GEZONDHEIDSIMPACT FIJN STOF

studiedag VMx vzw
4 september 2014

Sara Benoy

AGENTSCHAP ZORG & GEZONDHEID
PM Inhalation

Heart
- Altered cardiac autonomic function
- Increased dysrhythmic susceptibility
- Altered cardiac repolarization
- Increased myocardial ischemia

Lungs
- Inflammation
- Oxidative stress
- Accelerated progression and exacerbation of COPD
- Increased respiratory symptoms
- Effected pulmonary reflexes
- Reduced lung function

Blood
- Altered rheology
- Increased coagulability
- Translocated particles
- Peripheral thrombosis
- Reduced oxygen saturation

Systemic Inflammation
- Oxidative Stress
  - Increased CRP
  - Proinflammatory mediators
  - Leukocyte & platelet activation

Vasculature
- Atherosclerosis, accelerated progression of and destabilization of plaques
- Endothelial dysfunction
- Vasoconstriction and Hypertension

Brain
- Increased cerebrovascular ischemia
Schematic of a particle

by H. Miller
> A Tale of Six Cities

The ESCAPE study will investigate long-term effects on human health of exposure to air pollution in Europe. The background is that current estimates of the European health impact of especially fine particles in the air are large. However, available estimates are primarily based on exposure response relationships established in studies from North America. There is an urgent need to perform studies in Europe on recent and current exposures, and to use refined exposure assessment tools.

For published or accepted papers of the ESCAPE study look under Publications.

The overall strategy is to efficiently utilize health and confounder data from European cohort studies. To these studies, air pollution exposure assessment will be applied at the individual home address level of participants in each of these studies.

The objectives of the ESCAPE study are:
1. To develop a flexible methodology for assessment of long-term population exposure to air pollution focused primarily on fine particles, particle composition, and nitrogen oxides.
2. To apply the exposure assessment methodology on existing cohort studies of mortality and chronic disease in Europe that have been selected based on their potential to quantify relationships between long-term exposure and health response precisely.
3. Specifically, to investigate exposure-response relationships and thresholds for (a) adverse perinatal health outcomes, and development of diseases such as asthma in children; (b) respiratory disease endpoints in adults; (c) cardiovascular disease endpoints in adults; (d) all-cause and cause-specific mortality, and cancer incidence.
4. To develop a database for quantitative estimates of the health impacts of long-term exposure to air pollution for all of these health endpoints for the European population.

