182)	7	8	90 (43 - 188)
Other Cancers	116	117	99 (83 - 119)	31	32	98 (69 - 140)	22	25	87 (57 - 132)	26	29	91 (62 - 134)
Myelodysplastic Syndrome	10	15	68 (37 - 126)	---	---	86 (28 - 266)	---	---	125 (52 - 301)	---	---	89 (33 - 237)
Connective tissue [#]	27	27	100 (68 - 146)	11	7	149 (83 - 270)	---	---	20 (3 - 139)	---	---	18 (2 - 126)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**;

[#] Trend test p-value <0.05

Table 115: Cancer SIRs* for male coal mine workers by time since first assessment

Cancer Categories	≤5 years *N= 149,607; PY= 635,335*			>5-10 years *N= 116,281; PY= 448,572*			>10 – 15 years *N= 61,185; PY= 217,499*			>15 years *N= 24,520; PY= 200,494*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	**1647**	**1455**	**113 (108 - 119)**	1462	1459	100 (95 - 105)	**1038**	**944**	**110 (104 - 117)**	**1793**	**1710**	**105 (100 - 110)**
Lip, Oral Cavity and Pharynx	88	85	103 (84 - 128)	98	82	119 (98 - 146)	54	51	105 (81 - 138)	81	78	104 (83 - 129)
Lip	38	29	132 (96 - 181)	**44**	**26**	**172 (128 - 232)**	18	15	118 (74 - 187)	25	21	121 (82 - 179)
Pharynx	27	25	106 (73 - 155)	27	26	105 (72 - 154)	20	16	123 (79 - 191)	26	26	101 (69 - 148)
Digestive Organs	279	266	105 (93 - 118)	231	278	83 (73 - 95)	186	185	101 (87 - 116)	329	339	97 (87 - 108)
Oesophagus	22	17	126 (83 - 191)	11	19	58 (32 - 105)	16	13	125 (77 - 204)	21	25	84 (55 - 129)
Stomach	20	26	77 (50 - 120)	24	27	89 (60 - 133)	8	18	44 (22 - 88)	28	33	84 (58 - 122)
Colorectal	179	158	113 (98 - 131)	138	162	85 (72 - 101)	120	107	112 (93 - 134)	216	198	109 (95 - 125)
Colon	100	86	116 (96 - 141)	74	89	83 (66 - 104)	56	60	94 (72 - 122)	**139**	**112**	**124 (105 - 146)**
Rectum	79	68	117 (94 - 146)	62	69	90 (70 - 116)	**64**	**45**	**142 (111 - 181)**	79	82	96 (77 - 120)
Liver	20	28	71 (46 - 111)	29	31	95 (66 - 136)	16	20	79 (49 - 130)	18	35	52 (33 - 82)
Gallbladder	6	5	118 (53 - 263)	**11**	**6**	**192 (106 - 346)**	---	---	97 (36 - 257)	9	8	112 (58 - 214)
Pancreas	25	24	104 (70 - 153)	16	27	60 (37 - 98)	20	18	110 (71 - 170)	28	35	81 (56 - 117)
Respiratory and Intrathoracic Organs	105	104	101 (83 - 122)	111	114	97 (81 - 117)	89	81	110 (90 - 136)	180	163	110 (95 - 128)
Larynx	11	11	100 (56 - 181)	16	12	138 (85 - 226)	12	8	150 (85 - 264)	16	15	104 (64 - 169)
Lung	87	87	100 (81 - 124)	90	97	93 (76 - 114)	75	69	108 (86 - 136)	160	143	112 (96 - 131)
Melanoma [#]	**348**	**223**	**156 (140 - 173)**	**256**	**205**	**125 (110 - 141)**	**165**	**126**	**130 (112 - 152)**	215	191	112 (98 - 128)
Mesothelioma	10	5	183 (98 - 339)	10	6	160 (86 - 298)	---	---	106 (44 - 255)	11	11	99 (55 - 179)
Breast	---	---	82 (20 - 328)	---	---	117 (38 - 364)	---	---	58 (8 - 411)	---	---	94 (30 - 291)
Male Reproductive Organs	**427**	**383**	**112 (101 - 123)**	432	398	109 (99 - 119)	277	255	109 (97 - 122)	**586**	**513**	**114 (105 - 124)**
Prostate	**346**	**306**	**113 (102 - 126)**	**385**	**344**	**112 (101 - 124)**	**264**	**231**	**114 (101 - 129)**	**580**	**496**	**117 (108 - 127)**
Testis [#]	79	74	107 (86 - 133)	43	51	84 (63 - 114)	13	22	58 (34 - 101)	9	14	64 (33 - 122)
Urinary Tract	78	78	99 (80 - 124)	71	82	86 (68 - 109)	**70**	**55**	**127 (101 - 161)**	99	97	102 (83 - 124)
Kidney	51	55	93 (71 - 122)	46	56	82 (62 - 110)	45	36	125 (94 - 168)	58	58	100 (77 - 129)
Bladder	26	21	126 (86 - 185)	22	23	95 (63 - 145)	21	17	126 (82 - 193)	34	35	98 (70 - 137)
Brain and Other CNS	44	37	119 (88 - 159)	31	32	96 (67 - 136)	24	19	127 (85 - 190)	27	27	100 (69 - 146)
Brain	43	35	121 (90 - 164)	31	31	100 (70 - 142)	24	18	133 (89 - 198)	26	26	100 (68 - 147)

Cancer Categories	≤5 years *N= 149,607; PY= 635,335*			>5-10 years *N= 116,281; PY= 448,572*			>10 – 15 years *N= 61,185; PY= 217,499*			>15 years *N= 24,520; PY= 200,494*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)
Thyroid and Other Endocrine	37	33	113 (82 - 156)	25	29	87 (59 - 128)	16	16	99 (61 - 162)	21	20	107 (69 - 163)
Thyroid	37	30	123 (89 - 169)	24	27	89 (60 - 133)	14	15	93 (55 - 157)	19	18	103 (66 - 162)
Unknown Site	18	20	90 (57 - 143)	23	20	114 (76 - 172)	15	14	107 (65 - 178)	27	27	100 (68 - 145)
Lymphoid, Haematopoietic + Related Tissue	149	159	94 (80 - 110)	111	146	76 (63 - 91)	85	90	94 (76 - 117)	135	147	92 (78 - 109)
Hodgkin	15	21	72 (43 - 119)	6	14	43 (19 - 95)	6	6	93 (42 - 206)	---	---	47 (15 - 146)
Non-Hodgkin Lymphoma	59	68	87 (67 - 112)	44	65	68 (51 - 92)	35	40	87 (62 - 121)	62	66	94 (73 - 121)
Diffuse Non-Hodgkin Lymphoma	35	33	107 (77 - 149)	18	31	58 (36 - 91)	16	20	81 (50 - 132)	25	33	75 (51 - 111)
Multiple Myeloma	22	16	134 (88 - 203)	19	18	105 (67 - 165)	10	12	81 (43 - 150)	21	23	90 (58 - 138)
Leukaemia	51	49	105 (80 - 138)	44	45	97 (72 - 130)	33	28	116 (83 - 163)	53	48	110 (84 - 145)
Lymphoid Leukaemia	31	25	123 (87 - 175)	31	25	126 (88 - 179)	20	16	125 (81 - 194)	37	28	130 (94 - 180)
Myeloid Leukaemia	17	20	84 (52 - 135)	12	17	69 (39 - 122)	8	10	79 (40 - 158)	10	15	67 (36 - 125)
Other Cancers	52	57	91 (70 - 120)	51	54	94 (72 - 124)	34	34	100 (72 - 140)	56	57	98 (76 - 128)
Myelodysplastic Syndrome	---	---	94 (39 - 227)	---	---	16 (2 - 116)	6	4	135 (61 - 301)	10	11	92 (50 - 172)
Connective tissue	14	15	96 (57 - 162)	14	13	110 (65 - 186)	6	7	81 (37 - 181)	6	10	57 (26 - 127)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**;

[#] Trend test p-value <0.05

Table 116: Cancer SIRs* for male coal mine workers by age group

Cancer Categories	≤65 years *N= 149,132; PY= 1,466,127*			>65 years *N= 10,157; PY= 48,042*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	**4700**	**4418**	**106 (103 - 110)**	**1240**	**1150**	**108 (102 - 114)**
Lip, Oral Cavity and Pharynx	287	264	109 (97 - 122)	42	33	126 (93 - 171)
Lip	**120**	**82**	**146 (122 - 174)**	---	---	62 (26 - 150)
Pharynx	85	83	102 (83 - 127)	15	10	150 (90 - 249)
Digestive Organs	806	846	95 (89 - 102)	240	232	103 (91 - 117)
Oesophagus	62	57	108 (85 - 139)	9	17	53 (27 - 101)
Stomach	55	82	67 (52 - 88)	25	23	110 (74 - 163)
Colorectal	511	494	103 (95 - 113)	150	137	110 (94 - 129)
Colon	277	264	105 (93 - 118)	93	84	110 (90 - 135)
Rectum	229	215	106 (94 - 121)	55	50	111 (85 - 144)
Liver	69	95	73 (58 - 92)	14	19	74 (44 - 125)
Gallbladder	20	16	122 (79 - 189)	10	7	151 (81 - 280)
Pancreas	64	78	82 (64 - 104)	25	25	98 (66 - 145)
Respiratory and Intrathoracic Organs	333	335	99 (89 - 111)	**158**	**128**	**123 (105 - 144)**
Larynx	45	37	122 (91 - 164)	11	9	119 (66 - 215)
Lung	272	280	97 (86 - 109)	**144**	**117**	**123 (105 - 144)**
Melanoma	**893**	**649**	**138 (129 - 147)**	94	103	91 (75 - 112)
Mesothelioma	18	17	106 (67 - 169)	**18**	**11**	**170 (107 - 270)**
Breast	6	8	78 (35 - 173)	---	---	137 (44 - 426)
Male Reproductive Organs	**1297**	**1187**	**109 (103 - 115)**	432	407	106 (97 - 117)
Prostate	**1146**	**1017**	**113 (106 - 119)**	431	405	107 (97 - 117)
Testis	143	161	89 (76 - 105)	---	---	134 (19 - 954)
Urinary Tract	255	249	103 (91 - 116)	65	65	99 (78 - 127)
Kidney	174	174	100 (86 – 116)	27	30	89 (61 - 129)
Bladder	74	65	114 (91 - 143)	29	30	96 (67 - 138)
Brain and Other CNS	115	103	112 (93 - 134)	11	12	89 (49 - 160)
Brain	113	99	115 (95 - 138)	11	12	91 (51 - 165)
Thyroid and Other Endocrine	90	90	100 (81 - 123)	9	7	123 (64 - 236)
Thyroid	85	84	102 (82 - 126)	9	7	132 (69 - 253)
Unknown Site	64	63	102 (80 - 130)	19	18	103 (66 - 162)
Lymphoid, Haematopoietic + Related Tissue	383	453	85 (76 - 93)	107	92	116 (96 - 141)
Hodgkin	27	46	59 (41 - 86)	---	---	140 (45 - 434)
Non-Hodgkin Lymphoma	161	200	80 (69 - 94)	40	39	104 (76 - 141)
Diffuse Non-Hodgkin	78	96	81 (65 - 101)	16	21	77 (47 - 125)
Multiple Myeloma	53	54	98 (75 - 129)	19	17	115 (73 - 180)
Leukaemia	138	139	99 (84 - 117)	**44**	**32**	**139 (103 - 187)**
Lymphoid Leukaemia	92	75	122 (99 - 148)	**28**	**19**	**148 (102 - 214)**
Myeloid Leukaemia	38	54	70 (51 - 96)	9	8	108 (56 - 207)
Other Cancers	151	162	93 (79 - 109)	42	40	105 (78 - 142)
Myelodysplastic Syndrome	14	15	92 (55 - 156)	8	12	69 (35 - 139)
Connective tissue	36	40	90 (65 - 125)	---	---	76 (28 - 202)

***** Statistically significantly increased SIR results are in **red**, statistically significantly reduced SIR results are in **blue**

Table 117: All Malignancies SIRs by Work Category and Job Groups – all Site Types combined* – Women only

Job Group	*N=20,080; PY=151,875*		
	O	E	SIR (95% CI)
ONLY Unexposed Office			
Administration	148	131	113 (96 - 133)
ONLY Unexposed Non-Office	31	33	93 (66 - 133)
Blue Collar (Not Exposed)	24	24	99 (66 - 148)
Control Room	0		
Environmental Services	7	9	81 (38 - 169)
ONLY Occasionally Exposed	18	17	105 (66 - 167)
Engineer	8	5	176 (88 - 351)
Mine Services	8	6	130 (65 - 260)
Technical Services	---	---	31 (8 - 124)
EVER Maintenance - All	20	28	72 (47 - 112)
Maintenance – General (Nec)	9	12	77 (40 - 147)
Diesel Fitter	0		
Electrician	---	---	102 (25 - 407)
Industrial Cleaner	10	13	80 (43 - 148)
EVER Production - All	89	105	85 (69 - 105)
Blast Crew	---	---	61 (9 - 435)
Laboratory	9	13	68 (35 - 131)
Miner	---	---	63 (20 - 194)
Operator	78	88	88 (71 - 110)
EVER Driller (Exploration)	---	---	204 (29 - 1445)
EVER Construction	0		
EVER Unclear Work Category			
Labourer (Nec)	---	---	61 (20 - 188)
Cleaner (Nec)	65	69	95 (74 - 121)
Truck Driver (Nec)	15	22	70 (42 - 115)

* Only includes groups with >100 workers.

Table 118: All Malignancies SIRs* for female coal mine workers by Work Category and Job Group, by Site Type (mutually exclusive groupings)

Job Group	Only worked in Open Cut (excludes CHPP, Underground and only unknown) *N=8,732; PY=73,597*			Ever Underground (excludes CHPP) *N=2,457; PY=19,885*			Ever CHPP (excludes unknown) *N=787; PY=6,741*			All Other workers (unknown site type only) † *N=8,104; PY=53,174*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Workers	185	195	95 (82 – 110)	44	46	96 (71 – 129)	10	15	66 (35 – 122)	157	153	103 (88 – 120)
Only ever Unexposed Office												
Administration – General only	76	63	121 (96 - 151)	20	22	93 (60 - 144)	0			52	46	113 (86 - 149)
Only ever Unexposed Non-Office	13	11	121 (70 - 209)	---	---	41 (6 - 294)	0			17	20	85 (53 - 137)
Blue Collar (Not Exposed)	9	8	119 (62 - 228)	---	---	73 (10 - 522)	0			14	15	92 (54 - 155)
Control Room	0			0			0			0		
Environmental Services	---	---	132 (50 - 353)	0			NA			---	---	64 (21 - 199)
Only ever Occasionally Exposed	---	---	94 (39 - 225)	---	---	71 (18 - 286)	0			11	9	122 (68 - 221)
Engineer	---	---	157 (51 - 486)	---	---	113 (16 - 799)	0			---	---	232 (87 - 619)
Mine Services	---	---	115 (29 - 458)	0			NA			6	4	141 (64 - 315)
Technical Services	0			---	---	57 (8 - 404)	0			---	---	33 (5 - 235)
Ever Maintenance - All	---	---	42 (16 - 112)	---	---	53 (7 - 374)	0			10	11	91 (49 - 168)
Maintenance – General (Nec)	---	---	34 (5 - 239)	0			0			6	5	111 (50 - 246)
Diesel Fitter	0			0			NA			0		
Electrician	0			0			NA			---	---	187 (26 - 1324)
Industrial Cleaner	---	---	59 (19 - 182)	---	---	128 (18 - 909)	NA			---	---	89 (34 - 238)
Ever Production - All	45	54	83 (62 - 112)	---	---	108 (41 - 288)	9	14	63 (33 – 119)	22	25	87 (57 - 132)
Blast Crew	0			0			NA			0		
Laboratory	NA			NA			9	13	68 (35 – 131)	NA		
Miner	---	---	46 (7 - 327)	0			NA			---	---	131 (19 - 933)
Operator	48	55	88 (66 - 116)	---	---	153 (58 - 409)	0			21	24	89 (58 - 136)
Ever Driller (Exploration)	0			**---**	**---**	**2001 (282 - 14208)**	NA			0		
Ever Construction - All	0			0			NA			0		
Unclear Work Category												
Ever Labourer (Nec)	0			0			NA			---	---	42 (6 - 299)
Ever Cleaner (Nec)	24	30	81 (54 - 121)	---	---	90 (38 - 217)	NA			31	26	120 (84 - 170)
Ever Truck Driver (Nec)	---	---	39 (13 - 122)	---	---	190 (27 - 1347)	0			6	8	77 (34 - 170)

***** Statistically significantly increased SIR results are in **red**

-- Observed value < 6.

