Hazelwood Health Study Adult Survey

Volume 1 Comparison of Morwell and Sale

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Acknowledgements

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Abbreviations

A5	Metric paper size 148x210 mm
A6	Metric paper size 105x148 mm
ABS	Australia Bureau of Statistics
AUDIT-C	Alcohol Use Disorders Identification Test
BHR	Bronchial Hyper-reactivity (usually demonstrated by Methacholine challenge test)
BOLD	Burden of Obstructive Lung Disease study
CIDI	Composite International Diagnostic Interview
COPD	Chronic Obstructive Pulmonary Disease
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DOB	Date of birth
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, fourth edition
GOLD	Global Initiative for Obstructive Lung Disease
HRF	Hunter Research Foundation
IES-R	Impact of Events Scale – Revised
K10	Kessler 10 item Psychological Distress Scale
MICE	Multiple imputation by chained equations
MUHREC	Monash University Human Research Ethics Committee
PM$_{2.5}$	Particulate Matter less than 2.5 thousandths of a millimetre in diameter
PTSD	Post-traumatic Stress Disorder
SA1	Statistical Area Level 1
SF12	Short Form 12 item Health Survey
SPHPM	Monash University School of Public Health and Preventive Medicine
VEC	Victorian Electoral Commission
WHO	World Health Organization

Executive Summary

This report comprises Volume 1 of the Hazelwood Health Study Adult Survey findings, which aims to assess whether Morwell adults, who were heavily exposed to smoke from the Hazelwood mine fire, have adverse cardiovascular, respiratory or psychological symptoms compared to Sale adults, who were minimally exposed.

Eligible participants were people aged 18 or older, at the time of the mine fire, who lived in Morwell or in one of 16 selected areas in Sale. Contact details for eligible subjects were drawn from the electoral roll maintained by the Victorian Electoral Commission (VEC). The VEC identified 9,448 registered Morwell residents and 4,444 registered Sale residents. For their convenience, participants were offered the option of completing the Adult Survey in one of three ways: by telephone interview, online or by paper questionnaire. Diverse strategies were utilised in the effort to contact and maximise recruitment of eligible adults from Morwell and Sale. These included personalised mail, $20 gift vouchers as reimbursement, free public events, radio and print media, posters and flyers. Feedback was monitored in order to identify and address barriers to participation.

Recruitment commenced in May 2016 and concluded in February 2017. In total 3,096 (33%) Morwell residents and 960 (23%) Sale residents participated in the Adult Survey. These recruitment rates were similar to, if not higher than, comparable studies. However sampling (selection) bias was a concern, where the health of participants might differ from the health of non-participants. A comparison of participants with community data, collected by the Australian Bureau of Statistics (ABS), indicated that women, and people aged over 50, were slightly overrepresented amongst participants. Importantly this occurred in both the Morwell and Sale groups which makes bias, that might be caused by gender or age differences, unlikely. To reduce the possibility of participation bias, the results were weighted by gender and age group. Furthermore, to minimise the effects of important health risk factors, multivariable methods were used to adjust for differences between the participating groups in education, employment, smoking, and alcohol use, as well as gender and age.

Prior to the mine fire, the prevalences of most self-reported, doctor diagnosed medical conditions were similar in the two groups. Exceptions were high cholesterol and angina, which were slightly higher in Morwell, and arrhythmia (irregular heart rhythm) which was slightly lower. However, since the time of the mine fire, Morwell participants have been at 1.5-fold higher risk than Sale participants of having high blood pressure diagnosed, and nearly seven-fold risk of heart attack. While this finding for heart attack was striking, the numbers of people affected were small.
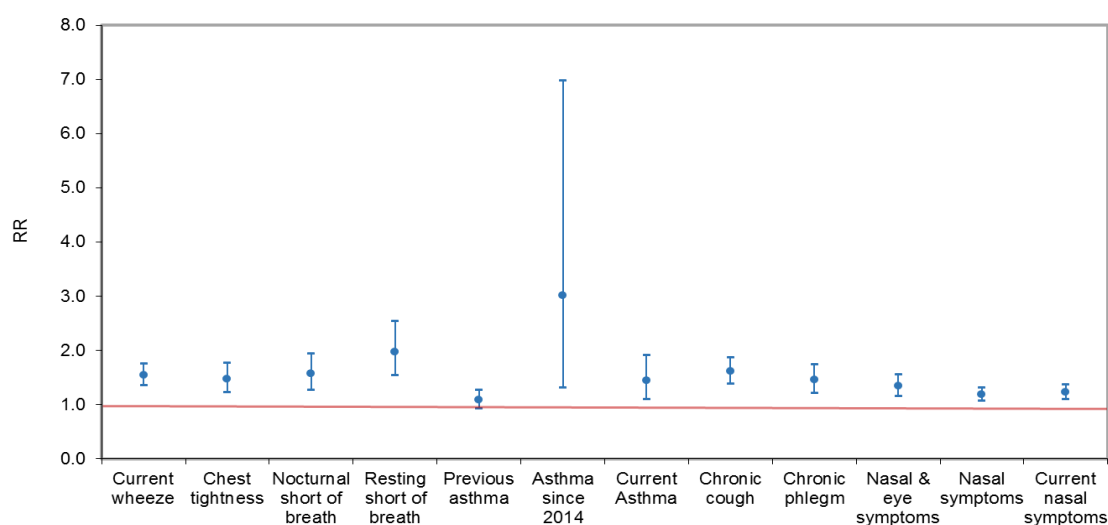
Figure 1 Adjusted Rate ratios and 95% Confidence Intervals for self-reported asthma and current respiratory symptoms

The differences between Morwell and Sale, in self-reported pre- and post-mine fire asthma and respiratory symptoms in the past 12 months, are summarised in Figure 1. Self-reported doctor diagnosed asthma, since the mine fire, and current respiratory symptoms were all significantly more common among Morwell compared with Sale participants. Amongst asthmatics, symptoms were also more severe in Morwell compared to Sale. The risks of irritant symptoms from the chest and nose, consistent with chronic bronchitis and rhinitis, were also significantly higher among Morwell participants compared with Sale.

The Adult Survey included a number of measures of psychological wellbeing, including distress specifically linked to the mine fire event (IES-R) as well as a non-specific measure of current distress (K10). Morwell participants reported higher levels of distress on both measures, including all three subscales of the IES-R representing intrusive thoughts, avoidance behaviours and hyperarousal. In addition, Morwell participants were over three times more likely than Sale participants to report a diagnosis of posttraumatic stress disorder (PTSD) since the mine fire event, although the numbers of people affected were very small.There appeared to be no significant differences between Morwell and Sale in regard to diagnoses of mental health conditions prior to the mine fire, nor any difference in number of lifetime stressful life events.

An important strength of the Adult Survey was the inclusion of a comparison group of adults, from selected areas of Sale, who were similar to the Morwell adults in terms of their regional location and socio-economic indices. The findings were further strengthened by the availability of gender and age information, allowing for appropriate weighting of results. Additional statistical adjustments for gender, age, education, employment, smoking and alcohol also reduced the potential confounding effects of these important health risk factors.

A methodological limitation, of the Adult Survey, was the reliance on self-reported health measures. Such measures could render the results vulnerable to differential recall/reporting bias. For example, this might occur if *exposed* participants had a heightened awareness of symptoms and therefore, reported them more frequently relative to *unexposed* comparison participants whose health was otherwise the same. The Adult Survey design aimed to minimise the risk of differential recall bias by utilising validated questionnaires where possible.

Future analyses will include linked administrative health datasets, such as ambulance and emergency presentations and hospital admissions, which should be less prone to recall bias. Finally, future analyses will also compare similarly exposed Morwell adults. That analysis should be less prone to recall bias and could investigate whether some sub-groups, of similarly exposed participants, are more vulnerable than others to health impacts.

This analysis of the Adult Survey provides the first available evidence of current adverse cardiovascular, respiratory and psychological effects of the Hazelwood mine fire on the adults in Morwell. Increased risks have been observed for high blood pressure, heart attacks, respiratory symptoms, asthma and psychological distress. This report presents just broad differences between Morwell and Sale based on self-reported data. Future linkages to administrative health datasets will complement the self-reported data. The Adult Survey findings will be further strengthened by analyses which blend CSIRO modelled air pollution data with participants' location information, to measure any association between estimated mine fire smoke exposure and health outcomes.

The Adult Survey sub-studies, commencing data collection in the 2nd half of 2017, will further complement the current work. The self-report data will be supplemented with clinical data on blood pressure, vascular function, inflammatory markers, respiratory function, and interview-based information on current perceptions of the mine fire events and the role of other social factors.

1. Introduction

During February and March 2014 a brown coal fire burned in the Hazelwood power station open-cut pit causing a period of smoky conditions in the Latrobe Valley, Victoria. The fire was unusual in that it burned and emitted smoke at the same location, adjacent to the town of Morwell, for over a month and was larger than previous coal fires in Australia and overseas. There were few precedents upon which to base public health protection messages or to assess adverse health effects. The Victorian State Department of Health (DOH) determined that it was important to learn from the fire, particularly for:

- the benefit of the local community who [were] exposed to this smoke by monitoring any potential long term health effects; and
- assisting health authorities, environment protection agencies and emergency services to inform and improve future policy and planning in the event of future similar events.

In order to achieve these objectives, the DOH released a Request for Tender for *A long term study into the potential health effects from the Hazelwood coal mine fire*. On 30th October 2014, the DHHS let the Tender to a Monash University-led research team with collaborators at Federation University, the University of Tasmania, the University of Adelaide and the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

The Hazelwood Health Study (HHS), as it has been renamed by the researchers, is a program of research that comprises several research streams, each with their own aims and objectives. They include the:

- Adult Survey stream (upon which this report is based) which focuses on the health of adults who lived in Morwell at the time of the fire, relative to a comparison group of adults who lived in Sale.
- Latrobe Early Life Followup (ELF) stream which focuses on the health and development of infants born in the Latrobe Valley close to the time of the mine fire;
- Child component of the Psychological Impacts stream (also termed the Schools Study) which focuses on the psychological health of school aged children in the Latrobe Valley;
- Impact on Older People stream which focuses on policy decisions made in regard to older people during the event;
- Community Wellbeing stream which describes the perceived impact of the event on community wellbeing as well as effectiveness of community rebuilding activities and of communications during and after the event;
- Hazelinks stream which investigates short, medium and long term health effects across the Latrobe Valley by using routinely collected health databases such as ambulance, hospital, cancer and death data.

This Report comprises Volume 1 of the findings from the Hazelwood Health Study Adult Survey. Specifically, this Volume presents the Adult Survey aims, methods and results specific to the cross-sectional comparison of the self-reported health of adults in Morwell with that in Sale.

It is anticipated that subsequent Hazelwood Health Study Adult Survey volumes will include aims, methods and results investigating the incidence rates of long term health outcomes based on linkage to administrative health datasets, and the association between estimated levels of exposure to the mine fire smoke and the health of adults in Morwell.

2. Research Question

The Adult Survey research question, which is addressed in this Volume, is as follows:

Is there evidence that people in general, and susceptible sub-populations in particular, who were heavily exposed to emissions from the Hazelwood mine fire, compared with otherwise similar people who were minimally exposed to emissions from the fire, currently have clinical or sub-clinical cardiovascular, respiratory or psychological conditions that could be associated with clinically important adverse health consequences in the future?

3. Human Research Ethics Committee approval

The protocol for the Adult Survey (Project number CF15/872) was considered by the Monash University Human Research Ethics Committee (MUHREC). The Committee was satisfied that the proposal met the requirements of the National Statement on Ethical Conduct in Human Research and granted approval for the period 21 May 2015 to 21 May 2020.

4. Methods

4.1. Study Design

This part of the Adult Survey comprises a cross-sectional study of self-reported health.

4.2. Eligible subjects

The Adult Survey exposed (study) group is defined as people who lived in Morwell, and were 18 years or older, on the 31st of March 2014. For the purpose of the study, Morwell is defined as the area within the township boundary.

The eligible comparison group are people aged 18 years or older on the 31st of March 2014, who live within one of 16 selected statistical areas Level 1 (SA1s) within Sale which have comparable median age, household size, Socio-Economic Indexes for Areas (SEIFA) and population stability as Morwell. Sale was determined, via CSIRO modelling, to have had little exposure to smoke during the Mine Fire event.

The electoral roll maintained by the Victorian Electoral Commission (VEC) was determined to be the preferred sampling frame from which to identify eligible subjects, and their contact details, for the Adult Survey.

4.3. Final sample size

The VEC identified 9,448 adults registered on the electoral roll as residents of Morwell at the time of the Hazelwood mine fire in February 2014.

The VEC identified 4,444 adults registered on the electoral roll as residents of the targeted areas of Sale in February 2014.

These numbers, provided by the VEC, excluded an unknown number of silent electors for whom the VEC could not disclose contact details.

4.4. Contact and recruitment methods

Numerous methods were employed in the attempt to contact and maximise recruitment of eligible adults from Morwell and Sale. As recruitment progressed, the researchers monitored feedback from residents via public events, calls and emails to the Recruitment Coordinator, also feedback from the interviewers who were

administering the Survey over the phone, the members of the Community Advisory Committee and Wordwise Communications. These various sources of feedback were used to identify barriers to participation and common areas of misunderstanding about the Adult Survey. Based on this feedback, the direct and indirect recruitment strategies, described below, were regularly updated and refined.

4.5. Direct contact methods

Using the name and address details provided by the VEC, all eligible adults were initially invited to participate via mailed invitation.

The first Invitation Pack contained:

- a personally addressed letter of invitation (one of two versions; those being one for Morwell and one for Sale) from the Principal Investigators, Professors Michael Abramson and Judi Walker;
- the Adult Survey and Health Record Linkage Information Sheet;
- an A5 insert showing "How to Participate" on one side and answers to "Frequently Asked Questions" on the other;
- an A6 insert showing that participants would be eligible to receive either a $20 Shop Latrobe City gift card (for Morwell residents) or a $20 Shop in Sale eVoucher (for Sale residents) as reimbursement for their participation.

If no response had been received within two weeks of the mailed Invitation Pack, attempts were made to contact the residents by phone in cases where publicly listed phone numbers could be found. These phone contact attempts were undertaken by a trained team of interviewers at the Hunter Research Foundation (HRF). This team was regularly updated about feedback being received from potential participants including barriers to participation.

If no response had been received within three weeks of the mailed Invitation Pack, a Reminder Postcard was mailed.

If no response was received within three weeks of the mailed Reminder Postcard, a Final Reminder Pack was mailed. The Final Reminder Pack contained:

- personally addressed cover letter (one of two versions; those being one for Morwell and one for Sale) from the Principal Investigators, Professors Michael Abramson and Judi Walker;
- a copy of the Adult Survey and Health Record Linkage Information Sheet;
- one of two versions of the Adult Survey and Health Record Linkage paper questionnaire; those being one for Morwell (Appendix A) and one for Sale, with accompanying Reply Paid envelope;
- an A5 insert showing "How to Participate" on one side and answers to "Frequently Asked Questions" on the other;
- an A6 insert showing either the Shop Latrobe City gift card or the Shop in Sale eVoucher.

4.6. Indirect contact methods

In addition to the direct mail and phone contact attempts, numerous promotional activities were carried out in order to generate interest in the Adult Survey across the two towns and to address possible barriers to participation. Those promotional activities included:

- letter box delivery of fridge magnets (
- Figure 2) promoting the launch of the study in Morwell and Sale and featuring local study supporters;
- monthly media releases tailored to promote the Adult Survey activities and to address community concerns or misconceptions (for example, Figure 3);

- regular updates to the FAQs on the Hazelwood Health Study website;
- radio advertising;
- attendance at numerous public events such as the Morwell 50 Mile Farmers Market and the Morwell Pop-up Park (Figure 5 and Figure 6);
- newspaper advertisements (Figure 7);
- a dedicated 1300 number, manned by the Adult Survey Recruitment Coordinator and additional trained Monash University researchers, to respond to incoming enquiries;
- advertised attendance of Monash University researchers at the local libraries to provide assistance or answer enquiries;
- attendance at existing community groups such as sports clubs;
- roadside banners (Figure 8);
- posters (Figure 9)
- questionnaire packs made available in public venues such as doctor's rooms, sports clubs, laundromats and libraries

4.7. Recruitment time line

Recruitment into the Adult Survey launched in May 2016 in Morwell, and June 2016 in Sale.

For the purpose of the mail-out of personalised invitation packs, Morwell was divided in to six areas (shown in Figure 10) which were targeted sequentially over a six month recruitment period; with Area 1 mailed invitation packs in May 2016, Area 2 in June 2016, Area 3 in July 2016 and so on until Area 6 was mailed invitation packs in October 2016. The VEC data included current address for residents who were registered at a Morwell address in early 2014 but had since moved out of the town. They were included in the July 2016 mail-out.

Sale was divided in to five areas (shown in) which were targeted sequentially over a five month recruitment period; with Area 1 mailed invitation packs in June 2016, Area 2 in July 2016 and so on until Area 5 was mailed invitation packs in October 2016. Residents who had moved out of Sale, since the time of the mine fire, were included in the August 2016 mail-out.

Recruitment for the Adult Survey closed in mid-February 2017.

Figure 2 Images of promotional fridge magnets which were delivered to letter boxes across Morwell (left) and Sale (right)

Morwell residents wanted for Hazelwood Health Study

28 Apr 2016, midnight

Leading the way: Hazelwood Health Study researchers Matthew Carroll, Judi Walker and Susan Denny. photograph bryan petts-jones

Researchers are urging as many Morwell residents as possible to participate in a large-scale survey critical to the success of the Hazelwood Health Study.

