Hazelwood Health Study

8th Annual Report

17 November 2022

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Document history

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Contents

Abbreviations....3
1 Executive Summary....4
2 Introduction....7
3 Previously completed contract milestones....8
4 Project Governance....9
4.1 Project Management Group.... 9
4.2 Gippsland Primary Health Network....10
4.3 Latrobe Health Assembly....11
4.4 Project Steering Committee....12
4.5 Scientific Reference Group....13
5 Stream coordination retreat....13
6 Research updates....14
6.1 The Latrobe Early Life Follow-up (ELF) Study....14
6.2 Psychological Impacts....16
6.3 Impact on Community Wellbeing....19
6.4 Adult Survey....21
6.5 Respiratory Stream....22
6.6 Hazelinks....24
6.7 Cardiovascular Stream....26
7 Dissemination of findings and community engagement....27
8 Appendices....29

Abbreviations

ABC	Australian Broadcasting Corporation
COVID-19	Coronavirus Disease 2019
ANZSRS	Australian and New Zealand Society of Respiratory Science
CWI	Community Wellbeing Index
DH	Victorian Government Department of Health
ED	Hospital Emergency Department
ELF	Latrobe Early Life Follow Up Study
EPA	Environmental Protection Authority
GP	General Practitioner
GPHN	Gippsland Primary Health Network
HHS	Hazelwood Health Study
HREC	Human Research Ethics Committee
LHA	Latrobe Health Assembly
MBNW	Multi-Breath Nitrogen Washout
MUHREC	Monash University Human Research Ethics Committee
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
TSANZ	Thoracic Society of Australia and New Zealand

1 Executive Summary

This is the eighth Annual Report to be submitted to the Department of Health (DH) and the Hazelwood Health Study's (HHS) 35th contractual milestone. This report provides a summary of progress made since the seventh Annual Report was submitted in November 2021.

In the last 12 months, the Project Management Group (PMG) has farewelled Emeritus Professor Malcolm Sim AM, who has retired, and has welcomed two new members: Drs Sharon Harrison and Tyler Lane. The PMG has remained central to all areas of Study governance; planning the annual stream coordination retreat, the Annual Community Briefing, the formal meetings of the Project Steering Committee and Scientific Reference Group and the regular finance committee meetings. The PMG has attended and presented at relevant meetings hosted by the DH Contract Committee, the Gippsland Primary Health Network and the Latrobe Health Assembly. The PMG continues to review and track all Study outputs from conception to publication, including maintaining the Study Outputs Directory of publicly available findings.

Since the previous Annual Report, the Latrobe Early Life Follow-Up (ELF) Study has been concentrating on analyses of previously collected clinical data as well as anonymous health services use data. Based on those data, a number of abstracts have been presented at national and international conferences while several scientific manuscripts have been progressed. Further data linkage activities are underway and planning has commenced for the third round of clinical assessments scheduled for 2023.

The Psychological Impacts Stream has launched its third Mental Health and Wellbeing Follow-Up Survey in order to continue investigating the longitudinal course of psychological health and wellbeing in the community. As of 17 November, 350 participants had completed the 2022 Survey. This Stream has also progressed a number of analyses from the previous 2019/2020 Mental Health and Wellbeing Follow-Up Survey, including publication of research demonstrating persistent psychological distress among adults six years after the mine fire. The researchers have also published findings showing how the mine fire impeded the academic progress of primary and secondary school students.

In collaboration with the Hazelinks Stream, the Psychological Impacts Stream has published a manuscript revealing a spike in mental health-related ambulance attendances and hospital emergency department presentations during the mine fire period. The Psychological Impacts and Community Wellbeing Streams are progressing collaborative work investigating associations between smoke exposure, psychological distress, socioeconomic circumstances and subsequent perceptions of community wellbeing. The Psychological Impacts and ELF Streams are continuing to collaborate on a study of parental mental health, family functioning and associations with the mental health and

development of children. A survey was completed between May and July 2022 by 226 parents of 243 ELF Study children.

The Impact on Community Wellbeing Stream has completed the initial design of a Community Wellbeing Barometer covering five key domains: health, the economy, environment, services and infrastructure, and social connection, with associated themes and objective measures. Quantitative data on these measures have been collected and the results have recently been discussed and validated with a focus group of key stakeholders in the Latrobe Valley. Qualitative data from interviews, media and social media is being analysed and will contribute to assessment of subjective aspects of community wellbeing. Ethics approval has been received to conduct a further round of qualitative interviews in early 2023. A conference paper delivered in 2021 has been submitted to an international journal on disaster and risk communication

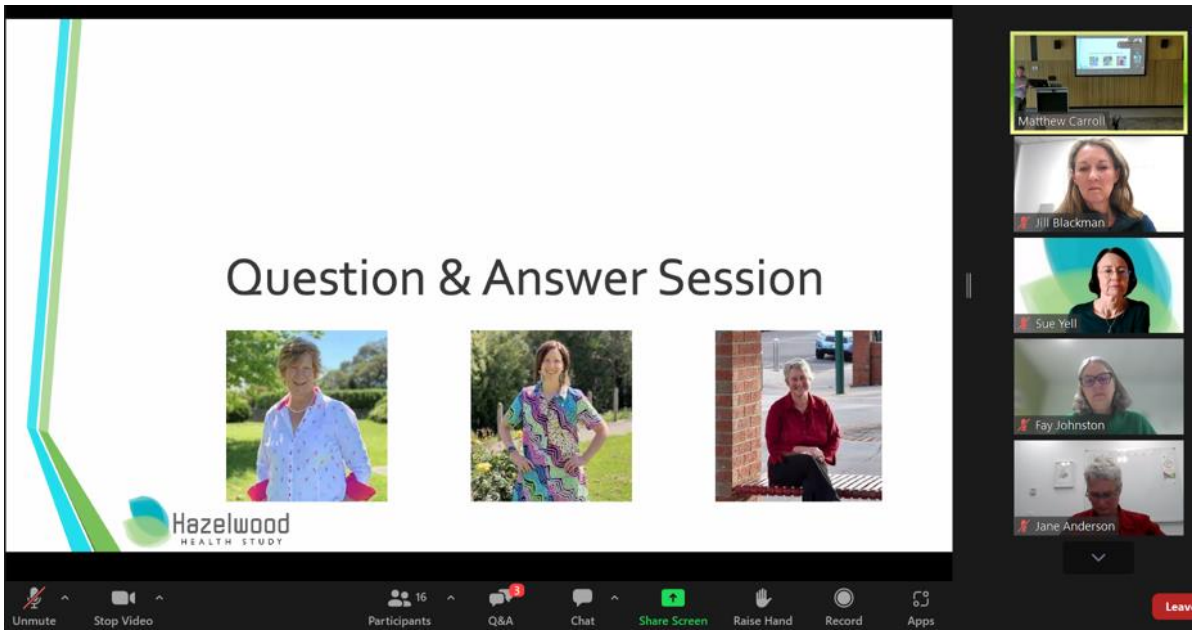
The Adult Survey continues to contribute valuable baseline data to the ongoing research of the Psychological Impacts, Respiratory, Cardiovascular and Hazelinks Streams. Not previously included in the Project Plan, a followup survey of a sub-sample of the Adult Survey cohort is being undertaken in 2022. The followup survey is investigating the association between mine fire-related $PM_{2.5}$ exposure and respiratory symptoms eight years later, any effects of smoke from the 2019/2020 Black Summer bushfires, Coronavirus Disease 2019 (COVID-19) and dietary quality. As of 17 November 2022, the followup survey had been undertaken by 608 participants.

In the early months of year 8, the Respiratory Stream completed its second round of clinical assessments. From 329 participants, 133 had abnormal respiratory findings and they each received a report to pass on to their medical practitioners. Those data have since been audited and analysed. From this work, an abstract has been submitted to the American Thoracic Society 2023 International Conference and a manuscript is underway. The review, analyses and write up of Multi-Breath Nitrogen Washout (MBNW) data from round 1 clinical assessments is near completion. From this work, an abstract has been submitted for consideration by the 2023 Annual Scientific Meeting of the Thoracic Society of Australia & New Zealand (TSANZ) and ANZ Society of Respiratory Science (ANZSRS) and a manuscript is underway. The researchers have also published a manuscript in the *Annals of the American Thoracic Society* and had some correspondence published in *Respirology*. Planning has commenced for the third round of clinical assessments scheduled for 2023.

The Hazelinks team has received new extractions of deidentified ambulance and hospital records which include an additional 5-6 years of data since the previous extractions. An extraction of deidentified cancer data is expected soon. Hazelinks has published two papers on the identified linkage of the Adult Survey cohort to Victorian Cancer Registry and hospital admissions data. A third paper on linked emergency department presentations is currently under review.

The Cardiovascular Stream has published a manuscript in *Vascular Health and Risk Management* describing flow mediated dilatation results from round 1 clinical testing. Since publication in April 2022, this manuscript has received 3214 online views.

A number of strategies have been employed to maximise community engagement. Findings have been disseminated via scientific journals, conferences, the media, an e-newsletter and the HHS website. The Study has produced a number of lay language Research Summaries and is looking into placing these in relevant community locations. The Annual Community Briefing, which was held in October 2022, attracted an audience of about 22 people. The Project Management Group are planning an advertising campaign intended to enhance the profile of the study across the local community. It is expected that the campaign will be rolled out in 2023.



8th Annual Community Briefing Zoom webinar

2 Introduction

This is the eighth Annual Report to be submitted to the Department of Health (DH) as part of the milestones for the Hazelwood Health Study (HHS). Previously completed milestones are shown in section 3. This report comprises an overview of all HHS activities in the 12 months since the seventh Annual Report was submitted in November 2021. Copies of all previous Annual Reports can be found at www.hazelwoodhealthstudy.org.au/study-findings/study-reports/.

The HHS is overseen by a number of governing bodies which are described in section 4. Their common goals are to ensure the Study's integrity, adherence to best research practice and connections with mine fire-impacted communities, key stakeholders and important scientific audiences.

The HHS comprises a number of related research Streams with their own aims, participants and methods. Combined, the research Streams bring together participant-reported health and wellbeing information, administrative health data, educational assessments, 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 aim to provide a comprehensive overview of the long-term health and wellbeing impacts of the 2014 Hazelwood mine fire upon the Latrobe Valley community. The recent activities of each Stream are presented in section 6.

Effective dissemination of findings and community engagement have been high priorities for the HHS throughout its tenure. These activities are outlined in section 7 and demonstrated further in the Appendices.

Respiratory Stream clinic 2021.

3 Previously completed contract milestones

Since commencement of the HHS in November 2014, and prior to the submission of this 8th Annual Report, 34 contractual milestones have been completed. Those milestones are presented in Table 1 with their delivery dates.

Table 1 Contractual milestones completed prior to this 8th 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

	Contractual milestone	Delivered
29	6th Annual Report	20 November 2020
30	7th Interim Report	16 June 2021
31	7th Annual Community Briefing	11 November 2021
32	7th Annual Report	19 November 2021
33	8th Interim Report	18 May 2022
34	8th Annual Community Briefing	18 October 2022

4 Project Governance

4.1 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.

The PMG has coordinated and participated in all formal meetings of the Project Steering Committee, Scientific Reference Group and the finance committee, and has attended relevant meetings hosted by the Department of Health Contract Committee, Gippsland Primary Health Network and the Latrobe Health Assembly. The PMG has also undertaken numerous out-of-session consultations in regard to strategic decision making, study progress and planning for the Study's annual stream coordination retreat and annual community briefing.

The PMG has farewelled Emeritus Professor Malcolm Sim AM, who retired, and has welcomed two new members: Drs Sharon Harrison and Tyler Lane. Previously the HHS Executive Officer, Dr Harrison was promoted to Project Manager in November 2021 and formally welcomed into the PMG in February 2022. A valued member of the Study team, Dr Harrison won the Monash University School of Public Health and Preventive Medicine's Teaching and Research Support Excellence Award in November 2021. Dr Lane was recruited into a new HHS Senior Research Fellow role in February 2022 and also welcomed onto the PMG at that time. Originally from the United States, Dr Lane was previously a Senior Research Fellow at Cancer Council Victoria, a Research Fellow in Monash's Insurance Work and Health Group, a Research Project Manager at the University of KwaZulu-Natal in South Africa, and a statistician in the British Civil Service. Dr Lane's research interests include health outcomes research, quasi

Dr Tyler Lane

experimental study designs, interrupted time series, R statistical package, social policy analysis, occupational health and workers' compensation.

