A Control-based Biological Monitoring Guidance value for PAHS and a follow-up study of exposure in UK workplaces.

J Cocker¹, J Wheeler² K Jones¹, A Easterbrook¹, C Keen¹
¹Health & Safety Laboratory, ²Health & Safety Executive

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Messages

• Biological Monitoring is a useful tool to assess exposure, controls (including behaviour)

• A biological monitoring guidance value based on the 90th percentile of data from workplaces with good practice is easy to develop and apply.
Introduction (1)

PAH’s are a group of hydrocarbon compounds with a structure in which 2-6 or more carbon rings are fused together

- PAH’s occur naturally and are formed from combustion of organic matter
- Found in a wide range of workplaces
- Thousands of workers may be exposed
- Some(>9) PAHS are carcinogenic

• Clear need to control exposure to PAHs
  - Reduce exposure
  - Reduce risk of ill-health

• HSE Disease Reduction Programme (DRP)
  - Respiratory Diseases (Asthma, COPD)
  - Carcinogens
    • PAHs
HSE survey in 1998 of 25 workplaces provides a baseline
- Data used by HSE to consider airborne and biological ‘limits’
  - Benzo(a)pyrene a good marker of carcinogenic PAHs but no limit set
  - Urinary 1-hydroxypyrene a good marker of exposure to B(a)P
    - Biological monitoring guidance value 4µmol/mol (~8µg/l)
- Biological monitoring useful
  - Dermal absorption
  - Where personal Respiratory Protective Equipment used
Aims

- Gather information on how UK industry is currently controlling and managing exposure to Polyaromatic Hydrocarbons (PAH’s)
- Gather biological monitoring data from workers potentially exposed to PAHs
- Compare results to previous study ~ 8 years ago
Biological monitoring guidance value based on the 90th percentile of data

Frequency distribution of urinary 1-hydroxypyrene

90% value from workplaces with good control < 4 µmol/mol creatinine

90% all workplaces < 7 µmol/mol creatinine

1 µmol/mol ~ 2 µg/g
1998 Survey results

Oil & Bitumen

CTPV

Others

1-hydroxypyrene µmol/mol

BMGV 4 µmol/mol (8 µg/g)

Unwin et al 2006 Annals of Occ Hyg

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Sites Visited in 2006

- Creosote (different site to the 1998 survey)
- Coal Tar distillation (same site, same workers as 1998 survey)
- Aluminium Smelting (same site as 1998 survey)
- Clay Pigeon Manufacture (same site as 1998 survey, no samples as yet)
- Chimney Sweeps (not included in the 1998 survey)
Methods

• Exposure controls on site were assessed:
  – Both hardware and software controls were assessed
  – On site the supply / storage / use / manufacture / disposal / export of polyaromatic hydrocarbons (PAH's) was assessed

• Biological monitoring on a cross section of workers exposed to PAH’s.
  – Workers asked to collect urine samples before and at end of shift for 5 consecutive days
  – Urine samples analysed for 1-hydroxy pyrene
## Overall Summary - results

<table>
<thead>
<tr>
<th></th>
<th>No. Workers</th>
<th>No Urine Samples</th>
<th>% compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creosote</td>
<td>6</td>
<td>58</td>
<td>97</td>
</tr>
<tr>
<td>Tar Distillation</td>
<td>9</td>
<td>88</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>105</td>
<td>85</td>
</tr>
<tr>
<td>Sweeps</td>
<td>35</td>
<td>330</td>
<td>94</td>
</tr>
<tr>
<td>Aluminium</td>
<td>25</td>
<td>241</td>
<td>96</td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td>822</td>
<td>94</td>
</tr>
</tbody>
</table>
Coal Tar Distillation Sites

Post-shift urinary 1-hydroxy pyrene

Guidance value

Average value

Site 1

Site 2

µmol/mol

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Coal Tar Distillation site 2

Post-shift urinary 1-hydroxy pyrene

Guidance value

Average value

µmol/mol

Site 2 all
S2 tanker loading
Coal Tar Distillation Site 1- same jobs

Urinary 1-hydroxy pyrene

<table>
<thead>
<tr>
<th>Role</th>
<th>1998</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Monitoring plant</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>Day chemist</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Blending &amp; Loading</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Tar plant</td>
<td>2</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Coal Tar Distillation - results

- Difference in controls observed
- High exposure found not a hardware issue
- Main issue 'software'
- Non-compliance in wearing gloves and handling product.
- Management/worker issues
Coal Tar Distillation – result follow-up

• High results intervention applied.

• Workers with high results monitored.

• Work in progress
Creosote – timber impregnation

Post shift urinary 1 hydroxy pyrene

µmol/mol

Guidance value
Average value

Post-shift
Creosote - timber impregnation

Post shift urinary 1 hydroxy pyrene

Guidance value

Average value

1998

Post-shift

µmol/mol
Chimney Sweeps 2006

Post Shift urinary 1 hydroxy pyrene

Guidance value

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Aluminium Smelting - results

Post-shift Urinary 1-hydroxy pyrene

µmol/mol

1998 2006

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Summary

Urinary 1-hydroxy pyrene

- Tar 1998
- Tar 2006
- Creosote 1998
- Creosote 2006
- Alumin 1998
- Alumin 2006
- Soot 2006

µmol/mol

P<.003
P<.0001
ns

BMGV

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Conclusions

• Multiple urine samples are easy to collect

• BM useful for overall exposure assessment
  – BM useful for targeting behaviour/software problems of control even at exposure levels below BMGV

• Regular BM is useful for tracking changes in exposure/reductions in risk over time
Messages

• Biological Monitoring is a useful tool
  – To assess exposure, controls (including behaviour)

• A biological monitoring guidance value based on the 90th percentile of data from workplaces with good practice is easy to develop and apply by:
  – Regulators
  – Individual companies
  – It targets resources where they are most needed
  – It is practical
  – It is achievable

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