† All assessments had Site Type Unknown or Various (excludes workers where Job Group was unknown)

‡ NA No worker in that Job Group within that Site Type

Table 119: Cancer SIRs* for female coal mine workers who ONLY worked in Administration jobs

Cancer Categories	*N= 6,608; PY= 51,610*		
	O	E	SIR (95% CI)
All Malignancies	148	131	113 (96 - 133)
Digestive Organs	18	15	119 (75 - 189)
Colorectal	14	11	133 (79 - 224)
Colon	7	6	109 (52 - 229)
Rectum	6	4	168 (75 - 374)
Respiratory and Intrathoracic Organs	7	6	119 (57 - 249)
Lung	7	5	128 (61 - 269)
Melanoma	**33**	**17**	**190 (135 - 267)**
Breast	55	47	118 (91 - 154)
Female Reproductive Organs	9	15	61 (32 - 118)
Cervix	---	---	81 (30 - 215)
Thyroid and Other Endocrine Glands	9	10	93 (48 - 179)
Thyroid	8	9	84 (42 - 169)
Lymphoid, Haematopoietic + Related Tissue	14	9	149 (89 - 252)
Hodgkin	---	---	195 (63 - 604)
Non-Hodgkin Lymphoma	7	4	181 (86 - 379)

***** Statistically significantly increased SIR results are in **red**

Table 120: SIRs for female coal mine workers who ONLY worked in Unexposed Non-Office jobs

Cancer Categories	*N= 1,721; PY= 10,944*		
	O	E	SIR (95% CI)
All Malignancies	31	33	93 (66 - 133)
Digestive Organs	---	---	73 (24 - 227)
Colorectal	---	---	36 (5 - 252)
Colon	---	---	59 (8 - 416)
Rectum	0		
Respiratory and Intrathoracic Organs	---	---	114 (28 - 455)
Lung	---	---	121 (30 - 486)
Melanoma	---	---	74 (24 - 230)
Breast	14	12	118 (70 - 199)
Female Reproductive Organs	---	---	82 (26 - 253)
Cervix	---	---	195 (49 - 781)
Thyroid and Other Endocrine Glands	---	---	91 (23 - 364)
Thyroid	---	---	93 (23 - 371)
Lymphoid, Haematopoietic + Related Tissue	---	---	126 (41 - 392)
Hodgkin	0		
Non-Hodgkin Lymphoma	---	---	99 (14 - 701)

Table 121: Cancer SIRs* for female coal mine workers who ONLY worked in Occasionally exposed jobs

Cancer Categories	*N= 1,474; PY= 9,463*		
	O	E	SIR (95% CI)
All Malignancies	18	17	105 (66 - 167)
Digestive Organs	0		
Respiratory and Intrathoracic Organs	---	---	309 (77 - 1236)
Lung	---	---	339 (85 - 1355)
Melanoma	---	---	158 (59 - 421)
Breast	---	---	72 (27 - 193)
Female Reproductive Organs	---	---	147 (47 - 456)
Cervix	0		
Thyroid and Other Endocrine Glands	0		
Lymphoid, Haematopoietic + Related Tissue	0		

Table 122: Cancer SIRs* for female coal mine workers who EVER worked in Maintenance jobs

Cancer Categories	*N= 1,503; PY= 10,946*		
	O	E	SIR (95% CI)
All Malignancies	20	28	72 (47 - 112)
Digestive Organs	---	---	31 (4 - 217)
Colorectal	0		
Respiratory and Intrathoracic Organs	0		
Melanoma	---	---	139 (58 - 335)
Breast	8	10	81 (41 - 162)
Female Reproductive Organs	---	---	99 (32 - 306)
Cervix	---	---	103 (15 - 734)
Thyroid and Other Endocrine Glands	0		
Lymphoid, Haematopoietic + Related Tissue	0		

Table 123: Cancer SIRs* for female coal mine workers who EVER worked in a Production job

Cancer Categories	*N= 5,361; PY= 41,637*		
	O	E	SIR (95% CI)
All Malignancies	89	105	85 (69 - 105)
Digestive Organs	13	12	111 (65 - 192)
Colorectal	7	8	85 (41 - 179)
Colon	---	---	81 (30 - 216)
Rectum	---	---	71 (18 - 283)
Respiratory and Intrathoracic Organs	---	---	91 (34 - 243)
Lung	---	---	99 (37 - 263)
Melanoma	16	14	115 (70 - 188)
Breast	25	38	65 (44 - 97)
Female Reproductive Organs	6	12	52 (23 - 115)
Cervix	---	---	25 (4 - 181)
Thyroid and Other Endocrine Glands	10	8	126 (68 - 235)
Thyroid	10	8	129 (69 - 239)
Lymphoid, Haematopoietic + Related Tissue	7	7	95 (45 - 199)
Hodgkin	---	---	162 (41 - 649)
Non-Hodgkin Lymphoma	---	---	66 (16 - 263)

***** Statistically significantly reduced SIR results are in **blue**

Table 124: Cancer SIRs* for female coal mine workers who EVER worked as an Operator

Cancer Categories	*N= 4,495; PY= 34,507*		
	O	E	SIR (95% CI)
All Malignancies	78	88	88 (71 - 110)
Digestive Organs	11	10	112 (62 - 202)
Colorectal	6	7	87 (39 - 194)
Colon	---	---	73 (23 - 226)
Rectum	---	---	84 (21 - 336)
Respiratory and Intrathoracic Organs	---	---	109 (41 - 290)
Lung	---	---	118 (44 - 314)
Melanoma	12	12	103 (58 - 181)
Breast	23	32	71 (47 - 107)
Female Reproductive Organs	---	---	51 (21 - 124)
Cervix	---	---	30 (4 - 216)
Thyroid and Other Endocrine Glands	9	7	135 (70 - 260)
Thyroid	9	7	138 (72 - 264)
Lymphoid, Haematopoietic + Related Tissue	6	6	97 (44 - 217)
Hodgkin	---	---	99 (14 - 702)
Non-Hodgkin Lymphoma	---	---	78 (20 - 313)

Table 125: Cancer SIRs* for female coal mine workers who EVER worked as a Cleaner (Work Category unclear)

Cancer Categories	*N= 2,529; PY= 19,729*		
	O	E	SIR (95% CI)
All Malignancies	65	69	95 (74 - 121)
Digestive Organs	10	9	117 (63 - 217)
Colorectal	8	6	137 (68 - 273)
Colon	---	---	85 (28 - 265)
Rectum	**---**	**---**	**250 (104 - 600)**
Respiratory and Intrathoracic Organs	7	4	187 (89 - 393)
Lung	6	4	171 (77 - 381)
Melanoma	---	---	62 (26 - 148)
Breast	18	26	70 (44 - 111)
Female Reproductive Organs	8	7	108 (54 - 216)
Cervix	---	---	108 (27 - 434)
Thyroid and Other Endocrine Glands	---	---	120 (50 - 287)
Thyroid	---	---	98 (37 - 260)
Lymphoid, Haematopoietic + Related Tissue	---	---	42 (10 - 168)
Hodgkin	---	---	374 (94 - 1496)
Non-Hodgkin Lymphoma	0		

***** Statistically significantly increased SIR results are in **red**.

Table 126: Cancer SIRs* for female coal mine workers by time between first and last assessment

Cancer Categories	*<5 years N= 20,339; PY= 137,319*			*≥ 5 years N=3,751; PY= 25,774*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	367	354	104 (94 - 115)	60	79	74 (59 - 98)
Digestive Organs	45	41	110 (82 - 147)	---	---	54 (22 - 129)
Colorectal	32	29	112 (79 - 158)	---	---	46 (15 - 144)
Colon	17	17	98 (61 - 157)	---	---	26 (4 - 182)
Rectum	14	10	144 (85 - 244)	---	---	90 (23 - 360)
Respiratory and Intrathoracic	19	16	116 (74 - 182)	---	---	79 (25 - 244)
Lung	18	15	118 (75 - 188)	---	---	85 (27 - 262)
Melanoma	**67**	**46**	**145 (114 - 184)**	9	10	89 (47 - 172)
Breast	124	126	99 (83 - 117)	25	29	87 (58 - 128)
Female Reproductive Organs	31	39	79 (55 - 112)	---	---	34 (11 - 107)
Cervix	10	13	78 (42 - 146)	---	---	37 (5 - 262)
Thyroid and Other Endocrine	26	25	103 (70 - 151)	---	---	75 (28 - 200)
Thyroid	24	25	97 (65 - 145)	---	---	77 (29 - 204)
Lymphoid, Haematopoietic + Related Tissue	27	25	107 (73 - 155)	---	---	56 (18 - 172)
Hodgkin	8	4	197 (98 - 394)	0		
Non-Hodgkin Lymphoma	12	11	114 (65 - 200)	---	---	43 (6 - 302)

***** Statistically significantly increased SIR results are in **red**; reduced SIR results are in blue.

Table 127: Cancer SIRs* for female coal mine workers by time since first assessment

Cancer Categories	*< 5 years N= 20,339; PY= 83,513*			*≥ 5 years N=14,330; PY= 79,580*		
	O	E	SIR (95% CI)	O	E	SIR (95% CI)
All Malignancies	**211**	**182**	**116 (101 - 132)**	216	251	86 (75 - 98)
Digestive Organs	26	20	128 (87 - 188)	24	30	80 (54 - 119)
Colorectal	20	14	139 (90 - 215)	15	21	72 (44 - 120)
Colon	10	9	114 (61 - 212)	8	13	64 (32 - 128)
Rectum	9	5	185 (96 – 355)	7	7	99 (47 – 208)
Respiratory and Intrathoracic	9	8	118 (61 - 227)	13	13	104 (60 - 178)
Lung	8	7	114 (57 - 228)	13	12	111 (64 - 191)
Melanoma	**39**	**25**	**156 (114 - 213)**	37	31	118 (86 - 163)
Breast	65	64	101 (79 - 129)	84	90	93 (75 - 115)
Female Reproductive Organs	22	20	108 (71 - 164)	12	28	43 (25 - 76)
Cervix	8	7	113 (57 - 227)	---	---	36 (12 - 111)
Thyroid and Other Endocrine	19	14	138 (88 - 216)	11	17	66 (36 - 118)
Thyroid	17	13	126 (78 - 203)	11	16	67 (37 - 121)
Lymphoid, Haematopoietic + Related Tissue	17	14	126 (78 - 202)	13	17	75 (44 - 130)
Hodgkin	**7**	**3**	**270 (129 - 566)**	---	---	46 (7 - 329)
Non-Hodgkin Lymphoma	7	5	130 (62 - 272)	6	7	80 (36 - 178)

***** Statistically significantly increased SIR results are in **red**; reduced SIR results are in blue.

Table 128: Cancer SIRs* for female coal mine workers by Age Group

Cancer Categories	≤65 years *N= 20,331; PY= 161,970*			>65 years *N= 346; PY= 1,123*		
	O	E	SMR (95% CI)	O	E	SMR (95% CI)
All Malignancies	419	418	100 (91 – 110)	8	16	52 (26 – 103)
Digestive Organs	50	47	106 (80 - 139)	0		
Colorectal	35	33	105 (76 - 147)	0		
Colon	18	20	90 (57 - 143)	0		
Rectum	16	11	140 (86 - 229)	0		
Respiratory and Intrathoracic Organs	22	18	120 (79 - 182)	0		
Lung	21	17	123 (80 - 189)	0		
Melanoma	**74**	**55**	**134 (107 - 169)**	---	---	151 (38 - 606)
Breast	145	150	96 (82 - 113)	---	---	92 (35 - 245)
Female Reproductive Organs	34	47	73 (52 - 102)	0		
Cervix	11	15	72 (40 - 129)	0		
Thyroid and Other Endocrine Glands	30	30	99 (69 - 142)	0		
Thyroid	28	30	95 (65 - 137)	0		
Lymphoid, Haematopoietic + Related Tissue	29	29	99 (68 - 142)	---	---	76 (11 - 539)
Hodgkin	8	5	169 (85 - 339)	0		
Non-Hodgkin Lymphoma	13	12	106 (62 - 182)	0		

***** Statistically significantly increased SIR results are in **red**

Appendix 10 Cancers from Queensland Cancer Registry

The cases identified from the ACD and the QCR were compared for the overlapping years (1983-2016). The proportion of total cancers identified in the ACD but not the QCR was 10.7% for men and 10.8% for women, although the proportion differed somewhat for different types of cancer (Figure 38) from between 22% for mesothelioma to 6% for melanoma.

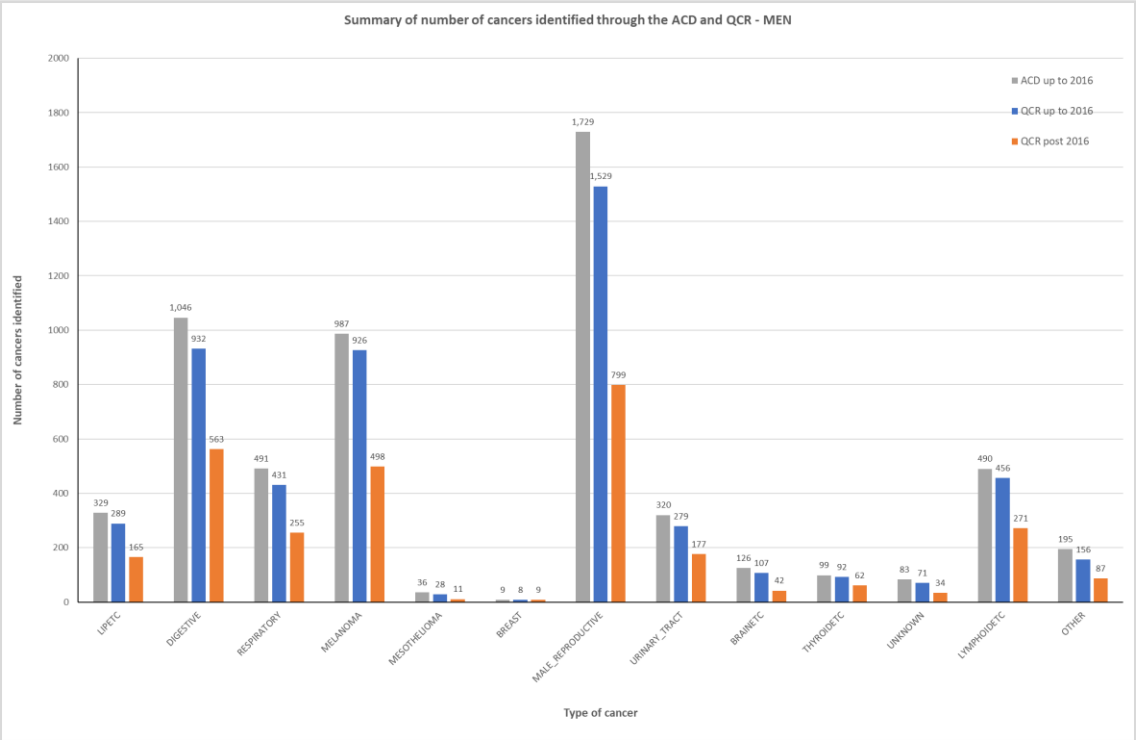

Figure 38: Number of cancers identified through ACD and QCR

The discrepancy in number of cases between the QCR and ACD was most likely because they were living in a different State or Territory at the time of their cancer diagnosis, so that their cancer would be reported to a different cancer registry. As we did not know who these people were, and state of residence data was not available for cohort members, person-years could not be adjusted to account for this. Using the whole cohort's person-years as the denominator for estimating the expected number of cancer would underestimate the risks.

The observed number of cancers in Queensland post 2016 (O_{QCR}) was therefore adjusted. To estimate the correct adjustment factor ($O_{Adjusted}$), the proportion by which each of the specific cancers differed from the number identified in the ACD linkages (O_{ACD}) for the pre 2017 matches was used, see Table 129 for men and Table 130 for women.

Table 129: Number of cancers identified among men – from ACD and QCR

Cancer category	Numbers of cancers, source and dates					
	pre-2017		Difference between O_{ACD} & O_{QCR} pre 2017		post-2016	
	O_{ACD}	O_{QCR}	n	%	O_{QCR}	$O_{Adjusted}$
Lip, Oral Cavity and Pharynx	329	289	40	12.2	165	188
Digestive Organs	1046	932	114	10.9	563	632
Respiratory & Intrathoracic Organs	491	431	60	12.2	255	290
Melanoma	987	926	61	6.2	498	531
Mesothelioma	36	28	8	22.2	11	14
Male Reproductive Organs	1729	1,529	200	11.6	799	904
Urinary Tract	320	279	41	12.8	177	203
Brain and other CNS	126	107	19	15.1	42	49
Thyroid and other endocrine glands	99	92	7	7.1	62	67
Lymphoid, Haematopoietic + Related Tissue	490	456	34	6.9	271	291
Total	**5,940**	**5,304**	**636**	**10.7**	**2,973**	**3,329**

Table 130: Number of cancers identified among women – from ACD and QCR

Cancer category	Numbers of cancers, source and dates					
	pre-2017		Difference between O_{ACD} & O_{QCR} pre 2017		post-2016	
	O_{ACD}	O_{QCR}	n	%	O_{QCR}	$O_{Adjusted}$
Lip, Oral Cavity and Pharynx	8	7	1	12.5	---	---
Digestive Organs	51	51	0	0.0	26	26
Respiratory & Intrathoracic Organs	23	19	4	17.4	23	28
Melanoma	76	67	9	11.8	62	70
Breast	150	136	14	9.3	92	101
Female Reproductive Organs	34	27	7	20.6	30	38
Urinary Tract	9	9	0	0.0	8	8
Thyroid and other endocrine glands	30	27	3	10.0	29	32
Lymphoid, Haematopoietic + Related Tissue	31	26	5	16.1	28	33
Total	**427**	**381**	**46**	**10.8**	**324**	**363**

Appendix 11 Relative Mortality Tables

Table 131: Comparison of All-Cause RMR * for male coal mine workers, across Work Categories

Work Category	Not in Work Category		In Work Category		Mortality rate comparison between workers in Work Category vs all the other workers (reference)	
	N [PY]	Number dead (% of cohort)	N [PY]	Number dead (% Category)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
ONLY Unexposed Office	150,291 [1,840,314.3]	4,334 (2.9)	12,596 [132,633.3]	295 (2.3)	0.97 (0.86 - 1.09)	0.76 (0.68 - 0.86)
ONLY Unexposed Non-Office	158,393 [1,931,914.9]	4,507 (2.8)	4,494 [41,032.7]	122 (2.7)	**1.31 (1.09 - 1.56)**	1.15 (0.95 - 1.38)
ONLY Occasionally exposed	152,173 [1,861,373.6]	4,485 (2.9)	10,714 [111,574.0]	144 (1.3)	0.56 (0.47 - 0.66)	0.80 (0.68 - 0.95)
EVER Maintenance - all	101,578 [1,213,998.0]	3,238 (3.2)	61,309 [758,949.6]	1,391 (2.3)	0.69 (0.65 - 0.73)	0.91 (0.86 - 0.97)
EVER Production - all	107,635 [1,219,054.0]	2,650 (2.5)	55,252 [753,893.6]	1,979 (3.6)	**1.17 (1.10 - 1.24)**	1.04 (0.97 - 1.10)
EVER Exploration Driller	157,917 [1,9182,57.4]	4,549 (2.9)	4,970 [54,690.3]	80 (1.6)	0.64 (0.52 - 0.80)	0.98 (0.78 - 1.22)
EVER Construction - all	153,853 [1,872,181.4]	4,375 (2.8)	9,034 [100,766.2]	254 (2.8)	1.12 (0.99 - 1.27)	1.10 (0.96 - 1.25)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
****** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 132: Comparison of All-Cause RMRs* across Work Categories among male coal mine workers with first examination date before 2010

Work Category	Not in Work Category		In Work Category		Mortality rate comparison between workers in Work Category vs all the other workers (reference)	
	N [PY]	Number dead (%)	N [PY]	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
ONLY Unexposed Office	80,529 [1,334,818]	3,569 (4.4)	5,004 [76,937]	216 (4.3)	1.08 (0.94 - 1.24)	0.78 (0.68 - 0.90)
ONLY Unexposed Non-Office	84,309 [1,393,702]	3,702 (4.4)	1,224 [18,053]	83 (6.8)	**1.76 (1.42 - 2.18)**	**1.29 (1.02 - 1.62)**
ONLY Occasionally exposed	81,323 [1,347,644]	3,687 (4.5)	4,210 [64,111]	98 (2.3)	0.59 (0.48 - 0.72)	0.79 (0.65 - 0.98)
EVER Maintenance - all	51,514 [846,568]	2,632 (5.1)	34,019 [565,187]	1153 (3.4)	0.66 (0.62 - 0.71)	0.90 (0.84 - 0.97)
EVER Production - all	51,290 [811,973]	2,050 (4.0)	34,243 [599,782]	1735 (5.1)	**1.11 (1.04 - 1.18)**	1.03 (0.96 - 1.10)
EVER Exploration Driller	83,297 [1,379,455]	3,727 (4.5)	2,236 [32,300]	58 (2.6)	0.70 (0.54 - 0.91)	1.04 (0.80 - 1.36)
EVER Construction - all	81,472 [1,349,595]	3,599 (4.4)	4,061 [62,160]	186 (4.6)	**1.17 (1.01 - 1.36)**	1.10 (0.95 - 1.27)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
****** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 133: RMRs* between male coal mine workers who ONLY worked in Unexposed Office Job vs all other coal mine workers

