Environmental Burden of Disease – European countries (EBoDE) project

Quantification, comparison and ranking of environmental stressors within and between participating countries

Report of the first project meeting

WHO European Centre for Environment and Health
Bonn, Germany

12–13 February 2009

ABSTRACT

The experts participating in the Environmental Burden of Disease – European countries project agreed on the specific tasks and timetable. The steering group and specific task groups were established. The first project results should be ready for presentation at the Fifth Ministerial Conference on Environment and Health in March 2010 in Parma, Italy.

CONTENTS

Executive summary

1. A total of 15 participants from 5 countries, World Health Organization (WHO) headquarters and the WHO Regional Office for Europe attended the first meeting of Environmental Burdon of Disease – European countries project (EBoDE) in Bonn, Germany, 12-13 February 2009.

2. Ongoing WHO and national activities regarding environmental burden of diseases were reviewed, the project objectives, methods, organization, tasks, and timetable were defined, and the priority target stressors were selected and assigned.

3. The objective of the EBoDE is to develop comparative methods for the international assessment of health impacts estimated as disability-adjusted life years (DALYs) lost from environmental stressors.

4. The methods would be based on (i) attributable fractions applied to WHO estimates for the national burden of diseases and; and (ii) disability-adjusted life year (DALY) calculated from data on incidences, durations and severity factors, depending on the availability and applicability of data.

5. The four task groups were set up, and responsibility for development and collaboration in the key areas were assigned. Task groups are: national exposure data; health endpoints and does-response (D-R) relationships; DALY valuations and EBD modelling; and uncertainty analysis.

6. New participants would be invited to join the project. Project information and progress reports would become available on a restricted-access web site.

7. First priority factors were benzene, dioxins, environmental tobacco smoke (ETS), formaldehyde, lead, environmental noise, ozone, particulate matter, and radon. Second priority list of exposure factors were 1, 2-dichloroethane, accidents – domestic, accidents – traffic, acrylamide, arsenic, chlorination by-products, carbon monoxide, damp housing, foodborne epidemics, indoor insecticides, methyl mercury, ultraviolet radiation, and waterborne epidemics.

8. The second meetings would be held in June 2009 in Berlin, organized by the WHO Collaborating Centre at the German Federal Environment Agency. National exposure data would be evaluated at the Berlin meeting, and the external review process would be launched in parallel with the DALY modelling.

9. The third meeting would be held in October in Rome, organized by the Italian National Institute of Health and the WHO European Centre for Environment and Health. Estimates for the first priority list stressors would be finalized at the Rome meeting for the contribution to the Fifth Ministerial Conference on Environment and Health in Italy in 2010.

Introduction

Environmental factors endanger human health in many ways. The development of policies for the protection of public health and research programmes to bridge the gaps in our understanding of the relationship between the environment and health both require quantitative estimates of the significance of various hazards. The WHO programme on quantifying environmental health impacts has addressed more than a dozen stressors from a global point of view [1]. WHO has performed a global burden of disease (BoD) quantification and ranking of selected exposures, published in *The World Health Report* [2]. To support further applications of the environmental burden of disease (EBD) assessments, WHO published methodological guidance in 2003 [3].

In Europe, EBD assessments are being conducted in several countries. The work by the National Institute for Public Health and the Environment, the Netherlands (RIVM) was one of the first systematic projects in this area in Europe to use disability-adjusted life years (DALYs) as a measure to compare the burden of different health outcomes attributable to environmental factors [4]. The results highlighted the facts that:

(i)   a number of environmental stressors may cause chronic or acute diseases or death;

(ii)   a few top ranking stressors cause over 90% of the national EBD; and

(iii)   these top ranking stressors are not necessarily those that have attracted the most concern, regulatory action and/or preventive investment.