The PMG has reviewed preliminary and final drafts of all reports, papers, abstracts, Research Summaries and media releases arising from HHS research, and facilitated their submission to the DH for approval. All study outputs are tracked by the PMG, from conception to publication, with updates regularly made to the Hazelwood Health Study Outputs Directory which lists all publicly available HHS findings (Appendix 1) and the Citations Master List (Appendix 2).

The HHS budget is monitored on a monthly basis by the PMG, with planned expenditure adjusted as needed. Accordingly, the PMG has overseen the renewal of sub-contracts with our key collaborators, University of Tasmania and Federation University, for years 8-10 of the HHS. In consultation with our Finance Business Partner, Dr Harrison has completed two compendia of documentation to accompany the reimbursable expenses claim for years 7 and 8 respectively.

The PMG continues to work with the DH to finalise an agreement regarding the long-term custodianship of the “Our Hopes for the Future of Morwell” photographic exhibition which comprises Intellectual Property arising from the Study. An agreement with the DH, in regard to the contractual milestone dates for years 8-10 of the Study, has also been executed.

4.2 Gippsland Primary Health Network

As previously reported, the HHS is now a standing item on the meeting agenda for the Latrobe Baw Baw Subregional Clinical Council of the Gippsland Primary Health Network (GPHN). 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 November 2021 meeting, the GPHN were invited to review and comment on the:

- joint Psychological Impacts/Hazelinks paper on ambulance call outs, emergency department presentations, and hospital admissions for mental health-related conditions;
- Psychological Impacts Stream paper on educational outcomes following the Hazelwood event.

In the February 2022 meeting, the HHS sought feedback on the:

- HHS 2021 Annual Report;

- Hazelinks paper on the incidence of cancer in the five years following the Hazelwood mine fire;
- potential for ongoing collaboration beyond the first ten years of the HHS.

In the May 2022 meeting, the HHS was keen to hear from GPHN members regarding their ideas on research priorities for the region. This was not necessarily restricted to Hazelwood mine fire outcomes, as there is potential to build upon the current study framework to look at wider public health issues. In response, the GPHN indicated an interest in early childhood implications and the planning that may be needed to understand the future needs of this cohort. The GPHN also indicated its desire for the Study to continue beyond 10 years.

In the August 2022 meeting the HHS presented the updated Outputs Directory and also findings in relation to the role of Hazelwood mine fire-related posttraumatic stress, and general psychological distress, in the presentation of physical symptoms such as pain, fatigue, shortness of breath and gastrointestinal problems experienced during the 2019-2020 Black Summer bushfires. The HHS also sought suggestions from the GPHN members regarding the dissemination of findings to the broader community.

4.3 Latrobe Health Assembly

The Latrobe Health Assembly (LHA) HHS subcommittee has met three times in the last 12 months and there has also been a meeting of the full Assembly with HHS representatives.

In December 2021 items presented included the HHS 2021 Annual Report and the joint Psychological Impacts/Hazelinks paper on ambulance call outs, Emergency Department (ED) presentations, and hospital admissions for mental health-related conditions. General discussion included members raising the question of whether psychological distress could cause cancer, which prompted the student project reported upon in the Psychological Impacts Stream summary. There were also preliminary discussions regarding potential future research plans beyond the first ten years of the Study.

The subcommittee met again in March 2022, which provided an opportunity to introduce new Senior Research Fellow Tyler Lane to members. The following matters were considered at the meeting:

- a proposed respiratory health follow-up, including consideration of nutritional risk factors, and the potential connections with ongoing LHA activities;
- the Hazelinks paper on ED presentations in the 5 years following the Hazelwood mine fire;

- the upcoming annual HHS stream coordination retreat, including discussion regarding the future research priorities for the HHS and the region.

Key LHA members subsequently participated in the stream coordination retreat and contributed considerably to a wide-ranging discussion regarding research priorities.

The June 2022 sub-committee meeting agenda included:

- presentation of Environmental Protection Authority (EPA) data on $PM_{2.5}$ levels in Gippsland during the Black Summer (2019/2020);
- findings in regard to physical symptoms, psychological distress and trauma in response to climate disasters;
- a discussion around strategies to improve dissemination of HHS findings to the broader community.

At the meeting of the full LHA in August 2022, the HHS attendees, Drs Carroll, Lane and Blackman, provided the Assembly with an overview of the previous 12 months of work.

4.4 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. The PSC has farewelled Prof Danny Liew who has departed Monash University for a new position as Dean and Head of the Adelaide Medical School. In his place, Assoc Prof Dion Stub has been appointed the Lead for the Cardiovascular Stream. Dion is a clinician, interventional cardiologist and a specialist in structural heart procedures.

During the last 12 months there have been three formal meeting of the PSC plus numerous out-of-session consultations and contributions to strategic decisions and reports, particularly the 8th Interim Report and this 8th Annual Report.

All Stream Leads presented progress updates and future plans for their streams at the annual stream coordination retreat in March and again at the Annual Community Briefing in October 2022.

The PSC has reviewed and approved all proposals for new analysis and write up of HHS findings. Recent proposals include analysis and write up of findings in relation to small airways dysfunction using Multi-Breath Nitrogen Washout (MBNW) data from the round 1 adult Respiratory Stream clinic; longitudinal change in lung function using round 1 and round 2 adult Respiratory clinic data; and emergency department presentations and hospital admissions amongst children exposed to the mine fire *in-utero* using ELF data.

4.5 Scientific Reference Group

The Scientific Reference Group has welcomed a new member, Professor Sherene Loi. Professor Loi is a consultant medical oncologist and Head of the Translational Breast Cancer Genomics and Therapeutics Laboratory at the Peter MacCallum Cancer Centre and University of Melbourne. At its September 2022 annual meeting, the HHS researchers provided the SRG with an overview of their previous 12 months of work and future plans.

5 Stream coordination retreat

The Study's eighth stream coordination retreat was hosted by Monash University's School of Public Health and Preventive Medicine on 23 March 2022. In order to limit travel and close contact, in the context of ongoing COVID-19 infection risks, participants joined by individual Zoom link or in small groups at key locations. The retreat involved members of all HHS research streams, overarching project staff and students. Guest participants included Ellen-Jane Browne, Tanya Rong and Jo Manco (from the Latrobe Health Assembly) and Alistair Edgar (Office of the Latrobe Health Advocate).

All Streams presented a review of findings to date, outputs, current status and their 2022 study plan. Other areas of discussion included identifying potential research collaborations for progressing future HHS research funding opportunities. Ongoing connections with the community via the Latrobe Health Assembly and the Office of the Latrobe Health Advocate were explored.

2022 stream coordination retreat

6 Research updates

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

In the last 12 months, the ELF Study has completed numerous analyses of previously collected data. These have been the focus of four abstracts submitted to national and international conferences, and a number of scientific manuscripts. The ELF Study has also collaborated with the Psychological Impacts Stream on a survey of parental mental health and has progressed plans for further data linkages and for its third round of clinical assessments.

Abstracts

- Ziou M, et al (2022) "Early life exposure to coal smoke and hospital visitation: findings from a data linkage cohort study" presented as a poster by the *34th Annual International Society of Environmental Epidemiology Conference* in September 2022.
- Ziou M, et al (2022) "Prenatal and early postnatal exposure to air pollution associations with primary care and prescription usage" presented as a poster by the *34th Annual International Society of Environmental Epidemiology Conference* in September 2022.
- Hemstock E, et al (2022). "Prenatal exposure to emissions from a coalmine fire and childhood lung function." Presented at three conferences: the *Centre for Air Pollution, Energy and Health Research Symposium in May 2022* (oral presentation); the International Society for Environmental Epidemiology Asia and Western Pacific Chapter & International Society for Exposure Science in Asia Chapter in June 2022 (poster); the *34th Annual Conference of the International Society for Environmental Epidemiology* in September 2022 (poster).
- Hemstock E, et al (2023). "The health impacts of exposure to air pollution in early childhood." Submitted in October 2022 for consideration by the *2023 Annual Scientific Meeting of the Thoracic Society of Australia and New Zealand (TSANZ).*

Manuscripts

- Ziou M, Tham R, Wheeler AJ, et al (2022). "Outdoor particulate matter exposure and upper respiratory tract infections in children and adolescents: A systematic review and meta-analysis." Published in July 2022 by *Environmental Research*. Freely available at https://doi.org/10.1016/j.envres.2022.112969
- Hemstock EJ, Foong RF, Hall GL et al (2022) "No association between in utero exposure to emissions from a coalmine fire and post-natal lung function." Submitted

for peer review. A lay language Research Summary has been placed on the HHS website.

- Ziou M, et al (2022) “Exposure to severe smoke from the Hazelwood coal mine fire and ambient air pollution in early life and subsequent hospital visits: Findings from a data linkage cohort study.” Submitted for peer review.

There are additional manuscripts in progress which should be completed in the coming months. These present analyses and findings in regard to:

- general practitioner (GP) visits and medical prescriptions in the anonymous linked Latrobe ELF cohort;
- allergic sensitisation in the identified Latrobe ELF cohort; and
- longitudinal changes to lung function in the identified Latrobe ELF cohort, at 4 and 7-years after exposure.

Assessment of parental mental health and family functioning

As discussed further in section 6.2, the ELF Study has joined forces with the Psychological Impacts Stream to survey ELF Study families to investigate the association between parental mental health and family functioning.

Data Linkage

Further linkage is planned for both the identified and the anonymised cohort. Applications are in progress to link data from our ELF cohort to data from the 2018 and 2021 Australian Early Development Censuses and also to link state-wide anonymised data with other health and development datasets through the AIHW.

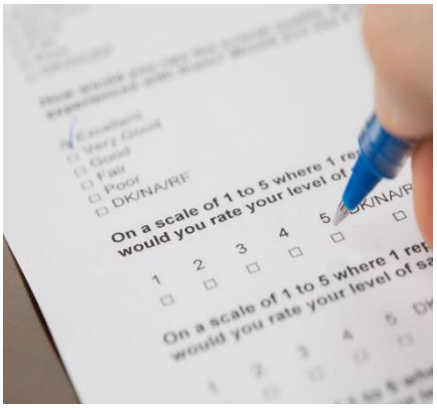
Round 3 clinical assessments

The ELF Study’s third round of clinical assessments is scheduled for the second half of 2023. This will enable the Stream to conduct longitudinal analyses of respiratory health in young children at three time points after the mine fire. Planning has commenced, with team meetings held to discuss the clinic requisites such as the testing protocols, Human Research Ethics Committee applications, staffing and staff accommodation in Gippsland, clinic rental, equipment purchasing of consumables.

Round 2 clinical assessment

6.2 Psychological Impacts

2022 Mental Health and Wellbeing Follow-Up Survey. Following months of planning and preparation, including protocol development, ethics applications and refinement of the recruitment and data collection database, the Psychological Impacts Stream has successfully launched its third-round Mental Health and Wellbeing Follow-Up Survey. This will enable the Stream to conduct longitudinal analyses of psychological health and wellbeing in the local community at three time points after the mine fire. As of 17 November, the 2022 Mental Health and Wellbeing Follow-Up Survey had been completed by 350 participants from 715 invitations. It is anticipated that recruitment will close in December 2022.



