Hazelwood Health Study

Annual Report 6

20 November 2020

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Contents

Abbreviations

CAC	Community Advisory Committee
COVID-19	Coronavirus Disease 2019
CRG	Clinical Reference Group
CWI	Community Wellbeing Index
DHHS	Victorian Government Department of Health and Human Services
ELF	Latrobe Early Life Follow Up Stream
GPHN	Gippsland Primary Health Network
HHS	Hazelwood Health Study
LHA	Latrobe Health Assembly
MAC	Ministerial Advisory Committee
MBS	Medicare Benefits Schedule
NAPLAN	National Assessment Program – Literacy and Numeracy
PBS	Pharmaceutical Benefits Scheme
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of 2.5 thousandths of a millimetre or less
PMG	Project Management Group
PSC	Project Steering Committee
SRG	Scientific Reference Group
T_Lco	Transfer factor of the lung for carbon monoxide

Document history

Version Number	Date Approved	Approved By	Brief Description
1.0	20 November 2020	Senior Project Manager	Submitted to DHHS

1 Executive Summary

This is the sixth Annual Report to be submitted to the Department of Health and Human Services as part of the milestones for the Hazelwood Health Study. This report provides a summary of progress made since the fifth Annual Report was submitted in November 2019.

In the past 12 months, the Hazelwood Health Study has undertaken substantial analyses and write-up of already-collected data, and has progressed a number of scientific papers toward publication, across all Streams. The adult Psychological Impacts Stream has completed data collection, and write-up of a comprehensive technical report, for its follow up survey. However, the Community Wellbeing, Early Life Follow-up and adult Respiratory Streams have delayed planned data collection due to restrictions related to the Coronavirus Disease 2019 (COVID-19) pandemic.

The Project Management Group's focus has been around adapting the Study's plans, and reviewing protocols, to minimise any adverse effects of COVID-19-related restrictions on Study progress. This has included ensuring that all staff are suitably resourced to work from home, prioritising already-collected data and reviewing timelines for new data collection. Professor Judi Walker took extended leave prior to her retirement from Monash in early November 2020. Dr Matthew Carroll filled in for Professor Walker during this leave period and has now been confirmed as Principal co-Investigator, Gippsland. Other Project Management Group activities have included evaluating the effect of the 2019/20 mega-fires on the Hazelwood Health Study activities, leading the Annual Retreat and Annual Community Briefing, monitoring and progressing the sharing of Study findings across the national and international scientific audience and developing an Outputs Directory and Citations Master List.

Since the previous Annual Report, the Latrobe Early Life Follow-Up (ELF) stream has progressed publications about vascular and lung function, respiratory and allergic conditions, health service and medication use, gestational diabetes, indoor air pollution and how movement within the Latrobe Valley during February and March 2014 affected air pollution exposure. Additional analyses are in progress involving hospital data, prescribed medication usage, and respiratory and cardiovascular links to air pollution. COVID-19 restrictions have led to the postponement of follow-up data collection that had been scheduled for 2020. Work has progressed on clinical protocols and risk assessment for 'COVID-safe' clinics, and a suitable venue has been identified for the conduct of the clinics in 2021.

The Psychological Impacts Stream has presented new findings to DHHS on student academic outcomes and the impacts of the mine fire on young adults. Recruitment and data collection for a large follow-up survey of Adult Survey participants has also been

completed. This has explored psychological distress, social support, community wellbeing and resilience among Morwell residents. The first report arising from this survey, focused on changes in psychological distress between the two survey rounds, has been submitted to DHHS for review. In addition, several journal papers have progressed toward publication. The Psychological Impacts and Community Wellbeing Streams are exploring the intersections of individual and community wellbeing in Morwell. The stream is also planning a study of parent-child-family wellbeing in collaboration with the ELF Stream. Further analyses of deidentified NAPLAN outcomes from schools across the region is underway, and a report on mental health service use data is in progress. The Stream also has a PhD and an M Psych student, and has supported fifth year Monash medical students undertaking Scholarly Intensive Placements.

The Community Wellbeing Stream has completed a comprehensive review of research on objective measures of community wellbeing relating to the development of a Community Wellbeing Barometer, and has developed the five key domains and associated themes for the barometer. The Stream received ethics approval in May for its next round of interviews, and those interviews with community members and stakeholders are commencing in late November. Data collection from media and social media will soon commence. Several publications are in preparation or in press, including a book chapter on rural older people, climate change and disasters, an editorial on older people and resilience and a journal article on best practice in disaster communication. New staff have joined the team: A/Prof Damian Morgan (to provide expertise in composite indicators for the proposed Community Wellbeing Barometer) and Dr Lynda McRae (as research assistant).

Sub-streams of the Adult Survey, including the Respiratory Stream, Cardiovascular Stream and Hazelinks (identified data component), continue to progress the release of a large number of findings. These have included manuscripts on the association between $PM_{2.5}$ and respiratory symptoms (published in IJERPH); asthma (in press J Asthma); markers of cardiovascular disease (to be submitted to IJERPH); hypertension and its management (published Aust J Rural Health); the Adult Survey Cohort methods (published Int J Epidemiol); diet quality and cardiometabolic risk factors (published Nutrients); lung mechanics (submitted to Thorax); chronic obstructive pulmonary disease (COPD; to be submitted to Thorax); ambulance attendances (submitted EHP) and the association between respiratory and psychological symptoms (recently approved by DHHS). Several abstracts have been accepted and published in conference proceedings. Further manuscripts in progress include vascular function, identified hospital data and e-cigarette use. A number of students are developing their skills through their involvement with these Hazelwood Health Study Streams, including two Monash Nutrition Studies students working with the Latrobe Health Assembly to run a series of nutrition workshops. Hazelinks

postponed analysis of linked cancer data in order to obtain a more current dataset from Cancer Council Victoria. The Respiratory Stream has delayed its follow-up round of data collection as a result of COVID-19 restrictions.

In February 2020, Hazelinks (deidentified data component) completed version 1.1 of the report describing analyses of deidentified mortality data for the period July 2009 to June 2015. This was publicly released on the HHS website and via local and national media outlets in October 2020. A manuscript based on the mortality report is under consideration by Environmental Research Letters. In March 2020, Hazelinks completed a revised technical report, and a manuscript, describing the association between $PM_{2.5}$ and deidentified ambulance attendances. That manuscript has been published in Environmental Research. Two additional manuscripts, one based on deidentified hospital data, the other on deidentified Medicare data, have been published in Chemosphere, and Int J Epidemiol, respectively.

The Exposure Assessment Stream has translated its 2016 technical report on modelled exposure to smoke from the mine fire, into a manuscript which has been published in the journal Atmospheric Environment.

Community engagement activities have included updating the HHS website (www.hazelwoodhealthstudy.org.au), preparing lay language Research Summaries, disseminating an e-newsletter to 2,176 subscribers and updating Respiratory stream participants about the postponement of the second round of clinical testing until next year. Due to the current COVID-19 restrictions, our Annual Community Briefing was held as an online Zoom webinar on 10 November 2020. A full recording of the session has been placed on the study website at https://hazelwoodhealthstudy.org.au/news-and-events/community-briefings. Hazelwood Health Study findings have been disseminated via a number of media outlets.

2 Introduction

This is the sixth Annual Report to be submitted to the Department of Health and Human Services (DHHS) as part of the milestones for the Hazelwood Health Study (HHS). This report includes a summary of progress made in the 12 months since the fifth Annual Report was submitted in November 2019. Copies of all Annual Reports can be found at http://hazelwoodhealthstudy.org.au/study-findings/study-reports/.

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

3 Previously completed contract milestones

Since commencement of the HHS in November 2014, and prior to the submission of this 6th Annual Report, 28 contractual milestones have been completed. Those milestones, with their delivery dates, are presented in Table 1.

Table 1 Contractual milestones completed prior to this 6th 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

4 The impact of COVID-19 on the Study

As a result of the 2020 COVID-19 pandemic, the Hazelwood Health Study has modified its work practices in accordance with Commonwealth Government and DHHS restrictions, and also in accordance with the guidelines of the researchers' respective Universities (eg. https://www.monash.edu/news/coronavirus-updates). By the end of March 2020, the majority of HHS staff and students were working from home, supported by resources such as Monash @ Home. Already proficient in the use of Zoom conferencing for routine Committee meetings, the HHS researchers have increased the use of this video-conferencing platform for daily collaboration, consultation and coordination of tasks. The three major Universities supporting HHS staff (Monash, University of Tasmania and Federation University) all provide remote encrypted connection to shared networks via a Virtual Private Network (VPN) such as Cisco AnyConnect Secure Mobility Client (https://www.cisco.com/c/en_au/products/security/anyconnect-secure-mobility-client/index.html). These allow the researchers to securely access their HHS work folders and to share confidential information.

The COVID-19 restrictions have impacted on the HHS Streams in different ways. The Hazelinks Stream has never relied on face-to-face data collection and therefore, this Stream's activities have continued unchanged. The Adult Survey, Psychological Impacts Schools Study and Cardiovascular Streams concluded face-to-face data collection prior to 2020. Therefore, those Streams have focussed on analyses and write-up of already-collected data, with no notable adverse effects of the COVID-19 restrictions on their progress. The adult Psychological Impacts Stream concluded a follow-up survey in early March 2020, immediately prior to COVID-19 becoming a major concern for the local community and prior to social distancing requirements

The Community Wellbeing Stream had planned to conduct face-to-face interviews, commencing September 2020. Those have been deferred to commence in late November 2020 and will be undertaken by Zoom in order to observe social distancing requirements. However, the COVID-19 restrictions have markedly delayed preparation for follow up data collection planned by both the Early Life Follow-up and adult Respiratory Streams. The Early Life Follow-up Stream intended to commence recruitment and in-clinic testing of young children in April 2020. The Respiratory Stream planned to commence recruitment and in-clinic testing of adults upon completion of Early Life Follow-up testing, in approximately September 2020. Both Streams intended to include spirometry (a common lung function test) among their assessments. The COVID-19 pandemic has resulted in a number of barriers to the commencement of in-clinic testing as planned by these two

Streams. A detailed risk assessment was undertaken and is attached to this Report in Appendix 1.

To summarise, the document incorporates:

- the recommendations of Australia's peak respiratory bodies, the Thoracic Society of Australia and New Zealand (TSANZ) and the Australia New Zealand Society of Respiratory Science (ANZSRS);
- the Australian Government Department of Health (DOH) and DHHS recommendations and restrictions;
- the Universities' health and safety duty of care to staff and students;
- the researchers' ethical responsibility to protect the health and safety of participants;
- the nature of COVID-19 transmission and level of risk likely to be associated with the existing in-clinic testing protocols;
- the involvement of vulnerable participants (and their carers) such as the very young, the elderly and participants with underlying medical conditions such as diabetes or asthma;
- the public's willingness to participate; and
- the reputational risk to the Study and the University.

This document will be reviewed in early 2021.

5 Project Governance

5.1 Project Management Group

The Project Management Group (PMG) has continued 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.

In February 2020 Principal co-Investigator (Gippsland) and PMG member Prof Judi Walker stepped aside from her HHS duties, announcing that she would be leaving Monash University at the end of the year and would be on extended leave until her departure. Prof Walker has been a key and critical contributor to the Study, instigating the School of Rural Health's role in the Study, leading the Gippsland based-activities, collaborating on the development of the tender and the study project plan, and championing governance, community engagement and dissemination protocols. Above all, she carried out her substantial responsibilities with a remarkable and unwavering *can-do* attitude. Fortunately,

Dr Matthew Carroll was the obvious successor to Prof Walker and he has stepped comfortably into the Principal co-Investigator (Gippsland) role, initially on an Acting basis until Prof Walker's formal retirement in early November 2020. Dr Carroll had worked very closely with Prof Walker since the Study's inception. He shares Prof Walker's intimate understanding of the Gippsland community, long history of rural health research and positive attitude. Dr Carroll is also the Psychological Impacts Stream lead.

As described in section 4 and Appendix 1, and in collaboration with the Project Steering Committee, the PMG has undertaken risk assessments and reviewed protocols in order to minimise any adverse effects of the COVID-19 pandemic on the Study. The PMG has prepared for disruptions to workflow, reviewing timelines for new data collection, prioritising the analysis of already-collected data, maximising staff retention and ensuring that all staff were suitably resourced to work from home.

A further major activity for the PMG in 2020 has been the creation of a Hazelwood Health Study Outputs Directory and a Citations Master List. Shown in Appendix 2, the Outputs Directory provides a list of all publicly available study outputs in approximate date-of-completion order. These include technical reports, scientific manuscripts, conference proceedings, videos, exhibits, lay language Research Summaries and Annual Reports which describe HHS findings and which are directly available to the public or available upon request. The Directory lists the relevant research Stream, approximate date of output, a brief description of the output, and URL links to where the items can be found. Where possible, comments are made that show which reports, papers, abstracts and Research Summaries belong together, describing the same data. The Outputs Directory has been updated on a regular basis and placed on the HHS website. Shown in Appendix 3 the Hazelwood Health Study Citations Master List comprises a bibliography of HHS scientific publications. These includes journal papers, conference proceedings and technical reports. These exclude Annual Reports and lay-language Research Summaries which would not typically be cited in other scientific publications. The Citations Master List has been updated on a regular basis.

In response to an enquiry from the Victorian Chief Health Officer, and in collaboration with the Project Steering Committee, the PMG has also assessed the potential impact of smoke, from the Southeast Australian mega-fires in December 2019 – February 2020, on the findings of the HHS. Our assessment is attached as Appendix 4.

Other PMG activities in the past 6 months include:

- ensuring all contractual obligations are met, and negotiating minor variations;
- participation in meetings with the DHHS Contract Committee, Ministerial Advisory Committee, HHS Community Advisory Committee, Scientific Reference Group,

Clinical Reference Group, the Latrobe Health Advocate, the Latrobe Health Assembly and the Gippsland Primary Health Network (GPHN);

- leading the HHS 2020 Annual Retreat;
- reviewing preliminary and final drafts of all reports, papers, abstracts, research summaries and newsletters arising from HHS research;
- facilitating the submission of all HHS findings to DHHS for approval;
- overseeing the public release of HHS findings via the HHS website, media and other internet sites;
- negotiating with DHHS in regard to an agreement that allows the study to share HHS Community Wellbeing Index data with relevant third parties (with the consent of participants) for the purpose of the development of population norms;
- monitoring monthly budget reports, adjusting planned expenditure accordingly;
- planning a revised format for the annual community briefing; and
- preparation and oversight of sub-contracts with collaborators.

5.2 Community Advisory Committee and Clinical Reference Group

On 11 December 2019 there was a joint meeting of the Community Advisory Committee (CAC) and the Clinical Reference Group (CRG). The meeting included a presentation of findings in regards to mortality, community perceptions of the effectiveness of community rebuilding activities, psychological distress and chronic obstructive pulmonary disease.

