Hazelwood Health Study

Annual Report 7

19 November 2021

Contributors

The Hazelwood Health Study team, whose work forms the basis for this Report, comprises a diverse and dedicated group of academic, clinical and administrative staff from several Institutions.

Monash University
School of Public Health and Preventive Medicine

Prof Michael Abramson (Principal Investigator)
Dr Juliana Betts
Dr Jillian Blackman
Mr Jonathan Broder
Mr David Brown
Mr Anthony Del Monaco
Ms Christina Dimitriadis
Dr Caroline Gao
Prof Yuming Guo
Dr Sharon Harrison
Dr Nicolette Holt
Prof Danny Liew
Dr Riana Samuel
Prof Malcolm Sim
Ms Catherine Smith
A/Prof Dion Stub
Prof Rory Wolfe
Dr Rongbin Xu
Dr Pei Yu

School of Rural Health

Dr Matthew Carroll (Principal co-Investigator, Gippsland)
Ms Shantelle Allgood
Mr Tim Campbell
Prof Darryl Maybery
Mr David Poland

Faculty of Education

Dr Emily Berger

Federation University

Dr Sue Yell
Dr Lynda McRae
Dr Larissa Walker

University of Tasmania, Menzies Institute for Medical Research

A/Prof Fay Johnston
Prof Graeme Zosky
Ms Ashley Bigaran
Ms Emerson Easley
Ms Marita Dalton
Ms Emily Hemstock
Dr Penelope Jones
Dr Shannon Melody
Prof Kazuaki Negishi
Ms Melanie Reeves
Dr Amanda Wheeler
Ms Myriam Ziou

Swinburne University

Prof Bruce Thompson

The Alfred Hospital

Ms Brigitte Borg
Ms Elizabeth Dewar
Dr Kris Nilsen
Dr Shivonne Prasad
Mr Thomas McCrabb
Dr Juan Mundisugih
Ms Mikayla Thomas

University of Newcastle

A/Prof Michelle Duffy

James Cook University

A/Prof Damian Morgan

Document history

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Contents

Abbreviations

ANZSRS	Australian and New Zealand Society of Respiratory Science
CAC	Community Advisory Committee
COVID-19	Coronavirus Disease 2019
CWI	Community Wellbeing Index
DH	Victorian Government Department of Health
ELF	Latrobe Early Life Follow Up Stream
GPHN	Gippsland Primary Health Network
HHS	Hazelwood Health Study
LGA	Local Government Area
LHA	Latrobe Health Assembly
NAPLAN	National Assessment Program – Literacy and Numeracy
$PM_{2.5}$	Particulate matter with a median aerodynamic diameter of 2.5 thousandths of a millimetre or less
PMG	Project Management Group
PSC	Project Steering Committee
SRG	Scientific Reference Group
TSANZ	Thoracic Society of Australia and New Zealand

1 Executive Summary

This is the seventh Annual Report to be submitted to the Department of Health (DH) and the 32nd contractual milestone for the Hazelwood Health Study (HHS). This report provides a summary of progress made since the sixth Annual Report was submitted in November 2020. In brief, the HHS Early Life Followup, Community Wellbeing and Respiratory Streams have undertaken data collection rounds which had previously been postponed due to the COVID-19 pandemic. The Psychological Impacts and Hazelinks Streams have progressed substantial analyses and write-up of previously-collected data. Two technical reports have been completed and more than 20 scientific papers have either been published or progressed toward publication.

A major activity for the Project Management Group (PMG) in year 7 has been the implementation of the new Governance structure involving the Gippsland Primary Health Network (GPHN) and Latrobe Health Assembly (LHA). The PMG has also continued to review, and adapt to, the impact of COVID-19 on the Study. Other PMG activities have included leading the Annual Retreat and Annual Community Briefing, negotiating minor contract variations with the DH, monitoring and progressing the sharing of Study findings across national and international scientific audiences and updating the Outputs Directory and Citations Master List.

Since the previous Annual Report, the Latrobe Early Life Follow-Up (ELF) stream has completed a technical report describing children's exposure to sources of indoor air pollution and how movement within the Latrobe Valley during February and March 2014 affected mine-fire air pollution exposure. They have also completed a manuscript describing the association between respiratory and cardiovascular function in early childhood. Manuscripts are being prepared to report on hospital admissions, emergency department attendances, GP visits and medical prescriptions in the anonymous linked Latrobe ELF cohort. Due to the relaxation of COVID-19 related restrictions, the ELF stream was able to commence its 2nd round of clinical data collection which had previously been planned for 2020. Testing was conducted between April and July 2021 of 167 children.

The Psychological Impacts Stream has presented new findings to the DH on the impact of exposure to mine fire smoke on student NAPLAN scores. The stream has also collaborated with Hazelinks to produce a manuscript on the association between smoke exposure and mental health service use with regards to ambulance attendances, emergency department presentations and hospitalisations. The Stream has also publicly released the first report arising from 2019-2020 Mental Health and Wellbeing Follow-up Survey, focussing on changes in psychological distress since the 2016 Adult Survey. These findings have been written up and are currently progressing towards journal publication. Further analyses of

data from the Mental Health and Wellbeing Follow-up Survey are currently underway, including further exploring the trajectory of distress and the association between somatic symptoms and distress.

The Psychological Impacts and Community Wellbeing Streams are progressing collaborative work investigating the intersections between individual and community wellbeing in Morwell. The Psychological Impacts and ELF Streams are also collaborating on a survey exploring parent-child-family mental health and wellbeing which is anticipated to commence in early 2022. The Stream continues to support students, with a Masters student completing her research thesis, a PhD thesis now under examination, and three final year Monash medical students undertaking Scholarly Intensive Placements.

The Community Wellbeing Stream had previously completed a comprehensive review of research relating to the Community Wellbeing Barometer, and developed five key domains and associated themes. Interviews with community members and stakeholders commenced in November 2020 and were completed in April 2021. Analysis of the interviews has confirmed the validity of the domains and themes, has suggested some additional themes and particularly affirmed the importance of social connection. Data collection from media and social media for 2017-2021 is almost complete. Two publications have been published: a book chapter on rural older people, climate change and disasters, and an editorial on older people and resilience. A conference paper on best practice in disaster communication has been delivered.

Sub-streams of the Adult Survey, including the Respiratory Stream, Cardiovascular Stream and Hazelinks (identified data component), continue to release a large number of findings. These have included manuscripts on the association between $PM_{2.5}$ and asthma, cardiovascular disease, lung mechanics, chronic obstructive pulmonary disease, ambulance attendances, hospital admissions and cancer. A further manuscript on linked hospital emergency presentations is near completion. A number of students have developed their skills through their involvement with these HHS Streams, including two PhD students and also Nutrition Studies students who worked with the LHA to run a series of nutrition workshops.

In the first half of the year, the Respiratory Stream undertook considerable planning and preparation, including hiring and training a new Respiratory Scientist and Bookings Officer, rebuilding the bookings database, and revising and obtaining Human Research Ethics Committee approval for all procedures, invitation letters and consent forms. The Stream finally launched its second round of clinical data collection in Morwell in May 2021, although four COVID-19-related lockdowns forced the subsequent closure of the clinic for a combined total of 7 weeks. Recruitment and data collection concluded in Morwell in mid-October 2021, when the clinic relocated to Sale. At the time of reporting, the recruitment

rate in both Morwell and Sale was lower than hoped, at 65% (n~336). The Sale clinic has closed in November 2021, about 2 months later than initially scheduled.

A manuscript describing the Hazelinks (deidentified data component) mortality findings has been published by the journal *Chemosphere*.

Community engagement activities have included presenting a study update at the Annual Community Briefing, sending a newsletter to ELF Study families, disseminating findings to the media, preparing lay language Research Summaries and updating the HHS website (www.hazelwoodhealthstudy.org.au).

www.abc.net.au/news/2014-02-17/morwell-main-street-on-feb-9-when-the-mine-fire-ignited

2 Introduction

This is the seventh Annual Report to be submitted to the Department of Health (DH) as part of the milestones for the Hazelwood Health Study (HHS). This report includes a summary of progress made in the 12 months since the sixth Annual Report was submitted in November 2020. Copies of all previous Annual Reports can be found at www.hazelwoodhealthstudy.org.au/study-findings/study-reports/.

The HHS comprises a number of research Streams with their own aims, participants and methods. Combined, the research Streams bring together participant-reported health and wellbeing information, administrative health data, clinical measurements and media-derived information. Participants include infants, school-aged children, adults including the elderly and pregnant women, community groups, the media and both Government and non-Government authorities. These activities provide a comprehensive overview of the long-term health and wellbeing impacts of the 2014 Hazelwood mine fire upon the Latrobe Valley community. The first three to four years of this project primarily comprised collection of a large volume of data by each of the research Streams. The fifth year of the HHS focussed on analyses of the data and reporting of the findings, both to the community and to scientific audiences. In addition, the development of the Strategic Overview and Revised Project Plan in year 5 involved considerable cross-stream review and planning, and extensive community engagement. Year 6 saw the adult Psychological Impacts Stream rollout and complete data collection for the follow-up mental health and wellbeing survey of Morwell-based Adult Survey participants. However, the COVID-19 pandemic and associated restrictions led the Community Wellbeing Stream to delay planned face-to-face interviews, and the Early Life Follow-up (ELF) and Respiratory Streams to delay their planned clinical testing of young children and adults. Instead, all Streams focussed on progressing numerous scientific papers toward publication. In this 7th year of the study, our focus predominantly returned to face-to-face data collection.

Early Life Followup Study clinic

3 Previously completed contract milestones

Since commencement of the HHS in November 2014, and prior to the submission of this 7th Annual Report, 31 contractual milestones have been completed. Those milestones are presented in Table 1 with their delivery dates.

Table 1 Contractual milestones completed prior to this 7th Annual Report

	Contractual milestone	Delivered
1	Project plan	17 December 2014
2	Community and stakeholder engagement strategy	17 December 2014
3	Organisational agreements with sub-contractors	9 February 2015
4	Research ethics submission	9 February 2015
5	Advisory groups established	10 March 2015
6	Outline of Ageing Policy Review	8 May 2015
7	1st Interim Report	15 June 2015
8	1st Annual Community Briefing	11 August 2015
9	1st Annual Report	13 November 2015
10	1st Recruitment Report	15 March 2016
11	2nd Interim report	15 June 2016
12	Ageing Population Policy review	30 November 2016
13	2nd Annual Community Briefings	29 November 2016
14	2nd Annual Report	15 November 2016
15	2nd Recruitment Report	19 March 2017
16	3rd Interim report	15 June 2017
17	Contract review & revised project plan	17 July 2017
18	3rd Annual Community Briefings	9 Oct 2017 Morwell & 10 Oct 2017 Sale
19	3rd Annual Report	16 November 2017
20	4th Interim Report	22 June 2018
21	4th Annual Community Briefing	22 August 2018
22	4th Annual Report	16 November 2018
23	5th Interim Report	21 June 2019
24	5th Annual Community Briefing	11 June 2019
25	Contract review & revised project plan	17 July 2019
26	5th Annual Report	15 November 2019
27	6th Interim Report	19 June 2020
28	6th Annual Community Briefing	10 November 2020
29	6th Annual Report	20 November 2020
30	7th Interim Report	16 June 2021
31	7th Annual Community Briefing	11 November 2021

4 The ongoing impact of COVID-19

As a result of the COVID-19 pandemic, the Hazelwood Health Study continues to adapt and modify its work practices in accordance with Commonwealth Government and DH restrictions, and also in accordance with the guidelines of the researchers' institutions (e.g. https://www.monash.edu/news/coronavirus-updates). In early 2021, the majority of HHS staff and students had returned to their workplace offices although, in some cases, on modified work days and hours to maximise social distancing within the office space. That was the case until late May, when the reintroduction of lockdowns saw the return of most staff and students to home-based offices. All staff and students were supported by resources such as Monash @ Home and remote encrypted connection to shared networks via a Virtual Private Network (VPN). Those allowed the researchers to securely access their HHS work folders and to share confidential information. Already proficient in the use of Zoom conferencing for routine Committee meetings, the HHS researchers continued their increased use of this video-conferencing platform for daily collaboration, consultation and coordination of tasks.

In 2021 the COVID-19 pandemic, its impact on the community's wellbeing and confidence to go about their usual activities, and the intermittently changing restrictions and lockdowns in Victoria, continued to affect the HHS Streams in different ways. In the first half of year 7, both the ELF and adult Respiratory Streams finally launched their round 2 clinic-based data collection, which had both previously been scheduled for year 6. However, lockdowns in Victoria temporarily closed both clinics on one or more occasions (refer sections 7.1 and 7.4 for further detail). Both Streams incorporated new COVID-19-related risk-assessments and protocols into their Standard Operating Procedures (SOPs). These were regularly monitored against the most up to date guidelines issued by relevant authorities such as the DH, Thoracic Society of Australia and New Zealand (TSANZ) and Australian and New Zealand Society of Respiratory Science (ANZSRS) recommendations for Lung Function testing (e.g. www.anzsrs.org.au/latest-news/704-lung-function-testing-in-victoria-3).

Respiratory Stream clinic

The adult component of the Psychological Impacts Stream previously planned to survey ELF Stream families in late year 6 or early year 7, approximately 6 months after the ELF round 2 data collection. Given the delays to the ELF data collection, the survey period has been moved into year 8.

The Community Wellbeing Stream had planned to conduct face-to-face interviews, commencing September 2020 (year 6). Those were deferred while the Stream applied for ethics committee permission to conduct them online or over the phone. Interviews by Zoom were conducted between November 2020 and April 2021.

The Hazelinks Stream has never relied on face-to-face data collection and, therefore, this Stream's activities have continued unchanged. The Adult Survey, Psychological Impacts Schools Study and Cardiovascular Streams had concluded face-to-face data collection prior to 2020. Therefore, those Streams have focussed on progressing analyses and/or write-up of previously-collected data, with no notable adverse effects of the COVID-19 restrictions on their progress.

5 Project Governance

5.1 Project Management Group

The Project Management Group (PMG) continues to provide oversight to the operationalisation of the Project Plan, reviewing study progress, managing staff appointments, monitoring the budget, ensuring adherence to good research practice standards and the successful delivery of contractual milestones.

A major activity in year 7 has been the implementation of the new Governance structure which has seen the disbanding of the Clinical Reference Group and Community Advisory Committee. These HHS activities have merged with the existing Gippsland Primary Health Network (GPHN) and Latrobe Health Assembly (LHA); refer to sections 5.2 and 5.3 for further details.

As described in section 4, the PMG continues to undertake risk assessments and review protocols in order to minimise any ongoing adverse effects of the COVID-19 pandemic on the Study.

Early in Year 7 the PMG concluded negotiations with the DH in regard to contract variations pertaining to the merging of the original contract's Third and Fourth Option Periods, with associated revisions to the payment structure, the merging of expense type

and expense descriptions and the reallocation of a proportion of year 6 reimbursable expenses to year 7.