ESCAPE is a project funded under the European Union’s Seventh Framework Programme Theme.
<table>
<thead>
<tr>
<th>Intervention</th>
<th>Investigator</th>
<th>Pollutant</th>
<th>Health outcome</th>
<th>Main Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper smelter strike in the U.S., 1960's</td>
<td>Pope et al., 2007</td>
<td>SO₂</td>
<td>Mortality counts (1960 – 1975)</td>
<td>● Decrease in mortality of 2.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>● Reopening → Hospital admissions for children x3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>● for adults ↑ ~44% with 24-hr PM₁₀ = 150µg/m³</td>
</tr>
<tr>
<td></td>
<td>Pope et al., 1992</td>
<td>PM₁₀</td>
<td>Mortality</td>
<td>● Closure → ↓ ~15µg/m³ in PM₁₀ levels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>● instantaneous 3.2% ↓ in average daily deaths</td>
</tr>
<tr>
<td>German reunification 1990</td>
<td>Peters et al.</td>
<td>PM₂.₅, PM₁₀</td>
<td>Daily mortality counts</td>
<td>● No clear association btw. all-cause mortality or specific-cause mortality and PM₂.₅, PM₁₀, or SO₂</td>
</tr>
<tr>
<td>The London Congestion Charging Scheme</td>
<td>Tonne et al., 2008</td>
<td>PM₁₀, NO₂</td>
<td>All-cause mortality counts of Greater London city residents (2001–2003)</td>
<td>In CCZ: ↑ Reductions levels: ↓ 2.3% of NOₓ, ↓ 0.8% of PM₁₀; YLGN₂O₅ per 100,000 population 25 years for Greater London, 183 years within CCZ; YLGN₂O₅ only 8 years for Greater London</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Outside: ↓ 0.4% of NOₓ, ↓ 0.1% of PM₁₀</td>
</tr>
<tr>
<td>European Air Emission Policies</td>
<td>Tonne et al., 2010</td>
<td>NOₓ</td>
<td>Cardio-respiratory hospital admissions in Greater London (2001-2004)</td>
<td>● Significant association btw. ↓ NOₓ and ↓ admissions only for bronchiolitis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>● Substantial spatial dependence in the data</td>
</tr>
<tr>
<td>The Stockholm Congestion Charging Trial</td>
<td>Johansson et al., 2008</td>
<td>PM₁₀, NOₓ, NO₂, CO</td>
<td>Residents of Stockholm comparing with and without the CCST for 2006</td>
<td>↑ Reductions levels in city centre in CCZ: -10.0% for NOₓ, -7.6% for PM₁₀; Greater Stockholm: -5.3% for NOₓ, -3.8% for PM₁₀; 206 YLG per 100,000 people for Greater Stockholm over a 10-year period</td>
</tr>
<tr>
<td>Reduction of fuel sulphur content in Hong Kong</td>
<td>Clancy et al., 2002</td>
<td>BS, SO₂</td>
<td>Mortality counts in Dublin: non-trauma, respiratory, cardiovascular (1984 - 1996)</td>
<td>↓ BS by ~70%, ↓ SO₂ by 34%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>↓ non-trauma death rates by 5.7%, ↓ respiratory by 15.8%, ↓ cardiovascular by 10.3%</td>
</tr>
<tr>
<td>The Irish coal ban</td>
<td>Goodman et al., 2009</td>
<td>BS, SO₂</td>
<td>Daily BS and SO₂ for the sequential bans in 11 cities</td>
<td>↓ BS in all centres post-ban (~45 to ~70%) largest in winter; no clear pattern in SO₂ changes</td>
</tr>
<tr>
<td>Domestic Emission Sources</td>
<td></td>
<td></td>
<td></td>
<td>● total mortality by 7%, ↑ respiratory by 8%, ↑ cardiovascular by 13%</td>
</tr>
<tr>
<td>1996 Summer Olympic Games in Atlanta, Georgia, U.S.</td>
<td>Clancy et al., 2002</td>
<td>BS, SO₂</td>
<td>Mortality counts in Atlanta: non-trauma, respiratory, cardiovascular (1984 - 1996)</td>
<td>↓ BS by ~70%, ↓ SO₂ by 34%</td>
</tr>
<tr>
<td>Olympic Games</td>
<td>Goodman et al., 2009</td>
<td>BS, SO₂</td>
<td>Daily BS and SO₂ for the sequential bans in 11 cities</td>
<td>↓ BS in all centres post-ban (~45 to ~70%) largest in winter; no clear pattern in SO₂ changes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>● total mortality by 7%, ↑ respiratory by 8%, ↑ cardiovascular by 13%</td>
</tr>
<tr>
<td>Air pollution intervention studies in South Africa</td>
<td>Leiman et al., 2006</td>
<td>Multiple studies in one</td>
<td>Varies btw. the 26 different interventions</td>
<td>Interventions with the highest positive economic NPVs all household based; majority of the industry based interventions had negative NPV</td>
</tr>
</tbody>
</table>

---

**Aphekom**

Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe

---

5.09.14

Agentschap Zorg en Gezondheid
Stijging aantal luchtwegenklachten
Luchtwegeninfecties en astma worden erger, meer hoesten
Stijging gebruik geneesmiddelen die de luchtwegen verwijden neemt toe
vervroegd overlijden (bestaande hart- en longproblemen)
aantal spoedopnames voor luchtwegklachten en hartklachten stijgt

chronisch
Blijvende afname longfunctie
chronische luchtwegaandoeningen zoals hoesten, bronchitis en astma veroorzaken of verergeren
hart- en vaatziekten zoals vaatverdamping, verhoogde bloedstolling, verhoogde hartslag, hartinfarct of beroerte
vroegtijdige sterfte
verlaagd geboortegewicht, groeivertraging, vroeggeboorte en zelfs vervroegde sterfte (miskramen)
Agentschap Zorg en Gezondheid

