Integrated HIA and environmental burden of disease

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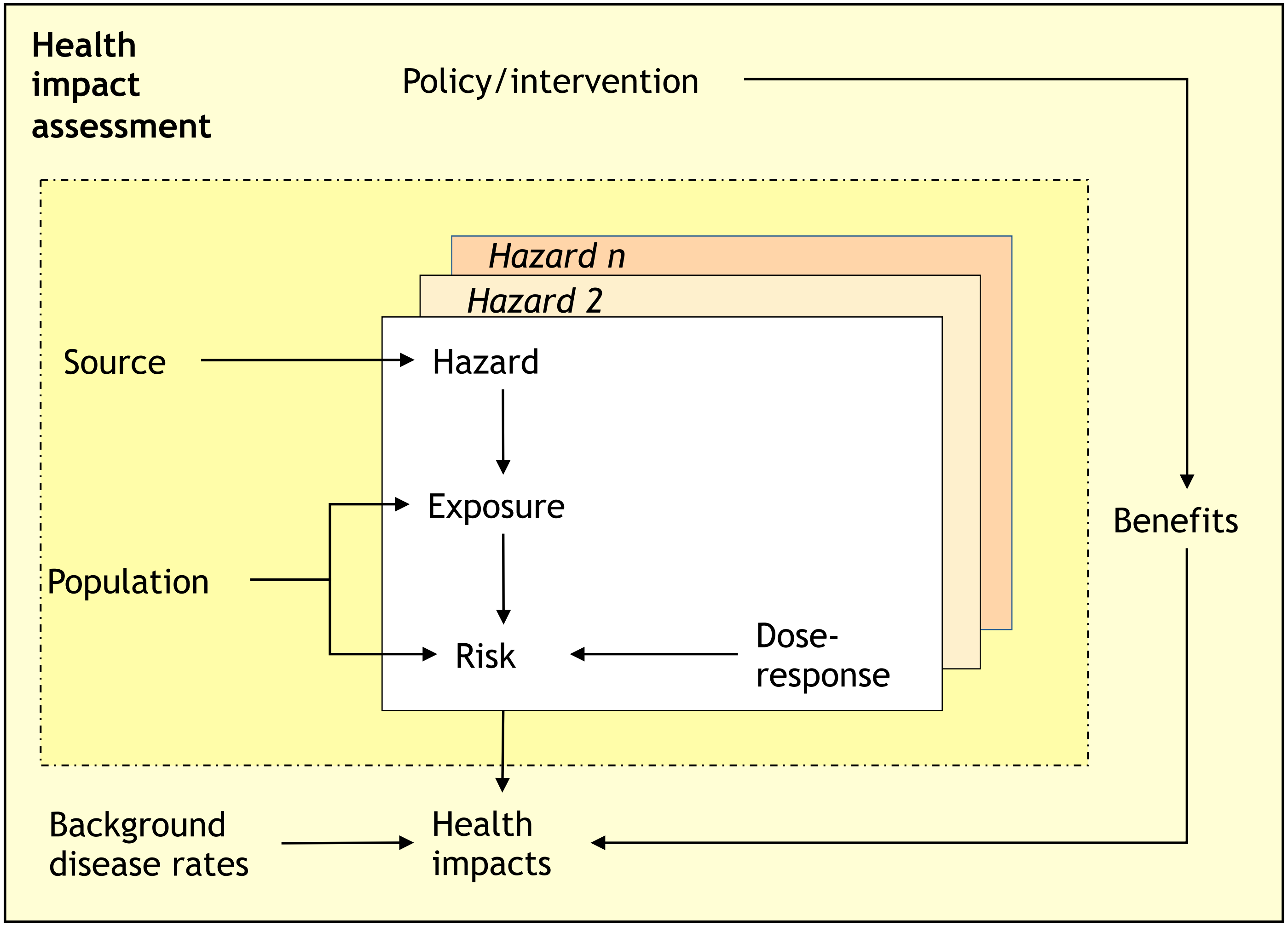
Background

- With exposure data, ERF functions and background disease (mortality) rates we now can calculate change in health status
- Variety of health effects may be calculated
- Mortality effects important in HIA
- How to express mortality and morbidity is controversial:
  - number of deaths versus life years lost
  - Weighing of the different health effects (eg. DALY)
  - Economic valuation (Euro)

Definition HIA

A combination of procedures, methods and tools by which a policy, program or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population.

[European Centre for Health Policy, WHO Regional Office for Europe. Gothenburg Consensus Paper (1999)]


Health
impact
assessment
Policy/intervention
Hazard n
Hazard 2
Source
Hazard
Exposure
Benefits
Population
Risk
Dose-
response
Background
disease rates
Health
impacts

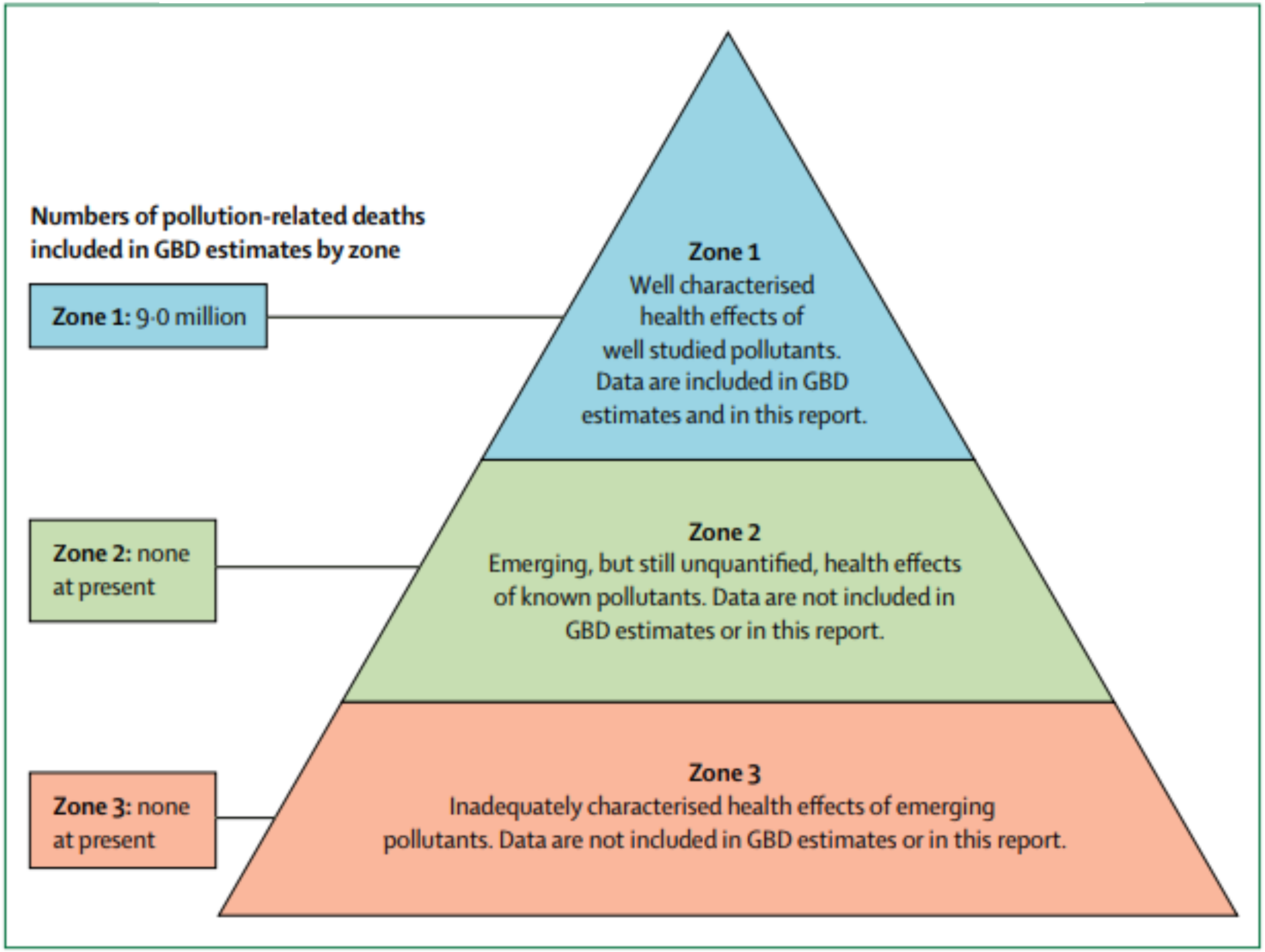
The *Lancet* Commission on pollution and health