The study is looking at the long-term health effects of the 2014 Hazelwood mine fire on the community and the survey component is the largest and most complex part.

"The study's success depends on as many people as possible completing the survey, whether they are older, younger, well or unwell," the study's principal co-investigator Professor Judi Walker said.

Information packs have begun arriving at Morwell households and will continue in the coming months, inviting adults to participate.

The survey will ask participants to answer questions about their health and wellbeing, where they were during the mine fire and the type of house in which they live.

They will also be asked to give the research team permission to access further health information from hospital, ambulance and cancer databases, making it possible to follow people's health without having to resurvey them.

The questionnaire is expected to take about 30 minutes either over the phone or online and participants will be compensated for their time with a $20 Latrobe City Gift Card which can be used at local shops across the Valley.

Professor Walker said responses from the Adult Survey, combined with information from other health datasets, would allow researchers to identify any health impacts from mine fire exposure and determine how widespread these impacts were felt in the region.

"This survey will also provide us with new information about the long-term or chronic health conditions of Morwell adults which will be fed back to the local community, local health service providers and the Department of Health and Human Services." Professor Walker said.

Figure 3 Example of news article arising from an Adult Survey media release

Hazelwood HEALTH STUDY

Have you received an invitation, but not completed the Adult Survey yet?

You are invited to chat to the researchers and complete the survey while you enjoy a free tea / coffee and muffin

Where:
Mid Valley Shopping Centre
(opposite Muffin Break, Centre Court)

When:
10am-2pm,
Saturday 10th September and
Thursday 13th October

All eligible adults who complete the survey also receive a **$20** Shop Latrobe City gift card

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Hazelwood HEALTH STUDY

Free Event for Parents & Grandparents*
by registration only

Explore! Fun! Wow!

Complete the survey while the kids play & eat for FREE!

Limited to 4 children per family*

Sunday 18th Sept 11.30-2.30

*To be eligible you must have lived in Morwell during the mine fires and have been over 18 years old

where? TRIBES EAT PLAY LAUGH
107-111 Crinigan Rd
MORWELL
get your gift card on the day! gift

To register phone **1800 985 899** or
e: recruitment@hazelwoodhealthstudy.org.au

Hazelwood HEALTH STUDY

HAVE YOU COMPLETED THE ADULT SURVEY YET?

Hazelwood HEALTH STUDY

The Hazelwood Health Study

is an important program of research measuring the health of children, adults and the elderly across the Latrobe Valley and parts of Gippsland.

Right now, the researchers are inviting adults who lived in Morwell during the Hazelwood Mine Fire to participate in the Adult Survey and Health Record Linkage Study.

The Adult Survey is being led by an independent team of researchers from the School of Public Health and Preventive Medicine, and the School of Rural Health at Monash University.

The study aims to address community concern about the long term health impacts of the mine fire and also to inform health service planning for the region.

This brochure provides information about how to participate, answers to some Frequently Asked Questions and invitations to some upcoming events.

For more information go to

hazelwoodhealthstudy.org.au

How to Participate

If you have received a mailed invitation, you can complete the Adult Survey:

OVER-THE-PHONE
by calling 1800 082 238
Please quote your name, the unique ID shown on your invitation letter, and a return telephone number.

ONLINE
at www.hazelwoodhealthstudy.org.au
click on the link under the heading "COMPLETE THE ADULT SURVEY ONLINE" and enter your unique ID shown on your invitation letter.

ON PAPER
by completing the paper questionnaire which you may have received in the mail, or you can request one by calling 1800 985 899

IN PERSON
at one of three upcoming events
(see overleaf for full details):
**Saturday 10th September 10am – 2pm or
Thursday 13th October 10am – 2pm
Mid Valley Shopping Centre.**
Free tea/coffee and muffin while you complete the Adult Survey

**Sunday 18th September
11.30 - 2.30pm Tribes Play Centre**
Children eat and play for free while carers complete the Adult Survey.
Registration essential on 1800 985 899

If you think you are eligible for the Adult Survey, but have not received a mailed invitation, please call 1800 985 899

Frequently Asked Questions

Who is included in the Adult Survey?
All adults who lived in Morwell, or selected parts of Sale, at the time of the Hazelwood mine fire.

Should I participate if I wasn't affected by the smoke?
Yes, all eligible adults should participate, even if not affected by the mine fire smoke.

What does Health Record Linkage mean?
This involves the researchers accessing some information about your health that is recorded by hospitals, ambulance services and the national cancer and death registries. This does not include any personal notes written about you by a doctor, or test results. You do not have to agree to Health Record Linkage to participate in the Adult Survey.

How private is my information when I complete the survey?
Your privacy is of utmost concern to the researchers who are bound by the Privacy and Data Protection Act 2014 and the Health Records Act 2001. Your name and contact details are removed from your health information. Findings from the Adult Survey will be presented in a way which ensures that participants cannot be identified.

What's in it for me and my community?
All participants receive a $20 voucher that can only be used in Latrobe Valley or Sale businesses to directly support the local economy. The study findings will inform health service planning for Gippsland, now and for future generations.

Figure 4 Tri-fold flyer promoting catered events in public venues for Adult Survey participants

Figure 5 Recruitment Coordinator, Susan Denny, at the Morwell 50 mile Farmers Market, June 2016.

Figure 6 HHS promotional stand at Morwell Pop-Up Park in April 2016
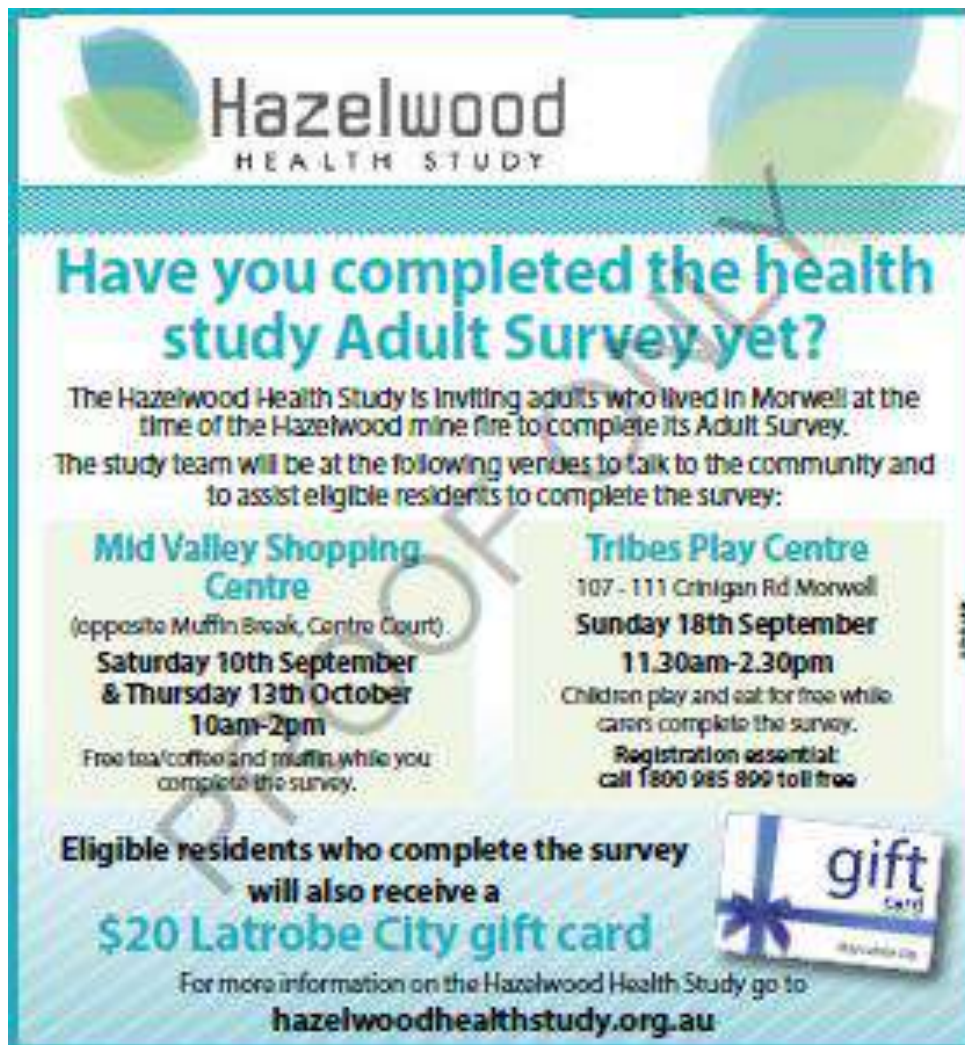
Figure 7 Proof of an ad intended for publication in the Latrobe valley Express

Figure 8 Roadside banner promoting the Hazelwood Health Study

Figure 9 Examples of posters promoting Adult Survey questionnaire packs available in Morwell and Sale
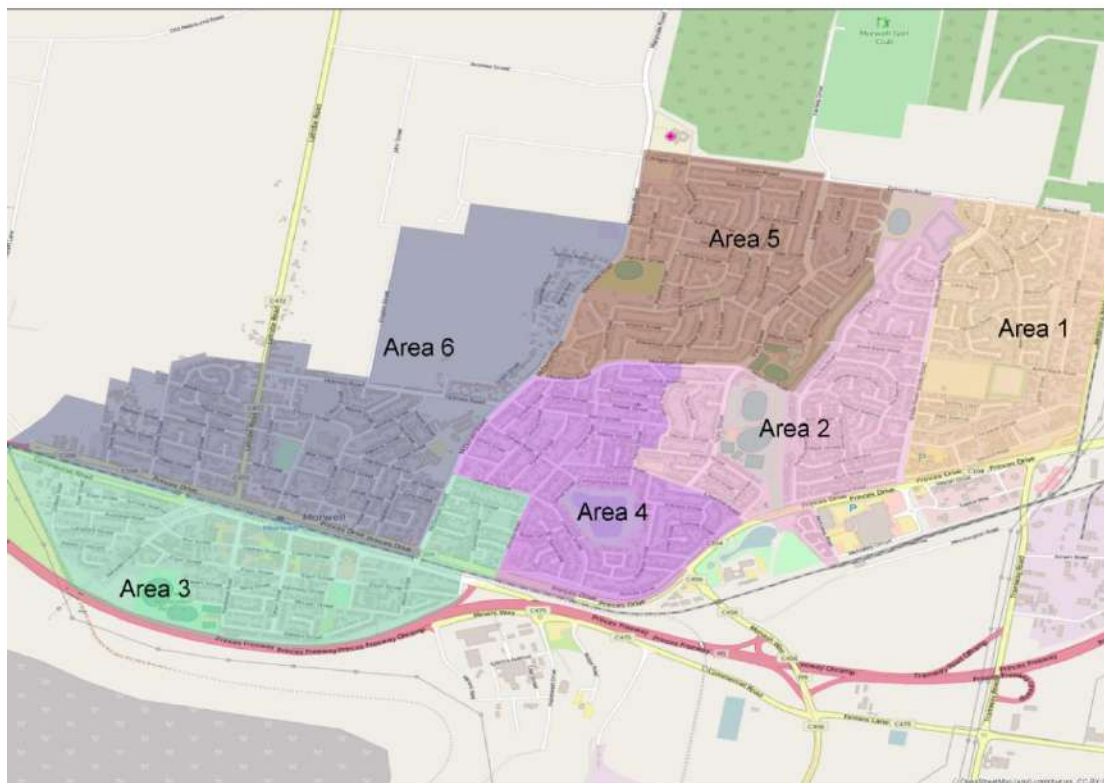
Figure 10 Map of Morwell demonstrating the Areas that were approached sequentially over a six month recruitment period from May to October 2016
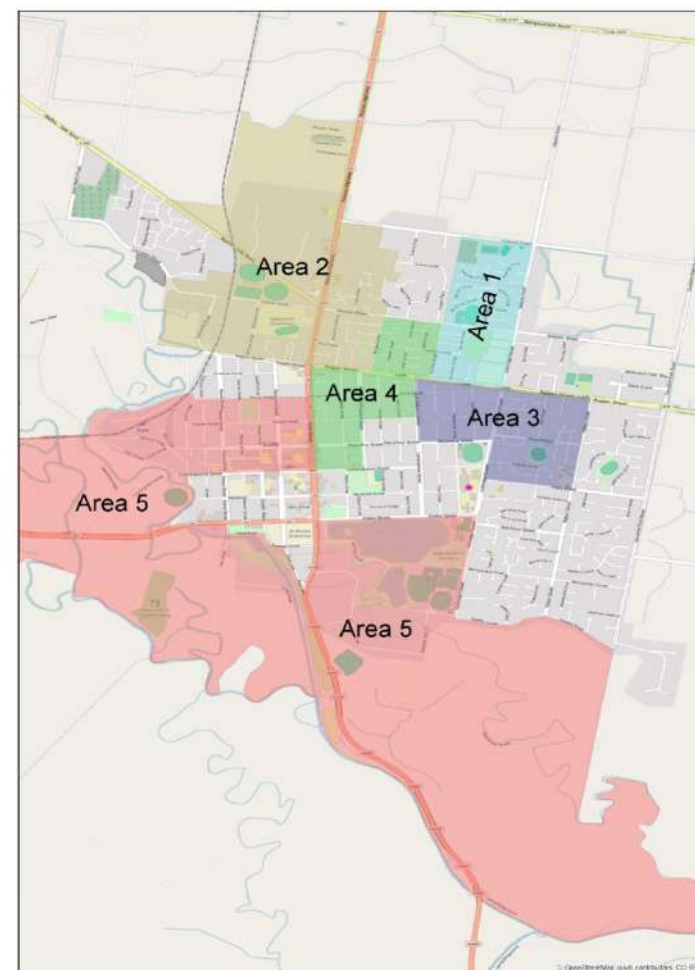
Figure 11 Map of Sale demonstrating the Areas that were approached sequentially over a five month recruitment period from June to October 2016

4.8. Data collection instrumentation and measures

4.8.1. Self-report health survey

The data that have been analysed and reported upon in this volume of results, were drawn from answers to the following sections of a self-report health survey/questionnaire (see Appendix A for the complete questionnaire for Morwell participants).

Section A - Details about you (questions A1-A14)

Participants were asked to provide demographic information including their age, gender, marital status, country of birth, language/s spoken at home, any Aboriginal or Torres Strait Island origin, highest level of education completed, employment status, current address, home ownership status and number of years lived in Gippsland

Section B – General Health

Self-perceived general health status (question B1)

The first question from the Short Form 12 Health Survey (SF-12)[1] was used as a broad measure of self-perceived general health status. The SF12 has become one of the most widely used instruments for measuring the health of populations. The first question has been used as a brief stand-alone measure of health status in the Australian Health Surveys.[2]

Doctor-diagnosed medical conditions (questions B2 – B5)

Participants were asked to report whether or not a medical doctor had ever told them that they had high blood pressure, high cholesterol, angina, heart attack, heart failure, irregular heart rhythm, other heart disease, stroke, cancer, diabetes, anxiety, depression, post-traumatic stress disorder, other mental health conditions or other medical conditions not previously listed. If Yes, the year of first diagnosis or episode was requested. If Yes to diabetes, the type of treatment received was also requested.

Where participants reported a medical condition with year of first diagnosis or episode in 2013 or earlier, these were coded as *prior to the mine fire*. Where participants reported a medical condition with year of first diagnosis or episode in 2014 or later, these were coded as *post mine fire*.

Section C - Respiratory Health (questions C1-C14)

A modified version of the European Community Respiratory Health Survey (ECHRS)[3] was included to identify respiratory symptoms such as wheeze, chest tightness, shortness of breath, allergies, cough and sputum and respiratory medical conditions including asthma, emphysema or chronic obstructive pulmonary disease (COPD) and associated medications. Pekkanen *et al*.[4] developed an asthma severity score based on eight symptoms from the ECRHS questionnaire. Seven of these questions were included in the Adult Survey and formed the basis of a modified asthma severity score.

Section D - Smoking history (questions D1-D3)

Cigarette smoking has been associated with numerous diseases including cardiovascular diseases, cancers, emphysema, stroke and thrombosis.[5] Therefore it was essential to measure participants' exposure to tobacco and other smoke. In the Adult Survey, respondents indicated whether they had ever smoked at least 100 cigarettes, or a similar amount of tobacco, in their life-times.

Participants who answered "No" were defined as *never smokers* as per the World Health Organization (WHO) definition.[6] Participants who answered "Yes", then reported whether they were current daily, weekly or less than weekly smokers, or former or occasional smokers.

Smokers were also asked to estimate their total number of years of smoking, and the average number of cigarettes smoked per day, week or month. That information was used to calculate the total number of cigarettes smoked, which was expressed in pack-years. It was assumed that one pack contained 20 cigarettes. Pack-years were calculated as total number of cigarettes per year, divided by 20 (cigarettes per pack), divided by 365 (days per year). One pack year is equivalent to smoking one pack of 20 cigarettes per day for a year. For example, a person who smoked an average of 10 cigarettes per day for a duration of 10 years (the equivalent of 36,500 cigarettes) received a pack-years score of 5 (36,500 ÷ 20 ÷ 365 = 5).

Amongst *never smokers*, passive tobacco smoke exposure in the past 12 months was measured by asking about other people in the household who smoked regularly inside the house.

Further, amongst *never smokers*, passive exposure to wood or briquette smoke was measured by asking the number of years in total a participant had lived in any home with a wood or briquette heater.