The WHO European Centre for Environment and Health (ECEH), Bonn, organized a meeting to constitute a project team to support the ongoing national activities in European countries on these topics. The main outcomes of the project will be provide a platform to uphold scientific works, to make the selection of environmental exposures and health endpoints comparable across the countries, and to make assessment methods available to countries that want to pursue the analysis. The project will set up a web site to share the methods and results, as well as to invite new countries to join and update their national data. Initial assessment results from the project will be available for the Fifth Ministerial Conference on Environment and Health, to be held in Italy in 2010.

Project objectives

The objective of the project is to update the previous EBD assessments, to add stressors relevant to the European Region, to provide harmonized EBD assessments for participating countries, and to develop and make available the methodology and databases for other countries.

The specific objectives are to provide:

- full comparability of the quantifications and ranking of the EBDs from environmental exposures between countries and between exposure agents;

- a unified valuation of the different risks; and

- assessments of variation and uncertainty in the input parameters and results.

Both variation and uncertainty of the input data will be evaluated, and carried through the assessments all the way to the results. The project will be carried out using a common plan and protocols. Each participant is responsible for domestic project management and funding. The

project is based on existing data and materials – no field work for collecting new data is anticipated. The overall project duration is 18 months, starting 1 January 2009. A project steering committee is formed from the principal investigators in each participating institute and representatives of WHO. The activities below are proposed.

1. **Environmental exposure agents** to be considered in the assessment are bundled together. The purpose is to cover a range of environmental exposures significant for public health that lead to concern in society, have a high individual risk and/or have a substantial bearing on the economy.

2. **Population exposure/intake/body burden** data are collected nationally, using common criteria and data formats.

3. **The national BoD data** is collected from the WHO database and controlled against, and supplemented when needed with, national health statistics.

4. **Dose/response and relative risks models** are selected jointly from the literature.

5. **DALY valuations** for the different diseases and symptoms are reviewed jointly from the literature.

6. **Analyses and reporting** are carried out both nationally and jointly using agreed methods and reporting formats at both levels.

The above activities will be carried out by four task groups.

- Task group 1 (TG1): National exposure background incidence data
- Task group 2 (TG2): Health endpoints (codes from the International Classification of Diseases tenth revision (ICD-10)[1]) and dose-response (D-R) relationships
- Task group 3 (TG3): DALY valuations and EBD modelling
- Task group 4 (TG4): Uncertainty analysis

Criteria for selection of the stressors

Four criteria were defined for selection of exposure factors to be included in the study:

(iv) public health impact

(v) high individual risk

(vi) high public concern

(vii) economic significance.

Occupational hazards and risks associated with lifestyles (e.g. alcohol, active smoking, nutrition) and infectious diseases were excluded from the assessment.

The meeting was opened by Dr Michal Krzyzanowski. Professor Matti Jantunen was selected as the meeting chairperson and Dr Otto Hänninen as the rapporteur.

Seven presentations were made about the WHO and national activities by Dr Annette Prüss-Üstün (WHO headquarters), Ms Anne Knol (RIVM, the Netherlands), Mr Olli Leino (National

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[1] A translation table is provided for ICD-9.

Institute for Health and Welfare (THL), Finland), Mr Tek-Ang Lim (Institute for Public Health Surveillance, France), Dr Odile Mekel (North Rhine-Westphalia Institute of Health and Work, Germany), Professor Paolo Carrer (University of Milan, Italy) and Dr Ivano Iavarone (National Institute of Health, Italy).

Selected exposure factors

Based on the selection criteria, the exposure factors identified for consideration from the previous studies were divided into two priority levels. Those given in Table 1 have a higher priority level and will be considered in the first phase of the project.

Table 1. First priority list of exposure factors

S1	Benzene
S2	Dioxins (including furans and dioxin-like polychlorinated biphenyls)
S3	Environmental tobacco smoke (ETS)
S4	Formaldehyde
S5	Lead
S6	Environmental noise
S7	Ozone
S8	Particulate matter
S9	Radon

Table 2. Second priority list of exposure factors

1,2-Dichloroethane
Accidents – domestic
Accidents – traffic
Acrylamide
Arsenic
Chlorination by-products
Carbon monoxide
Damp housing
Foodborne epidemics
Indoor insecticides
Methyl mercury
Ultraviolet radiation
Waterborne epidemics

Health endpoints and D-R modelling

A tentative list of the health endpoints to be considered for each exposure factor was agreed at the meeting. The D-R task group (TG2) will propose the D-R functions to be used, based on a review of the scientific literature. The D-R models and corresponding definitions of the exposure assessment and related health endpoints with the ICD-10 (with translation table for ICD-9) codes will be made available on the project wiki web site.

