Air Pollution and Health

The Aphekom Approach

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on behalf of the Aphekom network

www.aphekom.org
Particle action

- Chronic
  - Arteriosclerosis
  - Tissue damage

- Acute Effects
  - Bronchial Reflexes
  - Heart-rate
  - Inflammation
  - Oxidative Stress
Inflammation

Four macrophages attempting to ingest an asbestos fibre (approximately 0.03 μm long). (Reproduced by permission of Professor Ken Donaldson, University of Edinburgh.)
Figure 1. Adjusted relative risks (and 95% CIs) of ischemic heart disease (light gray), cardiovascular disease (dark gray), and cardiopulmonary disease (black) mortality plotted over baseline estimated daily dose of PM2.5.

Pope C A et al. Circulation 2009;120:941-948

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Logarithmischer Anstieg des Risikos für KHK / CVD mit Zigarettenzahl
ACS Study II: Cardiovasc. Mortality

Figure 2. Adjusted relative risks (and 95% CIs) of ischemic heart disease (light gray), cardiovascular disease (dark gray), and cardiopulmonary disease (black) mortality plotted over baseline estimated daily dose (using a log scale) of PM2.5, from current cigarette smoking (relative to never smokers), SHS, and air pollution.

Cardiovascular Mortality and Exposure to Airborne Fine Particulate Matter and Cigarette Smoke: Shape of the Exposure-Response Relationship
C. Arden Pope, III, Richard T. Burnett, Daniel Krewski, Michael Jerrett, Yuanli Shi, Eugenia E. Calle and Michael J. Thun
Circulation 2009;120:941-948; originally published online Aug 31, 2009;
DOI: 10.1161/CIRCULATIONAHA.109.857888
ACS Study III: Lung Cancer

Nahezu linearer Anstieg des Risikos für Lungenkrebs mit Zigarettenzahl

Estimated daily exposure, mg of PM$_{2.5}$, and increments of cigarettes/day

PM2.5

SHS
The Aphekcom project

- 3-year EU project (2008-2011)
  - Coordinated by InVS in collaboration of Umea University
  - 12 countries, 25 cities
  - 60 scientists
  - co-funded by the EC Programme on Community Action in the field of Public Health (Grant Agreement n° 2007105)
Q1. What are the latest findings on the health impacts and monetary costs of air pollution in European cities?

Christophe Declercq, Mathilde Pascal, Magali Corso, InVS

Olivier Chanel, CNRS

on behalf of the Aphekom WP5 team and of all the Aphekom centres
Long-term impacts of PM$_{2.5}$

Predicted average gain in life expectancy (months) for persons 30 years of age in 25 Aphekom cities for a decrease in average annual level of PM$_{2.5}$ to 10 $\mu$g/m$^3$.

- Compliance with WHO AQG (10 $\mu$g/m$^3$) would result in:
  - nearly 19,000 premature deaths avoided per annum (15,000 from cardiovascular causes)
  - €31,5 billion saved annually
Q2. Health Impact and Policy: novel approaches

How can we make HIAs more meaningful and actionable for developing policies and recommendations on air pollution for urban populations?

Nino Künzli, Laura Perez
Swiss Tropical and Public Health Institute, Basel, Switzerland
And University of Basel, Switzerland

Olivier Chanel, CNRS

on behalf of the Aphekóm WP4 team and of all the Aphekóm centres
Objectives for 10 European cities

- Estimate the number and fraction of population that may have developed their chronic disease due to chronic exposure to local traffic-related pollution, represented by living at proximity of busy roads
  - children with asthma
  - older adults with chronic obstructive pulmonary disease (COPD) and
  - older adults with coronary heart disease (CHD)

- Among those, estimate the number and fraction of exacerbations (i.e. hospitalisations and symptoms) due to both chronic exposure from local traffic-related pollution and additional day-to-day exposure to urban air pollutants above WHO recommended levels.
Fig 1. Approach for estimating the total burden of air pollution that considers a causal relationship between living at proximity of busy roads and onset of chronic disease. Example for asthma in children (Künzli et al. 2008).
Percentage of population living near busy roads in 10 Aphekoms cities

Figure 9 — Estimated percentage of people leaving near busy roads
Taking traffic into account in HIA

- Exploratory HIA in 10 cities
  - % of population living near roads travelled by 10,000 or more vehicles per day
  - influence on the development and exacerbation of chronic diseases

- Living close to traffic is responsible for:
  - 15 to 30% of all new asthma cases in children
  - 15 to 30% of asthma attacks in children
  - Similar or larger percentages for COPD and coronary heart diseases in adults >65 years
  - Added cost of €310 millions every year
Comparison of impact of air pollution on chronic diseases using two different HIA approaches in Aphekorn

- Assumes air pollution only causes exacerbation of existing chronic disease (traditional approach)
- Assumes air pollution causes both development of the chronic disease and episodes of exacerbation of the disease

- Episodes of bronchitis among asthmatic children (age 0-17)
- Asthma hospitalizations among asthmatic children (age 0-17)
- Bronchitis among adults with chronic obstructive pulmonary disease - COPD (age ≥ 65)
- COPD hospitalizations among adults with COPD (age ≥ 65)
- Myocardial infarction (non-fatal) among adults with coronary heart disease - CHD (age ≥ 65)
- Myocardial infarction hospitalizations among adults with CHD (age ≥ 65)
- Stroke hospitalizations among adults with CHD (age ≥ 65)
Fig 4. Total air pollution attributable hospitalization for asthma and COPD showing contribution of traffic proximity in the onset of chronic disease.
Q3. Do policies designed to reduce air pollution and its health impacts really work?

Air Pollution health impact assessment and monetary costs of a strategy already implemented to reduce air pollution in Europe

Patrick Goodman, Susann Henschel, Dublin Institute of Technology, Ireland

Olivier Chanel
CNRS

on behalf of the Aphekom WP6 team and of all the Aphekom centres
Effectiveness of EU policies: review of air quality legislation with respect to sulphur content in fuels

- SO$_2$ mean levels decreased by about -66%

- Associated HIA:
  - 2,200 premature deaths avoided annually
  - €192 millions saved each year
Q4. How can we improve communication both among and between stakeholders concerned with the impact of air pollution on health?

Yorghos Remvikos
UVSQ, France

on behalf of the Aphekom WP7 team and of all the Aphekom centres
Stakeholder involvement

- Decision-support tool to help decision-making by
  - Sharing opinions on uncertainties associated to the HIAs
  - Choosing common criteria to identify and prioritize stakeholder's needs and interests

http://aphekom.kertechno.net

- Case studies in Paris Ile-de-France area and Brussels
Relevance

• At national and city levels
  – communication on the benefits of reducing air pollution
  – contribution to national and local plans for better air quality
  – dissemination of methods and tools

• At the EU levels and beyond
  – contribution to current revision of EU directive on air quality
  – dissemination of methods and tools
To learn more

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