Over the last 12 months, the Psychological Impacts Stream has published four scientific manuscripts and has progressed several other manuscripts toward publication, as follows:

Manuscripts

Schools Study

- Berger E, Gao CX, Broder JC, et al. (2021). "The impact of a mine fire and smoke event on academic outcomes for primary and secondary school students." This manuscript has been published by the journal *Psychological Trauma: Theory, Research, Practice, & Policy* and is available by subscription at https://doi.org/10.1037/tra0001179. 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.
- Gao CX, Broder JC, Brilleman S et al. (2022) "Evaluating the impact of Hazelwood mine fire event on students' educational development with Bayesian interrupted time-series hierarchical meta-regression." This manuscript has been peer reviewed by the journal *PLoS One* and an invited revision has been recently submitted. A preprint version of the manuscript is available at https://doi.org/10.1101/2021.03.28.21254516 and the associated Research Summary is on the HHS website.
- Maybery D, Berger E, Dipnall J, et al. (2022). "Posttraumatic distress among primary and secondary school students following the 2014 Hazelwood mine fire." This manuscript is currently under peer review with the *Journal of Aggression, Maltreatment and Trauma*. This manuscript draws upon the survey results from a previously completed mixed methods paper which included both quantitative survey

data and qualitative interview data. That manuscript is available at https://psyarxiv.com/rw657 and the associated Research Summary is on the HHS website.

Adult psychological health

- Carroll M, Campbell TCH, Smith C, et al. (2022). "An exploration of the trajectory of psychological distress associated with exposure to smoke during the 2014 Hazelwood coal mine fire." This manuscript was published in April 2022 by the *International Journal of Hygiene and Environmental Health* and is available at https://doi.org/10.1016/j.ijheh.2022.113946. A preprint version is available at https://psyarxiv.com/tz5c4/ and the associated Research Summary is on the HHS website.
- Carroll M, Gao CX, Campbell TCH, et al. (2022). "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 published in May 2022 by the journal *Atmospheric Pollution Research* and is available at https://doi.org/10.1016/j.apr.2022.101415. A preprint version is available at https://psyarxiv.com/hgv7t and the associated Research Summary is on the HHS website.
- O'Donohue K, Berger E, McLean L, Gao CX et al. (2022). "The psychological impacts of a smoke event on young adults compared to other aged adults in Victoria, Australia". This manuscript was published in February 2022 by the *International Journal of Disaster Risk Reduction* and is available at https://doi.org/10.1016/j.ijdrr.2021.102727.
- Gao CX, Menssink J, Campbell TCH et al. (2022). "Somatic symptoms, psychological distress and trauma in response to climate disasters: Lessons from 2014 Hazelwood mine fire and 2019-20 Black Summer bushfires in Australia." This manuscript has recently been submitted for peer review. A preprint version is available at https://psyarxiv.com/wy5b7/ and the associated Research Summary is on the HHS website.
- Smith CL, Campbell TCH, Gao CX et al. (2022). "Trajectories of posttraumatic distress after smoke exposure during a coalmine fire: An analysis of risk and protective factors." This manuscript has been reviewed by the *Journal of Traumatic Stress* which has recently invited the authors to revise it as a brief report. A preprint version is available at https://psyarxiv.com/cp9f5/ and the associated Research Summary is on the HHS website.

In a collaboration with the Community Wellbeing Stream, the Psychological Impacts Stream is investigating the relationship between individual wellbeing and community

wellbeing in Morwell using the Community Wellbeing Index (CWI). The CWI was administered as part of the 2019/2020 Mental Health and Wellbeing Follow-Up Survey. Data analysis has been completed which investigated associations between smoke exposure, psychological distress, sociodemographic circumstances and perceptions of community wellbeing. The research team is currently in the process of drafting a manuscript from that analysis. As this was one of the first times the CWI had been used in English, the Stream is collaborating with the Spanish developers of the measure, and other international researchers, to conduct a cross-national psychometric evaluation. Approval to include deidentified HHS CWI data in this collaboration was provided by the DH in November 2020, but the psychometric analysis has been put on hold because of delays in the provision of data from the other contributing countries.

Another key point of collaboration with the Community Wellbeing Stream has involved the inclusion of questions relating to individual wellbeing in interviews conducted by that stream. The initial analysis of the qualitative interview data has been completed and the Streams are working on interpreting and writing up the findings.

In collaboration with the ELF Study, the Psychological Impacts Stream developed a survey to investigate parental mental health, family functioning and their association with the physical and mental health and development of the children. That survey was conducted between May and July 2022 and was completed by 226 parents of 243 children participating in the ELF Study. The data collected in that survey are currently being prepared for analysis and the release of findings is expected to begin in 2023.

The Stream continues to foster capacity building and skills development by supporting students. One student has recently had her PhD conferred. Her thesis explored the impact of the Hazelwood event on younger adults living and working in the region. As part of this doctoral project, her manuscript investigating psychological distress among young adults in the HHS was published in the *International Journal of Disaster Risk Reduction*. The stream also continues to support final year Monash Medical students to complete Scholarly Intensive Placements. Three placement students have completed their programs this year. The first, co-supervised by Professor Michael Abramson, Dr Matthew Carroll and Dr Tyler Lane, completed a systematic review looking at whether stress can cause cancer, prompted by discussion with the LHA HHS Subcommittee. The second student completed a literature review on the relationship between air pollution and childhood academic outcomes. The third student completed a literature review on pathways of association between the mental health of parents and children. The works produced during these placements have proven valuable in interpreting and placing and interpreting the Stream's research within the existing scientific literature.

6.3 Impact on Community Wellbeing

The Impact on Community Wellbeing Stream's current research aims are 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).

As previously described, a first round of qualitative data collection covering all three of the above research aims was completed in 2021, with interviews taking place with 30 stakeholders and community members. Those interviews have now been transcribed and qualitative analysis is almost complete.

The Stream has developed a Community Wellbeing Barometer focusing on five domains impacting on wellbeing: health; the economy; environment; services and infrastructure; and social connection. For each domain we have identified 4-5 themes, as shown in Figure 1.

This year, we undertook work to identify objective indicators which could serve as measures for each theme in all five domains. These have now been identified and data for these indicators have been extracted from databases such as those maintained by the Australian Bureau of Statistics and the Victorian Department of Health. The data have been fitted to the model to show changes in these domains between 2011 and 2020, with forecasts calculated for 2023. The next step was to consult with key stakeholders in the community (including the Latrobe Health Assembly, Latrobe Health Advocate and Latrobe City) on the design of the barometer and its quantitative findings. The aim was to test the validity of the barometer in terms of how it was measuring the past and present wellbeing and forecasting future wellbeing of the Latrobe community. This meeting took place on 15 November.

Ethics approval was sought for this focus group, and for a further round of interviews with stakeholders and community members, to be conducted in early 2023. The interviews will ask about their perceptions of this community's wellbeing and about their individual wellbeing. Approval for these activities was received from the Federation University Human Research Ethics Committee (HREC) in October 2022.

Figure 1. Model of the proposed Community Wellbeing Barometer domains and themes

As in Years 1-7, we continue to collect data from media and social media to contribute to analysing 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 has been completed for the period 2017-2021, and that data are still being analysed.

As referred to in section 6.2, the Impact on Community Wellbeing Stream is collaborating with the Psychological Impacts Stream to look at the intersection between individual and community wellbeing using the CWI. 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. As noted above in the Psychological Impacts Stream report, 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.

A conference presentation delivered in 2021 has been developed into a journal article on optimal communication during complex disasters with health impacts, and submitted for peer review. This work contains previously published findings from the Community Wellbeing Stream interviews and the previous HHS *Policy review of the impact of the Hazelwood mine fire on older people*, as part of a broader discussion with additional examples, including COVID-19 crisis communication.

6.4 Adult Survey

Participants, and their data, from the 2016/2017 Adult Survey continue to form the basis for the Mental Health and Wellbeing Follow up Surveys (see section 6.2), adult Respiratory Stream (see section 6.5), adult Cardiovascular Stream (see section 6.7) and Hazelinks identified linkages (see section 6.6).

In 2022, a new followup survey of a sub-sample of Adult Survey participants has been led by Dr Tyler Lane. Not previously included in the Hazelwood Health Study Project Plan, this followup survey repeats the respiratory symptom questions that were included in the baseline 2016/2017 survey for the purpose of investigating any association between mine fire-related $PM_{2.5}$ exposure and persistent respiratory symptoms in the longer term. The followup survey has also included questions about exposure to smoke from the 2019/2020 Black Summer bushfires, any COVID-19 diagnosis or undiagnosed COVID-19-like symptoms and dietary quality.

The specific research questions are:

1. Does $PM_{2.5}$ exposure from the Hazelwood mine fire predict poorer respiratory health eight years later?
    a. Are effects moderated by previous COVID infection, the Black Summer bushfires, or dietary quality?
2. Does $PM_{2.5}$ exposure from the Hazelwood mine fire or the Black Summer increase COVID infections and illness severity?
3. Is diet quality associated with slower deterioration in lung function in people with high $PM_{2.5}$ exposure?

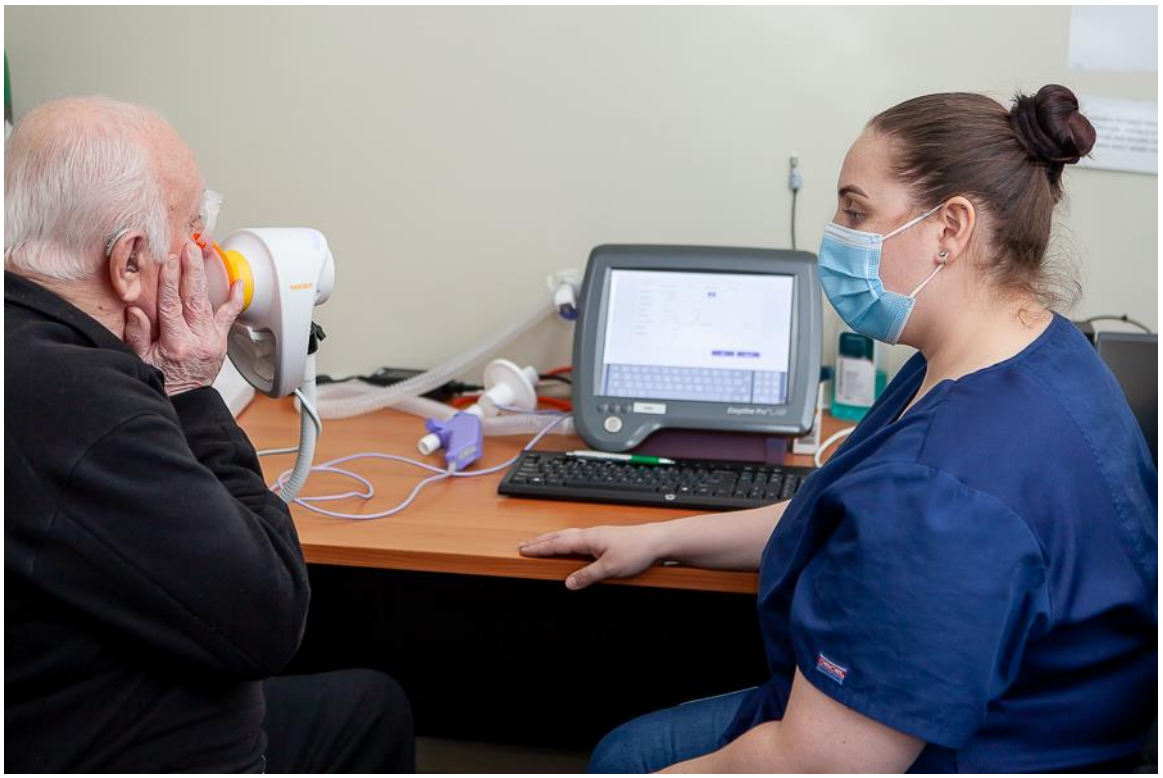


The study protocol, questionnaires, recruitment materials, analysis plan, database and data security requirements were reviewed and approved by the Monash University HREC in July 2022. Recruitment commenced in August 2022 with invitations and online survey links sent via SMS and email to prospective participants. As of 17 November 2022, 608 participants had been surveyed. Some complexities around the diet quality component of the survey have meant that a number of participants have not completed, or only part-completed, the dietary questions. In response, the HHS has committed additional resources to the Adult

Survey stream with interviewers phoning participants to assist them with completion of the diet quality questions.