Toward the middle of the year, the PMG worked closely with the Project Steering Committee to prepare the 7th Interim Report, followed by the year 7 Contract Review and years 8-10 Project Plan, which were submitted to DH in June and July 2021, respectively.

The PMG continues to update the recently developed Hazelwood Health Study Outputs Directory which lists all publicly available HHS findings (Appendix 1) and the Citations Master List (Appendix 2).

Other PMG activities in the past 12 months include:

- ensuring all contractual obligations are met, and negotiating minor variations;
- leading the HHS 2021 Annual Retreat;
- reviewing preliminary and final drafts of all reports, papers, abstracts, research summaries and newsletters arising from HHS research;
- facilitating the submission of all HHS findings to DH for approval;
- overseeing the public release of HHS findings via the HHS website, media and other internet sites;
- negotiating with DH in regard to an agreement that allows the study to share HHS Community Wellbeing Index data with relevant third parties (with the consent of participants) for the purpose of the development of population norms;
- negotiating with DH in regard to Federation University becoming the approved custodian of the “Our Hopes for the Future of Morwell” photographic exhibition;
- monitoring monthly budget reports, adjusting planned expenditure accordingly;
- preparation, oversight and renewal of sub-contracts with collaborators;
- participation in meetings with the DH Contract Committee;
- leading the HHS 2021 Annual Community Briefing.

5.2 Gippsland Primary Health Network

As previously reported, a Memorandum of Understanding is now in place with the GPHN regarding the provision of clinical input into the study. The HHS is now a standing item on the meeting agenda for the Latrobe Baw Baw Subregional Clinical Council. The group meets three times a year in February, May and August, followed by a joint meeting with the two other Subregional Clinical Councils in November. This will provide a regular opportunity for the study to brief members on HHS findings and seek input on clinical matters.

For the February 2021 meeting a brief Stream overview and a brief summary of key outputs was provided to the GPHN by way of an introduction to the Study. For the May 2021 meeting, the HHS provided a consolidated synopsis of our findings to date. For the August 2021 meeting, the HHS provided a copy of a draft cancer incidence manuscript and its associated Research Summary as well as a copy of the HHS Outputs Directory, providing an overview of all outputs to date. Following the meeting, the HHS team fielded questions from committee members regarding the cancer incidence calculations, and the role of factors such as socioeconomic status, alcohol and other drugs.

For the upcoming November 2021 meeting, the HHS has provided copies of recent findings on changes in ambulance call outs, ED presentations and hospital admissions for mental health conditions, and an analysis of aggregated NAPLAN data to examine educational outcomes in the years after the mine fire.

5.3 Latrobe Health Assembly

As previously reported, an alternative model to the Community Advisory Committee (CAC) has been implemented, involving folding the function and purpose of the CAC into the activities of the Latrobe Health Assembly (LHA). In discussions with the LHA Chair and Executive Officer, it was agreed that a working group be established, involving existing CAC members and LHA members, to determine the best model going forwards. From this process, Terms of Reference have been drafted and are under final review. The proposed membership is four LHA members and four community members.

The first meeting of the newly convened LHA HHS subcommittee took place on 15 July. The focus of the meeting was a review of the years 8-10 Project Plan. As part of the discussion, the HHS team responded to questions regarding the impact of the COVID-19 pandemic on research activities. It was also noted that the HHS research program had broadened over time to include a wider range of potential outcomes, including the focus on educational outcomes in the Schools Study analyses. Members noted the potential of the study to inform LHA projects, providing information on local health priorities.

The next meeting of the LHA HHS subcommittee is planned for December 2021, with a review of this annual report to be one of the key discussion points.

5.4 Scientific Reference Group

Scientific Reference Group (SRG) members have been actively involved throughout the year in the review and co-authorship of a number of the HHS reports and manuscripts describing new findings. In addition, a major activity of the SRG in July 2021 was to review the year 7 Contract Review and years 8-10 Project Plan.

5.5 Project Steering Committee

The Project Steering Committee (PSC) provides overall strategic guidance for the HHS. PSC membership comprises each of the Stream leads and the Project Management Group members. During the last year there have been five formal meetings of the PSC plus numerous out-of-session consultations and contributions to strategic decisions and reports, particularly the years 8-10 Project Plan and the 7th Interim and Annual Reports.

Key discussion items have included:

- Reviewing the Terms of Reference for the LHA HHS sub-committee.
- Review of all Stream activities and progress, including any variations to the project plan.
- Planning for, and delivery of, the HHS annual retreat.
- Review and approval of all proposals for analysis and write up of HHS findings.
- Ongoing assessment of, and adaptation to, constraints related to the COVID-19 pandemic such as the applicable TSANZ/ANZSRS guidelines for respiratory testing.
- Delayed commencement of, and interruptions to, the ELF Stream and Respiratory Stream Round 2 Clinical Testing due to COVID restrictions in 2020.
- Negotiation with various health service centres in Gippsland to source a suitable clinic location for the ELF Stream and Respiratory Stream Round 2 Clinical Testing.
- Sharing of resources, including equipment and staffing, between the ELF and Respiratory Streams.
- Oversight of community engagement activities such as the e-newsletter to Respiratory Stream participants to inform them of the ongoing delays in commencement of Round 2 clinical testing.
- Temporary suspensions, and resumptions, of the ELF Stream and Respiratory Stream Round 2 clinical testing due to COVID-19-related restrictions in 2021.
- Oversight of the dissemination of findings via reports, journal papers, abstracts, Research Summaries and media releases.
- Planning for the year 7 Annual Community Briefing.
- Planning for, and delivery of, the year 7 Interim Report.

- Planning for, and preparation of, the year 7 Contract Review and years 8-10 Project Plan, submitted to DH in July 2021.
- Contingency planning around staff leave;
- Review of budgetary constraints and cost-effective solutions;
- Planning for, and delivery of, this year 7 Annual Report.

Recently the Project Steering Committee comprised the panel of presenters for the 7th Annual Community Briefing.

6 Stream coordination retreat

The Study's seventh Stream coordination retreat was hosted by Monash University's School of Public Health and Preventive Medicine, St Kilda Rd, Melbourne, on 22 February 2021. Due to COVID-19 restrictions, travel to Melbourne was not possible so hubs in Gippsland and Tasmania were established to enable the bulk of participants to join together in the three locations, with others participating via individual Zoom links. The retreat involved members of all HHS research Streams, overarching project staff and PhD students. Guest participants included Prof Ross Coppel (Chair SRG), Ms Ellen-Jane Browne and Ms Tanya Rong (both from the Latrobe Health Assembly).

Key activities included:

- Review of findings to date, outputs, current status and the 2021 study plan for each HHS Stream.
- Proposals for the Project Plan for the years 8 – 10 contract period of the study.
- Identifying potential research collaborations for progressing HHS research funding opportunities.

7 Research updates

7.1 The Latrobe Early Life Follow-up (ELF) Study

In the last 12 months the ELF Stream has completed a technical report, published a scientific manuscript, progressed two others toward publication and presented two conference abstracts. The Stream has also undertaken its 2nd round of clinical data collection.

Report

Chappell K, Melody S, Wheeler A, Dalton M, O'Sullivan T, Williamson G, Johnston F (2020). Volume 5: A description of sources of air pollution inside and outside the home environments of children in the Latrobe ELF Cohort. Submitted to and approved by DH in December 2020. Uploaded to the HHS website in December 2020.

Manuscript

- Hemstock E, Shao J, Zhao B, et al (2021) Associations between respiratory and cardiovascular function in early childhood. Submitted to DH in December 2020. Published in *Respirology*, August 2021. Available at https://doi.org/10.1111/resp.14117.

Abstracts

Two abstracts prepared by Dr Shannon Melody, in regard to birth outcomes and maternal gestational diabetes, were previously submitted to the 2020 World Congress of Epidemiology. That conference was postponed, but finally took place September 2021.

Papers in Progress

1. Hospital admissions and emergency department attendances in the anonymous linked Latrobe ELF cohort (N=2,384).

We assessed the relationship between exposure *in utero* or in the first 14 months of life to $PM_{2.5}$ from the Hazelwood mine fire, and ambient levels of $PM_{2.5,}$ and hospital usage following the fire period in a cohort consisting of all children born in the Latrobe Valley between March 2012 and December 2015. Emergency department (ED) visits and hospitalisations occurring in a one-year period after birth (for children exposed *in utero*) or after the fire (for children exposed in infancy), recorded in the state-based Victorian Emergency Minimum Dataset and the Victorian Admitted Episodes Dataset, were compared to the same outcomes in both children conceived and born before or after the fire. In addition to all-cause presentations, ED visits and hospitalisations for different clinical categories were examined (all respiratory, respiratory-related infections, all infections,

allergies and skin rash). Dose-response analysis was performed to explore the relationship between levels of exposure to fire-related and ambient $PM_{2.5}$ and hospital usage, and categorical analysis (exposed vs non/minimally-exposed) was used to assess possible non-linear relationships between exposure to fire-related $PM_{2.5}$ and the same outcomes.

2. General Practice visits and medical prescriptions in the anonymous linked Latrobe ELF cohort (N=2,384).

We assessed the relationship between exposure *in utero* or in the first 14 months of life to $PM_{2.5}$ from the Hazelwood mine fire, and ambient levels of $PM_{2.5,}$ and general practitioner (GP) visits and prescribed medicines dispensed following the fire period in a cohort consisting of all children born in the Latrobe Valley between March 2012 and December 2015. GP attendances and dispensation of prescribed antibiotics, asthma inhalers and steroid skin creams occurring in a one-year period after birth (for children exposed *in utero*) or after the fire (for children exposed in infancy), and recorded by the Australian Medicare Benefits Schedule and Pharmaceutical Benefits Scheme, were compared to the same outcomes in both children conceived and born before or after the fire. Dose-response analysis was performed to explore the relationship between levels of exposure to fire-related and ambient $PM_{2.5}$ and GP attendances and prescriptions dispensed, and categorical analysis (exposed vs non/minimally-exposed) was used to assess possible non-linear relationships between exposure to fire-related $PM_{2.5}$ and the same outcomes.

Round 2 clinical data collection

The ELF Study's second round of follow-up clinical data collection had been planned for 2020, however it was postponed due to the COVID-19 pandemic. With restrictions easing in early 2021, substantial preparations commenced and clinical data collection finally began in April 2021. A risk assessment for conducting these clinics in a COVID-safe manner was prepared and accepted by both the University of Tasmania and Federation University Churchill (where the clinics were conducted). Seven local residents of the Latrobe Valley and close surrounds were employed and trained to staff these clinics. The COVID-related state-wide lockdown in May/June 2021 caused a further one-week suspension of clinic activities, which were able to resume once restrictions were eased in regional Victoria. A newsletter (see Appendix 3) was sent out to families in June to assist recruitment. Clinical testing was completed in July 2021.

A total of 167 children completed testing. Of those, 81% had previously attended the first round of clinics in 2017, although at that time many were too young to satisfactorily complete all respiratory testing. In this round of clinical testing, 136 children had pulse wave velocity measurements, 152 had measures of intima-media thickness (left and right carotid artery), 112 were able to complete the fractional exhaled nitric oxide (FeNO) testing, 165 undertook Forced Oscillation Technique (FOT) testing, and 107 had a blood sample taken. As an addition to previously collected exposure data, parents of participating children were asked to complete some questions about exposure to the bushfires of the 2019/2020 “black” summer. Families of clinic participants were sent a report of allergy test results, and these were also supplied to a nominated general practitioner if requested. Cardiovascular, respiratory and biochemical data are now in the process of being analysed by researchers at the Menzies Institute of Medical Research.

7.2 Psychological Impacts

Over the last 12 months the Psychological Impacts Stream has completed a technical report and has progressed several research manuscripts toward publication, as follows:

Report

- Carroll M, Campbell TCH, Gao CX, Smith C et al. (2020). 2019-2020 Mental Health and Wellbeing Follow-up Survey: Technical Report. This report and its associated Research Summary were completed and submitted to the DH on 19 November 2020. In December 2020 the documents were approved and uploaded to the HHS website.

Manuscripts

Schools Study

- Berger E, Gao CX, Broder JC, Campbell TCH, Maybery D, and Carroll M. (2021) The impact of a mine fire and smoke event on academic outcomes for primary and secondary school students. This manuscript has been accepted for publication by the journal *Psychological Trauma: Theory, Research, Practice, & Policy* and is currently in-press. A preprint version of the paper was previously placed on PsyArXiv at

https://psyarxiv.com/unms5/ and the associated Research Summary is on the HHS website.

- Maybery D, Carroll, M, Berger, E, Dipnall, J, and Lee, S. The psychological impact and experiences of children following the Hazelwood mine fire and subsequent smoke event. The researchers have prepared this manuscript for consideration for a special issue on Child Mental Health in the journal *Sustainability* (with Drs Berger and Carroll as the special issue editors). A preprint version has previously been made available at https://psyarxiv.com/rw657 and the associated Research Summary is on the HHS website.
- Gao CX, Broder JC, Brilleman S, Berger, EB, Ikin, J, Smith, C et al. (2021) Evaluating the impact of Hazelwood mine fire event on students' educational development. This manuscript was approved by DH in March 2021 and is currently under review by the journal *Science of The Total Environment*. A preprint version has been placed on medRXiv at https://doi.org/10.1101/2021.03.28.21254516 and the associated Research Summary is on the HHS website.

Adult psychological health

- Carroll M, Campbell TCH, Smith C, Gao CX et al. An exploration of the trajectory of psychological distress associated with exposure to smoke during the 2014 Hazelwood coal mine fire. This manuscript was approved by DH in August 2021 and is currently under review by the journal *International Journal of Hygiene and Environmental Health*. A preprint version has been placed on psyArXiv at https://psyarxiv.com/tz5c4/ and the associated Research Summary is on the HHS website.
- Carroll M, Gao CX, Campbell TCH, Smith C et al. Impacts of coal mine fire-related $PM_{2.5}$ on the utilisation of ambulance and hospital emergency services for mental health conditions. This manuscript was approved by DH in August 2021 and is currently under review by the journal *Chemosphere.* A preprint version has been placed on psyArXiv at https://psyarxiv.com/hgv7t and the associated Research Summary is on the HHS website.

A technical report based on the 2019/2020 Mental Health and Wellbeing Follow up Survey was released in December 2020. The report investigated changes in event-related psychological distress (scoring on the Impact of Event-Revised scale; IES-R) and generalised psychological distress (scoring on the Kessler 10-item Distress scale; K10) since the 2017 Adult Survey. A manuscript on the trajectory of distress based on the report has subsequently been prepared and submitted for publication in 2021. A series of further analyses of Mental Health and Wellbeing Follow up Survey data are underway, focused on:

- the factors associated with those people who showed little change in distress levels between survey rounds, compared to those who experienced an increase in distress and those where distress reduced over time.
- the association between somatic symptoms and distress, which could have implications for how GPs and other clinicians respond to somatic complaints following an exposure event.
- the relationship between exposure to the Hazelwood event and community wellbeing (scoring on the Community Wellbeing Index; CWI), including the intersection between individual and community wellbeing.