The main subject of discussion was around options to restructure the governance of the HHS. It was noted that both the CRG and CAC were initiatives of the HHS at the time of tendering for the study. Neither committee had been mandated by DHHS in their invitation to tender. It was also noted that dwindling Committee memberships were limiting the Study's engagement with the local GPs and primary health practitioners and with the community. An alternative model to the CRG was proposed, involving tapping into the pre-existing Gippsland Primary Health Network clinical councils. It was agreed that the HHS and GPHN would develop a memorandum of understanding (MOU) to formalise the agreement. An alternative model to the CAC was also proposed, involving folding the function and purpose of the CAC into the activities of the Latrobe Health Assembly (LHA).

Due to COVID-19 restrictions, no face-to-face meetings have been held in 2020. Members of the CAC and CRG were sent a joint email in May 2020, providing them with an update on study progress. This included information about COVID-19-related changes to our 2020 work plan, as well as an update on the discussions with the GPHN and LHA regarding taking on the clinical and community inputs into the study.

On the basis of positive discussions with the GPHN, it was agreed that the CRG would be disbanded. Members were thanked for their important and ongoing contribution to the study. An MOU is now in place with the GPHN regarding the HHS being a standing item on the meeting agenda for their Latrobe Baw Baw Subregional Clinical Council. The group meets three times a year in February, May and August, followed by a joint meeting with the two other Subregional Clinical Councils in November. This will provide a regular opportunity for the study to brief members on HHS findings and seek input on clinical matters.

Discussions with the LHA regarding taking over from the CAC have also progressed well. A brief proposal was put to the LHA board, which agreed in principle to act as the vehicle for community input into the study. In discussions with the LHA Chair and Executive Officer, it was agreed that a working group be established, involving existing CAC members and LHA members, to determine the best model going forwards. This could include HHS team members meeting regularly with the LHA to provide updates and seek input, as well as the LHA convening meetings with members and key stakeholders to consider local responses to key HHS findings.

A CAC meeting took place on 30 September 2020 via Zoom. In addition to the usual study update, the meeting provided the opportunity to seek advice from members on the release of the Hazelinks Mortality Report, including the wording of the accompanying Question and Answer (Q & A) document and lay language research Summary. Members were also updated on the discussions with the LHA, with two members subsequently volunteering to join the working group with LHA and HHS team members to determine the most appropriate approach for the LHA to facilitate community input into the study.

Once an appropriate model for working with the LHA has been determined, it is expected that the CAC will also be disbanded. It is anticipated that these new models of engagement with the GPHN and LHA will both broaden the Study's engagement with the clinical and general community and also reduce the resources that have been required by the Study to run our own Committees.

5.3 Scientific Reference Group

Respiratory Scientist Michael Keating has retired from clinical practice and has stepped down from the Scientific Reference Group (SRG). Mr Danny Brazzale, Senior Scientist Respiratory Laboratory, Austin Hospital, has joined the SRG. Dr Matthew Carroll has also joined the SRG in his capacity as (then) Acting Principal co-Investigator (Gippsland).

Two face-to-face meetings of the Scientific Reference Group (SRG) has been held since the 5th Annual Report. Brief details are as follows:

26 November 2019

At the 26 November 2019 meeting, the SRG discussed some proposed changes to the governance of the HHS, including the alternative models for the CAC and CRG as referred to in section 5.2 above. There was also discussion about the requirement that an SRG member review all Study findings. A priority at this meeting was the review of the preliminary Hazelinks Mortality Data Technical Report findings. A number of the SRG's suggestions and questions were subsequently addressed in the revised report.

21 October 2020

At the 21 October 2020 meeting, the SRG again reviewed the findings of the final Hazelinks Mortality Data Technical Report. SRG members agreed that it was important to get an understanding of the excess deaths due to injury during the mine fire event, so that the Study can provide recommendations to DHHS and practical learnings can be applied in future similar smoke events.

The SRG reviewed the ELF Stream findings in relation to General practitioner visits and medication use amongst young children exposed to the mine fire smoke and self-reported symptoms recorded by participating families in the monthly symptom diaries. Members explored possible mechanisms for the particulate matter entering the human body and what the findings meant for managing the public health response to smoke events.

The SRG also reviewed the Respiratory Stream findings in relation to the impact of coal mine fire smoke on lung health using FOT, and chronic obstruction of lung airflow in adults. SRG members noted that these findings are of public health significance. Study researchers will work with the LHA and Gippsland Primary Health Network to disseminate these findings to health practitioners working in Gippsland. The SRG also discussed recent Psychological Impacts, Hazelinks and Community Wellbeing Stream findings.

Out of session

Out of session, a number of individual SRG members have been consulted in regard to the review of study findings for which they have particular expertise. For example, Prof Wolfe has provided statistical oversight to the analyses of mortality, ambulance and NAPLAN data. Prof Wolfe also reviewed the Psychological Impacts Stream "2019-2020 Mental Health and Wellbeing Follow-up report." Assoc Prof Kippen reviewed the Hazelinks report "Mortality data: Time series analyses for the period July 2009 to June 2015" and the Psychological Impacts Stream paper "The psychological impact and experiences of children following the Hazelwood mine fire and subsequent smoke event." Prof McFarlane reviewed the Psychological Impacts Stream paper "The Impact of a Mine Fire and Smoke Event on Academic Outcomes for Primary and Secondary School Students." Prof Zosky reviewed the ELF paper "Parent-reported indicators of respiratory and atopic conditions in young children two to four years after the Hazelwood Coal Mine Fire." Prof Attia reviewed the Cardiovascular Stream paper "Vascular responses among adults exposed to smoke from Hazelwood coal mine fire."

5.4 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. With only a few exceptions, the PSC was meeting monthly until September 2019. The meeting frequency has since been extended to once every two months. During this 6th year of the study there has been six formal meetings of the PSC plus numerous out-of-session consultations and contributions to reports and strategic decisions.

Key discussion items have included:

- proposed changes to the HHS governance structure;
- appropriate avenues of engagement with the Latrobe Health Assembly, Latrobe Health Innovation Zone, Latrobe Health Advocate, Latrobe Regional Hospital and the Gippsland Primary Health Network;
- Study Stream progress;
- contingency planning around staff leave;
- review of all proposals for analysis and write up of HHS findings;
- review of budgetary constraints and cost-effective solutions;
- progress of recruitment for the HHS Adult Survey Adult Psychological follow-up survey;
- impact of the potential effects of smoke from the Southeast Australian mega-fires in December 2019 – February 2020 on the findings of the HHS;

- assessment of risk associated with the HHS clinical testing during the COVID-19 pandemic; and
- postponement of the ELF Stream and Respiratory Stream Round 2 Clinical Testing due to COVID restrictions.

6 Stream coordination retreat

The Study's sixth Stream coordination retreat was hosted by Monash University's School of Rural Health, at the Federation University Australia Gippsland campus, on 25 February 2020. The retreat involved members of all HHS research Streams, overarching project staff and PhD students. Guest participants included Professor John Catford, outgoing Chair, LHA, and Ms Tanya Rong, then Acting Executive Officer and later incoming Chair, LHA.

Key activities included:

- Review of findings to date, outputs, current status and 2020/2021 study plan for each HHS Stream;
- Identifying potential research collaborations for progressing HHS research funding opportunities.

7 Research updates

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

In the last year the ELF Study has completed a technical report and progressed a number of scientific manuscripts and conference abstracts toward publication.

Manuscripts

- Zhao B, Johnston FH, O'Sullivan T, Williamson GJ, Melody S, Dalton M, et al. (2019) Early life exposure to coal mine fire and tobacco smoke affect subclinical vascular function. Published December 2019 in the Archives of Disease in Childhood. DOI: 10.1136/archdischild-2019-317528. https://adc.bmj.com/content/archdischild/early/2019/12/20/archdischild-2019-317528.full.pdf.
- Shao J, Zosky GR, Wheeler AJ, Dharmage S, Dalton M, Williamson GJ, et al. (2020) Exposure to air pollution during the first 1000 days of life and subsequent health service and medication usage in children. Published January 2020 in

Environmental Pollution; 256:113340; DOI: 10.1016/j.envpol.2019.113340. https://www.ncbi.nlm.nih.gov/pubmed/31662257.

- Shao J, Zosky GR, Hall GL, Wheeler AJ, Dharmage S, Melody S, et al. (2020) Early life exposure to coal mine fire smoke emissions and altered lung function in young children. Published February 2020 in Respirology; DOI: 10.1111/resp.13617. https://onlinelibrary.wiley.com/doi/abs/10.1111/resp.13617
- Melody SM, Ford JB, Wills K, Venn A, Johnston FH. (2020) Maternal exposure to fine particulate matter from a large coal mine fire is associated with gestational diabetes mellitus: A prospective cohort study. Published April 2020 in Environmental Research; https://doi.org/10.1016/j.envres.2019.108956.
- Willis GA, Chappell K, Williams S, Melody SM, Wheeler AJ, Dalton M, et al. (2020) Parent-reported indicators of respiratory and atopic conditions in young children two to four years after the Hazelwood Coal Mine Fire. Published September 2020 in the Medical Journal of Australia; https://doi.org/https://doi.org/10.5694/mja2.50719
- Melody S, Wheeler A, Dalton M, Williamson G, Negishi K, Willis G et al (2020). Cohort Profile: The Hazelwood Health Study Latrobe Early Life Follow-Up (ELF) Study. Published October 2020 in the Int Journal of Epidemiology; https://doi.org/10.1093/ije/dyaa136.

Abstracts

Two abstracts prepared by Dr Shannon Melody, in regard to birth outcomes and maternal gestational diabetes, were submitted to the 2020 World Congress of Epidemiology. This conference has now been postponed until September 2021.

Report

Chappell K, Melody S, Wheeler A, Dalton M, O'Sullivan T, Williamson G, Johnston F (2020). Volume 5: A description of sources of air pollution inside and outside the home environments of children in the Latrobe ELF Cohort. To be submitted to DHHS November 2020.

Additional analyses in progress include emergency department and hospital admissions (from anonymised data linkage), prescribed medication usage (from anonymised data linkage) and links between respiratory and cardiovascular function in ELF study participants and their exposure to air pollution.

In November 2019 the ELF Stream hosted a “Thank You Party” for participating families at Tribes Playcentre, Morwell.

The ELF Study was to commence its second round of follow-up clinical data collection in April 2020. In preparation, a training session and pilot clinic was held in Hobart in March with volunteer participants. The restrictions resulting from the COVID-19 pandemic have meant that the clinical data collection has been postponed, and will hopefully commence in early 2021. Work has continued on clinical protocols and risk assessment for 'COVID-safe' clinics, and a suitable venue has been identified for the conduct of clinics.

Although skin prick testing was being considered as a measure of atopy in the next round of data collection, this has now been replaced by measurement of total IgE and Allergen-Specific IgE from a blood sample.

7.2 Psychological Impacts

In the last year the Psychological Impacts Stream has progressed a technical report and a number of manuscripts toward publication, as follows:

Report

- Carroll M, Campbell T, Gao CX, Smith C et al. (2020). 2019-2020 Mental Health and Wellbeing Follow-up Survey: Technical Report. Submitted to the DHHS on 19 November. Once approved, the report will be placed on the Hazelwood website along with an associated Research Summary.

Manuscripts

- Berger E, Gao CX, Broder JC, Campbell TCH, Maybery D, and Carroll M. The impact of a mine fire and smoke event on academic outcomes for primary and secondary school students. Approved by DHHS in April 2020. This manuscript has been revised based on external peer review and will be submitted to a new journal shortly. A preprint version of the paper has been placed on PsyArXiv Preprints at https://psyarxiv.com/unms5/. The associated Research Summary was made available on the HHS website in June 2020.
- Berger E, Maybery D, Carroll M. (2020). Children's Perspectives on the Impact of the Hazelwood Mine Fire and Subsequent Smoke Event. Child & Youth Care Forum. This paper is accessible to journal subscribers at https://doi.org/10.1007/s10566-020-09551-8. A preprint version of the paper has

been placed on PsyArXiv Preprints at https://psyarxiv.com/8mhxf/ and the associated Research Summary is on the HHS website.

- Maybery D, Jones R, Dipnall JF, Berger E, Campbell TCH, McFarlane A, 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. Anxiety, Stress, & Coping; 33(2):216-30. This paper is accessible to journal subscribers https://doi.org/10.1080/10615806.2019.1695523. A preprint version of the paper has been placed on PsyArXiv Preprints at https://psyarxiv.com/euj96/ and the associated Research Summary is on the HHS website.
- Broder JC, Gao CX, Campbell TCH, Berger E, Maybery D, McFarlane A, et al. (2020). The factors associated with distress following exposure to smoke from an extended coal mine fire. Environmental Pollution, 266 (pt. 2), 115131. This paper is accessible to journal subscribers at https://doi.org/10.1016/j.envpol.2020.115131. A preprint version of the paper has been placed on PsyArXiv Preprints at https://psyarxiv.com/a82fm and the associated Research Summary is on the HHS website.
- Maybery D, Carroll, M, Berger, E, Dipnall, J, Lee, S. The psychological impact and experiences of children following the Hazelwood mine fire and subsequent smoke event. The manuscript has been submitted and rejected by a journal in 2020, and is currently being prepared for further submission. A Preprint version is available at https://psyarxiv.com/rw657 and the associated Research Summary is on the HHS website.

Between December 2019 to March 2020, the Psychological Impacts Stream resurveyed a sample of Adult Survey participants to assess ongoing mental wellbeing. This Mental Health and Wellbeing Follow up Survey was completed by 713 people who were resident in Morwell at the time of the mine fire. The follow-up survey repeated core psychological measures from the original Adult Survey and introduced new measures to investigate resilience, social support and isolation, and community wellbeing. A technical report on the initial analysis investigating changes in event-related psychological distress (scoring on the Impact of Event-Revised scale) and generalised psychological distress (scoring on the Kessler 10-item Distress scale) since the 2017 Adult Survey has been completed. A series of further analyses of the data are planned, including consideration of newly included measures of community wellbeing, resilience, recent adverse life-events, social support and loneliness. It is anticipated that further findings from the survey will be released in 2021.

The Psychological Impacts Stream has been collaborating with the Community Wellbeing Stream to look at the relationship between individual wellbeing and community wellbeing in

the Morwell. This research is being approached in two ways: measures of current community wellbeing, and change in community wellbeing since the mine fire, were included in the follow-up survey recently conducted; questions relating to individual wellbeing will be included in interviews being conducted by the Community Wellbeing stream later in 2020. In a collaboration with the ELF Stream, a survey is being developed to explore parents' mental health, their child's emotional development, and family functioning. It had been anticipated that this survey would be conducted towards the end of 2020, but has been deferred due to restrictions associated with the COVID-19 pandemic impacting on the timeline for the ELF Stream's program of research (as reported in 7.1 above). This collaborative work is now likely to be conducted in 2021.