Cause of Death	All other coal mine workers N= 150,291	ONLY worked in unexposed office job N= 12,596	Mortality rate comparison between workers in Work Category vs all the other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	1636 (1.1)	140 (1.1)	**1.22 (1.03 - 1.45)**	0.84 (0.70 - 1.01)
Lung	377 (0.3)	30 (0.2)	1.13 (0.78 - 1.64)	0.85 (0.59 - 1.23)
Mesothelioma, pleural	28 (0.02)	---	2.03 (0.71 - 5.80)	1.16 (0.40 - 3.40)
Melanoma	76 (0.1)	10 (0.1)	1.87 (0.97 - 3.62)	1.44 (0.73 - 2.82)
Prostate	104 (0.1)	8 (0.1)	1.10 (0.53 - 2.25)	0.66 (0.32 - 1.36)
All Metabolic	104 (0.1)	10 (0.1)	1.37 (0.72 - 2.62)	0.97 (0.50 - 1.88)
All Mental and Behavioural	31 (0.02)	---	0.46 (0.06 - 3.37)	0.26 (0.04 - 1.80)
All Nervous System	77 (0.1)	6 (0.05)	1.11 (0.48 - 2.55)	0.74 (0.32 - 1.69)
All Circulatory	824 (0.5)	53 (0.4)	0.92 (0.69 - 1.21)	0.65 (0.49 - 0.87)
All Respiratory	180 (0.1)	18 (0.1)	1.42 (0.88 - 2.31)	1.01 (0.62 - 1.64)
COPD	116 (0.1)	6 (0.05)	0.74 (0.32 - 1.67)	0.50 (0.22 - 1.13)
All Digestive	113 (0.1)	10 (0.1)	1.26 (0.66 - 2.41)	1.05 (0.54 - 2.03)
All Injury and Trauma	1218 (0.8)	44 (0.3)	0.51 (0.38 - 0.69)	0.56 (0.42 - 0.76)
Accidents	612 (0.4)	17 (0.1)	0.40 (0.24 - 0.64)	0.43 (0.26 - 0.69)
Suicide	565 (0.4)	25 (0.2)	0.63 (0.42 - 0.94)	0.68 (0.46 - 1.03)
All Other Causes	175 (0.1)	13 (0.1)	1.06 (0.60 - 1.86)	0.80 (0.46 - 1.41)

* Adjusted for era of first examination, age, smoking status, age & era interaction and age & smoking status interaction
** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 134: RMRs* between male coal mine workers ONLY worked in Unexposed Non-Office Job vs all other coal mine workers

Cause of Death	All other coal mine workers N= 158,393	ONLY worked in Unexposed Non-Office job N= 4,494	Mortality rate comparison between workers in Work Category vs all the other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	1731 (1.1)	45 (1.0)	1.25 (0.93 - 1.68)	1.07 (0.79 - 1.47)
Lung	402 (0.3)	---	0.60 (0.25 - 1.45)	0.52 (0.21 - 1.25)
Mesothelioma, pleural	31 (0.02)	---	1.56 (0.21 - 11.40)	1.37 (0.19 - 1 .06)
Melanoma	83 (0.1)	---	1.74 (0.55 - 5.52)	1.83 (0.57 - 5.87)
Prostate	108 (0.1)	---	1.79 (0.66 - 4.84)	1.59 (0.60 - 4.19)
All Metabolic	111 (0.1)	---	1.30 (0.41 - 4.11)	1.14 (0.36 - 3.58)
All Nervous System	81 (0.1)	---	1.19 (0.29 - 4.85)	1.06 (0.26 - 4.36)
All Circulatory	845 (0.5)	32 (0.7)	**1.83 (1.28 - 2.60)**	**1.64 (1.15 - 2.35)**
All Respiratory	192 (0.1)	6 (0.1)	1.51 (0.67 - 3.40)	1.26 (0.57 - 2.81)
COPD	119 (0.1)	---	1.22 (0.39 - 3.82)	0.99 (0.32 - 2.99)
All Digestive	118 (0.1)	---	2.04 (0.84 - 5.00)	1.89 (0.76 - 4.68)
All Injury and Trauma	1240 (0.8)	22 (0.5)	0.86 (0.56 - 1.30)	0.74 (0.48 - 1.14)
Accidents	617 (0.4)	12 (0.3)	0.94 (0.53 - 1.66)	0.81 (0.45 - 1.47)
Suicide	580 (0.4)	10 (0.2)	0.83 (0.45 - 1.55)	0.73 (0.39 - 1.37)
All Other Causes	182 (0.1)	6 (0.1)	1.59 (0.71 - 3.58)	1.16 (0.48 - 2.79)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**

Table 135: RMRs* between male coal mine workers who were ONLY Occasionally Exposed vs all other coal mine workers

Cause of Death	All other coal mine workers N= 152,173	ONLY worked in Occasionally exposed job N= 10,714	Mortality rate comparison between workers in Work Category vs all other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	1714 (1.1)	62 (0.6)	0.63 (0.49 - 0.81)	0.98 (0.75 - 1.27)
Lung	393 (0.3)	14 (0.1)	0.62 (0.36 - 1.05)	1.20 (0.70 - 2.06)
Mesothelioma, pleural	29 (0.02)	---	1.80 (0.55 - 5.89)	1.76 (0.40 - 7.86)
Melanoma	83 (0.1)	---	0.63 (0.20 - 1.99)	0.88 (0.27 - 2.81)
Prostate	108 (0.1)	---	0.64 (0.24 - 1.74)	1.03 (0.38 - 2.80)
All Metabolic	113 (0.1)	---	0.15 (0.02 - 1.10)	0.23 (0.03 - 1.68)
All Nervous System	79 (0.1)	---	0.88 (0.32 - 2.40)	1.27 (0.45 - 3.55)
All Circulatory	852 (0.6)	25 (0.2)	0.51 (0.34 - 0.76)	0.82 (0.55 - 1.22)
All Respiratory	196 (0.1)	---	0.18 (0.04 - 0.71)	0.33 (0.08 - 1.35)
COPD	121 (0.1)	---	0.14 (0.02 - 1.03)	0.28 (0.04 - 1.99)
All Digestive	120 (0.1)	---	0.43 (0.14 - 1.36)	0.73 (0.23 - 2.32)
All Injury and Trauma	1221 (0.8)	41 (0.4)	0.58 (0.43 - 0.80)	0.64 (0.46 - 0.87)
Accidents	613 (0.4)	16 (0.1)	0.45 (0.28 - 0.74)	0.49 (0.29 - 0.80)
Suicide	566 (0.4)	24 (0.2)	0.74 (0.49 - 1.11)	0.81 (0.54 - 1.23)
All Other Causes	183 (0.1)	---	0.47 (0.20 - 1.16)	0.76 (0.31 - 1.87)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly; reduced RMR results are in blue.

Table 136: RMRs* for male workers who EVER worked in a Maintenance job vs all other coal mine workers

Cause of Death	ALL MALE WORKERS				ONLY WORKERS WITH FIRST EXAMINATION DATE <2010			
	NEVER Maintenance worker N= 101,578	EVER Maintenance worker N= 61,309	Comparison between workers in maintenance vs all the other workers (reference)		NEVER Maintenance workers N= 51,514	EVER Maintenance worker N= 34,019	Comparison between workers in maintenance vs all other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	1,262 (1.2)	514 (0.8)	0.65 (0.59 - 0.72)	0.97 (0.88 -1.08)	1,069 (2.1)	451 (1.3)	0.64 (0.57 - 0.71)	0.97 (0.87 - 1.08)
Lung	301 (0.3)	106 (0.2)	0.57 (0.45 - 0.71)	0.87 (0.69 - 1.09)	261 (0.5)	98 (0.3)	0.57 (0.45 - 0.72)	0.89 (0.70 - 1.13)
Mesothelioma pleural	17 (0.02)	15 (0.02)	1.42 (0.71 - 2.84)	**2.35 (1.11 - 4.96)**	14 (0.03)	14 (0.04)	1.51 (0.72 - 3.17)	**2.59 (1.16 - 5.78)**
Melanoma	58 (0.1)	28 (0.05)	0.78 (0.49 - 1.22)	1.00 (0.64 - 1.59)	51 (0.1)	21 (0.1)	0.62 (0.37 - 1.04)	0.82 (0.49 - 1.37)
Prostate	80 (0.1)	32 (0.1)	0.64 (0.43 - 0.97)	1.08 (0.71 - 1.64)	72 (0.1)	30 (0.1)	0.63 (0.41 - 0.96)	1.09 (0.71 - 1.68)
All Metabolic	86 (0.1)	28 (0.05)	0.52 (0.34 - 0.80)	0.75 (0.49 - 1.16)	74 (0.1)	25 (0.1)	0.51 (0.32 - 0.80)	0.76 (0.48 - 1.20)
All Nervous System	61 (0.1)	22 (0.04)	0.58 (0.36 - 0.94)	0.84 (0.52 - 1.37)	53 (0.1)	20 (0.1)	0.57 (0.34 - 0.95)	0.81 (0.49 - 1.36)
All Circulatory	650 (0.6)	227 (0.4)	0.56 (0.48 - 0.65)	0.80 (0.68 - 0.93)	532 (1.0)	199 (0.6)	0.57 (0.48 - 0.67)	0.83 (0.70 - 0.98)
All Respiratory	132 (0.1)	66 (0.1)	0.80 (0.60 - 1.08)	1.33 (0.99 - 1.79)	126 (0.2)	59 (0.2)	0.71 (0.52 - 0.96)	1.21 (0.89 - 1.66)
COPD	80 (0.1)	42 (0.1)	0.84 (0.58 - 1.22)	1.45 (0.99 - 2.12)	77 (0.1)	42 (0.1)	0.82 (0.57 - 1.20)	1.46 (0.99 - 2.13)
All Digestive	84 (0.1)	39 (0.1)	0.75 (0.51 - 1.09)	1.00 (0.68 - 1.48)	70 (0.1)	36 (0.1)	0.78 (0.52 - 1.16)	1.08 (0.71 - 1.63)
All Injury & Trauma	828 (0.8)	434 (0.7)	0.84 (0.75 - 0.95)	0.85 (0.76 - 0.96)	597 (1.2)	309 (0.9)	0.78 (0.68 - 0.90)	0.79 (0.68 - 0.90)
Accidents	422 (0.4)	207 (0.3)	0.79 (0.67 - 0.93)	0.80 (0.67 - 0.94)	321 (0.6)	161 (0.5)	0.76 (0.63 - 0.92)	0.76 (0.63 - 0.92)
Suicide	379 (0.4)	211 (0.3)	0.89 (0.76 - 1.06)	0.91 (0.77 - 1.08)	259 (0.5)	137 (0.4)	0.80 (0.65 - 0.98)	0.81 (0.66 - 1.00)
All Other Causes	128 (0.1)	60 (0.1)	0.75 (0.55 - 1.02)	1.08 (0.79 - 1.48)	75 (0.1)	36 (0.1)	0.73 (0.49 - 1.08)	1.03 (0.68 - 1.55)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 137: RMRs* between male workers who EVER worked in a Production job vs all other coal mine workers

Cause of Death	ALL MALE WORKERS				ONLY WORKERS WITH FIRST EXAMINATION DATE <2010			
	NEVER Production worker N= 101,578	EVER Production worker N= 61,309	Comparison between workers in production vs all the other workers (reference)		NEVER Production worker N= 51,290	EVER Production worker N= 34,243	Comparison between workers in production vs all other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	1,005 (0.9)	771 (1.4)	**1.20 (1.09 - 1.32)**	1.01 (0.91 - 1.11)	812 (1.6)	708 (2.1)	**1.14 (1.03 - 1.26)**	1.02 (0.92 - 1.14)
Lung	213 (0.2)	194 (0.4)	**1.43 (1.17 - 1.73)**	1.14 (0.93 - 1.40)	173 (0.3)	186 (0.5)	**1.41 (1.15 - 1.73)**	1.21 (0.97 - 1.50)
Mesothelioma pleural	27 (0.03)	---	0.29 (0.11 - 0.75)	0.29 (0.11 - 0.80)	23 (0.04)	5 (0.01)	0.28 (0.11 - 0.75)	0.32 (0.11 - 0.89)
Melanoma	45 (0.04)	41 (0.1)	1.43 (0.93 - 2.18)	1.20 (0.77 - 1.87)	34 (0.1)	38 (0.1)	1.46 (0.92 - 2.33)	1.28 (0.78 - 2.10)
Prostate	60 (0.1)	52 (0.1)	1.36 (0.94 - 1.97)	1.10 (0.75 - 1.61)	53 (0.1)	49 (0.1)	1.21 (0.82 - 1.79)	1.08 (0.73 - 1.60)
All Metabolic	68 (0.1)	46 (0.1)	1.06 (0.73 - 1.54)	0.93 (0.63 - 1.36)	54 (0.1)	45 (0.1)	1.09 (0.74 - 1.62)	1.05 (0.69 - 1.58)
All Nervous System	49 (0.05)	34 (0.1)	1.09 (0.70 - 1.68)	0.98 (0.62 - 1.57)	40 (0.1)	33 (0.1)	1.08 (0.68 - 1.71)	1.04 (0.63 - 1.70)
All Circulatory	466 (0.4)	411 (0.7)	**1.38 (1.21 - 1.58)**	**1.22 (1.06 - 1.40)**	368 (0.7)	363 (1.1)	**1.29 (1.12 - 1.49)**	**1.20 (1.04 - 1.40)**
All Respiratory	112 (0.1)	86 (0.2)	1.20 (0.91 - 1.59)	0.93 (0.69 - 1.24)	101 (0.2)	84 (0.2)	1.09 (0.82 - 1.45)	0.94 (0.70 - 1.27)
COPD	68 (0.1)	54 (0.1)	1.24 (0.87 - 1.78)	0.94 (0.64 - 1.37)	66 (0.1)	53 (0.2)	1.05 (0.73 - 1.51)	0.91 (0.62 - 1.33)
All Digestive	77 (0.1)	46 (0.1)	0.93 (0.65 - 1.35)	0.75 (0.52 - 1.08)	66 (0.1)	40 (0.1)	0.79 (0.54 - 1.18)	0.68 (0.46 - 1.00)
All Injury & Trauma	753 (0.7)	509 (0.9)	1.06 (0.95 - 1.18)	**1.12 (1.00 - 1.26)**	511 (1.0)	395 (1.2)	1.01 (0.89 - 1.15)	1.09 (0.95 - 1.24)
Accidents	362 (0.3)	267 (0.5)	1.15 (0.99 - 1.35)	**1.21 (1.03 - 1.43)**	263 (0.5)	219 (0.6)	1.09 (0.91 - 1.31)	1.16 (0.96 - 1.40)
Suicide	362 (0.3)	228 (0.4)	0.99 (0.84 - 1.16)	1.05 (0.89 - 1.25)	229 (0.4)	167 (0.5)	0.96 (0.78 - 1.17)	1.04 (0.85 - 1.27)
All Other Causes	114 (0.1)	74 (0.1)	1.02 (0.76 - 1.36)	0.85 (0.63 - 1.14)	66 (0.1)	45 (0.1)	0.89 (0.61 - 1.30)	0.80 (0.55 - 1.17)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue

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Table 138: RMRs*between male coal mine workers who EVER in a Construction job vs all other coal mine workers

Cause of Death	NEVER worked in Construction job N=153,853	EVER worked in Construction job N=9,034	Mortality rate comparison between workers in Work Category vs all other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	1,689 (1.1)	87 (1.0)	0.99 (0.80 - 1.23)	1.05 (0.84 - 1.31)
Lung	377 (0.2)	30 (0.3)	**1.53 (1.06 - 2.22)**	**1.60 (1.09 - 2.34)**
Mesothelioma, pleural	29 (0.02)	---	1.99 (0.61 - 6.54)	2.00 (0.61 - 6.59)
Melanoma	84 (0.1)	---	0.46 (0.11 - 1.86)	0.51 (0.13 - 2.08)
Prostate	107 (0.1)	---	0.90 (0.37 - 2.20)	1.11 (0.45 - 2.75)
All Metabolic	107 (0.1)	7 (0.1)	1.26 (0.59 - 2.70)	1.28 (0.59 - 2.74)
All Nervous System	78 (0.1)	---	1.23 (0.50 - 3.05)	1.06 (0.39 - 2.93)
All Circulatory	835 (0.5)	42 (0.5)	0.97 (0.71 - 1.32)	0.96 (0.70 - 1.31)
All Respiratory	188 (0.1)	10 (0.1)	1.02 (0.54 - 1.93)	1.15 (0.61 - 2.17)
COPD	114 (0.1)	8 (0.1)	1.35 (0.66 - 2.77)	1.51 (0.73 - 3.11)
All Digestive	109 (0.1)	14 (0.2)	**2.47 (1.42 - 4.31)**	**2.66 (1.50 - 4.73)**
All Injury and Trauma	1,185 (0.8)	77 (0.9)	1.25 (0.99 - 1.57)	1.07 (0.85 - 1.35)
Accidents	592 (0.4)	37 (0.4)	1.20 (0.86 - 1.68)	1.05 (0.75 - 1.48)
Suicide	553 (0.4)	37 (0.4)	1.29 (0.92 - 1.80)	1.08 (0.77 - 1.51)
All Other Causes	177 (0.1)	11 (0.1)	1.20 (0.65 - 2.20)	1.29 (0.71 - 2.39)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**;

Table 139: RMRs* for male coal mine workers in Maintenance Work Category Job Groups

Job Group	Never in Job Group		Ever in Job Group		Mortality rate comparison between workers in Job Group vs all other workers in the Work Category (reference)	
	N [PY]	Number dead (%)	N [PY]	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted RMR (95% CI)
Maintenance – General (Nec)	42,059 [507,875]	921 (2.2)	19,250 [251,075]	470 (2.4)	1.02 (0.92 - 1.14)	0.99 (0.88 - 1.11)
Abrasive, Blast, Sand, Paint	60,548 [749,533]	1,370 (2.3)	761 [9,417]	21 (2.8)	1.26 (0.82 - 1.93)	1.11 (0.73 - 1.71)
Shutdown Maintenance	55,134 [685,106]	1,184 (2.1)	6,175 [73,844]	207 (3.4)	**1.66 (1.43 - 1.92)**	**1.19 (1.02 - 1.38)**
Boilermaker	53,050 [653,402]	1,188 (2.2)	8,259 [105,548]	203 (2.5)	1.05 (0.90 - 1.21)	0.96 (0.83 - 1.12)
Fitter (nec)	48,613 [583,007]	1,111 (2.3)	12,696 [175,943]	280 (2.2)	0.82 (0.72 - 0.93)	0.88 (0.77 - 1.00)
Diesel fitter	51,224 [631,269]	1,275 (2.5)	10,085 [127,681]	116 (1.2)	0.45 (0.37 - 0.55)	0.81 (0.67 - 0.98)
Tyre fitter	60,633 [750,814]	1,369 (2.3)	676 [81,36]	22 (3.3)	1.45 (0.96 - 2.19)	1.45 (0.93 - 2.27)
Electrician	50,162 [619,082]	1,200 (2.4)	11,147 [139,868]	191 (1.7)	0.70 (0.60 - 0.82)	0.81 (0.69 - 0.94)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 140: RMRs* for male coal mine workers in Maintenance Work Category Job Groups, only for workers with first examination date before 2010