The community wellbeing analysis referred to above is part of the ongoing collaboration between the Psychological Impacts and Community Wellbeing Streams to look at the relationship between individual wellbeing and community wellbeing in Morwell. As this is one of the first times the CWI has been used in English, the stream is also collaborating with the Spanish developers of the measure, and other international researchers, to conduct a cross-national psychometric evaluation of the measure. Approval to include deidentified HHS CWI data in this collaboration was provided by the DH in November 2020. The other key point of collaboration with the Community Wellbeing Stream involved the inclusion of questions relating to individual wellbeing in interviews recently conducted by the Community Wellbeing stream. The initial analysis of the qualitative interview data has been completed and the streams are working on interpreting and writing up the findings.

The Psychological Impacts Stream is also collaborating with the ELF Stream to develop a survey which will explore parental mental health and family functioning. Research stemming from this survey will focus on how these factors are associated with the physical and mental health and development of the children participating in ELF research. It is anticipated that this survey will commence in early 2022.

The Stream continues to foster capacity building and skills development by supporting students. A PhD thesis looking at the impact of the Hazelwood event on younger adults living and working in the impacted region has been submitted and is currently under review. As part of this doctoral project, a manuscript utilising Adult Survey data to distress in young adults approved by the DH in November last year is currently under review by the International Journal of Disaster Risk Reduction. A Master of Educational and Developmental Psychology student completed her research thesis of the recent follow-up survey data, exploring the impact of prior mental health diagnoses on the development of longer-term psychological distress in response to the Hazelwood event.

The stream also continues to support final year Monash Medical students to complete Scholarly Intensive Placements. This year two placement students have completed the final stages of a systematic review on particulate matter air pollution and psychological

distress (co-supervised with HHS Principal Investigator Michael Abramson), building on the work of two previous placement students. Another placement student completed a set of rapid literature reviews of the relationship between mental health and somatic symptoms, and of the intersections between individual-level and community-level wellbeing, which are informing the Stream publications on somatic symptoms and community wellbeing respectively.

7.3 Impact on Community Wellbeing

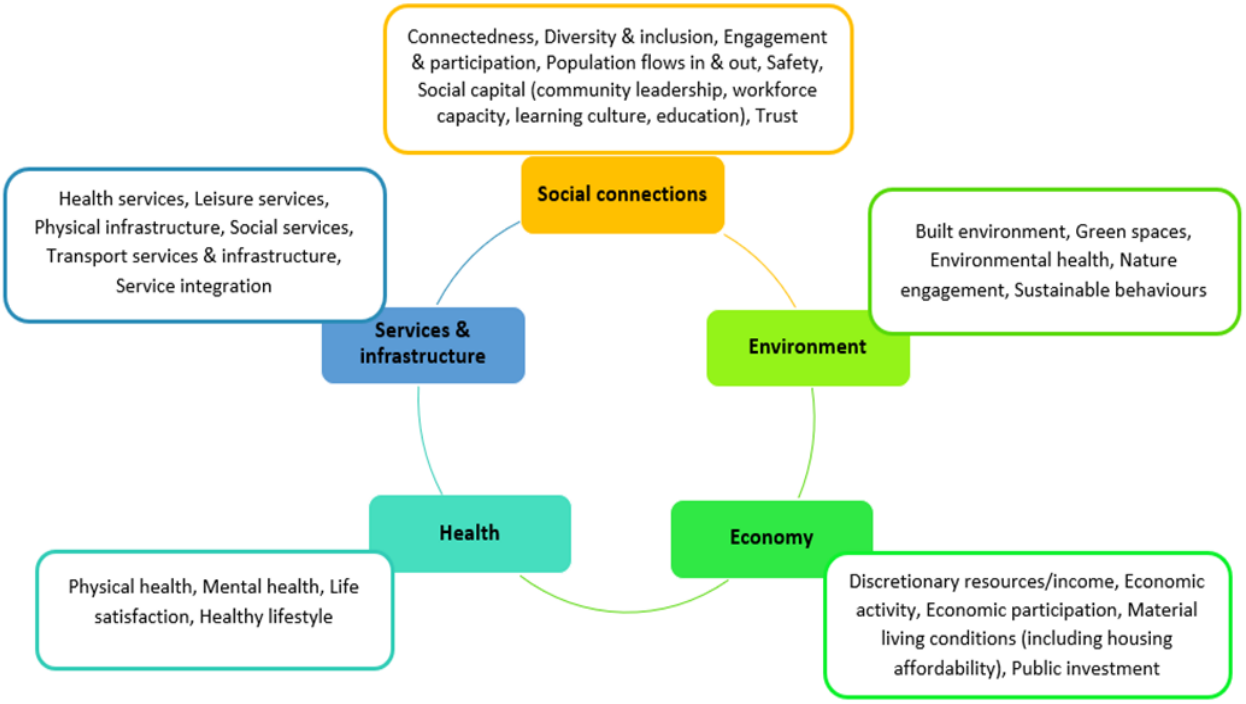
In 2021 the stream's research aims have been to:

- Continue to assess **perceptions of the community's wellbeing and recovery** after the Hazelwood mine fire, taking into consideration subsequent events (e.g., the closure of the Hazelwood power station and Morwell mine, and other large local employers, the release of HHS results) and recent initiatives (such as the Latrobe Health Innovation Zone, Latrobe Health Assembly and Latrobe Health Advocate);
- Develop a **community wellbeing barometer** that brings together community perceptions of wellbeing and existing community wellbeing indicator proxy measures. The aim of the barometer is to provide a holistic tool to capture the changes in key dimensions that underpin community wellbeing;
- Examine the **relationship between community wellbeing and personal wellbeing** (in conjunction with the Psychological Impacts stream).

Our first round of qualitative data collection covering all three of the above research aims is now complete. Interviews with 30 stakeholders and community members commenced in November 2020 and concluded in April 2021. Due to COVID-19-related precautions, our initial ethics approval was for telephone/videoconference interviews. Therefore, interviews were conducted on Zoom until the end of 2020. Approval was granted in 2021 to conduct face-to-face interviews where requested by the interviewees, however most participants still preferred to be interviewed by telephone or Zoom. Analysis of interview transcripts is almost completed.

A review of the scholarly literature on using objective measures to assess and document changes in community wellbeing was previously completed. This internal report, along with a similar review of research on applying composite measures of personal wellbeing, in Italy, Spain, the US, Japan and New Zealand, has been used to inform the design of the community wellbeing barometer. Based on these reviews, our team has identified five domains which are the focus of the barometer: health; the economy; the environment; services and infrastructure; and social connection. For each domain we have also identified

4-6 themes and, for each theme, objective indicators are being identified in order to measure changes in community wellbeing.



Model of the proposed Community Wellbeing barometer domains and themes

The interviews were used to check the validity of the domains and themes determined by the team. Preliminary analysis of the interviews has confirmed the validity of these domains and themes and particularly affirmed the importance of social connection. Some additional themes have been identified. For example, service integration is seen as an important theme within Services and Infrastructure; and workforce capacity and education are seen as important forms of social capital within the Social Connections domain. Work has begun on identifying potential measures for each theme, drawn from databases such as those maintained by the Australian Bureau of Statistics and the Victorian Department of Health.

As in Years 1-6, we continue to collect data from media and social media, to contribute to analysing the subjective aspects of community wellbeing. Data collection is focused around specific events since the mine fire. The identification of key events was based on interviewees' responses to a question about which events and initiatives they believed had impacted on the community's wellbeing since the mine fire. This data collection is almost complete for the period 2017-2021.

As referred to in section 7.2, the Community Wellbeing Stream is collaborating with the Psychological Impacts Stream to look at the intersection between individual and community wellbeing. Analysis of the CWI data has been completed, looking at current community wellbeing and change in community wellbeing since the mine fire, and taking into

consideration level of exposure to the smoke event and other sociodemographic and health risk factors. The two streams are working together to interpret the findings, to provide insights into changes to community wellbeing and the relationship between community wellbeing and individual wellbeing. This work will be informed by the qualitative analysis of the interview data regarding the links between individual and community wellbeing.

The Stream has a particular interest in ageing, following the merger with the Older People Stream several years ago. Two publications with an ageing focus have been progressed. These do not contain new HHS findings and instead, refer to previously released HHS findings as part of a broader discussion.

- Carroll, M. and Walker, J. (2021). Rural older people, climate change and disasters. In M. Skinner, R. Winterton and K. Walsh (Eds), *Rural Gerontology: Towards Critical Perspectives on Rural Ageing* (pp. 336-348). Routledge: London (ISBN 9780367894795).
- Carroll, M. (2020). Invited editorial - The vulnerability and resilience of older people in rural/regional areas in times of climate, environmental, and global health challenges. *Australasian Journal on Ageing,* 39 (4), 325-327.

This continuing focus on older people has informed the analyses undertaken by other research streams, particularly the Psychological Impacts Stream. For example, in the technical report on the 2019-2020 Mental Health and Wellbeing Follow-up Survey, the analyses found that older people reported lower distress levels in response to the Hazelwood event than younger age groups, after controlling for chronic health and other factors.

The Community Wellbeing team presented a conference paper at the Australian and New Zealand Communication Association conference in Melbourne, in July 2021. The presentation was on optimal communication during complex disasters with health impacts, and drew on existing findings from the Older Persons Policy Review and the Community Wellbeing Stream. The conference presentation is being developed as a full paper and will be submitted to a journal for publication. Again, this work includes previously published findings as part of a broader discussion.

7.4 Adult Survey, Respiratory Stream, Cardiovascular Stream and Hazelinks identified data

The Respiratory Stream, Cardiovascular Stream, and Hazelinks identified data analyses, are all based upon the Adult Survey Cohort. Combined, these data have been used in a

number of analyses culminating in numerous scientific manuscripts which have been progressed towards publication in the last year as follows:

Manuscripts

Respiratory Stream

- Taylor S, Borg B, Gao CX, Brown D, Hoy R, Makar A, et al. (2020) The impact of the Hazelwood coal mine fire smoke exposure on asthma. Published by the *Journal of Asthma* in December 2020. Available via the HHS website and at doi.org/10.1080/02770903.2020.1847931.
- Holt, N. R., Gao, C. X., Borg, B. M., Brown, D., Broder, J. C., Ikin, J., Makar, A., McCrabb, T., Nilsen, K., Thompson, B. R., & Abramson, M. J. (2021). Long term impact of coal mine fire smoke on lung mechanics in exposed adults. Published by *Respirology* in June 2021. Available via the HHS website and at https://doi.org/10.1111/resp.14102. Visual abstract prepared for social media. Preprint available at https://doi.org/10.1101/2020.10.14.20213009.
- Prasad, S., Gao, C., Borg, B., Broder, J., Brown, D., Ikin, J., Makar, A., McCrabb, T., Hoy, R., Thompson, B., & Abramson, M. J. (2021). Chronic Obstructive Pulmonary Disease in adults exposed to fine particles from a coal mine fire. Accepted by the *Annals of the American Thoracic Society*. Awaiting proofs. Cited on the HHS website and available at https://www.atsjournals.org/doi/10.1513/AnnalsATS.202012-1544OC. Pre-print also available at https://doi.org/10.1101/2020.10.14.20213033.
- Samuel, R., Gao, C.X., Broder, J., Brown, D., Del Monaco, A., Ikin, J.F., McFarlane, A., Berger, E., Maybery, D., Sim, M.R., Walker, J., Carroll, M.T.C. & Abramson, M.J. Associations between self-reported respiratory symptoms and psychological distress following exposure to a landscape fire. Published by the journal *Stress and Health* in September 2021.Available via the HHS website and at https://doi.org/10.1002/smi.3097.
- Lee WK, Smith CL, Gao CX et al (2021) Are E-cigarette use and vaping associated with increased respiratory symptoms and poorer lung function in a population exposed to smoke from a coal mine fire? Published by *Respirology* in October 2021. Available via the HHS website and at https://doi.org/10.1111/resp.14113. Recent correspondence around this paper is also to be published.

Cardiovascular Stream

- Mundisugih J, Gao CX, Ikin JF, et al (2021) Vascular responses among adults exposed to smoke from the Hazelwood coal mine fire. Submitted to, and approved

by DH in April 2021. Under review by the journal Vascular Health and Risk Management. Cited on the HHS website.

- Betts JM, Dewar EM, Stub DA, Gao CX, Brown D, Ikin JF, et al. (2021) Markers of cardiovascular disease among adults exposed to smoke from the Hazelwood coal mine fire. Published by the *International Journal of Environmental Research* in February 2021. Available on the HHS website and via https://doi.org/10.3390/ijerph18041587.

Hazelinks

- Broder, J.C., Gao, C.X, Abramson, M.J., Wolfe, R., Dimitriadis, C., Ikin, J.F., Sim, M.R., Del Monaco, A., Johnston, F., Carroll, M., Brown, D., Smith, K. & Guo, Y. (2021) Long-term impact of exposure to coalmine fire emitted $PM_{2·5}$ on emergency ambulance attendances: Hazelwood Health Study. Published by the journal *Chemosphere* in September 2021. Cited on the HHS website and available at https://doi.org/10.1016/j.chemosphere.2021.132339.
- Xu R, Gao CX, Dimitriadis C, et al (2021) Long-term impacts of coal mine fire emitted $PM_{2·5}$ on hospitalization: longitudinal analyses of the Hazelwood Health Study. Accepted for publication by the *International Journal of Epidemiology* in October 2021

- Yu, P., Guo, Y., Gao, C.X., Dimitriadis, C., Ikin, J.F., Del Monaco, A., Brown, D., Sim, M.R. & Abramson, M.J. (2021) Impacts of high concentration, medium duration coal mine fire related $PM_{2.5}$ on cancer incidence: 5-year follow-up of the Hazelwood Health Study. Accepted for publication by *Environmental Health Insights* in October 2021. Cited on the HHS website.

An analysis of linked hospital emergency presentations data has been completed and a manuscript is in preparation.

These Streams also support a number of students. Two PhD students are utilising Adult Survey and Hazelinks data to investigate the association between mine fire $PM_{2.5}$ exposure and linked hospital, and cancer registry outcomes, respectively. A medical student has worked with the Respiratory Stream to analyse data on e-cigarette use and vaping, and write up their associations with respiratory symptoms, lung function and markers of asthma control in Hazelwood participants.