5.09.14

WHO: "Luchtvervuilin kankerverwekkend"

Particulate matter, a major component of outdoor air pollution, was evaluated separately and was also classified as carcinogenic to humans (Group 1).

The IARC Monographs Programme concluded that there is sufficient evidence that exposure to outdoor air pollution causes lung cancer (Group 1). They also noted a positive association with an increased risk of bladder cancer.

Particulate matter, a major component of outdoor air pollution, was evaluated separately and was also classified as carcinogenic to humans (Group 1).

The IARC evaluation showed an increasing risk of lung cancer with increasing levels of exposure to particulate matter and air pollution. Although the composition of air pollution and levels of exposure can vary dramatically between locations, the conclusions of the Working Group apply to all regions of the world.

A major environmental health problem

Air pollution is already known to increase risks for a wide range of diseases, such as respiratory and heart diseases. Studies indicate that in recent years exposure levels have increased significantly in some parts of the world, particularly in rapidly industrializing countries with large populations. The most recent data indicate that in 2010, 233,000 deaths from lung cancer worldwide resulted from air pollution.

The most widespread environmental carcinogen

"The air we breathe has become polluted with a mixture of cancer-causing substances," says Dr Kurt Straif, Head of the IARC Monographs Section. "We now know that outdoor air pollution is not only a major risk to health in general, but also a leading environmental cause of cancer deaths."

The IARC Monographs Programme, dubbed the "encyclopedia of carcinogens," provides an authoritative source of scientific evidence on cancer-causing substances and exposures. In the past, the Programme evaluated many individual chemicals and specific mixtures that occur in outdoor air pollution. These included diesel engine exhaust, solvents, metals, and dusts. But this is the first time that experts have classified outdoor air pollution as a cause of cancer.

"Our task was to evaluate the air everyone breathes rather than focus on specific air pollutants," explains Dr Dana Loomis, Deputy Head of the Monographs Section. "The results from the reviewed studies point in the same direction: the risk of developing lung cancer is significantly increased in people exposed to air pollution."

IARC Monographs evaluations

Volume 120 of the IARC Monographs is based on the independent review of more than 1000 scientific papers from studies on five continents. The reviewed studies analyse the carcinogenicity of various pollutants present in outdoor air pollution, especially particulate matter and transportation-related pollution. The evaluation is driven by findings from large epidemiologic studies that included millions of people living in Europe, North and South America, and Asia.

* Please note that the summary evaluation will be published by The Lancet Oncology online on Thursday 24 October 2013
GEZONDHEIDSEFFECTEN NIET VOOR IEDEREEN GELIJK
Figuur 3: Schematische voorstelling van gevoeligheid onder invloed van externe factoren.

Optimale inschatting van de impact van blootstelling aan PM2,5 in Vlaanderen, Torfs, 2005
GAUDERMAN ET AL. EFFECT OF EXPOSURE TO TRAFFIC ON LUNG DEVELOPMENT FROM 10 TO 18 YEARS OF AGE: A COHORT STUDY. LANCET 2007, 369, 571-7

**Figure:** Percent-predicted lung function at age 18 years versus residential distance from a freeway. The horizontal line at 100% corresponds to the referent group, children living >1500 m from a freeway.
Public health importance of triggers of myocardial infarction: a comparative risk assessment

Tim S Nawrot, Laura Perez, Nino Künzli, Elke Munters, Benoit Nemery

Figure 2: Relation between OR and the PAF for each studies trigger
PAFs were calculated and reported with their 95% CI (error bars). Not significant triggers show 95% CIs that are lower than 0%. X-axis is log scale, and ORs are given as anti-logs. OR=odds ratio. PAF=population attributable fraction.
GEZONDHEIDSIMPACT FIJN STOF IN DALY’S