Job Group	Not in Job Group		In Job Group		Mortality rate comparison between workers in Job Group vs all other workers in the Work Category (reference)	
	N [PY]	Number dead (%)	N [PY]	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted RMR (95% CI)
Maintenance – General (Nec)	22,484 [368,906]	743 (3.3)	11,535 [196,281]	410 (3.6)	1.03 (0.91 - 1.16)	1.03 (0.91 - 1.16)
Abrasive, Blast, Sand, Paint	33,561 [557,991]	1134 (3.4)	458 [7,196]	19 (4.1)	1.36 (0.87 - 2.13)	1.22 (0.78 - 1.92)
Shutdown Maintenance	30,804 [513,104]	982 (3.2)	3,215 [52,083]	171 (5.3)	**1.76 (1.50 - 2.07)**	**1.21 (1.03 - 1.43)**
Boilermaker	29,081 [483,279]	980 (3.4)	4,938 [81,908]	173 (3.5)	1.03 (0.88 - 1.21)	0.94 (0.80 - 1.11)
Fitter (nec)	25,738 [422,919]	912 (3.5)	8,281 [142,268]	241 (2.9)	0.77 (0.67 - 0.89)	0.87 (0.75 – 1.00)
Diesel fitter	28,189 [467,375]	1064 (3.8)	5,830 [97,812]	89 (1.5)	0.40 (0.33 - 0.50)	0.77 (0.62 - 0.96)
Tyre fitter	33,678 [559,252]	1134 (3.4)	341 [5,934]	19 (5.6)	1.53 (0.98 - 2.39)	1.50 (0.92 - 2.44)
Electrician	27,973 [463,148]	1009 (3.6)	6,046 [102,039]	144 (2.4)	0.64 (0.54 - 0.76)	0.74 (0.62 - 0.88)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 141: RMRs* for male coal mine workers who EVER worked in a Shutdown Maintenance job vs all other maintenance workers

Cause of Death	All other maintenance workers N= 55,134	EVER worked in Shutdown Maintenance job N=6,175	Mortality rate comparison between workers in Job Group vs all other Maintenance workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	433 (0.8)	81 (1.3)	**1.78 (1.40 - 2.25)**	1.23 (0.96 - 1.57)
Lung	85 (0.2)	21 (0.3)	**2.34 (1.46 - 3.78)**	1.52 (0.92 - 2.51)
Mesothelioma, pleural	13 (0.02)	---	1.46 (0.33 - 6.47)	0.53 (0.07 - 3.94)
Melanoma	24 (0.04)	---	1.58 (0.55 - 4.56)	1.29 (0.43 - 3.85)
Prostate	26 (0.05)	6 (0.1)	2.19 (0.90 - 5.32)	1.71 (0.69 - 4.24)
All Metabolic	20 (0.04)	8 (0.1)	**3.80 (1.67 - 8.62)**	**2.84 (1.21 - 6.67)**
All Nervous System	19 (0.03)	3 (0.05)	1.50 (0.44 - 5.06)	1.11 (0.33 - 3.76)
All Circulatory	196 (0.4)	31 (0.5)	**1.50 (1.03 - 2.19)**	1.00 (0.68 - 1.47)
All Respiratory	57 (0.1)	9 (0.1)	1.50 (0.74 - 3.02)	1.01 (0.50 - 2.01)
COPD	34 (0.1)	8 (0.1)	**2.23 (1.03 - 4.82)**	1.44 (0.67 - 3.07)
All Digestive	32 (0.1)	7 (0.1)	2.08 (0.92 - 4.70)	1.32 (0.57 -3.07)
All Injury and Trauma	373 (0.7)	61 (1.0)	**1.55 (1.18 - 2.03)**	**1.35 (1.03 - 1.78)**
Accidents	179 (0.3)	28 (0.5)	**1.48 (1.00 - 2.21)**	1.35 (0.90 - 2.02)
Suicide	181 (0.3)	30 (0.5)	**1.57 (1.07 - 2.31)**	1.32 (0.89 - 1.95)
All Other Causes	53 (0.1)	7 (0.1)	1.25 (0.57 - 2.76)	0.92 (0.41 - 2.03)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

****** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 142: RMRs* for male coal mine workers who EVER worked as Diesel Fitter vs all other maintenance workers

Cause of Death	All other coal mine workers N= 51,224	EVER worked as Diesel Fitter N= 10,085	Mortality rate comparison between workers in Job Group vs all other Maintenance workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	482 (0.9)	32 (0.3)	0.33 (0.23 - 0.47)	0.78 (0.54 - 1.12)
Lung	98 (0.2)	8 (0.1)	0.41 (0.20 - 0.84)	1.18 (0.57 - 2.47)
Mesothelioma, pleural	13 (0.03)	---	0.77 (0.17 - 3.39)	2.63 (0.55 - 12.60)
Melanoma	26 (0.1)	---	0.38 (0.09 - 1.61)	0.58 (0.13 - 2.51)
Prostate	31 (0.1)	---	0.16 (0.02 - 1.18)	0.43 (0.06 - 3.17)
All Metabolic	25 (0.05)	---	0.60 (0.18 - 1.98)	1.22 (0.36 - 4.10)
All Nervous System	20 (0.04)	---	0.50 (0.12 - 2.13)	0.97 (0.24 - 3.88)
All Circulatory	208 (0.4)	19 (0.2)	0.45 (0.28 - 0.73)	1.02 (0.63 - 1.65)
All Respiratory	59 (0.1)	7 (0.1)	0.59 (0.27 - 1.29)	1.79 (0.79 - 4.06)
COPD	39 (0.1)	---	0.38 (0.12 - 1.24)	1.50 (0.46 - 4.88)
All Digestive	36 (0.1)	---	0.41 (0.13 - 1.35)	0.96 (0.28 - 3.30)
All Injury and Trauma	387 (0.8)	47 (0.5)	0.60 (0.45 - 0.82)	0.65 (0.48 - 0.88)
Accidents	189 (0.4)	18 (0.2)	0.47 (0.29 - 0.77)	0.48 (0.29 - 0.77)
Suicide	182 (0.4)	29 (0.3)	0.79 (0.54 - 1.17)	0.91 (0.61 - 1.36)
All Other Causes	57 (0.1)	---	0.26 (0.08 - 0.84)	0.56 (0.18 - 1.80)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

****** Statistically significantly reduced RMR results are in blue.

Table 143: RMRs* for male coal mine workers in Production Work Category Job Groups

Job Group	Production but not in specific Job Group		In Job Group		Mortality rate comparison between workers in Job Group vs all other production workers (reference)	
	N [PY]	Number dead (%)	N [PY]	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted RMR (95% CI)
Blast crew	53,395 [729,568]	1,939 (3.6)	1,857 [24,326]	40 (2.2)	0.63 (0.46 - 0.86)	0.85 (0.63 - 1.15)
Driller (General)	51,425 [704,650]	1,851 (3.6)	3,827 [49,243]	128 (3.3)	1.02 (0.86 - 1.22)	1.17 (0.98 - 1.41)
CHPP operator	53,750 [727,429]	1,933 (3.6)	1,502 [26,464]	46 (3.1)	0.60 (0.45 - 0.80)	0.60 (0.45 - 0.81)
Laboratory	54,342 [741,803]	1,957 (3.6)	910 [12,091]	22 (2.4)	0.69 (0.45 - 1.04)	0.90 (0.61 - 1.34)
ERZ/Deputy	54,213 [732,534]	1,933 (3.6)	1,039 [21,359]	46 (4.4)	0.76 (0.57 - 1.02)	0.73 (0.54 - 0.98)
Open cut examiner (OC only)	54,715 [742,009]	1,954 (3.6)	537 [11,885]	25 (4.7)	0.68 (0.46 - 0.99)	0.56 (0.38 - 0.84)
Dragline (OC only)	54,208 [731,107]	1,902 (3.5)	1,044 [22,787]	77 (7.4)	1.12 (0.89 - 1.39)	0.95 (0.76 - 1.19)
Miner [all]	44,781 [578,265	1,611 (3.6)	10,471 [175,629]	368 (3.5)	0.74 (0.66 - 0.82)	0.85 (0.75 - 0.95)
Underground miner	47,556 [628,616]	1,750 (3.7)	7,696 [125,278]	229 (3.0)	0.67 (0.58 - 0.76)	0.92 (0.79 - 1.05)
Operator	12,853 [182,342]	507 (3.9)	42,399 [571,551]	1,472 (3.5)	0.93 (0.84 - 1.03)	0.94 (0.85 - 1.05)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 144: RMRs* for Job Groups in the Production Work Category, only for male coal mine workers with first examination date before 2010

Job Group	Production but not in specific Job Group		In Job Group		Mortality rate comparison between workers in Job Group vs all the other production workers (reference)	
	N [PY]	Number dead (%)	N [PY]	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted RMR (95% CI)
Blast crew	33,116 [580,865]	1697 (5.1)	1,127 [18,917]	38 (3.4)	0.70 (0.51 - 0.97)	0.93 (0.68 - 1.27)
Driller (General)	31,910 [562,465]	1627 (5.1)	2,333 [37,317]	108 (4.6)	1.04 (0.86 - 1.26)	1.19 (0.98 - 1.46)
CHPP operator	33,045 [575,401]	1689 (5.1)	1,198 [24,381]	46 (3.8)	0.59 (0.44 - 0.79)	0.62 (0.46 - 0.84)
Laboratory	33,672] [590,251]	1715 (5.1)	571 [9,531]	20 (3.5)	0.72 (0.46 - 1.11)	0.92 (0.60 - 1.39)
ERZ/Deputy	33,322 [579,339]	1689 (5.1)	921 [20,442]	46 (5.0)	0.73 (0.55 - 0.97)	0.75 (0.56 - 1.01)
Open cut examiner (OC only)	33,725 [588,053]	1710 (5.1)	518 [11,729]	25 (4.8)	0.63 (0.43 - 0.92)	0.57 (0.38 - 0.84)
Dragline (OC only)	33,226 [577,212]	1658 (5.0)	518 [22,570]	77 (7.6)	1.03 (0.83 - 1.29)	0.95 (0.76 - 1.19)
Miner [all]	26,178 [442,709]	1382 (5.3)	8,065 [157,073]	353 (4.4)	0.71 (0.63 - 0.80)	0.86 (0.76 - 0.97)
Underground miner	28,430 [489,711]	1,518 (5.3)	5,813 [110,070]	217 (3.7)	0.65 (0.57 - 0.75)	0.94 (0.81 - 1.08)
Operator	8,310 [148,882]	465 (5.6)	25,933 [450,900]	1270 (4.9)	0.90 (0.81 - 1.00)	0.93 (0.83 - 1.03)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 145: RMRs* for male workers who EVER worked in a Driller (general) job vs all other production workers

Cause of Death	All other production workers N= 51,425	EVER worked as Driller (general) N= 3,827	Mortality rate comparison between workers in Job Group vs all the other Production workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	717 (1.4)	54 (1.4)	1.11 (0.85 - 1.47)	**1.45 (1.08 - 1.94)**
Lung	178 (0.3)	16 (0.4)	1.33 (0.80 - 2.22)	**1.74 (1.01 - 2.97)**
Mesothelioma, pleural	---	---	3.70 (0.41 - 33.09)	4.58 (0.39 - 53.93)
Melanoma	34 (0.1)	7 (0.2)	**3.05 (1.35 - 6.87)**	**3.79 (1.60 - 8.95)**
Prostate	50 (0.1)	---	0.59 (0.14 - 2.43)	0.93 (0.23 - 3.78)
All Metabolic	44 (0.1)	---	0.67 (0.16 - 2.77)	0.97 (0.24 - 3.95)
All Nervous System	32 (0.1)	---	0.92 (0.22 - 3.86)	1.26 (0.30 - 5.33)
All Circulatory	376 (0.7)	35 (0.9)	1.38 (0.98 - 1.95)	**1.67 (1.17 - 2.38)**
All Respiratory	84 (0.2)	---	0.35 (0.09 - 1.43)	0.55 (0.13 - 2.25)
COPD	53 (0.1)	---	0.28 (0.04 - 2.02)	0.44 (0.06 - 3.18)
All Digestive	46 (0.1)	0 (0)		
All Injury and Trauma	480 (0.9)	29 (0.8)	0.89 (0.61 - 1.30)	0.79 (0.54 - 1.15)
Accidents	253 (0.5)	14 (0.4)	0.82 (0.48 - 1.40)	0.74 (0.43 - 1.27)
Suicide	216 (0.4)	12 (0.3)	0.82 (0.46 - 1.47)	0.71 (0.40 - 1.28)
All Other Causes	70 (0.1)	---	0.85 (0.31 - 2.31)	1.22 (0.45 - 3.33)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**.

Table 146: RMRs* between male coal mine workers who EVER worked in Underground Miner job vs all other production workers

Cause of Death	All other production workers N= 51,613	EVER worked as Underground Miner N= 7,696	Mortality rate comparison between workers in Job Group vs all the other Production workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	689 (1.4)	82 (1.1)	0.61 (0.48 - 0.76)	0.91 (0.72 - 1.15)
Lung	178 (0.4)	16 (0.2)	0.46 (0.27 - 0.76)	0.71 (0.42 - 1.19)
Mesothelioma, pleural	---	0 (0)		
Melanoma	38 (0.1)	---	0.40 (0.12 - 1.30)	0.47 (0.14 - 1.56)
Prostate	46 (0.1)	6 (0.1)	0.66 (0.28 - 1.55)	1.01 (0.39 - 2.62)
All Metabolic	39 (0.1)	7 (0.1)	0.91 (0.41 - 2.04)	1.60 (0.70 - 3.63)
All Nervous System	30 (0.1)	---	0.68 (0.24 - 1.92)	1.18 (0.40 - 3.50)
All Circulatory	379 (0.8)	32 (0.4)	0.43 (0.30 - 0.62)	0.60 (0.41 - 0.88)
All Respiratory	79 (0.2)	7 (0.1)	0.45 (0.21 - 0.98)	0.77 (0.35 - 1.71)
COPD	50 (0.1)	---	0.41 (0.15 - 1.13)	0.72 (0.26 - 2.02)
All Digestive	40 (0.1)	6 (0.1)	0.76 (0.32 - 1.80)	1.10 (0.50 - 2.40)
All Injury and Trauma	426 (0.9)	83 (1.1)	0.99 (0.78 - 1.25)	1.08 (0.85 - 1.38)
Accidents	224 (0.5)	43 (0.6)	0.98 (0.70 - 1.35)	1.03 (0.74 - 1.43)
Suicide	190 (0.4)	38 (0.5)	1.02 (0.72 - 1.44)	1.17 (0.82 - 1.65)
All Other Causes	67 (0.1)	7 (0.1)	0.53 (0.24 - 1.16)	0.79 (0.38 - 1.65)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly reduced RMR results are in blue.

Table 147: RMRs* between male coal mine workers in the Unknown Work Category

Job Group	Not in Job Group		In Job Group		Mortality rate comparison between workers in Job Group vs all the other coal mine workers (reference)	
	N [PY]	Number dead (%)	N [PY]	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted RMR (95% CI)
Labourer (nec)	157,073 [1,903,506]	4,491 (2.9)	5,814 [69,441]	138 (2.4)	0.87 (0.74 - 1.04)	**1.24 (1.05 - 1.47)**
Cleaner (nec)	161,939 [1,962,836]	4,608 (2.8)	948 [10,112]	21 (2.2)	0.90 (0.59 - 1.37)	0.84 (0.54 - 1.29)
Supervisor (nec)	157,312 [1,887,107]	4,466 (2.8)	5,575 [85,840]	163 (2.9)	0.78 (0.67 - 0.91)	0.68 (0.58 - 0.80)
Truck driver (nec)	155,186 [1,876,745]	4,293 (2.8)	7,701 [96,203]	336 (4.4)	**1.53 (1.37 - 1.71)**	**1.12 (1.00 - 1.25)**

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 148: RMRs* for male coal mine workers who EVER worked in a Labourer (nec) job vs all other coal mine workers

Cause of Death	All other coal mine workers N= 157,073	EVER worked as Labourer (nec) N= 5,814	Mortality rate comparison between workers in Work Category vs all the other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	1,741 (1.1)	35 (0.6)	0.57 (0.41 - 0.80)	1.14 (0.81 - 1.59)
Lung	397 (0.3)	10 (0.2)	0.72 (0.38 - 1.34)	1.43 (0.75 - 2.71)
Mesothelioma, pleural	32 (0.02)	0 (0)		
Melanoma	85 (0.1)	---	0.33 (0.05 - 2.40)	0.53 (0.07 - 4.00)
Prostate	111 (0.1)	---	0.26 (0.04 - 1.84)	0.70 (0.10 - 5.07)
All Metabolic	111 (0.1)	---	0.77 (0.24 - 2.42)	1.28 (0.40 - 4.06)
All Nervous System	80 (0.1)	---	1.07 (0.34 - 3.38)	1.87 (0.58 - 6.05)
All Circulatory	849 (0.5)	28 (0.5)	0.94 (0.64 - 1.37)	**1.48 (1.01 - 2.17)**
All Respiratory	196 (0.1)	---	0.29 (0.07 - 1.17)	0.66 (0.16 - 2.66)
COPD	121 (0.1)	---	0.24 (0.03 - 1.68)	0.58 (0.08 - 4.21)
All Digestive	119 (0.1)	---	0.96 (0.35 - 2.59)	1.50 (0.56 - 4.06)
All Injury and Trauma	1,206 (0.8)	56 (1.0)	**1.32 (1.01 - 1.73)**	1.09 (0.83 - 1.42)
Accidents	599 (0.4)	30 (0.5)	1.43 (0.99 - 2.06)	1.24 (0.86 - 1.80)
Suicide	568 (0.4)	22 (0.4)	1.10 (0.72 - 1.69)	0.88 (0.57 - 1.35)
All Other Causes	181 (0.1)	7 (0.1)	1.10 (0.52 - 2.34)	1.93 (0.91 - 4.09)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**; reduced RMR results are in blue.

Table 149: RMRs* for male coal mine workers who EVER worked as a Truck Driver (nec) job vs all other coal mine workers

Cause of Death	All other coal mine workers N= 155,186	EVER worked as Truck Driver (nec) N= 7,701	Mortality rate comparison between Truck drivers vs all other coal mine workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	1643 (1.1)	133 (1.7)	**1.59 (1.33 - 1.89)**	1.07 (0.89 - 1.27)
Lung	397 (0.3)	10 (0.2)	**1.62 (1.12 - 2.33)**	1.00 (0.69 - 1.46)
Mesothelioma, pleural	31 (0.02)	---	0.63 (0.09 - 4.63)	0.38 (0.05 - 2.79)
Melanoma	86 (0.1)	0 (0)		
Prostate	103 (0.1)	9 (0.1)	1.71 (0.87 - 3.38)	1.15 (0.58 - 2.28)
All Metabolic	104 (0.1)	10 (0.1)	1.88 (0.98 - 3.60)	1.26 (0.66 - 2.40)
All Nervous System	77 (0.05)	6 (0.1)	1.53 (0.67 - 3.50)	1.08 (0.47 - 2.49)
All Circulatory	803 (0.5)	74 (1)	**1.81 (1.42 - 2.29)**	1.21 (0.95 - 1.54)
All Respiratory	179 (0.1)	19 (0.2)	**2.08 (1.30 - 3.34)**	1.37 (0.84 - 2.22)
COPD	110 (0.1)	12 (0.2)	**2.14 (1.18 - 3.88)**	1.40 (0.76 - 2.56)
All Digestive	117 (0.1)	6 (0.1)	1.00 (0.44 - 2.28)	0.73 (0.32 - 1.66)
All Injury and Trauma	1182 (0.8)	80 (1)	**1.33 (1.06 - 1.66)**	**1.29 (1.03 - 1.62)**
Accidents	583 (0.4)	46 (0.6)	**1.55 (1.14 - 2.09)**	**1.51 (1.12 - 2.05)**
Suicide	557 (0.4)	33 (0.4)	1.16 (0.82 - 1.65)	1.12 (0.79 - 1.60)
All Other Causes	180 (0.1)	8 (0.1)	0.87 (0.43 - 1.77)	0.60 (0.29 - 1.23)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RMR results are in **red**.