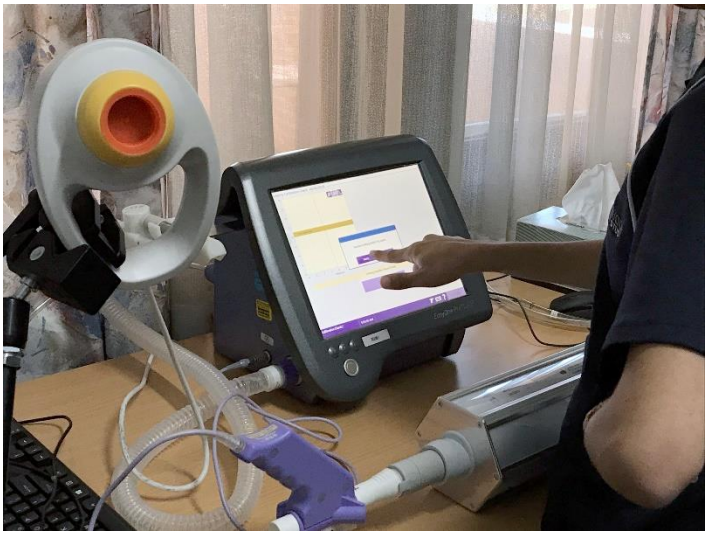
Following talks with the Latrobe Health Assembly regarding the food preferences of Gippsland residents and how to encourage healthier eating, two Monash Nutrition Studies

students have worked with the Assembly to run a series of nutrition workshops with key local partners, and a Nutrition Week social media campaign. This has also fed into national and local project funding proposals which aim to make *healthy eating the desirable and easy option.* The LHA is now funding a project called *MyFoodSwaps* to provide a tool that is accessible to the community of the Latrobe Valley, and supports the actions of the Assembly to improve dietary literacy

As described in section 4, the Respiratory Stream had originally planned to undertake a second round of data collection in 2020, however that was postponed due to COVID-19 restrictions. With many restrictions easing toward the end of 2020, the stream undertook considerable planning and preparation throughout the first 6 months of year 7, and launched the second round of data collection in May 2021. Activities in the lead up to recruitment and data collection included:

- reviewing and updating all recruitment and data collection protocols;
- writing new participant invitation letters, Informed Consent Forms and Information Statements;
- auditing, testing and calibration of equipment from the first round of testing to be reused during round 2;
- recruitment and training of respiratory scientists to undertake testing;
- recruitment and training of bookings officers;
- preparing and obtaining Human Research Ethics Committee approval from Monash University and Alfred Health;
- sourcing and rental of suitable clinical premises;
- sourcing and rental of housing for clinical testing staff;
- sourcing and purchase of all equipment and consumables required for the clinic;
- review and update of participant contact details;
- designing, programming and testing a new appointment bookings database;
- designing, programming and testing a new online consent form and questionnaire to be used by participants;
- designing, programming and testing a new online consent form and data collection database to be used by the respiratory scientists; and
- arranging the printing, packaging and mailing of invitation, first reminder and final reminder letters to participants.

Data collection finally commenced in Morwell in May 2021, however it was subsequently suspended three times due to COVID-19 related state-wide lockdowns and once due to an LGA specific lockdown. Combined, the data collection clinic closed for seven weeks. Around the time of each lockdown, pre-booked participants were cancelled, and then rebooked once a re-open date was known. The booking system was suspended during lockdowns to prevent participants attempting to make booking while the site was closed.



Respiratory Stream clinic

Whenever possible, the Morwell clinic continued recruitment and data collection through until 13 October 2021, when it closed in order for recruitment and data collection to commence in Sale. Throughout the data collection period in Morwell, recruitment was more challenging than anticipated, particularly considering that all eligible subjects had previously participated in round 1 testing in 2017. At that time, participants were made aware that the study intended to undertake two further rounds of testing, in 2020 and 2023, so that long-term respiratory health could be evaluated. We believe that a combination of factors contributed to challenges with recruitment in Morwell.

Not least was COVID-19 related anxiety, reducing the public's confidence in their safety away from home, even when restrictions were eased and local case numbers were low. For many people, COVID-19 also increased their work load, particularly if they were in essential service roles and/or had to support school aged children undertaking home-based learning. Some eligible participants were located in metropolitan Melbourne, and a few were even interstate, unable to travel to the Latrobe Valley during the Morwell data collection period. Another factor which likely contributed to challenges in recruitment, was the time elapsed since the mine fire (2014) and since the round 1 assessment (2017). During this elapsed time, a number of other significant adverse events have impacted the local community, including industry failures, job losses and bush fires. Each of these could potentially contribute to the community's reduced engagement with the Hazelwood Health Study.

At the time of reporting, approximately 222 Morwell (64%) and 114 Sale (66%) participants had attended a clinic for testing. Initially scheduled to close at the end of September 2021, data collection was completed in Sale on 15 November 2021.

7.5 Hazelinks deidentified data

Based upon deidentified data (anonymous extracts), the Hazelinks researchers have progressed the following scientific manuscript:

- Dimitriadis C, Gao CX, Ikin JF, Wolfe R, Gabbe BJ, Sim MR, Abramson MJ, Guo Y. Exposure to mine fire related particulate matter and mortality: A time series analysis from the Hazelwood Health Study. Based on the previously approved technical report, this manuscript was published by the journal *Chemosphere* in July 2021. Available on the HHS website and via https://doi.org/10.1016/j.chemosphere.2021.131351.

As referred to in section 7.2, Hazelinks has collaborated with the Psychological Impacts Stream on a manuscript describing patterns of hospital admissions, emergency presentations and ambulance attendances for mental health conditions in the Latrobe Valley region over the time of the mine fire event. The manuscript was approved for public release by the DH in August 2021 and is in preparation to be submitted to *Environmental Pollution*.

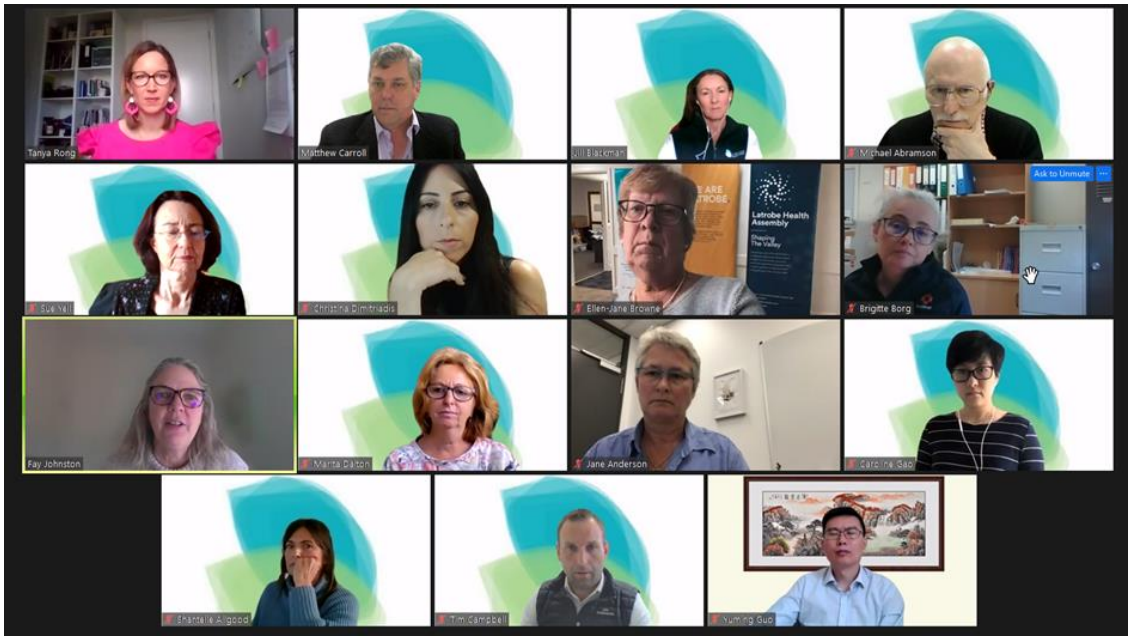
8 Community Engagement

In the last 12 months, five lay language Research Summaries (see Appendix 4) have been added to the Fact Sheets and Summaries page. The Outputs Directory (see Appendix 1) has been updated, as have the Citations Master List (see Appendix 2), Study Reports, Publications and Research Streams sections of the HHS website.

The 7th Annual Community Briefing took place on Thursday 11 November. Because of the ongoing COVID-19 pandemic and associated restrictions, the briefing was again held via Zoom with details distributed via social media and emails to our wider networks. In line with the 2020 Briefing, the virtual nature of the event allowed a wider range of participants to engage with the study team. Almost 50 people participated in the session, with the audience including local residents and service providers as well as participants from the wider HHS team and academia.

The session involved brief updates from each of the streams followed by an overview of key outcomes from the last year. The session ended with a Q+A moderated by Tanya Rong, Chair of the Latrobe Health Assembly, where stream leads responded to questions regarding the research program, including the impacts of COVID-19, recruitment rates and exploring specific findings in more detail. Jane Anderson, the Latrobe Health Advocate closed the session with her reflections on the previous year, where she emphasised the need for the study to work with local partners to ensure that the findings are translated into

policy and practice. A full recording of the briefing has been uploaded to the HHS website at www.hazelwoodhealthstudy.org.au/news-and-events/community-briefings.



The Study received media attention during the last 12 months, as shown on our website (www.hazelwoodhealthstudy.org.au/news-and-events/media) and briefly listed here:

- December 2020: Psychological Impacts Followup Mental Health and Wellbeing findings (ABC Gippsland)
- April 2021: Schools Study linked NAPLAN data (ABC News)
- May 2021: Schools Study deidentified NAPLAN findings (Latrobe Valley Express)
- May 2021: ELF Stream launch of round 2 clinical testing (TRFM).
- June 2021: Respiratory Stream findings of decreased lung stretchiness (The Guardian)
- July 2021: Respiratory Stream findings of decreased lung stretchiness (Latrobe Valley Express)
- July 2021: Respiratory Stream: impacts of vaping e-cigarettes (Herald Sun)
- November 2021: Respiratory Stream participants in Sale encouraged to take part (Gippsland Times)

The Respiratory Stream FAQs page on the website was updated to reflect information relevant to the 2nd round of data collection, and the ELF Stream sent out a newsletter to families in June 2021 (see Appendix 3).

9 Appendices

Hazelwood Health Study outputs which are publicly available

Stream	Release Date	Details of outputs to date and link (if applicable) to publicly available document
1. All	**Nov 2015**	1st Annual Report. Report: "Hazelwood Health Study Annual Report 1" available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0003/1636311/hhsannualreport_final121115_v1.0.pdf
2. Community Wellbeing	**July 2016**	Abstract about social media use, presented at the 2016 ANZCA conference. Conference Proceeding: Yell et al (2016) "Communities, authority and trust in the Fifth Estate: Social media use during the Hazelwood coalmine fire". Delivered at the 2016 Australia and New Zealand Communication Association Conference on *Creating Space in the Fifth Estate*, Newcastle, 6-8 July. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations
3. All	**Nov 2016**	2nd Annual Report Report: "Hazelwood Health Study Annual Report 2" available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0008/1636424/hazelwood-health-study-2nd-annual-report-v1.1-1.pdf
4. Exposure Assessment	**Feb 2017**	CSIRO report on the modelling of the smoke exposure providing information on $PM_{2.5}$ and CO and other chemical exposures for the mine fire period. Report: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/1636434/hazelwood_airqualitymodelling_december2016_final.pdf Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0003/1766055/Summary_AirQualityModelling_v1.1_13Feb2017.pdf
5. Older People	**Feb 2017**	Review of the impact of the Hazelwood mine fire on older people living in the Morwell community in the context of policy-driven decisions made at the time. Policy Review Report: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0004/1636384/policy-review-older-people-v1.0-website.pdf Policy Brief: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0011/1766072/Policy-Brief-Older-People-v1.1.pdf
6. Older People	**May 2017**	Abstract on older people and communications in future disaster events submitted to Australia and New Zealand Disaster and Emergency Management Conference. Conference Proceeding: Walker & Carroll (2017) Communications in future disaster events: best practice policy for older people. Presented at the Australia and New Zealand Disaster and Emergency Management Conference, Gold Coast May 2017. (Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations
7. Psychological Impacts (Schools)	**Jun 2017**	Initial findings from the first round of the Schools Study survey comparing students from Morwell schools with those from other Latrobe Valley schools. Report: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/1636476/schools-study-analysis-of-round-1-key-quantitative-data-v1.0.pdf

		Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/1766070/Schools-Study-Year-1-key-findings-summary-v1-170627.pdf
8. Hazelinks	**Sep 2017**	Analysis of deidentified emergency presentations and hospital admission data (1st extraction) during the smoke event compared with before and after the fire. Report: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0004/1636483/2018-08-20-Hospital-analysis-extract-1-technical-report.ver1.2.pdf Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0008/1766069/20170904-Hospital-Admissions-research-summary.pdf
9. Adult Survey	**Sep 2017**	First round of analysis comparing 3096 Morwell and 960 Sale residents who completed the HHS Adult Survey. Technical Report Volume 1. Report: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/1636395/hhsadultsurveyvol1_report_v1.1-compressed.pdf Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0007/1766077/20170904-Adult-Survey-research-summary.pdf
10. Hazelinks	**Sep 2017**	Analysis of cancer incidence data registered from 2009-2013 in Latrobe City compared to the surrounding LGAs to set the baseline for future comparisons. Report: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0003/1636482/20170919-cancer-analysis-data-extraction-technical-report-v1.0-1.pdf Research summary: https://www.monash.edu/__data/assets/pdf_file/0005/1766075/20170919-Baseline-Cancer-Analysis-research-summary-1.pdf
11. Community Wellbeing	**Sep 2017**	Paper on the use of social media during the Hazelwood mine fire. Academic paper: Yell & Duffy (2018) "Community Empowerment and trust: social media use during the Hazelwood mine fire." In the Australian Journal of Emergency Management available at https://knowledge.aidr.org.au/resources/ajem-apr-2018-community-empowerment-and-trust-social-media-use-during-the-hazelwood-mine-fire/. Full text also available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0010/1986931/Community-Empowerment-and-Trust_Yell-and-Duffy_ajem-33-2-21.pdf Citation and link also shown at https://hazelwoodhealthstudy.org.au/study-findings/publications
12. Older People	**Nov 2017**	Abstract describing the Older People Stream policy review. Conference Proceeding: Walker (2017). The impact of the Hazelwood mine fire in Australia on older people: review of policy-driven decisions made at the time. Aging and Society : Seventh Interdisciplinary Conference, UC Berkeley, USA, November 2017. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations
13. Older People	**Nov 2017**	Abstract about older people as active participants in disaster responses. Conference Proceeding: Carroll & Walker (2017). Beyond vulnerability: Older people as active participants in disaster responses. Presented at the 50th Australian Association of Gerontology (AAG) National Conference, Perth, WA November 2017. Available at https://www.aag.asn.au/documents/item/2003 on page 37. Cited on the HHS website https://hazelwoodhealthstudy.org.au/study-findings/presentations
14. All	**Nov 2017**	3rd Annual Report