Section D - Current wellbeing in regard to the Hazelwood event (questions E1-22)

The Impact of Events Scale – Revised (IES-R) [7] was utilised here as the primary psychological outcome measure. The IES-R measured the current subjective level of distress associated with exposure to the Hazelwood smoke event. The scale involved 22 items which respondents scored on a 0-4 scale (0 = Not at all; 1 = A little bit; 2 = Moderately; 3 = Quite a bit; 4 = Extremely). The items tapped into symptoms associated with Post-Traumatic Stress Disorder. The items were grouped into the three sub-scales which aligned with the diagnostic criteria for PTSD in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). These three groupings were: Intrusion (such as intrusive thoughts of the event), Avoidance (such as trying not to think about the event) and Hyperarousal (such as being jumpy and easily startled). Scoring the IES-R involved calculating the sum of the response items for each of the sub-scales and for the total score (so the total could range from 0 to 88).

According to the original publication, the IES-R subscales have high internal consistency with coefficient alpha scores ranging from 0.79 to 0.90 with acceptable six-month test-retest reliability correlations ranging from 0.57 to 0.92. [7] More recently, Beck *et al*. [8] assessed the psychometric properties of the scale and confirmed alpha coefficients between 0.85 and 0.90 for the subscales and 0.95 for the total scale.

The IES-R was not designed as a diagnostic tool, so there were no standardised cut-offs for PTSD. However a number of researchers have assessed the sensitivity and efficiency of the IES-R by comparing it with results from a diagnostic interview. These suggested cut-offs scores for likely diagnosis of PTSD range between 22[9] and 44[10] with scores above 33 being considered as the most appropriate cut-off for probable diagnosis of PTSD.[11, 12]

Section I - Recent wellbeing (questions I 1–10)

The Kessler Psychological Distress Scale (K10)[13] is a brief 10-item scale which was developed as a population screen for psychological distress. Kessler *et al.*[14] assessed the suitability of the K10 as a screen for serious mental illness and found that it performed as well as more lengthy clinical measures and had a high Cronbach alpha internal consistency score of 0.93.

The K10 has been commonly used in Australian population health surveys such as the ABS Australian Health Survey,[15] the Victorian Population Health Survey[16] and in longitudinal studies such as the 45 and Up Study.[17] The K10 was included in the Adult Survey to allow comparison with these existing datasets. Unlike the IES-R, the K10 is not specific to an event and is about the level of anxiety and depression experienced in the past four weeks.

Each item is scored on a 1-5 scale (1=none of the time; 2=a little of the time; 3=some of the time; 4=most of the time; 5=all of the time), resulting in a total score ranging from 10 to 50. There are no set cut-offs for the K10, with multiple approaches used in Australia. For example, the ABS used the following groupings: 10-15=Low, 16-21=Moderate, 22-29=High, 30-50=Very high.[18]

Section J - Stressful life events

Prior stressful life events have been shown to impact on traumatic outcomes for some individuals in relation to new critical events. It was therefore considered important to measure participant exposure to stressful events other than the mine fire.

The survey utilised a list of 11 stressful life events extracted from the PTSD module of the Composite International Diagnostic Interview (CIDI) Version 2.1 [19] which was developed by the World Health Organization. The list included exposure to combat, life-threatening accident, rape, and physical attack or any other extremely stressful or upsetting event including having suffered a great shock because of one of these events happening to a close associate.

Because the events list was extracted from the much longer CIDI, and was not designed as a standalone measure, there are no published indications of reliability or validity. The list or a variant of it, has commonly been used in research including two other Australian studies[20, 21] so it may be possible to compare the current population with those from earlier studies. There are no set rules for scoring the responses, so for the purpose of the Adult Survey, we report the number of participants with none, one or two, or three or more exposures to a stressful life event.

Section K - Alcohol use (questions K1-K3)

High alcohol consumption is a major contributor to the burden of disease in Australia. Excessive drinking is associated with numerous diseases, including cardiovascular disease, also social problems, hospitalisations and death.[2] The Alcohol Use Disorders Identification Test (AUDIT-C) is a brief three-item measure of alcohol consumption, based on the earlier 10-item scale first developed by the WHO in 1989.[22] The psychometric properties of the AUDIT-C, as well as its utility across diverse health settings, cultures and languages, have been extensively assessed. In 2009 a systematic review of 47 articles confirmed the psychometric properties of the measure and showed that the abbreviated AUDIT-C was in some instances more sensitive than the longer 10-item version.[23]

The three items relate to the frequency of drinking alcohol in the past year, the number of drinks on a typical day, and the frequency of drinking more than six standard drinks on the one occasion. Each item is scored on a zero (never) to 4 scale. The total score is the sum of the 3 items, thus ranges from zero to 12. Amongst drinkers, a threshold score of 3 or more for women, and 4 or more for men, has been used to identify high risk drinkers.[24]

Modes of health survey completion

Participants were offered the option of completing the self-report health survey in one of three ways.

1. Computer assisted telephone interview (CATI)

Using this method, trained interviewer from the HRF accessed an online version of the health survey and asked participants the questions over the phone. This mode of administration was the researchers' preferred option. Considerable resources were invested in the programming of the CATI and associated training and supervision of the interview team. The CATI was the preferred option for several reasons, including:

- the HRF interviewers were able to assist respondents to understand the intent of each question which enhanced the accuracy of responses and responder satisfaction;
- the computer programming included various logic checks to ensure that responses were within a reasonable range (eg. age at least 18 at the time of the mine fire), relevant/applicable (eg. if a participant had never been a smoker, then subsequent smoking questions were skipped), and complete (eg. program would not continue if a question was missed).

The limitations of participation by CATI included:

- participants needed to make, and keep, an appointment to do the health survey with an interviewer;
- appointments could not always be offered at any time a participant wished;
- participation over the phone was not suited to people with hearing difficulties.

2. Computer assisted web-based interview (CAWI)

This method involved the participants accessing the online version of the health survey themselves.

The advantages of this method included:

- the computer programming advantages as described above, which maximised the logic, relevance and completeness of the participant responses;
- the convenience, for respondents, of answering the questions at whatever time suited them, and to do this in several sessions if needed;
- suitability for participants with hearing difficulties.

The limitations of participation by CAWI included:

- no direct contact with the HRF interviewers or the Monash researchers, however respondents were encouraged to call the HHS 1800 number if they had any questions or difficulties with the Survey;

- the requirement for participants to have a high literacy level in order to read, understand and respond to the questions;
- the need for participants to have internet access and be sufficiently technology-savvy to access the online survey, navigate through the questions and key the responses.

3. Paper questionnaire

The third way of participating in the health survey was to complete the questions on a paper version of the questionnaire (see Appendix A).

The advantages of this method included:

- the convenience, for respondents, of answering the questions at whatever time suited them, and to do this in several sessions if needed;
- that many people were familiar with pen-and-paper type questionnaires;
- no need for participants to have internet access not associated technological skills;
- suitability for participants with hearing impairment.

The limitations of participation by paper questionnaire included:

- the requirement for participants to have a high literacy level in order to read, understand and respond to the questions;
- the need for participants to be able follow the "if… then…" skips in the questionnaire so that they did not answer irrelevant questions;
- the need for participants to take extra care to accurately answer each question without any computer-programmed prompts or checks;
- the inconvenience of needing to return the paper questionnaire to the researchers via Reply Paid mail.

4.8.2. Refuser Questionnaire

Residents wishing to decline participation in the study were offered the option of completing five brief questions in relation to their current health, smoking status, reasons for not participating, sex and age.

Specifically, the Refuser Questionnaire comprised:

1. Question 1 from the SF12[1] which was also included in the health survey. This allowed a comparison between the participants and those non-participants who completed the Refuser Questionnaire, on self-perceived health status.
2. A question about smoking status (never; never regularly; former; current but less than weekly; current weekly but not daily; current daily). This was designed to match as closely as possible to the smoking status questions in the health survey, so that a comparison could be made between participants and non-participants who completed the Refuser Questionnaire.
3. A question about reasons for non-participation including being too busy, not well enough, health not affected by the mine fire, not exposed to the mine fore, not interested in participating in a health study or 'another reason' that respondents could specify.
4. A question about sex (male, female, other).

4.9. Data quality

There were a number of strategies used to optimise the quality of the data collected from Adult Survey participants.

4.9.1. Instrument selection

As described in section 4.8, the Adult Survey used previously validated data collection instruments, and published scoring procedures, where possible.

4.9.2. Pilot studies

The Adult Survey Information Sheet, Consent Form and questionnaire were piloted in two phases. Phase 1 involved 17 adults from the Moe/Newborough area who were asked to complete a paper copy of the Adult Survey questionnaire and to review the Adult Survey Information Sheet and Consent Form. The aims were to identify inconsistencies or errors with the paper-based questionnaire, difficulties with the wording or comprehensiveness of the information sheet and consent form, and to assess the length of the Morwell questionnaire.

Phase 2 involved 20 adults from Morwell or Sale and aimed to assess any difficulties, inconsistencies or errors with the computer-assisted telephone or online versions of the questionnaire.

Feedback, from pilot study participants, was used to:

* identify misconceptions about, or barriers to, participation;
* polish the wording of invitation materials so as to maximise readability and comprehension and to minimise misconceptions and barriers to participation;
* to provide clarification, for the participant, as to why certain types of questions were included (eg. why smoking was included, or why we were asking about well-being in the last 7 days); and
* to augment instructions around 'if… then go to…' statements in the questionnaire in order to improve participant experience and data quality.

4.9.3. Training

All Monash University staff, involved in Adult Survey recruitment, data collection or data entry, completed a course on *Ethics and Good Research Practice* run by the Monash University School of Public Health and Preventive Medicine (SPHPM).

A *Database Procedures Manual* was developed and maintained by the Hazelwood Health Study Data Manager. This reference document was reviewed by all staff involved in data entry to ensure consistency in data entry across the project. The Adult Survey database was regularly reviewed by the Data Manager and Senior Project Manager, with daily feedback to staff in relation to quality and consistency.

All HRF staff, who were involved in interviewing Adult Survey participants by CATI, received training in regard to the background to the Adult Survey and the purpose of the questions in the questionnaire.

4.9.4. Data entry, cleaning and missing data

The method of data entry was determined by the mode of participation. CATI data were entered, by the HRF interviewers, in to an online database. CAWI data were entered, by the respondents, in to a

modified version of that same online database. There were a number of checks programmed into the online database in order to detect missing, invalid, inconsistent or outlying results. For example, the program would provide a prompt if a question was missed, or an error message if a response was outside of a feasible range.

Paper questionnaires were forwarded to Datatime Pty Ltd where the questionnaire responses were double keyed. That meant two Datatime operators separately keyed each questionnaire. If there was any disparity, between the two datasets created for each questionnaire, a supervisor viewed the disparity and made a judgement as to which was the correct entry. If the Datatime operators were not able to decipher a respondent's answer or, if the respondent put answers which were inconsistent with the questionnaire instructions (eg. the respondent selected two answers when they were instructed to choose one), these were referred to the Monash researchers for further review.

Data from the CATI, CAWI and paper questionnaires were then merged in to a single database, where they were then run through a series of additional statistical checks for missing, invalid, inconsistent or outlying results. Where such problems were found in the data, decision rules were made which allowed most records to be 'cleaned' in preference to treating the responses as missing. All such decision rules were incorporated in to the *Database Procedures Manual*.

Examples of the checks, and associated decision rules, include:

- CHECK: Was year of self-reported diagnosis before year of birth, and therefore invalid? This occurred, for example, when respondents misunderstood the question and answered with the number of years they had experienced a condition, and not the calendar year of diagnosis.
  DECISION RULE: If the answer was judged to be number of years, replace that answer with an estimate of which calendar year it would have been. For example, if a respondent who participated in 2016 answered '*5*' for year of angina diagnosis, replace the *5* with *2011*.
- CHECK: Was a *Yes* or *No* response provided for each medical condition listed in Section B2 of the questionnaire? Some respondents looked down the list of medical conditions and only ticked *Yes* to the conditions that they had, and skipped (left as missing) those medical conditions which they didn't have.
  DECISION RULE: Where the above pattern of responses occurred, replace the missing answers with *No*.
- CHECK: Did respondents choose **one** answer to each of the *Wellbeing* questions in Section E? Some participants found it difficult to choose a response category that fitted them and, instead, they chose two adjacent categories; eg. they might have ticked "quite a bit" and also "extremely" in response to one question.
  DECISION RULE: Use a random left-right list to select either the lower (left) or higher (right) response category. That ensured that the researchers didn't systematically over estimate or under estimate respondents' symptoms/health score.

Where data remained missing, after the above cleaning and decision rules were applied, methods of imputation were employed as part of the statistical analysis (see 4.10 for further detail).

4.10. Statistical analyses

Statistical analysis and data transformations were predominantly performed using Stata version 14 (Stata Corporation, College Station, Texas 2015).

4.10.1. Data transformations and preparation

Participant characteristics, symptoms and other adverse health outcomes were most typically measured on dichotomous (e.g. 'no', 'yes'), categorical (e.g. married; divorced; single, never married), ordinal (e.g. not at all; moderately; extremely) or continuous (e.g. score ranging from 1-100) scales.

Some categorical variables were combined for reporting purpose (e.g. divorced and separated were combined to one category). Where participants reported year of diagnosis for medical conditions, separate variables were created to represent diagnoses of a condition prior to the mine fire (2013 or early) or post mine fire (2014 or later).

4.10.2. Imputation for missing values

In population surveys it is common to have missing data, which can sometimes lead to biased estimations if the reasons for the data to be missing are related to variables of interest. For most of variables in the Adult Survey data, the missing proportion was generally less than 1%, however the missing proportion for some multi-scaled instruments were as high as 5%. To obtain more accurate estimations and control for nonresponse bias, imputation procedures were incorporated in the analysis. A widely accepted approach to dealing with missing data is multiple imputation(MI). In many situations, MI produces more statistically valid results compared with other approaches that might be considered, such as mean imputation or complete-case analysis.[25] MI is a technique that replaces each missing values with multiple sets of plausible values that are consistent with the observed data. Then each set of imputations is used to create multiple complete data sets and each of these is analysed separately. The results from each imputed data set are collected together and subsequently combined (averaged) to obtain valid statistical inference.

Multiple imputation by chained equations (MICE) was the method adopted. For health and respiratory outcomes, imputation and regression were carried out using Stata MI procedures.[26] The imputation procedure operated by first fitting a set of imputation models, one regression model for each variable with any missing values (linear, logistic or multinomial logistic regression depending on the measurement scale of the variable being continuous, binary or multi-category respectively). The procedure was then repeated ten times to yield ten imputed datasets [26]. Considering the small proportion of missing data and computational cost, only 10 imputed datasets were used[26]. Sensitivity analysis, for selected variables, identified that using 20 imputed datasets would not make any substantial difference in the eventual results. In the second stage, regression models were fitted with imputed datasets and results were combined and presented. For psychological outcomes with multiple sub-scales, MICE was carried out using a user-written package, which provided the ability to define use-specified chained equations. For each item, the imputation equation was reduced from including all other items to only include those items within the sub-scale and only the sum scores for other sub-scales.[26] The estimation process is carried out the same as the MI procedure.

4.10.3. Assessment of sampling bias and weighting of participant results

Sampling (participation or selection) bias can occur if participants differ from non-participants (ie. refusers and non-responders) on characteristics which are associated with the study outcomes, such as health status. A complete examination of sampling bias would require the collection of comprehensive and current health, demographics and mine-fire smoke exposure information for all of the non-participating study and comparison group subjects. Such comprehensive data were not available for non-participants. However, there are some data sources available which could be used to assess the extent to which the study participants were representative of the populations from which they were drawn.

These data sources included the Refuser Questionnaire data on gender, age, self-perceived health status and smoking status; the Australian Bureau of Statistics (ABS) 2011 Census data[15] on age and gender in Morwell and Sale; the Victorian Population Health Survey 2011-12 data[16] on smoking status in Latrobe City and the Shire of Wellington; and the CSIRO modelled data on air pollution for each SA1 in Morwell for the period of the mine fire.

Based on the findings of the assessment for sampling bias, post-stratification weights will be developed and all further analyses will be conducted using weighted methods of estimation.

4.10.4. Comparison between Morwell and Sale participants

The first stage of analysis involved a cross-sectional comparison of the Morwell and Sale participants.

Differences in participant characteristics between Morwell and Sale are assessed for statistical significance using Pearson chi-squared tests for categorical measures and t-tests for continuous measures, with post-stratification weighting being applied. Where the distribution of a continuous variable was extremely skewed, the nonparametric Somers' D statistic was used to compare groups[27]. On a technical note, the Somers' D was used because the equivalent but more widely used Wilcoxon rank-sum test is not available to be used with weighting in Stata.

Differences in the prevalence of pre-fire medical conditions in Morwell participants, relative to the Sale comparison group, were initially quantified as crude prevalence ratios (PR). Adjusted prevalence ratios (Adj PR) were then calculated using multivariable log binomial regression to control for known confounders such as age, gender, education, employment status, smoking and where appropriate, alcohol use. A technical issue encountered was that high prevalence of some health outcomes caused convergence issues with the log binomial regression model. In those cases the usual workaround was employed, that was to use Poisson regression model with robust error variance estimation.[28]

The difference between Morwell and Sale participants in incidence of health outcomes diagnosed after the fire (in 2014 or later) were quantified as crude rate ratios (RR) and adjusted rate ratios (Adj RR). Similar to the adjusted prevalence ratios, the adjusted rate ratios were obtained by fitting the log binomial regression and controlling for key confounders.

Continuous outcomes and sums of dichotomous or scaled items (e.g. Impact of Event Scale-Revised scores) were compared between Morwell and Sale participants using mean differences (mean diff) and adjusted mean differences (Adj mean diff) using multiple linear regression to control for key confounders.

