 Unequal exposure: the distribution and health impacts of air pollution in Australia

Climate Change Research Centre
4-5 March 2015
Air pollution and health monitoring

Climate Change Research Centre
4 March 2015

Bin Jalaludin
Conjoint Professor, School of Public Health and Community Medicine, UNSW
Centre for Air quality and health Research and evaluation (CAR)
Brief bio.

- MBBS (Syd; 1978); MPH (Syd; 1990); PhD (Syd; 2001)
- Clinical Paediatrics – Sydney, Perth, Kimberleys, Bristol
- Public Health Physician/epidemiologist – communicable disease control, environmental health
- Research areas – environmental health (air pollution, built environment), health services, clinical
Outline of this talk

• Describe the burden of disease due to particulate air pollution
• Air quality monitoring
• Health monitoring
PM10 levels for selected cities by WHO region, for last available year 2008-12

Source: WHO’s Ambient Air Pollution database - Update 2014
Percentage of the assessed urban population exceeding WHO Air Quality Guidelines (AQG)

WHO AQG: Annual mean PM$_{10}$: 20 ug/m$^3$; Annual mean PM$_{2.5}$: 10 ug/m$^3$

Source: WHO’s Ambient Air Pollution database - Update 2014
Burden of disease attributable to 20 leading risk factors in 2010, expressed as a percentage of global disability-adjusted life-years

Source: Lim SS et al. Lancet 2012;380:2224-60
Burden of disease due to ambient air pollution

- The cost of the health impact of air pollution in OECD countries about USD 1.7 trillion in 2010.

- In China, the cost of the health impact of air pollution about USD 1.4 trillion in 2010, and about USD 0.5 trillion in India.

Source: OECD 2014. The Cost of Air Pollution. Health Impacts of Road Transport
Causal relationships between particulates and health effects

**Long term PM$_{2.5}$ exposures**

- Not likely: Central Nervous System
- Inadequate to infer
- Suggestive: Respiratory effects
- Likely: Cardiovascular effects
- Causal: Mortality

**Short term PM$_{2.5}$ exposures**

Since 2009, there have also been the two IARC reports that classified diesel and particulates as carcinogens

Source: US EPA 2009. Integrated science assessment for particulate matter
Air pollution data for research

- Routine monitoring by NSW EPA

- Campaign monitoring
  - eg. Lower Hunter study
Air monitoring sites in the Sydney region
<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Ozone O₃</th>
<th>Ozone O₃</th>
<th>Nitrogen Dioxide NO₂</th>
<th>Visibility NEPH</th>
<th>Carbon Monoxide CO</th>
<th>Sulfur Dioxide SO₂</th>
<th>Particles PM10</th>
<th>Particles PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Averaging Periods</td>
<td>1-hour average</td>
<td>rolling 4-hour average</td>
<td>1-hour average</td>
<td>rolling 8-hour average</td>
<td>1-hour average</td>
<td>rolling 24-hour average</td>
<td>1-hour average</td>
<td>rolling 24-hour average</td>
</tr>
<tr>
<td>Sydney East</td>
<td>Randwick</td>
<td>2.1</td>
<td>0.7</td>
<td>0.13</td>
<td>0.4</td>
<td>16.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rozelle</td>
<td>1.9</td>
<td>1.2</td>
<td>0.7</td>
<td>0.06</td>
<td>0.3</td>
<td>16.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lindfield</td>
<td>2.3</td>
<td>1.3</td>
<td>0.5</td>
<td>0.09</td>
<td>0.5</td>
<td>9.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chullora</td>
<td>2.3</td>
<td>1.4</td>
<td>0.9</td>
<td>0.12</td>
<td>0.4</td>
<td>18.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Earlwood</td>
<td>1.9</td>
<td>1.2</td>
<td>0.6</td>
<td>0.11</td>
<td>0.4</td>
<td>17.1</td>
<td></td>
</tr>
<tr>
<td>Sydney North-West</td>
<td>Richmond</td>
<td>2.3</td>
<td>1.5</td>
<td>0.1</td>
<td>0.11</td>
<td>0.0</td>
<td>15.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>St Marys</td>
<td>2.8</td>
<td>1.6</td>
<td>0.0</td>
<td>0.13</td>
<td>0.0</td>
<td>17.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vineyard</td>
<td>2.3</td>
<td>1.6</td>
<td>0.1</td>
<td>0.09</td>
<td>0.0</td>
<td>15.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prospect</td>
<td>2.7</td>
<td>1.6</td>
<td>0.2</td>
<td>0.11</td>
<td>0.1</td>
<td>0.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Sydney South-West</td>
<td>Bargo</td>
<td>2.7</td>
<td>2.2</td>
<td>0.2</td>
<td>0.12</td>
<td>0.0</td>
<td>14.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bringelly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Camden</td>
<td>2.9</td>
<td>1.6</td>
<td>0.2</td>
<td>0.12</td>
<td>0.1</td>
<td>14.9</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Campbelltown West</td>
<td>2.5</td>
<td>1.4</td>
<td>0.5</td>
<td>0.13</td>
<td>0.4</td>
<td>0.0</td>
<td>18.4</td>
</tr>
<tr>
<td></td>
<td>Liverpool</td>
<td>2.6</td>
<td>1.4</td>
<td>0.3</td>
<td>0.11</td>
<td>0.5</td>
<td>19.8</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>Oakdale</td>
<td>2.7</td>
<td>2.4</td>
<td>0.1</td>
<td>0.19</td>
<td>12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illawarra</td>
<td>Wollongong</td>
<td>2.7</td>
<td>2.0</td>
<td>0.4</td>
<td>0.13</td>
<td>0.2</td>
<td>0.1</td>
<td>18.2</td>
</tr>
<tr>
<td></td>
<td>Kembla Grange</td>
<td>2.7</td>
<td>2.2</td>
<td>0.3</td>
<td>0.10</td>
<td></td>
<td></td>
<td>19.3</td>
</tr>
<tr>
<td></td>
<td>Albion Park Sth</td>
<td>3.0</td>
<td>2.1</td>
<td>0.2</td>
<td>0.10</td>
<td>0.2</td>
<td>15.0</td>
<td>3.1</td>
</tr>
<tr>
<td>Lower Hunter</td>
<td>Wallisend</td>
<td>2.3</td>
<td>1.4</td>
<td>0.2</td>
<td>0.11</td>
<td>0.0</td>
<td>17.8</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>Newcastle</td>
<td>2.3</td>
<td>1.3</td>
<td>0.4</td>
<td>0.14</td>
<td>0.3</td>
<td>0.1</td>
<td>19.6</td>
</tr>
<tr>
<td></td>
<td>Beresfield</td>
<td>2.4</td>
<td>1.5</td>
<td>0.1</td>
<td>0.14</td>
<td>0.0</td>
<td>22.9</td>
<td>6.8</td>
</tr>
<tr>
<td>Central Coast</td>
<td>Wyong</td>
<td>2.8</td>
<td>1.7</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.3</td>
<td>14.8</td>
</tr>
<tr>
<td></td>
<td>Bathurst</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tamworth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Albury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wagga Wagga Nth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26.0</td>
<td>7.4</td>
</tr>
<tr>
<td>Upper Hunter - Muswellbrook</td>
<td>Muswellbrook</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Upper Hunter - Singleton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Gaps indicate that an instrument was not online for that period OR an average could not be calculated as there were not enough valid hourly data values OR that a pollutant is not measured at the site. Data from monitoring sites is collected, stored and shown in reports using Australian Eastern Standard time (AEST). Normally data for any hour should be available approximately 30 minutes later. However, during daylight saving, data is still collected and stored in AEST and will be presented with an apparent 90 minutes delay.
### Search air quality data