Philip J Landrigan, Richard Fuller, Nereus J R Acosta, Olusoji Adeyi, Robert Arnold, Niladri (Nil) Basu, Abdoulaye Bibi Baldé, Roberto Bertollini, Stephan Bose-O'Reilly, Jo Ivey Boufford, Patrick N Breysse, Thomas Chiles, Chulabhorn Mahidol, Awa M Coll-Seck, Maureen L Cropper, Julius Fobil, Valentin Fuster, Michael Greenstone, Andy Haines, David Hanrahan, David Hunter, Mukesh Khare, Alan Krupnick, Bruce Lanphear, Bindu Lohani, Keith Martin, Karen V Mathiasen, Maureen A McTeer, Christopher J L Murray, Johanita D Ndahimananjara, Frederica Perera, Janez Potočnik, Alexander S Preker, Jairam Ramesh, Johan Rockström, Carlos Salinas, Leona D Samson, Karti Sandilya, Peter D Sly, Kirk R Smith, Achim Steiner, Richard B Stewart, William A Suk, Onno C P van Schayck, Gautam N Yadama, Kandeh Yumkella, Ma Zhong

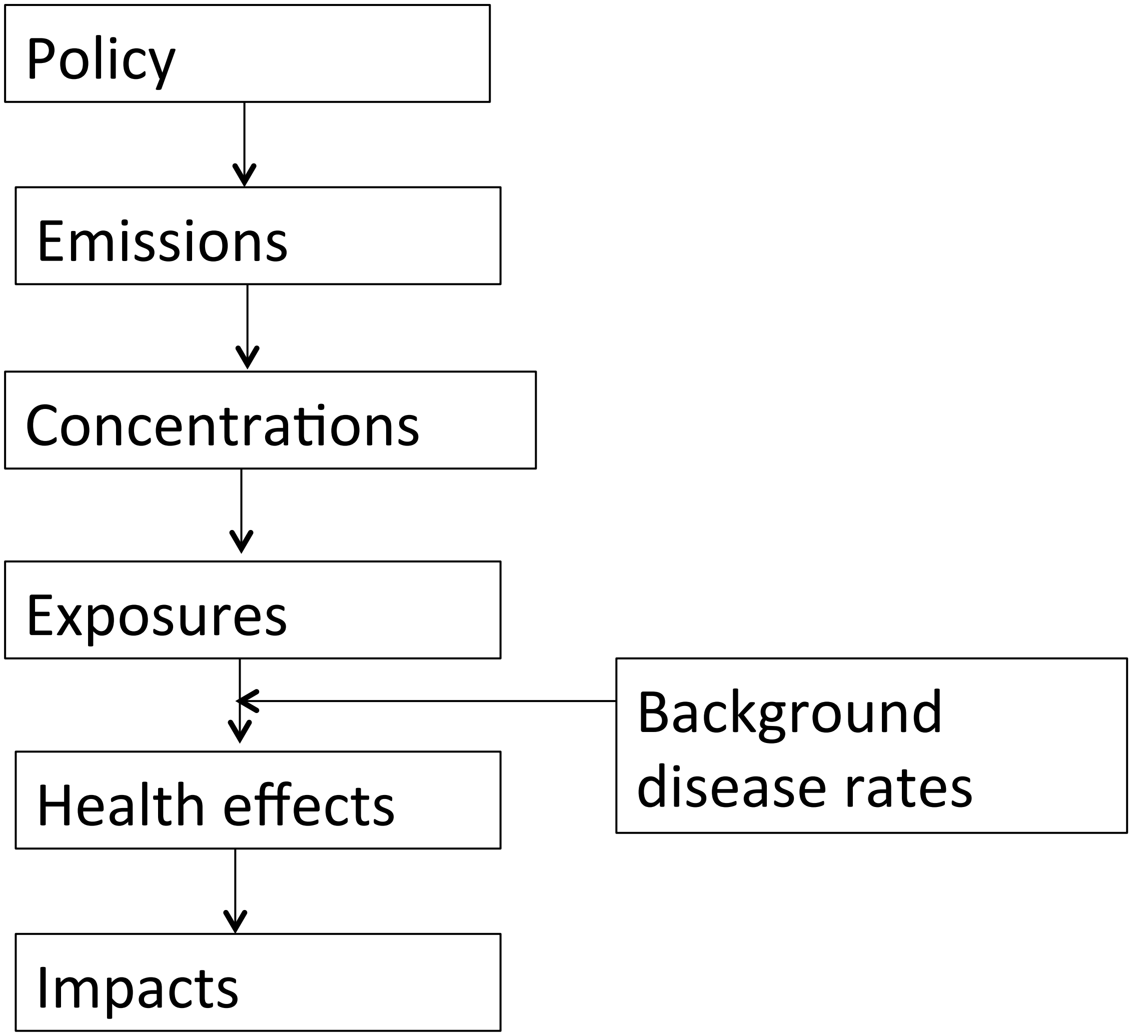
- "Robust call to arms. Stark in its warnings, but brimming with optimism"
- "[...] Air pollution results in a greater health burden than water, soil, or occupational exposures. Ambient and household air pollution (HAP), is responsible for 6.5 million deaths per year (with another 7 million from tobacco smoke) and this number will increase if urgent measures are not taken"

The *Lancet* Commission on pollution and health

Philip J Landrigan, Richard Fuller, Nereus J R Acosta, Olusoji Adeyi, Robert Arnold, Niladri (Nil) Basu, Abdoulaye Bibi Baldé, Roberto Bertollini, Stephan Bose-O'Reilly, Jo Ivey Boufford, Patrick N Breysse, Thomas Chiles, Chulabhorn Mahidol, Awa M Coll-Seck, Maureen L Cropper, Julius Fobil, Valentin Fuster, Michael Greenstone, Andy Haines, David Hanrahan, David Hunter, Mukesh Khare, Alan Krupnick, Bruce Lanphear, Bindu Lohani, Keith Martin, Karen V Mathiasen, Maureen A McTeer, Christopher J L Murray, Johanita D Ndahimananjara, Frederica Perera, Janez Potočnik, Alexander S Preker, Jairam Ramesh, Johan Rockström, Carlos Salinas, Leona D Samson, Karti Sandilya, Peter D Sly, Kirk R Smith, Achim Steiner, Richard B Stewart, William A Suk, Onno C P van Schayck, Gautam N Yadama, Kandeh Yumkella, Ma Zhong



Impact pathway



Definition IEHIA

A means of assessing health-related problems deriving from the environment, and health-related impacts of policies and other interventions that affect the environment, in ways that take account of the complexities, interdependencies and uncertainties of the real world.

Websites:

- http://www.integrated-assessment.eu
- http://en.opasnet.org/w/IEHIAS

EU funded projects: INTARESE and HEIMTSA

Key references:

- Briggs 2008. DOI: 10.1186/1476-069X-7-61

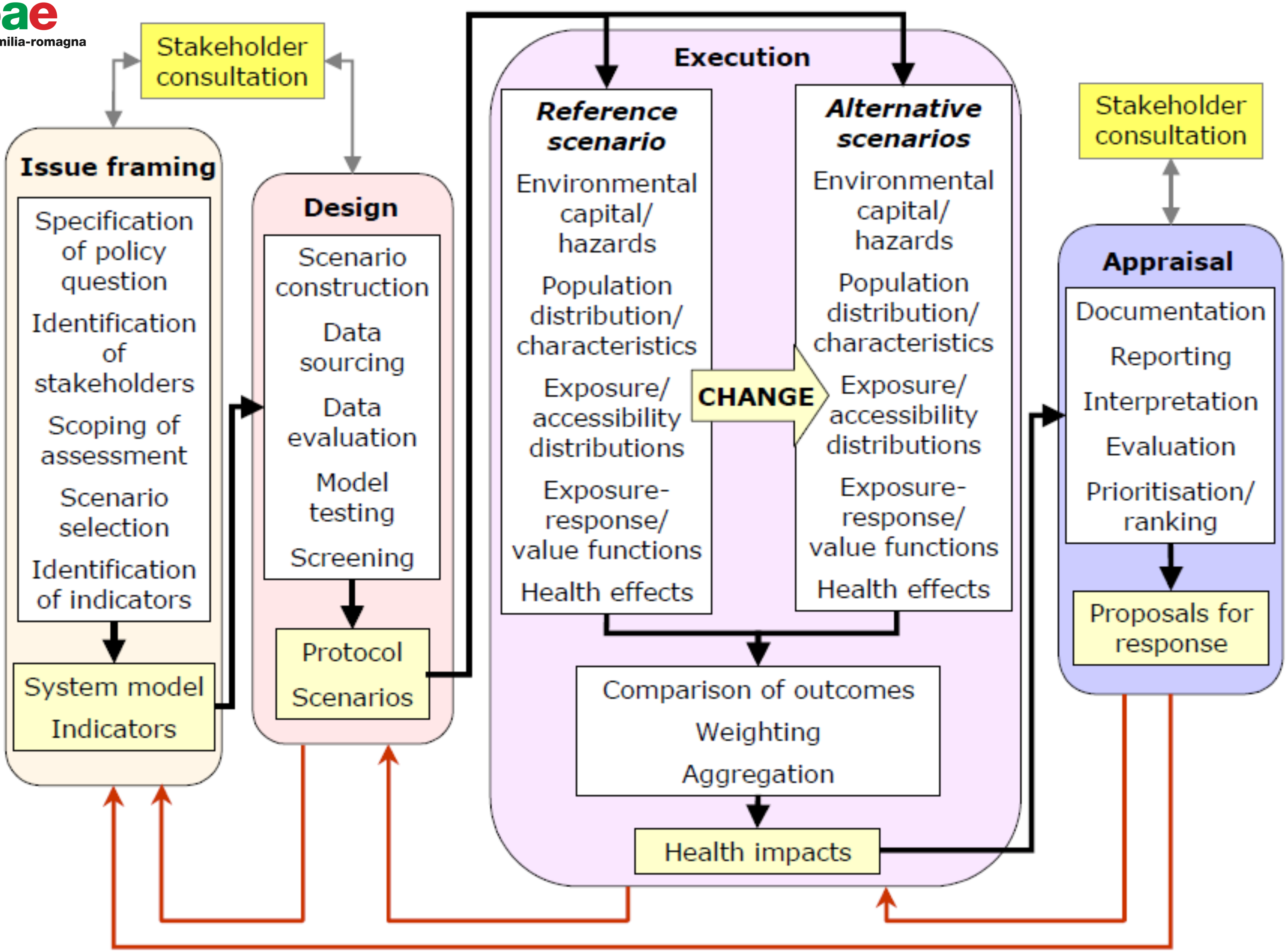
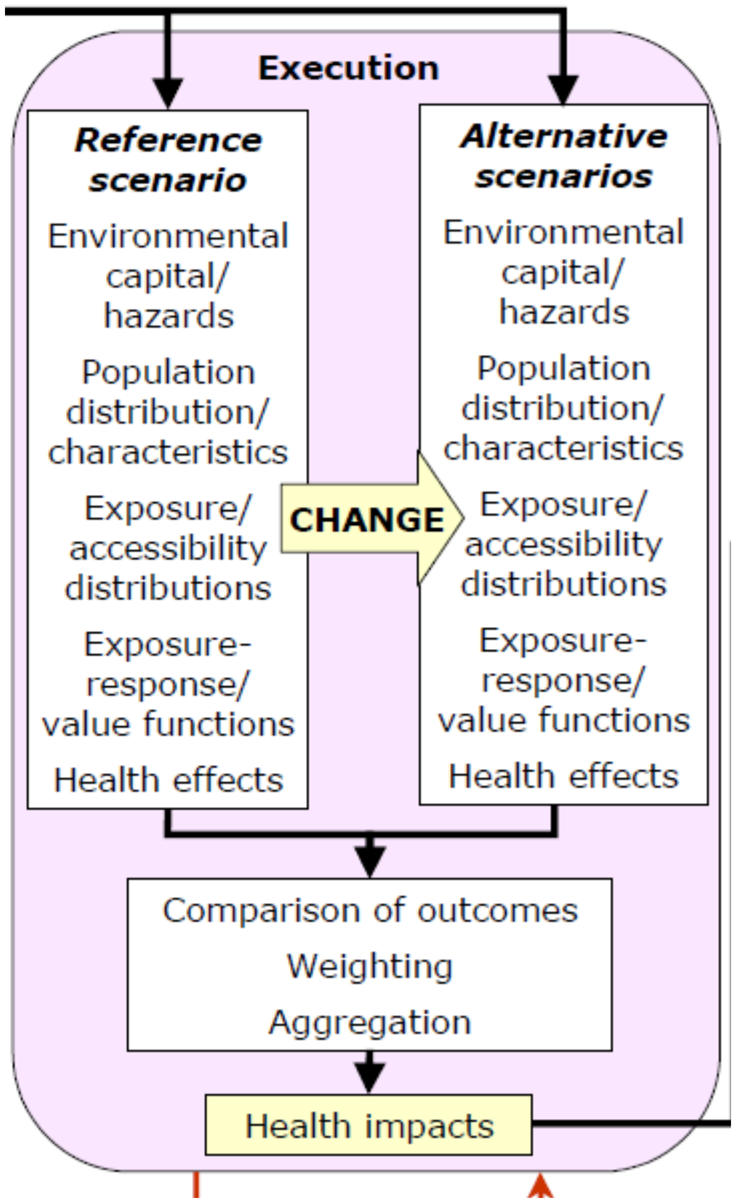


Figure 2. The analytical framework


Execution
Reference scenario
Environmental capital/ hazards
Population distribution/ characteristics
Exposure/ accessibility distributions
Exposure-response/ value functions
Health effects
CHANGE
Alternative scenarios
Environmental capital/ hazards
Population distribution/ characteristics
Exposure/ accessibility distributions
Exposure-response/ value functions
Health effects
Comparison of outcomes
Weighting
Aggregation
Health impacts

RR and attributable risk

- RR is measure of effect, not measure of public health impact
- We need to calculate impact: attributable number of cases due to the exposure
- Steenland and Armstrong provide nice overviews of calculations

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ORIGINAL ARTICLE

Epidemiology 2006

An Overview of Methods for Calculating the Burden of Disease Due to Specific Risk Factors

Kyle Steenland and Ben Armstrong†*

$$AF_{exp} = (R_1 - R_0)/R_1 = (RR - 1)/RR \qquad (1)$$

$$AF_{pop} = p_p\,(RR - 1)/(p_p\,(RR - 1) + 1) = (I - I_0)/I, \qquad (3)$$

where p_p is the percentage of the *total population* exposed and where I is the incidence rate in the combined population of exposed and nonexposed.[8,9] The first of the 2 expressions in formula (3) is the most commonly used formula for the

ATTRIBUTABLE CASES

General formula for the calculation of attributable cases:

$$AC = AFexp * Ratepopgen * Popexp$$

where:

AC = attributable cases;
AFexp = attributable fraction in exposed people (RR – 1) / RR;
Ratepopgen = background population incidence rate (proxy of rate in unexposed people)
Popexp = exposed people

$$AC = AFexp*B_0*(\Delta C/10)*P_{exp}$$

Where:

ΔC / 10: the increase in atmospheric concentrations for which the effect is to be evaluated.

Attributale fraction (AF) and Population Attributable Fraction (PAF)

AF: Everybody is exposed/affected

(1) $$AF = \frac{RR - 1}{RR}$$

Attributable fraction (AFexp)