Additionally, the Psychological Impacts Stream is progressing an analysis of NAPLAN outcomes utilising de-identified data for the wider region. The team are also finalising a report on patterns of mental health service use in the Latrobe Valley region over the time of the mine fire event, based on Hazelinks' MBS and PBS data.

The stream continues to foster capacity building and skills development by supporting students. A PhD student is progressing her work looking at the impact of the Hazelwood event on younger adults living and working in the impacted region. A Masters of Educational and Developmental Psychology student has conducted an analysis of the recent follow-up survey data to explore the impact of prior mental health diagnoses on the development of longer-term psychological distress in response to the Hazelwood event. We have also supported four fifth-year Monash Medical students to complete Scholarly Intensive Placements in 2020; two who looked at ways to disseminate study findings more broadly via brochures and video vignettes, and two others (co-supervised with HHS Principal Investigator Michael Abramson) participated in a systematic review of air pollution and mental health.

7.3 Impact on Community Wellbeing

In Years 6 and 7 the stream's research aims are to:

- Continue to assess **perceptions of the community's wellbeing and recovery** after the Hazelwood mine fire, taking into account 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).

Assoc. Prof. Damian Morgan has joined the team to provide his expertise on the development and use of objective composite indicators to measure resilience and wellbeing. Dr Lynda McRae has been appointed as Research Assistant.

A review of the scholarly literature on using objective measures to assess and document changes in community wellbeing has been completed. Considerable work has been done researching and applying composite measures of personal wellbeing in Italy, Spain, the US, Japan and New Zealand. This work will be used to inform the design of the proposed community wellbeing barometer. Based on this review, our team has identified five domains which will be the focus of the barometer: health; the economy; the environment; services and infrastructure; and social connection. For each domain, we have also identified 4-6 themes, each of which will be measured through a selection of objective indicators.

Considerable interest in the barometer was expressed by community members at the recent annual Hazelwood Health Study Annual Community Briefing, held on 10th November, with some attendees contacting us for further conversations after the briefing. Dr Sue Yell, A/Prof Damian Morgan and Dr Lynda McRae also had a productive meeting with Latrobe City Council on 12th November where we shared our plans regarding the barometer.

The next step will be to consult a range of community stakeholders and community members, to ensure the validity of the domains and themes as potential indicators of changes in wellbeing within this particular regional community.

The Stream has received final approval from Federation University's Human Research Ethics Committee for Years 6 and 7 data collection. The interviews with stakeholders and community members will commence in mid-November (originally planned to commence at the end of July, but delayed due to COVID-19 and the time needed to develop the initial stage of the barometer design). In addition to questions on the barometer, the interviews will include questions addressing the first, and third, of the research aims listed above. Our ethics approval is for telephone/videoconference interviews only at this point, due to

COVID-19 precautions, therefore we will be conducting these via Zoom, at least until the end of 2020. This will be reviewed in the new year.

As in Years 1-5, data will also be collected from media and social media, to contribute to analysing the subjective aspects of community wellbeing. Media and social media data collection will commence in late 2020.

The Stream is collaborating with the Psychological Impacts Stream to look at the intersection between individual and community wellbeing. The Community Wellbeing Index (CWI) 10-item measure of current community wellbeing, along with a modified version assessing change in community wellbeing since the Hazelwood event, was included in the Psychological Impacts Stream's Mental Health and Wellbeing Follow up Survey conducted earlier this year. The CWI data will be jointly analysed by both streams, to provide insights into changes to community wellbeing and the relationship between community wellbeing and individual wellbeing.

Susan Yell has co-authored a book chapter on social media's role in regional transition:

- Smith, N. and Yell. S (2019) "The dynamics of place-based virtual communities: Social media in a region in transition", in M. Duffy, A. Campbell and B. Edmondson (eds), *Located Research: Regional places, transitions and challenges*, Palgrave Macmillan.

This publication draws on the social media findings which have previously been presented in the Community Wellbeing Report Volume 1 at: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0018/2052540/CW-Report-Volume-1_v2.0.pdf). No new findings have been presented.

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

- Carroll, M. and Walker, J. (in press) "Rural older people, climate change and disasters", in M. Skinner, R. Winterton and K. Walsh, eds (in press), *Rural Gerontology: Towards Critical Perspectives on Rural Ageing*, Routledge: London (ISBN 9780367894795 – scheduled for publication in December with a 2021 publication year).
- Carroll, M. (in press). Invited editorial - The vulnerability and resilience of older people in rural/regional areas in times of climate, environmental, and global health challenges. *Australasian Journal on Ageing* - accepted 22 September 2020 and expected to be published later in 2020.

This continuing focus on older people has informed the analyses undertaken by other research streams, particularly the Psychological Impacts Stream. In both the Broder *et al.* (2020) analysis of Adult Survey data, and the technical report on the 2019-2020 Mental Health and Wellbeing Follow-up Survey, the analyses found that older people reported lower distress levels in response to the Hazelwood event than younger age groups, after controlling for chronic health and other factors.

The Community Wellbeing team is also working on a journal article on optimal communication during a complex disaster with health impacts, which is drawing on the findings from the Older Persons Policy Review and the Community Wellbeing Stream.

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

The Respiratory Stream, Cardiovascular Stream, and Hazelinks identified data analyses, are all based upon the Adult Survey Cohort. Combined, these data have been used in a number of analyses culminating in four abstracts and numerous scientific manuscripts which have been progressed towards publication in the last year as follows:

Manuscripts

- Johnson, A. L., Gao, C. X., Dennekamp, M., Williamson, G. J., Brown, D., Carroll, M. T. C., Ikin, J. F., Del Monaco, A., Abramson, M. J., & Guo, Y. Associations between Respiratory Health Outcomes and Coal Mine Fire $PM_{2.5}$ Smoke Exposure: A Cross-Sectional Study. Published November 2019 in the International Journal of Environmental Research and Public Health; 16(21), 4262; https://doi.org/doi:10.3390/ijerph16214262
- Taylor S, Borg B, Gao CX, Brown D, Hoy R, Makar A, et al. (2020) The impact of the Hazelwood coal mine fire smoke exposure on asthma. Accepted by the Journal of Asthma in July 2020. Proofs received and returned November 2020. Pre-print available at https://doi.org/10.1101/631317.
- Betts JM, Dewar EM, Stub DA, Gao CX, Brown D, Ikin JF, et al. (2020) Markers of cardiovascular disease among adults exposed to smoke from the Hazelwood coal mine fire. Rejected by Heart, Lung and Circulation. Currently under revision with the intention of submitting to the International Journal of Environmental Research.

- Betts JM, Gao CX, Brown D, Ikin JF, Maniam R, Stub DA, et al. (2020) Factors associated with hypertension and its management among older rural Australians. Published May 2020 in the Australian Journal of Rural Health; https://doi.org/https://doi.org/10.1111/ajr.12634.
- Ikin JF, Carroll M, Walker J, Borg B, Brown D, Cope M, et al. (2020) Cohort Profile: The Hazelwood Health Study adult cohort. Published July 2020 in the International Journal of Epidemiology; https://doi.org/10.1093/ije/dyaa083.
- Owen AJ, Abramson MJ, Ikin JF, McCaffrey TA, Pomeroy S, Borg BM, et al. (2020) Recommended Intake of Key Food Groups and Cardiovascular Risk Factors in Australian Older, Rural-Dwelling Adults. Published March 2020 in Nutrients; https://doi.org/10.3390/nu12030860.
- Holt, N. R., Gao, C. X., Borg, B. M., Brown, D., Broder, J. C., Ikin, J., Makar, A., McCrabb, T., Nilsen, K., Thompson, B. R., & Abramson, M. J. (2020). Long term impact of coal mine fire smoke on lung mechanics in exposed adults. Submitted October 2020 to the journal Thorax. Pre-print available at https://doi.org/10.1101/2020.10.14.20213009
- Prasad, S., Gao, C., Borg, B., Broder, J., Brown, D., Ikin, J., Makar, A., McCrabb, T., Hoy, R., Thompson, B., & Abramson, M. J. (2020). Chronic Obstructive Pulmonary Disease in adults exposed to fine particles from a coal mine fire. Under revision after the GLI released revised equations for $T_L$co calculations. To be submitted to the journal Thorax. Pre-print available at https://doi.org/10.1101/2020.10.14.20213033
- Broder, J.C., Gao, C.X, Abramson, M.J., Wolfe, R., Dimitriadis, C.,Ikin, J.F., Sim, M.R., Del Monaco, A., Johnston, F., Carroll, M., Brown, D., Smith, K. & Guo, Y. Long-term impact of exposure to coalmine fire emitted $PM_{2.5}$ on emergency ambulance attendances: Hazelwood Health Study. Submitted November 2020 to the journal Environmental Health Perspectives.
- Samuel, R., Gao, C.X., Broder, J., Brown, D., Del Monaco, A., Ikin, J.F., McFarlane, A., Berger, E., Maybery, D., Sim, M.R., Walker, J., Carroll, M.T.C. & Abramson, M.J. Associations between self-reported respiratory symptoms and psychological distress following exposure to a landscape fire. Approved by DHHS November 2020. Appropriate journal to be determined.

Abstracts

- Abramson, M. J., Blackman, J., Carroll, M., Gao, C. X., Del Monaco, A., Brown, D., Dimitriadis, C., Johnson, A., Guo, Y., Sim, M. R., & Walker, J. (2019). Chronic cough is related to cumulative $PM_{2.5}$ and exposure from a coal mine fire [abstract].

Published November 2019 in the European Respiratory Journal; https://doi.org/10.1183/13993003.congress-2019.PA4455

- Prasad SR, Borg B, Gao C, Broder J, Brown D, Ikin J, 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
- Holt N, Gao C, Borg B et al. (2020) Altered lung mechanics after coal mine fire smoke exposure in adults [abstract]. Accepted by the 2020 European Respiratory Society International Congress which was held online. Published in the European Respiratory Journal, 56(suppl 64), 3146; https://doi.org/10.1183/13993003.congress-2020.3146
- Samuel, R., Gao, C.X., Broder, J., Brown, D., Del Monaco, A., Ikin, J.F., McFarlane, A., Berger, E., Maybery, D., Sim, M.R., Walker, J., Carroll, M.T.C. & Abramson, M.J. Associations between self-reported respiratory symptoms and psychological distress following exposure to a landscape fire. Presented to the November 2020 TSANZ Victorian branch virtual ASM.

A further manuscript on vascular endothelial function is very close to completion.

These Streams also support a number of students. Two PhD students are utilising Adult Survey and Hazelinks data to investigate the association between mine fire $PM_{2.5}$ exposure and linked hospital, and cancer registry outcomes, respectively. A third-year medical

student is working with the Respiratory Stream to analyse data on e-cigarette use and vaping, and their association with respiratory symptoms, lung function and markers of asthma control in Hazelwood participants. The researchers are also in discussions with two Masters of Public Health students about possible small projects.

Following the release of the Owen *et al* (2020) paper on diet and cardiovascular markers, the researchers were invited to talk with the Latrobe Health Assembly regarding the food preferences of Gippslanders and how to encourage healthy eating. This has resulted in an ongoing collaboration, with two Monash Nutrition Studies students working with the Assembly to run a series of nutrition workshops with key local partners, and a successful Nutrition Week social media campaign. This has also fed into national and local project funding proposals which aim to make *healthy eating the desirable and easy option.*

Plans by the Hazelinks Stream to analyse linked cancer data were postponed. This was because a more complete dataset with 5 years of follow-up only became available from the Cancer Council Victoria in November 2020. A PhD student is now analysing these data.

As described in section 4, the Respiratory Stream has also delayed preparation for its follow-up round of data collection as a result of COVID-19 restrictions. It is anticipated that this data collection will commence in 2021 and a planning meeting is scheduled for 30 November 2020.

7.5 Hazelinks deidentified data

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

Reports

- Guo Y, Gao CX, Dipnall J, Wolfe R, Blackman J, Dimitriadis C, et al. Hazelwood Health Study Hazelinks Ambulance Victoria Data: Time Series Analyses (First Data Extraction) version 1.1. This 2017 report was revised and version 1.1 was completed in March 2020.
- Guo Y, Dimitriadis C, Gao CX, Wolfe R, Ikin J et al (2020) Hazelinks Mortality data: Time series analyses for the period July 2009 to June 2015 version 1.1. Following the submission of version 1.0 in November 2019, version 1.1 was submitted to DHHS in February 2020. The report was publicly released in October 2020, with an accompanying Question and Answer document and lay-language Research Summary, on the HHS website and via local and national media outlets.

- Johnson A, Guo Y, Dipnall J, Ikin J, Gao CX, Dimitriadis C, Abramson M. Hazelinks Medicare Benefits Schedule and Pharmaceutical Benefits Scheme data: time series analyses. This 2018 report was revised based on feedback received in the peer review process that required some refinements of the statistical analyses. Version 2.0 was completed in September 2020.

Manuscripts

- Johnson AL, Gao CX, Dennekamp M, Williamson GJ, Carroll MTC, Dimitriadis C, 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. Published February 2020 in the International Journal of Epidemiology; 49(1), 80-93; https://doi.org/10.1093/ije/dyz219
- Guo Y, Gao CX, Dennekamp M, Dimitriadis C, Straney L, Ikin J, et al. (2020) The association of coal mine fire smoke with hospital emergency presentations and admissions: Time series analysis of Hazelwood Health Study. Published August 2020 in Chemosphere; https://doi.org/10.1016/j.chemosphere.2020.126667.
- Gao CX, Dimitriadis C, Ikin J, Dipnall J, Wolfe R, Sim M, Smith K, Cope M, Abramson, M, Guo Y. (2020) Impact of exposure to mine fire emitted $PM_{2.5}$ on ambulance attendances: a time series analysis from the Hazelwood Health Study. Published October 2020 in Environmental Research; https://doi.org/https://doi.org/10.1016/j.envres.2020.110402
- Dimitriadis C, Gao CX, Ikin JF, Wolfe R, Gabbe BJ, Sim MR, Abramson MJ, Guo Y. Exposure to mine fire related particulate matter and mortality: A time series analysis from the Hazelwood Health Study. Submitted October 2020 to the journal Environmental Research Letters.

7.6 Exposure Assessment Stream

In late 2016 researchers from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Oceans and Atmosphere completed a technical report titled “Air quality modelling of smoke exposure from the Hazelwood Mine Fire”. This was publicly released on the HHS website in 2017. More recently the findings have been rewritten as a scientific manuscript which was published in May 2020 by the prestigious journal Atmospheric Environment.