		Report: "Hazelwood Health Study Annual Report 3" available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0003/1636419/hazelwood-health-study-3rd-annual-report_v1.2.pdf
15. Community Wellbeing	**Dec 2017**	Paper on the politics of loss and hope in the Latrobe Valley, drawing on information from the Community Wellbeing interviews and focus groups. Academic paper: https://www.anzrsai.org/assets/Uploads/PublicationChapter/AJRS-23.3-pages-421-to-446.pdf
16. Community Wellbeing	**Dec 2017**	Video summary on the major role that social media played during the Hazelwood mine fire. Video link: http://hazelwoodhealthstudy.org.au/research-areas/community-wellbeing/ and https://youtu.be/LVwQBvaNgtM
17. Early Life Follow-up	**Jan 2018**	Volume 1 technical report on ELF survey data completed by parents of 548 children sampled across the Valley and born between 2012 and 2015. Report: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/1636452/elf-vol-1_-cohortdesciption_parentreportedoutcomes-v1.2.pdf Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/1766085/20180201-HHS-ELF-Volume-1-Research-Summary.pdf
18. Hazelinks	**Mar 2018**	Hazelinks technical report describing the association between $PM_{2.5}$ and data from the MBS (health service use) and PBS (pharmaceutical dispensation). Report: https://www.hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0010/2324908/Hazelinks-MBS-PBS-Technical-Report-Version-2.0.pdf. Research Summary: https://www.hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/2324907/Hazelinks-MBS-and-PBS-Time-Series-Research-Summary-v2.0.pdf
19. Hazelinks	**May 2018**	Abstract on deidentified hospital emergency presentations and admissions presented at ATS 2018. Conference Proceeding Abramson et al (2018). "Emergency Presentations and Hospital Admissions Following Exposure to Smoke from a Coal Mine Fire". Available at: https://www.abstractsonline.com/pp8/#!/4499/presentation/14343 (To be listed in a new section of the HHS website)
20. Adult Survey	**May 2018**	Abstract on Adult Survey self-reported asthma and respiratory symptoms presented at ATS 2018. Conference Proceeding: Abramson et al (2018). "Adults Exposed to Coal Mine Fire Smoke Report More Asthma and Respiratory Symptoms than Those Not Exposed". Available at: https://www.abstractsonline.com/pp8/#!/4499/presentation/19606 (To be listed in a new section of the HHS website)
21. Hazelinks	**July 2018 & March 2020**	Paper describing the association between mine fire $PM_{2.5}$ and deidentified hospital emergency presentations and admissions (based on findings previously presented in the technical report (row 8 above). Academic paper: Guo et al (2020) The association of coal mine fire smoke with hospital emergency presentations and admissions: Time series analysis of Hazelwood Health Study" in Chemosphere, available at https://www.sciencedirect.com/science/article/pii/S0045653520308602. Citation also shown at https://hazelwoodhealthstudy.org.au/study-findings/publications.

		No Research Summary for this publication as a previous Research Summary was produced for the preceding technical report (see row 8 above)
22. Early Life Followup	**July 2018**	Abstract on children's lung health submitted to the Australia & New Zealand Society of Respiratory Science and the Thoracic Society of Australia and New Zealand (ANZSRS/TSANZ) Annual Scientific Meeting, July 2018. Conference Proceeding: Shao J et al. (2018). An assessment of early life exposure to coalmine fire smoke and children's lung health (abstract TOL 003). Available at https://doi.org/10.1111/resp.13267 and cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations
23. Community Wellbeing	**Nov 2017 May 2018**	A travelling photographic exhibition featuring images generated by local community groups and residents symbolising their hopes for the future of Morwell. Exhibition photos: https://hazelwoodhealthstudy.org.au/media/our-hopes Exhibition catalogue: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0005/2073362/Updated-Catalogue-Final.pdf
24. Early Life Followup	**August 2018**	Abstract describing the association between smoking during pregnancy and early development atherosclerosis, presented to the European Cardiology Congress 2018. Conference proceeding: Zhao et al (2018) Smoking during pregnancy significantly increases the risk of early atherosclerosis: a study from coalmine smoke exposure [abstract] available at https://esc365.escardio.org/Congress/ESC-Congress-2018/Best-Posters-6-Best-Posters-in-preventive-cardiology/176295-smoking-during-pregnancy-significantly-increases-the-risk-of-early-atherosclerosis-a-study-from-coalmine-smoke-exposure#abstract also cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations
25. Early Life Followup	**August 2018**	Abstract on smoke exposure during infancy and lung function submitted to ISEE 2018. Conference proceeding: Shao et al (2018) Exposure to Smoke from a Coal Mine Fire during Infancy and Lung Function Three Years after the Event. Available at https://ehp.niehs.nih.gov/doi/10.1289/isesisee.2018.P02.1800 and cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations
26. Psychological Impacts (Adult)	**August 2018**	Paper summarising the findings from qualitative interviews with adult Morwell residents on the social and psychological impacts of the event. Academic paper: Jones et al 2018 "Experiences of a prolonged coal-mine fire. In Disaster Prevention and Management. Available by subscription https://doi.org/10.1108/DPM-05-2018-0145. Pre-print version freely available at https://research.monash.edu/files/252507394/252145312_oa.pdf Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/1766079/20180605-adults-Psych-stream-research-summary-4.pdf
27. Hazelinks	**August 2018**	Abstract on $PM_{2.5}$ and PBS data submitted to ISEE 2018 Conference Proceeding: Johnson et al (2018) Fine particulate matter and medications dispensed during and after a brown coal mine fire: a time series analysis. Presented at the International Society of Exposure Science and International Society for Environmental Epidemiology 2018 Joint Annual Meeting. 26–30 August 2018, Ottawa, Canada. Available at https://ehp.niehs.nih.gov/doi/10.1289/isesisee.2018.P02.1550 (To be listed in a new section of the HHS website)
28. Hazelinks	**August 2018**	Abstract on $PM_{2.5}$ and Medicare health service data submitted to ISEE 2018. Conference Proceeding: Johnson et al (2018) Brown coal mine fire-related fine particulate matter and medical service utilisation in Australia: a time series analysis. Presented at the International Society of Exposure Science and International Society for Environmental Epidemiology 2018 Joint Annual Meeting, Ottawa, Canada, 26–30 August 2018. Available at https://ehp.niehs.nih.gov/doi/10.1289/isesisee.2018.O02.04.19 (To be listed in a new section of the HHS website)

29. Psychological Impacts (Schools)	**Sep 2018**	Paper on the perception of staff from a specialist school on the impacts of the smoke and relocation on students and staff at the school. Academic paper: Berger et al (2018) "Disaster Impacts on Students and Staff from a Specialist, Trauma-Informed Australian School" in Journ Child Adol Trauma. Available by subscription at https://doi.org/10.1007/s40653-018-0228-6. Full text freely avail on pre-print server at: https://doi.org/10.31234/osf.io/agdb5 Link also provided at https://hazelwoodhealthstudy.org.au/study-findings/publications Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0010/1766080/20180910-Psychological-Impacts-Stream-Specialist-School-Interviews-Research-Summary.pdf
30. Psychological Impacts (Schools)	**Sep 2018**	Analysis of round 1 Schools Study interviews on the impacts of the mine fire on students. Academic publication: Berger et al (2020) "Children's Perspectives on the Impact of the Hazelwood Mine Fire and Subsequent Smoke Event". Child & Youth Care Forum. Available by subscription from: https://doi.org/10.1007/s10566-020-09551-8. Pre-print version available at https://doi.org/10.31234/osf.io/8mhxf (also https://psyarxiv.com/8mhxf/) Link also provided at https://hazelwoodhealthstudy.org.au/study-findings/publications Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0004/1766083/20180906-Psychological-Impacts-Stream-Childrens-perspectives.pdf
31. Early Life Follow-up	**Oct 2018**	ELF Technical Report Volume 2 reporting on the clinical assessments looking at the relationship between smoke exposure and respiratory functioning. Technical Report: Link provided at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0003/2052516/ELFVol-2-Lung-Function-Testing-v1.1.pdf Research summary: One Research Summary which combines the findings from ELF Volumes 2 and 3 is available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0005/1766102/ELF-vols-2_3-Research-Summary.pdf
32. Early Life Follow-up	**Oct 2018**	ELF Technical Report Volume 3, reporting on the clinical assessments looking at the relationship between smoke exposure and cardiovascular functioning. Technical Report: Zhao et al (2018) "The Latrobe Early Life Follow-up (ELF) Cohort Study Volume 3 Investigation of possible associations between coal mine fire emissions and vascular outcomes in the ELF cohort three years after the fire" Link provided at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/2150547/ELF-Cohort-Study_Volume-3-CV-Report_v1.1.pdf Research summary: One Research Summary which combines the findings from ELF Volumes 2 and 3 is available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0005/1766102/ELF-vols-2_3-Research-Summary.pdf
33. Early Life Followup	**Nov 2018**	Abstract presented to the American Heart Association Scientific Sessions 2018 on normal ranges of IMT in young children. Followed by a paper on this same subject, submitted to Pediatric Cardiology. Conference Proceeding: Zhao et al, (2018) Feasibility and Normal Ranges of Arterial Intima-Media Thickness and Stiffness in 2-Year-Old Children. Available at https://www.ahajournals.org/doi/10.1161/circ.138.suppl_1.13237 and cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations Academic paper: Zhao et al (2019). "Feasibility and Normal Ranges of Arterial Intima-Media Thickness and Stiffness in 2-Year-Old Children: A Pilot Study" in Pediatric Cardiology. Available by subscription at https://link-springer-com.ezproxy.lib.monash.edu.au/content/pdf/10.1007/s00246-019-02088-1.pdf. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications.

34. Psychological Impacts (Adult)	**Nov 2018**	Paper on adult psychological outcomes which combined analysis of Adult Survey findings with follow up face to face interviews. Academic paper: Maybery et al (2020) "A mixed-methods study of psychological distress following an environmental catastrophe: the case of the Hazelwood open-cut coalmine fire in Australia" in Anxiety, Stress, & Coping. Available by paid subscription at https://www.tandfonline.com/doi/abs/10.1080/10615806.2019.1695523 Full text also available on a preprint server at: https://psyarxiv.com/euj96/ Citation also shown at https://hazelwoodhealthstudy.org.au/study-findings/publications Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0004/1766101/Psych-stream-mixed-methods-research-summary-V2.pdf
35. All	**Nov 2018**	4th Annual Report Report: "Hazelwood Health Study Annual Report 4" available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/1636251/hhs-4th-annual-report-v1.0.pdf
36. Hazelinks	**Dec 2018**	Report on risk of ambulance attendances during the Hazelwood mine fire compared with before and after the event (1st extraction, deidentified data). Report version 1.0 placed on https://hazelwoodhealthstudy.org.au/study-findings/study-reports in Dec 2018 but removed in Feb 2020 for revisions to be made. Report version 1.1 listed on https://hazelwoodhealthstudy.org.au/study-findings/study-reports in March 2020 as being available upon request by calling 1800 985 899 or emailing contact@hazelwoodhealthstudy.org.au Research summary: available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0003/1766100/Ambulance-attendances-during-the-Hazelwood-mine-fire.pdf Refer row 63 for the academic paper based on these findings.
37. Early Life Follow-up	**Dec 2018**	Paper on birth outcomes in the Latrobe Valley following the mine fire based on analysis of anonymous Victorian Perinatal Data Collection records. Academic paper: Melody et al (2019) Maternal exposure to fine particulate matter from a coal mine fire and birth outcomes in Victoria, Australia. Published in Environment International .Full text available at https://doi.org/10.1016/j.envint.2019.03.028 and citation shown at https://hazelwoodhealthstudy.org.au/study-findings/publications Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/1766097/Birth-outcomes-using-anonymous-Victorian-Perinatal-Data-Collection-Records.pdf
38. Adult Survey	**Jan 2019**	Second round of analysis on the Adult Survey looking at the relationship between level of smoke exposure and health outcomes. Technical Report Volume 2. Report: Ikin et al (2019) Hazelwood Health Study Adult Survey Volume 2: The relationship between Hazelwood mine fire smoke exposure and health outcomes. Available on the HHS website at: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0008/1636460/hazelwoodhealthstudy-adult-survey-volume-2-report-v1.1.pdf Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/1766094/20190123-Adult-Survey-Volume-2-Research-Summary.pdf
39. Psychological Impacts (Schools)	**March 2019**	Report on the second round of face to face interviews with students participating in the Schools Study tracking ongoing impacts. Report: Allen et al (2019) Hazelwood Health Study Schools Study: Report of Round 2 Qualitative Findings available on the HHS website at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0011/1766135/Schools-Study-Round2-Interviews.pdf

		Research summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0007/1766104/Research-Summary-Schools-Study-Round-2-Interviews.pdf
40. Hazelinks	**March 2019**	Paper based on revised analysis of PBS data (see row 18 above) assessing the relationship between smoke exposure and medication dispensing. Academic publication: Johnson et al (2019) "Fine particulate matter exposure and medication dispensing during and after a coal mine fire: A time series analysis from the Hazelwood Health Study". Available by subscription at https://doi.org/10.1016/j.envpol.2018.12.085. Citation also shown at https://hazelwoodhealthstudy.org.au/study-findings/publications with readers advised to email contact@hazelwoodhealthstudy.org.au to request a full copy of the paper. No Research Summary for this publication as a previous Research Summary was produced for the preceding technical report (see row 18 above)
41. Psychological Impacts (Schools)	**March 2019**	Paper on the first round of the Schools Study combining analysis of survey and interview findings. Academic paper: Maybery et al (2019) The psychological impact and experiences of children following the Hazelwood mine fire and subsequent smoke event. Preprint version available at https://psyarxiv.com/rw657 Cited on the HHS website at: https://hazelwoodhealthstudy.org.au/study-findings/publications. Currently awaiting submission to a special issue on Child Mental Health in the journal *Sustainability.* Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0007/1766104/Research-Summary-Schools-Study-Round-2-Interviews.pdf
42. Community Wellbeing	**May 2019**	CWB Stream Technical Report Volume 1 (Version 1.0 of this report replaced with version 2.0 in October 2019) Report: Yell et al (2019) Community Wellbeing Stream Report Volume 1: Community perceptions of the impact of the smoke event on community wellbeing and of the effectiveness of communication during and after the smoke event. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0018/2052540/CW-Report-Volume-1_v2.0.pdf Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/1766103/community-perceptions-of-the-impact.pdf
43. Early Life Follow-up	**May 2019**	Paper on the relationship between mine fire smoke and risk of pregnancy-related health outcomes incl gestational diabetes. Academic paper: Melody et al (2019) "Maternal exposure to fine particulate matter from a large coal mine fire is associated with gestational diabetes mellitus: A prospective cohort study" available by subscription at https://doi.org/10.1016/j.envres.2019.108956 Full citation shown on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications; website viewers invited to request a copy of the paper by emailing contact@hazelwoodhealthstudy.org.au Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/1795830/Research-Summary-ELF-Exposure-to-mine-fire-smoke-and-the-risk-of-pregnancy-related-health-problems.pdf Abstract submitted to the World Congress of Epidemiology 2020 (which was cancelled)
44. Early Life Follow-up	**May 2019**	ELF Technical Report Volume 4 on updated analysis of birth outcomes using additional information provided by parents and maternal health data.