PAF: Not everybody is exposed/affected

Numerator: Additional population risk from the exposure

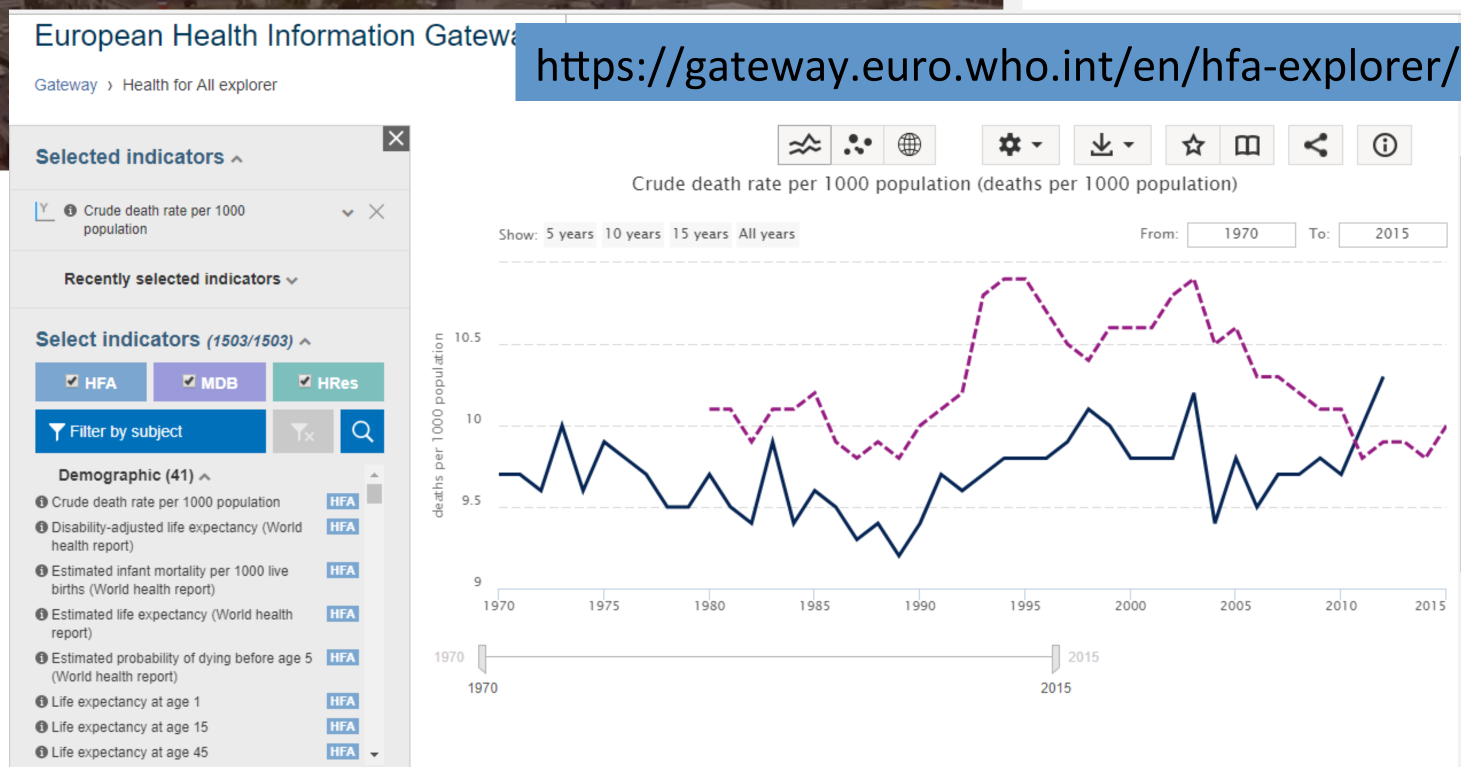
This fraction of population x Has this much elevated risk

(2) $$PAF = \frac{f \times (RR - 1)}{f \times (RR - 1) + 1}$$

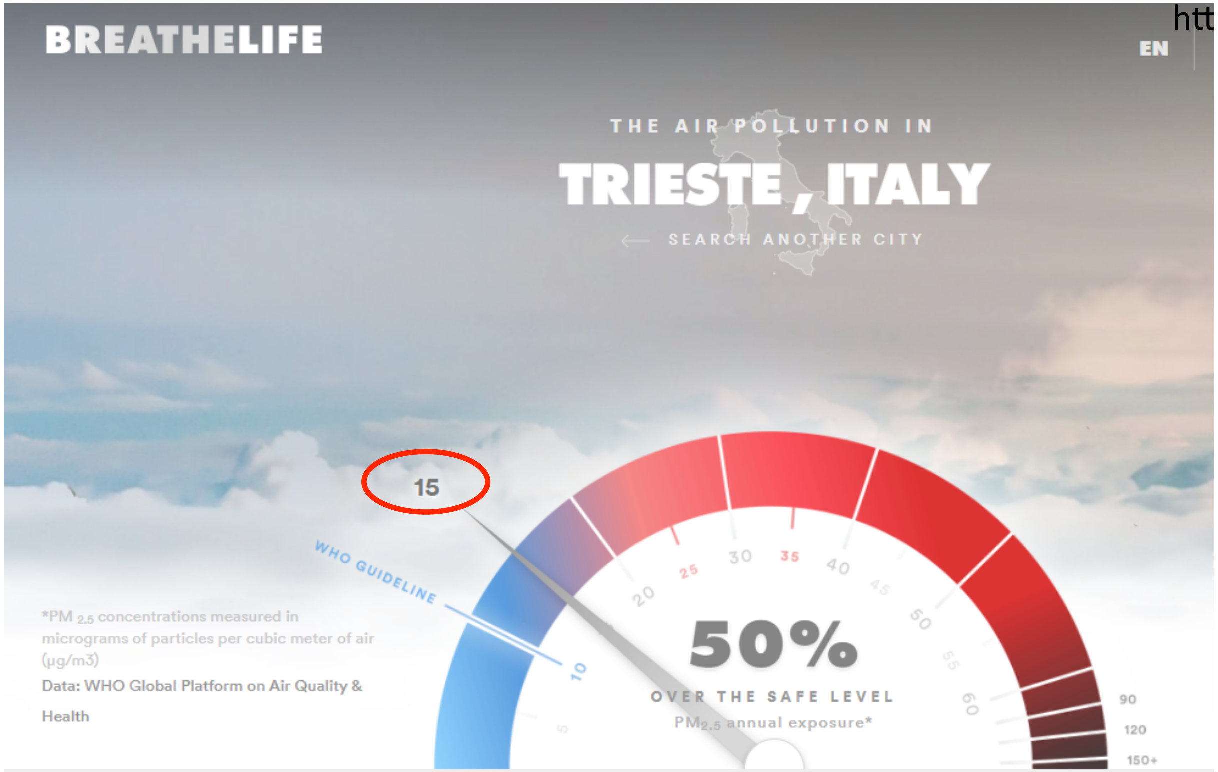
Additional risk from the exposure (same as in numerator) + Baseline risk is always 1

Denominator: Total risk, including the additional risk and the baseline risk http://breathelife2030.org/

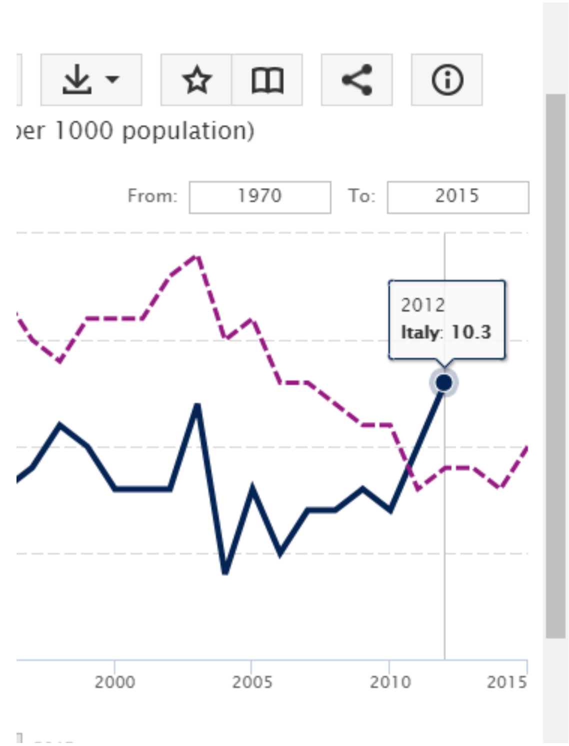
https://gateway.euro.who.int/en/hfa-explorer/



Rough estimate of AC in Trieste



https://gateway.euro.who.int/en/hfa-explorer/



Population: 205.000 (Wikipedia source)

CRF: 1.07 (WHO estimate for natural mortality and 10 µg/m3 increase of PM2.5

$$AC = AFexp*B_0*(\Delta C/10)*P_{exp}$$

AC (Trieste)= ((1.07-1)/1.07)*(205000*0.0103) *((15-10)/10)*1=0.065*2112*0.5=69

3.5% of total mortality (Italy about 6%)

AirQ+: software tool for health risk assessment of air pollution

Quantifying the effects of exposure to air pollution in terms of public health has become a critical component in policy discussion. WHO/Europe's software tool AirQ+ performs calculations that allow quantification of the health effects of exposure to air pollution, including estimates of the reduction in life expectancy.

AirQ+ estimates:

- the effects of short-term changes in air pollution (based on risk estimates from time-series studies);
- the effects of long-term exposures (using life-tables approach and based on risk estimates from cohort studies).

AIRQ+

- AirQ+ can be used, with some limitations, for cities, countries or regions to estimate:
- How much of a particular health effect is attributable to selected air pollutants?
- Compared to the current scenario, what would be the change in health effects if air pollution levels changed in the future?

AIRQ+

- AirQ+ enables users to use pre-loaded datasets for:
- relative risks (RRs) for selected pollutant health end-points pairs;
- conversion factors between PM2.5 and PM10 at the national level; and worldwide solid fuel use statistics at the national level.