Differences between groups in outcomes measured as categorical variables, were presented as crude and adjusted relative risk ratios (RRR) using multinomial logistic regression to control for key confounders.

4.10.5. Guide to interpreting the PR and RR

In these analyses the PR is a measure of the percentage of participants, with a self-reported medical condition which pre-dates the mine fire, in Morwell compared to Sale. In contrast the RR is a measure of the risk of a health outcome happening in the post-fire period, in Morwell participants compared to Sale participants.

A PR or a RR with a CI that includes the value one (e.g. a 95%CI of 0.80 to 1.2) means there is a 95% chance that no real difference exists between the two groups in terms of their risk of the measured health outcome. A PR or a RR with a CI lower limit that is greater than one (e.g. a 95% CI of 1.2 to 3.0) means there is at least a 95% chance that Morwell participants are at greater risk of the health outcome than the Sale comparison group. In contrast, a PR or RR with a CI upper limit that is less than one (e.g. a 95% CI of 0.25 to 0.90) means there is at least a 95% chance that Morwell participants are at lower risk of the health outcome than the Sale comparison group.

5. Results

5.1. Recruitment results

5.1.1. Recruitment from the VEC list

As described above, the VEC identified a study group of 9,448 adults residing in Morwell at the time of the mine fire. Of those, 435 were removed from the recruitment denominator because they were identified as being deceased (n=326) or as ineligible. Consequently the recruitment denominator for study group residents on the VEC list was **9,013**.

The VEC identified a study group of 4,444 adults residing in the targeted areas of Sale at the time of the mine fire. Of those 238 were removed from the recruitment denominator because they were identified as being deceased (n=174) or as ineligible. Consequently the recruitment denominator for comparison group residents on the VEC list was **4,206**.

Table 1 Recruitment outcomes for the Morwell and Sale residents on the VEC list

VEC list recruitment rate denominator	Morwell N=9013	Sale N=4206		Study total N=13219
	n (%)	n (%)	χ2 p-value	n (%)
Participants	3096 (34%)	960 (23%)	<0.001	4056 (31%)
Refusers	1170 (13%)	829 (20%)		1999 (15%)
Non-responders	4806 (53%)	2420 (58%)		7226 (55%)

Table 1 shows that a third (34%) of eligible Morwell residents on the VEC list, and almost a quarter (23%) of eligible Sale residents on the VEC list, participated in the Adult Survey. Overall one seventh (15%) declined participation, whilst the majority (55%) simply did not respond with a decision about participation during the study recruitment period.

Figure 12 shows the recruitment rates in Morwell for each of the mail out Areas 1 to 6 (as previously described in Figure 10) and also for those former Morwell residents who had moved out of the town. Residents who received their mailed invitations in the earlier mail outs had more time to participate than those who received their invitations later. The highest participation rate (40%) was in Area 3 which also happened to be the residential neighbourhood closest to the location of the mine fire. The lowest participation rate (20%) was for those residents who had moved out of Morwell, which likely reflected the more mobile nature of this group.
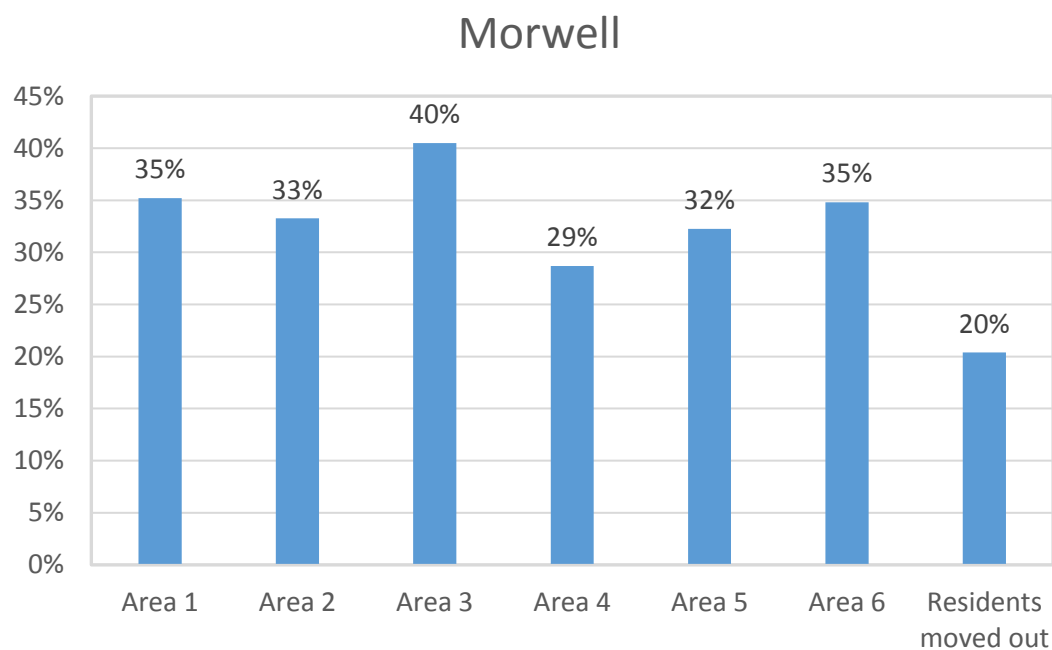
Figure 12 Adult Survey recruitment rate by mail-out Area for Morwell
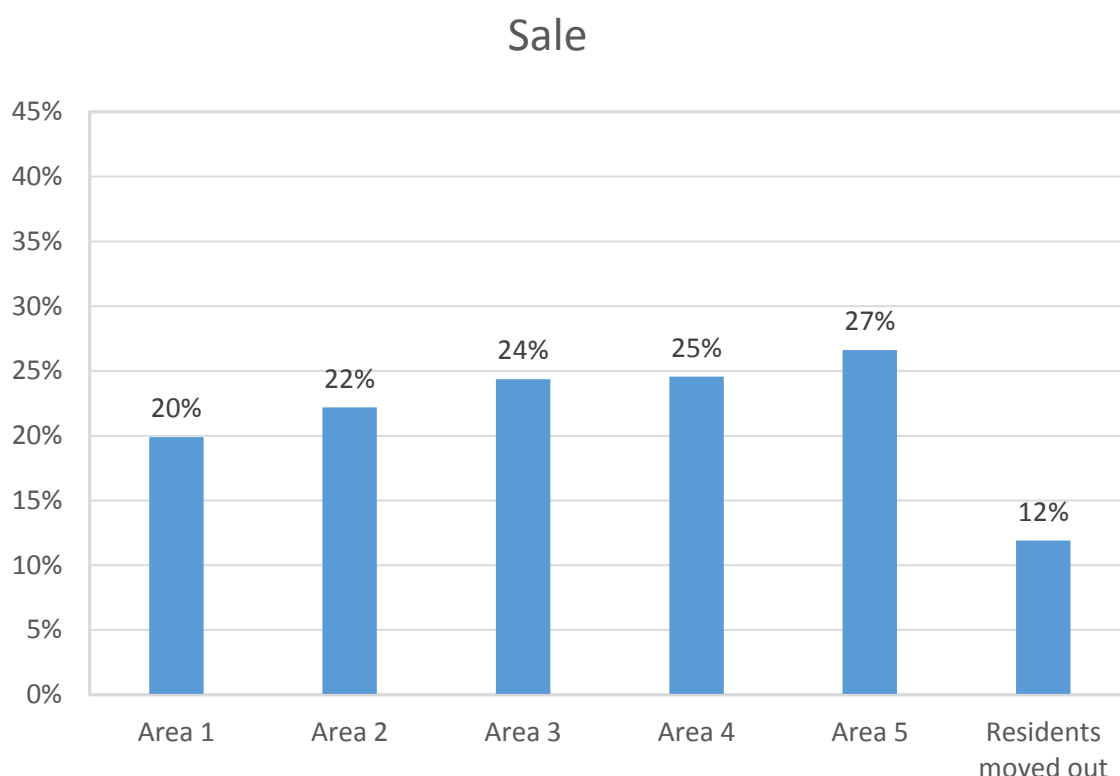
Sale

Figure 13 Adult Survey recruitment rate by mail-out Area for Sale

Figure 13 shows the recruitment rates in Sale for each of the mail-out Areas 1 to 5 (as described in Figure 11) and also for those former Sale residents who had moved out of the town. There was a gradual, though consistent, increase in participation rates over time, with the highest participation rate (27%) in mail-out Area 5 which received invitation packs last. In the lead up to the Adult Survey launch the Hazelwood Health Study, as a whole, had relatively less publicity in Sale than in Morwell. The pattern in recruitment across mail out Areas may reflect the fact that the Areas approached last had been exposed to several months of additional publicity by the time their invitation packs arrived; whereas Area 1 had been exposed to proportionately less publicity. However, the Areas targeted early also had the greatest amount of time to participate before recruitment closed. Consistent with the finding for the Morwell group, the lowest participation rate (12%) was for those residents who had moved out of Sale.

5.1.2. Recruitment of Morwell and Sale residents not listed in the VEC data

Whilst registration on the Electoral Roll is compulsory in Australia, there would have been a number of Morwell and Sale residents who were not listed in the VEC data for various reasons. Silent electors, whilst listed on the Electoral Roll, were also not included with the VEC data. However, these residents remained eligible to participate in the Adult Survey. Such residents did not receive personalised, mailed invitations to participate. Instead, it was hoped that some might respond to the additional recruitment strategies shown at section 4.6.

Termed "**opt-ins**", **59** Morwell residents and **three** Sale residents, who were not included on the VEC list, participated in the Adult Survey.

5.1.3. Final number of participants and mode of participation

The final number of participants in the Adult Survey, adding those from the VEC list and the opt-ins, was **3,096 in Morwell** and **960 in Sale**.

Table 2 shows the proportions of Morwell and Sale participants by mode of Survey completion. The pattern of participation was very similar in the two study groups, with greater proportions of participants in both groups completing the Adult Survey by telephone (38%) or online (38%) and slightly smaller proportions participating on paper (24%).

Table 2 Percentage of participants completing the Adult Survey by telephone, online or on paper.

Total number of participants Mode of participation	Morwell N=3096	Sale N=960		Study total N=4027
	n (%)	n (%)	χ^2 p-value	n (%)
			0.443	
Telephone interview	1171 (38%)	377 (39%)		1548 (38%)
Online questionnaire	1181 (38%)	371 (39%)		1552 (38%)
Paper questionnaire	744 (24%)	212 (22%)		956 (24%)

5.2. Assessment of sampling bias

As described in 4.10.3, there were some data sources available which could be used to assess the extent to which the study participants were representative of the populations from which they were drawn.

5.2.1. Australian Bureau of Statistics data

Australian Bureau of Statistics (ABS) 2011 Census data provided population estimates by age and gender for the Morwell and Sale areas. The breakdown is shown in Table 3 alongside the Adult Survey participant proportions. Adult Survey participants in both the Morwell and Sale groups were more likely to be female and aged 50 or above, compared with the 2011 ABS estimates for the two towns respectively. That is, there was over-representation of women and older people participating in the Adult Survey, in both Morwell and Sale.

It is on the basis of these ABS data, that post-stratification weighting of Adult Survey participant results, by gender and 5-year age band, were applied. This weighting aimed to minimise any bias in health outcomes, which may have been caused by the over-representation of women and older people.

Table 3 ABS*2011 Census estimated adult resident population by age and gender for Morwell and Sale compared with Adult Survey participants

	Participants N=3096	Morwell Census N=10429		Participants N=960	Sale Census N=4816	
	n (%)	n (%)	χ² p-value	n (%)	n (%)	χ² p-value
Gender			0.002			0.136
Male	45%	48%		43%	45%	
Female	55%	52%		57%	55%	
Age Category			<0.001			<0.001
18-29	8%	25%		9%	28%	
30-39	9%	16%		10%	14%	
40-49	14%	17%		13%	17%	
50-59	20%	16%		20%	16%	
60-69	24%	13%		22%	11%	
70+	25%	13%		27%	14%	

* Data source Population Estimates by Age and Sex, Victoria by Statistical Geography [ASGS 2011], 2011, ABS, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3235.02011?OpenDocument

As tobacco smoking is a major risk factor for cardiovascular and respiratory diseases, among others,[2] it was important to know whether smokers were fairly represented amongst the participants. The breakdown of Adult Survey participants, by smoking status, are shown in Table 4 alongside Victorian Population Health Survey 2011-12 data[16] for Latrobe City (which includes Morwell and several surrounding towns) and the Shire of Wellington (which includes Sale and several surrounding towns).

Compared with the pattern of smoking recorded in Latrobe City, Morwell participants were equally likely to be current smokers, more likely to be former smokers and less likely to be never smokers. Compared with the pattern of smoking recorded in Wellington Shire, Sale participants were less likely to be current smokers, slightly more likely to be former smokers and equally likely to be never smokers. The slight over-representation of former smokers amongst the Morwell participants, and under representation of current smokers amongst Sale participants, highlighted the importance of statistically adjusting for this health risk factor.

However an important limitation, to the use of the Latrobe City and Shire of Wellington data to assess sampling bias, is that the people across the wider municipality regions may not be completely representative of the non-participants in Morwell and Sale.

Table 4 Self-reported smoking status in Latrobe City and Shire of Wellington compared with Adult Survey participants

	Morwell participants N=3096	Latrobe City* N=42068		Sale participants N=960	Shire of Wellington* N=73788	
			χ² p-value			χ² p-value
Smoking status			<0.001			<0.001
Current smoker	19%	20%		14%	19%	
Former smoker	32%	26%		33%	28%	
Never	49%	54%		52%	53%	

* Data source: Victorian Population Health survey 2011-12 Findings, https://www2.health.vic.gov.au/Api/downloadmedia/%7B14305C13-A130-4AB1-A5E1-4E94370DBC78%7D

5.2.2. Exposure to the mine fire smoke

As part of the Hazelwood Health Study, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Oceans & Atmosphere Flagship have modelled hourly and 12-hourly cumulative exposure to air pollution particles smaller than 2.5 micrometres (µm; $PM_{2.5}$) for all SA1s in Morwell for the period of the mine fire. A report describing this air quality modelling is available at http://hazelwoodhealthstudy.org.au/study-findings/study-reports/.

By mapping each Adult Survey participant's residential address (at the time of the mine fire) to the SA1s, the CSIRO modelled data could be used to assess whether participants were representative of the wider Morwell population in regard to their *likely* mine fire exposure.

Figure 14 shows the Adult Survey participation rates in the various SA1s across Morwell and also the cumulative 12 hourly $PM_{2.5}$ exposure level modelled for those SA1s. In general, participation rates were slightly higher among residents in the areas to the south of Morwell which were most highly exposed to the mine fire smoke. That may mean that more highly exposed residents were over represented amongst the Morwell-based Adult Survey participants, which may result in the study slightly over-estimating the average difference in health between the Morwell and Sale groups.

Whilst this slight over-representation of highly exposed residents cannot be adjusted for in these analyses, future analyses will aim to evaluate any association between modelled level of air pollution exposure with health impacts within the Morwell study group.
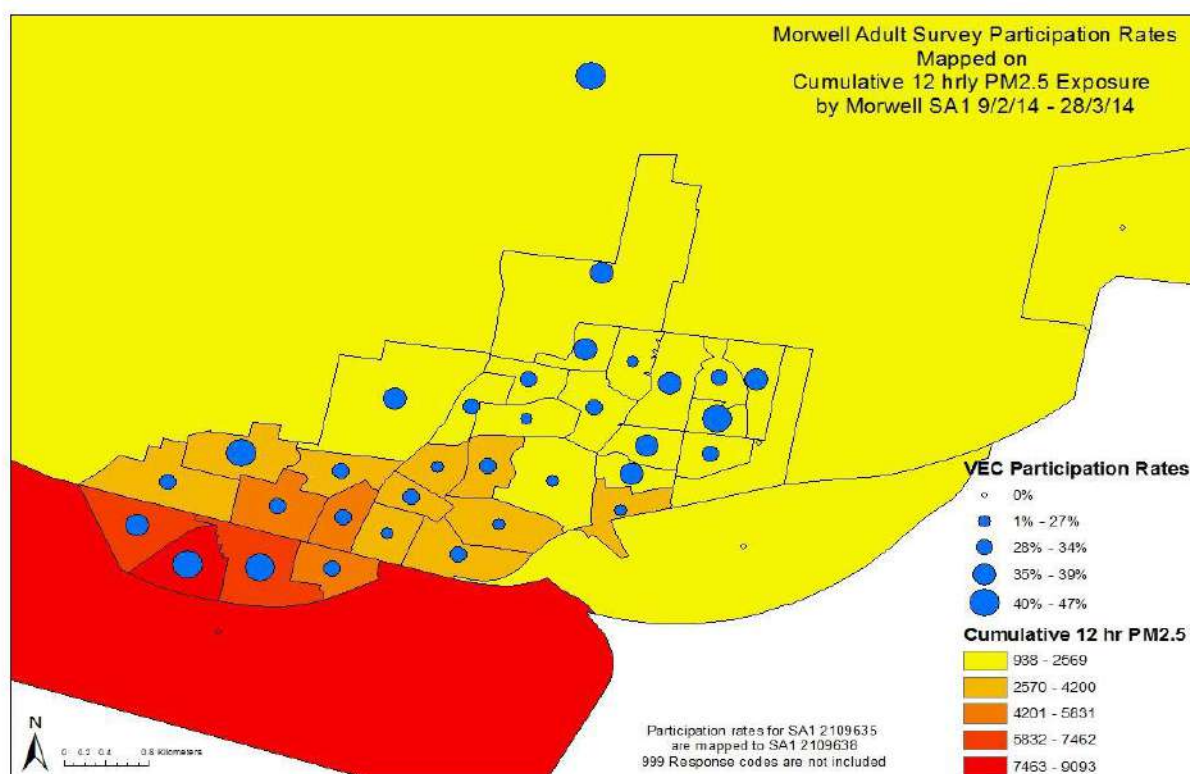
Figure 14 Adult Survey participation rate by CSIRO modelled cumulative 12 hourly $PM_{2.5}$ exposure

5.2.3. Refuser Questionnaire data

The Refuser Questionnaire was completed by 358 refusers; 235 from Morwell and 123 from Sale. This provided a further source of information from which to assess the representativeness of participants.

