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Transport-related health impact assessment
Estimation of health benefits of speed limit reduction at 9 highway sections in the Netherlands
Traffic-related Health Impact Assessment

- Assessment of transport-related health impact:
  - may guide policy decisions
  - can provide information on the effects of interventions on public health

- Studies quantifying the transport-related health impacts are scarce and lack common methodology

- Assessment of transport-related health effects usually concern estimates at lower (more local) aggregation levels
  - other input data and models are required
Speed limit reduction in the Netherlands

• Policy document traffic emissions (VROM, 2004):
  ➔ Traffic in densely populated urban areas causes health problems
  ➔ Speed limit reduction suggested as one of the possible measures

• 2002: pilot intervention on highway A13
• 2004: TRC estimated effects of speed limit reduction on noise and air pollution levels at highway sections
• 2005: Speed limit reduction introduced at highway hotspots

➔ What are health impacts in population (living near highway) of speed limit reduction?
A13 Overschie
Methods: an overview

**INPUT**
- Population density, modelled or measured exposure levels
- Meta-analysis, pooled analysis epidemiological studies
- Prevalence, incidence data, demographics
- Severity weights duration

**EFFECT OF POLICY**
- Selection of health endpoints
- Assessment of population exposure
- Identification of exposure-effect relations
- Estimation of the number of cases
- Calculation of the disease burden

- Air pollution concentrations and noise levels before and after: TRC-study
- Number of traffic accidents before and after: NRSI-study
Transport hot spots

- Length of the selected road sections: ± 6 km (0.1% of all Dutch highways)
## Selection of health endpoints

<table>
<thead>
<tr>
<th>Traffic-related exposure</th>
<th>Selected health endpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic-related air pollution</td>
<td>Cardiovascular mortality</td>
</tr>
<tr>
<td></td>
<td>Wheeze</td>
</tr>
<tr>
<td>Road traffic noise</td>
<td>Severe annoyance</td>
</tr>
<tr>
<td></td>
<td>Sleep disturbance</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular effects</td>
</tr>
<tr>
<td>Risk of traffic accidents/driving speed</td>
<td>Mortality</td>
</tr>
<tr>
<td></td>
<td>Injury (long term, &gt; 1 yr)</td>
</tr>
</tbody>
</table>
Population at risk

- **Traffic safety**: people that use the road

- **Traffic-related air pollution & road traffic noise**:
  - effects expected in population living close to the highway

→ HIA for people living within 500 m distance from highway
Assessment of population exposure before

- Traffic-related air pollution and road traffic noise:
  - combining data on the place of residence of the population with environmental quality data: modelled concentrations and noise levels

- Traffic safety:
  - actual speed (km/hr) data (TRC)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Exposure metric</th>
<th>Estimation method</th>
<th>Year**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic-related air pollution</td>
<td>NO$_2$ concentration in µg/m$^3$</td>
<td>Modelled, VLW *</td>
<td>2004</td>
</tr>
<tr>
<td>Road traffic noise</td>
<td>Noise level ($L_{den}$ and $L_{night}$) in dB(A)</td>
<td>Modelled, EMPARA †</td>
<td>2003</td>
</tr>
<tr>
<td>Traffic safety</td>
<td>Average speed (km/hr)</td>
<td>Actual data TRC ‡</td>
<td>2003</td>
</tr>
</tbody>
</table>

* TRC, 2004; † Dassen et al., 2001; ‡ Aarts and Van Stipdonk, in preparation; ** year for which the exposure was assessed.
## Change in exposure

*Modelled change in NO$_2$-concentration (in %) and noise levels (in dB(A))*

<table>
<thead>
<tr>
<th>Location</th>
<th>Average reduction in total NO$_2$ concentration (%)*</th>
<th>Average reduction in NO$_2$ concentration caused by the road (%)*</th>
<th>Reduction in noise level (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td>A10 west</td>
<td>3-6</td>
<td>12-20</td>
<td>0.9-1</td>
</tr>
<tr>
<td>A20 Rotterdam</td>
<td>1-3</td>
<td>7-9</td>
<td>0.4</td>
</tr>
<tr>
<td>A16 Dordrecht</td>
<td>0.5-2</td>
<td>4-7</td>
<td>0.4</td>
</tr>
<tr>
<td>A12 Voorburg</td>
<td>2-3</td>
<td>7-10</td>
<td>0.5</td>
</tr>
<tr>
<td>A9 Badhoevedorp</td>
<td>1-2</td>
<td>10-14</td>
<td>0.2</td>
</tr>
<tr>
<td>A12 Utrecht</td>
<td>4-5</td>
<td>14-16</td>
<td>1.3</td>
</tr>
<tr>
<td>A2 Waardenburg</td>
<td>4-6</td>
<td>10-16</td>
<td>0.4</td>
</tr>
<tr>
<td>A16 Rotterdam</td>
<td>1-2</td>
<td>7-9</td>
<td>0.4</td>
</tr>
<tr>
<td>A4/A10 Zuid</td>
<td>3-5</td>
<td>10-20</td>
<td>0.6-0.7</td>
</tr>
</tbody>
</table>

