Australian Work Exposures Study (AWES)

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Occupational Carcinogens

- Over 165 occupational carcinogens identified by IARC, plus 18 occupations or circumstances

- Occupational exposures of particular concern because encountered involuntarily
  - Also more likely amenable to risk reduction

- Exposures contribute to burden of cancer
  - In UK, 8.2% of cancers in males and 2.3% in females estimated to be occupational
Prevalence of Exposure

- Significant knowledge gaps regarding prevalence
  - Important for understanding pattern, targeting prevention, estimating burden

- Existing studies generally:
  - Rely on job title; and/or
  - Focus on specific exposures or industries

- Need large-scale community-based studies
  - E.g. NHEWS survey (Australia) 2008 – n=4500
Exposure Assessment Methods

- Number of methods of exposure assessment may be applied in large studies
  - Job Exposure Matrices (JEMs)
  - Self-report
  - Expert assessment (gold standard)

- Automated expert assessment - OccIDEAS
Australian Work Exposures Study (AWES)

- Aimed to investigate prevalence of current occupational exposure to carcinogens
  - Using automated expert assessment method
- Cross-sectional telephone survey of Australian workers aged 18 to 65
Priority Carcinogens

- 38 carcinogens relevant to working conditions in Australia
- 3 criteria for prioritisation:
  - Evidence of carcinogenicity (IARC)
  - Use in occupational circumstances
  - Evidence of use in Australian industry
Final list comprising 7 groups:

- 3 combustion products
- 2 inorganic dusts
- 2 organic dusts
- 7 metals
- 4 sources of radiation
- 19 industrial chemicals
- 1 non-chemical agent (shiftwork)
Interview process

Demographic Questionnaire

Screening Questionnaire

Unexposed

Potentially Exposed

Job History

JSM (OccIDEAS)
Job Specific Modules (JSMs)

- Developed JSMs for 57 jobs/industries
- Questions on determinants of exposure and use of controls
  - Frequency of tasks
  - Task method
- Also generic JSM if appropriate JSM could not be determined
Exposure Assessment - OccIDEAS

- Automated rule-based expert assessment method
  - JSM answers trigger rules which relate to exposure
  - Rules from literature and expert opinion
- Reviewed by project coordinator and occupational hygienists where necessary
Exposure Assessment (2)

- Probability – probable, possible, none
- Level – high, medium, low, unknown
- Frequency (hours per week, weeks per year)
Participants

- 5,023 Australian workers
- 55% male
- Mean age 46 (SD=11)
- 80% born in Australia
- Respondents significantly older and more likely to have been born in Australia
  - Similar to Census population in terms of gender, SES, education
- Overall 72% cooperation rate
Exposures

- 1,880 respondents (38%) exposed to at least one carcinogen
- 100% of farmers, heavy vehicle drivers, plumbers, miners, and painters exposed
- But respondents in all occupational groups exposed (including office workers, 9% exposed)
Most Common Exposures

1. Solar radiation (22%)
2. Diesel engine exhaust (18%)
3. Environmental tobacco smoke (14%)
4. Benzene (10%)
5. Wood dust (7%)
6. Silica (6%)
7. Shiftwork (6%)
8. Lead (6%)
9. Other polycyclic aromatic hydrocarbons (6%)
10. Artificial ultraviolet radiation (5%)
Demographic Differences

- Exposures higher among:
  - Male workers (53% exposed) vs. female workers (19%)
  - Those aged under 35 (44% exposed) vs. 35 to 54 (36%) or 55+ (39%)
  - Those who had completed a trade certificate (51% exposed) vs. high school education (41%) or bachelor degree (23%)

- No difference between Australian-born (38%) and migrant workers (36%)
Extrapolation to Australian Population

- Extrapolated exposures to Australian working population
  - Conducted separately by occupational group and gender
- Overall 3.6 million workers (40%, 95% CI 39-42) expected to be exposed
  - 2.7 million male workers (58%; 95% CI 56-60)
  - 0.9 million female workers (21%; 95% CI 19-22)
### Exposures by Occupation - Farmers

- 148 farmers, 76% male
- All exposed to at least one carcinogen, mean 5.6
- Most prevalent exposures: solar UV, diesel exhaust, benzene
- Exposure differences by gender, farm type

<table>
<thead>
<tr>
<th>Carcinogen</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar UV</td>
<td>98</td>
</tr>
<tr>
<td>Diesel Engine Exhaust</td>
<td>93</td>
</tr>
<tr>
<td>Benzene</td>
<td>80</td>
</tr>
<tr>
<td>Other PAHs</td>
<td>74</td>
</tr>
<tr>
<td>Wood Dust</td>
<td>70</td>
</tr>
<tr>
<td>Artificial UV</td>
<td>43</td>
</tr>
<tr>
<td>Silica</td>
<td>25</td>
</tr>
<tr>
<td>Lead</td>
<td>24</td>
</tr>
<tr>
<td>Chromium VI</td>
<td>10</td>
</tr>
<tr>
<td>Nickel</td>
<td>8</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>8</td>
</tr>
</tbody>
</table>
Exposures by Carcinogen – Wood Dust

- 341 workers (7%) exposed to wood dust
  - 44% at low level, 25% medium, 30% high
  - 1% at unknown level (n=3)

- Most commonly exposed occupations:
  - Carpenters (92% exposed)
  - Painters (83%)
  - Farmers (70%)
  - Handypersons (45%)
Exposures by Carcinogen – Wood Dust (2)