In regard to the research question relating to COVID-19, Dr Lane has supervised a final year medical student on a Scholarly Intensive Placement, who undertook a systematic review of scientific literature exploring the association between fine particulate matter, risk of COVID-19 infection, severity of illness and mortality. A manuscript describing this work is nearing completion.

6.5 Respiratory Stream



Respiratory Scientist Mikayla Thomas with a round 2 clinic participant

Analysis of round 1 Multi-Breath Nitrogen Washout data

HHS Respiratory Scientist, Mr Thomas McCrabb, has investigated the impact of coal mine fire smoke on small airways dysfunction using Multi-Breath Nitrogen Washout (MBNW) data from the Respiratory Stream's round 1 clinical assessments. Preparation of the data is complete and the analysis plan has been reviewed and approved by the PSC. Analysis has now been completed and an abstract describing findings has been submitted to the 2023 Annual Scientific Meeting of the TSANZ and ANZSRS. Write up of a manuscript for consideration by a scientific journal is near completion. Whilst this work was initially part of a Masters of Philosophy, Mr McCrabb has since withdrawn his candidature.

Round 2 clinical data collection

Round 2 clinical data collection concluded on 15 November 2021 with 329 participants having attended the clinic. They comprised 217 adults from Morwell, and 112 adults from Sale. They represented approximately 64% of the 519 eligible participants who had previously undertaken round 1 assessment. Whilst it is very common for there to be attrition between data collection rounds in population health research, it is likely that community anxiety around the COVID-19 pandemic, and related disruptions, were contributors to the drop in participant numbers.

Of the 329 round 2 attendees, 133 were assessed as having abnormal respiratory findings and they each received a report to pass on to their medical practitioners. All data collected during the round 2 assessments have undergone extensive review and cleaning. The analysis plan has been written and reviewed by the PSC. Analysis of the lung function data has been completed and an abstract has been submitted for consideration by the American Thoracic Society 2023 International Conference. Write up of a manuscript for consideration by a scientific journal is underway. Analysis of respiratory symptom data has commenced. Those data will be merged with new data from the new Adult Survey followup.

Round 3 clinical data collection

The Respiratory Stream's third round of clinical assessments is scheduled for the first half of 2023. This will enable the Stream to conduct longitudinal analyses of respiratory health in adults at three time points after the mine fire. Planning has commenced, with team meetings held to discuss the clinic requisites such as the testing protocols, HREC applications, staffing and staff accommodation in Gippsland, clinic rental, equipment calibration and the purchasing of consumables.

Publications

The adult Respiratory Stream has published one scientific manuscript in the last year and has had some correspondence published in regard to an earlier manuscript.

- Prasad S, Gao C, Borg B, et al (2022). Chronic Obstructive Pulmonary Disease in adults exposed to fine particles from a coal mine fire. Published in February 2022 by the *Annals of the American Thoracic Society*. 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.
- Lee WK, Smith CL, Gao CX, et al (2021) Reply to "Respiratory harms from vaping: Questions for debate and discussion". Correspondence published in December 2021 by *Respirology* (https://onlinelibrary.wiley.com/doi/10.1111/resp.14181 in regard to our previously published manuscript: 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?" (refer Figure 2; https://doi.org/10.1111/resp.14113).

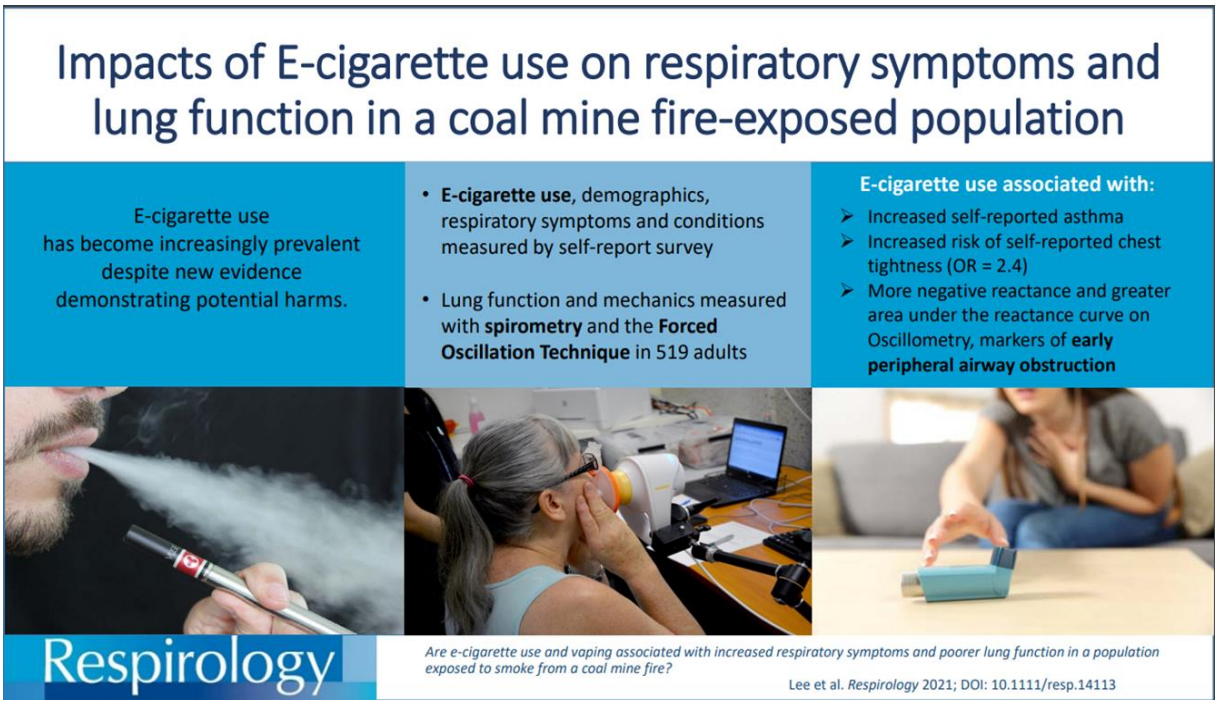


Figure 2 Visual abstract accompanying Lee et al. *Respirology* 2021.

6.6 Hazelinks

Deidentified data extractions

After several months of preparation, including revising the analysis plans and seeking updated approvals from the relevant HRECs, data custodians and the PSC, the Hazelinks team requested second extractions of anonymised cancer, ambulance and hospital records. It was anticipated that these would include an additional 5-6 years of data since the first extractions. The first extractions included data for the east of Victoria only. However, for the newer extractions the request was expanded to include all of Victoria. Including the additional geographical areas in our analyses will provide greater statistical power to control for confounding effects. The original analysis plans for data extractions were revised to detail how the additional geographical areas would be used in subsequent analyses.

The second extractions of ambulance and hospital records have already been received, and those data are currently being audited for completeness. The second extraction of cancer records is expected in the next few weeks.

Identified data linkages

At the time of the 2016/2017 Adult Survey, approximately 2800 participants consented to the HHS linking their survey responses to identified data held by the custodians of Victorian ambulance, hospital, cancer and death databases. These datasets allow the HHS researchers to track aspects of the health of the Adult Cohort whilst taking into consideration important health-related risk factors such as sex, age, education, occupational history, smoking status and, importantly, mine fire-related $PM_{2.5}$ exposure levels. Hazelinks is currently preparing all of the documentation necessary in order for the next round of identified linkages with the cancer, ambulance and death datasets to take place in 2023.

Publications

Hazelinks has progressed a number of scientific manuscripts toward publication in the last 12 months, as follows:

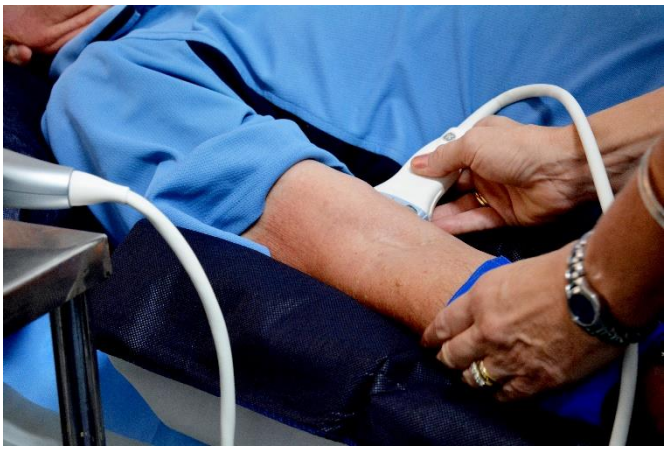
Manuscripts

- Yu P, Guo Y, Gao CX, 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.” Published by *Environmental Health Insights* in November 2021.
- Xu R, Gao CX, Dimitriadis C, et al (2021) “Long-term impacts of coal mine fire emitted $PM_{2\cdot5}$ on hospitalization: longitudinal analyses of the Hazelwood Health Study.” Published by the *International Journal of Epidemiology* in December 2021.
- Smith C, Gao CX, Xu R, et al (2022) “Long-term impact of exposure to the 2014 Hazelwood coal mine fire on emergency department presentations in Australia.” Approved for public release by the DH in January 2022. A lay language Research Summary describing these findings was placed on the HHS website in March 2022. The manuscript has been accepted for publication by the journal *Environmental Research*, subject to some minor revisions. The authors have recently submitted their response.

As referred to in section 6.2, 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. That manuscript was accepted in March by the journal *Atmospheric Pollution Research* and published in May 2022.

6.7 Cardiovascular Stream

The Cardiovascular Stream has published its manuscript describing flow mediated dilatation results from round 1 clinical testing. The manuscript by Mundisugih J, Gao CX, Ikin JF, et al "Vascular responses among adults exposed to smoke from the Hazelwood coal mine fire" was published by the journal *Vascular Health and Risk Management*. This is an open-access journal and the manuscript can be accessed without subscription at www.doi.org/10.2147/VHRM.S339439. In the 8 months following its April 2022 publication, the manuscript received 3,214 online views and was downloaded 269 times. The citation has been placed on the HHS website. Ongoing assessment of cardiovascular outcomes in the community will be achieved as part of the ELF and Hazelinks Streams.



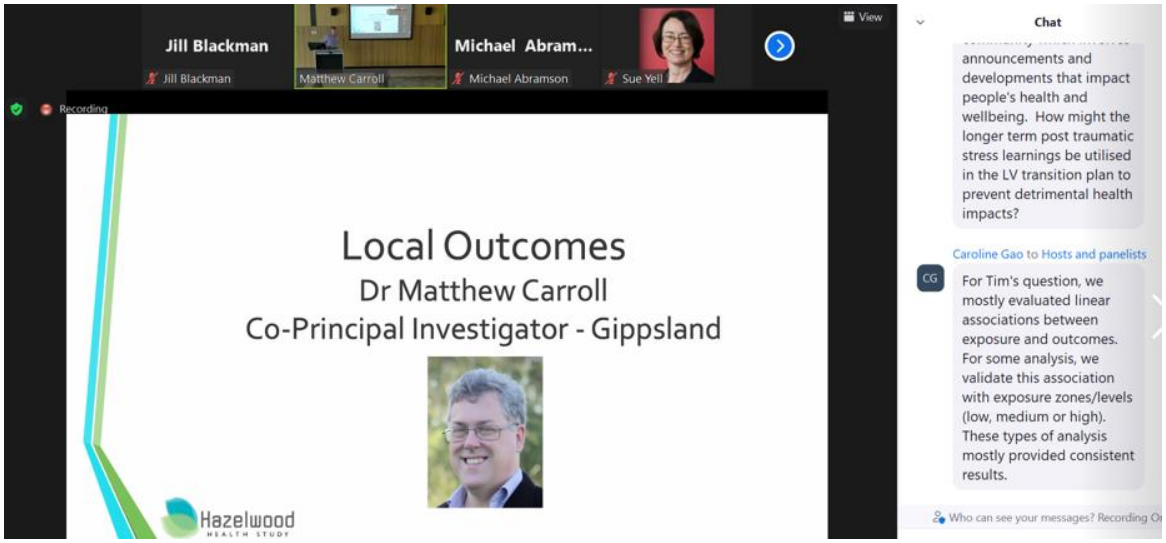
Flow mediated dilatation testing in the HHS Cardiovascular Stream clinic

7 Dissemination of findings and community engagement

The HHS employs a number of strategies in order to disseminate findings across a wide range of audiences and to maintain engagement with the local community. As part of this activity, we are looking at the possibility of placing key Hazelwood documents (such as our lay language Research Summaries) in relevant community locations. We are in discussion with our community partners (Latrobe Health Assembly, Latrobe Health Advocate, and GPHN) regarding the possibility of them having our materials on display, as well as their suggestions for other appropriate locations such as GP clinics, council offices, libraries and community centres.