* Close to the road (50 – 100 m). Source: TRC, 2004
## Change in speed

*Estimated change in average traffic speed based on actual data.*

<table>
<thead>
<tr>
<th>Location</th>
<th>Average speed (km/hr)*</th>
<th>Before</th>
<th>After</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A10 Westlandgracht</td>
<td></td>
<td>83.4</td>
<td>66.6</td>
<td>16.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>89.6</td>
<td>72.4</td>
<td>17.2</td>
</tr>
<tr>
<td>Overtoomse veld</td>
<td></td>
<td>90.3</td>
<td>71.4</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>89.8</td>
<td>72.2</td>
<td>17.6</td>
</tr>
<tr>
<td>A10 De Kolenkit Sloterdijk</td>
<td></td>
<td>93.7</td>
<td>76.2</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80.8</td>
<td>67.0</td>
<td>13.8</td>
</tr>
<tr>
<td>A20 Rotterdam</td>
<td></td>
<td>90.0</td>
<td>70.6</td>
<td>19.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>85.9</td>
<td>64.4</td>
<td>21.5</td>
</tr>
<tr>
<td>A12 Voorburg</td>
<td></td>
<td>92.4</td>
<td>72.3</td>
<td>20.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>83.0</td>
<td>70.4</td>
<td>12.6</td>
</tr>
<tr>
<td>A12 Utrecht</td>
<td></td>
<td>97.8</td>
<td>91.3</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>99.0</td>
<td>89.1</td>
<td>9.9</td>
</tr>
</tbody>
</table>

*Source: Aarts and Van Stipdonk, in preparation.*

These results were extrapolated to the other locations.
Identification of exposure-effect relations

Relations that were derived from:

→ quantitative summary of (published) data (pooled analysis or meta-analysis)

Source: Miedema & Oudshoorn, 2001)
Estimation of the disease burden

Outcome | Population | Prevalence (per 1,000)
---|---|---
Cardiopulmonary mortality | 55-80 yrs | 6.34* 
Wheezing | 7-12 yrs | 50-200†
Ischemic heart disease | (m) 45-64 yrs | 72.3†
Injury | Gen pop | -

DALY = Number affected * Duration * Severity
Results: change in exposure distribution

Number of people living within 500 meters of the highway

Traffic-related air pollution (NO₂) in µg/m³

Before

After

Traffic-related air pollution (NO₂) in µg/m³

30 35 40 45 50 55 60

0 5000 10000 15000 20000

Number of people living within 500 meters of the highway
Result: change in exposure distribution

Road traffic noise ($L_{den}$) in dB(A)

Number of people living within 500 meters of the highway

Before

After
Traffic-related disease burden: *before* & *after*

![Bar chart showing traffic-related disease burden before and after interventions](chart.png)

- **Before** vs. **After**
  - **Road traffic noise**
  - **Traffic-related air pollution**
  - **Traffic accidents**

- DALYs (absolute) scale:
  - 0 to 900 DALYs

**Legend**:
- Pink: Before Road traffic noise
- Purple: After Road traffic noise
- Yellow: Before Traffic-related air pollution
- Green: After Traffic-related air pollution
- Light green: Before Traffic accidents
- Light green: After Traffic accidents
Conclusion

Our results were not a surprise:

• Intervention was rather local, affecting a relatively small # people;

• Only the highest exposure-levels were affected; background levels hardly changed;

• Modelled estimated reductions in noise and traffic-related air pollution were rather small (TRC, 2004; 2006)
Discussion (1)

• What is a good exposure indicator for traffic-related air pollution?
  → by choosing NO₂ we assume that reduction in other relevant pollutants by speed limit reduction was similar

• To what distance does the impact of the intervention extend?
  → choice of 500 m is arbitrary
  → although we estimated effects only for selected sections it is expected that consequences of intervention extend beyond
  → when do the calculated health benefits occur?
Discussion (2)

• People in urban areas are often exposed to several environmental exposures
  ➔ combined exposures might have synergistic, additive or antagonistic effects, still unknown

• Policy interventions/directions often are not evaluated and quantified in terms of health
  ➔ Lack of data about the effects of policy interventions on traffic-related emissions and/or
  ➔ Direct evidence is lacking about the extent to which transport interventions may improve health

➔ Is (method) case study of interest to other countries???????