- Carpenter (n=88)
- Painter (n=23)
- Farmers (n=148)
- Handypersons (n=38)

Unexposed
Unknown
High
Medium
Low
Exposures in Western Australia

- AWES-WA - investigating prevalence of current occupational exposure to carcinogens among WA workers
- Possible that prevalence higher in WA
  - AWES found slightly higher prevalence of exposure in WA (43% vs 38% national), not significant when controlling for occupation
  - Possibly due to different pattern of industries – higher percentage employed in construction (10.4% vs 8.4% national) and mining (6.3% vs 1.8%)
  - Workplace regulations governed by state
AWES-WA Participants

- 505 Western Australian workers
  - 61% male
  - Mean age 47 (SD=11)
  - 71% born in Australia

- Combined with 561 WA workers from national AWES – final sample 1,066 respondents

- Respondents significantly older and more likely to have completed a higher education degree (compared with Census)
  - Similar to Census population in terms of gender, SES, occupation
Prevalence of Exposure - WA

- 447 respondents (42%) probably exposed to at least one carcinogen
  - Significantly higher than national study (38%)

- Extrapolated to 429,500 WA workers (44%) – 329,250 males (63%) & 100,250 females (22%)
  - Again significantly higher than national study (40%)
Most Common Exposures - WA

1. Solar radiation (25%)
2. Diesel engine exhaust (22%)
3. Environmental tobacco smoke (15%)
4. Silica (11%)
5. Benzene (10%)
6. Lead (8%)
7. Shiftwork (8%)
8. Other polycyclic aromatic hydrocarbons (7%)
9. Wood dust (7%)
10. Artificial ultraviolet radiation (7%)
Demographic Differences - WA

- Exposures higher among:
  - Male workers (53% exposed) vs. females (26%)
  - Those who had completed trade certificate (53% exposed) vs. high school (47%) or higher education (29%)
  - Those who live in remote or very remote areas (64%) vs. major city (37%) or regional areas (52%)

- No differences between Australian-born (41% exposed) and migrant workers (43%)
Differences by Occupation – Males (WA)

- In males, 100% of respondents in 12 of 30 occupational groups exposed

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Common Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Vehicle Drivers</td>
<td>DEE, Solar UV</td>
</tr>
<tr>
<td>Farmers</td>
<td>DEE, Solar UV</td>
</tr>
<tr>
<td>Vehicle Trades</td>
<td>DEE, Asbestos</td>
</tr>
<tr>
<td>Animal &amp; Horticultural</td>
<td>Solar UV, Benzene</td>
</tr>
<tr>
<td>Miners</td>
<td>Silica, ETS</td>
</tr>
<tr>
<td>Carpenters</td>
<td>Wood Dust, Solar UV</td>
</tr>
<tr>
<td>Painters</td>
<td>Solar UV, Wood Dust</td>
</tr>
<tr>
<td>Plumbers</td>
<td>Solar UV, Silica</td>
</tr>
<tr>
<td>Automobile Drivers</td>
<td>DEE, Benzene</td>
</tr>
<tr>
<td>Outdoor Work NEC</td>
<td>Solar UV, Wood Dust</td>
</tr>
<tr>
<td>Passenger Transport</td>
<td>DEE, ETS</td>
</tr>
<tr>
<td>Nurses</td>
<td>Other PAHs, Shiftwork</td>
</tr>
</tbody>
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Differences by Occupation – Females (WA)

<table>
<thead>
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<tbody>
<tr>
<td>Farmers</td>
<td>DEE, Solar UV</td>
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<tr>
<td>Automobile Drivers</td>
<td>Solar UV, Benzene</td>
</tr>
<tr>
<td>Passenger Transport</td>
<td>Shiftwork, DEE</td>
</tr>
<tr>
<td>Warehousing</td>
<td>DEE, Wood Dust</td>
</tr>
<tr>
<td>Emergency Workers</td>
<td>DEE, Other PAHs</td>
</tr>
<tr>
<td>Heavy Vehicle Drivers</td>
<td>DEE, ETS</td>
</tr>
<tr>
<td>Metal Workers</td>
<td>DEE, Artificial UV</td>
</tr>
<tr>
<td>Carpenters</td>
<td>Formaldehyde, Wood Dust</td>
</tr>
<tr>
<td>Construction Workers</td>
<td>Silica, Solar UV</td>
</tr>
<tr>
<td>Electrical Workers</td>
<td>Benzene, DEE</td>
</tr>
<tr>
<td>Engineers</td>
<td>Silica, Solar UV</td>
</tr>
<tr>
<td>Miners</td>
<td>DEE, Silica</td>
</tr>
<tr>
<td>Vehicle Trades</td>
<td>DEE, ETS</td>
</tr>
</tbody>
</table>

- In females, 100% of respondents in 13 of 30 occupational groups exposed
Summary

- Prevalence of exposure to occupational carcinogens quite high among Australian workers
  - Higher among WA workers
- Exposures across all occupational groups, including those traditionally thought unexposed, but patterns of exposure different
Limitations

- Exposure assessments based on self-report of tasks
- Under-representation of younger and migrant workers
- Relatively low response fraction
Conclusions and Implications

- Methodology useful in pinpointing areas where controls inadequate
- Population-based approach and ability to capture exposures across occupations and demographic groups particular strengths of study
- Results will allow more accurate planning of prevention activities
  - Will be used to estimate lifetime risk of future occupational cancers in Australia and potential success of intervention strategies
  - Can suggest areas where regulatory activities may be of most use
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