S1 Benzene

Health endpoints selected include leukaemia morbidity and mortality (disaggregated by type of leukaemia). Exposure data consists of annual average (i.e. long-term) exposure levels of respiratory and dietary exposures of the population in general. The issue of different risk levels for children and adults should be considered in the project. Paolo Carrer was nominated as coordinator for the benzene data.

S2 Dioxins

Health endpoints selected for dioxins include non-Hodgkin's lymphoma, developmental defects and diabetes. Long-term childhood dietary exposures are used. THL of the Netherlands and the German Federal Environment Agency were selected to coordinate the dioxin data.

S3 Environmental tobacco smoke

Environmental tobacco smoke (ETS) is associated with a large number of relevant health endpoints. Exposures and background risks vary by gender and therefore the data should be collected by gender. The health effects selected include mortality and morbidity attributable to lung cancer and ischaemic heart disease (IHD), sudden infant death, and morbidity attributable to aggravation of asthma, lower respiratory symptoms, and acute otitis media. Exposure data consists of mainly the fraction of homes with smokers, disaggregated by the presence of children (for the child-specific health outcomes). Odile Mekel and Annette Prüss-Üstün were nominated to coordinate the ETS data. The ETS work will rely on the ongoing WHO review of the latest scientific evidence.

S4 Formaldehyde

Health effects selected for formaldehyde were respiratory, skin and eye irritation, nasal cancer and aggravation of asthma caused by short-term and long-term exposures. The work will build on the chapter in the forthcoming WHO publication on housing [5] (contact person: Matthias Braubach) and the European Union's INDEX project report [6]. Paolo Carrer was nominated to coordinate the formaldehyde data.

S5 Lead

Neurocognitive development, cardiovascular diseases (blood pressure) and renal effects were selected as health endpoints for long-term lead exposures, disaggregated by age group: children (developmental effects) and adults (blood pressure). Because of the threshold model, distributional data (main percentiles) are needed for the blood-lead levels. The work will build

on the updated assessment for the United States (contact person: Annette Prüss-Üstün) and the WHO ECEH work on housing EBD (contact person: Matthias Braubach). Marianne Rappolder/André Conrad and Annette Prüss-Üstün were nominated to coordinate the lead data.

S6 Environmental noise

The health effects of environmental noise were selected to cover psychosocial effects (sleep disturbance), cardiovascular effects (elevated blood pressure, IHD including myocardial infarction), and learning performance. Exposure data consists of night-time and 24-hour ambient noise levels. The work will build upon the WHO ECEH work on noise and health (contact person: Rokho Kim). Thomas Classen and Rokho Kim were nominated to coordinate the noise data.

S7 Ozone

Health endpoints for ozone were defined as mortality from respiratory and cardiovascular causes and pneumonia, hospital admissions and emergency room visits resulting from respiratory diseases caused by short-term exposures (eight-hour daily maxima). The work builds upon the WHO Air Quality Guideline update [7]. Otto Hänninen was selected to coordinate the ozone data.

S8 Particulate matter

Particulate matter (PM) health effects are associated with both short-term and long-term exposure estimates. Mortality outcomes, in particular, are dominated by the long-term exposures, and the additional inclusion of short-term effects would lead to double counting; therefore the main focus for PM was set on long-term exposures (annual population-representative ambient $PM_{2.5}$ and PM_{10} concentrations as nationally available). The mortality effects include total, cardiopulmonary causes and lung cancer. Additionally morbidity effects include chronic respiratory symptoms in children, chronic bronchitis in adults (long-term exposures) and hospital admissions (cardiovascular and respiratory), emergency room visits (respiratory), aggravation of asthma and respiratory symptoms. The work will build on the WHO Air Quality Guideline update [7] (contact person: Michal Krzyzanowski). Matti Jantunen, Annette Prüss-Üstün, Thomas Classen and Ivano Iavarone were nominated to coordinate the PM data.