- There is currently increased bushfire activity in many parts of New South Wales, it is anticipated that during this period, visibility and air quality alerts may be raised. For more information go to CurrentFire and HistoricFire on the NSW Rural Fire Service web site.

### Daily Averages

**Time Range:** 01/01/2006 00:00 to 01/01/2014 00:00

<table>
<thead>
<tr>
<th>Date</th>
<th>STN MINTY</th>
<th>24th day average from 4th average (gpm)</th>
<th>STN MINTY</th>
<th>24th day average from 1st average (gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27/12/2006</td>
<td>1.9</td>
<td>17.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28/12/2007</td>
<td>3.7</td>
<td>17.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29/12/2007</td>
<td>1.9</td>
<td>14.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30/12/2007</td>
<td>1.6</td>
<td>14.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31/12/2007</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01/01/2008</td>
<td>1.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02/01/2008</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03/01/2008</td>
<td>1.4</td>
<td>18.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>04/01/2008</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05/01/2008</td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06/01/2008</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07/01/2008</td>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/01/2008</td>
<td>1.6</td>
<td>27.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/01/2008</td>
<td>1.9</td>
<td>24.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/01/2008</td>
<td>1.9</td>
<td>23.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/01/2008</td>
<td>1.8</td>
<td>19.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/01/2008</td>
<td>2.5</td>
<td>27.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13/01/2008</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14/01/2008</td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15/01/2008</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16/01/2008</td>
<td>2.6</td>
<td>21.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17/01/2008</td>
<td>1.5</td>
<td>21.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18/01/2008</td>
<td>2.0</td>
<td>13.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19/01/2008</td>
<td>0.4</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20/01/2008</td>
<td>1.8</td>
<td>9.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21/01/2008</td>
<td>2.6</td>
<td>12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22/01/2008</td>
<td>1.4</td>
<td>12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23/01/2008</td>
<td>1.7</td>
<td>18.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lower Hunter Particle Characterisation Study

3rd Progress Report (Spring)

Mark F. Hibberd, Melita D. Keywood, David D. Cohen (ANSTO), Ed Stakic (ANSTO), Yvonne Scorgie (OEH), and Scott Thompson (OEH)

January 2015

Prepared for
NSW Environment Protection Authority (Contact: Judy Greenwood)
Health data for research

