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Appendix

This appendix was part of the submitted manuscript and has been peer reviewed. It is posted as supplied by the authors.

Appendix to: Broome R, Johnston FH, Horsley J, Morgan GG. A rapid assessment of the impact of hazard reduction burning around Sydney, May 2016. *Med J Aust* 2016; 205: 407-408. doi: 10.5694/mja16.00895.

Appendix - Detailed description of methods

Methods

We defined our study region as the Australian Bureau of Statistics (ABS) Sydney Greater Capital City Statistical Area (GCCSA). Within this region we estimated the number of deaths, cardiovascular (CV) hospitalisations and respiratory hospitalisations attributable to short-term exposure to smoke from hazard-reduction burning using the equation:

$$\begin{aligned}\text{Attributable number} &= (\text{Risk in exposed} - \text{Risk in unexposed}) \times \text{Population}\\ &= \text{Baseline incidence} \times (e^{\beta \Delta X} - 1) \times \text{Population}\end{aligned}$$

$e^{\beta \Delta X}$ is the relative risk associated with a ΔXµg/m^3 change in $PM_{2.5}$ concentration. β is a coefficient defining the relationship between a 1 µg/m^3 increase in $PM_{2.5}$ and a health outcome of interest. It is derived from epidemiological studies.

Exposure assessment (estimating ΔX)

Identification of smoky days

Daily-average $PM_{2.5}$ concentrations were obtained for all monitors in the Sydney, Lower Hunter and Illawarra regions of NSW for May 2016 from the NSW Office of Environment and Heritage air quality website.

The daily-average $PM_{2.5}$ concentration at all monitors in Sydney was averaged to give a daily city-wide concentration for all days in May. The daily city-wide values that exceeded the 99th centile of city-wide daily concentrations for the period 1997 to 2014 were considered "smoky" (Figure 1) (1,2). The presence of smoke plumes over the study area on these days was visually validated using satellite imagery (3).

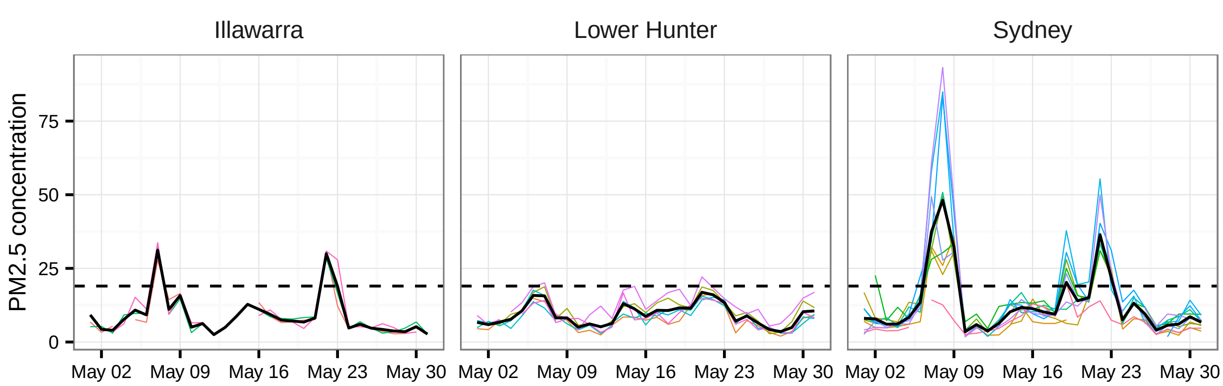

Figure 1: Daily average $PM_{2.5}$ concentrations (µg/m^3) at monitors in Illawarra, the Lower Hunter and Sydney. The coloured lines are the values for individual monitors. The solid black lines are the region-wide averages. The dashed black line is the 99th centile of the Sydney-wide daily concentration for the period 1997 to 2014. Days where the Sydney-wide average exceeded the 99th percentile were considered "smoky".