Bewijslast

<table>
<thead>
<tr>
<th>Hoog</th>
<th>Medium</th>
<th>Laag</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fijn stof (74000)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Passief roken (6600) | Geluid (7400) | Dioxines (2500)
| Radon (3800) | Lood (2200) | Hitte (1000)
| | Schimmels en vocht (800) | CO (600) | Ozon (500)
| Benzeen (10) | | EMF (2)
| Nikkel (1) | Arseen (1) | Cadmium (1)
| | | Formaldehyde (1)

Bron: Inschatting ziektelast en externe kosten veroorzaakt door verschillende milieufactoren in Vlaanderen, juli 2012 (Buekers, Torfs, 2012)
Gezondheidseffecten van milieupolluventen (DALY’s)

- fijn stof 73%
- radon 4%
- passief roken 6%
- geluid 7%
- lood 2%
- dioxines 2%
- UV 3%
- CO 1%
- ozon 1%
- hitte 1%
- schimmels en vocht 1%
- benzeen <1%
- EMF <1%
- nikkel <1%
- arseen <1%
- cadmium <1%
- formaldehyde <1%

op basis van de berekende verloren gezonde levensjaren (DALY’s) ten gevolge van de beschouwde set van polluventen. De onzekerheid verschilt per polluent en per gezondheidseffect; berekening op basis van meest recente blootstellingsdata.

Bron: VITO (2012)
GEZONDHEIDSIMPACT FIJN STOF IN DALY’S

Bron: Inschatting ziektebelast en externe kosten veroorzaakt door verschillende milieufactoren in Vlaanderen, juli 2012 (Buikers, Torfs, 2012)
De gemiddelde jaarlijks vroegtijdige sterfte ten gevolge van PM$_{2.5}$ in Vlaanderen tijdens de periode 1997-2004 trof 652 personen (of 110 vroegtijdige sterftegevallen per 1.000.000 inwoners). Voor België komen we dan uit op een duizendtal sterftegevallen alleen door

<table>
<thead>
<tr>
<th>Risicofactor</th>
<th>Gemiddeld aantal DALY's per jaar in Vlaanderen</th>
<th>Gemiddeld aantal verloren gezonde levensjaren per een heel leven per inwoner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roken</td>
<td>144687</td>
<td>1,9</td>
</tr>
<tr>
<td>Overgewicht &amp; Obesitas</td>
<td>94750</td>
<td>1,3</td>
</tr>
<tr>
<td>Fijn stof</td>
<td>79000</td>
<td>1,1</td>
</tr>
<tr>
<td>Fysieke inactiviteit</td>
<td>54134</td>
<td>0,7</td>
</tr>
<tr>
<td>Hypertensie</td>
<td>53690</td>
<td>0,7</td>
</tr>
<tr>
<td>Verkeersongevallen*</td>
<td>36476</td>
<td>0,5</td>
</tr>
<tr>
<td>Hypercholesterolemie</td>
<td>27930</td>
<td>0,4</td>
</tr>
<tr>
<td>Overmatig alcohol gebruik</td>
<td>10113</td>
<td>0,1</td>
</tr>
<tr>
<td>Omgevingstabsrook</td>
<td>6600</td>
<td>0,1</td>
</tr>
<tr>
<td>Tuberculose</td>
<td>&lt;1000</td>
<td>&lt;0,01</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>&lt;1000</td>
<td>&lt;0,01</td>
</tr>
</tbody>
</table>

* Op basis van enkel gekende dosis-respons curves, beschikbare incidentie/prevalentie data. Aannames per risicofactor worden beschreven in de tekst.
* : Vlaanderen en Brussel

bron: Inschatting ziekteffect levensstijlfactoren en klassieke belangrijke risicofactoren voor de gezondheid, april 2014, Buekers
Antwerpenaar verliest 438 gezonde levensdagen door luchtvervuiling