• Primary data
  – fit for purpose
  – expensive

• Secondary data
  – routinely collected data, surveys, etc.
  – data collected for other purposes
  – may not be exactly what you need
  – relatively inexpensive
Health data

• Routinely collected data
• Ongoing population surveys
  – NSW Population Health Survey
  – National Health Survey, Longitudinal Study of Australian Children
  – 45&Up Study
• Opportunistic research data
  – Australian Child Health and Air Pollution Study (ACHAPS)
• Data linkage
Routinely collected health data

- Deaths
- Hospitalisations
- Emergency department visits
- Births
- Cancers
- Ambulance call-out
HOIST Dataset Documentation (by library)

ACS  
NSW Ambulatory Care Sensitive Condition Data

ARIA  
Accessibility / Remoteness Index of Australia

ASGC  
Australian Standard Geographical Classification

BDR  
NSW Birth Defects Register 1990 - Current

DEATHS  
All Deaths 1964-2004  
Perinatal Deaths, 1983-2004

EDDC  
Emergency Department Data Collection (EDDC),  
August 1994 - present

FALL_SVY  
Falls Baseline Survey

GP  
Dendrite General Practice and Practitioner data

HIV  
NSW HIV/AIDS Database

ISC  
Inpatient Statistics Collection, 1988-present

ISC  
Australian and NSW Map Datasets

MAPSAUS  
NSW Midwives Data Collection (MDC)  

MDC  
The Notifiable Conditions Information Management System (NCIMS)

NCIMS  
NSW Notifiable Diseases Database (NDD)  
1993-2009

NDD (aka IDSS)
<table>
<thead>
<tr>
<th>Dataset Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pdthrevw</td>
<td>NSW Maternal and Perinatal Death Review Datasets</td>
</tr>
<tr>
<td>POPS</td>
<td>ABS Populations, 1972-2017</td>
</tr>
<tr>
<td>SOKS</td>
<td>NSW Save Our Kids Smile oral health data 1996-98</td>
</tr>
<tr>
<td>SURVEYS</td>
<td>NSW Population Health Survey 2002 onwards</td>
</tr>
<tr>
<td></td>
<td>NSW School Students Health Behaviours Survey 2002 onwards</td>
</tr>
<tr>
<td></td>
<td>NSW Child Health Survey 2001</td>
</tr>
<tr>
<td></td>
<td>NSW Health Older Persons Health Survey 1999</td>
</tr>
<tr>
<td></td>
<td>NSW Health Survey 1997</td>
</tr>
<tr>
<td></td>
<td>NSW Health Survey combined 1997/1998</td>
</tr>
<tr>
<td></td>
<td>1995 National Health Survey</td>
</tr>
<tr>
<td>NSW Health Promotion Survey 1994</td>
<td></td>
</tr>
<tr>
<td>WPAGES</td>
<td>NSW and ACT White and Yellow Pages, Nov 1998</td>
</tr>
</tbody>
</table>
Examples using routinely collected health data


A recently funded ARC project using routinely collected data

- to develop health risk-based metrics to define a heatwave across different areas
- **deaths, hospitalisations, emergency department visits, ambulance call-outs**
NSW Adult Population Health Survey

• Telephone survey conducted by NSW Health
• Since 1997
• About 15,000 participants aged 16+ years of age each year
• Conducted between February and December
• Ongoing survey

The 45 and Up Study

- Funded by NSW Health plus others; managed by the Sax Institute
- 267,153 participants recruited (2006-2009)
- Follow-up survey every 5 years
- 2nd wave - 2012-March 2015 (60% response rate)
- Participants have given consent to link their questionnaire data to a range of health datasets (eg. cancer, death, ED visits, hospitalisation, PBS, MBS)
- Questionnaires available on the Sax Institute website (https://www.saxinstitute.org.au/our-work/45-up-study/questionnaires/)
Examples using health survey data


Using other research data opportunistically

- Australian Child Health and Air Pollution Study (ACHAPS; ARC LP)
  - Conducted in six cities
  - Local data to inform air quality guidelines
  - Utilised national monitoring network
  - Focused on respiratory outcomes
  - Report published 2012
Additional analysis of ACHAPS – PhD project


Data linkage

• Powerful method for answering health related research questions
• Particularly useful when cannot ethically conduct studies in humans
Some examples:

• Does the measles vaccine predispose to Crohn’s disease?
• Does abortion increase the risk of breast cancer?
• Are outcomes better for stroke patients if they are admitted to a hospital with a Stroke Unit?
In NSW, there is the Centre for Health Record Linkage (CHeReL)

- joint venture between NSW Health and a number of institutions (including UNSW)
- based in NSW Health Department, North Sydney
- links routinely collected health datasets
- will also link data project specific datasets to routinely collected health datasets
- there are costs involved

Impact of long term exposure to air pollution - a data linkage project

• Link the following datasets:
  – Baseline 45&Up study (approx. 260,000 participants)
  – Follow-up 45&Up study
  – Deaths
  – Hospitalisations
  – Emergency department visits
  – Cancer Registry data

• Received data custodian approvals

• Received HREC approval last week
Thank you