Luhar AK, Emmerson KM, Reisen F, Williamson GJ, Cope ME. (2020) Modelling smoke distribution in the vicinity of a large and prolonged fire from an open-cut coal mine. Atmos Environ:117471. https://doi.org/10.1016/j.atmosenv.2020.117471

8 Community Engagement

Relative to previous years, year 6 for the HHS has involved less community engagement. It was anticipated that there would be promotional activities in the lead up to the ELF and Respiratory Stream’s data collection, however those have been delayed due to COVID-19 restrictions. Instead, the HHS has utilised this relatively quiet time to update its website across a number of sections including the Findings, Research Streams, News and Events and Study Team. Ten lay language Research Summaries (see Appendix 5) have been added to the Fact Sheets and Summaries page. A new section called Conference Proceedings has been added to demonstrate the extent to which HHS researchers are sharing findings with scientific audiences worldwide. In addition, the new Outputs Directory has been added to the website, to provide users with a consolidated listing of all outputs to date, including reports, journal articles, conference presentations, and research summaries.

The ELF Stream distributed a newsletter (see Appendix 6) to 486 participant families in May 2020 in order to maintain engagement, provide an update on the status of the ELF clinics and provide child-focused information about COVID-19.

An e-newsletter was distributed to 2,176 subscribers on 15 June 2020 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. Recipients included cohort participants, interested individuals and key stakeholders. The e-newsletter can be found at https://hazelwoodhealthstudy.org.au/news-and-events/e-newsletters and a copy is reproduced in Appendix 7.

The adult Respiratory stream participants were sent a Respiratory stream newsletter by email and SMS In October 2020. This informed participants about the postponement of the

2020 clinics because of COVID-19 restrictions. It also included a summary of stream findings to date, the uptake of those findings locally, and community information about COVID-19 and asthma management. The newsletter is reproduced in Appendix 8 and available at on the HHS website at https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0006/2370057/Respiratory-Update-October-2020.pdf.

In October 2020 a media release, describing the findings from the Hazelinks mortality report, was disseminated to local and national media outlets. The resulting media attention included:

- Health effects of Hazelwood fire studied (7 News) Identical articles to this were reproduced on more than 40 online news sites including thecourier.com.au, the canberratimes.com.au, bendigoadvertiser.com.au, portlincolntimes.com.au, margaretrivermail.com.au etc)
- Smoke-impacted at risk of death by injury, study finds (Latrobe Valley Express)
- Hazelwood mine fire health risk, news broadcast features Prof. Malcolm Sim (TRFM & Gippsland's Gold)

The Study has received a range of additional media attention throughout the last 12 months, as shown on our website (https://hazelwoodhealthstudy.org.au/news-and-events/media) and briefly listed here:

- November 2019 Hazelwood Health Study findings 'validated' in wake of Supreme Court's mine fire guilty verdict (Latrobe Valley Express)
- December 2019 Breathtaking: Study reveals negative impact of mine fire on children's health (Latrobe Valley Express)
- May 2020 A model disaster: Studying the 2014 Hazelwood coal mine fire (Lab Down Under)
- August 2020 Unborn children at higher risk of respiratory infections after Morwell fire, study finds (The Guardian)
- August 2020 Hazelwood coal mine fire affected foetuses exposed to smoke in utero, study finds (ABC Gippsland)
- September 2020 Hazelwood fire ignited kids' fears (Herald Sun)
- September 2020 How did the Hazelwood fire impact children (ABC Gippsland)

Because of COVID-19 restrictions, the decision was made to provide the 2020 Annual Community Briefing via a live Zoom webinar. The session took place on Tuesday 10 November and a full recording has been placed on the HHS website at Annual Community

Briefings (https://hazelwoodhealthstudy.org.au/news-and-events/community-briefings). Participants included Stream Leads, PMG members, key stakeholders (including the Latrobe Health Advocate and representatives from the Latrobe Health Assembly), and community members. The session involved brief presentations from each of the active stream areas, as well as an update on local outcomes from the study. An unexpected benefit of hosting the session virtually was that it opened the session up to a wider audience, with participation from people and agencies who may not have been able to attend a face to face meeting in Morwell. An image of the panellists, subsequently tweeted by the Latrobe Health Advocate and re-used here with permission, is provided below.

2020 Annual Community Briefing Panellists

Top row: (from left to right) Matthew Carroll, Jane Anderson (Latrobe Health Advocate), Judi Walker, Ellen-Jane Browne (Latrobe Health Assembly). Second row: Susan Yell, Michael Abramson, Malcolm Sim, Brigitte Borg. Third row: Carolyne Boothman (CAC Chair), Tanya Rong (Latrobe Health Assembly), Graeme Zosky, Yuming Guo. Bottom row: Christina Dimitriadis, Caroline Gao, Jill Blackman, Shantelle Allgood (not shown).

9 Appendices

Risk assessment for Hazelwood Health Study clinical testing during the 2020 COVID-19 Pandemic

Version 1.0 **5 May 2020**

Background

Based on the available evidence, the COVID-19 virus is transmitted between people through close contact and droplets, not by airborne transmission.[1] COVID-19 is stable for several hours to days in aerosols and on surfaces, such as steel, plastic or cardboard.[2] There is overlap between the symptoms of COVID-19 with cold or flu symptoms (fever, cough, sore throat, runny nose, body aches, headaches, fatigue), such that they are indistinguishable without confirmation through laboratory testing. The estimated risk of death is currently ≈1-5%.[3] As outlined by the Centre for Disease Control (CDC), the risk of death from COVID-19 is likely associated with a breakdown of the healthcare system in the absence of medical interventions, enhanced public health interventions (including social distancing measures, quarantine, enhanced infection control in clinical settings, and movement restrictions), as well as enhanced hygienic measures in the general population. Effective management and prevention of COVID-19 focuses on early recognition, immediate isolation and implementation of appropriate infection prevention and control (IPC) measures.

Australia's peak respiratory bodies, the Thoracic Society of Australia and New Zealand (TSANZ) and the Australia New Zealand Society of Respiratory Science (ANZSRS), have advised that some respiratory therapies, including nebulisation, high flow oxygen, non-invasive ventilation, and the use of cough assist devices, can and do produce aerosols. In patients with SARS-CoV-2 these aerosols probably contain virus particles. The use of these therapies therefore poses a significant risk of transmission of viral infection to staff and patients.[4]

Spirometry requires a forced expiratory manoeuvre which could spread droplets in the air if an infected person is tested, even if he or she is asymptomatic. The risk of other individuals inhaling the droplets exists, even if the exact risk of infection in this situation is as yet unknown. The respiratory plume of exhaled particles contains virus for several hours and surfaces may retain viruses for several days. On 25 March 2020 the TSANZ and ANZSRS advised that they consider it is prudent to suspend spirometry testing unless it is deemed clinically essential, due to the potential risk of transmitting SARS-CoV-2. This approach is consistent with recent recommendations by national and international agencies.

Following the recent recommendation from the Commonwealth Department of Health to restore some categories of elective surgery and endoscopy on 27 April 2020, the TSANZ in conjunction with the ANZSRS then recommend the following:

- All Pulmonary Function Testing including cardiopulmonary exercise testing and bronchoprovocation testing can now be performed in patients who are afebrile, and who have no symptoms of a viral illness.
- In such patients, infection control measures (such as level of PPE and cleaning of equipment between patients) in line with respective Federal and State health departments, and physical distancing in public areas is still required.

- It is recommended that Body Temperature is measured on all patients prior to testing to ensure they are afebrile.
- Pulmonary Function Testing is NOT recommended in patients who are febrile, or who have an escalating acute respiratory condition.
- We also recommend that testing only be performed using lung function equipment that utilise inline filters.

Health and Safety Responsibilities

Under Part 3, Division 2 of the OHS Act, employers have a duty of care to protect their employees by:

- Reducing exposure to hazards (s 35(1)(a));
- Providing staff with information about hazards (s 35(1)(d)(iv));
- Providing staff with training (s 35(1)(d)(iv));
- Providing personal protective equipment and clothing (OHS Regulations 2007 (VIC) r 163(4));

Employees also have responsibilities to work safely and not jeopardise the health and safety of others. Under section 25 of the OHS Act 2004, employee responsibilities include:

- Take reasonable steps to protect their own safety and health (s 25(1)(a));
- Take reasonable steps to prevent their actions from affecting the safety of others (s 25(1)(b));
- Cooperate with steps taken by the employer for OHS compliance (s 25(1)(c)); and
- Not recklessly endanger the safety of themselves or others (s 25(2)).

HHS Research activities during the COVID-19 Pandemic

During the COVID-19 pandemic, HHS staff and students will need to evaluate their current research and clinical activities, and consequently may need to change or eliminate these activities in order to reduce spread of COVID-19 to other staff, students, and the community. This is an iterative process: as Government and University advice changes, or as practices outlined here are implemented and tested, this document can be revised.

All researchers should revise existing research procedures and risk assessments at this time.

Face-to-face participant-based research activities

The HHS Respiratory Stream and Early-Life Follow-up Streams both include clinical testing which involves face-to-face contact with members of the community, including vulnerable individuals such as very young children, the elderly, those with chronic illnesses and their carers or relatives. These activities include participant research undertaken off campus (e.g. in community healthcare centres and private healthcare clinics in the communities of Morwell and Sale).

These activities therefore place staff and students working at the HHS clinical testing sites at a greater risk of exposure to COVID-19. Clinical activities also pose a risk of transmission to participants and, thereby, the wider community, including vulnerable populations.

The HHS has a duty of care to staff and students working with members of the community, as well as to members of the community who engage with the HHS.

The recruitment and testing of research participants should not proceed until the risks associated with COVID-19 have sufficiently abated if:

- Research involves collection of saliva, or other biological specimen collection
- Research involves working with vulnerable participants (see "*Who is at greatest risk"*), e.g. children, elderly
- If a distance of 1.5m between the researcher and participant cannot be maintained
- Research involves prolonged, direct interaction with participant >15 minutes
- Incentives for participants to take part (e.g. payments, assessment results, credit towards classes) or other factors incentivise the participant to misrepresent their symptoms
- If research equipment or surfaces cannot be adequately sanitised between users, i.e. computer keyboards, touch screens, testing equipment, seating, soft toys, paper forms or questionnaires, pens.
- If there are insufficient numbers of trained researchers who can take over (i.e. to contact participants for cancellations/rescheduling/testing) if a researcher becomes unwell.

Victorian DHHS statistics on COVID-19 infections by Local Government Area show the following case numbers as of 4 May 2020:

Latrobe City Council (which includes Morwell): 7
Wellington Shire Council (which includes Sale): 11

While COVID-19 infection numbers in Latrobe City Council and Wellington Shire Council are lower than other Victorian Local Government Areas, participants may be reluctant to attend HHS clinical testing sites. Public health officials have encouraged those with chronic health conditions not to neglect their regular health care amid concerns patients may be delaying appointments with general practitioners or specialists due to concerns regarding the risk of COVID-19 infection. Participants' concerns regarding the risk of COVID-19 infection may impact on recruitment for the HHS clinical testing rounds in 2020/2021, particularly for older participants, those who have chronic health conditions, very young children, and those with vulnerable family members.

Many GP clinics are currently limiting face-to-face medical appointments and are conducting many consultations via telehealth in order to reduce the number of patients attending the clinic in person. The managers of clinics may be reluctant for the HHS clinical testing to be conducted, given that this will involve a large number of participants attending the clinic in person.

Understanding the risks

Who is at greatest risk[5]**?**

COVID-19 is a new disease and there is limited information regarding risk factors for severe disease. Based on currently available information and clinical expertise, **older adults and people of any age who have serious underlying medical conditions** might be at higher risk for severe illness from COVID-19.

Based on what we know now, those at high-risk for severe illness from COVID-19 are:

- People 65 years and older

- People who live in a nursing home or long-term care facility

People of all ages with underlying medical conditions, particularly if not well controlled, including:

- People with chronic lung disease or moderate to severe asthma
- People who have serious heart conditions
- People who are immunocompromised. Many conditions can cause a person to be immunocompromised, including cancer treatment, smoking, bone marrow or organ transplantation, immune deficiencies, poorly controlled HIV or AIDS, and prolonged use of corticosteroids and other immune weakening medications
- People with severe obesity (body mass index [BMI] of 40 or higher)
- People with diabetes
- People with chronic kidney disease undergoing dialysis
- People with liver disease
- Aboriginal and Torres Strait Islander people, who have higher rates of chronic illness
- Carers of, or those who live with, a person who meets the above criteria

The HHS adult Respiratory Stream oversampled those who had reported an asthma attack or taking asthma medication in the previous year such that 40% met these criteria. People of all ages with underlying medical conditions, particularly if not well controlled, including moderate to severe asthma might be at higher risk for severe illness from COVID-19.

Children attending ELF clinical testing appointments are accompanied by their parents or carers, and in some case siblings.

What are the non-financial risks:

- **Health risk:** Inadequate work practices may result in staff or students exposure to, or transmission of, COVID-19 to another staff member, student, client/participant or their family, which can result in illness, permanent harm or death.
- **Reputational risk:** Failure to take adequate steps to ensure the safety of students, staff, client/participants, resulting in transmission to the community, will have consequences for the reputation of the HHS and Monash University.
- **Psychological risk:** It is possible that students or staff who are involved in face to face clinical testing will experience anxiety in relation to their perceived risk of contracting COVID-19. Staff or students who contract COVID-19 may also experience great anxiety in relation to having that diagnosis. In the event that a staff member or student is responsible for transmission of COVID-19 to a participant or another staff member or student, and if such transmission results in permanent harm or death, this may have severe ongoing psychological consequences for the staff or student and their colleagues.

The role of the Research Stream Lead

- It is the role of the Research Stream Leads to ensure that staff and students undertake work safely.

- The Research Stream Leads and Senior Project Manager are responsible for developing, and revising current clinical and research protocols as new clinical information regarding COVID-19 comes to hand
- The Research Stream Leads can seek assistance from the School OHS Committee or Central OHS consultants

The Research Stream Leads should be aware that staff or students may feel real or perceived pressure to continue to undertake work which puts them at higher risk of contracting COVID-19, when they have cold or flu symptoms, or if they are working with a member of the community who appears sick. This may happen if:

- the supervisor has directed that work should continue as usual during this time;
- data collection or clinical activities are necessary for student milestones or class credit;
- Ithere are not enough suitably trained staff/students available to replace team members if they become sick themselves;
- staff/students have a lack of clarity around when they should proceed with a clinical or research assessment; or
- taff/students are unsure how to terminate a session if a client or participant appears symptomatic.

Clinical activities

HHS staff/students are to comply with the Victorian State government guidelines (DHHS website) and any University directives in the context of exposure and containment through self-isolation. HHS staff/students must adhere to the requirements of the clinic where clinical testing is being conducted.

