

Change in lung function after exposure to smoke from a mine fire: a clinical follow-up

Michael J Abramson¹, Nicolette Holt¹, Catherine L Smith¹, Caroline X Gao¹, Brigitte Borg^{1,2}, Tyler J Lane¹, David Brown¹, Jillian Ikin¹, Annie Makar², Thomas McCrabb², Mikayla Thomas², Kristopher Nilsen², Bruce R Thompson³

1. School of Public Health & Preventive Medicine, Monash University, Melbourne, Australia; 2. Respiratory Medicine, Alfred Health, Melbourne, Australia; 3. School of Health Sciences, University of Melbourne, Melbourne, Australia.

Introduction

- In 2014, a 45-day fire at the Hazelwood open cut brown coal mine exposed residents in the adjacent town of Morwell, Australia, to high concentrations of fine particulate matter $\leq 2.5\mu\text{m}$ diameter ($\text{PM}_{2.5}$).
- The Hazelwood Health Study (HHS) assessed the long-term respiratory consequences of exposure to mine fire smoke.
- HHS participants were also exposed to the 2019-20 “Black Summer” wildfires, with the “unexposed” town of Sale closer to the wildfires.
- The aim of this analysis was to evaluate the longer-term impact of these exposures to air pollution on respiratory health.



Photo of the Hazelwood mine fire courtesy of Keith Pakenham, Country Fire Authority

Methods

- Respiratory testing was conducted 3.5-4 years (Round 1) and 7.3-7.8 years (Round 2) after the mine fire.
- Individual $\text{PM}_{2.5}$ exposure was retrospectively estimated from emission, chemical transport models and time location diaries.
- Participants completed validated respiratory questionnaires and performed spirometry, gas transfer (GLI z-scores) and oscillometry (FOT, non-linear transformations).
- Mixed-effects regression models were fitted to analyse associations between $\text{PM}_{2.5}$ exposure and outcomes, controlling for key confounders.
- Covariates included (where relevant): age, sex, height, weight (for FOT), education, employment, smoking, asthma, spirometric COPD (post bd $\text{FEV}_1/\text{FVC} < 5\%$), whether bronchodilators were withheld prior to testing, and town (Morwell / Sale) as a sensitivity analysis.

Results

- Clinical assessments were completed by 519 (346 exposed) in Round 1 and 329 (217 exposed) participants in Round 2.
- Participant characteristics were comparable across survey rounds.
- Detailed examination of $\text{PM}_{2.5}$ levels during the “Black Summer” wildfires suggested exposure was not significantly different between the two towns.
- Spirometry and gas transfer in Round 2 were lower compared with Round 1, excepting FVC (increased) and FEV_1 (minimal change) [Figure 1].
- The effect of $\text{PM}_{2.5}$ exposure changed over time from a negative effect in Round 1 to no effect in Round 2 for both baseline FVC ($p_{\text{int}}=0.005$) and post-bronchodilator FVC z-scores ($p_{\text{int}}=0.032$) [Figure 1].
- A reversed direction of association for FEV_1/FVC z-scores was evident both at baseline ($p_{\text{int}}=0.007$) and post-bronchodilator ($p_{\text{int}}=0.002$).
- However, the estimated mean change in spirometry with increasing $\text{PM}_{2.5}$ exposure, overlapped with a null effect in both rounds [Figure 1].
- Similarly, exposure to mine fire-related $\text{PM}_{2.5}$ was not associated with gas transfer at either Round 1 or Round 2 and the effect was unchanged between rounds (data not shown).
- For the estimated effect of $\text{PM}_{2.5}$ exposure on transformed FOT outcomes, both post-bronchodilator reactance ($\text{exp}[\text{Xrs5}]$) and area under the reactance curve ($\ln[\text{AX5}]$), a negative impact of exposure in Round 1 showed signs of recovery in Round 2 (both $p_{\text{int}} < 0.001$) [Figure 2].

