Change in Lung Function After Exposure to Smoke From a Mine Fire: A Clinical Follow-up

N. Holt[1], C. L. Smith[1], C. X. Gao[1], B. Borg[2], T. J. Lane[1], D. Brown[1], J. Ikin[1], A. Makar[3], T. McCrabb[3], M. Mikayla[3], K. Nilsen[3], B. R. Thompson[4], M. J. Abramson[1]; [1]School of Public Health & Preventive Medicine, Monash University, Melbourne, Australia, [2]Respiratory Medicine, The Alfred, Melbourne, Australia, [3]Respiratory Medicine, Alfred Health, Melbourne, Australia, [4]School Health Sciences, Mail H21, Swinburne University, Melbourne, Australia.

RATIONALE: In 2014, a 45-day fire at the Hazelwood coal mine exposed residents in the adjacent town of Morwell, Australia, to high concentrations of fine particulate matter <2.5µm ($PM_{2.5}$). 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. We evaluated the impact of exposures on respiratory health.METHODS: Respiratory testing was conducted 3.5-4 (Round 1) and 7.3-7.8 years (Round 2) after the mine fire. Individual $PM_{2.5}$ 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 $PM_{2.5}$ exposure and outcomes, controlling for key confounders.RESULTS: Clinical assessments were completed by 519 (346 exposed) in R1 and 329 (217 exposed) participants in R2. Participant characteristics were comparable across survey rounds. Detailed examination of $PM_{2.5}$ levels during the 'Black Summer' wildfires suggested exposure was not significantly different between the two towns. Spirometry and gas transfer in R2 were lower compared with R1, excepting FVC (increased) and FEV_1 (minimal change). The analysis found evidence that the effect of exposure changed over time from a negative effect in R1 to no effect in R2 for both baseline FVC (p=0.005) and post-bronchodilator FVC z-scores (p=0.032). As a result, a reversed direction of association for FEV_1/FVC z-scores was evident both at baseline (p=0.007) and post-bronchodilator (p=0.002). However, the estimated mean change in spirometry with increasing $PM_{2.5}$ exposure overlapped with a null effect in both rounds. Similarly, exposure to mine fire-related $PM_{2.5}$ was not associated with gas transfer at either R1 or R2 and the effect was unchanged between rounds. For the estimated effect of $PM_{2.5}$ exposure on transformed FOT outcomes, both post-bronchodilator reactance (exp[Xrs5]) and area under the reactance curve (ln[AX5]), a negative impact of exposure in R1 showed signs of recovery in R2 (both p<0.001). 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 should inform public health policies and planning for future events.Funding source: Victorian Department of Health

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