S9 Radon

Health effects selected for radon include mortality and morbidity attributable to lung cancer associated with long-term average population exposures. The work will build upon the WHO ECEH work on housing and health and the Darby et al. review [8]. Matti Jantunen and Tek-Ang Lim were selected to coordinate the radon data.

National exposure data

Each participating country is responsible for collecting the national exposure data and national incidence data on the background risks for the selected health endpoints. The key criteria for selecting exposure data from various sources are the representativeness, completeness and current status of the data. The exposure task group (TG1) will collaborate with the health (TG2)

and modelling (TG3) task groups. Templates for the data and information expected from these task groups will be made available on the project wiki web site.

The country-specific DALY data for 2004 is available from WHO. However, the meeting acknowledged that national data for both environmental exposures and health endpoint incidence rates would have to be from later years to be relevant for the Fifth Ministerial Conference. The effects of demographics, especially population ageing, and temporal trends in exposures will be accounted for separately.

Project schedule

The project schedule was organized on the basis of the two priority levels of target exposures. The first priority group exposure data are to be collected in March-May 2009 parallel to the D-R reviews and background health data. The model for DALY calculations will need to be built. These data and models will be reviewed at the second project meeting in Berlin on 25 and 26 June 2009. The Berlin meeting will discuss, among other things, the comparative scenario (exposure decrease by 10%, zero exposure, etc.), the processing of temporal trends, the analysis of uncertainty, and the effects of demographics on the assessment.

First priority group EBD modelling will be conducted parallel to the external review between June and September 2009 and the first results will be reported at the third project meeting in Rome on 22 and 23 October 2009 to make them available for the preparation of the WHO Fifth Ministerial Conference in Parma in 2010.

The exposure, D-R and health data for the second priority list are to be collected in parallel in 2009 as much as practically possible alongside the main priority exposures.

Wiki-site for documentation and data sharing

THL will create a wiki web site for the use of the task groups and national teams for sharing the definitions, models, templates and documentation of the data as well as collection of the data in collaboration with the task group on EBD modelling (TG3).

The web site will specifically include a section for suggesting and discussing the inclusion of new exposures and stressors into the evaluation.

Steering group and task groups

The project steering group was set up to coordinate the project with a representative from each of the participating countries: Annette Prüss-Üstün, Anne Knol, Tek-Ang Lim, Otto Hänninen, Claudia Hornberg, and Paolo Carrer/Ivano Iavarone.

The four task groups set up were given responsibility for development and collaboration in the key areas of the project.

Task group 1: National exposure data

The task group on exposures and other national data (incidence/ prevalence or mortality statistics – where WHO BoD data are not available for specific health endpoints) will develop the templates for the collection of national data and coordinate the collection activities. The task group will define the required distributional and/or mean exposure parameters as well as disaggregation by age, gender, urban/rural and other required factors. The members nominated were Olli Leino, Ivano Iavarone, Anne Knol, Tek-Ang Lim, Andre Conrad, and Otto Hänninen (chair).

Task group 2: Health endpoints and D-R relationships

The task group on D-R relationships will collect the most recent reviews available, updated with the newest scientific literature for characterization of the evidence on the quantitative association between exposures and the selected health outcomes. The selected health outcomes will be defined with ICD-10 (ICD-9) codes in order to facilitate comparison across countries. The objective of the task group is to create non-country-specific general D-R models for each selected exposure–endpoint pair to be used across the participating countries. Additionally, the collection of health-related data on the background risk levels and duration of the target diseases is specified by the task group – the latter only if WHO BoD data is not available for the specific health endpoint. The members of TG2 are Thomas Classen, Annette Prüss-Üstün, Rokho Kim, Marianne Rappolder, and Paolo Carrer (chair).