As described in section 6, a number of scientific journal papers have been progressed toward publication and several abstracts have been submitted for presentation at scientific conferences. A Citations Master List (see Appendix 2) is maintained by the PMG and this provides scientific audiences with the citations for all HHS scientific publications.

The HHS website (www.hazelwoodhealthstudy.org.au) is regularly updated with Study Reports, Conference Proceedings and Publications. When appropriate, new findings are accompanied by a lay language Research Summary which is written with the local community audience in mind. In the last 12 months, five lay language Research Summaries (see Appendix 3) have been added to the Fact Sheets and Summaries page of the HHS website. The Research Streams section of the HHS website is routinely revised to reflect the up-to-date status for each Stream. In an effort to further develop engagement within the community, the HHS website has being populated with additional audio-visual resources, ranging from photographs of research activities, through to edited / segmented excerpts of our past Annual Community Briefing sessions.



Screenshot from the 8th Annual Community Briefing Zoom webinar

The Study's eighth Annual Community Briefing was held on the 18th October 2022. This was conducted in a hybrid format with audience members and presenters able to attend either in person at the Morwell Innovation Centre or via Zoom webinar. The Study's Stream Leads presented their recent findings, and their future plans, to an audience of approximately 22 people. The presentation slides are replicated in Appendix 4. The presentation was recorded and excerpts will be uploaded to the HHS website.

The HHS Outputs Directory (see Appendix 1) is maintained by the PMG. This lists all publicly available study outputs and how to access them, e.g. scientific journal papers, conference abstracts, technical reports, Research Summaries and exhibits. The Outputs Directory is regularly updated and posted to the HHS website.

An e-newsletter was prepared (see Appendix 5) as a further activity aimed at maintaining the Study's public profile, keeping the community updated on findings and maintaining contact with the participating cohorts. The e-newsletter was distributed by email to more than 2,100 subscribers in May 2022. Recipients include cohort participants, interested individuals and key stakeholders. The e-newsletter was also placed on the HHS website at https://hazelwoodhealthstudy.org.au/news-and-events/e-newsletters.

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:

- November 2021: Respiratory Stream clinical assessments in Sale. (Latrobe Valley Express and Gippsland Times).
- November 2021: Mental health-related ambulance, emergency department and hospital admissions. (Latrobe Valley Express).
- February 2022: HHS researcher, Dr Emily Berger, wins award for "Significant contribution to Rural and Remote Communities" Schools Study deidentified NAPLAN findings (Australian Psychological Society)
- February 2022: Coal fire exposure increases COPD risk (Healio.com).
- March 2022: Children caught in a crisis or traumatic event can be impacted for years to come. (ABC Radio: The Conversation Hour).
- October 2022: Following the Annual Community Briefing, HHS co-investigator Dr Matthew Carroll, was interviewed regarding recent HHS findings (TRFM Radio)
- November 2022: Increase in child visits to hospital emergency departments after the mine fire. (Latrobe Valley Express; ABC Gippsland)

The PMG are currently working with Wellmark (www.wellmark.com.au), an advertising agency specialising in healthcare, on a campaign designed to enhance the profile of the study findings across the local community. It is expected that the campaign will be rolled

out in 2023. The PMG are also proposing to present study findings to relevant community groups and health and social service agencies to maximise the dissemination and translation of study findings.

8 Appendices

Appendix 1

Hazelwood Health Study Outputs Directory Page 30

Appendix 2

Hazelwood Health Study Citations Master List Page 48

Appendix 3

Research Summaries released since November 2021 Page 59

Appendix 4

8th Annual Community Briefing slides Page 69

Appendix 5

HHS e-newsletter Page 86

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 Schools Study participants, linked NAPLAN data and CRIES measures. Academic paper: Berger at al "The Impact of a Mine Fire and Smoke Event on Academic Outcomes for Primary and Secondary School Students" in *Psychological Trauma: Theory, Research, Practice, and Policy*. Available by subscription at www.doi.org/10.1037/tra0001179. Pre-print freely available at https://psyarxiv.com/unms5/. Pre-print link provided on the HHS website at www.hazelwoodhealthstudy.org.au/study-findings/publications. 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. (2021) "Long term impact of coal mine fire smoke on lung mechanics in exposed adults" in Respirology. Available by subscription at https://onlinelibrary.wiley.com/doi/10.1111/resp.14102. 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. 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_LCO 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" published by the journal *Annals of the American Thoracic Society*. Available by subscription at www.atsjournals.org/doi/10.1513/AnnalsATS.202012-1544OC. Pre-print version freely available at https://doi.org/10.1101/2020.10.14.20213009. 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 published in *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 (2022) "The psychological impacts of a smoke event on young adults compared to other aged adults in Victoria, Australia". Published in the *Int Jnl Risk Reduction*. Freely available at www.doi.org/10.1016/j.ijdrr.2021.102727 Conference Proceeding: abstract accepted for presentation at the 4th International Childhood Trauma Conference held in Melbourne, Australia in August 2022. No Research Summary released with this publication.

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 (2021). Associations between respiratory and cardiovascular function in early childhood. Published by the journal *Respirology* and cited on the HHS website at www.hazelwoodhealthstudy.org.au/study-findings/publications. Available by subscription at https://doi.org/10.1111/resp.14117 or 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? Published in *Respirology* and cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. Available by subscription at https://doi.org/10.1111/resp.14113 or 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 *PLOS 1.* 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. Published by the *International Journal of Epidemiology* and available at https://doi.org/10.1093/ije/dyab249. 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". Published in *Vascular Health and Risk Management* and freely available at www.doi.org/10.2147/VHRM.S339439. Cited on the website at https://hazelwoodhealthstudy.org.au/study-findings/publications. 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'Donohue 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 (2022) "Impacts of coal mine fire-related $PM_{2.5}$ on the utilisation of ambulance and hospital services for mental health conditions" published in *Atmospheric Pollution Research.* Available by subscription at: https://doi.org/10.1016/j.apr.2022.101415. A free pre-print version of this paper (not externally peer reviewed) is available at https://psyarxiv.com/hgv7t/

		Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/2745873/Research-Summary_AdultPsych_HospitalAmbulance.pdf
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". Published by *Environmental Health Insights*. Freely available at https://journals.sagepub.com/doi/10.1177/11786302211059722. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. 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 (2022) "An exploration of the trajectory of psychological distress associated with exposure to smoke during the 2014 Hazelwood coal mine fire". Published by the *International Journal of Hygiene and Environmental Health*. Freely available until 16 April 2022 at https://authors.elsevier.com/c/1eel8574Px5z6b. Available by subscription at https://doi.org/10.1016/j.ijheh.2022.113946. 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
86. All	**Nov 2021**	7th Annual Report Report: "Hazelwood Health Study Annual Report 7" available at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0011/2834399/HHS-7th-Annual-Report-v1.0.pdf
87. Hazelinks	**Dec 2021**	A short commentary describing findings in regard to the association between $PM_{2.5}$ exposure and Emergency Department presentations linked to Adult Survey participants. Academic paper: Smith et al "Long-term impact of exposure to the 2014 Hazelwood coal mine fire on emergency department presentations in Australia". Accepted in Oct 2022 by *Environmental Research* subject to minor revisions. Awaiting publication. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/2881458/Linked-emergency-dept-presentations.pdf

88. Early Life Followup	**March 2022**	Based on the ELF Study's round 2 clinical data, this abstract describes the association between in-utero $PM_{2.5}$ exposure and lung mechanics 7 years later. Conference proceeding: Hemstock et al "Prenatal exposure to emissions from a coalmine fire and childhood lung function." Accepted for presentation at three conferences; the Centre for Air Pollution, Energy and Health Research Symposium in May 2022 (oral presentation); the International Society for Environmental Epidemiology Asia and Western Pacific Chapter & International Society for Exposure Science in Asia Chapter in June 2022 (poster); the 34th Annual Conference of the International Society for Environmental Epidemiology in September 2022 (poster). The poster is available on the HHS website at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0005/3078446/Poster_HemstockEtAl_2022_ELF-PrenatalPM-exposure_lung-function.pdf. Formal citations not yet available. Research Summary: NA
89. Early Life Followup	**March 2022**	An abstract describing the association between in-utero and infant $PM_{2.5}$ exposure and subsequent hospital emergency department presentations and admissions. Conference proceeding: Ziou et al "Early life exposure to coal smoke and hospital visitation: findings from a data linkage cohort study". Accepted and presented as a poster at the 2022 Annual conferences of the International Society for Environmental Epidemiology. Awaiting formal citation. The poster is available on the HHS website at https://www.monash.edu/hazelwood-health-study/study-findings/presentations?a=3076583 Research Summary: NA
90. Early Life Followup	**March 2022**	An abstract describing the association between in-utero and infant $PM_{2.5}$ exposure, and subsequent primary care medical service use and prescribed medications. Conference proceeding: Ziou et al "Prenatal and early postnatal exposure to air pollution associations with primary care and prescription usage". Accepted and presented as a poster at the 2022 Annual conferences of the International Society for Environmental Epidemiology. Awaiting formal citation. The poster is available on the HHS website at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0011/3076589/Poster_ZiouEtAl_ISEE2022_544_PM-exposure_Primary-care_prescriptions.pdf Research Summary: NA
91. Adult Psychological Impacts	**April 2022**	A paper describing explore the role of Hazelwood mine fire-related posttraumatic stress, and general psychological distress, in the presentation of physical symptoms such as pain, fatigue, shortness of breath and gastrointestinal problems experienced during the 2019-2020 Black Summer bushfires. Academic paper: Gao et al "Somatic symptoms, psychological distress and trauma in response to climate disasters: lessons from 2014 Hazelwood mine fire and 2019-20 Black Summer wildfires in Australia". Submitted for consideration by *BMC Public Health*. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/2997033/May-2022-Physical-symptoms.pdf
92. Early Life Followup	**July 2022**	A paper based on the ELF Study round 2 clinical assessments, describing the lack of an association between in utero exposure to mine fire smoke and lung function 7 years later. Academic paper: Hemstock et al (2022) "No association between in utero exposure to emissions from a coalmine fire and post-natal lung function." Submitted for consideration by *BMC Pulmonary Medicine.*

		Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0009/2999232/July-2022-Childhood-lung-function.pdf
93. Early Life Followup	**Sept 2022**	Abstract describing longitudinal analysis of ELF Study round 1 and 2 FOT and IMT data. Abstract: Hemstock et al (2023). The Health Impacts of Exposure to Air Pollution in Early Childhood. Submitted to the Annual Scientific Meeting for Leaders in Lung Health & Respiratory Science scheduled for 25-28th March 2023. Research Summary: NA
94. Early Life Followup	**Sept 2022**	Manuscript describing early life exposure to mine fire smoke and associated emergency department presentations and hospital admissions. Academic paper: Ziou et al (2022). "Exposure to severe smoke from the Hazelwood coal mine fire and ambient air pollution in early life and subsequent hospital visits: Findings from a data linkage cohort study." Submitted for consideration by *Environmental Health Perspectives*. Research Summary: to be uploaded on 14 November 2022 to the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/fact-sheets-and-summaries
95. Respiratory Stream	**Oct 2022**	Abstract describing adult Respiratory Stream round 1 clinic MBNW results. Abstract: "Increased conductive ventilation heterogeneity following exposure to coal-mine fire smoke." Submitted to the *Annual Scientific Meeting for Leaders in Lung Health & Respiratory Science* scheduled for 25-28th March 2023. Research Summary: NA
96. Respiratory Stream	**Nov 2022**	Abstract describing longitudinal change in lung function based on adult Respiratory Stream round 1 and round 2 clinics. Abstract: Holt et al (2023). "Change in Lung Function After Exposure to Smoke from a Mine Fire: A Clinical Follow-up" submitted to the *Annual Conference of the American Thoracic Society* scheduled for May 2023. Research Summary: NA

Hazelwood Health Study citations

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Hazelwood HEALTH STUDY

Hazelwood mine fire smoke exposure and hospital emergency department presentations in the following years **Research Summary**

February 2022

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 presented to a hospital emergency department in the years following the event, compared with people who were less exposed or not exposed.