- AirQ+ requires users to load their own data for the population studied:
- Air quality (average levels or frequency of days with specific levels)
- Population (e.g., number of adults aged ≥ 30 years)
- Health (e.g., baseline rates of health outcomes)
- AirQ+ also enables users to load their own data for pollutants not included in AirQ+ if RRs are available

AirQ+ 1.0 example of calculations

(April 2016)

Pierpaolo Mudu, Christian Gapp and Maria Dunbar

Contents

- Experiences of IHIA on air pollution

THE LANCET

< Previous Article | Volume 356, No. 9232, p795–801, 2 September 2000 | Next Article >

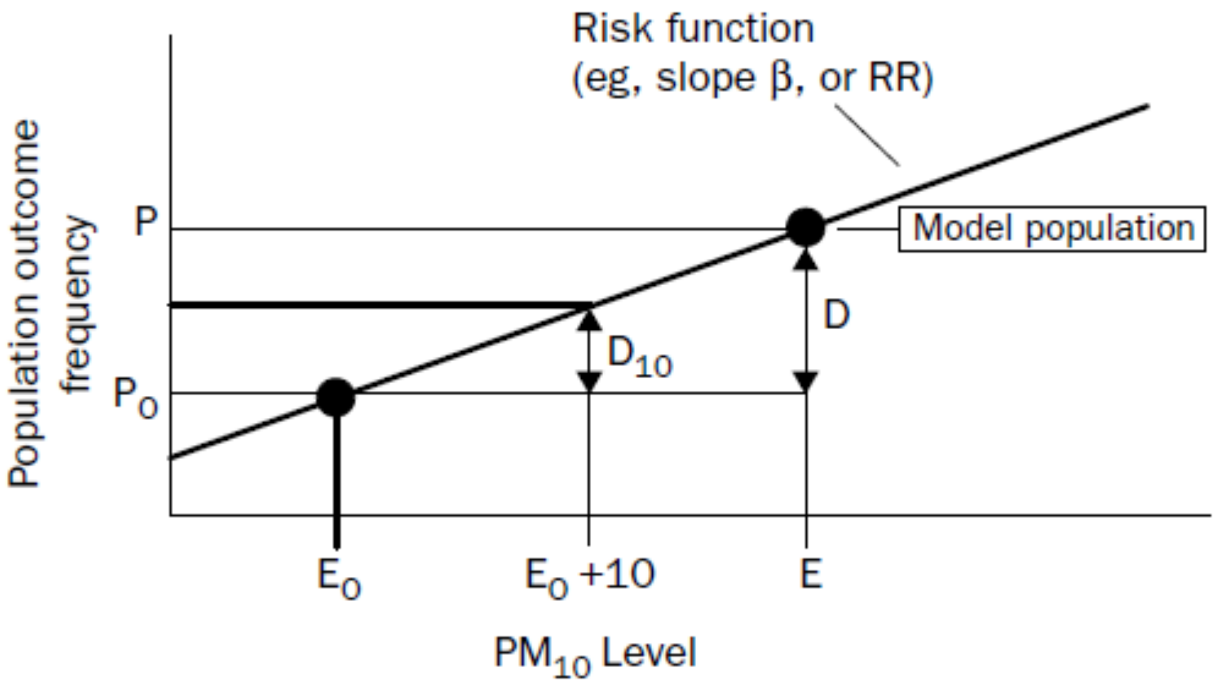
Articles

Public-health impact of outdoor and traffic-related air pollution: a European assessment

N Künzli, MD, R Kaiser, MD, S Medina, MD, M Studnicka, MD, O Chanel, MD, P Filliger, PhD, M Herry, PhD, F Horak Jr, MD, V Puybonnieux-Texier, MSc, P Quénel, MD, J Schneider, PhD, R Seethaler, MEc, J-C Vergnaud, PhD, H Sommer, PhD

Table 7. **Population weighted annual PM_{10} averages for the three countries (calculated from the original grid values of the PM_{10} maps)[11]**

	PM10 concentration in µg/m³ (annual mean)		
	Austria	France	Switzerland
Total PM_{10}	26.0	23.5	21.4
PM10 without fraction attributable to road traffic	18.0	14.6	14.0
PM10 due to road traffic	8.0	8.9	7.4



Model to derive number of cases attributable to air pollution
Based on exposure-response function (slope or relative risks, RR, from epidemiological studies), population frequency of the outcome, P (ie, prevalence, incidence, or number of days), and respective level of exposure, E. We assume reference exposure level (E_0). Health effects below this level are ignored. P_0 is expected outcome frequency, given exposure level E_0. D_{10} is number of cases attributed to increase in exposure by 10 units (10 $\mu g/m^3$ PM_{10}). D is total number of cases attributed to air pollution for model population.

a

EURO/02/5040650
ORIGINAL: ENGLISH

WORLD HEALTH ORGANIZATION
EUROPE

HEALTH IMPACT ASSESSMENT OF AIR POLLUTION IN THE EIGHT MAJOR ITALIAN CITIES

The WHO Regional Office for Europe

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health.
The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

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Over the last few decades, the evidence on the adverse effects on health of air pollution has been mounting. A broad range of adverse health outcomes due to short- and long-term exposure to air pollutants, at levels usually experienced by urban populations throughout the world, are established.

This report estimates the health impact of PM_{10} and ozone on urban populations of 13 large Italian cities. To do so, concentration–response risk coefficients were derived from epidemiological studies, and 25 adverse health outcomes and different exposure scenarios were considered. Average PM_{10} levels for the years 2002–2004 ranged from 26.3 µg/m³ to 61.1 µg/m³. The health impact of air pollution in Italian cities is large: 8220 deaths a year, on average, are attributable to PM_{10} concentrations above 20 µg/m³. This is 9% of the mortality for all causes (excluding accidents) in the population over 30 years of age; the impact on short term mortality, again for PM_{10} above 20 µg/m³, is 1372 deaths, which is 1.5% of the total mortality in the whole population. Hospital admissions attributable to PM_{10} are of a similar magnitude. Also, the impact of ozone at concentrations higher than 70 µg/m³ amounts to 0.6% of all causes of mortality. Higher figures were obtained for the effects on heath that result in morbidity.

The magnitude of the health impact estimated for the 13 Italian cities underscores the need for urgent action to reduce the health burden of air pollution. Compliance with European Union legislation can result in substantial

HEALTH IMPACT OF PM_{10} AND OZONE IN 13 ITALIAN CITIES

WORLD HEALTH ORGANIZATION
EUROPE

HEALTH IMPACT OF PM_{10} AND OZONE IN 13 ITALIAN CITIES

BY

Marco Martuzzi
Francesco Mitis
Ivano Iavarone

APAT
Agenzia per la protezione dell'ambiente e per i servizi tecnici

WORLD HEALTH ORGANIZATION
EUROPE

Comunicato Stampa APAT-OMS
Roma, 15 giugno 2006

Oltre 8000 decessi l'anno stimati in 13 città italiane per gli effetti a lungo termine dell'inquinamento atmosferico da particolato

Burden of disease

Multiple exposures
Multiple health endpoints } Environmental burden of disease (EBoD)

- Burden of disease (BoD)