Task group 3: DALY valuations and EBD modelling

The review of DALY valuations consisting of severity factors for each target health endpoint that is not covered by the WHO BoD database and the final EBD modelling is coordinated by task group 3. The members of TG3 are Marianne Rappolder, Tek-Ang Lim, Anne Knol (chair), Olli Leino, Odile Mekel, Annette Prüss-Üstün, Matti Jantunen, and Ivano Ivarone.

Task group 4: Uncertainty analysis

Data uncertainty is evaluated and collected as part of the national data and the definition of the D-R models. Additionally, one member from each of the other three task groups is nominated to TG4 on uncertainty analysis. The members of TG4 are Olli Leino, Otto Hänninen, Thomas Classen, Anne Knol, and Odile Mekel (chair).

Conclusions

Significant public health impacts are associated with various environmental risk factors. Policy development requires quantitative information on the magnitude of the impacts for efficient allocation of research and abatement resources. The objective of the Environmental Burdon of Disease – European countries project is to develop comparative methods for the international assessment of health impacts estimated as disability-adjusted life years (DALYs). Two parallel methodologies are applied, using:

(viii) World Health Organization estimates for the national burden of diseases and attributable fractions; and

(ix)   DALY calculations based on incidences, durations and severity factors. The latter more detailed method is applied in conjunction with the life-table method that accounts for the changes in population age structures and utilizes optimally age-specific risk factors.

Environmental stressors were divided into three categories. The priority one category, consisting of 9 stressors (benzene, dioxins, environmental tobacco smoke, formaldehyde, lead, environmental noise, ozone, particulate matter and radon) will be evaluated first, followed by the second priority list of 19 stressors. The third category will consist of identified stressors that will not be evaluated within the current project.

The evaluation process is open and new participants are welcome to join the project. Project information is made available along the progress on a restricted-access web site.

Collected national exposure data will be evaluated at the second project meeting in Berlin on 25 and 26 June 2009, when the external review process will also be launched. The third project meeting, to be held in Rome on 22 and 23 October 2009, will finalize the first priority stressor list estimates to make it available for the Fifth Ministerial Conference on Environment and Health in Italy in 2010.

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Further reading

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Annex 1

Final programme

Thursday 12 February 2009

11:30–12:00	Registration
12:00–12:15	Welcome, introduction of the participants, selection of the meeting chairperson and rapporteur
12:15–13:45	Presentations about the respective WHO and national activities
	- Annette Prüss-Üstün, WHO
	- Anne Knol, RIVM
	- Olli Leino, THL
	- Tek-Ang Lim, InVS
	- Odile Mekel, LIGA
	- Paolo Carrer, University of Milano
	- Ivano Iavarone, ISS, Rome
13:45–14:00	Introduction of the project objectives, draft work-plan, initial list of exposures, tasks and schedule (Matti Jantunen)
14:00–15:00	Discussion and agreement about the general work-plan and timetable
15:00–15:30	*Coffee break*
15:30–15:45	Selection of the Project Steering Group
15:45–16:30	Discussion and agreement about the project tasks and initial list of exposures
16:30–17:00	Nomination of the task group members (exposure data, D/R data and models, attributable risk data, DALY-valuations, EBD modelling)
17:00–19:00	General discussion and introduction to the second day's work in task groups
19:00	*Informal dinner at Zur Lese restaurant (optional)*

Friday 13 February 2009

9:00–10:00	Plenary: Presentation and discussion of the short list of exposures and selection of health endpoints and relevant exposures characteristics
10:00–12:00	Tasks of the small groups (TG1 exposure, TG2 health, TG3 methodology): Discussion and suggestions on objectives, criteria, division of tasks, deliverables, schedule
12:00–12:30	Consensus and summary of the meeting
12:30	Closing/Michal Krzyzanowski
	Lunch (optional)

Annex 2

List of participants

Temporary advisers

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