Measures that could be adopted to reduce risk to staff, students and the community at HHS clinical testing sites, including:

- **Prominent signage and patient/client screening** by reception, staff and students at first and subsequent contact, consistent with current DHHS advice.
- **Provide instructions** about hand hygiene, respiratory hygiene and cough etiquette.
- **Provide supplies for respiratory hygiene and cough etiquette**, including alcohol-based hand sanitiser.
- **Additional cleaning of work spaces**, including testing materials and related objects. Careful consideration should be given to use of assessment materials made of paper/cardboard, or equipment that cannot be readily sanitised.
- **Temporary reallocation of shared office spaces:** if one staff member is exposed, both would need to self isolate which would assert a huge impact on the program.
- **Provision of appropriate Personal Protective Equipment (PPE)** in accordance with DHHS requirements and TSANZ and ANZSRS recommendations.
- **Screening of participants via telephone** before they attend the clinic to verify they do not have symptoms of COVID-19.
- **Use separate entry at clinic for HHS participants, where possible,** to limit contacts with patients at the GP clinic.

- **Limit time participants spend waiting at clinic** before their clinical testing appointment.
- **Limit contact between participants at clinics,** by allowing gaps between appointments.
- **Body Temperature checks** for all participants prior to testing to ensure they are afebrile.
- **Limiting the number of staff/students in the clinic and the time participants spend at the clinic:** Look at options for undertaking informed consent with participants before they attend the clinic**.** Look at options for conducting any HHS questionnaires, normally done during the clinic visit, either before or after the clinic visit, i.e. over the phone or on-line.
- **Avoid paper-based questionnaires.** Consider delivering questionnaires through touch screens/iPads, which are more readily sanitised.

References

1. https://wwwnc.cdc.gov/eid/article/26/6/20-0233_article
2. https://www.nih.gov/news-events/news-releases/new-coronavirus-stable-hours-surfaces
3. https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf
4. https://www.thoracic.org.au/documents/item/1864
5. https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-at-higher-risk.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fspecific-groups%2Fpeople-at-higher-risk.html

Updated 19 November 2020

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 emergency presentations and hospital admission data 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: currently removed from the HHS website for revisions to be made. Research Summary: currently removed from the HHS website for revisions to be made.
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 4 above). There was no Research Summary prepared to accompany this paper. 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.
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 ongoing**	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 at doi: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. DOI: 10.1007/s10566-020-09551-8. 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 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 (extracted 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://www.sciencedirect.com/science/article/pii/S0269749118335279?via%3Dihub. 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. As of 03/03/2020 the article has not been published in a journal. TO BE UPDATED 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
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://academic.oup.com/ije/article-abstract/49/1/80/5607294?redirectedFrom=fulltext. 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/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 (2020) "Markers of cardiovascular disease among adults exposed to smoke from the Hazelwood coal mine fire" to be submitted to the Australian Journal of Environmental Research and Public Health. TO BE UPDATED. Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0015/2011830/CVD-Blood-Vessel-Health-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
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:
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
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/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/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*. DOI:10.1093/ije/dyaa083. Available by subscription at https://doi.org/10.1093/ije/dyaa083. Cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A free copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au No Research Summary released with this publication as it does not present new findings.
65. Psychological Impacts (Schools)	**April 2020**	Paper describing linked NAPLAN data. Academic paper: Berger at al "The Impact of a Mine Fire and Smoke Event on Academic Outcomes for Primary and Secondary School Students". Pre-print freely available at https://psyarxiv.com/unms5/. Pre-print link provided on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications. Paper to be submitted to Psychological Trauma: Theory, Research, Practice, and Policy. TO BE UPDATED 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 has been 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 at doi: 10.1093/ije/dyaa136. Cited on the website at https://hazelwoodhealthstudy.org.au/study-findings/publications. A free copy of the paper can be requested by emailing contact@hazelwoodhealthstudy.org.au. No Research Summary released with this publication as it does not present new findings.
68. Respiratory Stream	**July 2020**	Paper and conference abstract describing the association between $PM_{2.5}$ and lung mechanics using the forced oscillation technique (FOT) in the adult Respiratory Stream. Academic paper: Holt et al. "Long term impact of coal mine fire smoke on lung mechanics in exposed adults". Pre-print version freely available at https://doi.org/10.1101/2020.10.14.20213009. Pre-print link also cited on the HHS website at https://hazelwoodhealthstudy.org.au/study-findings/publications . Paper under review by the journal Thorax. TO BE UPDATED. 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. Submitted to the journal Environmental Health Perspectives. 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" to be submitted to Thorax. 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. TO BE UPDATED Research Summary: https://hazelwoodhealthstudy.org.au/__data/assets/pdf_file/0007/2351095/Research-Summary_RespStream_COPD-paper.pdf
71. Adult Survey/Psych Impacts	**October 2020**	Paper describing the association between psychological distress and respiratory symptoms in the context of the mine fire.

		Academic paper: Samuel et al "Associations between self-reported respiratory symptoms and psychological distress following exposure to a landscape fire" approved by DHHS on 9 November 2020. Conference proceeding: Poster accepted for TSANZ Vic 2020. No Research Summary released with this publication as it does not address a HHS research question.
72. Adult Psych Impacts	**Nov 2020**	Paper and abstract describing psychological distress in young adults. Academic paper: O'Donohue et al "The psychological impacts of a smoke event on young adults compared to other aged adults in Victoria, Australia". Submitted to DHHS 11 November 2020. To be submitted to the Journal of Environmental Psychology. Conference Proceeding: abstract to be submitted for consideration by the 4th International Childhood Trauma Conference, which will be held in Melbourne, Australia from the 30th of May to the 4th of June 2021.
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. Submitted to DHHS November 2020. Awaiting approval. Research Summary: Submitted to DHHS November 2020. Awaiting approval.
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. To be submitted to DHHS November 2020

Hazelwood Health Study citations

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6 May 2020

The potential effects of smoke from the Southeast Australian mega-fires on the findings of the Hazelwood Health Study

The unprecedented mega-fires which took place in Southeast Australia from December 2019 to February 2020, have resulted in questions about the effects of the mega-fire smoke on Hazelwood Health Study findings. Of particular interest, is how the effects of recent exposure can be disentangled from the 2014 mine fire smoke event, and whether Sale is still a valid control population.

These questions have been considered by the Project Steering Committee and discussed with the chair of the Scientific Reference Group.

The extent to which exposure to fine particles ($PM_{2.5}$) in mega-fire smoke effects Hazelwood Health Study findings varies by research stream. For example, while the ***Community Wellbeing*** stream is interested in discussing the impact of events since the mine fire with our participants in qualitative interviews, they do not foresee the mega-fires as putting at risk any of the research aims. The investigators will be including that event in analysis of impacts on community wellbeing. Furthermore, they are not studying a Sale sample in that stream.

The ***Early Life Followup*** (ELF) stream recruited an identified cohort throughout the Latrobe Valley (not including Sale). Comparisons are being made between children who were *in utero* at the time of the Hazelwood mine fire, those who were up to 2 years of age and those who were conceived after the mine fire. The primary aim of this stream is to evaluate the critical windows of exposure during the first 1000 days of life from conception and this time period is now well past. We will be able to measure and adjust for any impacts of pollution from the recent summer bushfires and this likely affected all ELF participants in a similar way, as all are from the Latrobe Valley.

The ***Schools study*** is utilising Sale and the wider region in the deidentified NAPLAN analysis. However, the NAPLAN data are prior to 2020, so not impacted by the recent smoke exposures. Thus for this analysis, Sale and the wider region remain a valid control.

The recent ***Adult psychological follow-up*** survey was conducted in Morwell during the mega-fires, so we will need to factor additional smoke exposure into that analysis. We are planning to model recent $PM_{2.5}$ exposure based on residential address (see details below). Rather than perceiving the recent exposures as a methodological concern, they provide a unique opportunity to examine the impact of repeated $PM_{2.5}$ exposures on distress and wellbeing.

In relation to the Adult Survey, the main interest now is follow up of the Morwell group via data linkage for outcomes such as cardiovascular disease, cancer and deaths. We emphasise that the already-assembled study groups and collected data are also valuable to provide baselines to investigate other community hazards, such as the mega-fires or COVID-19. This is a big advantage of longitudinal study programs such as the Hazelwood Health Study.

The ***Respiratory stream*** has completed analysis of asthma, COPD and the forced oscillation technique (FOT) which did show effects of the coal mine fire smoke exposure. Further respiratory testing has been delayed by the COVID-19 pandemic and associated restrictions on aerosol generating procedures. We are now planning to undertake further lung function testing of adults in both Morwell and Sale during 2021. The longitudinal analysis of these data will examine further exposure to $PM_{2.5}$ from mega-fire smoke. We have high quality individual data on relevant confounders such as age, sex, height, past occupational exposures, tobacco smoking etc.

We plan to use three popular and reliable ***models to predict bushfire smoke air pollution***.

1. *CSIRO Air Pollution Model* (TAPM): High resolution concentration predictions could be generated using TAPM. This model has already been successfully used to estimate coal mine fire related $PM_{2.5}$ concentrations for Hazelwood Health study[1,2]. Details of this model have recently been published[3].

2. *Chemical Transport Model* (CTM): High resolution concentration predictions could be generated using a CTM. This model has been successfully used to predict bushfire related $PM_{2.5}$ concentrations which has been used to assess its health impacts[4,5]. Details of this model have also been published[6].

3. *Machine Learning* (ML): We will develop ML methods to predict high resolution concentrations of bushfire air pollution with remote sensing data, weather data, and land use information. This method has already been successfully applied by a team led by Yuming Guo and myself[7,8]. The estimated air pollution data have been widely used to assess health impacts [9].

Then we would use a Deep Ensemble Machine Learning Model to blend the concentrations from these three models. This deep ensemble model would provide more accurate estimates than any single model. Yuming and his team have completed a free R package “deeper” to perform the deep ensemble model (https://github.com/Alven8816/deeper).

We consider that this blended model should allow us to take on board any additional effects of $PM_{2.5}$ exposure from the recent mega-fires. Sale remains a valid control group for those streams that have recruited participants there. Fortunately, the mega-fires did not lead to further coal mine fires, so the findings should not be seriously confounded.

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Hazelwood HEALTH STUDY

Research Summary | The Latrobe ELF Study:

Were children exposed to mine fire smoke more likely to have minor illnesses a few years later?

Aims of the study

We wanted to find out if children who were exposed to more smoke from the coal mine fire during their mother's pregnancy or in their first two years of life were more likely to have common illnesses like coughs and colds, asthma, and skin rashes in the two to four years after the fire.

Our study team is

Fay Johnston
Gabriela Willis
Kate Chappell
Shannon Melody
Amanda Wheeler
Marita Dalton
Grant Williamson
Tierney O'Sullivan
Shyamali Dharmage
Graeme Zosky

Background

In February and March 2014, the Hazelwood coal mine caught fire and burned for about six weeks. The air in the nearby town of Morwell was full of smoke and ash for most of this time, affecting the people who lived there and causing a lot of concern in the community.

The Hazelwood Health Study was set up to find out the impact of the fire on the health of the people in Morwell, particularly children and older people.

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

What we found

For unborn babies exposed to the fire, we found that the more smoke they were exposed to during their mother's pregnancy, the more likely parents were to report coughs, runny noses, wheeze, visiting a health care professional, and having a cold, in the two to four years after the fire. For example, children unexposed to the fire reported coughs or colds in 13% of their monthly diaries, while children exposed to the fire during their mother's pregnancy reported coughs or colds in 17% of diaries (once we accounted for other factors which might affect this).

For children exposed in early life the results were not as clear.

Smoke exposure was not linked with reports of rashes, fever, use of antibiotics or steroid skin creams.

We found that cough and cold symptoms were much more common in younger children and during winter. Reports of rashes and prescribed skin creams were more evenly spread across the age-groups and seasons.

To request a copy of the full technical report,
please call 1800 985 899 or email contact@hazelwoodhealthstudy.org.au

Hazelwood HEALTH STUDY

What we did

We enrolled children living in the Latrobe Valley into the study in late 2016. This included children aged two years and under at the time of the fire, children whose mothers were pregnant with them at the time of the fire, and a comparison group of children who were born after the fire.

Between June 2016 and October 2018, each month we asked parents in the study to complete a short online questionnaire. We asked whether, in the previous month, their child had any symptoms such as cough, runny nose, wheeze, or rash; whether they had been to a doctor or another health care professional; whether they had used any antibiotics, asthma inhalers, or skin steroid cream; and whether a doctor had diagnosed any coughs/colds or other lung infections, asthma, or eczema/dermatitis.

We worked out how much smoke each child had been exposed to by looking at where the child was (or mother for children in the womb) during each day of the fire and how smoky the air was in that place.

Then we looked to see if the things we asked about in the monthly diaries were reported the same, more, or less in children exposed to different amounts of smoke during their mother's pregnancy or their first two years of life.

We also looked at other factors that can affect how commonly these illnesses occur, including the age of the child, the season, if they lived with a smoker, and how much air pollution from traffic or other sources they were exposed to.

Considerations

It was not possible to know whether the differences we saw were completely due to the coal mine fire smoke. It might be that parents of young children or those who were pregnant at the time of the fire may have been more concerned about their child's health and reported more symptoms or been quicker to take their child to the doctor.

The differences we found were small and it is difficult to know what they mean for the risk to an individual child. We need to do more studies to understand this better.

Where to from here?

We will share these findings with the community and local organisations to make sure that they are used to improve the health of people in the Latrobe Valley.

What we find in the Latrobe ELF Study also helps us understand more about the effects of smoke on children's health in general. This is important to know as other children may be exposed to smoke from bushfires or other sorts of fires in the future.

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

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

The Hazelwood Health Study is led by Monash University with help from Menzies, Federation University, the University of Adelaide, and CSIRO.

Hazelwood HEALTH STUDY

General practitioner visits and medication use amongst young children exposed to the mine fire smoke

Research Summary

December 2019

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 HHS that follows the health and growth of children who were younger than two years old when the fire happened. This includes children who were in the womb and had not been born yet.

Analysis aims

We aimed to find out if exposure to smoke from the mine fire either during pregnancy, or during the first two years of life, was associated with visits to a General medical Practitioner (GP) or the prescription of asthma puffers, steroid skin creams and antibiotics over a one-year period following the fire.

Meet the team

Fay Johnston
Jingyi Shao
Graeme Zosky
Amanda Wheeler
Shyamali Dharmage
Marita Dalton
Grant Williamson
Tierney O'Sullivan
Katherine Chappell

What we found

We found that children exposed to the mine fire smoke during their first two years of life were more likely to have antibiotics dispensed in the year after the fire, compared with those not exposed. For those exposed children, there were no other associations between mine fire smoke and visits to GPs or the dispensing of other medications.
In the group of children whose mothers were exposed to the mine fire smoke during pregnancy there were no associations between mine fire smoke and visits to GPs or dispensing of medications in their first year of life.

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

Hazelwood HEALTH STUDY

What we did

- With the permission of the parents of 286 children in the ELF Study, we obtained Medicare Benefits Schedule (MBS) data on the number of GP visits, and Pharmaceutical Benefits Scheme (PBS) data on the numbers of prescribed asthma puffers, steroid containing skin creams, and antibiotics dispensed from pharmacies during the period 2014-2016.