As shown in Table 5 participants in Morwell were very similar to those non-participants in Morwell who completed the Refuser Questionnaire, in regard to gender and self-perceived health. However, Morwell participants were more likely to be aged in their 20s to 50s, less likely to be aged over 70, and more likely to be current smokers than these non-participants.

Participants in Sale were more likely to be male, more likely to be aged 20 to 59, less likely to be aged over 70, more likely to rate their health as good and less likely to rate it as fair or poor, and more likely to be current smokers than non-participants in Sale who completed the Refuser Questionnaire.

Because the most elderly residents and current smokers were underrepresented in both groups of participants these factors were unlikely to notably effect the magnitude or direction of any observed differences in health outcomes between study groups.

It was encouraging to observe that Morwell participants reported a similar pattern, of self-perceived health, as Morwell non-participants. If people with poor health were over-represented in the Morwell participants, that would artificially inflate the observed differences between the two groups. In contrast, the slight over-representation of Sale participants in good health may reduce the observed differences between the two groups. The underrepresentation of women among Sale participants, which was not reflected in the Morwell participants, could also possibly effect the magnitude or direction of differences in health outcomes between study groups. For this reason it was important to adjust for gender as a potential confounder in the statistical analyses.

An important limitation, in regard to the use of Refuser Questionnaire data to assess sampling bias, is that the people who complete the Refuser Questionnaire may not themselves be representative of the remaining non-participant group. For example, people who completed the Refuser Questionnaire were often those with publically listed landline phone numbers and therefore, they may have been older residents at long-term addresses.

Table 5 Comparison of participants with non-participants who completed a Refuser Questionnaire

Question	Morwell Participants N=3096	Morwell Refuser questionnaire N=235		Sale Participants N=960	Sale Refuser questionnaire N=123	
	n (%)	n (%)	χ^2 p-value	n (%)	n (%)	χ^2 p-value
Gender			0.914			0.085
Male	1389 (45%)	105 (45%)		410 (43%)	41 (34%)	
Female	1705 (55%)	127 (55%)		550 (57%)	78 (66%)	
Age Category			<0.001			<0.001
18-29	243 (8%)	13 (6%)		85 (9%)	4 (3%)	
30-39	270 (9%)	5 (2%)		94 (10%)	5 (4%)	
40-49	417 (13%)	14 (6%)		127 (13%)	7 (6%)	

50-59	630 (20%)	28 (12%)		189 (20%)	19 (16%)	
60-69	748 (24%)	50 (22%)		208 (22%)	24 (20%)	
70+	782 (25%)	116 (51%)		257 (27%)	60 (50%)	
In general would you say your health is:			0.395			0.185
Excellent	263 (9%)	19 (9%)		144 (15%)	18 (15%)	
Very good	800 (26%)	54 (24%)		325 (34%)	39 (33%)	
Good	1087 (35%)	82 (37%)		289 (30%)	27 (23%)	
Fair	659 (21%)	41 (18%)		151 (16%)	24 (20%)	
Poor	266 (9%)	27 (12%)		45 (5%)	10 (8%)	
Smoking status			<0.001			0.093
Current smoker	516 (17%)	24 (11%)		126 (13%)	11 (9%)	
Former smoker	992 (32%)	79 (36%)		315 (33%)	44 (38%)	
Occasional	60 (2%)	25 (11%)		10 (1%)	4 (3%)	
Never	1495 (49%)	90 (41%)		498 (52%)	58 (50%)	

5.3. Health-related risk factors

5.3.1. Demographic measures

Table 6 Demographic characteristics for participants from Morwell and Sale

Participant characteristics	Morwell N=3096			Sale N=960			
	n	%	Weighted %	n	%	Weighted %	p-value
Gender							0.190
Male	1389	45%	48%	410	43%	45%	
Female	1705	55%	52%	550	57%	55%	
Age Category							0.404
18-29	243	8%	17%	85	9%	19%	
30-39	270	9%	15%	94	10%	15%	
40-49	417	13%	18%	127	13%	16%	
50-59	630	20%	17%	189	20%	17%	
60-69	748	24%	16%	208	22%	13%	
70+	782	25%	19%	257	27%	20%	
Marital status							0.016
Married/de facto	1852	60%	57%	611	65%	62%	
Divorced/separated	398	13%	11%	103	11%	8%	
Widowed	309	10%	8%	102	11%	10%	
Single/never married	508	17%	24%	128	14%	20%	
Country at birth							<0.001
Australia	2460	80%	85%	829	86%	90%	
Other	632	20%	15%	131	14%	10%	
Language usually spoken in household							<0.001
English	2815	91%	93%	934	97%	98%	
Other	276	9%	7%	25	3%	2%	
Aboriginal or Torres Strait Islander							0.989
Yes	30	1%	1%	8	1%	1%	
No	3025	99%	99%	947	99%	99%	
Highest educational qualification							<0.001
Up to year 10	1006	33%	27%	241	25%	21%	
Year 11-12	668	22%	24%	162	17%	18%	
Certificate/Diploma	996	33%	34%	379	40%	42%	
Tertiary degree	385	13%	15%	167	18%	20%	
Employment							<0.001
Paid employment	1311	43%	51%	451	48%	56%	
Student/volunteer/ home-duties/retired	1368	45%	35%	431	46%	37%	
Unemployed	139	5%	6%	19	2%	3%	
Unable to work	239	8%	7%	44	5%	4%	
	Mean	Weighted mean	Weighted SD	Mean	Weighted mean	Weighted SD	p-value

Years lived In Gippsland	41	37	19	38	34	20	<0.001

The demographic characteristics of Morwell and Sale participants are shown in Table 6. Although females were over-represented in both samples, after weighting there was no significant difference in the gender balance between Morwell and Sale. Younger participants were under-represented, but after weighting, there was no significant difference in age distribution between Morwell and Sale either. Morwell participants were significantly less likely than Sale participants to be married or in de facto relationships and more likely to be single or never married. Morwell participants were significantly more likely than Sale participants to have been born outside of Australia. Only very small numbers of Aboriginals or Torres Strait Islanders participated in the Adult Survey. Morwell participants were also significantly less educated than Sale participants, also significantly less likely to be in paid employment and more likely to be unemployed or unable to work. On average, Morwell participants had lived in Gippsland for three years longer than Sale participants.

5.3.2. Tobacco and passive smoke exposure

Table 7 Tobacco and passive smoke exposure in Morwell and Sale participants

Cigarette smoke exposure	Morwell N=3096			Sale N=960			
	n	%	Weighted %	n	%	Weighted %	Weighted p-value
Smoking status							<0.001
Current smoker	516	17%	18%	126	13%	13%	
Former smoker	992	32%	28%	315	33%	28%	
Occasional	60	2%	2%	10	1%	1%	
Never	1495	49%	51%	498	52%	58%	
Passive smoke exposure among never smokers							0.010
No exposure	990	66%	71%	302	61%	65%	
Tobacco smoke	93	6%	7%	20	4%	4%	
Wood or briquette heater	408	27%	23%	176	35%	30%	
	Median	Weighted median	Weighted IQR	Median	Weighted median	Weighted IQR	Weighted p-value *
Years of smoking							
Current smokers	30	23	12-35	30	25	15-38	0.141
Former smokers	20	15	9-27	20	15	7-30	0.969
Cigarette pack years							
Current smokers	20	14	5-29	19	15	6-29	0.598
Former smokers	12	10	3-23	13	11	4-23	0.727

*Estimated using nonparametric statistics Somers' D corresponding to rank-sum tests

After weighting for age and gender, Morwell participants were significantly more likely than Sale participants to be current smokers and less likely to have never smoked (Table 7). These findings highlighted the importance of statistically adjusting for smoking status when measuring differences

in respiratory health between the two groups. Amongst never-smokers, Morwell participants were slightly more likely to have been exposed to passive smoke from other smokers in the household, but less likely to be exposed to passive smoke from wood or briquette heaters. Amongst smokers, there was no difference of note between groups in regard to median pack years of smoking.

5.3.3. Alcohol use

After weighting for age and gender, Table 8 shows that Morwell participants reported drinking alcohol significantly less frequently than Sale participants. Morwell participants were also significantly less likely to be categorised as risky drinkers on the AUDIT-C. These findings highlighted the importance of statistically adjusting for alcohol use, which is an important risk factor for cardiovascular health and psychological health. There were no differences between the groups in regard to the number of alcoholic drinks on a standard day or the frequency of having six drinks or more on one occasion.

Table 8 Frequency of alcohol use and proportion of participants classified as low risk and high risk drinkers

AUDIT-C alcohol use	Morwell N=3096			Sale N=960			
	n	%	Weighted %	n	%	Weighted %	Weighted p-value
Frequency of having a drink							**<0.001**
Never	830	27%	25%	219	23%	20%	
Monthly or less	868	29%	32%	221	23%	26%	
2 to 4 times per month	484	16%	17%	153	16%	18%	
2 to 4 times per week	486	16%	16%	190	20%	21%	
4 or more times per week	361	12%	9%	159	17%	15%	
Amongst drinkers: number of drinks on a standard day							0.634
1 or 2	1449	67%	62%	462	64%	60%	
3 or 4	418	19%	22%	149	21%	21%	
5 or 6	193	9%	10%	75	10%	11%	
7 to 9	57	3%	3%	19	3%	4%	
10 or more	40	2%	2%	15	2%	4%	
Amongst drinkers: frequency of having six drinks or more on one occasion							0.666
Never	1254	57%	49%	389	54%	47%	
Less than monthly	545	25%	30%	186	26%	30%	
Monthly	206	9%	12%	76	11%	12%	
Weekly	154	7%	8%	58	8%	10%	
Daily or almost daily	42	2%	2%	13	2%	2%	
Amongst drinkers: proportion scoring above and below threshold							**0.001**
Low risk drinker	1087	50%	50%	302	42%	41%	
High risk drinker	1067	50%	50%	418	58%	59%	

5.3.4. Stressful life events

As shown in Table 9, more than 60% of Morwell and Sale participants reported that they had experienced at least one of the 11 stressful life events included in the CIDI v2.1[19] PTSD module. Further, approximately one quarter of Morwell and Sale participants reported that they had experienced three or more of the 11 stressful life events. The two groups did not differ on these measures.

Table 9 Number of stressful life events reported by Morwell and Sale participants

Stressful life events	Morwell	Sale			
	Weighted %	Weighted %	RRR	Adj RRR* 95% CI	p-value
None	34%	36%	-	-	-
One or two	38%	40%	1.11	0.99 (0.81 ,1.23)	0.957
Three or more	28%	24%	0.81	1.12 (0.89 ,1.41)	0.319

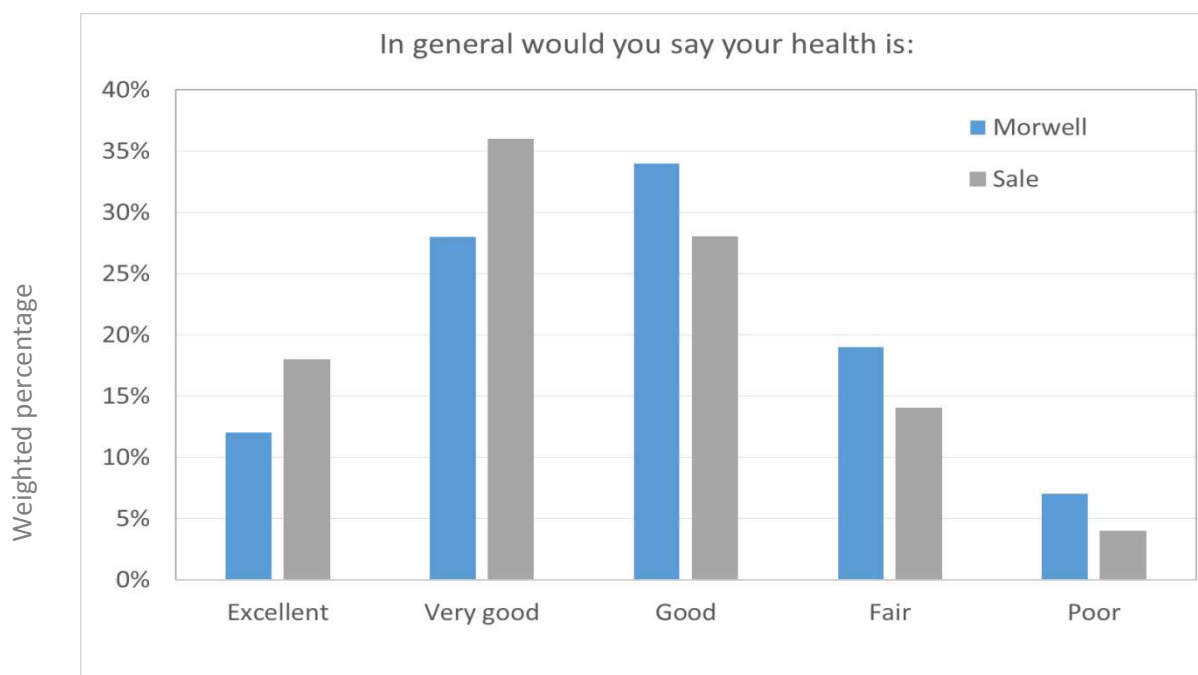*Adjusted for age, gender, education, employment, drinking and smoking

5.4. Self-perceived general health

As shown in Table 10, and graphically presented in Figure 15, there was a statistically significant difference between Morwell and Sale participants on self-perceived general health status. Morwell participants were more likely to report their health to be poor or fair, and less likely to report their health to be excellent or very good.

Table 10 Self perceived health status in Morwell and Sale participants

Self-perceived general health	Morwell N=3096			Sale N=4229			
	n	%	Weighted %	n	%	Weighted %	Weighted p-value
In general would you say your health is:							<0.001
Excellent	263	9%	12%	144	15%	18%	
Very good	800	26%	28%	325	34%	36%	
Good	1087	35%	34%	289	30%	28%	
Fair	659	21%	19%	151	16%	14%	
Poor	266	9%	7%	45	5%	4%	

Figure 15 Self-perceived health status reported by Morwell and Sale participants

5.5. Self-reported doctor-diagnosed medical conditions

Data on self-reported, doctor-diagnosed medical conditions are summarised in Table 11. In the pre-mine fire period, an increased prevalence of high cholesterol and angina, and a decreased prevalence of arrhythmia, was reported by Morwell participants relative to Sale participants. Other pre-mine fire prevalences of medical conditions were similar between the two towns, after statistical adjustment for age, gender, education, employment, drinking and smoking.

In contrast there were statistically significant increases, in post-mine fire diagnoses of high blood pressure and heart attack, in Morwell relative to Sale. Morwell participants reported a 40% greater likelihood of having high blood pressure diagnosed, and a nearly seven-fold increase in likelihood of heart attack. However, for the latter estimate, absolute numbers were very small, meaning that this heart attack finding should be interpreted with caution.

Most of the other medical conditions, included in Table 10, were also in the direction of increased risk for Morwell participants in the post-mine fire period, except for angina. Those findings, however, did not reach statistical significance.

Table 11 Self-reported doctor-diagnosed medical conditions first diagnosed prior to the mine fire (2013 or earlier) or post mine fire (2014 or later)

Medical Condition	First diagnosed in 2013 or early					First diagnosed in 2014 or later				
	Morwell participants	Sale participants				Morwell participants	Sale participants			
	Weighted %	Weighted %	PR	Adj PR^ (95% CI)	p-value	Weighted %	Weighted %	RR	Adj RR^ (95% CI)	p-value
High blood pressure / hypertension	30.7	28.6	1.07	1.07 (0.96, 1.19)*	0.248*	6.6	4.5	1.44	**1.41 (1.01, 1.96)**	**0.041**
High cholesterol	24.9	19.8	1.26	**1.24 (1.08, 1.42)***	**0.002***	5.3	4.1	1.31	1.31 (0.92, 1.87)	0.131
Angina	3.8	2.5	1.53	**1.48 (1.02, 2.14)***	**0.039***	0.5	0.8	0.70	0.64 (0.26, 1.55)	0.318
Heart attack	4.5	4.4	1.03	0.93 (0.69, 1.25)	0.627	1.0	0.1	8.25	**6.98 (1.64, 29.73)**	**0.009**
Heart failure	1.6	1.9	0.82	0.79 (0.48, 1.32)	0.369	0.7	0.5	1.28	1.30 (0.45, 3.73)	0.625
Irregular heart rhythm / arrhythmia	8.1	10.2	0.79	**0.78 (0.63, 0.97)**	**0.025**	3.6	2.9	1.24	1.25 (0.83, 1.88)	0.285
Other heart diseases	1.2	1.8	0.68	0.64 (0.38, 1.10)	0.105	0.4	0.1	5.08	5.33 (0.69, 41.20)	0.109
Stroke	2.9	2.8	1.04	0.99 (0.66, 1.49)	0.970	1.3	0.9	1.38	1.30 (0.64, 2.66)	0.472
Any cardiovascular diseases	15.1	15.3	0.98	0.96 (0.80 , 1.12)*	0.588*	6.0	4.7	1.29	1.26 (0.92, 1.72)	0.150
Cancer	6.5	7.0	0.93	0.92 (0.72, 1.18)	0.520	2.4	2.5	0.98	0.96 (0.64, 1.46)	0.862
Diabetes	9.2	7.5	1.23	1.18 (0.94, 1.48)*	0.143*	1.6	1.0	1.58	1.41 (0.73, 2.74)	0.306

* Estimation based on log Poisson model; ^ Adjusted for age, gender, education, employment, drinking and smoking.