		Report: Melody et al (2019) https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0004/2052517/Latrobe-ELF-tech-report-volume-4_v1.0.pdf Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0004/2052562/Research-Summary-ELF-Repeat-analysis-of-birth-outcomes.pdf Abstract submitted to the World Congress of Epidemiology 2020.
45. Early Life Followup	**May 2019**	Abstract on nitrogen dioxide and lung function, submitted to the American Thoracic Society Scientific Meeting, Conference Proceeding: Shao et al (2019) " Ambient Nitrogen Dioxide Exposure During Infancy Influences Respiratory Mechanics in Preschool Years [Abstract]" published in the American Journal of Respiratory and Critical Care Medicine available by paid subscription at https://doi.org/10.1164/ajrccm-conference.2019.199.1_MeetingAbstracts.A7058. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations
46. Respiratory	**July 2019**	Paper examining whether exposure to smoke from the mine fire is associated with respiratory symptoms, asthma control and decline in lung function. Academic paper: Taylor et al (2019) "Is asthma associated with exposure to smoke from a coal mine fire?" Pre-print available at: https://www.biorxiv.org/content/10.1101/631317v1 Pre-print citation and link provided on HHS website shown at https://hazelwoodhealthstudy.org.au/study-findings/publications Nb. as of 17/3/20, this paper was yet to be published in a scientific journal. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0019/1840024/Research-Summary-Respiratory-Stream-Lung-Function-and-Asthma-Impacts.pdf
47. Hazelinks	**Oct 2019**	Paper describing revised analysis (see row 18 above) of the association between $PM_{2.5}$ and Medicare health service use. Academic paper: Johnson et al. (2020) "Coal-mine fire-related fine particulate matter and medical-service utilization in Australia: a time-series analysis from the Hazelwood Health Study" in the International Journal of Epidemiology. Full text available by subscription at https://doi.org/10.1093/ije/dyz219. Citation shown on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications and readers may request a full copy by emailing contact@hazelwoodhealthstudy.org.au No Research Summary for this publication as a previous Research Summary was produced for the preceding technical report (see row 18 above)
48. Cardiovascular	**Oct 2019**	Paper aiming to estimate the prevalence of hypertension in the cohort and identify predictors of hypertension management (does not address any research question about the impact of the mine fire) Academic paper: Betts et al (2020) "Factors associated with hypertension and its management among older rural Australians" published in the Australian Journal of Rural Health (May 2020) 28(4), 399-407. Full text available by subscription at https://doi.org/10.1111/ajr.12634. Citation shown on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications and readers may request a full copy by emailing contact@hazelwoodhealthstudy.org.au Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0016/2011831/CVD-Hypertension-Research-Summary.pdf The Research Summary invites readers to request the full copy of the paper by calling 1800 985 899 or emailing contact@hazelwoodhealthstudy.org.au
49. Cardiovascular	**Oct 2019**	Paper aiming to measure any association between mine fire $PM_{2.5}$ and CVD risk factors.

		Academic paper: Betts et al (2021) "Markers of cardiovascular disease among adults exposed to smoke from the Hazelwood coal mine fire" published in the International Journal of Environmental Research and Public Health, 18(4), 1587. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications and freely available at https://doi.org/10.3390/ijerph18041587. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0015/2011830/CVD-Blood-Vessel-Health-Research-Summary.pdf.
50. Adult Survey	**Oct 2019**	Abstract submitted to the European Respiratory Society International Congress on $PM_{2.5}$ and chronic cough. Conference Paper: Abramson et al (2019) "Chronic cough is related to cumulative $PM_{2.5}$ and exposure from a coal mine fire [abstract]" available at https://erj.ersjournals.com/content/54/suppl_63/PA4455 and cited on the HHS website https://hazelwoodhealthstudy.org.au/study-findings/presentations
51. Respiratory	**Nov 2019**	Abstract describing the association between $PM_{2.5}$ and COPD based on adult Respiratory Stream clinic data. Submitted to the ATS 2020. Conference Proceeding: Prasad SR, Borg B, Gao CX et al (2020) Chronic Obstructive Pulmonary Disease Is Associated with Exposure to Fine Particles from a Coal Mine Fire [abstract]. Accepted as an e-poster for inclusion in the American Thoracic Society 2020 Virtual meeting. Also published in the American Journal of Respiratory and Critical Care Medicine; 201:A7835. https://www.atsjournals.org/doi/abs/10.1164/ajrccm-conference.2020.201.1_MeetingAbstracts.A7835
52. Exposure Assessment	**Nov 2019**	Paper written by CSIRO describing the modelling of $PM_{2.5}$ data. Academic paper: Luhar et al (2020) Modelling smoke distribution in the vicinity of a large and prolonged fire from an open-cut coal mine. Atmospheric Environment, 117471. Available from http://www.sciencedirect.com/science/article/pii/S1352231020302089. Citation shown on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications No Research Summary for this paper as it replicates CSIRO's modelling report and Research Summary described in Row 4 above.
53. All	**Nov 2019**	5th Annual Report Report: "Hazelwood Health Study Annual Report 5" available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/2052828/HHS-5th-Annual-Report-v-1.0-with-Appendices.pdf
54. Adult Survey/ Psychological Impacts	**Dec 2019**	Paper describing the association between $PM_{2.5}$ and symptoms of distress and contributing factors Academic paper: Broder et al (2020) "The factors associated with distress following exposure to smoke from an extended coal mine fire" published in *Environmental Pollution 266*, 115131. Available by paid subscription at https://doi.org/10.1016/j.envpol.2020.115131 or http://www.sciencedirect.com/science/article/pii/S0269749119373907. To request a free copy of the paper call 1800 985 899 or email contact@hazelwoodhealthstudy.org.au. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/2052585/Long-term-psychological-health-following-the-Hazelwood-mine-fire.pdf
55. Community Wellbeing	**Dec 2019**	CWB Stream Technical Report Volume 2 on the community perceptions of effectiveness of community rebuilding activities. Report: Yell et al (2019) Community Wellbeing Stream Report Volume 2: Community perceptions of the effectiveness of community rebuilding activities

		https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/2059236/CW-Report-Volume-2_version-1.0.pdf Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0003/2058960/Research-Summary-Community-perceptions-of-the-effectiveness-of-community-rebuilding-activities.pdf
56. Early Life Followup	**Nov 2019**	Paper describing association between smoke and health service and medication usage in children. Academic paper: Shao et al (2020) "Exposure to air pollution during the first 1000 days of life and subsequent health service and medication usage in children" published by Environmental Pollution. Available by subscription at https://doi.org/10.1016/j.envpol.2019.113340. Full citation shown on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications; website viewers invited to request a copy of the paper by emailing contact@hazelwoodhealthstudy.org.au Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0010/2052568/ELF-Research-Summary-GP-visits-and-medication-use.pdf
57. Early Life Followup	**Dec 2019**	Paper describing the association between exposure to coal mine fire and tobacco smoke, and subclinical vascular function in young children. Academic paper: Zhao et al 2019 "Early life exposure to coal mine fire and tobacco smoke affect subclinical vascular function" published in Archives of Disease in Childhood. Available by subscription at https://adc.bmj.com/content/early/2019/12/20/archdischild-2019-317528. Full citation shown on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications; website viewers invited to request a copy of the paper by emailing contact@hazelwoodhealthstudy.org.au
58. Early Life Followup	**Dec 2019**	Technical Report, Research Summary and paper describing the association between $PM_{2.5}$ and common illnesses like coughs, colds and asthma based on parent-reported monthly diaries. Report: Willis et al (2019) Latrobe Early Life Follow-up (ELF) Cohort Study Volume 6. The impact of exposure to coal mine fire smoke in early life on parent-reported indicators of childhood atopic and respiratory illness. Version 1.0. Available upon request by calling 1800 985 899 or emailing contact@hazelwoodhealthstudy.org.au Academic paper: Willis et al (2020) "Respiratory and atopic conditions in children two to four years after the 2014 Hazelwood coalmine fire" in the Medical Journal of Australia, 2020, vol 213(6), pp 269-275. Freely available at https://doi.org/10.5694/mja2.50719. Link also shown on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications Research Summary: available on the HHS website at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0011/2052569/2019.09-Monthly-diary-summary-for-participants-.pdf The Research Summary invites readers to request the full copy of the technical report by calling 1800 985 899 or emailing contact@hazelwoodhealthstudy.org.au
59. Adult Survey	**Dec 2019**	Paper based upon the Adult Survey, respiratory symptoms, building materials and $PM^{2.5}$ Academic paper: Johnson et al (2019) Associations between Respiratory Health Outcomes and Coal Mine Fire PM2.5 Smoke Exposure: A Cross-Sectional Study. In the International Journal of Environmental Research and Public Health. Available at https://www.mdpi.com/1660-4601/16/21/4262 Also cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications
60. Hazelinks	**Jan 2020**	Technical report describing the association between mortality, the mine fire period and $PM_{2.5.}$ Report: v1.0 submitted to DHHS in November 2019 and resubmitted as v1.1 in February 2020. Report and accompanying Q and A document freely available on the Hazelwood Health Study website at https://hazelwoodhealthstudy.org.au/study-findings/study-reports

		Research Summary: https://hazelwoodhealthstudy.org.au/study-findings/fact-sheets-and-summaries
61. Early Life Followup	**Feb 2020**	Paper describing association between smoke and lung function in young children. Academic paper: Shao et al (2020) "Early life exposure to coal mine fire smoke emissions and altered lung function in young children" in *Respirology*. Available by subscription at https://doi.org/10.1111/resp.13617. Full citation shown on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications; website viewers invited to request a copy of the paper by emailing contact@hazelwoodhealthstudy.org.au
62. Cardiovascular	**March 2020**	Paper describing the relationship between diet quality scores and cardiometabolic risk factors in regionally-dwelling older Australian adults with increased cardiovascular risk. Academic paper: Owen et al (2020) Recommended Intake of Key Food Groups and Cardiovascular Risk Factors in Australian Older, Rural-Dwelling Adults. Published in *Nutrients*. Freely available at https://www.mdpi.com/2072-6643/12/3/860/htm and on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications As this publication does not address a Hazelwood Health Study research question, a HHS Research Summary has not been prepared.
63. Hazelinks	**April 2020**	Paper describing the association between $PM_{2.5}$ and deidentified ambulance data (based on analysis previously presented in the technical report (see row 36 above). Academic paper: Gao Et Al "Impact of acute exposure to mine fire emitted $PM_{2.5}$ on ambulance attendances: a time series analysis from the Hazelwood Health Study" in *Environmental Research*, 110402. Available by subscription at https://doi.org/10.1016/j.envres.2020.110402. For a free copy of this article, please email contact@hazelwoodhealthstudy.org. No Research Summary as findings were previously presented (see row 36)
64. Adult Survey	**April 2020**	Paper describing the establishment, recruitment and followup of the HHS adult cohort. Academic paper: Ikin et al "Cohort Profile: The Hazelwood Health Study adult cohort" in the *International Journal of Epidemiology*. Available by subscription at https://doi.org/10.1093/ije/dyaa083. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A free copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au No Research Summary released with this publication as it does not present new findings.
65. Psychological Impacts (Schools)	**April 2020**	Paper describing linked NAPLAN data. Academic paper: Berger at al "The Impact of a Mine Fire and Smoke Event on Academic Outcomes for Primary and Secondary School Students". Pre-print freely available at https://psyarxiv.com/unms5/. Pre-print link provided on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. Paper under review with the journal *Psychological Trauma: Theory, Research, Practice, and Policy*. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0018/2232054/20201606-NAPLAN-The-Impact-of-a-Mine-Fire-and-Smoke-Event-on-Academic-Outcomes-for-Primary-and-Secondary-School-Students.pdf
66. Respiratory Stream	**May 2020**	Abstract describing the association between $PM_{2.5}$ and COPD submitted to the American Thoracic Society Annual Meeting 2020. Nb. the Meeting was replaced with ATS Virtual. The abstract has been accepted and published. Conference Proceeding: Prasad et al (2020) Chronic Obstructive Pulmonary Disease Is Associated with Exposure to Fine Particles from a Coal Mine Fire [abstract]. *American Journal of Respiratory and Critical Care Medicine*; 201:A7835. Available at https://www.atsjournals.org/doi/abs/10.1164/ajrccm-

		conference.2020.201.1_MeetingAbstracts.A7835. Also cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations.
67. Early Life Followup	**June 2020**	Paper describing the establishment, recruitment and followup of the HHS Early Life Followup cohort. Academic paper: Melody et al. "Cohort Profile: The Hazelwood Health Study Latrobe Early Life Follow-Up (ELF) Study" in the *International Journal of Epidemiology* 2020. Available by subscription https://doi.org/10.1093/ije/dyaa136. Cited on the website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A free copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au. No Research Summary released with this publication as it does not present new findings.
68. Respiratory Stream	**July 2020**	Paper and conference abstract describing the association between $PM_{2.5}$ and lung mechanics using the forced oscillation technique (FOT) in the adult Respiratory Stream. Academic paper: Holt et al. "Long term impact of coal mine fire smoke on lung mechanics in exposed adults". Pre-print version freely available at https://doi.org/10.1101/2020.10.14.20213009. Pre-print link also cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications . Paper accepted by the journal *Respirology*. Citation not yet available. Conference Proceeding: Holt et al Altered lung mechanics after coal mine fire smoke exposure in adults. Abstract accepted by ERS International Virtual Congress 2020. In European Respiratory Journal, 56(suppl 64), 3146. https://doi.org/10.1183/13993003.congress-2020.3146 Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0008/2351096/Research-Summary_RespStream_FOT-paper.pdf
69. Hazelinks	**August 2020**	Paper describing the describing the association between $PM_{2.5}$ and linked ambulance attendance data in consented Adult Survey participants. Academic paper: Broder et al. Long-term impact of exposure to coalmine fire emitted PM2·5 on emergency ambulance attendances: Hazelwood Health Study. (2021) Published by *Chemosphere*. Available by subscription at doi.org/10.1016/j.chemosphere.2021.132339. Cited on the HHS website and a free copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0012/2351100/Hazelinks-Research-summary_linked-ambulance-paper.pdf
70. Respiratory Stream	**August 2020**	Paper describing the association between $PM_{2.5}$ and COPD, $T_L$co and symptoms in adult Resp Stream participants. Same findings as those presented in the abstract at row 66 above. Academic paper: Prasad et al. "Chronic Obstructive Pulmonary Disease is associated with exposure to fine particles from a coal mine fire" under final review with the journal *Annals of the American Thoracic Society*. Pre-print version freely available at https://doi.org/10.1101/2020.10.14.20213009. Pre-print link also cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0007/2351095/Research-Summary_RespStream_COPD-paper.pdf
71. Adult Survey/ Psych Impacts	**Oct 2020**	Paper describing the association between psychological distress and respiratory symptoms in the context of the mine fire. Not a Hazelwood Health Study research question. Academic paper: Samuel et al "Associations between self-reported respiratory symptoms and psychological distress following exposure to a landscape fire" 2021. *Stress and Health*. Available