Estimation of the average smoke concentration at monitor locations

The smoke-related $PM_{2.5}$ concentration at the location of each monitor was estimated as the difference between the average concentration on smoky days in May 2016 and the concentration on the remaining

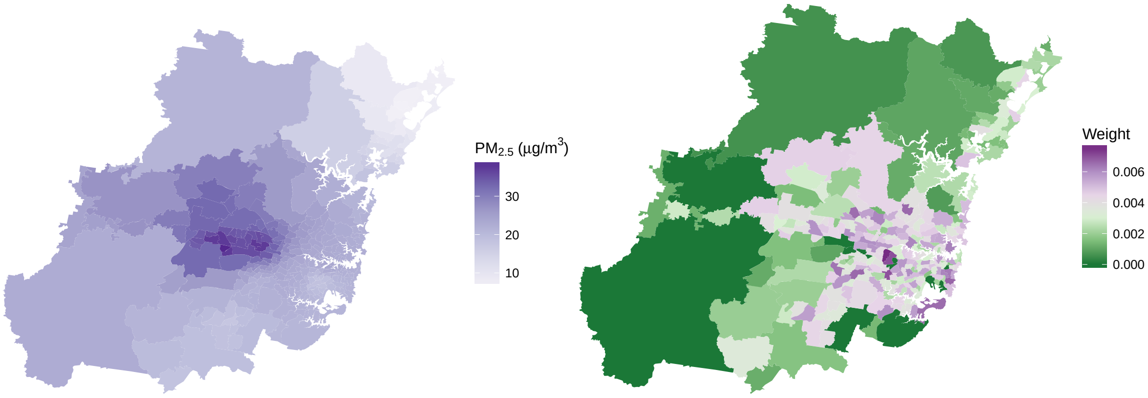

Figure 2: SA2-level smoke-related $PM_{2.5}$ concentrations (left) and the weights (right) applied to estimate the population weighted–mean concentration across the Sydney Greater Capital City Statistical Area.

non-smoky days. Review of satellite imagery suggested that smoke might be present on a number of other days, so this approach is most likely to result in an underestimate of the concentration.

Estimation of the population weighted-mean concentrations

The estimated smoke-related $PM_{2.5}$ concentration at each monitor was interpolated to a 500 × 500 grid that included the Sydney Greater Capital City Statistical Area (longitudes 150 to 151.8, latitudes -34.6 to -32.8) using kriging with a squared inverse distance weighting.

Statistical Area Level 2 (SA2) smoke-related $PM_{2.5}$ concentrations were then estimated by averaging of values at grid centroids within the SA2 boundaries. The result of this step was a smoke-related $PM_{2.5}$ concentration for each SA2 that represented the average concentration across all smoky days in May. These SA2-level concentrations were used to calculate a population weighted-mean concentration for the whole GCCSA study region, using Australian Bureau of Statistics SA2-level Estimated Resident Populations for 2014 (Figure 2).

Baseline incidence

The baseline death rate was calculated from SA2-level ABS deaths data, aggregated to the Sydney GCCSA (4). A crude cardiovascular disease (CVD) hospitalisation rate and respiratory disease hospitalisation rate for the Sydney region was calculated from NSW Ministry of Health hospitalisation data (5). CV hospitalisation data were only available at Local Government Area level and the rate was calculated for the subset of all NSW LGAs that lay completely within the Sydney GCCSA. Respiratory hospitalisation data were only available at a Local Health District level. We assumed that crude rate in the Sydney GCCSA was the same as the rate for all Sydney Metropolitan Local Health Districts.

Table 1: Baseline incidence rates used in the assessment.

Health outcome	Data source	Rate (per 100,000 per day)
All cause mortality	ABS	1.6
CVD Hospitalisation	HealthStats NSW	4.5
Respiratory hospitalisation	HealthStats NSW	4.3

Concentration response coefficients (β)

We used concentration response coefficients recommended by the World Health Organization Health Risks of Air Pollution in Europe project (6). These coefficients are derived from meta-analyses of European studies.

Table 2: HRAPIE concentration response coefficients.

Health outcome	Age group	Estimate per 10 μg/m^3	β-coefficient
All cause mortality	All	1.0123 (1.0045 – 1:38153)	0.0012 (0.0004 – 0.002)
CVD Hospitalisation	All	1.0091 (1.0017 – 1.0166)	0.0009 (0.0002 – 0.0016)
Respiratory hospitalisation	All	1.019 (0.9982 – 1.0402)	0.0019 (-0.0002 – 0.0039)

The confidence intervals presented in the report reflect the statistical imprecision in the health outcome risk coefficient only. While reporting results in this way is consistent with the approach taken in previous assessments (7,8) it must be emphasised that there are numerous other sources of uncertainty in this assessment.

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