WHO Recommendations for the modelling of health impacts – REVIHAAP and HRAPIE projects

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Presentation outline

- WHO projects REVIHAAP and HRAPIE
- Key questions for EU policy
- Main conclusions from REVIHAAP evidence review
- First results and future work for recommendation of concentration-response functions

Context for REVIHAAP and HRAPIE work

DIRECTIVE 2008/50/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 21 May 2008

on ambient air quality and cleaner air for Europe

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 175 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Economic and Social Committee (1),

(2) In order to protect human health and the environment as a whole, it is particularly important to combat emissions of pollutants at source and to identify and implement the most effective emission reduction measures at local, national and Community level. Therefore, emissions of harmful air pollutants should be avoided, prevented or reduced and appropriate objectives set for ambient air quality taking into account relevant World Health Organisation standards, guidelines and programmes.

REVIHAAP and HRAPIE Projects: Review of evidence for guidance of EU policy

OBJECTIVE:
To provide the European Commission and its stakeholders with scientific evidence- based advice on health aspects of air pollution in support of the comprehensive review of air quality legislation due in 2013.

**While some of the questions directly address policies, the recommendations from the projects are based solely on scientific conclusions on health aspects of air pollution, and do not consider other issues which are relevant for policy formulation.*

WHO projects

- Jointly financed WHO/EC
- Coordinated by WHO-ECEH
- More than 60 experts involved, 2 WHO Experts meetings, …

REVIHAAP (answers to 24 questions)		HRAPIE (2 questions, building on REVIHAAP work)		
Review of evidence on health aspects of air pollution	Oct 2011 to April 2013 (18 months)	Identification of CRF for key pollutants and health outcomes	Survey on newly emerging issues on risks to health from air pollution	Sept 2012 to Sept 2013 (12 months)

REVIHAAP main conclusions from evidence review

- Considerable amount of new scientific information on health effects of PM, ozone and NO_2 has been published in the recent years
  - Evidence has *strengthened*
  - Effects observed *at levels commonly present in Europe*
  - Supports the scientific conclusions of the WHO Air Quality Guidelines, last updated in 2005
  - Indicates that the *effects can occur at air pollution concentrations lower* than those serving to establish the 2005 Guidelines
- Provides scientific arguments for the decisive actions to improve air quality and reduce the burden of disease associated with air pollution in Europe.

Questions on CRF and thresholds for PM, O_3 and NO_2

1. … What is the **latest evidence on thresholds** and linearity for $PM_{2.5}$?
2. What new health evidence has been published in relation to the **evidence or likeliness of a threshold** [O_3 concentration] below which impacts are not expected?
3. Based on currently available health evidence, what PM, O_3, NO_2 **metrics, health outcomes and concentration-response functions** can be used for health impact assessment?
4. What concentration-response functions for key pollutants should be **included in cost-benefit analysis** supporting revision of EU air quality policy?

Timeline for HIA work

- January 2013: First REVIHAAP recommendations on pollutant-outcome pairs

- March 2013: Recommendations for CRF for core analysis for **cost-effectiveness** of pollution reduction strategies for $PM_{2.5}$ and O_3

- June 2013: Recommendations for CRF for **cost-benefit** analysis of selected policy options for $PM_{2.5}$, O_3 and NO_2

Latest evidence on thresholds and linearity for $PM_{2.5}$ – short-term exposure

- Substantial evidence on associations observed down to very low levels of $PM_{2.5}$;
- No observed threshold below which no one would be affected;
- No deviations from linearity for ambient levels of $PM_{2.5}$ observed in Europe.

Latest evidence on thresholds and linearity for $PM_{2.5}$ – long-term exposure

- Few data at low $PM_{2.5}$ levels;
- No evidence of a threshold in the observed $PM_{2.5}$ range;
- Recent studies reporting effects on mortality at concentrations below an annual average of 10 µg/m^3;
- Suggestions of a steeper exposure-response relation at lower $PM_{2.5}$ levels;

In the **absence of a threshold** and in light of **linear or supra-linear risk functions**, *public health benefits will result from any reduction of $PM_{2.5}$ concentrations whether or not the current levels are above or below the limit values*.