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

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What we did

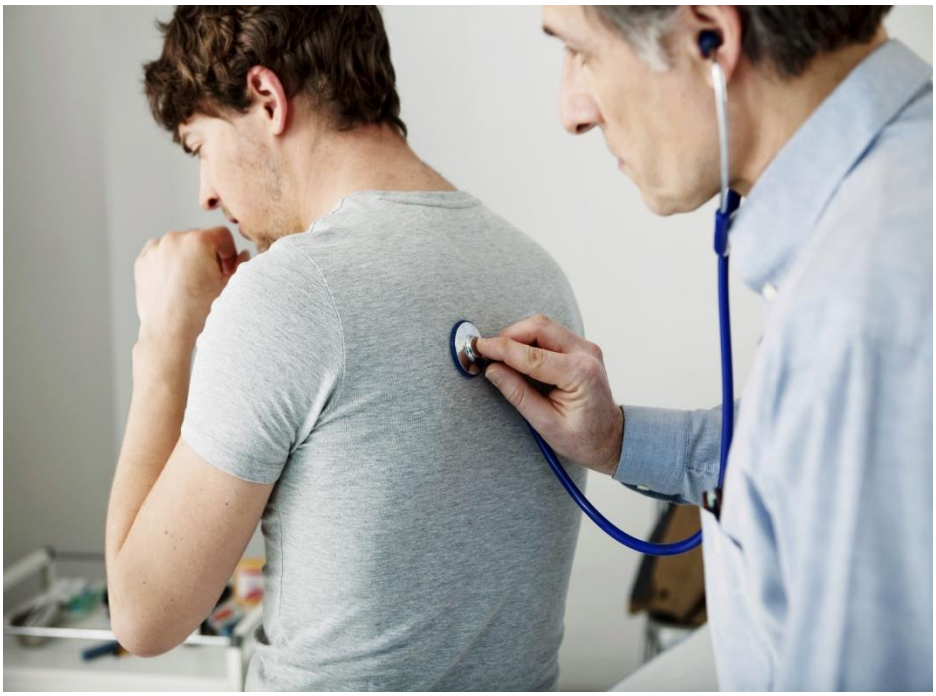
Approximately 2.5 years after the Hazelwood mine fire, 4,056 residents from Morwell (exposed to the mine fire smoke) and Sale (unexposed) participated in the HHS Adult Survey. Each participant filled in a time-location diary to show where they were on each day and night of the mine fire period. This 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 emergency department (ED) presentations data held by the Department of Health. For this analysis we looked at ED presentations from January 2009 to February 2019.

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

Hazelwood HEALTH STUDY

Considerations

The analysis used a number of statistical methods to account for other factors that might have influenced ED presentations, 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 ED presentations. 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.



What we found

We found that as the levels of exposure to smoke-related $PM_{2.5}$ increased, the likelihood of presenting to the ED with a respiratory-related (lung) condition increased during the following 5 years. The likelihood of presenting to the ED with a cardiovascular-related (heart) condition also increased during the first 2.5 years after the mine fire, particularly for ischaemic heart disease and atherothrombotic disease.

These findings could mean that the mine fire smoke impacted the lung- and heart-health of people for a prolonged period after the fire was put out.

Where to from here

These findings which used ED presentations data, will be looked at along side other findings which used hospital admission, ambulance, Medicare, pharmaceutical, cancer 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.

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

The research was funded by the Department of Health.

Hazelwood HEALTH STUDY

Research Summary

Physical symptoms, psychological distress and trauma in response to climate disasters

May 2022

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.

Analysis aims

The aim of this analysis was to explore the role of Hazelwood mine fire-related posttraumatic stress, and general psychological distress, in the presentation of physical symptoms such as pain, fatigue, shortness of breath and gastrointestinal problems experienced during the 2019-2020 Black Summer bushfires.

Considerations

Evaluation of the mental and physical health of a community that has been impacted by a previous traumatic event, at the time of experiencing a new and similar event, is somewhat novel in disaster research. This study contributes to a better understanding of the mental health implications of repeated exposures to disasters, which is particularly important given extreme weather events, including bushfires, are likely to become more common due to climate change.

There were some limitations to this research, including the use of self-reported health information which is not always accurate. Specifically, the somatic symptoms that were more commonly reported by survey respondents are largely non-specific, and can be experienced by the wider population. Also, the experiences of the 709 participants may not reflect the experiences of the rest of the community, and without a control group the strength of the link between the prevalence of self-reported symptoms and the subsequent event may not be an accurate representation.

What we did

Between December 2019 and early March 2020, 709 Morwell residents, who had previously participated in the 2016-2017 Adult Survey, completed a Mental Health and Wellbeing Follow-up Survey.

The follow-up survey coincided with the Black Summer bushfires which impacted south-eastern Australia. In both survey rounds, we measured posttraumatic stress currently experienced specifically in relation to the 2014 Hazelwood mine fire, and psychological distress experienced more generally. Then we looked at the association between posttraumatic stress, general distress, and self-reported physical symptoms (also known as somatic symptoms in the clinical literature) measured during the follow-up survey.

Hazelwood HEALTH STUDY

What we found

Just over one third (36%) of survey respondents reported a medium or high level of physical symptoms. The most frequently reported symptoms included fatigue, limb pain, trouble sleeping, back pain, headaches and shortness of breath. We found that higher levels of posttraumatic stress and general distress were each associated with the presence of most of the measured physical symptoms. That is, people who reported higher levels of mine fire-related posttraumatic stress, or higher levels of general distress, also reported more physical symptoms, or more severe physical symptoms, than people reporting lower levels of stress. These associations were independent of other risk factors that could also have influenced physical symptoms, such as age, smoking history and diagnosed medical conditions.

Healthcare providers and public health authorities should be aware of this high prevalence of physical symptoms observed in a climate disaster-exposed community during a later event, which is suggestive of a possible link between physical symptoms, trauma-related stress and general distress. The findings of this study highlight the importance of screening and monitoring for posttraumatic stress symptoms in communities impacted by climate disasters to ensure unmet care needs are identified and addressed. As pain was among the most frequently reported symptoms, this study has also highlighted the need for better funding and referral pathways to multidisciplinary pain management and care in fire impacted communities.

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

Meet the team

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Where to from here

The Hazelwood Health Study will conduct a future follow-up with the cohort to understand whether physical symptoms and posttraumatic stress persist. In addition, a collaboration between the HHS Psychological Impacts and Early Life Follow-up streams will explore parental mental health and family functioning following the mine fire.

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

Hazelwood HEALTH STUDY

Research Summary

Lung function in children whose mothers were exposed to mine fire smoke during pregnancy

July 2022

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 Latrobe Early Life Follow up (ELF) Study is the part of the Hazelwood Health Study that follows the health and growth of children who were younger than two years old when the fire occurred. This includes children whose mothers were pregnant with them at the time.

Analysis aims

Seven years after the mine fire, this research aimed to discover whether there were differences in the lung function of children whose mothers were exposed to mine fire smoke during pregnancy compared to unexposed children.

What we did

We invited children from the Early Life Follow-up stream who were exposed to mine fire smoke during pregnancy and children that were not exposed ('unexposed') to attend clinical testing. We did a simple lung function test on 79 children, known as the forced oscillation technique. It uses small vibrations to measure how easily air moves in and out of the lungs while the children were breathing through a tube. We measured resistance to air flow, and the stiffness of the lungs. We worked out how much smoke each child had been exposed to by looking at where the child's mother was each day during the fire and how polluted the air was in that area. When we analysed the data, we considered other factors that can affect lung function such as age, sex, height, and exposure to tobacco smoke.

Meet the team

Emily Hemstock
Rachel Foong
Graham Hall
Amanda Wheeler
Shyamali Dharmage
Marita Dalton
Grant Williamson
Caroline Gao
Michael Abramson
Fay Johnston
Graeme Zosky

Hazelwood HEALTH STUDY

What we found

We didn't find any difference in the lung function of children exposed to smoke during pregnancy compared to unexposed children. We also didn't find any differences in the lung function of children whose mothers were exposed to high levels of smoke during pregnancy compared to those whose mothers were exposed to lower levels of smoke.

A detailed paper describing the findings from this analysis can be requested from the study team by emailing contact@hazelwoodhealthstudy.org.au

Considerations

Lung function varies a lot between days and between children of different ages and genders. Although we did not find any evidence of changes to lung function resulting from the coal mine fire there are two plausible explanations. Firstly, the six-week extreme smoke exposure event may have been too short for any substantial changes to lung function to occur in children who were exposed during pregnancy. Secondly, there may have been short term changes in lung function that did occur, which disappeared before the seven-year follow-up test. It is also important to mention that the small number of participants may have limited our ability to see any differences if they did exist.

Where to from here?

Further studies are needed to confirm these results. Childhood is a rapid period of lung development and growth. Therefore, lung function should be evaluated at various time points to fully understand the health implications of mine fire smoke exposure during pregnancy.

The Latrobe ELF Study is led by the Menzies Institute for Medical Research at the University of Tasmania with collaborations from Melbourne University and the Telethon Kids Institute.

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

The research was funded by the Department of Health.

Hazelwood HEALTH STUDY

Research Summary

Factors shaping the pattern of distress after the 2014 Hazelwood mine fires

August 2022

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.

Analysis aims

The aims of this analysis were to assess the level of posttraumatic distress in the community after the Hazelwood mine fire, how distress levels have changed over time, and what factors might have influenced those changes.

What we did

Between December 2019 and early March 2020, 709 Morwell residents, who had previously participated in the 2016-2017 Adult Survey, completed a Mental Health and Wellbeing Follow-up Survey. In both survey rounds, we used a questionnaire called the Impact of Events Scale-Revised (IES-R) to measure the level of posttraumatic distress being experienced, at that time, in direct relation to the 2014 Hazelwood mine fire. We looked to see whether participants' distress had remained the same, become worse or improved over time; we called that the posttraumatic distress trajectory. Participants were then grouped into one of four posttraumatic distress trajectory categories:

- Resilience – a low level of distress at the time of both surveys
- In-recovery - distress that progressed from a high to low level across surveys
- Delayed-onset - distress that progressed from a low to high level across surveys
- Chronic – a high level of distress at the time of both surveys

We explored how each of these distress trajectories were related to participants' levels of smoke exposure during the mine fire, and to a variety of important personal and social circumstances such as medical history, social support, education, employment and experiences of other stressful life events.

Meet the team

Catherine Smith
Timothy Campbell
Caroline Gao
Tyler Lane
Darryl Maybery
Emily Berger
David Brown
Jillian Ikin
Alexander McFarlane
Michael Abramson
Matthew Carroll

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What we found

The most common distress trajectory was resilience (77% of participants), which was associated with higher levels of social support, paid employment, and education. Loneliness and low levels of social support were associated with chronic and delayed-onset distress trajectories. Adversities such as prior trauma, recent stressful life-events, and diagnosed physical or mental health conditions were also associated with chronic and delayed-onset distress trajectories. The amount of smoke that participants were exposed to during the mine fire was not a strong determinant of which distress trajectory they were on. These findings indicate that socioeconomic circumstances, connections with others, health, and life experiences were the most important factors shaping peoples' posttraumatic distress trajectories during the six years after the mine fire.