  BoD [DALY] =YLL + YLD

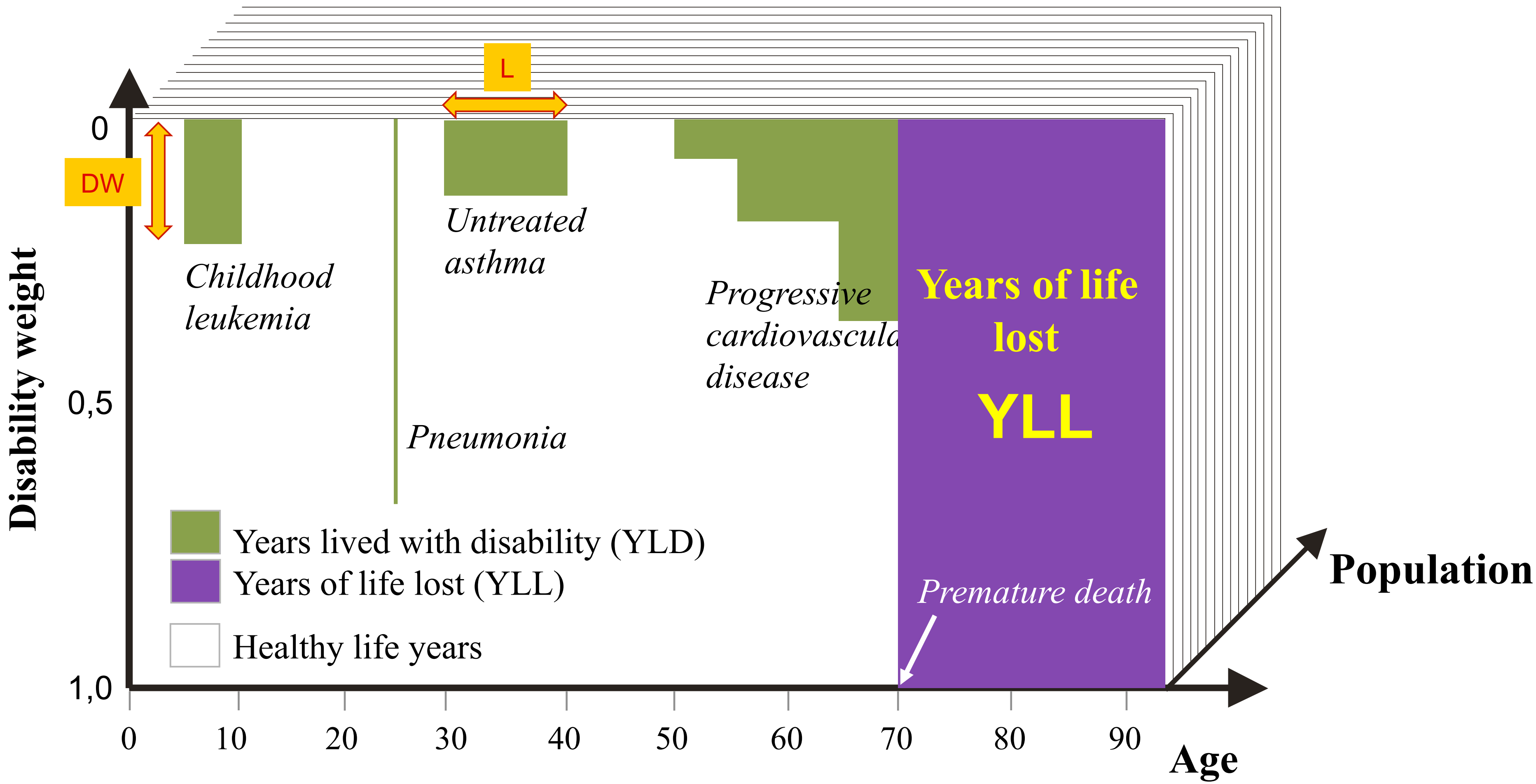
  - years of life lost (due to premature mortality) (YLL)
  - years lived with disability (YLD) (scaled using disability weights)

- Followed by environmental burden (EBD)
  - burden attributable to defined risk factors

  EBD = PAF × BoD

Disability adjusted lifeyears (DALY)

DALY = AC×DW×L



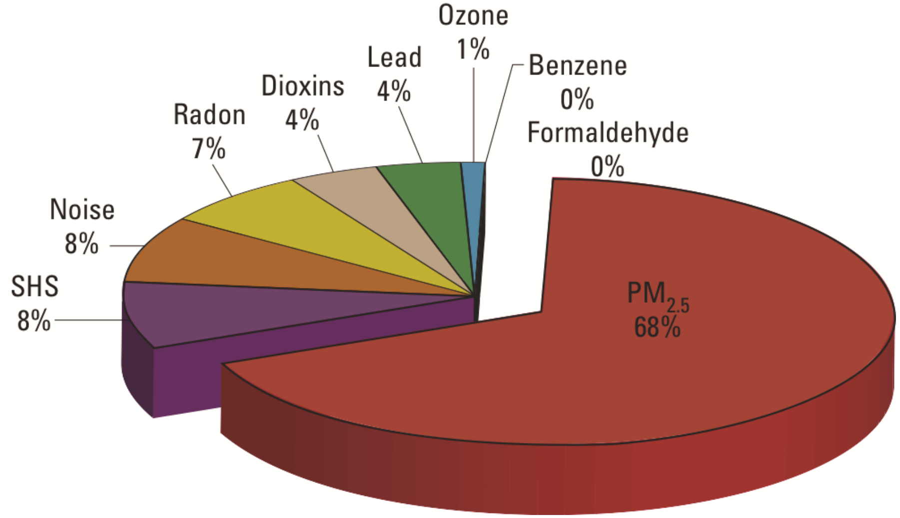
Adopted from Guus de Hollander et al., 1999
Hänninen, Lehtomäki et al. 2016

All *EHP* content is accessible to individuals with disabilities. A fully accessible (Section 508–compliant) HTML version of this article is available at http://dx.doi.org/10.1289/ehp.1206154.

Review

Environmental Burden of Disease in Europe: Assessing Nine Risk Factors in Six Countries

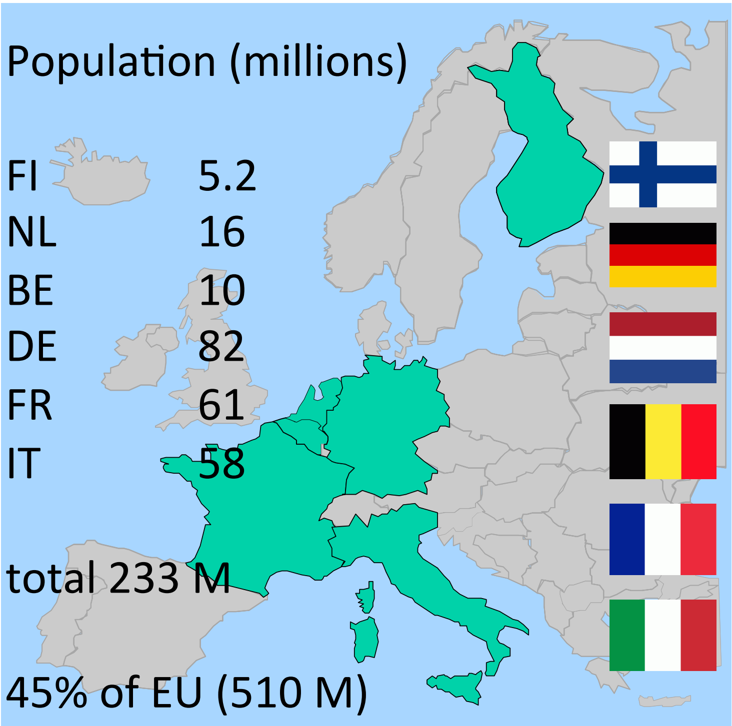
Otto Hänninen,[1] Anne B. Knol,[2] Matti Jantunen,[1] Tek-Ang Lim,[3] André Conrad,[4] Marianne Rappolder,[4] Paolo Carrer,[5] Anna-Clara Fanetti,[5] Rokho Kim,[6] Jurgen Buekers,[7] Rudi Torfs,[7] Ivano Iavarone,[8] Thomas Classen,[9] Claudia Hornberg,[9] Odile C.L. Mekel,[10] and the EBoDE Working Group



EBoD=PAF x BD

Three different methods (methods 1a, 2a, or 2b) were used to estimate the EBD, depending on the type of exposure–response function estimate available for each exposure–outcome pair [either an RR based on environmental epidemiology, or a unit risk (UR) based on toxicological or occupational data], and on the availability of a WHO baseline burden of disease (BD) estimate for the outcome.

Environmental Burden of Disease in Europe (EBoDE) -project



rivm
National Institute for Public Health and the Environment

vito
vision on technology

Umwelt Bundes Amt
for our Environment

Universität Bielefeld

InVS

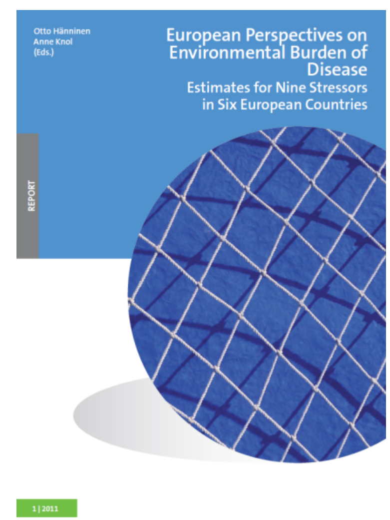
Hänninen et al. 2014


Review

Environmental Burden of Disease in Europe: Assessing Nine Risk Factors in Six Countries

http://ehp.niehs.nih.gov/1206154/

Hänninen & Knol, 2011



http://urn.fi/URN:ISBN:978-952-245-413-3

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Hänninen O, Knol A, Jantunen M, Lim T-A, Conrad A, Rappolder M, Carrer P, Fanetti A-C, Kim R, Buekers J, Torfs R, Iavarone I, Classen T, Hornberg C, Mekel O, and the EBoDE Group, 2014. **Environmental burden of disease in Europe: Assessing nine risk factors in six countries**. Environmental Health Perspectives: 122(5):439-446. DOI:10.1289/ehp.1206154