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Table 150: RMRs across site types (mutually exclusive) compared to Open cut, male coal mine workers

Cause of death	Site type						
	Only worked in open cut (excludes CHPP and Underground) (reference) N=58,799; PY=779,630	Ever worked in underground N=33,284; PY = 440,468			Ever worked in CHPP N= 2,929; PY = 47,217		
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted RMR (95% CI)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
ALL CAUSES OF DEATH	1,985 (3.4)	756 (2.3)	0.69 (0.64 - 0.75)	0.90 (0.83 - 0.98)	78 (2.7)	0.61 (0.49 - 0.77)	0.67 (0.54 - 0.85)
All Malignancies	838 (1.4)	278 (0.8)	0.60 (0.53 - 0.69)	0.87 (0.76 - 1.00)	29 (1.0)	0.54 (0.37 - 0.78)	0.59 (0.41 - 0.86)
Lung	220 (0.4)	60 (0.2)	0.50 (0.37 - 0.66)	0.76 (0.57 - 1.02)	6 (0.2)	0.43 (0.19 - 0.96)	0.49 (0.22 - 1.11)
Mesothelioma, pleural	14 (0.02)	6 (0.02)	0.78 (0.30 - 2.03)	1.13 (0.44 - 2.89)	0 (0)		
Melanoma	36 (0.1)	16 (0.05)	0.81 (0.45 - 1.46)	0.94 (0.52 - 1.68)	---	1.30 (0.40 - 4.22)	1.27 (0.39 - 4.13)
Prostate	52 (0.1)	19 (0.1)	0.66 (0.39 - 1.12)	1.04 (0.60 - 1.79)	---	0.90 (0.28 - 2.88)	0.93 (0.28 - 3.08)
All Metabolic	51 (0.1)	15 (0.05)	0.53 (0.30 - 0.95)	0.79 (0.44 - 1.42)	---	0.31 (0.04 - 2.21)	0.35 (0.05 - 2.55)
All Nervous System	34 (0.1)	18 (0.1)	0.96 (0.54 - 1.70)	1.34 (0.74 - 2.42)	0 (0)		
All Circulatory	392 (0.7)	128 (0.4)	0.59 (0.49 - 0.72)	0.81 (0.66 - 1.00)	19 (0.6)	0.76 (0.48 - 1.20)	0.83 (0.51 - 1.33)
All Respiratory	105 (0.2)	24 (0.1)	0.42 (0.27 - 0.65)	0.69 (0.44 - 1.09)	---	0.59 (0.22 - 1.61)	0.69 (0.26 - 1.87)
COPD	63 (0.1)	12 (0.04)	0.35 (0.19 - 0.64)	0.58 (0.31 - 1.09)	---	0.74 (0.23 - 2.36)	0.92 (0.29 - 2.91)
All Digestive	60 (0.1)	14 (0.04)	0.42 (0.24 - 0.76)	0.59 (0.33 - 1.04)	---	0.78 (0.25 - 2.49)	0.85 (0.27 - 2.67)
All Injury and Trauma	430 (0.7)	251 (0.8)	1.06 (0.91 - 1.24)	1.08 (0.92 - 1.26)	14 (0.5)	0.51 (0.30 - 0.87)	0.58 (0.34 - 0.99)
Accidents	208 (0.4)	132 (0.4)	1.15 (0.93 - 1.44)	1.16 (0.93 - 1.45)	7 (0.2)	0.53 (0.25 - 1.12)	0.57 (0.27 - 1.22)
Suicide	210 (0.4)	112 (0.3)	0.97 (0.77 - 1.22)	1.00 (0.79 - 1.25)	7 (0.2)	0.52 (0.25 - 1.11)	0.62 (0.29 - 1.31)
All Other Causes	48 (0.1)	21 (0.1)	0.80 (0.48 - 1.33)	1.11 (0.67 - 1.83)	---	1.63 (0.65 - 4.08)	1.72 (0.67 - 4.40)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

** Statistically significantly reduced RMR results are in blue.

Table 151: All-cause mortality RMRs between Work Categories and Job Groups among female coal mine workers

Work Category	Not in Work Category		In Work Category		Mortality rate comparison between workers in Work Category vs all other workers (reference)	
	N [PY]	Number dead (%)	N [PY]	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
ONLY Unexposed Office	16,594 [161,314]	152 (0.9)	7,538 [79,488]	50 (0.7)	0.67 (0.49 - 0.92)	0.81 (0.59 - 1.12)
ONLY Unexposed Non-Office	22,083 [222,355]	182 (0.8)	2,049 [18,448]	20 (1.0)	1.34 (0.84 - 2.12)	1.08 (0.67 - 1.73)
ONLY Occasionally exposed	22,258 [224,617]	193 (0.9)	1,874 [16,186]	9 (0.5)	0.65 (0.33 - 1.27)	1.06 (0.54 - 2.07)
EVER Maintenance - all	22,107 [222,893]	193 (0.9)	2,025 [17,909]	9 (0.4)	0.58 (0.30 - 1.13)	0.58 (0.30 - 1.13)
EVER Production - all	17,219 [174,755]	151 (0.9)	6,913 [66,048]	51 (0.7)	0.90 (0.65 - 1.23)	1.04 (0.75 - 1.43)
Operator **	1,066 [10,961]	6 (0.6)	5,847 [55,087]	45 (0.8)	1.50 (0.64 - 3.51)	1.54 (0.63 - 3.76)
Unknown						
EVER Cleaner (nec)	21,369 [210,769]	154 (0.7)	2,763 [30,034]	48 (1.7)	**2.21 (1.60 - 3.05)**	1.34 (0.97 - 1.87)

* Adjusted for era of first examination, age and smoking status.
** Compared with the rest of workers in the production Work Category.
**** Statistically significantly increased RMR results are in **red**.

Table 152: RMRs* for female coal mine workers who ONLY worked in unexposed Office (Administration) jobs

Cause of death	All other female coal mine workers N=16,594; PY=161,314	In Work Category N=7,538; PY = 79,488	Mortality rate comparison between workers in Work Category vs all other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	65 (0.4)	30 (0.4)	0.94 (0.61 - 1.45)	1.15 (0.74 - 1.79)
Lung	16 (0.1)	7 (0.1)	0.89 (0.37 - 2.17)	1.36 (0.49 - 3.72)
All Circulatory	19 (0.1)	9 (0.1)	0.97 (0.44 - 2.14)	1.21 (0.55 - 2.67)
All Injury and Trauma	41 (0.2)	---	0.10 (0.02 - 0.41)	0.12 (0.03 - 0.49)
Accident	20 (0.1)	---	0.10 (0.01 - 0.76)	0.12 (0.02 - 0.96)
Suicide	17 (0.1)	0 (0)		
All other causes of death	27 (0.2)	9 (0.1)	0.68 (0.32 - 1.45)	0.80 (0.38 - 1.68)

* Adjusted for era of first examination, age and smoking status.
** Statistically significantly reduced RMR results are in blue.

Table 153: RMRs* for among female coal mine workers who EVER worked in Production Work Category

Cause of death	All other female coal mine workers N= 17,219; PY = 174,755	In Work Category N= 6,913; PY = 66,048	Mortality rate comparison between workers in Work Category vs all women other workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	73 (0.4)	22 (0.3)	0.80 (0.50 - 1.29)	1.00 (0.62 - 1.61)
Lung	17 (0.1)	6 (0.1)	0.94 (0.37 - 2.38)	1.33 (0.52 - 3.35)
All Circulatory	21 (0.1)	7 (0.1)	0.89 (0.38 - 2.09)	1.07 (0.43 - 2.64)
All Injury and Trauma	27 (0.2)	16 (0.2)	1.58 (0.85 - 2.93)	1.51 (0.79 - 2.87)
Accident	15 (0.1)	6 (0.1)	1.06 (0.41 - 2.74)	1.06 (0.39 - 2.87)
Suicide	7 (0.04)	10 (0.1)	**3.80 (1.45 - 9.98)**	**3.48 (1.25 - 9.67)**
All other causes of death	30 (0.2)	6 (0.1)	0.53 (0.22 - 1.28)	0.66 (0.27 - 1.63)

* Adjusted for era of first examination, age and smoking status.
** Statistically significantly increased RMR results are in **red**.

Table 154: RMRs* for female coal mine workers who EVER worked in as a Cleaner (unknown Work Category)

Cause of death	All other female coal mine workers N= 21,369; PY = 210,769	Ever Cleaner N= 2,763; PY = 30,034	Mortality rate comparison between Cleaners and all other female coal mine workers (reference)	
	Number dead (%)	Number dead (%)	Unadjusted RMR (95% CI)	Adjusted* RMR (95% CI)
All Malignancies	74 (0.3)	21 (0.8)	**2.01 (1.24 - 3.26)**	1.14 (0.70 - 1.85)
Lung	17 (0.1)	6 (0.2)	2.50 (0.99 - 6.34)	1.14 (0.45 - 2.88)
All Circulatory	25 (0.1)	---	0.85 (0.26 - 2.81)	0.48 (0.15 - 1.57)
All Injury and Trauma	28 (0.1)	15 (0.5)	**3.80 (2.03 - 7.11)**	**2.89 (1.53 - 5.45)**
Accident	13 (0.1)	8 (0.3)	**4.36 (1.81 - 10.52)**	**3.13 (1.30 - 7.57)**
Suicide	13 (0.1)	---	2.18 (0.71 - 6.69)	1.80 (0.56 - 5.74)
All other causes of death	27 (0.1)	9 (0.3)	**2.36 (1.11 - 5.02)**	1.41 (0.65 - 3.08)

* Adjusted for era of first examination, age and smoking status.
** Statistically significantly increased RMR results are in **red**.

Appendix 12 Relative Cancer Incidence Tables

Table 155: Comparison of Relative Cancer Incidence rates* (RIRs) for all-malignancies across Work Categories among male workers

Work Category	Not in Work Category		In Work Category		Incidence rate comparison between workers in Work Category vs all the other workers (reference)	
	N [PY]	Number with at least one cancer (%)	N [PY]	Number with at least one cancer (%)	Unadjusted RIR (95% CI)	Adjusted* RIR (95% CI)
ONLY Unexposed Office	136,499 [1,266,466]	4,757 (3.5)	11,339 [84,512]	409 (3.6)	**1.29 (1.17 - 1.42)**	0.89 (0.80 - 0.99)
ONLY Unexposed Non-Office	144,005 [1,326,517]	5,060 (3.5)	3,833 [24,461]	106 (2.8)	1.14 (0.94 - 1.38)	1.03 (0.84 - 1.26)
ONLY Occasionally exposed	138,316 [1,279,721]	4,971 (3.6)	9,522 [71,257]	195 (2.0)	0.70 (0.61 - 0.81)	0.98 (0.85 - 1.14)
EVER Maintenance - all	92,333 [825,158]	3,613 (3.9)	55,505 [525,820]	1,553 (2.8)	0.67 (0.64 - 0.72)	0.92 (0.87 - 0.98)
EVER Production - all	96,920 [811,677]	2,839 (2.9)	50,918 [539,301]	2,327 (4.6)	**1.23 (1.17 - 1.30)**	**1.09 (1.03 - 1.15)**
EVER Exploration Driller	143,217 [1,315,155]	5,098 (3.6)	4,621 [35,823]	68 (1.5)	0.49 (0.39 - 0.62)	1.02 (0.80 - 1.30)
EVER Construction - all	139,403 [1,284,640]	4,949 (3.6)	8,435 [66,338]	217 (2.6)	0.85 (0.74 - 0.97)	0.93 (0.81 - 1.07)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 156: Cancer RIRs* for all-malignancies across Work Categories among male workers – only for workers with first examination date before 2010

Work Category	Not in Work Category		In Work Category		Incidence rate comparison between workers in Work Category vs all the other workers (reference)	
	N [PY]	Number with at least one cancer (%)	N [PY]	Number with at least one cancer (%)	Unadjusted RIR (95% CI)	Adjusted* RIR (95% CI)
ONLY Unexposed Office	80,495 [1,010,963]	4,153 (5.2)	5,004 [56,549]	303 (6.1)	**1.30 (1.16 - 1.46)**	0.87 (0.77 - 0.98)
ONLY Unexposed Non-Office	84,276 [1,054,291]	4,385 (5.2)	1,223 [13,221]	71 (5.8)	**1.29 (1.02 - 1.63)**	0.99 (0.78 - 1.27)
ONLY Occasionally exposed	81,289 [1,020,249]	4,308 (5.3)	4,210 [47,263]	148 (3.5)	0.74 (0.63 - 0.87)	1.00 (0.84 - 1.18)
EVER Maintenance - all	51,487 [638,352]	3,088 (6)	34,012 [429,160]	1,368 (4)	0.66 (0.62 - 0.70)	0.92 (0.86 - 0.98)
EVER Production - all	51,264 [607,105]	2,335 (4.6)	34,235 [460,407]	2,121 (6.2)	**1.20 (1.13 - 1.27)**	**1.09 (1.02 - 1.16)**
EVER Exploration Driller	83,263 [1,043,999]	4,402 (5.3)	2,236 [23,513]	54 (2.4)	0.54 (0.42 - 0.71)	1.09 (0.83 - 1.43)
EVER Construction - all	81,439 [1,021,428]	4,282 (5.3)	4,060 [46,084]	174 (4.3)	0.90 (0.77 - 1.05)	0.95 (0.82 - 1.11)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 157: Cancer RIRs* for male coal mine workers who ONLY worked in unexposed Office (Administration) jobs, compared with the rest of the male cohort

Cancer Categories	All other coal mine workers	ONLY worked unexposed office jobs	Comparison of cancer incidence between those who worked in unexposed office job vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and Pharynx	270 (0.2)	14 (0.1)	0.77 (0.45 - 1.32)	0.62 (0.36 - 1.07)
Lip	101 (0.1)	---	0.30 (0.07 - 1.20)	0.32 (0.08 - 1.32)
Pharynx	86 (0.1)	7 (0.1)	1.22 (0.56 - 2.63)	0.82 (0.38 - 1.77)
Digestive Organs	890 (0.7)	74 (0.7)	1.24 (0.98 - 1.57)	0.83 (0.65 - 1.06)
Oesophagus	63 (0.05)	---	0.95 (0.35 - 2.60)	0.69 (0.24 - 1.95)
Stomach	72 (0.1)	---	0.62 (0.20 - 1.97)	0.43 (0.13 - 1.42)
Colorectal	562 (0.4)	48 (0.4)	1.28 (0.95 - 1.71)	0.88 (0.65 - 1.19)
Liver	72 (0.1)	7 (0.1)	1.45 (0.67 - 3.15)	0.86 (0.39 - 1.87)
Pancreas	77 (0.1)	7 (0.1)	1.36 (0.63 - 2.94)	0.77 (0.33 - 1.78)
Respiratory and Intrathoracic Organs	420 (0.3)	33 (0.3)	1.17 (0.82 - 1.67)	0.89 (0.62 - 1.26)
Lung	351 (0.3)	32 (0.3)	1.36 (0.95 - 1.95)	1.04 (0.72 - 1.49)
Melanoma	832 (0.6)	78 (0.7)	**1.40 (1.11 - 1.77)**	1.06 (0.83 - 1.34)
Mesothelioma	25 (0.02)	6 (0.1)	**3.58 (1.47 - 8.73)**	2.09 (0.84 - 5.19)
Male Reproductive Organs	1,503 (1.1)	140 (1.2)	**1.39 (1.17 - 1.66)**	0.88 (0.74 - 1.05)
Prostate	1,379 (1.0)	129 (1.1)	**1.40 (1.17 - 1.68)**	0.85 (0.71 - 1.03)
Testis	119 (0.1)	11 (0.1)	1.38 (0.74 - 2.56)	1.44 (0.75 - 2.77)
Urinary Tract	280 (0.2)	23 (0.2)	1.23 (0.80 - 1.88)	0.82 (0.53 - 1.28)
Kidney	177 (0.1)	16 (0.1)	1.35 (0.81 - 2.25)	0.89 (0.52 - 1.52)
Bladder	89 (0.1)	7 (0.1)	1.17 (0.54 - 2.53)	0.84 (0.38 - 1.86)
Brain and Other CNS	110 (0.1)	7 (0.1)	0.95 (0.44 - 2.04)	0.78 (0.35 - 1.73)
Brain	109 (0.1)	6 (0.1)	0.82 (0.36 - 1.87)	0.67 (0.29 - 1.58)
Thyroid and Other Endocrine Glands	81 (0.1)	11 (0.1)	**2.03 (1.08 - 3.81)**	1.64 (0.89 - 3.05)
Thyroid	76 (0.1)	11 (0.1)	**2.16 (1.15 - 4.07)**	1.72 (0.93 - 3.21)
Unknown Site	70 (0.1)	8 (0.1)	1.71 (0.82 - 3.55)	1.23 (0.60 - 2.52)
Lymphoid, Haematopoietic + Related Tissue	421 (0.3)	31 (0.3)	1.10 (0.76 - 1.58)	0.78 (0.54 - 1.14)
Hodgkin	26 (0.02)	---	0.57 (0.08 - 4.23)	0.60 (0.07 - 4.90)
Non-Hodgkin Lymphoma	180 (0.1)	11 (0.1)	0.91 (0.50 - 1.68)	0.71 (0.38 - 1.33)
Leukaemia	156 (0.1)	13 (0.1)	1.24 (0.71 - 2.19)	0.85 (0.47 - 1.53)
Other Cancers	171 (0.1)	11 (0.1)	0.96 (0.52 - 1.77)	0.64 (0.34 - 1.22)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**.