A detailed paper describing the findings from this analysis can be found at
hazelwoodhealthstudy.org.au

Considerations

There were some limitations to this research. Health information which is self-reported in surveys is not always accurate and the experiences of the 709 participants may not necessarily reflect the experiences of the rest of the community. Additionally, the second survey coincided with the 2019-20 Black Summer bushfires which caused smoky conditions in the Latrobe Valley. We were not able to directly assess what effects that event may have had on participants' distress trajectories related to the earlier mine fire.

Where to from here?

The Hazelwood Health Study will conduct a future follow-up survey to further monitor long-term posttraumatic distress outcomes after the mine fire, including how the Black Summer bushfires and ongoing COVID-19 pandemic may have impacted these outcomes.

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

The research was funded by the Department of Health.

Hazelwood HEALTH STUDY

Research Summary

Emergency department visits and hospital admissions among infants following exposure to smoke from the mine fire

November 2022

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.

The **Latrobe Early Life Follow up (ELF) Study** is the part of the Hazelwood Health Study that follows the health and growth of children who were younger than two years old when the fire occurred. This includes children whose mothers were pregnant with them at the time.

Analysis aims

We aimed to find out if exposure to smoke from the mine fire either during pregnancy, or during the first year of childhood, was associated with increased hospital presentations and admissions over a one-year period following the fire.

What we did

After getting ethical approval for this research, we obtained anonymous birth records for all babies born in the Latrobe Valley before, during and after the fire (born 1st March 2012 to 31st December 2015), who had been linked with records of presentations to the emergency department or admissions to hospital by the Victorian Data Linkage Unit. We used air pollution data provided by CSIRO and the residential address at the time of birth to estimate how much mine fire smoke the child or their pregnant mother was exposed to during the fire period.

We looked to see if different amounts of mine fire smoke exposure were associated with higher risks of emergency department visits or hospital admissions, for either any reason or for causes related to infections, allergies or respiratory conditions. For children whose mothers were exposed to smoke during pregnancy, we evaluated these outcomes in their first year of life. For children who were exposed to smoke during infancy, we evaluated them in the year following the fire. In our analysis we considered other factors that can affect health of children, such as infant sex, the mother's smoking status during pregnancy, and usual background levels of air pollution, to distinguish the specific influence of the smoke from the mine fire.

Meet the team

Fay Johnston
Graeme Zosky
Myriam Ziou
Amanda Wheeler
Nicola Stephens
Caroline Gao
Shyamali Dharmage
Luke Knibbs
Marita Dalton
Shannon Melody
Alison Venn

Hazelwood HEALTH STUDY

What we found

We found that children whose mothers were exposed to higher levels of mine fire smoke during pregnancy were more likely to present to the emergency department for allergies or skin rash than children whose mothers were exposed to lower levels or no smoke at all during pregnancy.

We also found that children exposed to the mine fire smoke during their first year of life were more likely to present to the emergency department for respiratory conditions and infections, compared to those not exposed. There were no other associations between exposure to smoke, by pregnant mothers or by children in their first year of life, and emergency department presentations. Also, no association was found between exposure to smoke and hospital admissions in any group of children.

A detailed paper describing the findings from this analysis can be requested from the study team by emailing contact@hazelwoodhealthstudy.org.au

Considerations

We calculated exposure based on the mother's home address. This means we may not have captured changes in smoke exposure that resulted from each family's movements within and outside of the Latrobe Valley during the fire. Also, this study could not determine contributing reasons for increases in emergency department visits following the fire. For example, an increase in presentations to an emergency department might reflect an increase in some health conditions following the fire, or it might reflect a heightened level of worry among parents in the year after the fire, leading them to be more likely to seek care for their children at an emergency department.

Where to from here?

These findings will be shared with relevant organisations and the scientific community to ensure they are used to shape services for the future health of the Latrobe Valley. Additionally, findings will help guide responses to severe smoke events in the future. We will also assess if exposure to smoke from the coal mine fire was associated with increases in other indicators of health care utilisation among this group of children in the year following the fire. These will include evaluation of attendances to general practitioners, and dispensations of prescriptions for medications that treat infections, allergies and asthma.

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

The research was funded by the Victorian Department of Health.

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2022 Annual Community Briefing

Virtual presentation, October 2022

Welcome and Introductions

Professor Michael Abramson
Principal Investigator

Hazelwood
HEALTH STUDY

Briefing outline

- Welcome and introductions
- Presentations from Hazelwood Health Study research streams
  - Early Life Follow-up Study
  - Respiratory Stream
  - Hazelinks
  - Community Wellbeing
  - Psychological Impacts
- Local impacts and community engagement
- Q+A session

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Early Life Follow-up (ELF) Study

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Recent Activities – Data analysis!

- Analysis of the 2021 clinical testing in Churchill (N=167)
- Analysis of the full linked dataset of children born in the Latrobe Valley between 2012 and 2016 (N=3,700)

What's it like to be in the ELF Study?

- https://drive.google.com/file/d/1r9UGd_PZ6K6VRnY_VhYFgx31N7rFNRdM/view

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Recent Findings

Clinic 2021 N=167 (2017 N=248)

- Mine fire smoke: No association with blood vessel or lung function

ELF Links N=3,600

- Mine fire smoke: association ED visits for **skin rashes,** and **prescriptions** for **oral steroid medication**
- Background (non-fire) air pollution in pregnancy: associated with **ED presentations** (all causes, infections), and **admissions for infections**.

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Recent Findings

Clinic 2021 N=167

- Mine fire smoke: no association with blood vessel or lung function

ELF Links N=3,600

- Mine fire smoke: associated with ED presentations for **respiratory conditions, respiratory-related infections and all infections,** and prescriptions for **antibiotics**.
- Background air pollution in infancy: **GP visits** and prescriptions for **antibiotics**.

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Future Plans

- More clinics in 2023!
- More data Linkage on the full Latrobe cohort

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Adult Respiratory Stream

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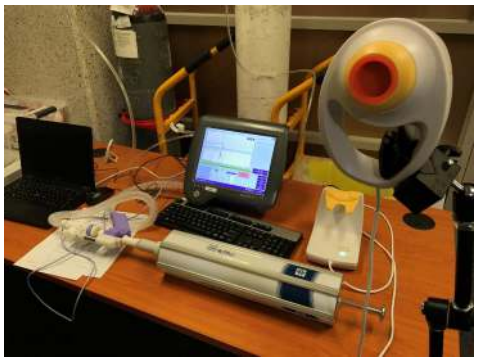
Recent activities

- Continued data analysis of the first round of clinical assessments (2017-18)
- Data analysis of Round 2 clinical data collection (2021) underway
- Data collection for Long Term Respiratory Study and Eating Survey underway currently 2022



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Round 2 Data collection

Preliminary Findings – Lung Function

Town	Round 1	Round 2
Morwell	346	217
Sale	173	112
total	519	329

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Round 2 Data collection

Preliminary Findings – Lung Function

In Round 1, exposure to increasing levels of mine fire smoke **was** associated with:

- less stretchy lungs
- higher prevalence of COPD-like lung function in non-smokers
- worse asthma control

In Round 2, preliminary analysis suggests exposure to increasing levels of mine fire smoke may no longer be associated with changes in lung function.

This suggests that there may be some recovery of lung changes seen in round 1.

These results need confirmation.

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Future plans

2022

- Complete analysis of the round 2 questionnaire data (respiratory symptoms)
- Commence planning for round 3 data collection in 2023

2023

- Recruitment and data collection for round 3 clinical testing

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Follow-up survey to answer longer-term respiratory questions

- Eight years later, do those exposed to the mine fire smoke have more respiratory problems?
- Has the Black Summer made respiratory problems worse?
- Were those exposed to mine fire smoke more likely to get COVID-19?
- Do good eating habits offer protection against respiratory problems?

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Current Status & Related Work

- Follow-up in field since mid-August
  - Approximately 600 people surveyed
  - Currently wrapping up
- Student-led review of air pollution and COVID-19
  - Strong evidence fine particulate matter increases risk of infection
  - Weaker evidence it increases severity of disease and mortality

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Hazelinks

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Recent Activities

2nd round of data extractions which involves requesting anonymised data (data that does not have names attached) for all ages, for a specific time period, for all of Victoria **are underway.**

Data	Time period of data request	Additional years of data
Ambulance attendances data	Jan 2009 ⟷ Dec 2021	approx. 6 years
Hospital data	Jan 2009 ⟷ June 2022	approx. 6 years
Cancer data	Jan 2009 ⟷ Dec 2020	approx. 5 years

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Recent Findings- since last update

Identified linkage uses participant information from the Adult Survey (name, date of birth, sex etc.) to link to health datasets.

Linked emergency department presentations data were analysed to investigate the association between mine fire-related $PM_{2.5}$ exposure and subsequent presentations to public hospital emergency departments (ED)

What period of emergency presentations data was used?

1 January 2009 to early 2019 (approx. 5 years of data after the fire)

Findings

The six-week exposure to coal mine fire related $PM_{2.5}$ was associated with:

- an increased risk of respiratory-related emergency department presentations over the following five years post the mine fire
- an increased risk of cardiovascular-related emergency department presentations in the first 2.5 years post-mine fire, which subsided after this time

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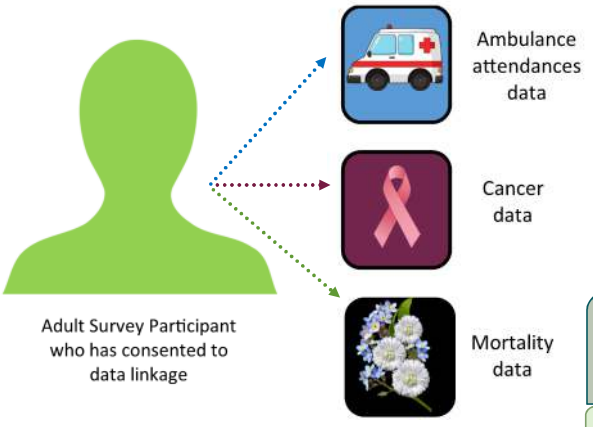
Future Plans

2nd round of data linkages



Up to 2,856 Adult Survey Participants

Up to 2208 in Morwell

Up to 646 in Sale

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Community Wellbeing Stream

Sue Yell (Stream Lead, Federation Uni)
Matthew Carroll (Monash SRH)
Michelle Duffy (Uni of Newcastle)
Damian Morgan (James Cook University)
Larissa Walker (RA, Federation Uni)



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Recent Activities

- Conducted 30 interviews with community members and stakeholders, asking about their perceptions of community wellbeing.
- Monitoring local media and social media groups to understand local issues.
- Analysing data on community wellbeing survey responses (from the Psych Stream's 2020 Mental Health and Wellbeing Follow-Up Survey).
- Developing a Community Wellbeing Barometer (based on objective indicators from public data sources).

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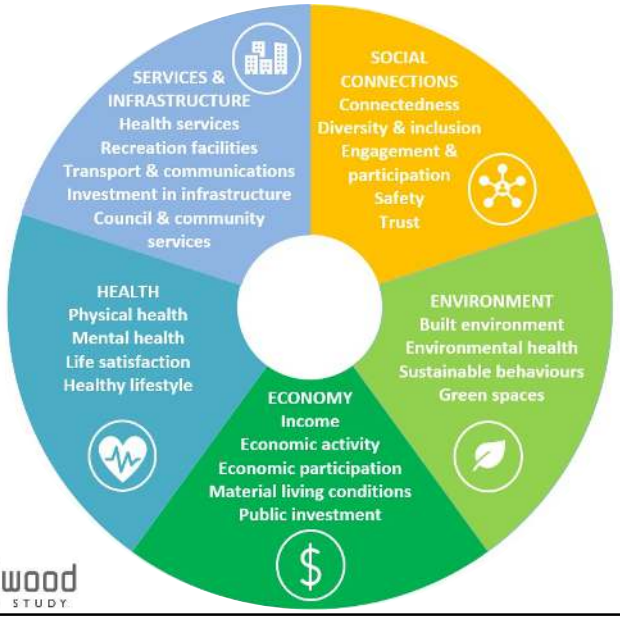
Community Wellbeing Barometer



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Future Plans

- Check the barometer and its data with key stakeholders.
- Conduct another round of interviews in early 2023, to see how community wellbeing is changing.
- Look at what all our data sources tell us about community resilience as well as vulnerability.
- Continue to focus on older people and to consider age in the analyses being undertaken by other streams.