- We used each child's home address and locations during the fire period to estimate how much smoke had been experienced by each child, or mother if pregnant. The analysis included children who had a range of exposure to the smoke, including some who had no exposure in pregnancy or infancy.

- For children whose mother were exposed to smoke during pregnancy we evaluated these outcomes for their first year of life. For children who were exposed to smoke during their infancy we evaluated outcomes for the year following the fire.

- When we analysed the data, we took into account other factors that can affect health outcomes such as age, second hand smoke exposure, the mothers' level of stress during pregnancy, socioeconomic status and the background air quality in this area.

Considerations

PBS data only captures prescribed and subsidised medications, so some asthma puffers and steroid skin creams bought without a medical prescription are not included. This study could not determine reasons for the observed increases in antibiotic prescribing. This might have reflected an increased tendency to prescribe antibiotics because of heightened health concerns following the fire, or it might have reflected an increase in the diagnosis of infections requiring antibiotics.
These results were based on a relatively small number of children. Further analysis of anonymous health data from the entire Latrobe Valley will include many more children.

Where to from here
The results 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.

The Latrobe ELF Cohort Study is led by the Menzies Institute for Medical Research at the University of Tasmania with collaborators from Melbourne University and the Telethon Kids Institute. The HHS is led by Monash University with collaborators from Menzies, Federation University, The University of Adelaide, and CSIRO.

Hazelwood HEALTH STUDY

Research Summary

Long term psychological health following the Hazelwood mine fire

December 2019

Analysis aims

This research aimed to assess whether adults who were heavily exposed to air pollution from the mine fire had more symptoms of long-term posttraumatic distress than adults who were less or minimally exposed.

Meet the team

Jonathan Broder
Caroline Gao
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Emily Berger
Darryl Maybery
Alexander McFarlane
Jessica Tsoutsoulis
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Michael Abramson
Malcolm Sim
Judi Walker
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Matthew Carroll

Considerations

The experiences of the participants may not necessarily reflect the experiences of all adults following the mine fire. The researchers used a number of statistical methods to correct for known differences between participants and non-participants, and between Morwell and Sale. However, there remains the possibility that factors other than the mine fire air pollution were responsible for some of the differences in posttraumatic distress reported by highly exposed and less exposed participants.

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

Background

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

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

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

What we did

We surveyed 3,096 adults from Morwell and 960 from Sale approximately 2.5 years after the mine fire. Using air pollution modelling conducted by CSIRO, we calculated each participant's level of exposure to fine air particles less than 2.5 thousandths of a millimetre in diameter ($PM_{2.5}$) during the mine fire. We then compared symptoms of posttraumatic distress in people with different levels of exposure. We also examined the contribution of other factors that can influence psychological health such as age, prior mental health, prior traumatic exposures, and chronic respiratory and cardiovascular conditions.

What we found

Increases in exposure to air pollution during the mine fire were shown to be related to increases in symptoms of posttraumatic stress reported by adults two and a half years later. The link between air pollution and post-traumatic distress was strongest in the youngest adult participants. Other factors, such as prior mental health, were also associated with distress related to the Hazelwood mine fire.

Where to from here?

A follow-up survey of some participants is planned, as is new data collection about the psychological health of young children and their families.

To request a copy of the full technical report, please call 1800 985 899 or email contact@hazelwoodhealthstudy.org.au

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

Hazelwood HEALTH STUDY

Community perceptions of the effectiveness of community rebuilding activities
Research Summary

December 2019

Analysis aims
The purpose of this analysis is to explore community perceptions of the effectiveness of community rebuilding activities.
This work extends the previous analysis released in May this year looking at the community perceptions of the impacts of the event and the effectiveness of communication during and after the event.

Meet the Team
Dr Susan Yell
Assoc Prof Michelle Duffy
Dr Sue Whyte
Dr Larissa Walker
Dr Matthew Carroll
Prof Judi Walker

The Community Wellbeing Stream is led by Federation University. The HHS is led by Monash University with collaborators from Federation University, the University of Tasmania, the University of Adelaide, the University of Newcastle and CSIRO.

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

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 **Community Wellbeing Stream** is the part of the Hazelwood Health Study that looks at the impact of the smoke event on the community wellbeing of those living in Morwell and the Latrobe Valley. This includes looking at the communication during and after the mine fire, and at the community rebuilding efforts that have taken place since the fire.

What we did

We held group discussions with community members and interviewed people from community organisations and agencies involved in the emergency response and recovery, local journalists and social media users. We also collected media articles about the mine fire, along with social media posts by community members on three local Facebook groups. We interviewed a total of 85 people, and analysed 1,096 media reports and 1,709 social media posts. We partnered with community members to produce a photographic exhibition which expressed their aspirations for the future.

Hazelwood HEALTH STUDY

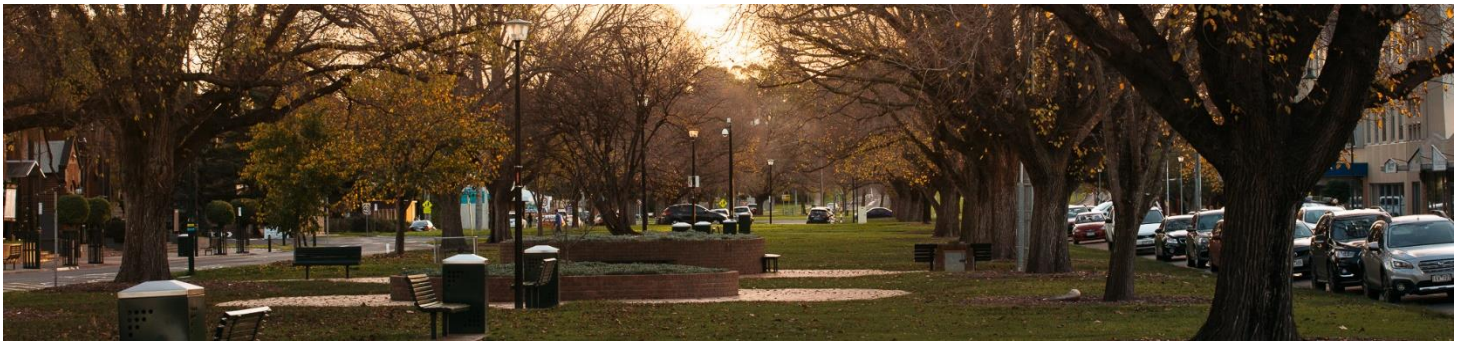
What we found

A range of recovery initiatives were undertaken by various agencies, but not all the work that was done was recognised or valued by the community. Effective recovery initiatives involved a partnership between agency and community, and open dialogic communication. The distinctive characteristics of this community require a place-based approach to the recovery process.

Three years after the mine fire and smoke event, there were still community concerns regarding the apparent lack of planning for a similar future emergency. Stakeholders identified a need for clear and distinct strategies for managing the recovery phase, and for transitioning from the emergency phase to the recovery phase.

The question of 'recovery to what' was very important to this community, as was the development of a long-term vision. The community's focus on recovery shifted over the 3-year period (2014-2017) from a primary concern with physical health, to include a range of concerns: broader wellbeing, job creation and sustainability, and the implications of a transition from coal.

This volume of work is intended to be read in conjunction with the earlier work on the impacts of the event released in May 2019.
Copies of both reports describing the full findings from these analyses can be found at
www.hazelwoodhealthstudy.org.au/study-reports



Considerations

The findings of this study would be useful for policy and planning for future disasters. Stakeholders noted the challenges needed in developing an appropriate emergency plan, and that it would require significant resources and financial support.

The community used different communication spaces to communicate and receive information at different times during the recovery period, and this knowledge can be used to inform future emergency planning. Effective rebuilding and recovery should involve collaborative community-led approaches and partnerships.

While every attempt was made to speak to a broad array of individuals and organisations, it is possible that the participant sample may not represent the full range of viewpoints. However, the analysis of media and social media broadened the range of potential viewpoints.

Where to from here?
Additional data collection is planned to track the ongoing wellbeing of the community.

Hazelwood HEALTH STUDY

Research Summary

The Impact of a Mine Fire and Smoke Event on Academic Outcomes for Primary and Secondary School Students

June 2020

Analysis aims

This study aimed to determine whether students in years 3, 5, 7 and 9 who were from schools highly exposed to the Hazelwood mine fire, or who reported higher levels of ongoing distress associated with the event, had different academic outcomes from students who were less exposed or who reported less distress associated with the event.

Meet the team

Dr Emily Berger
Dr Caroline Gao
Mr Jonathan Broder
Mr Tim Campbell
Prof Darryl Maybery
Dr Matthew Carroll

Background

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

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

What we did

This analysis compared students from schools in Morwell, which were highly exposed to the smoke event, with those from lesser exposed schools located elsewhere in the Latrobe Valley. 303 students aged 7 to 16 years completed a survey more than one year after the event, which included the Children's Revised Impact of Events Scale (CRIES-13); a measure of distress associated with the mine fire. This survey information was coupled with students' NAPLAN scores (obtained from the Australian Curriculum, Assessment and Reporting Authority) from the years before and the year after the Hazelwood event. When we analysed the data, we took into account other known factors that can affect academic performance, including age, sex and school sector.

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

Hazelwood HEALTH STUDY

What we found

The longitudinal analysis found that secondary school students from schools most exposed to the smoke had delayed academic development (as measured by NAPLAN scores) after the event compared to students from lesser exposed schools. Primary school students from Morwell did not show the same delay in academic development. Having a higher level of distress was not associated with delayed academic outcomes.

Considerations

The number of participating students was relatively low. We cannot rule out the possibility that the results occurred by chance, or were due to other unmeasured factors that can affect academic performance such as another distressing event.

The finding that primary school students from Morwell did not have the same delay in academic development as older secondary students could be because more supports may have been targeted at primary schools following the event.

Where to from here

Future research will aim to analyse NAPLAN data for all students across the Latrobe Valley, and not just those who completed our survey. HHS results will be shared with relevant organisations to ensure they are used to shape services for the future wellbeing of the Latrobe Valley.

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

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

Hazelwood HEALTH STUDY

Use of health services and medications **Research Summary**

September 2020

Analysis aims

The aims of these analyses were to examine whether coal mine fire-related air pollutants were associated with increased use of health services, and increased dispensing of prescription medications, for cardiovascular, respiratory and mental health conditions.

Meet the team

Michael Abramson

Yuming Guo

Amanda Johnson

Joanna Dipnall

Jillian Ikin

Caroline Gao

Christina Dimitriadis

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

Background

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

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

What we did

Data on health service use in the Latrobe Valley area were obtained from the Medicare Benefits Schedule (MBS) database for the period 1 July 2012 to 30 June 2016. Data on prescription medications dispensed by pharmacists were obtained from the Pharmaceutical Benefits Scheme (PBS) database for the period 1 January 2013 to 31 December 2016. MBS and PBS data were provided by the Commonwealth Department of Human Services. The Commonwealth Scientific and Industrial Research Organisation Oceans and Atmosphere modelled hourly levels of mine fire-related air pollutants based on concentrations of fine air particulate matter with a diameter of 2.5 thousandths of a millimetre or less ($PM_{2.5}$). Daily maximum temperatures were collected from the Australian Bureau of Meteorology. A statistical method called time series analysis was used to measure the associations between daily average $PM_{2.5}$, use of health services and dispensing of medications in the Latrobe Valley. These models took into account the influences of other contributing factors such as season, temperature and public holidays.

What we found

The analyses found that levels of mine fire-related $PM_{2.5}$ were associated with increased health service use and increased rates of dispensing prescription medications in the Latrobe Valley area. During the 30 day period from 9 February to 10 March 2014, it was estimated that there were an additional 3,274 General Practitioner consultations and 159 respiratory health service visits attributed to coal mine-fire related $PM_{2.5}$. Increased General Practitioner consultations occurred after about 4-5 days of smoke exposure. Increased respiratory health service visits occurred after about 7 days of smoke exposure. There was also a small increase in mental health consultations after about 15 days of exposure.

Furthermore, it was estimated that an additional 2,093 cardiovascular medications, 890 respiratory medications and 1,053 mental health related medications were dispensed as a result of coal mine-fire related $PM_{2.5}$.

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

Considerations

While the findings suggest there was an increase in the use of medical services and dispensing of medications in the Latrobe Valley associated with the coal mine fire smoke, the data are not sufficient to link any individual's case to the mine fire.

There are some limitations to interpretation of these data. Numbers of medications dispensed may not equal numbers of medications taken by recipients. Medications provided over the counter at pharmacies (without a prescription) are not included in the PBS dataset and medical services that do not qualify for Medicare benefits are not included in the MBS dataset.

Finally, in this instance measurement of air pollution was limited to $PM_{2.5}$ and did not include other possible pollutants such as carbon monoxide.

Where to from here

To complement these findings based on MBS and PBS data, the HHS is also evaluating data from clinical examinations and interviews to further assess cardiovascular, respiratory and mental health in smoke effected communities.

The HHS results will be shared with relevant organisations to ensure that findings are used to shape services for the future health of the Latrobe Valley.

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

Hazelwood HEALTH STUDY

Research Summary

Results from the Respiratory Stream. The impact of coal mine fire smoke on lung health in adults.

September 2020

Analysis aims

Three and a half years after the mine fire, this research aimed to discover whether adults who were more highly exposed to the mine fire smoke had poorer lung function than adults who had less exposure.

Meet the team

Nicolette Holt
Caroline Gao
Brigitte Borg
David Brown
Jonathan Broder
Jillian Ikin
Annie Maker
Tom McCrabb
Kris Nilsen
Bruce Thompson
Michael Abramson

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 **Respiratory Stream** is the part of the HHS that examines whether exposure to smoke from the mine fire is associated with respiratory symptoms, asthma control and decline in lung function.

What we did

We worked with CSIRO to estimate the levels of fine particles in the smoke smaller than 2.5 thousandths of a mm in diameter ($PM_{2.5}$). Particles this fine can travel deep into people's lungs. We tested 346 adults from Morwell who were grouped into three levels of mine fire $PM_{2.5}$ exposure (*low*: daily average of 6 micrograms per cubic metre of air ($\mu g/m^3$); *medium*: average of 12 $\mu g/m^3$; and *high*: average of 28 $\mu g/m^3$) and 173 adults from Sale who had little or no exposure. Participants underwent a test of lung health using the forced oscillation technique (FOT). FOT involves normal breathing on a machine while sound waves are used to measure how easily air can move through the lungs and the stretchiness of the lungs. The test was conducted both before and after using an asthma puffer containing salbutamol (Ventolin). Participants also answered questions about respiratory symptoms such as cough and wheeze and medication use. We took into consideration other factors that could influence lung health, such as age, height, weight, cigarette smoking and participants' jobs that may have involved exposure to dusts, smoke or fumes.