Bron: Voorstel van maatregelen om de luchtkwaliteit te verbeteren en de geluidshinder te beheersen in de stad Antwerpen (Lefebvre et al., maart 2011)
GEZONDHEIDSIMPACT FIJN STOF IN EURO’S

Bron: Inschatting ziektelast en externe kosten veroorzaakt door verschillende milieufactoren in Vlaanderen, juli 2012 (Buekers, Torfs, 2012)
Guideline values

**PM$_{2.5}$**
- 10 µg/m$^3$ annual mean
- 25 µg/m$^3$ 24-hour mean

**PM$_{10}$**
- 20 µg/m$^3$ annual mean
- 50 µg/m$^3$ 24-hour mean

---

**Normen voor fijn stof en de gezondheidsrisico’s**

(Pope et al. 2002)

---

Longkanker
Hart- en longziektes
Alle doodsoorzaken

---

**PM$_{2.5}$** (deeltjes met diameter kleiner dan 2,5 micrometer)
Based on a synthesis of the best available evidence, the Panel identified an exposure zone within a range of up to 300 to 500 m from a highway or a major road as the area most highly affected by traffic emissions (the range reflects the variable influence of background pollution concentrations, meteorologic conditions, and season) and estimated that 30% to 45% of people living in large North American cities live within such zones.

9. Siting of school and child care facilities should include consideration of proximity to roads with heavy traffic and other sources of air pollution. New schools should be located to avoid “hot spots” of localized pollution.
Toxic cities mock 'healthy' cycle riding

Jonathan Leake, Environment Editor

CYCLING to work may seem the healthy option, but a study has shown that people riding in cities inhale tens of millions of toxic nanoparticles with every breath, at least five times more than drivers or pedestrians.

The research involved fitting cyclists with devices that could count the particles, mostly emitted by car exhausts, in the air that they breathed.

It showed that urban concentrations of nanoparticles, which measure just a few millionths of a millimetre, could reach several hundred thousand in a cubic centimetre of air.

The particles, when inhaled, have been linked to heart disease and respiratory problems.

Related Links
- Tracking air pollution with Twitter
- Smoggy Delhi unveils giant air freshener

Because they are exiting themselves, cyclists breathe harder and faster than other road users. The study found that they suck in about 1,000 cubic cm with each breath, meaning they may inhale tens of millions of the particles each time they fill their lungs, and billions during a whole journey.

"This is the first time anyone has counted the particles while also measuring people's breathing during city commuting. It showed that cyclists can inhale an astonishing number of pollutant particles in one journey," said Luc Int Panis of the transport research institute of Hasselt University in Belgium, who led the study.

Fietsers ademen massa's fijn stof in

maandag 31 mei 2010

TomLeBacq

Wie met de fiets naar ademt vijf tot negen fijn stof in dan wie met de auto. 'Fietsers kiezen het wegen en blijven het mogelijk weg van het verkeer', zegt onder anderen IntPanis.
Points of discussion

» Urban cycling / sports is associated with both + and – health effects

» Active mobility is a good way to increase physical activity levels in cities

» Urban Cyclists are healthier and live longer than non-cyclists

» The (cardiovascular) benefits of physical activity far outweigh the health risks

» The accident risk is the major health risk to tackle (in cities)

» Traffic related air pollution affects the health of urban cyclists

» Cyclists are exposed to lower concentrations but higher doses

» Higher exposure is associated with small physiological effects
WELKOM!

Hier vind je alle informatie omtrent luchtverontreiniging versameld op één plaats.
Onze familie heeft gezegd dat meer uitleg over het belang van een gezonde luchtkwaliteit:
ieder familiedeel heeft een vraag over luchtverontreiniging en informeer op een toegankelijke manier.
Altijd al willen weten hoe je kan bijdragen tot een betere luchtkwaliteit? Ontdek het hier!
Ga met je muis over de personages heen en ontdek hun vraag.