Recommendations of CRF for $PM_{2.5}$ (1/2)

- Core analysis for cost-effectiveness:
  - Long-term (annual average) exposure to $PM_{2.5}$
    - All-cause mortality, in adults age 30+
    - Linear CRF (RR = 1.062 per 10 µg/m^3 $PM_{2.5}$), using recent meta-analysis of 13 cohort studies by Hoek et al. (2013)
- Cost-benefit analysis (ongoing):
  - Cause-specific mortality due to:
    - Ischaemic heart disease;
    - Cerebrovascular diseases;
    - Chronic obstructive pulmonary diseases;
    - Trachea, bronchus and lung cancers.
    - CRFs based on GDB2010 analysis of all available cohort studies (linearized).

Recommendations of CRF for $PM_{2.5}$ (2/2)

- Short-term exposure to $PM_{2.5}$ and several morbidity outcomes, such as:
  - Bronchitis symptoms in children under age 18
  - Chronic bronchitis in adults over age 30
  - Asthma attacks, all ages
  - Cardiovascular, cerebrovascular (possibly) and respiratory hospital admissions, all ages
  - Urgent care visits due to asthma (and possible other respiratory outcomes) and cardiovascular disease, all ages
  - Restricted activity days, adults
- Alternative PM matrix, such as BC, may be used in sensitivity analysis.

Evidence or likeliness of a threshold for O_3

- Short-term exposure:
  - The evidence for a threshold for short-term exposure is inconsistent, but where a threshold is observed, it is likely to lie below 45 ppb (90 µg/m^3) (max 1-hr) (therefore consistent with SOMO35 concept).
- Long-term exposure:
  - No data to permit the firm identification of a threshold for the effects of long-term exposure to ozone, within the range observed in ACS study (long-term mean of max daily 1-hour in summer months: 33 - 104 ppb).

Recommendations for CRF for ozone (1/2)

- Core analysis for cost-effectiveness:
  - Short term effects (daily max 8-hour mean):
    - All-cause mortality, all ages;
    - Exposure: SOMO35 (and SOMO10 if available);
    - CRF based on APHENA study (adjusted for PM_{10}).
- Sensitivity analysis for cost-benefit assessment:
  - Short term effects:
    - Respiratory and cardiovascular mortality (approach as in cause-specific analysis);
  - Long term effects:
    - Respiratory and cardiovascular mortality;
    - Impacts above 35 ppb for summer months;
    - Risk coefficients from ACS cohort (single pollutant model).

Recommendations for CRF for ozone (2/2)

- Short-term exposure:
  - Hospital admissions for the 65+ age group:
    - respiratory and cardiovascular diseases;
    - CRF: all-year coefficients with daily maximum 8-hour ozone (adjusted for PM_{10}).

Recommendations for CRF for NO_2 (1/2)

- Work ongoing for cost-benefit analysis only
- Assumption:
  - application in health impact assessment for NO_2 itself, given that impacts of other pollutants – notably PM mass - are also being quantified.
- Short-term exposures (1-hour or 1-day mean):
  - All-cause mortality;
  - Respiratory hospital admissions;
  - *Cardiovascular hospital admissions (sensitivity analysis only);*
  - Risk coefficients adjusted for PM mass.

Recommendations for CRF for NO_2 (2/2)

- Long-term exposures:
  - Bronchitic symptoms in asthmatic children
    - Coefficient, adjusted for a PM metric, based on the Southern California Children's Health Study.
  - Sensitivity analysis:
    - Mortality: all-cause and cardiovascular
      - CRF from cohort studies with effect estimates for NO_2 adjusted for at least PM mass;
    - Asthma prevalence
      - Only estimates from single pollutant models available;
      - Analysis to compare with results of HIA for PM mass.

Conclusions on HIA

- Enhanced evidence supporting recommendations for CRF for $PM_{2.5}$ and O_3;
- New evidence supporting recommendation of CRF for NO_2;
- Several options for core and sensitivity analysis of HIA;
- No evidence on threshold of $PM_{2.5}$ effects in the range of exposures observed in Europe;
- If threshold for O_3 effects exists, it is most likely below 45 ppb (90 µg/m^3) (daily maximum 1-hour mean);
- Work continues for recommendation of CRF for cost-benefit analysis.