Hänninen O, Knol A (eds.), Jantunen M, Kollanus V, Leino O, Happonen E, Lim T-A, Conrad A, Rappolder M, Carrer P, Fanetti A-C, Kim R, Prüss-Üstün A, Buekers J, Torfs R, Iavarone I, Comba P, Classen T, Hornberg C, Mekel O, 2011. **European perspectives on Environmental Burden of Disease; Estimates for nine stressors in six countries**. THL Reports 1/2011, Helsinki, Finland. 86 pp + 2 appendixes. ISBN 978-952-245-413-3

EBoDE Overall stressor comparison Six countries (BE, DE, FI, FR, IT, NL)

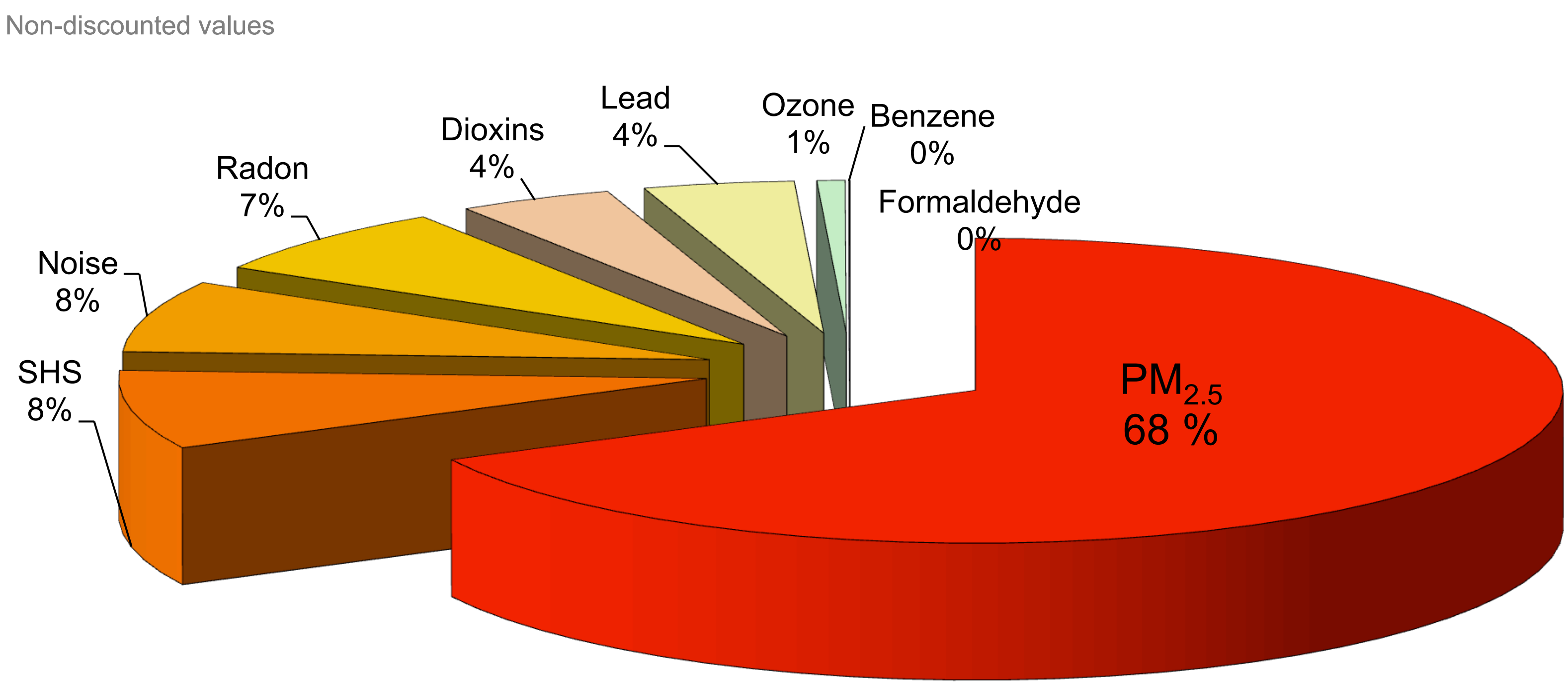


Figure 1. Relative contribution of the nine targeted stressorrisk factors to the burden of disease attributed to these stressorrisk factors, average over the six participating countries.

Hänninen & Knol, 2011
Hänninen et al. 2014

TABLE 3-19. Summary of health endpoints, exposure units and exposure/response-relationships. Unless otherwise stated, both mortality and morbidity were estimated.

Hänninen & Knol, 2011

Stressor	Health endpoint	Population	Exposure estimate	Unit of exposure	Type of ERF	Point estimate of ERF [a)]	LCL (95%)	UCL (95%)	Reference(s) for ERF	Threshold	Calculation method [b)]
Benzene	Leukemia	All	Annual mean exposure	μg m⁻³ → $\mu g\ m^{-3}$	UR	6.00×10^{-6}	2.20×10^{-6}	7.80×10^{-6}	WHO, 2000a; IRIS 2003		2A
Dioxin	Total cancer incidence	All	Daily intake of adults	pg/kg/d	UR	1.00×10^{-3}	5.70×10^{-4}	5.10×10^{-3}	NAS, 2004, IRIS, 2006, Leino 2008		2A
SHS	Tracheas, bronchus and lung cancers [c)]	Adult non-smokers	% of people exposed (= yes)	yes/no	RR	1.21	1.13	1.30	US S.G., 2006		1A
	Ischemic heart disease	Adult non-smokers		yes/no	RR	1.27	1.19	1.36	US S.G., 2006		1A
	Asthma induction	Adult non-smokers		yes/no	RR	1.97	1.19	3.25	Jaakkola et al., 2003		1A
	Asthma induction	Children (<14 yr)		parental y/n	RR	1.32	1.24	1.41	Cal-EPA, 2005		1A
	Lower respiratory infections	Infants (<2 yr)		parental y/n	RR	1.55	1.42	1.69	US S.G., 2006		1A
	Otitis media	Toddlers (<3 yr)		parental y/n	RR	1.38	1.21	1.56	Etzel et al., 1992; Cal-EPA 2005		1A
Formaldehyde	Asthma aggravation (children) (morbidity only)	Toddlers (<3 yr)	Annual mean residential indoor concentration	$\mu g\ m^{-3}$	RR	1.017	1.004	1.025	Rumchev et al., 2002	100	1A
Lead	IQ loss	Children (<5 yr)	Distribution of blood lead levels	μg/l	UR	0.051	0.032	0.07	Landphear et al., 2005	24	2B
	Mild mental retardation (morbidity only)	Children (<5 yr)		μg/l	DS [d)]	function	-	-	-	24	2B
	Hypertensive diseases (morbidity only)	Adults/All		μg/l	DS [d)]	function	-	-	-	50	2B
	Increased blood pressure	Adults/All		μg/l	UR	2.50×10^{-2}	1.70×10^{-2}	3.20×10^{-2}	Fewtrell et al. 2003, Schwartz, 1995	50	2B
Road traffic noise	High sleep disturbance (HSD) (morbidity only)	All	Persons exposed to predefined exposure categories	Lnight (dB)	UR	function	function	function	Miedema et al., 2007		2B
	Ischemic heart disease (IHD)	All		Lday16h (dB)	OR	function	function	function	Babisch, 2006		1A
Railway noise	High sleep disturbance (HSD) (morbidity only)	All		Lnight (dB)	UR	function	function	function	Miedema et al., 2007		2B
Aircraft noise	High sleep disturbance (HSD) (morbidity only)	All		Lnight (dB)	UR	function	function	function	Miedema et al., 2007		2B

