Health and Environment Analysis for Decision-making, Linkage Analysis and Monitoring Project:

Methodologies for using Epidemiologic Data in Work Environment and Health Analysis

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UNEP USEPA WHO
THE HEADLAMP PROCESS

1. Environ. Health - risk hazard
2. Socio-demographic data
   - Confounder data
   - Health effects data
   - Environmental exposure data
3. Risk reduction

DEFINITION OF PROBLEM
SPECIFICATION OF INFO. NEEDS
DATA COLLECTION & LINKAGE
QUANTIFICATION OF INDICATORS
POLICY ACTION / ASSESSMENT

MONITORING
THE AIMS AND PRINCIPLES

The HEADLAMP project is aimed at improving information support for environmental health (EH) policies; specifically:

• to produce and analyze EH data
• to convert these data into information
• to present this information easily
DISTINCTIVE FEATURES

• Reliance on established relationships between environmental exposure and health effects
• The use of routinely-collected data
• Intended to be an on-going activity
**USERS AND USES**

**HEADLAMP** is aimed primarily at senior public health officials and their technical personnel.

The main uses are:
- To create an information base
- To define policy actions
- To survey policy effectiveness

The potential scope of **HEADLAMP** is broad.
ACTIVITIES

Development and application of methodology

AEH indicators

Data collection and analysis

Publication of instructional material

Health and environment analysis and indicators for decision-making (*WHSQ*, 1995)

Linkage methods for environment and health analysis:
- General guidelines (*WHO*, 1996)
- Technical guidelines (*WHO*, 1997)

www3.occuphealth.fi/users/markku.nurminen/headlamp.htm
ACTIVITIES

Conduct of field studies (1994-1995)
- Accra, Ghana
- Calcutta, India
- Cape Town, South Africa
- Cotonou, Benin
- Dar es Salaam, Tanzania
- Managua, Nicaragua
- Manila, The Philippines
- Santiago, Chile
- São Paulo, Brazil
- Talcuhuano, Chile

Arrangement of consultation meetings:
- Geneva, Switzerland, 1994
- Nairobi, Kenya, 1995

Teaching of methods in workshops:
- Sosnowiec, Poland, 1996
- Prague, Czech Republic, 1997
- Harare, Zimbabwe, 1997
MODE OF LINKAGE ANALYSIS

INDIVIDUAL-LEVEL ANALYSIS

GROUP-LEVEL ANALYSIS

MULTI-LEVEL MODELING
MODE OF LINKAGE ANALYSIS

INDIVIDUAL-LEVEL ANALYSIS

GROUP-LEVEL ANALYSIS

MULTI-LEVEL MODELING
METHODS OF AGGREGATE DATA ANALYSIS

• ECOLOGIC ANALYSIS
• TIME-SERIES ANALYSIS
• HEALTH RISK ANALYSIS
ECOLOGIC FALLACY = AGGREGATION BIAS

The failure of group-level associations to properly reflect individual-level associations.

Aggregation bias occurs when data are aggregated ignoring the subgroups of data from which the individual observations came.
“AGGREGATION THEOREM”

If the individual-level regression of disease rate on exposure and covariates is linear, the ecological regression of the average rate on average exposure rate and average covariate rate level in any group will be linear with the same coefficients.

Langbein & Lichtman, *Ecological Inference*, 1978
TIME SERIES ANALYSIS:
REGRESSION OF DAILY MORTALITY ON SO₂

\[
\log \text{[daily mortality risk]} \{\text{lag 2 days}\} = 0.0268 \times \log \text{[SO₂ daily mean]} \{\mu g/m^3}\]

Distribution of SO₂ daily mean:
- 95th percentile = 929 µg/m³
- 5th percentile = 23 µg/m³

Risk Ratio (RR) = \exp[0.0268 \times \log(929) - \log(23)] = 1.10

Excess Risk (%) = RR - 1 = (1.10 - 1) \times 100% = 10 %
QUANTATIVE RISK ASSESSMENT OF THE HEALTH IMPACTS OF SILICA IN THE AUSTRALIAN LABOR FORCE

Aggregated data on exposure to chrystalline silica: level of exposure and number of exposed workers cross-classified by type of industry and occupation

Risk modeling: South African gold miner material


Prediction of expected number of silicosis cases and excess number of lung cancer cases according to a simple demographic model.

Leigh, Macaskil, Nurminen, Ann Occup Hyg 1997;41, suppl. 1
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Predicted number of **lung cancer** cases per year over a 40-year period in a working population of 136 400 men exposed to silica


<table>
<thead>
<tr>
<th>Exposure Level (respirable quartz)</th>
<th>Number of Cases (95% conf. interval)</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current levels</td>
<td>106 (93 - 123)</td>
<td>1.18</td>
</tr>
<tr>
<td>≤ 0.2 mg/m³</td>
<td>104 (93 - 117)</td>
<td>1.16</td>
</tr>
<tr>
<td>≤ 0.1 mg/m³</td>
<td>100 (92 - 110)</td>
<td>1.11</td>
</tr>
<tr>
<td>≤ 0.05 mg/m³</td>
<td>96 (91 - 102)</td>
<td>1.07</td>
</tr>
<tr>
<td>No exposure</td>
<td>90</td>
<td>1.00</td>
</tr>
</tbody>
</table>
CONCLUDING REMARKS

Providing decision makers estimates of environmental risks without corresponding estimates of the multiple uncertainties is not keeping with good epidemiologic practice.

The HEADLAMP are useful when used professionally.