5.6. Self-reported respiratory health symptoms and conditions

Self-reported respiratory symptoms and conditions are presented in Table 12.

Table 12 Self-reported respiratory symptoms and conditions in Morwell and Sale participants

Respiratory symptom or condition	Morwell participants	Sale participants			
	Weighted %	Weighted %	RR	Adj RR (95% CI)	p-value
Current wheeze	42.4%	25.8%	1.64	**1.52 (1.33, 1.73)**	**<0.001**
Chest tightness	26.8%	16.4%	1.63	**1.48 (1.23, 1.79)**	**<0.001**
Nocturnal shortness of breath	20.0%	11.4%	1.75	**1.55 (1.26, 1.92)**	**<0.001**
Resting shortness of breath	20.3%	8.9%	2.27	**1.94 (1.50, 2.50)**	**<0.001**
Asthma diagnosed 2013 or prior	25.7%	23.2%	1.11*	1.13* (0.96, 1.34)	0.140
Asthma diagnosed 2014 or later	1.9%	0.6%	3.49	**3.71 (1.53, 8.98)**	**0.004**
Current Asthma	11.5%	7.4%	1.56	**1.46 (1.10, 1.94)**	**0.009**
Chronic cough	30.9%	17.4%	1.78	**1.60 (1.37, 1.86)**	**<0.001**
Chronic phlegm	25.3%	15.1%	1.67	**1.41 (1.18, 1.69)**	**<0.001**
Nasal & eye symptoms	31.5%	22.7%	1.39	**1.35 (1.16, 1.57)**	**<0.001**
Nasal symptoms	49.6%	41.5%	1.19	**1.18 (1.07, 1.30)**	**<0.001**
Current nasal symptoms	44.3%	35.4%	1.25	**1.23 (1.10, 1.37)**	**<0.001**
	Weighted mean (SD)	Weighted mean (SD)	Mean diff	Adj mean diff (95% CI)	p-value
Amongst asthmatics: symptom severity score	3.64 (2.06)	2.85 (1.84)	0.79	**0.58 (0.25,0.90)**	**<0.001**

* This pre-mine fire difference is measured as a PR

After adjustment for age, gender, employment, education and smoking, participants from Morwell were significantly more likely than those from Sale to report current wheeze, chest tightness, nocturnal and resting shortness of breath and current asthma. Whilst there was little difference in asthma diagnosed 2013 or prior, the risk was increased almost fourfold among Morwell participants from 2014. The modified mean symptom severity score was significantly higher among Morwell participants with asthma compared to those from Sale. Chronic cough and phlegm, nasal and eye symptoms were also significantly more likely to be reported by Morwell participants.

5.7. Psychological wellbeing

Data on self-reported, doctor-diagnosed psychological conditions are summarised in Table 13. Prior to the mine fire event, there were no statistically significant differences between Morwell and Sale in terms of self-reported diagnoses of anxiety, depression, PTSD, other mental health conditions or any mental health condition. However following the mine fire, Morwell residents were more than three times more likely to be diagnosed with PTSD, although this did not quite reach statistical significance and was reported by a very small proportion of participants.

Table 13 Self-reported doctor-diagnosed psychological conditions first diagnosed prior to the mine fire (2013 or earlier) or post mine fire (2014 or later)

Psychological Condition	First diagnosed in 2013 or earlier					First diagnosed in 2014 or later				
	Morwell	Sale				Morwell	Sale			
	Weighted %	Weighted %	RR	Adj RR^ (95% CI)	p-value	Weighted %	Weighted %	RR	Adj RR^ (95% CI)	p-value
Anxiety	19.9	17.1	1.16	1.05 (0.88 ,1.26)*	0.574*	5.0	3.6	1.37	1.37 (0.91 , 2.06)	0.137
Depression	22.4	21.3	1.05	0.93 (0.80 ,1.08)*	0.335*	4.6	3.0	1.55	1.43 (0.89 , 2.29)	0.145
Posttraumatic stress disorder	4.5	3.2	1.41	1.22 (0.82 ,1.80)	0.324	1.4	0.4	3.83	3.12 (0.96 , 10.14)	0.058
Other mental health conditions	3.2	2.6	1.25	0.73 (0.41 ,1.30)	0.289	0.8	0.6	1.17	1.07 (0.39 , 2.89)	0.900
Any mental health conditions	28.9	26.4	1.09	0.98 (0.86 ,1.11)*	0.710*	7.5	5.6	1.35	1.29 (0.93 , 1.80)	0.130

*Estimation based on log Poisson model; ^Adjusted for age, gender, education, employment, drinking and smoking

Results for the IES-R and K10 are shown in Table 14. Morwell participants scored significantly higher than Sale participants on all three subscales of the IES-R, as well as on the total score, indicating increased mine-fire-related stress in the previous week. Morwell participants also reported significantly higher K10 scores, indicating greater levels of psychological distress, compared to Sale participants.

Table 14 IES-R and K10 scores for Morwell and Sale participants

Psychological Wellbeing measure	Morwell	Sale			
	Weighted mean (SD)	Weighted mean (SD)	Mean diff	Adj mean* diff (95% CI)	p-value
IES-R score					
Intrusion (range 0-32)	3.88 (6.23)	0.64 (2.43)	3.25	**2.94 (2.65 ,3.24)**	**<0.001**
Avoidance (range 0-32)	3.43 (5.77)	0.72 (2.55)	2.71	**2.44 (2.15 ,2.73)**	**<0.001**
Hyperarousal (range 0-24)	2.47 (4.69)	0.30 (1.58)	2.16	**1.91 (1.70 ,2.12)**	**<0.001**
Total score (range 0-88)	9.84 (15.70)	1.78 (6.18)	8.06	**7.28 (6.53 ,8.02)**	**<0.001**
K10 score	16.62 (8.09)	14.06 (6.35)	2.56	**2.08 (1.51 ,2.64)**	**<0.001**

* Adjusted for age, gender, education, employment, drinking and smoking

6. Discussion

This volume of Hazelwood Health Study Adult Survey findings sought to determine whether Morwell adults, who were heavily exposed to smoke from the Hazelwood mine fire, have adverse cardiovascular, respiratory or psychological conditions or symptoms compared to Sale adults, who were minimally exposed.

Recruitment and sampling bias

Substantial resources were invested in multiple strategies aimed at optimising contact and recruitment of eligible participants. Consequently, recruitment rates of 33% for Morwell, and 23% for Sale, were achieved. Whilst the researchers had hoped for a greater response from the two communities, these rates would be considered satisfactory relative to other population health surveys. For example, Sinclair *et al.* [29] tested a number of different recruitment methods for a community-based survey. They achieved response rates which ranged from as low as 2% to 30%. Tran *et al.*[30] only achieved a 10% recruitment rate for their Australian community trial of vitamin D supplementation.

The high rate of non-participation in the Adult Survey rendered the results vulnerable to sampling (participation or selection) bias. This occurs when participants differ in important ways, such as health status, from the larger population they represent. Comparisons with local community data, showed that both the Morwell and Sale samples appeared to exhibit biases towards women and older people having higher response rates. These are commonly encountered trends for population-based surveys in general. Importantly the direction and strength of the bias appeared very similar for the two communities, which meant that gender and age were unlikely to affect the strength or direction of the results observed in this study. Weighting of results to account for differences between participants and non-participants in gender and age, further minimised the possible bias conferred by these factors and promoted confidence in the findings.

Recent international research indicates that participation bias is unlikely to significantly affect the results of associations or multivariate analyses.[31] For example, the next phase of Adult Survey analyses, which involves examining any associations between estimated exposure to the mine fire smoke, and subsequent health outcomes within Morwell participants, should not be affected.

Another comparison, between participants and non-participants, indicated that smokers were somewhat fairly represented amongst participants in both groups, with slight over-representation of former smokers from Morwell, and under representation of current smokers from Sale. As cigarette smoking is a major contributor to both respiratory and cardiovascular disease, smoking status and estimated pack years of smoking were included in the Adult Survey questionnaire as were other health-related risk factors.

Determinants of health other than the mine fire

In Australia, almost one third of ill health, disability and premature deaths can be attributed to lifestyle health risk factors.[32] Therefore, it was important that the Adult Survey assessed likely determinants of health other than the Hazelwood mine fire. The health risk factors that were measured included socioeconomic indices (eg. employment status, marital status and education), tobacco and passive smoke exposure, alcohol use, exposure to traumatic life events and previous medical history.

Compared with Sale, it was observed that the Morwell participants were slightly more likely to be unemployed or unable to work, less highly educated, more likely to be current smokers, but less likely to be risky drinkers. It was important to be confident that differences in cardiovascular, respiratory and psychological health outcomes, observed between Morwell and Sale, were not related to these health risk factors. Therefore statistical adjustments for these core confounders, along with gender and age, were applied throughout the analyses.

Morwell and Sale participants were equally likely to report traumatic life events, so that risk factor was unlikely to be contributing to the differences in psychological health outcomes, observed between the two groups. Where applicable previous medical history was also assessed, with those findings discussed below.

Self-perceived general health status

Morwell participants were more likely, than Sale participants, to report their health to be poor or fair, and less likely to report their health to be excellent or very good. In an additional comparison of Morwell responses with AIHW population data for Australia's most disadvantaged citizens,[2] Morwell participants were also less likely to report their health status as excellent or very good (40% Morwell, 46% AIHW), and more likely to report their health status as fair or poor (26% Morwell, 23.5% AIHW). Self-assessed health status is not only a consequence of previous adverse health but also a good predictor of subsequent illness, future health care and premature mortality.[33]

Cardiovascular health

The findings based on self-reported, doctor-diagnosed medical conditions indicated that, prior to the mine fire, there was already an increased prevalence of high cholesterol and angina in Morwell relative to Sale, but a decreased prevalence of angina. Prevalences, of other pre-existing cardiovascular conditions, were similar in the two towns. However since the mine fire, Morwell participants were at higher risk of having high blood pressure and heart attack diagnosed, by 1.5-fold and nearly seven-fold, respectively. While the finding for heart attack appeared striking, it should be noted that the numbers of people affected were very small: 1% versus 0.1%. More definitive information about the risk of cardiovascular disease conferred by the mine fire will be provided by the cardiovascular sub-study of the HHS Adult Survey which will be collecting data in the 2nd half of 2017.

Respiratory health

All respiratory symptoms in the last 12 months were significantly more common among Morwell than Sale participants, after adjusting for age, gender, employment, education and smoking. The risk of post-mine fire self-reported doctor-diagnosed asthma appeared to be significantly increased. Furthermore, symptoms were more severe among asthmatics from Morwell compared with those from Sale. The risks of irritant symptoms from the chest and nose consistent with chronic bronchitis and rhinitis were also significantly higher among Morwell than Sale participants.

Table 15 Prevalence of respiratory symptoms in other Australian research

Symptom / Condition	Young adults (20-44yo)[34]	Middle aged and older adults (45-70yo)[35]	Adults > 40yo[36]
Wheeze	28.1%	20.5%	30%
Nocturnal chest tightness	20.5%	14.2%	-
Asthma	17.4%*	12.5% †	18.0%‡
Current asthma	9.7%	6.7%	-
Chronic bronchitis	-	12.0%	7.4%
COPD GOLD Stage II+	-	6.8%	7.5%

* ECRHS definition † Wheeze + BHR ‡ Asthma ever

However, the prevalence of respiratory symptoms such as wheeze and nocturnal chest tightness, and current asthma in Sale was similar to our previous research in Melbourne and elsewhere in Australia, summarised in Table 15. The prevalence of chronic bronchitis (chronic cough and phlegm) appeared a little higher in Sale than Melbourne. It will not be possible to comment on objective evidence of chronic obstructive pulmonary disease (COPD) until lung function testing has been completed as part of the HHS Adult Survey respiratory sub-study. That research stream will be collecting data in the 2nd half of 2017.

Psychological health

The Adult Survey included a number of measures of psychological wellbeing, including a measure of distress specifically linked to the mine fire event (IES-R) as well as a general measure of current distress (K10). Morwell residents reported higher levels of distress for the total IES-R score as well as all three subscales relating to the occurrence of intrusive thoughts, avoidance behaviours and hyperarousal. The average IES-R score, for Morwell participants, was 9.84 which is below any of the proposed thresholds for PTSD,[10-12] suggesting that the impact on psychological wellbeing was moderate. However the increase in this measure is not surprising given the feedback we have had from community members via the qualitative components of the Older People, Community Wellbeing and Schools Study research programs regarding how concerned residents continue to be about the smoke event. While average IES-R scores in Morwell were below clinical levels, further analysis within the Morwell group is necessary to identify the most vulnerable sub-groups. That further analysis will address the core HHS research questions regarding the development and persistence of psychological distress, including the role of exposure to the mine fire smoke, sociodemographic, and other factors.

Morwell participants also reported significantly higher general distress levels in the past month on the K10, that being more than two years after the smoke event and on a measure not specifically linked to the smoke event. While the adjusted mean difference between Morwell and Sale participants was only two points, at 16.62 the average for Morwell was just over the published ABS cut-off of 16 for moderate distress.[18] Like the IES-R results, further analysis is necessary to identify the high scorers on the K10 and examine the relationship with other factors.

Furthermore, Morwell participants were over three times more likely to report a diagnosis of PTSD following the mine fire event than were Sale participants. There was also a non-significant trend towards higher levels of anxiety and depression. Prior to the mine fire event, there were no significant differences between Morwell and Sale participants in terms of self-reported diagnosis of mental health conditions, nor was there a difference in the lifetime number of stressful life events. This suggests that the two groups were comparable in terms of their mental health history prior to the mine fire and this lends weight to the argument that there has been an impact on psychological health since the event.

As with the cardiovascular and respiratory findings, the psychological health findings will be complemented by interviews to be conducted as part of the HHS Adult Survey Psychological sub study which is planned for the 2nd half of 2017.

Strengths and limitations

The Adult Survey had various strengths which gave confidence to the observed findings, but also some limitations which affected interpretation. An important strength was the inclusion of a comparison group of adults, from selected areas of Sale, who were similar to the Morwell adults in terms of their regional location and socio-economic indices, but differed in regard to the primary exposure of interest, that being exposure to the mine fire smoke. The Sale participants provided an important bench-mark against which the health of the Morwell participants could be usefully compared.

The Adult Survey findings were further strengthened by the availability of gender and age information, at the community level, allowing for appropriate weighting of results so that the impact of those important confounders could be minimised. Additional statistical adjustments for gender, age, education, employment, smoking and alcohol, also mitigated the potential confounding effects of important health risk factors and increased confidence that the findings were associated with smoke exposure.

A methodological limitation, of the Adult Survey, was the reliance on self-reported health measures. Such measures could render the results vulnerable to differential recall/reporting bias.[37] For example, this might occur if *exposed* participants had a heightened awareness of symptoms and therefore, reported them more frequently relative to *unexposed* comparison participants whose health was otherwise the same. The Adult Survey design aimed to minimise the risk of differential recall bias in several ways: Firstly, validated health questionnaires were utilised where possible. Secondly, consent was obtained from participants to link to administrative health datasets, such as ambulance and emergency presentations and hospital admissions. Analyses of these more objectively collected measures of health, which should be less prone to recall bias, are still to be conducted. Finally, future analyses will also compare similarly exposed Morwell adults with each other, to eliminate differential recall bias which might be influenced by exposure level. That analysis should be less prone to differential recall bias and will aim to investigate whether sub-groups of similarly exposed participants are more vulnerable than others to health impacts.

Conclusion

This analysis of the HHS Adult Survey provides the first available evidence of current adverse cardiovascular, respiratory and psychological health effects of the Hazelwood mine fire on the adults in Morwell. Increased risks have been observed for hypertension and heart attacks, numerous respiratory symptoms and asthma, and psychological distress.

This volume of findings represents just the first step in the interrogation of the Adult Survey data, providing only broad group differences between Morwell and Sale based on self-reported data. Future linkage to administrative health datasets will complement the self-reported data. That linkage will provide more objective measures of health upon which to address research questions about long term health outcomes in the Latrobe Valley. Following that, the Adult Survey findings will be further strengthened by analyses which will blend CSIRO modelled air pollution data with participants' location information, to measure any association between estimated mine fire smoke exposure and health outcomes. At that stage, examination of any additional predictors of poor health in the community may provide valuable information about the most vulnerable sub-groups.

The HHS Adult Survey sub-studies, commencing data collection in the 2nd half of 2017, will further complement the current work. The self-report data will be supplemented with clinical data on, for example, blood pressure, endothelial (vascular) function and inflammatory markers, spirometry, gas transfer and small airway function, and interview-based information on current perceptions of the mine fire events, and the role of social factors other than the smoke.