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

Hazelwood HEALTH STUDY

What we found

We found that as the level of mine fire $PM_{2.5}$ exposure increased, lung stretchiness decreased. That is, three and a half years after the mine fire, higher levels of smoke exposure were associated with poorer lung function in adults. It is normal for the lungs to become less stretchy as we age. However, our findings indicated that each 10 µg/m^3 increment in smoke exposure was associated with reduced stretchiness that you would normally observe after approximately four years of aging. This finding was independent of participants' actual age.

Hazelwood Health Study Respiratory Scientists above from left to right: Brigitte Borg, Tom McCrabb, Annie Makar.

Considerations

We cannot be absolutely certain that the mine fire smoke caused the change in lung stretchiness because additional factors can affect lung health, such as genes, previous exposure to other sources of smoke, infections or access to health services. The small decreases in lung stretchiness that we measured may not mean that the affected adults will experience any noticeable lung problems now or in the future. However, people with symptoms like shortness of breath, wheezing, or frequent coughing should always have these checked by a doctor. Further, because a large proportion of adults from Morwell and Sale did not participate in the baseline Adult Survey from which the Respiratory Stream participants were drawn, it is possible that the findings do not truly represent lung health in the two communities.

Where to from here

Follow up testing of the Respiratory Stream participants is important so that longer term health effects of the mine fire smoke can be investigated and we can see if changes in lung stretchiness resolve, persist or worsen.

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 Department of Health and Human Services.

Website: www.hazelwoodhealthstudy.org.au @hazelwoodhealthstudy @HazelwoodHS

Hazelwood HEALTH STUDY

Research Summary

Results from the Respiratory Stream. Coal mine fire smoke exposure and chronic obstruction of lung airflow in adults.

September 2020

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 **Respiratory Stream** is the part of the HHS that examines whether exposure to smoke from the mine fire is associated with respiratory symptoms, asthma control and decline in lung function.

Meet the team

Shivonne Prasad
Caroline Gao
Brigitte Borg
Jonathan Broder
David Brown
Jillian Ikin
Annie Maker
Tom McCrabb
Ryan Hoy
Bruce Thompson
Michael Abramson

What we did

Chronic Obstructive Pulmonary Disease (COPD) is characterised by persistent obstruction of lung airflow that interferes with normal breathing and is not fully reversible. In the past COPD has been called 'chronic bronchitis' and 'emphysema'. We measured COPD in 346 adults from Morwell and 173 from Sale, using a breathing test called spirometry. Spirometry measures how much air you inhale and exhale, and how fast you exhale. The test was performed ten minutes after using an asthma puffer containing salbutamol (Ventolin). We also conducted a test called 'transfer factor for carbon monoxide' ($T_L$co) which measures the ability of the lung to transport gas into and out of blood. Participants also answered questions about respiratory symptoms such as cough and chest tightness and medication use.
We worked with CSIRO to estimate the levels of fine particles in the mine fire smoke smaller than 2.5 thousandths of a mm in diameter ($PM_{2.5}$). Particles this fine can travel deep into people's lungs. Morwell participants were grouped into three levels of mine fire $PM_{2.5}$ exposure (*low*: daily average of 6 micrograms per cubic metre of air (µg/m^3); *medium*: average of 12 µg/m^3; and *high*: average of 28 µg/m^3). Sale participants were categorised as having little or no exposure. We took into consideration other factors that could influence lung health, such as age, height, weight, cigarette smoking and participant's jobs that may have involved exposure to gases, dusts or fumes.

Analysis aims

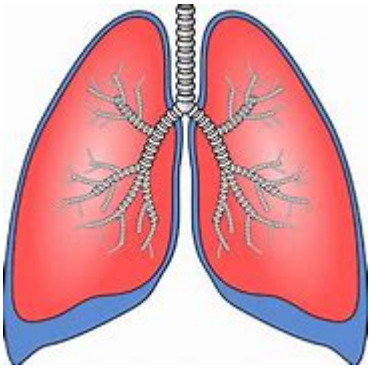
Three and a half years after the mine fire, this research aimed to discover whether adults who were more highly exposed to the mine fire smoke had more Chronic Obstructive Pulmonary Disease than adults who had less exposure.

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

Hazelwood HEALTH STUDY

What we found

We found that as the level of mine fire $PM_{2.5}$ exposure increased evidence of chest tightness and chronic cough was increased more than three years later. When we investigated COPD, the results differed depending on whether participants were cigarette smokers or non-smokers. Amongst non-smokers, there was strong evidence of increasing levels of $PM_{2.5}$ exposure being associated with increased levels of COPD. We did not see this dose response relationship between $PM_{2.5}$ exposure and COPD amongst smokers. However, amongst smokers we did see that increased $PM_{2.5}$ exposure was particularly associated with increased evidence of chronic cough. We did not find any evidence of an association between mine fire $PM_{2.5}$ exposure and the ability of the lung to transport gas into and out of blood.



Considerations

We cannot be absolutely certain that the mine fire smoke caused the changes that we observed in lung airflow obstruction, chronic cough and chest tightness. This is because additional factors can affect lung health, such as genes, previous exposure to other sources of smoke, infections or access to health services. Regardless of the cause, people with symptoms like shortness of breath, chest tightness or frequent coughing should always have these checked by a doctor.

Where to from here

Follow up testing of the Respiratory Stream participants is important so that longer term health effects of the mine fire smoke can be investigated and we can see if the changes in lung health resolve, persist or worsen.

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 Department of Health and Human Services.

Website: www.hazelwoodhealthstudy.org.au @hazelwoodhealthstudy @HazelwoodHS

Hazelwood HEALTH STUDY

Hazelwood mine fire smoke exposure and ambulance attendances in the following years

Research Summary

September 2020

Meet the team

Jonathan Broder
Caroline Gao
Michael Abramson
Rory Wolfe
Christina Dimitriadis
Jillian Ikin
Malcolm Sim
Anthony Del Monaco
Fay Johnston
Matthew Carroll
David Brown
Karen Smith
Yuming Guo

Background

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

Analysis aims

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

What we did

Approximately 2.5 years after the Hazelwood mine fire, 3096 Morwell residents 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 2223 of the Adult Survey participants for the researchers to access their Ambulance Victoria attendance records. For this analysis we looked at ambulance attendances from just after the fire, 1 April 2014 to 31 December 2017.

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

Website: www.hazelwoodhealthstudy.org.au @hazelwoodhealthstudy @HazelwoodHS

What we found

We found that as the levels of exposure to smoke-related $PM_{2.5}$ increased, the likelihood that a participant required an ambulance attendance in the following years also increased. This is evidence for a dose-response relationship. In particular we observed that increases in smoke exposure during the fire, were associated with increases in ambulance attendances for respiratory (lung) conditions and for cardiovascular (heart) conditions in the years after the fire. 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.

Considerations

The analysis used a number of statistical methods to account for other factors that might have influenced ambulance attendances, 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 ambulance attendances. Further, because a proportion of adults from Morwell did not participate in the Adult Survey, it is possible that the findings do not truly reflect that community.

Where to from here

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

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

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

Hazelwood HEALTH STUDY

Risk of death in Morwell, the broader Latrobe Valley and surrounding smoke impacted areas during and after the Hazelwood mine fire

Research Summary

October 2020

Analysis aims

This research aimed to determine whether death rates increased during or after the mine fire and whether these rates were affected by changes in the levels of mine fire smoke pollution.

Background

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

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

Meet the team

Associate Professor Yuming Guo
Ms Christina Dimitriadis
Dr Caroline Gao
Professor Rory Wolfe
Dr Jillian Ikin
Professor Michael Abramson
Professor Malcolm Sim

What we did

For this research we defined the 'mine fire period' as the 30 days from 9 February to 10 March 2014. After these dates the smoke levels dropped quickly. We used national death records to calculate the rates of death during the mine fire period, and during the six months after the mine fire, in Morwell, in the broader Latrobe Valley, and in surrounding smoke impacted areas. We also calculated the rates of death after daily changes in smoke levels. The national death records provided information about the cause of death which was defined as the disease or injury that led to the death (for example asthma, heart disease or an accident). The term *cause of death* did not relate to whether the mine fire smoke pollution contributed to the death, but assisted us to investigate whether certain types of deaths were more common during or after the mine fire. We took in to consideration other factors that could influence death rates such as season, temperature and the age of the population.

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

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

Hazelwood HEALTH STUDY

What we found

When all deaths were counted (regardless of cause of death), the overall risk of death in Morwell and in other smoke impacted areas was similar to what would usually be expected during the 30 day mine fire period. However, in the six months after the mine fire, the overall risk of death in Morwell (but not in other smoke impacted areas) was slightly higher than what would usually be expected.

When specific causes of death were investigated, the following results were found.

During the 30 day mine fire period, in the Latrobe Valley:

- there was an increase in the risk of death from injury. The greatest increases in risk of death from injury during the mine fire period were observed in men and in residents aged 80 years and older. Across all smoke-impacted communities, there were approximately 11 extra deaths from injury during the mine fire period.

In the six months after the mine fire, in the Latrobe Valley and particularly Morwell:

- there was an increased risk of death from cardiovascular conditions, particularly ischaemic (coronary) heart disease. Greatest risks were observed in men and residents aged 80 years and older. There were approximately 26 extra deaths in Morwell from cardiovascular conditions in the six months after the mine fire.

There was no association between mine fire smoke and an increased risk of death from respiratory conditions.

Where to from here

These findings will be shared with relevant health and emergency services to help inform future responses to air pollution events. The Hazelwood Health Study will continue to monitor the long-term health of communities impacted by the mine fire.

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

Considerations

Some of the findings from this research were based on quite small numbers of deaths. When numbers are small, it is possible that the increases in risk of death have occurred by chance. It is not possible from these records to tell what activity or behavior led to the injury related deaths that were observed in this research.

The finding of no association between mine fire smoke and respiratory-related deaths does not mean that the smoke was safe for people with respiratory illnesses. Instead it is possible that some people with chronic respiratory illnesses took precautionary action during the mine fire, such as leaving the smoky areas, staying indoors and/or taking additional medication. These actions may have prevented some potential respiratory-related deaths and contributed to the lack of an association between the mine fire and respiratory deaths. Other Hazelwood Health Study research has shown that the mine fire smoke contributed to a worsening of respiratory symptoms.

Even though the researchers were able to investigate changes in the rates of death across the community that might have been associated with the mine fire smoke, the data did not allow the researchers to answer questions about whether any individual person's death was caused by the fire.

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

ELF STUDY NEWSLETTER

May 2020

We are with you during challenging times as we face the many impacts of the coronavirus pandemic. The Latrobe Valley community has shown great spirit and resilience in times of adversity and has been called to draw on this strength once again.

Health bodies rely on established procedures such as hand hygiene, cleaning, social isolation and also new emerging methods for COVID-19 specific control. Home isolation, remote learning for school children and social distancing are now part of daily life, as we follow these necessary regulations. The spread and transmission mode of the virus is closely monitored by state Chief Health Officers. Guidelines are regularly reviewed and modified based on specific conditions and patterns seen in countries across the globe, who have experienced the pandemic ahead of Australia. Infection rates for Victoria are thankfully beginning to slow at the time of this publication.

We have included some helpful information for families, particularly with young children in mind. The ELF team wishes all our study families well and that you can stay healthy and happy until we next get to see you in person at the clinic visit.

ELF Clinics

♦ The ELF team will be in touch after health authorities advise it is safe to run our clinic, most likely in 2021.

♦ If your child was unable to attend the clinic in 2017, we would love to see you at the next clinic visit.

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

HAVE YOU MOVED OR CHANGED YOUR CONTACT DETAILS?

Update the ELF Team at latrobe.elf@utas.edu.au or call 1800 322 102

More about the clinic...

What happens at the ELF clinic?

Coronavirus

♦ For local COVID-19 updates, regularly refer to the Latrobe City Council website (https://www.latrobe.vic.gov.au). Some local services have been cancelled, while other essential services continue to run in line with State Government guidelines.

♦ New or existing health conditions should be monitored by your regular family GP - your clinic will advise the most suitable method of consultation during this time.

♦ For urgent health issues visit your nearest hospital emergency department, (call ahead of time for current advice) or ring for an ambulance if appropriate. If you suspect you have COVID-19 symptoms call the Coronavirus hotline on 1800 675 398 for information on which local GP clinic to attend for assessment or treatment. Additionally public testing may now be available in your local area.

♦ If you or a family member experiences mental health concerns such as anxiety or stress, seek help by reaching out to one of the mental health services listed overleaf or contact your GP for further assistance with severe concerns.

COVID 19

Simple answers for children

What is the coronavirus?
A kind of germ that can make people feel sick. Remember how the flu made (someone your child knows) feel. The virus can be a lot like that.

How do you catch the virus?
The virus spreads like the flu, or a cold or cough. If a person who has the virus sneezes or coughs, this is how germs that are inside the body can come out and spread. If they sneeze or cough into a tissue or elbow, this helps keep germs from traveling and making other people sick. Touching your face is a way that the little germs can enter our body, washing our hands makes sure the germs are gone.

For Parents...

Ask open questions and listen. Find out how much your child already knows and follow their lead. If they are particularly young, take the chance to remind them about good hygiene practices without introducing new fears.

Provide just enough information without fuelling anxiety, using age-appropriate language.

Show them how to protect themselves. Encourage regular handwashing. Sing along with a favourite tune, dance for 20 seconds or imagine that their hands are two octopuses having a wrestle for fun, see over page.

Use a tissue or their elbow for a sneeze or cough. Draw a googly-eyed face in the crease of the elbow, to make a 'sneeze and cough eating' pet Elbow Monster.

Limit viewing news stories to when children are not in the room to avoid alarm.

Stick to regular routines as much as possible, especially at bedtime and when in a new environment; such as home schooling.

Identify the helpers in the community, it is important for your child to know that people are helping others with acts of kindness and generosity.

Look after yourself. You'll be able to help your kids better if you're coping, too. Children will pick up on your own reactions, it helps them to know you're calm and in control. Take time for yourself to do things that help you to relax.

Offer reassurance. Help children cope with stress by making opportunities for play and relaxation when possible. If your child appears distressed, remind them that they can have scary conversations with you at any time. Remind them that you care, you're listening and that you're available whenever they're feeling worried.

Why can't I hug Grandma or my friends? Explain that social distancing does not mean that your child or the other people are sick, but that this is a way to keep them both safe and well. It may be impossible to explain this to younger children. Instead of high fives or hugs, create an alternative greeting such as a silly wink, dance step or special hand wave. Use face time or other social media to keep in regular contact.

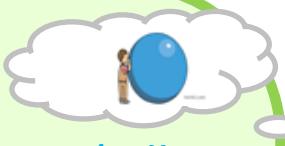
Why are some people wearing masks? Masks are for people who are sick to wear, so that they don't share germs or for doctors and nurses to keep them safe when they are helping people.