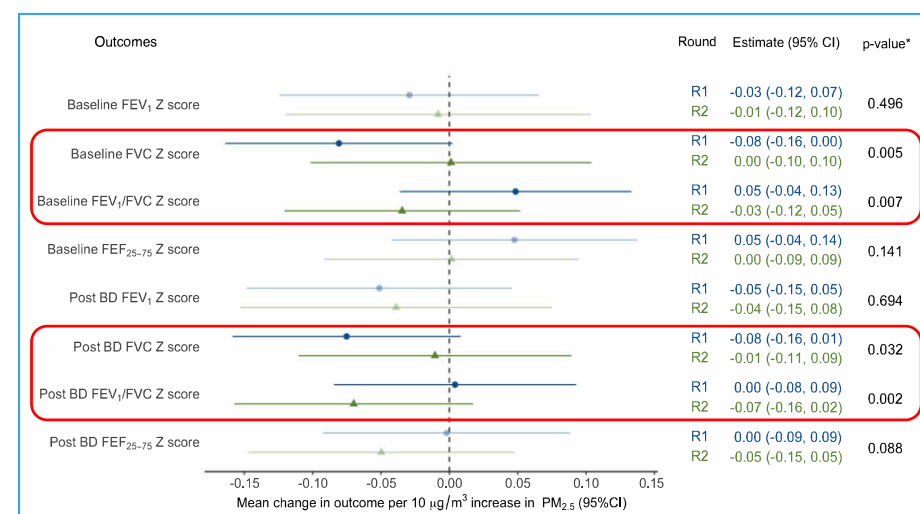


Figure 1. Models of spirometry as a function of $\text{PM}_{2.5}$ adjusting for education, employment, asthma and smoking
* p-value for the interaction between testing rounds and $\text{PM}_{2.5}$ exposure

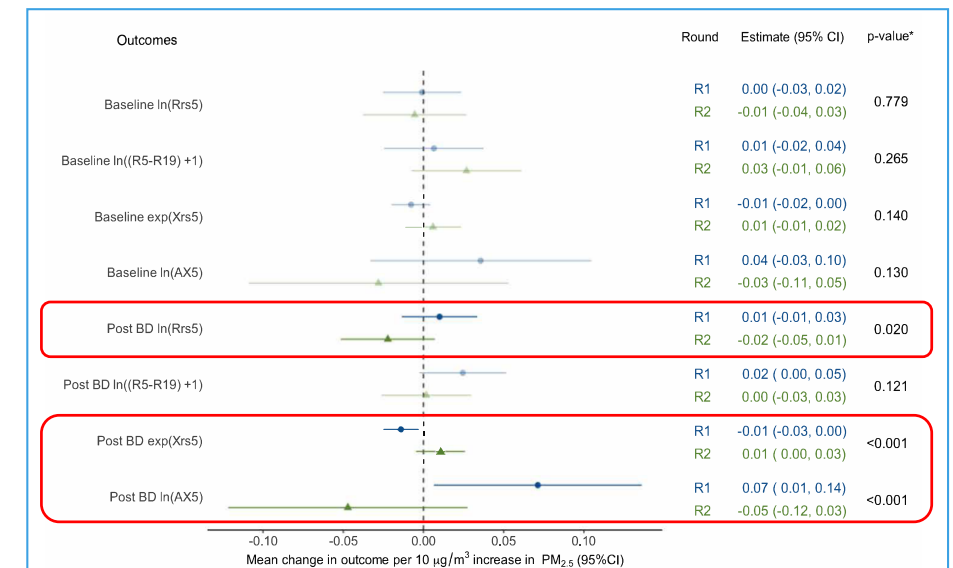


Figure 2. Models of FOT as a function of $\text{PM}_{2.5}$ adjusting for age, sex, height, weight, education, employment, asthma, spirometric COPD and smoking
* p-value for the interaction between testing rounds and $\text{PM}_{2.5}$ exposure

Conclusions

- In this long-term assessment of air pollution on lung health, the attenuated association between exposure and respiratory function measures may indicate some recovery in lung function.
- With climate change driving increased frequency and severity of landscape fires, these results inform public health policies and planning for future events.

Disclosure of support & Relevant financial interests

- The Hazelwood Health Study is funded by the Victorian Department of Health. However, the views on this poster are those of the authors and not those of the Department.
- MJA holds investigator-initiated grants from Pfizer, Boehringer-Ingelheim and GSK for unrelated research. He has undertaken an unrelated consultancy for Sanofi and received a speaker's fee from GSK.

CONTACT DETAILS

- Professor Bruce Thompson
- School of Health Sciences, University of Melbourne
- Tel: +61 3 8344 7272
- E-mail: b.thompson@unimelb.edu.au
- Web: hazelwoodhealthstudy.org.au



AlfredHealth