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8. Document History

Version number	Date approved	Approved by	Brief description
1.0	4 July 2017	DHHS	Hazelwood Health Study Adult Survey Volume 1 Report
1.1	30 August 2017	Senior Project Manager	Minor reformatting

Appendix A Adult Survey questionnaire for Morwell participants

ADULT SURVEY AND HEALTH RECORD LINKAGE STUDY

QUESTIONNAIRE FOR ADULTS
WHO LIVED IN MORWELL DURING
THE HAZELWOOD MINE FIRE

THANK YOU

For participating in the Hazelwood Adult Survey and Health Record Linkage Study

Please read the following instructions for completing the questionnaire

1. It is important that you have **read** and **signed** the **Informed Consent Statement** on the next page of this questionnaire.

2. Please be sure to read each question and its instructions very carefully.

3. Unless directed otherwise, EVERY question should be answered if possible. Please choose the best available response to each question, even if there is not one that suits perfectly.

4. To answer a question please place crosses ☒ in the boxes **next to your answers**. Please do NOT circle the boxes ⬭

   Alternatively, when required, please write clear numbers in the number boxes provided.

   For example $\boxed{1\ 5}$ *years*

5. Please follow the blue arrows ⟶ and the **'go to'** instructions carefully, so you don't answer more questions than you need to.

6. Please phone the Recruitment Coordinator on **1800 985 899** if you are unsure about how to complete any section of this questionnaire. Please call during business hours, Eastern Standard Time, Monday to Friday, or leave a clear message outside of these hours.

Informed Consent Statement
Hazelwood Adult Survey & Health Record Linkage Study

IMPORTANT INFORMATION

Complete this form to consent to participate in all, or part, of the *Hazelwood Adult Survey & Health Record Linkage Study*. Incomplete forms may result in the study not being provided with your decision and information.

BY SIGNING THIS FORM, YOU ACKNOWLEDGE THAT:

1. You have received, read and understood the Information Sheet provided that explains this study to you and what is required of you if you choose to participate in the *Hazelwood Adult Survey & Health Record Linkage Study.*

2. You understand that participation in the study is voluntary, **that you can choose not to participate in part or all** of the study and that you may withdraw your information prior to the publication of any reports by contacting the study team on 1800 985 899.

YOUR DETAILS

☐ Mr ☐ Mrs ☐ Miss ☐ Ms Other _____

Family name (Surname): _____

First given name:_____ Other given (middle) name(s): _____

Date of birth: [D][D] [M][M] [1][9][Y][Y] Sex: ☐ Male ☐ Female

---

To agree to participate in the QUESTIONNAIRE ONLY, please read the consent statement below numbered 1 and mark the box to show you agree.

1. ☐ **I agree to participate in the questionnaire part of the *Hazelwood Adult Survey.***

OR

To agree to the QUESTIONNAIRE <u>AND</u> HEALTH RECORD LINKAGE, please read the consent statements below numbered 2 and 3 and mark the boxes to show you agree.

2. ☐ **I agree to participate in the questionnaire part of the *Hazelwood Adult Survey* <u>and</u> the *Hazelwood Health Record Linkage Study* by giving Monash University permission to access my information from health databases such as ambulance, hospital, cancer and death records in future years for as long as it remains scientifically valid to do so.**

3. ☐ **I authorise Monash University to release my personal details to the Victorian Department of Health and Human Services to extract hospital and emergency information in future years for as long as it remains scientifically valid to do so.**

If yes, my Medicare card number is: ☐☐☐☐ ☐☐☐☐☐ ☐ Ref no. ☐

DECLARATION: I declare that the information on this consent form is true and correct.

_____ _____/_____/__2016__
your signature *date of signing*

Blank page

SECTION A - DETAILS ABOUT YOU

Please provide some information about your personal or demographic details

A2. What is your age? ☐☐ *years old*

A3. Are you ☐ Male ☐ Female ☐ Other

A4. What is your current marital status?
Choose one

☐ Married   ☐ Divorced

☐ De Facto   ☐ Widowed

☐ Separated   ☐ Other (please specify)

☐ Single   _____

A5. In which country were you born?

☐ Australia

☐ United Kingdom (including England, Scotland, Wales, Northern Ireland)

☐ New Zealand

☐ Italy

☐ Other (please specify) _____

A6. Do you speak a language other than English at home?

☐ No, English only

☐ Yes, Other (please specify) _____

A7. Are you of Aboriginal or Torres Strait Islander origin?
Choose one

☐ No, not Aboriginal or Torres Strait Islander

☐ Yes, Aboriginal

☐ Yes, Torres Strait Islander

☐ Yes, Aboriginal and Torres Strait Islander

A8. What is the highest level of education and training you have **completed?**

Choose one

☐ Year 10 or below   ☐ TAFE or Trade Certificate or Diploma

☐ Year 11   ☐ University, or other Tertiary Institute degree (i.e. postgraduate diploma, Master's degree, PhD)

☐ Year 12   ☐ Other (please specify)

_____

A9. Are you currently in paid employment?

☐ No   ☐ Yes

A10. Which of these best describes your current employment status?
Select all that apply

☐ Self employed   ☐ Engaged in home duties

☐ Employed full-time   ☐ Retired

☐ Employed part-time or casual   ☐ Unable to work

☐ Unemployed   ☐ Other (please specify)

☐ A student   _____

A11. What is your **current** residential address?

Unit/ Flat	Street number	Street name	Suburb or town	Post Code	State

A12. For how many years have you lived at this address? ☐☐ *Number of years*

A13. Is this home:

☐ Owned or being purchased by you, the occupants?

☐ Rented from the housing trust or any other public agency?

☐ Rented privately?

☐ Other (please specify) _____

A14. For how many years in total did you/have you lived in Gippsland (including current residence if it is in Gippsland)

☐☐ *Number of years*

SECTION B – GENERAL HEALTH

B1. In general, would you say your health is (**select one option**):

☐ Excellent　　　☐ Very good　　　☐ Good　　　☐ Fair　　　☐ Poor

DIAGNOSED MEDICAL CONDITIONS

B2. Have you ever been **told by a doctor** that you have any of the following conditions?

If Yes, please estimate the year this was first diagnosed, or year of first episode

a) High blood pressure/hypertension　　☐ No　☐ Yes ⟶ ☐☐☐☐

b) High cholesterol　　☐ No　☐ Yes ⟶ ☐☐☐☐

c) Angina　　☐ No　☐ Yes ⟶ ☐☐☐☐

d) Heart attack (this includes a myocardial infarction or coronary)　　☐ No　☐ Yes ⟶ ☐☐☐☐

e) Heart failure　　☐ No　☐ Yes ⟶ ☐☐☐☐

f) Irregular heart rhythm/arrhythmia (e.g. atrial fibrillation)　　☐ No　☐ Yes ⟶ ☐☐☐☐

g) Stroke (this includes a 'mini stroke', TIA or cerebrovascular accident)　　☐ No　☐ Yes ⟶ ☐☐☐☐

h) Cancer　　☐ No　☐ Yes ⟶ ☐☐☐☐

i) Other heart disease not listed above　　☐ No　☐ Yes ⟶ ☐☐☐☐

If Yes to 'other heart disease' please describe:

_____

j) Diabetes　　☐ No　☐ Yes ⟶

If No, go to B3 over the page

If Yes to diabetes, please estimate the year this was first diagnosed, or year of first episode

☐☐☐☐

And, what treatment are you currently receiving for diabetes? **Choose one**

☐ Diet only

☐ Insulin and tablets

☐ Tablets

☐ Insulin

☐ Other (please specify)

_____

B3. Have you ever been **told by a doctor** or **psychologist** that you have:

If Yes, please estimate the year this was first diagnosed

a) Anxiety ☐ No ☐ Yes ⟶ ☐☐☐☐

b) Depression ☐ No ☐ Yes ⟶ ☐☐☐☐

c) Posttraumatic stress disorder ☐ No ☐ Yes ⟶ ☐☐☐☐

d) Other **mental health conditions** ☐ No ☐ Yes ⟶ ☐☐☐☐

If Yes to 'other mental health conditions' please describe:

_____

_____

_____

B5. Has a doctor ever told you that you have any **other medical conditions** not mentioned in this section?

☐ No   ☐ Yes

☐   **If Yes,** please list them here.

_____

_____

_____

_____

_____

_____

Remember, to answer questions please place crosses ☒ in the boxes next to your answers or write clear numbers in to the number boxes.
For assistance, please call 1800 985 899.

SECTION C - RESPIRATORY HEALTH

C1. Have you had wheezing or whistling in your chest at any time **in the last 12 months?**

☐ No   ☐ Yes

If NO, go to C2   **If Yes,**

C1A. Have you been at all breathless when the wheezing noise was present?

☐ No ☐ Yes

C1B. Have you had this wheezing or whistling when you did not have a cold?

☐ No ☐ Yes

C2. Have you woken up with a feeling of tightness in your chest at any time **in the last 12 months?**

☐ No   ☐ Yes

C3. Have you been woken by an attack of shortness of breath at any time **in the last 12 months?**

☐ No   ☐ Yes

C4. Have you had an attack of shortness of breath that came on during the day when you were at rest at any time **in the last 12 months?**

☐ No   ☐ Yes

C5. Have you ever had **asthma?**

☐ No   ☐ Yes

If No, go to C8   **If Yes,**

C5A. How old were you when you had your first attack of asthma (if unknown please provide estimate)?

☐☐ *years old* (If started as a baby please enter '1')

C6. Have you had an attack of asthma **in the last 12 months?**

☐ No ☐ Yes

C7. Are you **currently** taking any medicine (including inhalers, aerosols or tablets) for asthma?

☐ No ☐ Yes

C8. Do you have any nasal allergies including hay fever?

☐ No   ☐ Yes

If No, go to C9   **If Yes,**

        C8A. How old were you when you first had hay fever or nasal allergy (if unknown please provide estimate)?

        ☐☐   *years old (If started as a baby please enter '1')*

C9. Have you **ever** had a problem with sneezing, or a runny or a blocked nose when you did not have a cold or the flu?

☐ No   ☐ Yes

If No, go to C11   **If Yes, C10.** Have you had a problem with sneezing or a runny nose when you did not have a cold or the flu **in the last 12 months**?

        ☐ No   ☐ Yes

        If No, go to C11   **If Yes, C10A.** Has this nose problem been accompanied by itchy or watery eyes?

                        ☐ No   ☐ Yes

C11. Do you cough on most days for as much as **three months a year?**

☐ No   ☐ Yes

C12. Do you bring up phlegm from your chest on most days for as much as **three months a year?**

☐ No   ☐ Yes

C13. Have you **ever** been told by a doctor that you had chronic obstructive pulmonary disease or emphysema?

☐ No   ☐ Yes

If No, go to C14   **If Yes,**

        C13A. How old were you when a doctor told you that you had chronic obstructive pulmonary disease or emphysema (if unknown please provide estimate)?

        ☐☐   *years old*

C14. **In the last 12 months**, have you regularly (on most days) taken Flixotide, Pulmicort, Qvar, Alvesco, Seretide, Symbicort, BreoEllipta, Flutiform or any other steroid inhaler?

☐ No   ☐ Yes

SECTION D - SMOKING HISTORY

To properly evaluate your respiratory health it is important to know about your smoking history and other exposure to smoke.

D1. Have you smoked at least 100 cigarettes, or a similar amount of tobacco, in your entire lifetime?

☐ No   ☐ Yes

If No, go to D2   **If Yes, D1A.** Which of the following **best** describes your smoking status?

☐ you currently smoke daily?

☐ you currently smoke at least weekly, but not daily?

☐ you currently smoke less often than weekly?

☐ you don't smoke now but you used to?
   D1A_1. At what age did you **last stop** smoking? ☐☐ *years old*

☐ you've tried it a few times but never smoked regularly?

D1B. For how many years in total have you smoked? (if stopped and started, add smoking periods together) ☐☐ *years*

D1C. Over those years, what is the **average number of cigarettes** that you have smoked **per day** or, if less than daily, per week or month?

☐ *cigarettes per day*   Or, if less than daily   ☐ *cigarettes per week*   or   ☐ *cigarettes per month*

D2. Have you been exposed to tobacco smoke on **most days and nights** in the **last 12 months?**

☐ No   ☐ Yes

If No, go to D3   **If Yes, D2A.** Not counting yourself, how many people in your household smoke regularly? ☐☐ *People (if none, enter '0')*

If 1 or more, D2B. Where do they usually smoke? **Choose one**

☐ Inside the house   ☐ Outside the house   ☐ Both inside & outside the house

D3. Have you ever used a wood or briquette heater in any residence you have lived?

☐ No   ☐ Yes → **If Yes, D3A** For how many **years in total** have you had a wood or briquette heater across all residences you have lived? (if not sure please estimate) ☐☐ *number of years*

SECTION E – CURRENT WELLBEING IN REGARD TO THE HAZELWOOD MINE FIRE EVENT

We ask about your **current** wellbeing to see if the mine fire event has had a long term impact on your health. Below is a list of difficulties people sometimes have after stressful life events. Please read each item, and then indicate how distressing each difficulty has been for you **during the past seven days** with respect **to the Hazelwood mine fire event**.

During the past seven days, in regard to the mine fire event, how much were you distressed or bothered by these difficulties?		**Not at all**	**A little bit**	**Moderately**	**Quite a bit**	**Extremely**
1	Any reminder brought back feelings about it.	☐	☐	☐	☐	☐
2	I had trouble staying asleep.	☐	☐	☐	☐	☐
3	Other things kept making me think about it.	☐	☐	☐	☐	☐
4	I felt irritable and angry.	☐	☐	☐	☐	☐
5	I avoided letting myself get upset when I thought about it or was reminded of it.	☐	☐	☐	☐	☐
6	I thought about it when I didn't mean to.	☐	☐	☐	☐	☐
7	I felt as if it hadn't happened or wasn't real.	☐	☐	☐	☐	☐
8	I stayed away from reminders of it.	☐	☐	☐	☐	☐
9	Pictures about it popped into my mind.	☐	☐	☐	☐	☐
10	I was jumpy and easily startled.	☐	☐	☐	☐	☐
11	I tried not to think about it.	☐	☐	☐	☐	☐
During the past seven days, in regard to the mine fire event, how much were you distressed or bothered by these difficulties?		**Not at all**	**A little bit**	**Moderately**	**Quite a bit**	**Extremely**
12	I was aware that I still had a lot of feelings about it, but I didn't deal with them.	☐	☐	☐	☐	☐
13	My feelings about it were kind of numb.	☐	☐	☐	☐	☐
14	I found myself acting or feeling like I was back at that time.	☐	☐	☐	☐	☐
15	I had trouble falling asleep.	☐	☐	☐	☐	☐
16	I had waves of strong feelings about it.	☐	☐	☐	☐	☐
17	I tried to remove it from my memory.	☐	☐	☐	☐	☐
18	I had trouble concentrating.	☐	☐	☐	☐	☐
19	Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart.	☐	☐	☐	☐	☐
20	I had dreams about it.	☐	☐	☐	☐	☐
21	I felt watchful and on-guard.	☐	☐	☐	☐	☐
22	I tried not to talk about it.	☐	☐	☐	☐	☐

SECTION F - YOUR RESIDENCE DURING THE HAZELWOOD MINE FIRE

The Hazelwood mine fire period is defined as the time between 9 February 2014 (the date the mine fire started) and 31 March 2014. The following questions relate to **the home you lived in during the Hazelwood mine fire period**, your use of air conditioning and air filters at that time and any occasions you slept away from that home.

F1. When the fire started in February 2014, what was the address of the home you lived in?

Unit/ Flat	Street number	Street name	Suburb or town	Post Code	State

F2. When was that home built?

☐ ☐ ☐ ☐ *Year* or, if you do not know the exact year, please estimate using the year ranges provided below:

☐ Prior to 1986

☐ 1986-2004

☐ After 2004

F3. What is the **main** building material of that home?
Choose one

☐ Concrete / Brick (veneer or double brick)

☐ Timber / weatherboard

☐ Fibro / asbestos cement sheeting

☐ Fibreglass

☐ Aluminium

☐ Other (please specify) _____

☐ Don't know

F4. What is the **main** type of roofing material on that home?
Choose one

☐ Tiles

☐ Metal, like tin or iron

☐ Concrete

☐ Other (please specify) _____

☐ Don't know

F5. Does the home (which you listed at F1 on the previous page) have **air conditioning**?

☐ No   ☐ Yes

If No, go to F6

If Yes, F5A. What type of air conditioning is it?

☐ Reverse cycle or split system.   **If reverse /split system, Go to F5B**

☐ Window box unit

☐ Evaporative

☐ Other (please specify)

_____

☐ Don't know

F5B. Is the **Reverse cycle** air conditioner

☐ Ducted

☐ Wall or floor mounted

☐ Don't know

F5C. During the period of the fire, when you were living in the home listed in F1, how often did you use the air conditioning?
Choose one

☐ Never

☐ Rarely (once a week or less)

☐ Occasionally (2-3 times a week)

☐ Regularly (most of the time)

☐ Daily

☐ Don't know

F6. During the period of the fire, when you were living in the home listed in F1, how often did you use a portable **air filter** (e.g. an air purifier)?
Choose one

☐ Never

☐ Rarely (once a week or less)

☐ Occasionally (2-3 times a week)

☐ Regularly (most of the time)

☐ Daily

F7. During the period of the fire (from 9 February 2014 to 31 March 2014), **did you sleep at a different location**, other than your usual home that you listed in question F1?

☐ YES   ☐ NO, **if NO, please go to Section G on the next page** ⟶

F7A Please specify the first location that you slept at during the mine fire period, other than your usual home? Provide as much address information as possible

Building/hotel name if applicable	Street number and street name	Suburb or town	Post Code	State

On the calendar below, please mark with a ☒ the dates for **the nights** you slept at this location.