		by subscription at https://doi.org/10.1097/EE9.0000000000000042. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A free copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au Conference proceeding: Poster accepted for TSANZ Vic 2020. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/presentations. No Research Summary released with this publication as it does not address a HHS research question.
72. Adult Psych Impacts	**Nov 2020**	Paper and abstract describing psychological distress in young adults. Academic paper: O'Donohue et al "The psychological impacts of a smoke event on young adults compared to other aged adults in Victoria, Australia". Under review with *Int Jnl Risk Reduction*. Conference Proceeding: abstract accepted for presentation at the 4th International Childhood Trauma Conference, which will be held in Melbourne, Australia from the 31 July to 5 August 2022.
73. Adult Psych Impacts	**Nov 2020**	Technical report describing the initial analysis of data from the 2019-2020 Mental Health and Wellbeing Follow-up Survey. Report: Carroll M. et al (2020). Hazelwood Health Study Technical Report. 2019-2020 Mental Health and Wellbeing Follow-up Survey: A follow-up to the 2016-2017 Adult Survey investigating the ongoing psychological health of adults who lived in Morwell during the 2014 Hazelwood mine fire. Freely available on the Hazelwood Health Study website at https://hazelwoodhealthstudy.org.au/study-findings/study-reports Research Summary: Reseach-summary-Mental-Health-Follow-up-Report-07122020.pdf (hazelwoodhealthstudy.org.au)
74. Early Life Followup	**Nov 2020**	Technical report describing the sources of air pollution to which ELF families were exposed. Report: Chappell K et al (2020) The Latrobe Early Life Follow-up (ELF) Cohort Study Volume 5. A description of sources of air pollution inside and outside the home environments of children in the Latrobe ELF Cohort. Available on the Hazelwood Health Study website at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0010/2424871/ELF-Report-Vol-5_Version1.0.pdf No Research Summary released with this publication as it does not address a HHS research question.
75. Early Life Followup	**Nov 2020**	Paper describing the association between respiratory and cardiovascular function in young children. Academic paper: Hemstock E et al (2020). Currently under review with the journal *Respirology*. Not available on the HHS website. Cited on the website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A free copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au. No Research Summary released with this publication as it does not address a HHS research question.
76. All	**Nov 2020**	6th Annual Report Report: "Hazelwood Health Study Annual Report 6" available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/2452866/HHS-6th-Annual-Report-v1.0.pdf
77. Respiratory Stream	**Dec 2020**	Paper describing the characteristics of e-cigarette users. Academic paper: Lee WK et al (2021) Are E-cigarette use and vaping associated with increased respiratory symptoms and poorer lung function in a population exposed to smoke from a coal mine fire? Under review by the journal *Respirology*. Cited on the website at

		https://hazelwoodhealthstudy.org.au/study-findings/publications. A copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au. No Research Summary released with this publication as it does not address a HHS research question.
78. Psych Impacts Schools	**Feb 2021**	Paper describing analysis of deidentified NAPLAN data Academic paper: Gao CX et al (2021). Evaluating the impact of Hazelwood mine fire event on students' educational development with Bayesian interrupted time-series hierarchical meta-regression. medRxiv, 2021.2003.2028.21254516. Under review by the journal *Environmental Research.* Pre-print version freely available at https://doi.org/10.1101/2021.03.28.21254516. Pre-print link also cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0004/2560378/Deidentified-NAPLAN_Research-Summary.pdf
79. Hazelinks	**March 2021**	Paper describing hospital admission data linked to Adult Survey participants. Academic paper: Xu R et al (2021) Long-term impacts of coal mine fire emitted $PM_{2.5}$ on hospitalization: a longitudinal analyses of the Hazelwood Health Study. Accepted by the *International Journal of Epidemiology*. Awaiting proofs. Cited on the website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0007/2552263/Linked-Hospital-Paper-Research-Summary.pdf
80. Cardiovascular	**April 2021**	Paper describing the flow mediated dilatation results from CVD Stream round 1 clinical testing. Academic paper: Mundisugih et al (2021) "Vascular responses among adults exposed to smoke from the Hazelwood coal mine fire". Under review by the journal *Vascular Health and Risk Management*. Cited on the website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A free copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au No Research Summary released with this publication because the findings are very similar to those previously reported (refer row 49 above).
81. Adult Psych Impacts	**May 2021**	Literature review exploring the psychological outcomes for young adults after disaster events Academic paper: O'Donokue et al (2021) "Psychological outcomes for young adults after disastrous events: A mixed-methods scoping review". Published by Social Science & Medicine. Available by subscription https://doi.org/10.1016/j.socscimed.2021.113851. No Research Summary released with this publication as it does not address a HHS research question.
82. Hazelinks	**June 2021**	Paper describing the results from the previously release mortality report (refer row 60 above). Academic paper: Dimitriadis et al (2021) "Exposure to mine fire related particulate matter and mortality: A time series analysis from the Hazelwood Health Study" published in *Chemosphere.* Available by subscription at https://doi.org/10.1016/j.chemosphere.2021.131351. The more detailed report (refer row 60 above) and a FAQ document is freely available on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/study-reports. Research Summary: the Research Summary for the previously released report (refer row 60 above) is available on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/fact-sheets-and-summaries.

83. Adult Psych Impacts	**July 2021**	Paper based on mental health related Ambulance, emergency department presentations & hospital admissions. Academic paper: Carroll et al (2021) "Impacts of coal mine fire-related PM2.5 on the utilisation of ambulance and hospital services for mental health conditions". Under review with the journal *Chemosphere.* Cited on the HHS website. A pre-print version of this paper (not externally peer reviewed) is available at https://psyarxiv.com/hgv7t/ Research Summary: In preparation.
84. Hazelinks	**July 2021**	A short paper regarding the incidence of cancer in the 5 years after the Hazelwood mine fire. Academic paper: Yu et al (2021) "Impacts of high concentration, medium duration coal mine fire related $PM_{2.5}$ on cancer incidence: 5-year follow-up of the Hazelwood Health Study". Accepted by *Environmental Health Insights*. Awaiting proofs. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A copy of this paper is available by emailing contact@hazelwoodhealthstudy.org.au Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0008/2718962/Research-Summary_linked-cancer-5years-v1.0-1.pdf
85. Adult Psych Impacts	**July 2021**	Paper exploring the ongoing psychological distress associated with exposure to smoke during the 2014 Hazelwood coal mine fire. This is based on the previously released Technical report describing the initial analysis of data from the 2019-2020 Mental Health and Wellbeing Follow-up Survey (refer row 73). Academic paper: Carroll et al (2021) "Exploring the trajectory of psychological distress associated with exposure to smoke during the 2014 Hazelwood coal mine fire". Under review by the *International Journal of Hygiene and Environmental Health*. Cited on the website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A pre-print version of this paper (not externally peer reviewed) is available at https://doi.org/10.31234/osf.io/tz5c4 Research Summary: the Research Summary for the previously released report (refer row 73 above) is available on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/fact-sheets-and-summaries

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ELF Study Newsletter

JUNE 2021

ELF CLINICS UP AND RUNNING!

After the challenges of 2020, and a year's delay to our second round of clinics, we are all go!! ELF Study clinics commenced in April this year at Federation Uni in Churchill. We are thrilled with the response from families so far, but of course hope to see as many enrolled ELFlings as possible this time round!

To the right are some pictures of our willing participants having ultrasound of their big blood vessels and some breathing tests. Families are also offered a blood test which will test for allergies to some common household things like dust mite, grass, and pet hair. If requested, results of that testing will be shared with parents and the family GP.

Clinic visits take about an hour and half. We have appointment times available every Wed, Thurs and Fri afternoon from 1pm till 5pm, and then all day Saturdays and Sundays. We will also be offering daily appointments during the July school holidays!

To say thank you! - every family attending clinic receives a $30 Coles voucher and goes in the draw for one of five $200 vouchers.

What is it like to visit the clinics?

You can watch a video that explains each of the tests to kids!

https://youtu.be/evgyK7snjc8

HOW WAS THE CLINIC VISIT?

"I had explained on the morning of the appointment what was going to happen thinking she might be a little nervous, but she was so excited to go. I found everyone to be very friendly and welcoming, and the explanations of the procedures and patience shown with Izabelle was wonderful. Izabelle enjoyed herself immensely and had a great time, she took all of her test equipment to school for show and share to tell her class all about it. Her favourite parts were the gooey gel on her neck and arm patches, and the 'snippy crab' (nose clip)."

- Mother of Izabelle aged 5

FREQUENTLY ASKED QUESTIONS

"My child did these tests in 2017. Is it necessary to come back again?"

Even if your child attended an appointment at the last clinic in 2017, it is still important to visit the clinic again. This may help us to further support information we have already gathered about possible impacts of the 2014 mine fire, on exposed infants and the unborn. To best do this, we aim to look at blood vessel and lung development over a period of several years, to investigate possible changes as children grow.

"We didn't take part at the last clinics in 2017. Can we come this time?"

YES! It is still valuable to do assessments on children who haven't been measured before, to see if there are any differences between blood vessel and lung development in children who were and who were not exposed to the mine fire.

"Does my child have to do every test?"

The more measurements we can perform on your child the more information we have, but every bit of information is another piece of the puzzle, so it is great to get something rather than nothing. Some parents opt for their child not to have the blood test, which is perfectly OK!

"Are you taking extra precautions because of COVID-19?"

YES we are. The day before your appointment you are contacted by one of our team members and taken through a screening questionnaire, aimed to prevent anyone at higher risk from attending the clinic. The same questions are repeated as families arrive at their clinic appointment. All study participants and clinic staff are temperature-checked on arrival.

Staff go through a special cleaning routine of all equipment and frequently touched surfaces between participants. Social distancing is practised wherever it is possible to do so.

"How do I book, or who do I contact if I have more questions?"

Ring us on 1800 322 102, or email us at Latrobe.elf@utas.edu.au

A huge thank you from the ELF Study Team

to all the families who visited so far!

HOW WAS THE CLINIC VISIT?

"I'm grateful to have the opportunity for Oliver to participate in the clinic, it gives me peace of mind regarding his ongoing health status whilst building his confidence in dealing with real life experiences."

Mother of Oliver aged 8

"I would like to thank the members of the study who performed the tests as they kept my son calm throughout the whole session. I would also like to thank Jordan for talking to and interacting with my other son who sat in the waiting area while all the tests were happening."

Mother of Peter aged 7

"The staff were very friendly & professional. With lots of praise, encouragement & rewards Bryce felt fairly comfortable with the tests conducted in him."

Mother of Bryce aged 8

Hazelwood HEALTH STUDY

Research Summary

The ongoing psychological health in adults six years after 2014 Hazelwood mine fire

December 2020

Analysis aims

This analysis aimed to investigate whether levels of psychological distress in adult Morwell residents have changed in the three years since the 2016-2017 Adult Survey. The analysis also investigated whether changes in psychological distress were associated with smoke exposure during the event, and examined the role of other risk factors.

Background

The fire in the Morwell open cut brown coal mine adjacent to the Hazelwood Power Station blanketed the town of Morwell and the surrounding area in smoke and ash for six weeks in February and March 2014. The smoke event was recognised as one of the most significant air quality incidents in Victoria's history. It caused considerable community concern within Morwell and the broader community. In response to these concerns, and following extensive community consultation, the Hazelwood Health Study was established to examine the impacts of the mine fire. The HHS involves multiple research streams targeting different health outcomes and different vulnerable groups.

Meet the team

Dr Matthew Carroll
Mr Tim Campbell
Dr Caroline Gao
Ms Catherine Smith
Prof Darryl Maybery
Dr Emily Berger
Mr David Brown
Ms Shantelle Allgood
Dr Jillian Ikin
Prof Rory Wolfe
Prof Judi Walker
Dr Susan Yell
Prof Malcolm Sim
Prof Michael Abramson

What we did

We invited a sample of Morwell residents who participated in the 2016-2017 Adult Survey to complete a Mental Health and Wellbeing Follow-up Survey. In both survey rounds, we measured psychological distress experienced specifically in relation to the 2014 Hazelwood mine fire (Impact of Events Scale-Revised: IES-R), and psychological distress experienced more generally (Kessler-10 Scale: K10). We estimated smoke exposure levels for each participant using CSIRO data on the density of fine airborne particles ($PM_{2.5}$) in the smoke plumes. In total, 713 people participated in the follow-up survey.

A more detailed paper describing the findings from this analysis can be found at
https://hazelwoodhealthstudy.org.au/study-findings/publications

Hazelwood HEALTH STUDY

What we found

The main finding was that, 6 years after the Hazelwood event, there was a continuing relationship between participants' level of exposure to $PM_{2.5}$ during the 2014 mine fire and the level of ongoing psychological distress they associated with the event, with the most exposed people reporting higher distress levels on the IES-R. In addition, participants' psychological distress (scoring on both the IES-R and K10) increased in the three years between the two survey rounds. Consistent with the earlier Adult Survey analysis, the impact of $PM_{2.5}$ exposure on event-related psychological distress was most severe for younger adults. Furthermore, higher psychological distress remained associated with several other key risk factors, including asthma, chronic obstructive pulmonary disease (COPD), having experienced multiple prior traumatic events, and being unemployed or unable to work.

Considerations

The data collection period for the follow-up survey (December 2019 to March 2020) coincided with the catastrophic bushfire and smoke events that impacted south-eastern Australia during the 2019-2020 summer. These background circumstances likely had an influence on some participants' survey responses, and may be one of the reasons for the increasing distress levels between the two rounds.

Where to from here

This is the first of several analyses planned for the data collected in the follow-up survey. Analyses in 2021 will explore the role of additional factors important to understanding mental health outcomes, including social support, loneliness, resilience, and community wellbeing. A third survey round to further explore long-term mental health outcomes in the Morwell community is planned for 2022.

The HHS is led by Monash University with collaborators from Menzies, Federation University, The University of Adelaide, and CSIRO.