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Psychological Impacts

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Recent Activities

- In collaboration with the ELF Stream, we have recently concluded surveying parents of participating children about mental health and wellbeing within the family
- We are also currently conducting the next round of the Mental Health and Wellbeing Follow-up Survey to investigate the longer-term wellbeing of adult HHS participants

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Recent Findings

Over the previous 12 months we have completed further analyses of data collected in the 2019-2020 Mental Health and Wellbeing Survey:

- A study of differing posttraumatic distress responses over time
- A study of associations between physical health concerns (somatic symptoms) and distress

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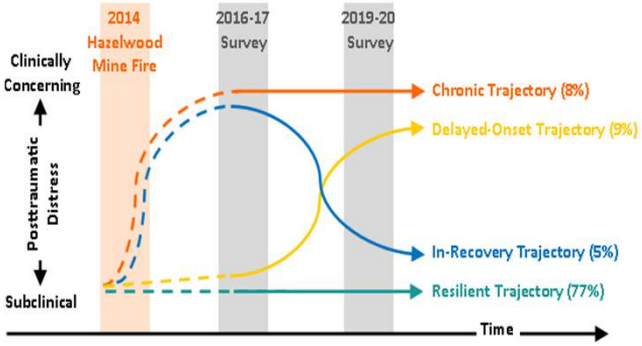
Longer-term posttraumatic distress responses after the Hazelwood mine fire

Resilience associated with:

- ↑ social support
- ↑ employment
- ↑ education
- ↑ socioeconomic advantage



Chronic and delayed-onset distress associated with:

- ↓ social support
- → prior trauma
- → recent stressful events
- → physical health diagnoses
- → mental health diagnoses
- → loneliness

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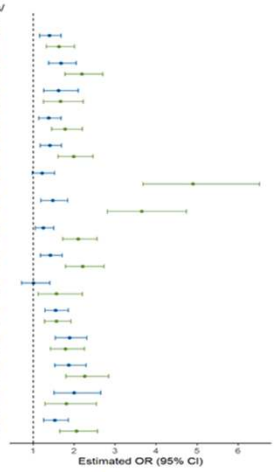
Associations between physical health symptoms & psychological distress after the mine fire

Outcomes	Not bothered	Bothered a little	Bothered a lot	Distress/ PTSD
Stomach pain	70.8%	22.3%	6.9%	IES-R K10
Shortness of breath	52.5%	30.3%	17.2%	IES-R K10
Pain sexual intercourse	87.3%	8.2%	4.5%	IES-R K10
Diarrhea/constipation	65.3%	22.6%	12.2%	IES-R K10
Indigestion	59.3%	27.8%	12.9%	IES-R K10
Fatigue	25.1%	41.8%	33.1%	IES-R K10
Trouble sleeping	38.9%	34.4%	26.7%	IES-R K10
Back pain	39.5%	41.5%	19.0%	IES-R K10
Pain in limbs	35.6%	36.2%	28.2%	IES-R K10
Menstrual problems*	87.1%	7.5%	5.4%	IES-R K10
Headaches	49.8%	32.9%	17.3%	IES-R K10
Chest pain	76.8%	17.5%	5.7%	IES-R K10
Dizzinesss	68.5%	24.0%	7.4%	IES-R K10
Fainting spells	92.3%	5.2%	2.6%	IES-R K10
Palpitations	67.9%	25.7%	6.5%	IES-R K10



- 36% reported a medium or high level of physical health symptoms
- higher mine fire-related posttraumatic stress associated with more prevalent and severe physical health symptoms
- higher general distress also associated with more prevalent and severe physical health symptoms
- these associations were independent of other factors that could also have influenced physical health symptoms

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Future Plans

- We are continuing work with the Community Wellbeing Stream to look at the link between individual wellbeing and community wellbeing
- We will soon begin work with the ELF Stream on analysing data collected in the Parent and Family Wellbeing Survey
- In 2023 we will also be conducting analyses and reporting on findings coming out of the third-round Mental Health and Wellbeing Follow-up Survey

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Local Outcomes

Dr Matthew Carroll

Co-Principal Investigator - Gippsland

Hazelwood HEALTH STUDY

Key Outcomes in the past year

- Continued reporting on **short-term impacts** like increased Emergency presentations for heart-related conditions in the 2.5 years after the mine fire, but not in the next 2.5 years.
- Increasingly reporting on **longer-term impacts**, such as the findings regarding the risk factors for ongoing distress and its association with physical symptoms.
- **Reassuring findings** from the adult respiratory and ELF clinical assessments suggesting that that some of the effects seen in 2017 may have resolved by 2021.
- New research underway providing information about the **general health of the community**:
  - Our long-term respiratory survey will light on the role of black summer, COVID-19 and eating patterns on respiratory health, which will have broader relevance
  - The information on eating patterns will also inform Latrobe Health Assembly activities on healthy eating.

Hazelwood HEALTH STUDY

Where next?

- We are in final stages of our 10-year research program, so we need to make sure that our findings are being used to improve the health and wellbeing of our local community.

- We have a few copies of research summaries available in the room here today and we are looking at placing copies in community locations.

- More importantly, we are keen to come out and talk to interested groups including community groups as well as health and community.
- As part of these discussions, we are starting to talk about where to next for the Hazelwood study, including building a proposal for possible further funding and connecting to other research areas.

- So email us at contact@hazelwoodhealthstudy.org.au if you have any suggestions

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Question & Answer Session

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Newsletter - May, 2022

In this edition

- Latest findings
- Recent data collection
- Upcoming data collection
- Chief Health Officer endorses years 8 to 10
- Researchers in the news

Latest findings

- Hazelwood mine fire smoke exposure and hospital emergency department presentations in the following years
- Hazelwood mine fire smoke exposure and hospital admissions in the following years
- Impacts of the Hazelwood mine fire on ambulance attendances, emergency department presentations and hospital patient admissions for mental health conditions
- Research on cancer, five years after the mine fire
- Evaluating the impact of the Hazelwood mine fire event on students' educational development
- Psychological health in adults six years after 2014 Hazelwood mine fire
- Risk of death in Morwell, the broader Latrobe Valley and surrounding smoke impacted areas during and after the Hazelwood mine fire

Recent data collection

In 2021, the **Community Wellbeing Stream** completed a round of interviews with community members and representatives from key organisations supporting the community. Thirty passionate people participated in the interviews, which covered their perceptions of community wellbeing, the factors that most impact community wellbeing, and the relationship between individual and community wellbeing. The data are currently being analysed. A further round of interviews is planned for 2023.

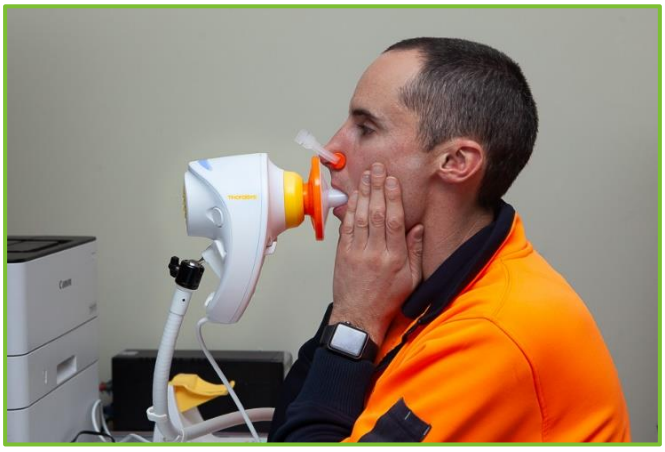
The **Early Life Follow-Up (ELF) Study** of children conducted its second round of clinical assessments between April and July 2021, after a 12 month delay due to COVID-19. Children who attended the clinic underwent a number of tests of their heart health, lung health and allergies.

These included ultrasound imaging of the stiffness of the large blood vessels in their neck. Also, the stretchiness of the lungs was measured using a test

called the Forced Oscillation Technique (FOT) and airway inflammation was measured using a test called Fractional Exhaled Nitric Oxide (FeNO).

Children also underwent a blood test for common allergies such as dust mite, grass and pet hair. The third and final round of clinical testing will take place in 2023. The ELF team would like to thank all participating families for their ongoing commitment to the study.

The adult **Respiratory Stream** also conducted its second round of clinical assessments between May and November 2021, again with a delayed start due to COVID-19. Clinics were conducted in both Morwell and Sale. Similar to the ELF assessments, the adults underwent FOT and FeNo testing and answered questionnaires regarding lung health, asthma symptoms and smoking history.



The Respiratory Stream would particularly like to thank the participants for their dedication and flexibility, particularly given that testing was halted on four separate occasions because of COVID-19 lockdowns, requiring many appointments to be rescheduled. A further round of respiratory assessments is planned for 2023.

Upcoming data collection

There is a lot of new data to be collected in 2022. The **Community Wellbeing Stream** will be tracking the ongoing wellbeing of the community through analysis of media and social media content, and through the development of a community wellbeing barometer which will bring together existing health and social datasets.

The **Psychological Impacts Stream** is collaborating with the **ELF Study** to assess parental mental health, family functioning and their associations with the mental health and development of children. **ELF Study** families can expect to receive this survey soon. The **Psychological Impacts Stream** will also be rolling out its second Mental Health and Wellbeing Followup Survey later in the year.

In 2022 the **Respiratory Stream** is collaborating with the **Adult Survey Stream** to undertake a followup survey of respiratory symptoms in participants from the 2016/2017 Adult Survey. That research aims to investigate the association between mine fire smoke and respiratory symptoms eight years later, but also any additive effect of smoke from the 2019/2020 Black Summer bushfires and COVID-19 diagnosis or symptoms. That survey also aims to investigate any protective effects of diet quality. If you participated in the 2016/2017 Adult Survey, you may receive an invitation to participate in this 2022 follow up respiratory health survey.

This year **Hazelinks** is preparing to receive large, anonymised and updated sets of cancer, ambulance and hospital data for Gippsland and beyond. These will be used to assess any change in the trajectory or pattern of cancer diagnosis in the region, and use of health services, since the mine fire. They may also provide information about the health impacts of other major events since the mine fire, such as the Black Summer fires and COVID-19.

Chief Health Officer endorses years 8-10 of the study

The Hazelwood Health Study's Project Management Group are very pleased to report that, upon review of our Study's progress in its first 7 years, the Victorian Government's Chief Health Officer has endorsed the continuation of our contract for years 8-10 of the Study. This takes us through to November 2024. The Study team remain dedicated to the task of answering all of their research questions about the long-term impact of the Hazelwood mine fire on the health and wellbeing of the local community.

Hazelwood Health Study researchers in the news

- Dr Emily Berger wins award for her "Significant Contribution to Rural and Remote Communities" (Australian Psychological Society)
- Fire sparked rise in anxiety (Latrobe Valley Express)
- Vaping side effects unclear (Herald Sun)
- Study uncovers poorer lung health (Latrobe Valley Express)
- Hazelwood coalmine fire has had lasting health effects on Latrobe valley residents (The Guardian)
- Hazelwood mine fire held back children's literacy, numeracy via lower NAPLAN results (ABC Gippsland)
- Smoke-impacted at risk of death by injury, study finds (Latrobe Valley Express)
- Hazelwood lessons are worth hearing as Australian children prepare for another summer (The Sector)
- Hazelwood fire ignited kids' fears (Herald Sun)

- Unborn children at higher risk of respiratory infections after Morwell fire, study finds (The Guardian)

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