Table 158: Cancer RIRs* for male coal mine workers who ONLY worked in Unexposed Non-Office jobs, compared with the rest of the male cohort

Cancer Categories	All other coal mine workers	ONLY worked Unexposed Non-Office jobs	Comparison of cancer incidence between those who worked in Unexposed Non-Office job vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and Pharynx	278 (0.2)	6 (0.2)	1.17 (0.52 - 2.63)	1.11 (0.49 - 2.50)
Lip	100 (0.1)	---	1.63 (0.52 - 5.14)	1.69 (0.53 - 5.35)
Pharynx	91 (0.1)	---	1.19 (0.29 - 4.84)	1.12 (0.28 - 4.57)
Digestive Organs	934 (0.6)	30 (0.8)	**1.75 (1.22 - 2.51)**	1.40 (0.94 - 2.08)
Oesophagus	67 (0.05)	0 (0)		
Stomach	73 (0.1)	---	1.49 (0.37 - 6.06)	1.25 (0.30 - 5.22)
Colorectal	590 (0.4)	20 (0.5)	**1.84 (1.18 - 2.87)**	1.39 (0.84 - 2.30)
Liver	77 (0.1)	---	1.41 (0.35 - 5.74)	1.06 (0.26 - 4.30)
Pancreas	79 (0.1)	---	**3.44 (1.39 - 8.48)**	**3.23 (1.30 - 8.03)**
Respiratory and Intrathoracic Organs	448 (0.3)	---	0.61 (0.25 - 1.46)	0.52 (0.21 - 1.26)
Lung	380 (0.3)	---	0.43 (0.14 - 1.33)	0.36 (0.12 - 1.14)
Melanoma	895 (0.6)	15 (0.4)	0.91 (0.55 - 1.51)	0.93 (0.55 - 1.54)
Mesothelioma	31 (0.02)	0 (0)		
Male Reproductive	1,613 (1.1)	30 (0.8)	1.01 (0.70 - 1.45)	0.89 (0.62 - 1.29)
Prostate	1,484 (1.0)	24 (0.6)	0.88 (0.59 - 1.31)	0.75 (0.50 - 1.14)
Testis	124 (0.1)	6 (0.2)	**2.63 (1.16 - 5.97)**	**2.61 (1.15 - 5.93)**
Urinary Tract	295 (0.2)	8 (0.2)	1.47 (0.73 - 2.97)	1.41 (0.70 - 2.83)
Kidney	187 (0.1)	6 (0.2)	1.74 (0.77 - 3.93)	1.76 (0.78 - 3.95)
Bladder	94 (0.1)	---	1.16 (0.29 - 4.68)	1.00 (0.25 - 4.04)
Brain and Other CNS	114 (0.1)	---	1.43 (0.45 - 4.50)	1.42 (0.45 - 4.47)
Brain	112 (0.1)	---	1.46 (0.46 - 4.58)	1.44 (0.46 - 4.52)
Thyroid and Other Endocrine Glands	90 (0.1)	---	1.21 (0.30 - 4.90)	1.23 (0.30 - 5.02)
Thyroid	85 (0.1)	---	1.28 (0.31 - 5.19)	1.28 (0.31 - 5.24)
Unknown Site	76 (0.1)	---	1.43 (0.35 - 5.82)	1.40 (0.34 - 5.75)
Lymphoid, Haematopoietic + Related Tissue	444 (0.3)	8 (0.2)	0.98 (0.49 - 1.97)	0.91 (0.45 - 1.84)
Hodgkin	27 (0.02)	0 (0)		
Non-Hodgkin Lymphoma	189 (0.1)	---	0.57 (0.14 - 2.31)	0.55 (0.14 - 2.24)
Leukaemia	166 (0.1)	---	0.98 (0.31 - 3.07)	0.93 (0.30 - 2.91)
Other Cancers	179 (0.1)	---	0.91 (0.29 - 2.85)	0.88 (0.28 - 2.77)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

** Statistically significantly increased RIR results are in **red**

Table 159: Cancer RIRs* for male coal mine workers who EVER worked in a Maintenance job, compared with the rest of the male cohort

Cancer Categories	ALL WORKERS				ONLY WORKERS WITH FIRST EXAMINATION BEFORE 2010			
	All other coal mine workers	EVER worked in a Maintenance job	Comparison of cancer incidence between those who worked in a maintenance job vs all other coal mine workers		All other coal mine workers	EVER worked in a Maintenance job	Comparison of cancer incidence between those who worked in a maintenance job vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and Pharynx	186 (0.2)	98 (0.2)	0.83 (0.65 - 1.06)	1.04 (0.81 - 1.34)	156 (0.3)	90 (0.3)	0.87 (0.67 - 1.12)	1.09 (0.84 - 1.42)
Lip	64 (0.1)	39 (0.1)	0.96 (0.65 - 1.43)	1.06 (0.70 - 1.59)	60 (0.1)	37 (0.1)	0.92 (0.61 - 1.39)	1.02 (0.67 - 1.56)
Pharynx	62 (0.1)	31 (0.1)	0.79 (0.51 - 1.22)	1.07 (0.69 - 1.66)	50 (0.1)	28 (0.1)	0.84 (0.53 - 1.33)	1.15 (0.72 - 1.83)
Digestive Organs	668 (0.7)	296 (0.5)	0.70 (0.61 - 0.80)	1.02 (0.88 - 1.17)	566 (1.1)	264 (0.8)	0.70 (0.60 - 0.81)	1.04 (0.90 - 1.21)
Oesophagus	49 (0.1)	18 (0.03)	0.58 (0.34 - 1.00)	0.85 (0.49 - 1.48)	42 (0.1)	18 (0.1)	0.64 (0.37 - 1.12)	0.96 (0.55 - 1.68)
Stomach	48 (0.1)	27 (0.05)	0.89 (0.55 - 1.42)	1.35 (0.83 - 2.18)	39 (0.1)	23 (0.1)	0.88 (0.53 - 1.48)	1.40 (0.82 - 2.38)
Colorectal	429 (0.5)	181 (0.3)	0.67 (0.56 - 0.79)	0.96 (0.80 - 1.14)	370 (0.7)	163 (0.5)	0.66 (0.55 - 0.79)	0.97 (0.80 - 1.17)
Liver	55 (0.1)	24 (0.05)	0.69 (0.43 - 1.11)	1.06 (0.65 - 1.71)	41 (0.1)	20 (0.1)	0.73 (0.43 - 1.25)	1.15 (0.67 - 1.97)
Pancreas	58 (0.1)	26 (0.05)	0.71 (0.45 - 1.12)	1.08 (0.67 - 1.73)	52 (0.1)	20 (0.1)	0.58 (0.34 - 0.97)	0.9 (0.53 - 1.53)
Respiratory and Intrathoracic Organs	325 (0.4)	128 (0.2)	0.62 (0.51 - 0.76)	0.94 (0.77 - 1.16)	293 (0.6)	116 (0.3)	0.59 (0.48 - 0.74)	0.92 (0.74 - 1.15)
Lung	281 (0.3)	102 (0.2)	0.57 (0.46 - 0.72)	0.88 (0.70 - 1.10)	256 (0.5)	96 (0.3)	0.56 (0.44 - 0.71)	0.89 (0.70 - 1.13)
Melanoma	629 (0.7)	281 (0.5)	0.70 (0.61 - 0.81)	0.84 (0.73 - 0.97)	520 (1.0)	237 (0.7)	0.68 (0.59 - 0.80)	0.82 (0.07 - 0.96)
Mesothelioma	18 (0.02)	13 (0.02)	1.14 (0.56 - 2.33)	1.84 (0.85 - 3.96)	15 (0.05)	12 (0.03)	1.20 (0.56 - 2.56)	2.03 (0.90 - 4.58)
Male Reproductive Organs	1,171 (1.3)	472 (0.9)	0.63 (0.57 - 0.71)	0.93 (0.84 - 1.04)	1030 (2.0)	421 (1.2)	0.61 (0.55 - 0.68)	0.91 (0.81 - 1.02)
Prostate	1,079 (1.2)	429 (0.8)	0.63 (0.56 - 0.70)	0.96 (0.85 - 1.07)	966 (1.9)	390 (1.1)	0.60 (0.54 - 0.68)	0.93 (0.83 - 1.05)
Testis	88 (0.1)	42 (0.1)	0.75 (0.52 - 1.09)	0.70 (0.48 - 1.01)	62 (0.1)	31 (0.1)	0.75 (0.49 - 1.15)	0.68 (0.44 - 1.05)
Urinary Tract	209 (0.2)	94 (0.2)	0.71 (0.56 - 0.91)	0.98 (0.77 - 1.26)	179 (0.3)	84 (0.2)	0.07 (0.54 - 0.91)	0.99 (0.76 - 1.29)
Kidney	130 (0.1)	63 (0.1)	0.77 (0.57 -1.03)	1.02 (0.75 - 1.39)	109 (0.2)	55 (0.2)	0.76 (0.55 - 1.05)	1.02 (0.73 - 1.42)
Bladder	71 (0.1)	25 (0.05)	0.56 (0.35 - 0.88)	0.81 (0.51 - 1.28)	62 (0.1)	24 (0.1)	0.58 (0.36 - 0.93)	0.85 (0.53 - 1.37)

Cancer Categories	ALL WORKERS				ONLY WORKERS WITH FIRST EXAMINATION BEFORE 2010			
	All other coal mine workers	EVER worked in a Maintenance job	Comparison of cancer incidence between those who worked in a maintenance job vs all other coal mine workers		All other coal mine workers	EVER worked in a Maintenance job	Comparison of cancer incidence between those who worked in a maintenance job vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Brain and Other CNS	83 (0.1)	34 (0.1)	0.65 (0.43 - 0.96)	0.76 (0.51 - 1.14)	68 (0.1)	30 (0.1)	0.66 (0.43 - 1.02)	0.79 (0.51 - 1.22)
Brain	81 (0.1)	34 (0.1)	0.66 (0.44 - 0.99)	0.79 (0.52 - 1.18)	67 (0.1)	30 (0.1)	0.67 (0.44 - 1.03)	0.8 (0.52 - 1.24)
Thyroid and Other Endocrine Glands	64 (0.1)	28 (0.1)	0.69 (0.44 - 1.08)	0.80 (0.51 - 1.24)	53 (0.1)	25 (0.1)	0.71 (0.44 - 1.14)	0.83 (0.52 - 1.33)
Thyroid	60 (0.1)	27 (0.05)	0.71 (0.45 - 1.12)	0.82 (0.52 - 1.29)	49 (0.1)	24 (0.1)	0.73 (0.45 - 1.20)	0.86 (0.53 - 1.40)
Unknown Site	57 (0.1)	21 (0.04)	0.58 (0.35 - 0.96)	0.89 (0.54 - 1.47)	49 (0.1)	19 (0.1)	0.58 (0.34 - 0.99)	0.92 (0.54 - 1.57)
Lymphoid, Haematopoietic + Related Tissue	301 (0.3)	151 (0.3)	0.79 (0.65 - 0.96)	1.05 (0.86 - 1.28)	255 (0.5)	139 (0.4)	0.82 (0.66 - 1.00)	1.11 (0.90 - 1.37)
Hodgkin	19 (0.02)	8 (0.01)	0.66 (0.29 - 1.52)	0.70 (0.30 - 1.64)	13 (0)	6 (0)	0.69 (0.26 - 1.82)	0.75 (0.27 - 2.05)
Non-Hodgkin Lymphoma	119 (0.1)	72 (0.1)	0.96 (0.71 - 1.28)	1.22 (0.91 - 1.65)	105 (0.2)	64 (0.2)	0.91 (0.67 - 1.25)	1.2 (0.87 - 1.65)
Leukaemia	112 (0.1)	57 (0.1)	0.80 (0.58 - 1.11)	1.11 (0.80 - 1.53)	95 (0.2)	55 (0.2)	0.87 (0.62 - 1.21)	1.22 (0.87 - 1.71)
Other Cancers	132 (0.1)	50 (0.1)	0.60 (0.43 - 0.83)	0.80 (0.57 - 1.11)	115 (0.2)	42 (0.1)	0.55 (0.38 - 0.78)	0.76 (0.53 - 1.08)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

** Statistically significantly reduced RIR results are in blue.

Table 160: Cancer RIRs* for male coal mine workers who EVER worked in a Production job, compared with the rest of the male cohort

Cancer Categories	ALL WORKERS				ONLY WORKERS WITH FIRST EXAMINATION BEFORE 2010			
	NEVER Production worker	EVER Production worker	Comparison of cancer incidence between those who worked in Production jobs vs all other coal mine workers		NEVER Production workers	EVER Production worker	Comparison of cancer incidence between those who worked in Production jobs vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and Pharynx	157 (0.2)	127 (0.2)	1.21 (0.96 - 1.53)	1.07 (0.85 - 1.36)	126 (0.2)	120 (0.4)	1.25 (0.97 - 1.60)	1.15 (0.89 - 1.48)
Lip	49 (0.1)	54 (0.1)	**1.65 (1.12 - 2.43)**	1.42 (0.95 - 2.14)	43 (0.1)	54 (0.2)	**1.65 (1.10 - 2.46)**	**1.53 (1.00 - 2.33)**
Pharynx	56 (0.1)	37 (0.1)	0.99 (0.65 - 1.50)	0.88 (0.59 - 1.33)	44 (0.1)	34 (0.1)	1.01 (0.65 - 1.58)	0.92 (0.59 - 1.43)
Digestive Organs	542 (0.6)	422 (0.8)	**1.17 (1.03 - 1.32)**	1.01 (0.88 - 1.15)	452 (0.9)	378 (1.1)	1.10 (0.96 - 1.26)	0.97 (0.84 - 1.12)
Oesophagus	32 (0.03)	35 (0.1)	**1.64 (1.01 - 2.64)**	1.41 (0.84 - 2.34)	27 (0.1)	33 (0.1)	1.60 (0.96 - 2.66)	1.42 (0.82 - 2.45)
Stomach	45 (0.05)	30 (0.1)	1.00 (0.63 - 1.58)	0.83 (0.49 - 1.40)	36 (0.1)	26 (0.1)	0.95 (0.57 - 1.57)	0.79 (0.44 - 1.41)
Colorectal	329 (0.3)	281 (0.6)	**1.28 (1.09 - 1.50)**	1.09 (0.92 - 1.29)	280 (0.5)	253 (0.7)	**1.19 (1.00 - 1.40)**	1.04 (0.86 - 1.24)
Liver	55 (0.1)	24 (0.05)	0.65 (0.40 - 1.05)	0.69 (0.43 - 1.13)	42 (0.1)	19 (0.1)	0.59 (0.34 - 1.02)	0.65 (0.38 - 1.13)
Pancreas	50 (0.1)	34 (0.1)	1.02 (0.66 - 1.57)	0.85 (0.55 - 1.31)	40 (0.1)	32 (0.1)	1.05 (0.66 - 1.67)	0.91 (0.57 - 1.46)
Respiratory and Intrathoracic Organs	226 (0.2)	227 (0.4)	**1.50 (1.25 - 1.81)**	1.19 (0.97 - 1.45)	192 (0.4)	217 (0.6)	**1.48 (1.22 - 1.80)**	**1.23 (1.00 - 1.51)**
Lung	186 (0.2)	197 (0.4)	**1.58 (1.30 - 1.93)**	1.23 (0.99 - 1.52)	162 (0.3)	190 (0.6)	**1.54 (1.25 - 1.90)**	**1.26 (1.00 - 1.57)**
Melanoma	524 (0.5)	386 (0.8)	1.10 (0.97 - 1.26)	1.01 (0.88 - 1.15)	408 (0.8)	349 (1.0)	**1.12 (0.97 - 1.30)**	**1.04 (0.89 - 1.20)**
Mesothelioma	26 (0.03)	---	0.29 (0.11 - 0.75)	0.29 (0.10 - 0.83)	23 (0.05)	4 (0.01)	0.23 (0.08 - 0.66)	0.24 (0.07 - 0.77)
Male Reproductive Organs	875 (0.9)	768 (1.5)	**1.32 (1.19 - 1.45)**	**1.16 (1.05 - 1.28)**	744 (1.5)	707 (2.1)	**1.25 (1.13 - 1.38)**	**1.15 (1.03 - 1.28)**
Prostate	796 (0.8)	712 (1.4)	**1.34 (1.21 - 1.48)**	**1.17 (1.05 - 1.31)**	694 (1.4)	662 (1.9)	**1.25 (1.13 - 1.39)**	**1.15 (1.02 - 1.28)**
Testis	76 (0.1)	54 (0.1)	1.06 (0.75 - 1.51)	1.15 (0.81 - 1.62)	48 (0.1)	45 (0.1)	1.23 (0.82 - 1.85)	1.37 (0.92 - 2.05)
Urinary Tract	156 (0.2)	147 (0.3)	**1.41 (1.13 - 1.77)**	1.23 (0.97 - 1.55)	132 (0.3)	131 (0.4)	**1.30 (1.02 - 1.66)**	1.16 (0.90 - 1.49)
Kidney	99 (0.1)	94 (0.2)	**1.42 (1.07 - 1.88)**	1.27 (0.95 - 1.69)	80 (0.2)	84 (0.2)	**1.38 (1.01 - 1.87)**	1.25 (0.91 - 1.71)
Bladder	50 (0.1)	46 (0.1)	1.38 (0.92 - 2.05)	1.15 (0.74 - 1.79)	46 (0.1)	40 (0.1)	1.14 (0.75 - 1.74)	0.97 (0.62 - 1.54)

Cancer Categories	ALL WORKERS				ONLY WORKERS WITH FIRST EXAMINATION BEFORE 2010			
	NEVER Production worker	EVER Production worker	Comparison of cancer incidence between those who worked in Production jobs vs all other coal mine workers		NEVER Production workers	EVER Production worker	Comparison of cancer incidence between those who worked in Production jobs vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Brain and Other CNS	65 (0.1)	52 (0.1)	1.20 (0.83 - 1.72)	1.13 (0.76 - 1.69)	54 (0.1)	44 (0.1)	1.07 (0.72 - 1.59)	1.02 (0.66 - 1.57)
Brain	64 (0.1)	51 (0.1)	1.19 (0.82 - 1.72)	1.14 (0.76 - 1.70)	53 (0.1)	44 (0.1)	1.09 (0.73 - 1.62)	1.05 (0.68 - 1.62)
Thyroid and Other Endocrine Glands	51 (0.1)	41 (0.1)	1.20 (0.80 - 1.81)	1.14 (0.75 - 1.73)	42 (0.1)	36 (0.1)	1.12 (0.72 - 1.75)	1.09 (0.70 - 1.71)
Thyroid	48 (0.05)	39 (0.1)	1.22 (0.80 - 1.85)	1.18 (0.76 - 1.81)	39 (0.1)	34 (0.1)	1.14 (0.72 - 1.81)	1.13 (0.72 - 1.80)
Unknown Site	42 (0.04)	36 (0.1)	1.28 (0.82 – 2.00)	0.95 (0.60 - 1.50)	35 (0.1)	33 (0.1)	1.24 (0.77 - 1.99)	0.93 (0.57 - 1.50)
Lymphoid, Haematopoietic + Related Tissue	265 (0.3)	187 (0.4)	1.06 (0.88 - 1.27)	0.94 (0.77 - 1.14)	222 (0.4)	172 (0.5)	1.02 (0.83 - 1.24)	0.94 (0.77 - 1.16)
Hodgkin	14 (0.01)	13 (0.03)	1.39 (0.65 - 2.95)	1.49 (0.71 - 3.12)	8 (0.02)	11 (0.03)	1.80 (0.72 - 4.48)	1.89 (0.78 - 4.62)
Non-Hodgkin Lymphoma	112 (0.1)	79 (0.2)	1.05 (0.79 - 1.41)	0.89 (0.66 - 1.20)	95 (0.2)	74 (0.2)	1.02 (0.75 - 1.38)	0.90 (0.66 - 1.24)
Leukaemia	99 (0.1)	70 (0.1)	1.06 (0.78 - 1.44)	0.93 (0.67 - 1.28)	84 (0.2)	66 (0.2)	1.03 (0.75 - 1.42)	0.95 (0.68 - 1.33)
Other Cancers	89 (0.1)	93 (0.2)	**1.56 (1.17 - 2.09)**	**1.37 (1.02 - 1.85)**	73 (0.1)	84 (0.2)	**1.51 (1.10 - 2.06)**	1.36 (0.99 - 1.87)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 161: Cancer RIRs* for male coal mine workers who EVER worked in Construction jobs, compared with the rest of the male cohort