This research was funded by the Victorian Department of Health and Human Services.

Hazelwood HEALTH STUDY

Research Summary

Evaluating the impact of the Hazelwood mine fire event on students' educational development

April 2021

Background

The fire in the Morwell open cut brown coal mine adjacent to the Hazelwood Power Station blanketed the town of Morwell and the surrounding area in smoke and ash for six weeks in February and March 2014. The smoke event was recognised as one of the most significant air quality incidents in Victoria's history, with the concentration of smoke contaminants reaching high levels.

The smoke event caused considerable community concern within Morwell and the broader community. In response to these concerns, and following extensive community consultation, the Hazelwood Health Study (HHS) was established to examine the impacts of the mine fire. The HHS involves multiple research streams targeting different health outcomes and different vulnerable groups.

Meet the team

Dr Caroline Gao
Dr Jonathan Broder
Dr Sam Brilleman
Dr Emily Berger
Dr Jillian Ikin
Ms Catherine Smith
Mr Tim Campbell
Prof Rory Wolfe
Prof Fay Johnston
Prof Yuming Guo
Dr Matthew Carroll

Analysis aims

This study aimed to determine whether students in years 3, 5, 7 and 9 from schools in Morwell which were highly exposed to the Hazelwood mine fire, had different academic outcomes to students from schools which were moderately exposed, or from schools with little or no exposure.

What we did

A new statistical approach was used to analyse NAPLAN and school administrative data from 2008 to 2018 to analyse change in educational outcomes as a result of exposure to the 2014 mine fire. School-level data from 69 primary and secondary schools, including average scores in each NAPLAN domain for years 3, 5, 7 and 9, were used rather than individual student-level data. The analysis compared academic progress in students from highly exposed schools in Morwell, to those from moderately exposed schools in the rest of the Latrobe Valley, and students from schools in Wellington Shire which had little or no exposure to the smoke event. The analysis took into consideration differences in school profile, including socioeconomic status, school size, gender ratio, and school sector (government vs non-government), as well as grade level and longer term trends in NAPLAN.

A more detailed paper describing the findings from this analysis can be found at
https://hazelwoodhealthstudy.org.au/study-findings/publications

Hazelwood HEALTH STUDY

What we found

In the year following the mine fire, major academic interruptions across all NAPLAN domains were evident in the highly exposed Morwell schools. Compared to the Victorian regional average, this interruption equated to a three to four-month delay in educational attainment which had not fully recovered several years later. This evidence of considerable and enduring delays highlights the need to provide educational and community-based supports in response to future events. Importantly, this work introduces a new statistical method to use readily available school-level data to assess educational impacts resulting from other disasters.

Considerations

Due to the low number of secondary schools in the region, we were unable to evaluate which year levels were most impacted by the mine fire event. The aggregated nature of the school-level data meant that we were unable to consider individual-level factors that influence academic outcomes, such as each student's physical, psychological or social health. More detailed region-specific data on unemployment, service availability and other factors which might influence academic performance were not available for this analysis.

Where to from here

HHS results will be shared with relevant organisations to ensure they are used to shape services for the future wellbeing of the Latrobe Valley

The Hazelwood Health Study is a collaborative program of research led by the Monash University Schools of Public Health and Preventive Medicine and Rural Health in partnership with Federation University, the Menzies Institute for Medical Research at the University of Tasmania, the University of Adelaide and the CSIRO.

This research was funded by the Department of Health.

Hazelwood HEALTH STUDY

Hazelwood mine fire smoke exposure and hospital admissions in the following years

Research Summary

April 2021

Background

The fire in the Morwell open cut brown coal mine adjacent to the Hazelwood Power Station blanketed the town of Morwell and the surrounding area in smoke and ash for six weeks in February and March 2014. The smoke event was recognised as one of the most significant air quality incidents in Victoria's history.

It caused considerable community concern within Morwell and the broader community. In response to these concerns, and following extensive community consultation, the Hazelwood Health Study (HHS) was established to examine the impacts of the mine fire. The HHS involves multiple research streams targeting different health outcomes and different vulnerable groups.

The Hazelinks Stream of the HHS investigates the long-term health of the smoke-exposed communities by using administrative health datasets, such as ambulance, hospital, Medicare, pharmaceutical, cancer and death records.

Analysis aims

This analysis aimed to see whether people who were most exposed to smoke from the Hazelwood mine fire were more likely to have been admitted to hospital in the years following the event, compared with people who were less exposed or not exposed.

Meet the team

Mr Rongbin Xu
Dr Caroline Gao
Ms Christina Dimitriadis
Ms Catherine Smith
Dr Matthew Carroll
Dr Jillian Ikin
Prof Fay Johnston
Prof Malcolm Sim
Prof Michael Abramson
Prof Yuming Guo

What we did

Approximately 2.5 years after the Hazelwood mine fire, 4,056 residents from Morwell (exposed to the mine fire smoke) and Sale (unexposed) participated in the HHS Adult Survey. Each participant filled in a time-location diary to show where they were on each day and night of the mine fire period. This was important because the smoke levels varied quite a bit from day to day. Using the diaries and air pollution modelling conducted by CSIRO, we calculated each participant's level of exposure during the fire, to fine air particles in the smoke of less than 2.5 thousandths of a mm in diameter ($PM_{2.5}$). Consent was given by 2,725 of the Adult Survey participants for the researchers to access their hospital admissions data held by the Department of Health. For this analysis we looked at hospital admissions from January 2009 to February 2019.

A detailed report describing the findings from this analysis can be found at
hazelwoodhealthstudy.org.au/study-findings/study-reports

Website: www.hazelwoodhealthstudy.org.au/study-reports @hazelwoodhealthstudy @HazelwoodHS

Hazelwood HEALTH STUDY

What we found

Amongst women, we found that as the levels of exposure to smoke-related $PM_{2.5}$ increased, the likelihood of being admitted to hospital in the following 5 years for a respiratory-related condition, also increased. This relationship was not observed for men. There was no evidence that mine-fire $PM_{2.5}$ exposure was associated with increased hospitalizations for cardiovascular diseases, mental illness, injuries, type 2 diabetes, renal diseases or neoplasms during the 5 years after the fire. These findings could mean that the mine fire smoke impacted the lung health of women for a prolonged period after the fire was put out.

Considerations

The analysis used a number of statistical methods to account for other factors that might have influenced hospital admissions, such as previous health, age, gender, marital status, smoking history and employment in jobs that involved exposure to dust, fumes, smoke, mist or gas. However, there remains a possibility that factors other than the mine fire smoke influenced the hospital admissions. Further, because a proportion of adults from Morwell did not participate in the Adult Survey, it is possible that the findings do not truly reflect that community.

Where to from here

These findings which used hospital admissions data, will be looked at alongside other findings which used ambulance, Medicare, pharmaceutical, cancer and death records, self-reported symptoms and clinical examinations of participants, to get a comprehensive overview of the long-term effects of the Hazelwood coalmine smoke on the health of adults in the Latrobe Valley.

The Hazelwood Health Study is led by Monash University with collaborators from Menzies, Federation University, The University of Adelaide and CSIRO.
The research was funded by the Department of Health.

Website: www.hazelwoodhealthstudy.org.au/study-reports @hazelwoodhealthstudy @HazelwoodHS

Hazelwood HEALTH STUDY

Research on cancer, five years after the mine fire
Research Summary

October 2021

Background

The fire in the Morwell open cut brown coal mine adjacent to the Hazelwood Power Station blanketed the town of Morwell and the surrounding area in smoke and ash for six weeks in February and March 2014. The smoke event was recognised as one of the most significant air quality incidents in Victoria's history. It caused considerable community concern within Morwell and the broader community. In response to these concerns, and following extensive community consultation, the Hazelwood Health Study (HHS) was established to examine the impacts of the mine fire. The HHS involves multiple research streams targeting different health outcomes and different vulnerable groups.
The Hazelinks Stream of the HHS investigates the long-term health of the smoke-exposed communities by using administrative health datasets, such as ambulance, hospital, Medicare, pharmaceutical, cancer and death records.

Meet the team

Pei Yu
Yuming Guo
Caroline Gao
Christina Dimitriadis
Jillian Ikin
Anthony del Monaco
David Brown
Malcolm Sim
Michael Abramson

Analysis aims

This analysis aimed to see whether people who were most exposed to smoke from the Hazelwood mine fire were more likely to have a diagnosis of cancer during the five years following the event, compared with people who were less exposed or not exposed.

What we did

We searched the Victorian Cancer Registry (VCR) for any records matching 2208 Morwell residents who were exposed to the Hazelwood mine fire smoke, and 646 Sale residents who were much less exposed or not exposed, who had previously participated in the Hazelwood Health Study Adult Survey and agreed to VCR linkage. Each participant had filled in a time-location diary to show where they were on each day and night of the mine fire period. This was important because the smoke levels varied quite a bit from day to day. Using the diaries and air pollution modelling conducted by CSIRO, we calculated each participant's level of exposure during the fire, to fine particles in the smoke of less than 2.5 thousandths of a mm in diameter ($PM_{2.5}$). For this analysis we looked at new cancers diagnosed between 9 August 2014 and 31 December 2019. Cancers usually take a long time to develop. For this reason, cancers diagnosed within 6 months after the mine fire were not included as these were extremely unlikely to have been caused by the smoke.

A detailed paper describing the findings from this analysis can be requested from the Hazelwood Health Study researchers by email contact@hazelwoodhealthstudy.org.au or phone 1800 985 899

Hazelwood HEALTH STUDY

What we found

We found that overall cancer incidence was higher in Morwell than in Sale during the 5 years after the mine fire. However, within exposed Morwell participants, we did not observe a difference in cancer incidence between highly exposed and less exposed participants. That is, we observed a difference in overall cancer incidence between the two towns, but no strong evidence that cancer incidence was associated with smoke exposure. This suggests the possibility that the difference in cancer incidence between the two towns *may* not have been caused by the mine fire. When we looked at specific cancer sites such as lung, colorectal and urinary cancers, numbers were too small to show any definite evidence of a difference between the two towns or between higher and lesser $PM_{2.5}$ exposed participants.

Considerations

The analysis used a number of statistical methods to account for other factors that might have influenced cancer incidence, such as age, sex, education, smoking history and employment in jobs that involved exposure to dust, fumes, smoke, mist or gas. We did not find that these factors explained the difference in cancer between the two towns. However, there remains the possibility that factors other than the mine fire smoke influenced the difference in cancer between Morwell and Sale, such as differences in job types or diet. Further, because proportions of adults from Morwell and Sale did not participate in the Adult Survey, it is possible that the findings do not truly reflect those communities. Finally, a five year follow up period may be too brief to detect some cancers which can be very slow to develop.

Where to from here

These findings which used cancer registry data will be looked at alongside other findings which used ambulance, hospital, Medicare, pharmaceutical and death records, self-reported symptoms and clinical examinations of participants, to obtain a comprehensive overview of the long-term effects of the Hazelwood coalmine smoke on the health of adults in the Latrobe Valley. A further linkage with the VCR is planned for 2023 in order to obtain approximately 9 years of cancer data.

The Hazelwood Health Study is led by Monash University with collaborators from Menzies, Federation University, The University of Adelaide and CSIRO.
The research was funded by the Department of Health.

Hazelwood HEALTH STUDY

Research Summary

Impacts of the Hazelwood mine fire on ambulance attendances, emergency department presentations and hospital patient admissions for mental health conditions

October 2021

Background

The fire in the Morwell open cut brown coal mine adjacent to the Hazelwood Power Station blanketed the town of Morwell and the surrounding area in smoke and ash for six weeks in February and March 2014. The smoke event was recognised as one of the most significant air quality incidents in Victoria's history, with the concentration of smoke contaminants reaching high levels.

The smoke event caused considerable community concern within Morwell and the broader community. In response to these concerns, and following extensive community consultation, the Hazelwood Health Study (HHS) was established to examine the impacts of the mine fire. The HHS involves multiple research streams targeting different health outcomes and different vulnerable groups.

Meet the team

Matthew Carroll
Caroline X Gao
Tim Campbell
Catherine Smith
Emily Berger
Darryl Maybery
Jillian Ikin
Michael Abramson
Malcolm Sim
Alexander McFarlane
Christina Dimitriadis
Karen Smith
Yuming Guo

Analysis aims

The aim of this analysis was to examine whether coal mine fire-related air pollutants were associated with increased rates of ambulance attendances, emergency department presentations and hospital patient admissions for mental health conditions.

What we did

Latrobe Valley ambulance and hospital services data were obtained from Ambulance Victoria and the Victorian Department of Health for the period 1 July 2010 to 31 March 2015. Air pollution modelling by the CSIRO estimated hourly levels of fine air particles in the smoke with a diameter of 2.5 thousandths of a millimetre or less ($PM_{2.5}$). A statistical method called time series analysis was used to measure the associations between daily average $PM_{2.5}$, and daily rates of ambulance attendances, emergency department presentations and hospital admissions for mental health conditions in the Latrobe Valley. We looked at the use of these health services during the first 30-days of the fire when smoke concentrations were highest, from 9 February to 10 March 2014, and compared that with health service use before and after the Hazelwood event. We also took into account the influences of other factors, such as season, temperature, and public holidays.

A more detailed paper describing the findings from this analysis can be found at
https://hazelwoodhealthstudy.org.au/study-findings/publications

Hazelwood HEALTH STUDY

What we found

The analyses found that levels of mine fire-related $PM_{2.5}$ during the first 30 days of the fire, were associated with short-term increases in ambulance attendances and emergency department presentations, but not hospital patient admissions, for mental health conditions in the Latrobe Valley area.

The most prominent effects were observed after about 5 days of smoke exposure, where for each 10 $\mu g/m^3$ increase in mine fire-related $PM_{2.5}$, the estimated risk of an ambulance attendance for anxiety increased by 38% and the risk of an emergency department presentation for depression increased by 36%.

Considerations

While the findings suggest there was an increase in the rates of ambulance attendances and emergency department presentations for mental health conditions in the Latrobe Valley associated with the coal mine fire smoke, the data are not sufficient to link any individual's case to the mine fire.

An important limitation to interpretation of these data relates to the challenge of making rapid clinical judgements in relation to mental health status during an emergency situation such as an ambulance attendance. There is potential for misdiagnosis in these circumstances.

Where to from here

The HHS has a continuing program of research, which includes clinical respiratory examinations and periodic surveys of mental health and wellbeing, to better understand health impacts of the mine fire in affected communities.

These HHS results will be shared with relevant organisations to ensure they are used to shape services for the future health and wellbeing of the Latrobe Valley

The Hazelwood Health Study is a collaborative program of research led by the Monash University Schools of Public Health and Preventive Medicine and Rural Health in partnership with Federation University, the Menzies Institute for Medical Research at the University of Tasmania, the University of Adelaide and the CSIRO.

This research was funded by the Department of Health.