February 2014							March 2014													
Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9	10	11	12	13	14	15							1	2	3	4	5	6	7	8
16	17	18	19	20	21	22	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28		23	24	25	26	27	28	29	30	31					

F7B If applicable, please specify a second location that you slept at during the mine fire period, other than your usual home? Provide as much address information as possible.

Building/hotel name if applicable	Street number and street name	Suburb or town	Post Code	State

On the calendar below, please mark with a ☒ the dates for **the nights** you slept at this location.

February 2014							March 2014													
Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9	10	11	12	13	14	15							1	2	3	4	5	6	7	8
16	17	18	19	20	21	22	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28		23	24	25	26	27	28	29	30	31					

F7C If applicable, please specify a third location that you slept at during the mine fire period, other than your usual home? Provide as much address information as possible.

Building/hotel name if applicable	Street number and street name	Suburb or town	Post Code	State

On the calendar below, please mark with a ☒ the dates for **the nights** you slept at this location.

February 2014							March 2014													
Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9	10	11	12	13	14	15							1	2	3	4	5	6	7	8
16	17	18	19	20	21	22	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28		23	24	25	26	27	28	29	30	31					

SECTION G - WORK HISTORY

The following questions are about **paid jobs** that you have had for **at least 6 months**.

G1. Have you ever worked in the **construction industry** for a period of at least 6 months?

☐ No

☐ Yes

If No, go to G2

If Yes, G1A. Were you a: **(choose as many as apply)**

☐ labourer, for how many years in total ☐☐ *years*

☐ builder, for how many years in total ☐☐ *years*

☐ carpenter (not incl. builder), for how many years in total ☐☐ *years*

☐ brick layer, for how many years in total ☐☐ *years*

☐ painter, for how many years in total ☐☐ *years*

☐ concreter, for how many years in total ☐☐ *years*

☐ driver, for how many years in total ☐☐ *years*

G1A_1 If driver in construction industry, what did you mostly drive? _____

☐ Other _____ for how many years ☐☐ *years*
please specify main job

G2. Have you ever worked as a **driver** (not including in the construction industry) for a period of at least 6 months?

☐ No   ☐ Yes, **if Yes, G2A.** What did you mostly drive? _____

G2B. For how many years in total were you a driver? ☐☐ *years*

G3. Have you ever worked in **farming** for a period of at least six months?

☐ No   ☐ Yes, **if Yes, G3A.** What type of farm was it? _____

G3B. What was your main job title? _____

G3C. For how many years in total did you have that job (in G3B)? ☐☐ *years*

G4. Have you ever worked at the **coal mines**, or the **coal fired power stations** in the Latrobe Valley, such as at Yallourn, Loy Yang or Hazelwood for a period of at least six months?

☐ No   ☐ Yes, **if Yes, G4A.** What was your main job title? _____

G4B. For how many years in total did you have that job (in G4A)? ☐☐ *years*

G5. *Not including the coal fired power stations in G4*, have you ever worked for the **SEC** (State Electricity Commission, also SECV or ECV) for a period of at least six months?

☐ No   ☐ Yes, **G5A.** What was your main job title? _____

G5B. For how many years in total did you have that job (in G5A)? ☐☐ *years*

G6. For a period of at least six months, have you ever worked as a: **(choose as many as apply)**

☐ **welder**, for how many years in total? ☐☐ *years*

☐ **cleaner**, for how many years in total? ☐☐ *years*

☐ **baker**, for how many years in total? ☐☐ *years*

☐ **garbage** collector or at a **waste/recycling depot**, for how many years in total? ☐☐ *years*

☐ **spray painter** (motor vehicle), for how many years in total? ☐☐ *years*

☐ **saw mill operator**, for how many years in total? ☐☐ *years*

☐ **wood worker** (not carpenter), for how many years in total? ☐☐ *years*

☐ **asbestos remover**, for how many years in total? ☐☐ *years*

G7. Have you ever had a paid job with an **emergency service** for at least six months?

☐ No   ☐ Yes, **if Yes, G7A.** Which emergency service?

If No, go to G8

☐ **Police**. What was your **main** job title? _____

For how many years in total did you have that job? ☐☐ years

☐ **Ambulance**. What was your **main** job title? _____

For how many years in total did you have that job? ☐☐ years

☐ **Fire** (**paid only**, we ask about volunteer firefighting later)

What was your **main** job title? _____

Which fire service was that main job with:

☐ **Metropolitan Fire Brigade**

☐ **Country Fire Authority**

☐ **Other,** please specify _____

For how many years in **total** did you have that job? ☐☐ years

☐ **Other emergency service**. Please specify which service_____

What was your main job title? _____

For how many years in total did you have that job? ☐☐ years

G8. Have you ever worked at the Maryvale **paper mill** for a period of at least six months?

☐ No   ☐ Yes, **if Yes, G8A.** What was your main job title? _____

   G8B. For how many years in total did you have that job (in G8A)? ☐☐ *years*

G9. **Not including jobs you have listed so far**, have you ever worked in a job for at least 6 months where the air you breathed contained a lot of **dust, fumes, smoke, gas, vapour or mist?**
(Please don't include a job here if the only period of smoky air was during the mine fire).

☐ No   ☐ Yes, **if Yes, G9A.** What was the title of the **longest held job?**

   _____

   G9B. For how many years in total did you have that job? ☐☐ *years*

G10. During the mine fire period (9 February to 31 March 2014), were you involved in *fighting* the Hazelwood mine fire (paid or volunteer) or working in the Controlled Area as part of the response?

☐ No   ☐ Yes**, if Yes, G10A.** For how many **days** in total were you involved in fighting the Hazelwood mine fire or working in the Controlled Area? ☐☐ *number of **days***

G11. <u>Not</u> including the Hazelwood mine fire, have you ever been a volunteer firefighter involved in *fighting fires*?

☐ No   ☐ Yes, **if Yes, G11A.** For how many years in total? ☐☐ *years*

Well done - you are well past half way.

Remember, if you need assistance please call 1800 985 899.

SECTION H - YOUR WORK LOCATION DURING THE PERIOD OF THE FIRE

The following questions are designed to measure any changes to your **employment location** during the time of the mine fire. We are asking about the **whole period of the fire** from **9 February 2014 to 31 March 2014. Please carefully follow the arrows and 'go to' instructions.**

H1. Were you **employed** during the period of **9 February 2014 to 31 March 2014?**

☐ YES   ☐ NO, **if No, go to Section HH on page 18** ⟶
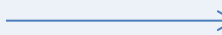
If Yes, H2. What was your **main** job during the period of the fire? _____

main job title

H3. For how many hours per week, **on average**, was that job? ☐☐☐ *hours per week*

H4. On which days of the week did you **usually** work on that job?

☐ Monday   ☐ Tuesday   ☐ Wednesday   ☐ Thursday   ☐ Friday

☐ Saturday   ☐ Sunday

H5. Was that job (listed at H2) usually located at **one or more fixed locations/addresses** (like an office/clinic/shop/factory job) or at **multiple changing locations** (like a taxi or delivery vehicle driver, emergency responder or visiting nurse). Please choose the option that **best** decsribes your work location/s.

☐ One or more usual fixed addresses. **Go to H6**

☐ Multiple changing locations mostly or entirely in Morwell ⟶ **Go to H7**

☐ Multiple locations, mostly outside of Morwell but in the Latrobe Valley ⟶ **Go to H7**

☐ Multiple locations, mostly or entirely outside of the Latrobe Valley ⟶ **Go to H7**

H6. Please specify **the usual address** during the mine fire period for that main job (listed at H2). If more than one address (eg. different sites for the same business), please choose **one main address** where you worked.

Building name/ business	Street number	Street name	Town	Post code	State

H6A. Did the job (listed at H2) **relocate from this usual address** during the mine fire period **for more than one day?**

☐ YES ☐ NO, **If No, go to H7 down the page**

If Yes, H6B_1. Please specify the first address this job relocated to.

Building name/ business	Street number	Street name	Town	Post code	State

On the calendar below, please mark with a ☒ the dates your job relocated to this address.

February 2014							March 2014												
Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9	10	11	12	13	14	15							1	2	3	4	5	6	7	8
16	17	18	19	20	21	22	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28		23	24	25	26	27	28	29	30	31					

H6B_2. If this job relocated to a second address, please specify the address here, **otherwise go to H7**

Building name/ business	Street number	Street name	Town	Post code	State

On the calendar below, please mark with a ☒ the dates your job relocated to this second address.

February 2014							March 2014												
Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9	10	11	12	13	14	15							1	2	3	4	5	6	7	8
16	17	18	19	20	21	22	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28		23	24	25	26	27	28	29	30	31					

H7. During the mine fire period, and on the days that you would usually be at this main job (listed at H2), **did you stay at home for more than one day for any reason** (e.g. because you worked from home or took annual leave or sick leave at home)?

☐ No, **go to H8 over the page**

☐ Yes, I always work at home for that job, **go to H8 over the page**

☐ Yes, I stayed at home on the following work days, **please answer H7A**

H7A. On the calendar below, please mark with a ☒ the work days that you **stayed at home**.

February 2014							March 2014												
Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9	10	11	12	13	14	15							1	2	3	4	5	6	7	8
16	17	18	19	20	21	22	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28		23	24	25	26	27	28	29	30	31					

H8. For the **main** job (listed at H2), did you take **any leave which you spent away from home** (eg. annual leave or sick leave) during the mine fire period?

☐ YES   ☐ NO**, If NO, go to H9 down the page**

If YES, H8A. Please specify where you first stayed away from home when you took leave from this main job?

Building name/ hotel	Street number	Street name	Town	Postcode	State

On the calendar below, please mark with a ☒ the dates you took leave at this address.

February 2014							March 2014												
Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9	10	11	12	13	14	15							1	2	3	4	5	6	7	8
16	17	18	19	20	21	22	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28		23	24	25	26	27	28	29	30	31					

H8B. If applicable, please specify a second place you stayed away from home when you took leave from this job?

Building name/ hotel	Street number	Street name	Town	Postcode	State

On the calendar below, please mark with a ☒ the dates you took leave at this address.

February 2014							March 2014												
Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9	10	11	12	13	14	15							1	2	3	4	5	6	7	8
16	17	18	19	20	21	22	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28		23	24	25	26	27	28	29	30	31					

H9. In addition to the main job you listed at H2, did you have **another job** during the mine fire period 9 February 2014 to 31 March 2014?

☐ YES   ☐ NO, **if No, go to Section HH on the next page** ⟶

If Yes, H10. What was your **second** job during the period of the fire? _____

second job title

H11. For how many hours per week, **on average**, was that job? ☐☐☐ *hours per week*

H12. On which days of the week did you **usually** work on that second job?

☐Monday   ☐Tuesday   ☐Wednesday   ☐Thursday   ☐Friday

☐Saturday   ☐Sunday

H13. Was that second job (listed at H10) usually located at one or more fixed locations/addresses (like an office/clinic/shop/factory job) or at multiple changing locations (like a taxi or delivery vehicle driver, emergency responder or visiting nurse). Please choose the option that **best** decsribes your work location/s.

☐ One or more usual fixed addresses. **Go to H14**

☐ Multiple changing locations mostly or entirely in Morwell ⟶ **Go to Section HH**

☐ Multiple locations, mostly outside of Morwell but in the Latrobe Valley ⟶ **Go to Section HH**

☐ Multiple locations, mostly or entirely outside of the Latrobe Valley ⟶ **Go to Section HH**

H14. Please specify **the usual address** during the mine fire period for that **second job** (listed at H10). If more than one address (eg. different sites for the same business), please choose **one main address** where you worked.

Building name/ business	Street number	Street name	Town	Post code	State

SECTION HH - FIRST 20 DAYS/NIGHTS OF THE HAZELWOOD MINE FIRE

For the next two questions please think about the **first 20 days and nights** of the Hazelwood mine fire. That was the period 9 February to 28 February 2014.

H17A. For how many, of those 20 **days** from 9 February to 28 February 2014, did you spend **most of the day** in Morwell?

☐ all 20 days   ☐ less than 20 days, **please estimate the number** ☐☐ *days*

H17B. For how many, of those 20 nights from 9 February to 28 February 2014, did you spend **most of the night** in Morwell?

☐ all 20 nights   ☐ less than 20 nights, **please estimate the number** ☐☐ *nights*

SECTION I - RECENT WELLBEING

I1. The following questions concern how you have been feeling over the **past 4 weeks**. This is a standard set of health questions and some may seem repetitive.

In the past 4 weeks:		None of the time	A little of the time	Some of the time	Most of the time	All of the time
1.	About how often did you feel tired out for no good reason?	☐	☐	☐	☐	☐
2.	About how often did you feel nervous?	☐	☐	☐	☐	☐
3.	About how often did you feel so nervous that nothing could calm you down?	☐	☐	☐	☐	☐
4.	About how often did you feel hopeless?	☐	☐	☐	☐	☐
5.	About how often did you feel restless or fidgety?	☐	☐	☐	☐	☐
6.	About how often did you feel so restless you could not sit still?	☐	☐	☐	☐	☐
7.	About how often did you feel depressed?	☐	☐	☐	☐	☐
8.	About how often did you feel that everything was an effort?	☐	☐	☐	☐	☐
9.	About how often did you feel so sad that nothing could cheer you up?	☐	☐	☐	☐	☐
10.	About how often did you feel worthless?	☐	☐	☐	☐	☐

SECTION J - STRESSFUL LIFE EVENTS

J1. Because stressful life events can affect health, it is important that we ask you about very stressful events that might have happened in your life other than the Hazelwood mine fire.

	No	Yes
1. Did you ever have direct combat experience in a war?	☐	☐
2. Were you ever involved in a life-threatening accident?	☐	☐
3. Other than the Hazelwood mine fire, were you ever involved in a fire, flood or other natural disaster?	☐	☐
4. Did you ever witness someone being badly injured or killed?	☐	☐
5. Were you ever raped, that is someone had sexual intercourse with you when you did not want to, by threatening you, or using some degree of force?	☐	☐
6. Were you ever sexually molested, that is someone touched or felt your genitals when you did not want them to?	☐	☐
7. Were you ever seriously physically attacked or assaulted?	☐	☐
8. Have you ever been threatened with a weapon, held captive or kidnapped?	☐	☐
9. Have you ever been tortured or the victim of terrorists?	☐	☐
10. Have you ever experienced any other extremely stressful or upsetting event?	☐	☐
11. Have you ever suffered a great shock because one of the events happened to someone close to you?	☐	☐

SECTION K - ALCOHOL USE

Because alcohol use can affect health and interfere with certain medications and treatments, it is important that we ask you some questions about your use of alcohol. Your answers will remain confidential, so please be as accurate as possible. Try to answer the questions in terms of **'standard drinks'**.

Light Beer 425ml 2.9% Alcohol	Full Strength Beer 285ml 4.9% Alcohol	Wine 100ml 12% Alcohol	Fortified Wine 60ml 20% Alcohol	Spirits 30ml 40% Alcohol

The guide above contains examples of **one standard drink**.

Full Strength Can or Stubbie 375ml 4.9% Alcohol

A full strength can or stubbie contains **1 ½ standard drinks**

Please mark the response that <u>best fits</u> your drinking.

K1. How often did you have a drink containing alcohol in the past year?

☐ Never ⟶ **If Never, go to Section L over the page**

☐ Monthly or less

☐ 2 to 4 times per month

☐ 2 to 3 times per week

☐ 4 or more times per week

K2. How many drinks did you have on a typical day when you were drinking in the past year?

☐ 1 or 2

☐ 3 or 4

☐ 5 or 6

☐ 7 to 9

☐ 10 or more

K3. How often did you have 6 or more drinks on one occasion during the past year?

☐ Never

☐ Less than monthly

☐ Monthly

☐ Weekly

☐ Daily or almost daily

SECTION L - FUTURE CONTACT

It is important that we be able to contact you in future. We may need to ask you about the information you have provided in this survey, or contact you about important study findings or follow up investigations.

For these purposes only, please provide the following contact details:

L1. Home phone | 0 | | | | | | | | |

L2. Mobile phone | 0 | 4 | | | | | | | |

L3. E-mail address _____@_____

L4. What is your preferred way for us to contact you?

☐ Mobile phone
☐ Home phone
☐ E-mail
☐ Post

L5. In case you move and we lose contact with you, please provide the contact details for up to two relatives or friends who do not live with you, but who would be likely to know your new address or contact details. We would only attempt to contact those people if we could not get in touch with you.

Person 1	Person 2
Name	Name
Relationship to you	Relationship to you
Address	Address
Telephone	Telephone
Email	Email

OTHER COMMENTS

If you have any further comments about your health or the Hazelwood Health Study, please add them here.

_____

_____

_____

_____

_____

_____

Congratulations on completing the questionnaire

YOUR GIFT CARD

As reimbursement for the time you have taken to complete the questionnaire, we are pleased to offer you a **$20 Shop Latrobe City gift card** that can be collected from Newspower Newsagent at 174/176 Commercial Rd, Morwell.

Please give us permission to pass on your name to Newspower Newsagent so that they can correctly identify you as being eligible to receive the gift card. Your details will **not** be used for any other purpose.

☐ Yes, I give permission for my name to be passed on to Newspower Newsagent so they can correctly identify me as eligible for the gift card.

☐ No, I want to be phoned by the researchers to make an alternative arrangement. Please phone _0_____

☐ No, I don't want the gift card.

After the date that you mail this questionnaire back to the researchers, please allow two weeks for your card to be available at the Newspower Newsagent. Please take identification when you go to collect your card.

Thank you for participating in the Hazelwood Adult Survey and Health Record Linkage Study.

Please return your completed questionnaire using the reply-paid envelope provided.

Follow the progress of this important health study at *hazelwoodhealthstudy.org.au*