Can you die from Coronavirus? Most people who have caught the virus have not died, just like with the flu. Some people can easily catch germs that make them very sick, especially if they are very old or already unwell.

Some fun things to do at home

- Cook up a storm with simple recipes the whole family can help with
- Have some outdoor fun digging in the garden
- Make up some pot plants to give as welcoming gifts for when you next see grandparents, family or friends
- Wash the family pet or help clean the car

Guided meditation for children: The Balloon



This guided meditation brings a visual component to a very simple deep breathing exercise. You can do this standing or seated, or encourage younger children to stand up in a relaxed way. To keep younger children engaged, you can add a little more detail and fun to the exercise. This is a great way to help wind down after home school learning for older children.

- Relax your body and start to take a slow, deep breath to fill your belly up with air, as if you're trying to blow up a big balloon in your favourite colour. Expand your belly as much as you can, stretching your arms open and overhead.
- Slowly let the air out of the balloon (through the nose) as you release breath from the belly.
- When their balloon is totally full, have them hold their breath at the top, and then you can "pop the balloon" for them (gesture finger to belly) and they can fall down as they exhale. This one will likely elicit giggles and awareness of their breath.
- Encourage your kids to feel their entire body relax each time they exhale, each time air is slowly being released from the balloon. *For older children* you can even make a "hissing" noise to encourage them to slow down the exhale even more, "like letting air out of the balloon."
- Continue and repeat for several minutes. Play some calming music (check options for kids on free-to-air tv radio channels, to save on data), scatter some cosy cushions, blankets and books around the room and encourage children to feel comfortable with rest and relaxation.

Adapted from The Chopra Center https://chopra.com/articles/3-kid-friendly-meditations-your-children-will-love

Useful Contacts and References

Coronavirus Hotline Call: 1800 675 398

Latrobe City Council Call: 1300 367 700
https://www.latrobe.vic.gov.au

Victorian Department of Health and Human Services
https://www.dhhs.vic.gov.au/coronavirus-covid-19-daily-update

Australian Government Department of Health
https://www.australia.gov.au

Lifeline Call: 13 11 14 Crisis Support lifeline.org.au

Beyond Blue Call: 1300 224636 beyondblue.org.au

Facebook: Coronavirus (COVID-19) Information
https://www.facebook.com/coronavirus_info/?page_ source=bookmark

ABC Life: How to talk to kids about coronavirus pandemic
https://www.abc.net.au/life/how-to-talk-to-kids-about-coronavirus-covid-19/12084666

World Health Organisation https://www.who.int/

UNICEF https://www.unicef.org.au

UNICEF blog: How to talk to your children about coronavirus
https://www.unicef.org.au/blog/news-and-insights/march-2020/how-to-talk-to-your-children-about-coronavirus

The Lancet : Parenting in a time of COVID-19 https:www.thelancet.com/action/showPdf?pii=S0140-6736%2820%2930736-4

Harvard Health Blog: How to talk to children about corona-virus
https://www.health.harvard.edu/blog/how-to-talk-to-children-about-the-coronavirus-2020030719111

Hazelwood
HEALTH STUDY

June, 2020

In this edition

Latest findings

- Community perceptions of the effectiveness of community rebuilding activities
- General practitioner visits and medication use amongst young children exposed to the mine fire smoke
- Summary of child health outcomes reported by parents in monthly diaries
- Long term psychological health following the Hazelwood mine fire
- Heart and blood vessel health in older adults exposed to smoke from the Hazelwood mine fire
- Factors associated with high blood pressure and its management among older Gippslanders
- The impact of exposure on lung function and asthma

Share Tweet Forward

Impact of the COVID-19 lockdowns on the study

Like the rest of the community, the Hazelwood team has modified its work practices in line with the COVID-19 restrictions. With minimal disruption to Study progress, the majority of staff have been able to work from home and have been well resourced by their respective Universities. By prioritising the analysis of already-collected data, over new data collection, the researchers continue to work hard to address the core health questions set by the local community following the 2014 mine fire. Fortunately, we were already experienced Zoom users, having used this video platform to collaborate across Universities and States since the Study commenced.

However, the COVID-19 restrictions have led to some changes in our plans for the year. In particular, the Early Life Follow up Stream had intended to collect new respiratory and cardiovascular health data from its cohort of children, commencing April 2020. Those clinical assessments have been delayed until late 2020 or early 2021. The adult Respiratory Stream had also planned to undertake clinical assessments in 2020, and those are now likely to go ahead in 2021.

Other planned data collection this year has been unaffected. The Psychological Impacts Stream concluded a major follow-up of the Adult Survey Cohort, prior to COVID-19 pandemic reaching its peak (see more details below).

In addition, the Community Wellbeing stream will go ahead with a second round of interviews with community members and key stakeholders in the coming months. These will shed light on the ongoing recovery of the community post-Hazelwood, but also provide insights into how the community has coped during the recent smoke event and the current COVID-19 event.

New data collected on longer-term psychological, social and community impacts of the mine fire

In late 2019, a large number of Morwell residents who had previously participated in the 2016-2017 Adult Survey, were invited to complete a follow-up survey which looked at ongoing psychological, social and wellbeing impacts of exposure to the Hazelwood mine fire. The survey included concepts such as anxiety, social isolation and community wellbeing, to shed light on any changes in the community following the mine fire.

There was strong interest in the survey, with almost 700 people completing the survey between December 2019 and early March 2020. This was a larger response than we had hoped for, so we are very appreciative of the support from our community members.

The survey happened to coincide with the major bushfire event over the 2019/2020 summer period, which saw periods of considerable smoke exposure in the region. This gives us a unique opportunity to look at the impact of exposure to a current smoke event on people previously exposed to the earlier Hazelwood event.

The findings from the survey are being analysed, and we expect to release a report by the end of the year. The information gathered will help the local community and health-service providers respond to the ongoing health needs of the community as well as inform responses to future events.

Chief Health Officer endorses years 6 and 7 of the Study

The Hazelwood Project Management Group would like to thank everyone who contributed to the extensive strategic overview of the Hazelwood Health Study which took place in 2019. In response to a request from the Victorian Minister for Health, we were asked to review our project plan for years 6 to 10 of the study.

As part of this review process, an extensive consultation process took place with key groups and stakeholders including our Community Advisory Committee, Clinical Reference Group and Scientific Reference Group. It culminated with a Community Engagement Session in Morwell in June last year facilitated by Professor John Catford, the then Chair of the Latrobe Health Assembly, with commentary by Jane Anderson, the Latrobe Health Advocate. The community session involved round tables with representatives from each of the research areas talking with community members. The session generated considerable discussion, with the key feedback highlighted on our website.

The strategic overview was positively received by the Chief Health Officer and resulted in the endorsement of a contract for Years 6 & 7 of the Study. A copy of the project plan for years 6 & 7 can be found on our website. The contract for years 8 onwards will be negotiated in 2021.

Hazelwood Health Study researchers in the news

Note: Some of our leading researchers have provided commentary on recent smoke events not related to the Hazelwood Health Study.

May 2020 A Model Disaster: Studying the 2014 Hazelwood coal mine fire Lab Down Under

January 2020 Health experts warn about long-term dangers of smoke haze ABC - 7.30 Report

May 2020 Bushfire royal commission hears that Black Summer smoke killed nearly 450 people ABC News

March 2020 Smoke from Australia's bushfires killed far more people than the fires did, study says. The Guardian

January 2020 'No safe level': Study links PM2.5 pollution to increased risk of cardiac arrest The Age

November 2019 Hazelwood Health Study findings 'validated' in wake of Supreme Court's mine fire guilty verdict Latrobe Valley Express

October, 2020

Respiratory Stream and COVID-19 Status Update

Thank you for participating in the Hazelwood Health Study Respiratory Stream testing in 2017-2018. We had planned to contact you about testing your respiratory (lung) health for a second time in 2020, however, those plans have been delayed while COVID-19 restrictions remain in place.

We understand this is a very challenging time as the community faces the many impacts of the coronavirus pandemic. Like the rest of the community, the Hazelwood Health Study has modified its work practices. With minimal disruption to study progress, the majority of staff have been able to work from home and have been well resourced by their respective Universities. By prioritising the analysis of already-collected data, over new data collection, the researchers continue to work hard to address the core health questions set by the local community following the 2014 mine fire.

Thanks to the hard work of all Victorians, the number of new cases of coronavirus, especially in regional areas like the Latrobe Valley, is coming down. Hopefully restrictions will soon be sufficiently relaxed for us to plan the next round of respiratory health testing. At this point, we don't know if the testing will commence later this year or next year. We would like to wish you well during this difficult time and to extend our thanks and appreciation for your past participation and ongoing support. The Hazelwood Health Study team will be in touch when it is possible to recommence testing.

Do you have any questions, have you moved or changed your contact details?
Contact the Hazelwood Health Study team at contact@hazelwoodhealthstudy.org.au or call 1800 985 899

Respiratory health key findings

The Hazelwood Health Study has released a number of findings about the Hazelwood mine fire and respiratory health. Here are some key findings:

Increased reporting of respiratory symptoms

In 2016-2017 over 3000 adults from Morwell who were exposed to the mine fire smoke, and almost 1000 adults from Sale with little or no exposure, reported their respiratory symptoms as part of the Adult Survey. Using air pollution modelling conducted by CSIRO, we estimated each participant's level of exposure to the smoke. 2 ½ years after the fire, we found that participants with low, medium or high exposure were between 15% to 110% more likely to report respiratory symptoms (wheeze, night-time and resting shortness of breath, chronic cough and phlegm, chest tightness and nasal symptoms) relative to participants with no exposure. Cough, in particular, appeared to increase in line with increasing smoke exposure.

Poorer lung health

About a year after the Adult Survey, approximately 520 participants from Morwell and Sale underwent a number of tests of their lung health as part of the Hazelwood Health Study Respiratory Stream. This included a test of stretchiness of their lungs using the forced oscillation technique (FOT). We found that as the level of mine fire smoke exposure increased, lung stretchiness decreased. That is, three and a half years after the mine fire, people who had been exposed to the highest levels of smoke had the poorest lung health.

This research was funded by the Department of Health and Human Services. More detailed reports and research summaries describing these findings can be found at www.hazelwoodhealthstudy.org.au/study-findings

Increased obstruction of lung airflow in non-smokers

Chronic Obstructive Pulmonary Disease (COPD) is characterised by persistent obstruction of lung airflow that interferes with normal breathing. We measured COPD in Respiratory Stream participants using spirometry to measure how much air they inhale and exhale, and how fast they exhale. Participants also answered questions about cough, chest tightness and medication use. We found that higher levels of smoke exposure from the 2014 mine fire were associated with increased chest tightness and chronic cough 3 ½ years later. Amongst non-smokers, there was strong evidence of increasing levels of mine fire smoke exposure being associated with increased levels of COPD. In smokers, this relationship was not seen, but we did see that increased mine fire smoke exposure was associated with increased evidence of chronic cough.

Poorer asthma control

About 230 of the Respiratory Stream participants had asthma. When Morwell adults with asthma who were exposed to the mine fire smoke were compared to Sale adults with asthma who were not exposed, we found no differences in asthma-related symptoms or severity, lung function or airway inflammation when measured 3 ½ years later. However, there was some evidence that adults with asthma from Morwell had poorer asthma control. This finding was taken up by the Latrobe Health Assembly (see over the page).

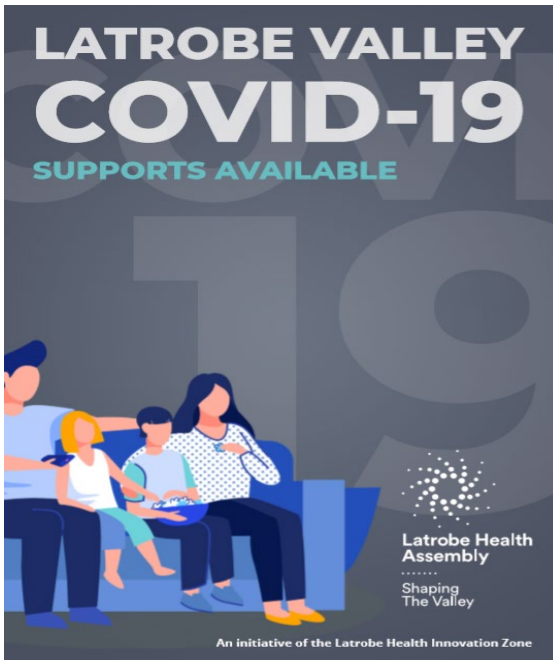
Hazelwood HEALTH STUDY

Local Learnings

Latrobe Health Assembly – Following on from the asthma findings referred to over the page, The Latrobe Health Assembly launched the #Scarfie campaign in June 2018. The awareness campaign to promote the importance of having an up to date asthma management plan. For more information go to www.healthassebly.org.au

Gippsland Air Quality and Health Forum – this public online event was organised by Healthy Futures together with Lung Foundation Australia and Asthma Australia. Health experts, including Hazelwood researcher Fay Johnston, came together to provide an overview of air quality in Gippsland, including pollution sources, health impacts and potential relationships with COVID-19. For more information visit www.healthyfutures.net.au/gippsland

Community information



Latrobe Health Assembly COVID-19 Supports Directory

The Latrobe Health Assembly has launched a comprehensive online COVID-19 Supports Directory featuring a growing list of support services operating within the Latrobe Health Innovation Zone to support the community during and following the COVID-19 pandemic. For more information go to www.healthassebly.org.au

Stay Safe & Stop the Spread by:
washing your hands regularly, wearing a face covering when you leave home, coughing and sneezing into your elbow, keeping at least 1.5 metres from others, staying home if you feel unwell.
If you have symptoms of coronavirus (COVID-19) **get tested** then stay home.

Check your asthma control

Although at present there is no cure, with good management, people with asthma can lead normal, active lives.
For good asthma management, it is important that you:

- understand what triggers your asthma (this can be different for everyone).
- try to avoid or reduce your exposure to these triggers.
- see your doctor for regular check-ups and work together to manage your asthma.
- follow your personal written asthma action plan, developed with your doctor.
- use your medications as instructed by your doctor, even when you feel well.
- make sure you are using your inhaler (puffer) correctly.

If you have allergies or COPD as well as asthma, it is important to treat the symptoms of both conditions, as treating one can help you manage the other.

Is your asthma under control?

Asthma control tests are a set of health questions used to help measure asthma control in children and adults.
There are a number of asthma control tests available online, including the Asthma Score, available via www.asthma.org.au.

Good asthma control means having all of the following:

- no night-time asthma symptoms.
- no asthma symptoms on waking.
- no need for reliever medication.
- no restriction of day-to-day activities.
- no days off school or work due to asthma.
- no asthma attacks or flare-ups.

For more information visit www.nationalasthma.org.au or www.asthma.org.au or see your doctor for an asthma review.