Cancer Categories	NEVER Construction workers	EVER Construction worker	Comparison of cancer incidence between those who worked in Construction jobs vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and Pharynx	268 (0.2)	16 (0.2)	1.16 (0.70 - 1.92)	1.09 (0.65 - 1.85)
Lip	101 (0.1)	---	0.39 (0.10 - 1.56)	0.19 (0.03 - 1.38)
Pharynx	82 (0.1)	11 (0.1)	**2.61 (1.39 - 4.90)**	**2.68 (1.43 - 5.04)**
Digestive Organs	927 (0.7)	37 (0.4)	0.78 (0.56 - 1.08)	0.82 (0.58 - 1.16)
Oesophagus	64 (0.05)	---	0.91 (0.29 - 2.90)	0.67 (0.16 - 2.72)
Stomach	72 (0.1)	---	0.81 (0.26 - 2.57)	0.85 (0.27 - 2.71)
Colorectal	590 (0.4)	20 (0.2)	0.66 (0.42 - 1.03)	0.72 (0.45 - 1.15)
Liver	73 (0.1)	6 (0.1)	1.60 (0.70 - 3.68)	1.44 (0.62 - 3.30)
Pancreas	82 (0.1)	---	0.47 (0.12 - 1.93)	0.52 (0.12 - 2.21)
Respiratory and Intrathoracic Organs	421 (0.3)	32 (0.4)	**1.48 (1.03 - 2.12)**	**1.60 (1.11 - 2.31)**
Lung	354 (0.3)	29 (0.3)	**1.59 (1.09 - 2.33)**	**1.78 (1.20 - 2.62)**
Melanoma	873 (0.6)	37 (0.4)	0.82 (0.59 - 1.14)	0.92 (0.66 - 1.27)
Mesothelioma	29 (0.02)	---	1.34 (0.32 - 5.62)	1.37 (0.33 - 5.73)
Male Reproductive Organs	1,577 (1.1)	66 (0.8)	0.81 (0.64 - 1.04)	0.94 (0.73 - 1.21)
Prostate	1,450 (1.0)	58 (0.7)	0.78 (0.60 - 1.01)	0.91 (0.70 - 1.20)
Testis	122 (0.1)	8 (0.1)	1.28 (0.62 - 2.61)	1.20 (0.59 - 2.45)
Urinary Tract	291 (0.2)	12 (0.1)	0.80 (0.45 - 1.43)	0.91 (0.51 - 1.62)
Kidney	185 (0.1)	8 (0.1)	0.84 (0.41 - 1.71)	0.96 (0.47 - 1.97)
Bladder	93 (0.1)	---	0.63 (0.20 - 1.98)	0.70 (0.22 - 2.21)
Brain and Other CNS	115 (0.1)	---	0.34 (0.08 - 1.37)	0.36 (0.09 - 1.46)
Brain	113 (0.1)	---	0.34 (0.09 - 1.39)	0.37 (0.09 - 1.49)
Thyroid and Other Endocrine Glands	91 (0.1)	---	0.21 (0.03 - 1.53)	0.23 (0.03 - 1.66)
Thyroid	86 (0.1)	---	0.23 (0.03 - 1.62)	0.24 (0.03 - 1.73)
Unknown Site	76 (0.1)	---	0.51 (0.13 - 2.08)	0.61 (0.14 - 2.58)
Lymphoid, Haematopoietic + Related Tissue	442 (0.3)	10 (0.1)	0.44 (0.24 - 0.82)	0.49 (0.26 - 0.92)
Hodgkin	25 (0.02)	---	1.56 (0.37 - 6.57)	1.37 (0.33 - 5.68)
Non-Hodgkin Lymphoma	188 (0.1)	---	0.31 (0.10 - 0.97)	0.37 (0.12 - 1.14)
Leukaemia	166 (0.1)	---	0.35 (0.11 - 1.10)	0.41 (0.13 - 1.29)
Other Cancers	174 (0.1)	8 (0.1)	0.89 (0.44 - 1.82)	1.01 (0.50 - 2.05)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 162: Cancer RIRs* for all-malignancies across men in Job Groups in the Maintenance Work Category

Job Group	Never in Job Group		Ever in Job Group		Cancer incidence rate comparison between workers in Job Group vs all the other workers in the Work Category (reference)	
	N [PY]	Number with cancer (%)	N [PY]	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Maintenance – General (Nec)	37,970 [348,224]	997 (2.6)	17,535 [177,596]	556 (3.2)	1.09 (0.99 - 1.21)	1.05 (0.95 - 1.17)
Abrasive, Blast, Sand, Paint	54,802 [519,286]	1,538 (2.8)	703 [6,534]	15 (2.1)	0.78 (0.47 - 1.29)	0.83 (0.50 - 1.39)
Shutdown Maintenance	49,825 [475,588]	1,357 (2.7)	5,680 [50,232]	196 (3.5)	**1.37 (1.18 - 1.59)**	1.05 (0.91 - 1.23)
Boilermaker	47,938 [451,740]	1,337 (2.8)	7,567 [74,080]	216 (2.9)	0.99 (0.85 - 1.14)	0.94 (0.81 - 1.09)
Fitter (nec)	43,484 [399,465]	1,212 (2.8)	12,021 [126,355]	341 (2.8)	0.89 (0.79 - 1.00)	0.90 (0.80 - 1.02)
Diesel fitter	46,435 [436,212]	1,405 (3)	9,070 [89,608]	148 (1.6)	0.51 (0.43 - 0.61)	0.94 (0.79 - 1.12)
Tyre fitter	54,923 [520,185]	1,539 (2.8)	582 [5,635]	14 (2.4)	0.84 (0.50 - 1.41)	0.90 (0.53 - 1.53)
Electrician	45,170 [428,835]	1,284 (2.8)	10,335 [96,985]	269 (2.6)	0.93 (0.81 - 1.06)	0.97 (0.85 - 1.11)

* Adjusted for era of first examination, age, smoking status, age * era & age * smoking status interactions.
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 163: Cancer RIRs* for all-malignancies in men across Job Groups in the Maintenance Work Category – only workers with first examination date before 2010

Job Group	Nevert in Job Group		Ever in Job Group		Cancer incidence rate comparison between workers in Job Group vs all the other workers in the Work Category (reference)	
	N [PY]	Number cancer (%)	N [PY]	Number cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Maintenance – General (Nec)	22,477 [279,071]	856 (3.8)	11,535 [150,088]	512 (4.4)	**1.11 (1.00 - 1.24)**	1.09 (0.98 - 1.22)
Abrasive, Blast, Sand, Paint	33,554 [423,742]	1354 (4.0)	458 [5,417]	14 (3.1)	0.81 (0.48 - 1.37)	0.89 (0.52 - 1.51)
Shutdown Maintenance	30,797 [389,911]	1197 (3.9)	3,215 [39,248]	171 (5.3)	**1.42 (1.21 - 1.66)**	1.07 (0.91 - 1.26)
Boilermaker	29,076 [366,864]	1178 (4.1)	4,936 [62,296]	190 (3.8)	0.95 (0.82 - 1.11)	0.90 (0.77 - 1.06)
Fitter (nec)	25,733 [320,233]	1058 (4.1)	8,279 [108,927]	310 (3.7)	0.86 (0.76 - 0.98)	0.90 (0.79 - 1.03)
Diesel fitter	28,183 [354,450]	1241 (4.4)	5,829 [74,709]	127 (2.2)	0.49 (0.40 - 0.58)	0.90 (0.75 - 1.09)
Tyre fitter	33,671 [424,554]	1355 (4.0)	341 [4,606]	13 (3.8)	0.88 (0.52 - 1.52)	0.92 (0.53 - 1.61)
Electrician	27,967 [351,469]	1144 (4.1)	6,045 [77,690]	224 (3.7)	0.89 (0.77 - 1.02)	0.92 (0.80 - 1.07)

* Adjusted for era of first examination, age, smoking status, age * era & age * smoking status interactions.
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 164: Cancer RIRs* for male coal mine workers who EVER worked in Maintenance (general) Job Group, compared with other maintenance workers

Cancer Categories	All other maintenance workers	EVER worked in a maintenance (general) job	Comparison of cancer incidence between those who worked in a maintenance (general) job vs all other maintenance workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and Pharynx	69 (0.2)	29 (0.2)	0.82 (0.53 - 1.27)	0.81 (0.52 - 1.25)
Lip	29 (0.1)	10 (0.1)	0.68 (0.33 - 1.39)	0.66 (0.32 - 1.38)
Pharynx	24 (0.1)	7 (0.04)	0.57 (0.25 - 1.33)	0.52 (0.23 - 1.20)
Digestive Organs	196 (0.5)	100 (0.6)	1.00 (0.79 - 1.27)	0.95 (0.74 - 1.21)
Oesophagus	13 (0.03)	---	0.75 (0.27 - 2.11)	0.72 (0.26 - 2.01)
Stomach	20 (0.1)	7 (0.04)	0.69 (0.29 - 1.62)	0.69 (0.28 - 1.65)
Colorectal	116 (0.3)	65 (0.4)	1.10 (0.81 - 1.49)	1.05 (0.77 - 1.44)
Liver	18 (0.05)	6 (0.03)	0.65 (0.26 - 1.64)	0.65 (0.26 - 1.65)
Pancreas	17 (0.05)	9 (0.1)	1.04 (0.46 - 2.33)	1.02 (0.46 - 2.30)
Respiratory and Intrathoracic Organs	83 (0.2)	45 (0.3)	1.06 (0.74 - 1.53)	1.01 (0.69 - 1.46)
Lung	66 (0.2)	36 (0.2)	1.07 (0.71 - 1.60)	1.01 (0.66 - 1.54)
Melanoma	178 (0.5)	103 (0.6)	1.13 (0.89 - 1.45)	1.11 (0.87 - 1.42)
Mesothelioma	6 (0.02)	7 (0.04)	2.29 (0.77 - 6.80)	3.10 (0.93 - 10.35)
Male Reproductive Organs	302 (0.8)	170 (1)	1.10 (0.91 - 1.33)	1.06 (0.88 - 1.29)
Prostate	268 (0.7)	161 (0.9)	1.18 (0.97 - 1.43)	1.14 (0.93 - 1.39)
Testis	33 (0.1)	9 (0.1)	0.53 (0.26 - 1.12)	0.56 (0.27 - 1.16)
Urinary Tract	60 (0.2)	34 (0.2)	1.11 (0.73 - 1.69)	1.07 (0.70 - 1.64)
Kidney	38 (0.1)	25 (0.1)	1.29 (0.78 - 2.13)	1.25 (0.75 - 2.09)
Bladder	17 (0.05)	8 (0.05)	0.92 (0.40 - 2.14)	0.89 (0.37 - 2.12)
Brain and Other CNS	21 (0.1)	13 (0.1)	1.21 (0.61 - 2.42)	1.19 (0.59 - 2.41)
Brain	21 (0.1)	13 (0.1)	1.21 (0.61 - 2.42)	1.19 (0.59 - 2.41)
Thyroid and Other Endocrine Glands	17 (0.05)	11 (0.1)	1.27 (0.59 - 2.71)	1.20 (0.57 - 2.54)
Thyroid	17 (0.05)	10 (0.1)	1.15 (0.53 - 2.52)	1.10 (0.51 - 2.38)
Unknown Site	15 (0.04)	6 (0.03)	0.78 (0.30 - 2.02)	0.74 (0.28 - 1.91)
Lymphoid, Haematopoietic + Related Tissue	93 (0.2)	58 (0.3)	1.22 (0.88 - 1.70)	1.17 (0.83 - 1.64)
Hodgkin	---	---	1.18 (0.28 - 4.92)	1.17 (0.26 - 5.34)
Non-Hodgkin Lymphoma	42 (0.1)	30 (0.2)	1.40 (0.88 - 2.24)	1.26 (0.77 - 2.05)
Leukaemia	36 (0.1)	21 (0.1)	1.14 (0.67 - 1.96)	1.17 (0.67 - 2.03)
Other Cancers	33 (0.1)	17 (0.1)	1.01 (0.56 - 1.81)	1.00 (0.56 - 1.79)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

Table 165: Cancer RIRs* for male coal mine workers who EVER worked in Shutdown Maintenance Job Group, compared with all other maintenance workers

Cancer Categories	All other maintenance workers	EVER worked in shutdown maintenance	Comparison of cancer incidence between those who worked in shutdown maintenance job vs all other maintenance workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and Pharynx	87 (0.2)	11 (0.2)	1.19 (0.64 - 2.23)	0.94 (0.49 - 1.81)
Lip	35 (0.1)	---	1.08 (0.38 - 3.03)	0.87 (0.31 - 2.42)
Pharynx	27 (0.1)	---	1.40 (0.49 - 3.99)	1.03 (0.34 - 3.17)
Digestive Organs	256 (0.5)	40 (0.7)	**1.48 (1.06 - 2.06)**	1.12 (0.80 - 1.57)
Oesophagus	16 (0.03)	---	1.18 (0.27 - 5.13)	0.78 (0.18 - 3.44)
Stomach	25 (0.1)	---	0.75 (0.18 - 3.19)	0.55 (0.13 - 2.30)
Colorectal	158 (0.3)	23 (0.4)	1.37 (0.89 - 2.13)	1.09 (0.70 - 1.70)
Liver	16 (0.03)	8 (0.1)	**4.72 (2.02 -**	**3.22 (1.40 - 7.40)**
Pancreas	25 (0.1)	---	0.38 (0.05 - 2.79)	0.24 (0.03 - 1.78)
Respiratory and Intrathoracic Organs	102 (0.2)	26 (0.5)	**2.41 (1.57 - 3.70)**	**1.63 (1.05 - 2.55)**
Lung	81 (0.2)	21 (0.4)	**2.45 (1.52 - 3.95)**	**1.67 (1.01 - 2.76)**
Melanoma	258 (0.5)	23 (0.4)	0.84 (0.55 - 1.29)	0.75 (0.48 - 1.15)
Mesothelioma	10 (0.02)	---	2.83 (0.78 -	1.33 (0.27 - 6.63)
Male Reproductive Organs	407 (0.8)	65 (1.1)	**1.51 (1.16 - 1.96)**	1.18 (0.90 - 1.53)
Prostate	370 (0.7)	59 (1)	**1.51 (1.15 - 1.98)**	1.17 (0.88 - 1.54)
Testis	37 (0.1)	---	1.27 (0.50 - 3.24)	1.36 (0.54 - 3.43)
Urinary Tract	81 (0.2)	13 (0.2)	1.52 (0.84 - 2.72)	1.16 (0.64 - 2.09)
Kidney	59 (0.1)	---	0.64 (0.23 - 1.76)	0.50 (0.18 - 1.40)
Bladder	19 (0.04)	6 (0.1)	**2.98 (1.19 - 7.46)**	2.26 (0.88 - 5.79)
Brain and Other CNS	30 (0.1)	---	1.26 (0.44 - 3.57)	1.17 (0.41 - 3.41)
Brain	30 (0.1)	---	1.26 (0.44 - 3.57)	1.17 (0.41 - 3.41)
Thyroid and Other Endocrine Glands	25 (0.1)	---	1.13 (0.34 - 3.75)	1.00 (0.28 - 3.57)
Thyroid	24 (0.05)	---	1.18 (0.36 - 3.91)	1.05 (0.29 - 3.75)
Unknown Site	17 (0.03)	---	2.22 (0.75 - 6.60)	1.45 (0.47 - 4.48)
Lymphoid, Haematopoietic + Related Tissue	143 (0.3)	8 (0.1)	0.53 (0.26 - 1.07)	0.36 (0.17 - 0.77)
Hodgkin	8 (0.02)	0 (0)		
Non-Hodgkin Lymphoma	71 (0.1)	---	0.13 (0.02 - 0.96)	0.11 (0.02 - 0.80)
Leukaemia	51 (0.1)	6 (0.1)	1.11 (0.48 - 2.59)	0.71 (0.28 - 1.79)
Other Cancers	40 (0.1)	10 (0.2)	**2.36 (1.18 - 4.72)**	1.91 (0.94 - 3.86)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 166: All-malignancies RIRs* for male coal mine workers in the Production Work Category Job Groups

Job Group	Not in Job Group		In Job Group		Cancer Incidence rate comparison between workers in Job Group vs all the other production workers (reference)	
	N [PY]	Number with cancer (%)	N [PY]	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted RIR (95% CI)
Blast crew	49,211 [522,228]	2,258 (4.6)	1,707 [17,073]	69 (4.0)	0.93 (0.74 - 1.18)	1.26 (0.99 - 1.61)
Driller (General)	47,269 [504,905]	2,195 (4.6)	3,649 [34,396]	132 (3.6)	0.88 (0.74 - 1.05)	1.16 (0.97 - 1.39)
CHPP plant operator	49,495 [518,832]	2,250 (4.5)	1,423 [20,469]	77 (5.4)	0.87 (0.69 - 1.08)	0.75 (0.60 - 0.95)
Laboratory	50,056 [530,711]	2,301 (4.6)	862 [8,590]	26 (3.0)	0.70 (0.48 - 1.02)	0.93 (0.63 - 1.36)
ERZ/Deputy	49,893 [522,374]	2,244 (4.5)	1,025 [16,927]	83 (8.1)	1.14 (0.92 - 1.42)	0.89 (0.71 - 1.12)
Open cut examiner	50,383 [529,826]	2,270 (4.5)	535 [9,475]	57 (10.7)	**1.40 (1.09 - 1.81)**	0.91 (0.69 - 1.19)
Dragline	49,878 [521,078]	2,207 (4.4)	1,040 [18,223]	120 (11.5)	**1.55 (1.30 - 1.86)**	1.04 (0.86 - 1.25)
Miner [all]	40,897 [405,496]	1,833 (4.5)	10,021 [13,380]	494 (4.9)	0.82 (0.74 - 0.90)	0.94 (0.85 - 1.04)
Underground miner	43,497 [444,485]	2,047 (4.7)	7,421 [94,816]	280 (3.8)	0.64 (0.57 - 0.73)	0.94 (0.82 - 1.07)
Operator	11,941 [132,321]	551 (4.6)	38,977 [406,981]	1776 (4.6)	1.05 (0.95 - 1.15)	1.04 (0.94 - 1.14)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 167: All-malignancies RIRs* across Job Groups in the Production Work Category – only male coal mine workers with first examination date before 2010

Job Group	Not in Job Group		In Job Group		Cancer Incidence rate comparison between workers in Job Group vs all the other production workers (reference)	
	N [PY]	Number with cancer (%)	N [PY]	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted RIR (95% CI)
Blast crew	33,108 [446,078]	2060 (6.2)	1,127 [14,330]	61 (5.4)	0.92 (0.72 - 1.19)	1.24 (0.96 - 1.60)
Driller (General)	31,902 [432,438]	2003 (6.3)	2,333 [27,969]	118 (5.1)	0.91 (0.76 - 1.09)	1.17 (0.97 - 1.41)
CHPP plant operator	33,037 [440,983]	2045 (6.2)	1,198 [19,424]	76 (6.3)	0.84 (0.67 - 1.06)	0.76 (0.60 - 0.96)
Laboratory	33,664 [453,127]	2096 (6.2)	571 [7,281]	25 (4.4)	0.74 (0.50 - 1.09)	0.97 (0.65 - 1.43)
ERZ/Deputy	33,314 [443,960]	2039 (6.1)	921 [16,447]	82 (8.9)	1.09 (0.87 - 1.35)	0.91 (0.72 - 1.14)
Open cut examiner	33,717 [451,017]	2064 (6.1)	518 [9,391]	57 (11.0)	**1.33 (1.03 - 1.72)**	0.91 (0.70 - 1.20)
Dragline	33,218 [442,301]	2001 (6.0)	1,017 [18,106]	120 (11.8)	**1.46 (1.22 - 1.75)**	1.04 (0.86 - 1.26)
Miner [all]	26,170 [336,488]	1640 (6.3)	8,065 [123,919]	481 (6.0)	0.8 (0.72 - 0.88)	0.94 (0.85 - 1.05)
Underground miner	28,422 [373,892]	1849 (6.5)	5,813 [86,515]	272 (4.7)	0.64 (0.56 - 0.72)	0.96 (0.84 - 1.09)
Operator	8,310 [115,034]	524 (6.3)	25,925 [345,373]	1597 (6.2)	1.02 (0.92 - 1.12)	1.02 (0.92 - 1.13)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 168: Cancer RIRs* for among male coal mine workers who EVER worked as Dragline Operator, compared with all other Production workers

Cancer Categories	All other production workers	EVER worked as dragline operator	Comparison of cancer incidence between those who worked as dragline operator vs all other production workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and Pharynx	118 (0.2)	9 (0.9)	2.15 (1.09 - 4.23)	1.67 (0.83 - 3.34)
Lip	53 (0.1)	---	0.53 (0.07 - 3.83)	0.52 (0.07 - 3.76)
Pharynx	31 (0.1)	6 (0.6)	**5.44 (2.27 - 13.04)**	**3.94 (1.61 - 9.65)**
Digestive Organs	402 (0.8)	20 (1.9)	1.40 (0.89 - 2.19)	0.92 (0.58 - 1.47)
Oesophagus	33 (0.1)	---	1.70 (0.41 - 7.08)	1.17 (0.26 - 5.18)
Stomach	29 (0.1)	---	0.97 (0.13 - 7.10)	0.94 (0.12 - 7.13)
Colorectal	269 (0.5)	12 (1.2)	1.25 (0.70 - 2.24)	0.80 (0.44 - 1.46)
Liver	23 (0.05)	---	1.22 (0.16 - 9.03)	1.14 (0.15 - 8.65)
Pancreas	33 (0.1)	---	0.85 (0.12 - 6.21)	0.48 (0.06 - 3.63)
Respiratory and Intrathoracic Organs	218 (0.4)	9 (0.9)	1.16 (0.60 - 2.25)	0.80 (0.40 - 1.58)
Lung	188 (0.4)	9 (0.9)	1.34 (0.69 - 2.62)	0.88 (0.44 - 1.75)
Melanoma	373 (0.7)	13 (1.3)	0.98 (0.56 - 1.70)	0.71 (0.41 - 1.24)
Mesothelioma	---	0 (0)		
Male Reproductive Organs	712 (1.4)	56 (5.4)	**2.23 (1.71 - 2.91)**	**1.37 (1.03 - 1.81)**
Prostate	661 (1.3)	51 (4.9)	**2.18 (1.65 - 2.89)**	1.29 (0.96 - 1.73)
Testis	48 (0.1)	6 (0.6)	**3.52 (1.51 - 8.23)**	**3.90 (1.68 - 9.02)**
Urinary Tract	139 (0.3)	8 (0.8)	1.62 (0.79 - 3.30)	1.05 (0.50 - 2.19)
Kidney	90 (0.2)	---	1.25 (0.46 - 3.40)	0.80 (0.29 - 2.27)
Bladder	42 (0.1)	---	2.68 (0.96 - 7.46)	1.93 (0.66 - 5.69)
Brain and Other CNS	52 (0.1)	0 (0)		
Brain	51 (0.1)	0 (0)		
Thyroid and Other Endocrine Glands	38 (0.1)	---	2.22 (0.68 - 7.18)	1.84 (0.52 - 6.51)
Thyroid	36 (0.1)	---	2.34 (0.72 - 7.60)	2.04 (0.57 - 7.26)
Unknown Site	35 (0.1)	---	0.80 (0.11 - 5.85)	0.48 (0.06 - 3.66)
Lymphoid, Haematopoietic + Related Tissue	177 (0.4)	10 (1.0)	1.59 (0.84 – 3.00)	1.08 (0.56 - 2.09)
Hodgkin	12 (0.02)	---	2.34 (0.30 - 17.99)	3.47 (0.42 - 28.31)
Non-Hodgkin Lymphoma	75 (0.2)	---	1.50 (0.55 - 4.09)	0.95 (0.35 - 2.57)
Leukaemia	65 (0.1)	---	2.16 (0.87 - 5.36)	1.36 (0.51 - 3.64)
Other Cancers	88 (0.2)	---	1.60 (0.65 - 3.93)	1.12 (0.44 - 2.87)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**.

Table 169: Cancer RIRs* for all malignancies for male workers across Job Groups in the Unknown Work Category

Job Group	Not in Job Group		In Job Group		Cancer Incidence rate comparison between workers in Job Group vs all the other coal mine workers (reference)	
	N [PY]	Number with cancer (%)	N [PY]	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Labourer (nec)	142,394 [1,303,646]	5,062 (3.6)	5,445 [47,332]	104 (1.9)	0.57 (0.47 - 0.69)	1.04 (0.85 - 1.26)
Cleaner (nec)	146,993 [1,344,394]	5,152 (3.5)	846 [6,585]	14 (1.7)	0.55 (0.33 - 0.93)	0.56 (0.33 - 0.95)
Supervisor (nec)	142,362 [1,287,681]	4,901 (3.4)	5,477 [63,298]	265 (4.8)	1.10 (0.97 - 1.24)	0.94 (0.83 - 1.06)
Truck driver (nec)	140,630 [1,284,577]	4,802 (3.4)	7,209 [66401]	364 (5.0)	**1.47 (1.32 - 1.63)**	1.06 (0.95 - 1.18)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 170: Cancer RIRs* for male coal mine workers who EVER worked as Truck Drivers, compared with all other coal mine workers

Cancer Categories	All other coal mine workers	EVER worked as truck driver	Comparison of cancer incidence between those who worked as truck drivers vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted * RIR (95% CI)
Lip, Oral Cavity and	260 (0.2)	24 (0.3)	**1.78 (1.17 - 2.70)**	1.30 (0.85 - 1.98)
Lip	94 (0.1)	9 (0.1)	1.85 (0.93 - 3.66)	1.64 (0.83 - 3.25)
Pharynx	88 (0.1)	---	1.09 (0.44 - 2.69)	0.74 (0.30 - 1.84)
Digestive Organs	901 (0.6)	63 (0.9)	**1.35 (1.04 - 1.74)**	0.97 (0.75 - 1.25)
Oesophagus	60 (0.04)	7 (0.1)	**2.25 (1.03 - 4.92)**	1.64 (0.75 - 3.61)
Stomach	67 (0.05)	8 (0.1)	**2.30 (1.11 - 4.79)**	1.52 (0.72 - 3.21)
Colorectal	571 (0.4)	39 (0.5)	1.32 (0.95 - 1.82)	0.98 (0.71 - 1.36)
Liver	77 (0.1)	---	0.50 (0.12 - 2.04)	0.30 (0.07 - 1.22)
Pancreas	79 (0.1)	---	1.22 (0.49 - 3.01)	0.85 (0.34 - 2.11)
Respiratory and Intrathoracic Organs	422 (0.3)	31 (0.4)	1.42 (0.98 - 2.04)	0.96 (0.67 - 1.39)
Lung	356 (0.3)	27 (0.4)	1.46 (0.99 - 2.16)	1.00 (0.67 - 1.49)
Melanoma	849 (0.6)	61 (0.8)	**1.39 (1.07 - 1.80)**	1.14 (0.88 - 1.47)
Mesothelioma	31 (0.02)	0 (0)		
Male Reproductive Organs	1521 (1.1)	122 (1.7)	**1.55 (1.29 - 1.86)**	1.08 (0.89 - 1.30)
Prostate	1392 (1.0)	116 (1.6)	**1.61 (1.33 - 1.94)**	1.10 (0.91 - 1.33)
Testis	126 (0.1)	---	0.61 (0.23 - 1.65)	0.66 (0.24 - 1.80)
Urinary Tract	290 (0.2)	13 (0.2)	0.86 (0.50 - 1.50)	0.61 (0.35 - 1.08)
Kidney	181 (0.1)	12 (0.2)	1.28 (0.71 - 2.29)	0.95 (0.52 - 1.72)
Bladder	96 (0.1)	0 (0)		
Brain and Other CNS	109 (0.1)	8 (0.1)	1.41 (0.69 - 2.90)	1.21 (0.58 - 2.51)
Brain	107 (0.1)	8 (0.1)	1.44 (0.70 - 2.95)	1.22 (0.59 - 2.54)
Thyroid and Other Endocrine Glands	89 (0.1)	---	0.65 (0.21 - 2.05)	0.56 (0.18 - 1.78)
Thyroid	84 (0.1)	---	0.69 (0.22 - 2.18)	0.58 (0.18 - 1.85)
Unknown Site	75 (0.1)	---	0.77 (0.24 - 2.44)	0.57 (0.18 - 1.82)
Lymphoid, Haematopoietic + Related Tissue	418 (0.3)	34 (0.5)	**1.57 (1.11 - 2.22)**	1.16 (0.81 - 1.66)
Hodgkin	26 (0.02)	---	0.74 (0.10 - 5.46)	0.71 (0.10 - 5.15)
Non-Hodgkin Lymphoma	180 (0.1)	11 (0.2)	1.18 (0.64 - 2.16)	0.97 (0.52 - 1.80)
Leukaemia	151 (0.1)	18 (0.2)	**2.3 (1.41 - 3.75)**	1.60 (0.96 - 2.64)
Other Cancers	167 (0.1)	15 (0.2)	**1.73 (1.02 - 2.93)**	1.34 (0.79 - 2.27)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction
** Statistically significantly increased RIR results are in **red**.

Table 171: Cancer RIRs* for men across Site Types (mutually exclusive) for all-malignancies and specific cancers

Cancer categories	Site type						
	Only worked in open cut (excludes CHPP and Underground) (reference) N=52,521; PY= 554,934	Ever worked in underground N=30,858; PY = 312,349			Ever worked in CHPP N= 2,784; PY = 35,666		
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted RIR (95% CI)	Number cancers (%)	Unadjusted RIR (95% CI)	Adjusted* RIR (95% CI)
All malignancies	2431 (4.6)	984 (3.2)	0.72 (0.67 - 0.77)	0.97 (0.90 - 1.04)	122 (4.4)	0.78 (0.65 - 0.93)	0.80 (0.66 - 0.96)
Lip, Oral Cavity and Pharynx	135 (0.3)	55 (0.2)	0.73 (0.53 – 1.00)	0.93 (0.68 - 1.27)	---	0.46 (0.17 - 1.25)	0.49 (0.18 - 1.33)
Digestive Organs	458 (0.9)	176 (0.6)	0.69 (0.58 - 0.82)	0.99 (0.83 - 1.18)	18 (0.6)	0.61 (0.38 - 0.98)	0.62 (0.38 - 1.01)
Respiratory and Intrathoracic Organs	247 (0.5)	77 (0.2)	0.56 (0.43 - 0.72)	0.86 (0.66 - 1.11)	9 (0.3)	0.57 (0.29 - 1.11)	0.64 (0.33 - 1.26)
Melanoma	408 (0.8)	192 (0.6)	0.84 (0.71 – 1.00)	0.99 (0.83 - 1.17)	20 (0.7)	0.77 (0.49 - 1.20)	0.72 (0.45 - 1.14)
Mesothelioma	15 (0.03)	6 (0.02)	0.71 (0.28 - 1.84)	1.01 (0.40 - 2.57)	0 (0)		
Male Reproductive Organs	787 (1.5)	306 (1.0)	0.69 (0.61 - 0.79)	1.00 (0.88 - 1.15)	51 (1.8)	1.01 (0.76 - 1.34)	1.06 (0.79 - 1.41)
Urinary Tract	150 (0.3)	54 (0.2)	0.64 (0.47 - 0.88)	0.87 (0.64 - 1.19)	7 (0.3)	0.73 (0.34 - 1.55)	0.75 (0.35 - 1.61)
Brain and Other CNS	56 (0.1)	18 (0.1)	0.57 (0.34 - 0.98)	0.69 (0.40 - 1.17)	---	0.28 (0.04 - 2.02)	0.26 (0.03 - 1.90)
Thyroid and Other Endocrine Glands	40 (0.1)	22 (0.1)	0.98 (0.58 - 1.65)	1.06 (0.63 - 1.78)	---	0.39 (0.05 - 2.84)	0.42 (0.06 - 2.99)
Unknown Site	36 (0.1)	15 (0)	0.74 (0.41 - 1.36)	1.04 (0.55 - 1.97)	---	0.87 (0.21 - 3.60)	0.93 (0.22 - 3.98)
Lymphoid, Haematopoietic + Related Tissue	211 (0.4)	84 (0.3)	0.71 (0.55 - 0.92)	0.91 (0.70 - 1.18)	10 (0.4)	0.74 (0.39 - 1.40)	0.79 (0.42 - 1.49)
Other Cancers	83 (0.2)	34 (0.1)	0.73 (0.49 - 1.09)	0.94 (0.63 - 1.40)	---	0.38 (0.09 - 1.53)	0.39 (0.10 - 1.59)

* Adjusted for era of first examination, age, smoking status, age * era interaction & age * smoking status interaction

** Statistically significantly reduced RIR results are in blue.

Table 172: Cancer RIRs* for all malignancies across Work Categories in women

Work Category	Not in Work Category		In Work Category		Comparison between workers in Work Category vs all the other workers (reference)	
	N [PY]	Number with cancer (%)	N [PY]	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted* RIR (95% CI)
ONLY Unexposed Office	13,472 [100,898]	236 (1.8)	6,608 [50,978]	142 (2.1)	1.19 (0.97 - 1.47)	**1.31 (1.05 - 1.63)**
ONLY Unexposed Non-Office	18,359 [141,027]	350 (1.9)	1,721 [10,849]	28 (1.6)	1.04 (0.71 - 1.53)	0.90 (0.61 - 1.33)
ONLY Occasionally exposed	18,606 [142,470]	360 (1.9)	1,474 [9,406]	18 (1.2)	0.76 (0.47 - 1.22)	1.09 (0.68 - 1.76)
EVER Maintenance - all	18,577 [141,012]	358 (1.9)	1,503 [10,864]	20 (1.3)	0.73 (0.46 - 1.14)	0.68 (0.42 - 1.09)
EVER Production - all	14,719 [110,541]	293 (2.0)	5,361 [41,335]	85 (1.6)	0.78 (0.61 - 0.99)	0.86 (0.67 - 1.09)
Unknown						
EVER Cleaner (nec)	17,551 [132,374]	318 (1.8)	2,529 [19,502]	60 (2.4)	1.28 (0.97 - 1.69)	0.93 (0.70 - 1.24)

* Adjusted for era of first examination, age and smoking status.
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 173: Cancer RIRs* among female coal mine workers who ONLY worked in Unexposed Office jobs

Cancer Categories	All other female coal mine workers	Unexposed Non-Office workers	Comparison of cancer incidence between those who worked in Unexposed Non-Office jobs vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted* RIR (95% CI)
Digestive Organs	30 (0.2)	18 (0.3)	1.18 (0.66 - 2.12)	1.39 (0.75 - 2.59)
Colorectal	19 (0.1)	14 (0.2)	1.45 (0.73 - 2.90)	1.75 (0.84 - 3.63)
Respiratory and Intrathoracic Organs	15 (0.1)	7 (0.1)	0.92 (0.38 - 2.26)	1.28 (0.48 - 3.44)
Lung	14 (0.1)	7 (0.1)	0.99 (0.40 - 2.44)	1.36 (0.49 - 3.72)
Melanoma	37 (0.3)	33 (0.5)	**1.76 (1.10 - 2.81)**	**1.70 (1.03 - 2.81)**
Breast	82 (0.6)	54 (0.8)	1.30 (0.92 - 1.83)	1.44 (0.99 - 2.08)
Female Reproductive Organs	23 (0.2)	9 (0.1)	0.77 (0.36 - 1.67)	0.80 (0.36 - 1.77)
Cervix	6 (0.04)	---	1.32 (0.37 - 4.66)	1.12 (0.28 - 4.49)
Thyroid and other Endocrine Glands	19 (0.1)	9 (0.1)	0.93 (0.42 - 2.07)	1.05 (0.47 - 2.34)
Thyroid	18 (0.1)	8 (0.1)	0.88 (0.38 - 2.02)	0.98 (0.43 - 2.24)
Lymphoid, Haematopoietic + Related Tissue	13 (0.1)	13 (0.2)	1.97 (0.92 - 4.26)	2.01 (0.91 - 4.41)
Hodgkin	---	---	1.48 (0.33 - 6.61)	1.42 (0.38 - 5.30)
Non-Hodgkin Lymphoma	---	7 (0.1)	**3.45 (1.01 - 11.8)**	3.27 (0.94 - 11.35)
Leukaemia	---	---	0.99 (0.18 - 5.38)	1.25 (0.20 - 7.67)

* Adjusted for era of first examination, age and smoking status.
** Statistically significantly increased RIR results are in **red**; reduced RIR results are in blue.

Table 174: Cancer RIRs* for female coal mine workers who EVER worked in Production jobs with the rest of the women in the cohort

	All other female coal mine workers	Production workers	Comparison of cancer incidence between those who worked in production jobs vs all other coal mine workers	
	Number with cancer (%)	Number with cancer (%)	Unadjusted RIR (95% CI)	Adjusted* RIR (95% CI)
Digestive Organs	35 (0.2)	13 (0.2)	1.00 (0.53 - 1.88)	1.13 (0.58 - 2.18)
Colorectal	26 (0.2)	7 (0.1)	0.72 (0.31 - 1.66)	0.79 (0.34 - 1.85)
Respiratory and Intrathoracic Organs	18 (0.1)	---	0.60 (0.20 - 1.76)	0.83 (0.28 - 2.44)
Lung	17 (0.1)	---	0.63 (0.21 - 1.88)	0.88 (0.30 - 2.58)
Melanoma	54 (0.4)	16 (0.3)	0.80 (0.46 - 1.39)	0.85 (0.48 - 1.51)
Breast	111 (0.8)	25 (0.5)	0.60 (0.39 - 0.93)	0.70 (0.45 - 1.08)
Female Reproductive Organs	26 (0.2)	6 (0.1)	0.62 (0.25 - 1.50)	0.68 (0.28 - 1.63)
Cervix	9 (0.1)	---	0.30 (0.04 - 2.35)	0.34 (0.04 - 2.58)
Thyroid and other Endocrine Glands	18 (0.1)	10 (0.2)	1.49 (0.69 - 3.23)	1.36 (0.64 - 2.91)
Thyroid	16 (0.1)	10 (0.2)	1.68 (0.76 - 3.70)	1.53 (0.70 - 3.32)
Lymphoid, Haematopoietic + Related Tissue	19 (0.1)	7 (0.1)	0.99 (0.42 - 2.35)	1.11 (0.48 - 2.59)
Hodgkin	---	---	1.07 (0.21 - 5.53)	1.11 (0.23 - 5.30)
Non-Hodgkin Lymphoma	9 (0.1)	---	0.60 (0.13 - 2.76)	0.77 (0.16 - 3.72)
Leukaemia	---	---	1.34 (0.25 - 7.33)	1.76 (0.43 - 7.16)

* Adjusted for era of first examination, age and smoking status. ** Statistically significantly reduced RIR results are in blue.

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