Stressor	Health endpoint	Population	Exposure estimate	Unit of exposure	Type of ERF	Point estimate of ERF [a)]	LCL (95%)	UCL (95%)	Reference(s) for ERF	Threshold	Calculation method [b)]
Ozone	Total mortality (non-violent)	Adults (>30 yr)	Population weighed ambient SOMO35 level	$\mu g\ m^{-3}$	RR	1.0003	1.0001	1.000	WHO, 2006a		~~1A~~ 1B
	Minor restricted activity days (morbidity only)	Working age (18–64 yr)		$\mu g\ m^{-3}$	UR	0.0115	0.0044	0.02	Hurley et al., 2005, WHO 2006b		2B
	Cough days, children (morbidity only)	School children (5–14)		$\mu g\ m^{-3}$	UR	0.093	0.019	0.22	Hurley et al., 2005, WHO 2006b		2B
	LRS days in children (excl cough) (morbidity only)	School children (5–14)		$\mu g\ m^{-3}$	UR	0.016	-0.043	0.08	Hurley et al., 2005, WHO 2006b		2B
$PM_{2.5}$	Cardiopulmonary disease	Adults (>30 yr)	Population weighted ambient level	$\mu g\ m^{-3}$	RR	1.0077	1.0020	1.0132	Pope et al., 2002, WHO, 2006a		1A
	Lung cancer	Adults (>30 yr)		$\mu g\ m^{-3}$	RR	1.012	1.004	1.020	Pope et al., 2002, WHO, 2006a		1A
	Chronic bronchitis (new cases)	Adults (>27 yr)		$\mu g\ m^{-3}$	UR	5.33×10^{-5}	1.70×10^{-6}	1.13×10^{-4}	Hurley et al., 2005, WHO, 2006b		~~1A~~ 2B
	Restricted activity days (RAD)	15–64 yr		$\mu g\ m^{-3}$	UR	0.0902	0.0792	0.101	Hurley et al., 2005, WHO, 2006b		2B
Radon	Lung cancer	All	Residential mean level	$Bq\ m^{-3}$	RR	1.0016	1.0005	1.0031	Darby et al. 2005		1A + 2A

Four BoD estimation methods

A. Top-down (PAF)

B. Bottom-up: BoD=n×DW×L

1 Epi (RR)

2 Unit risk

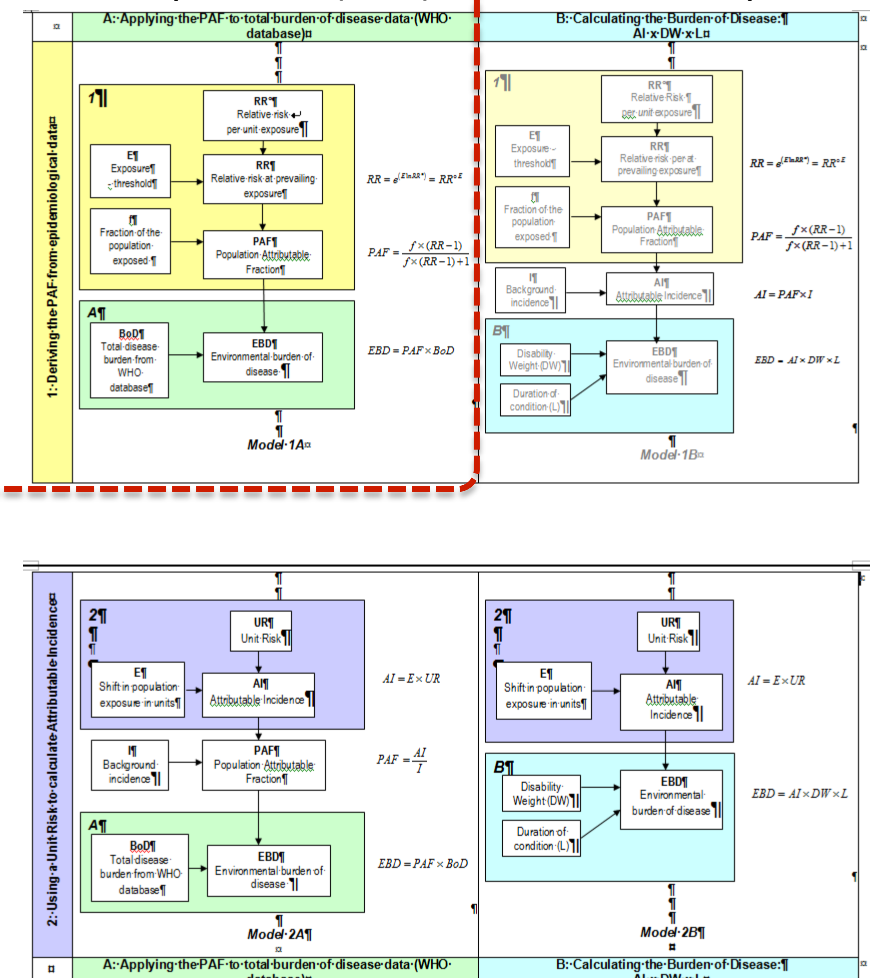
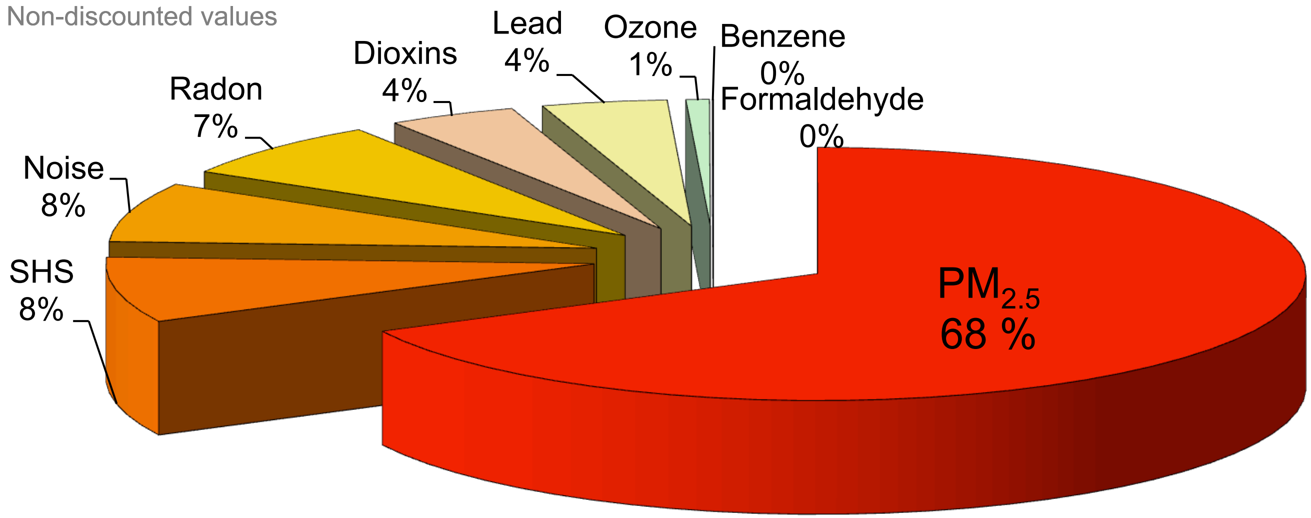
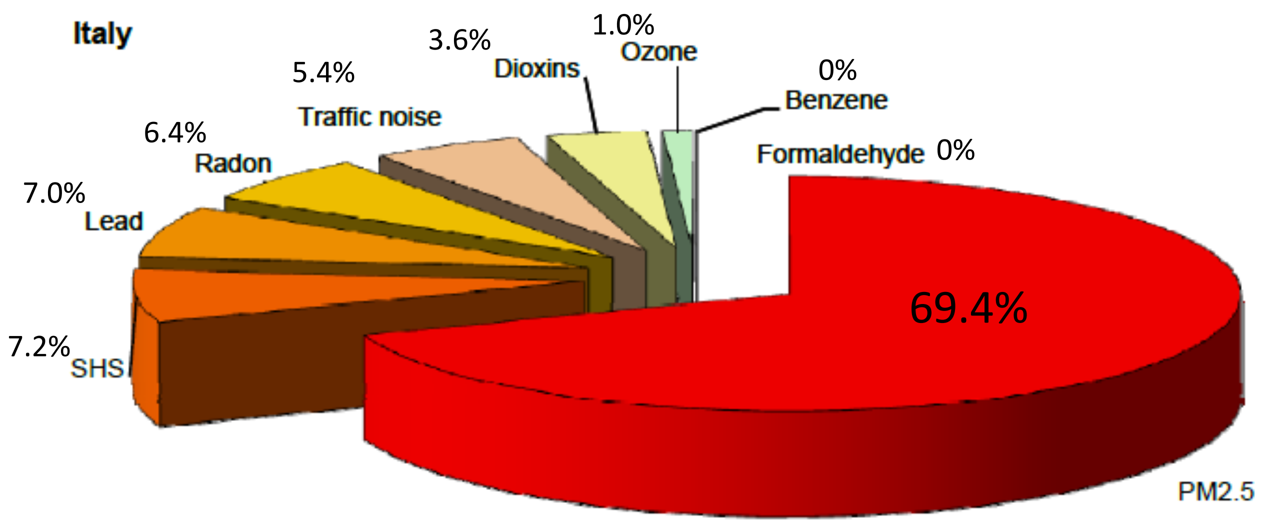


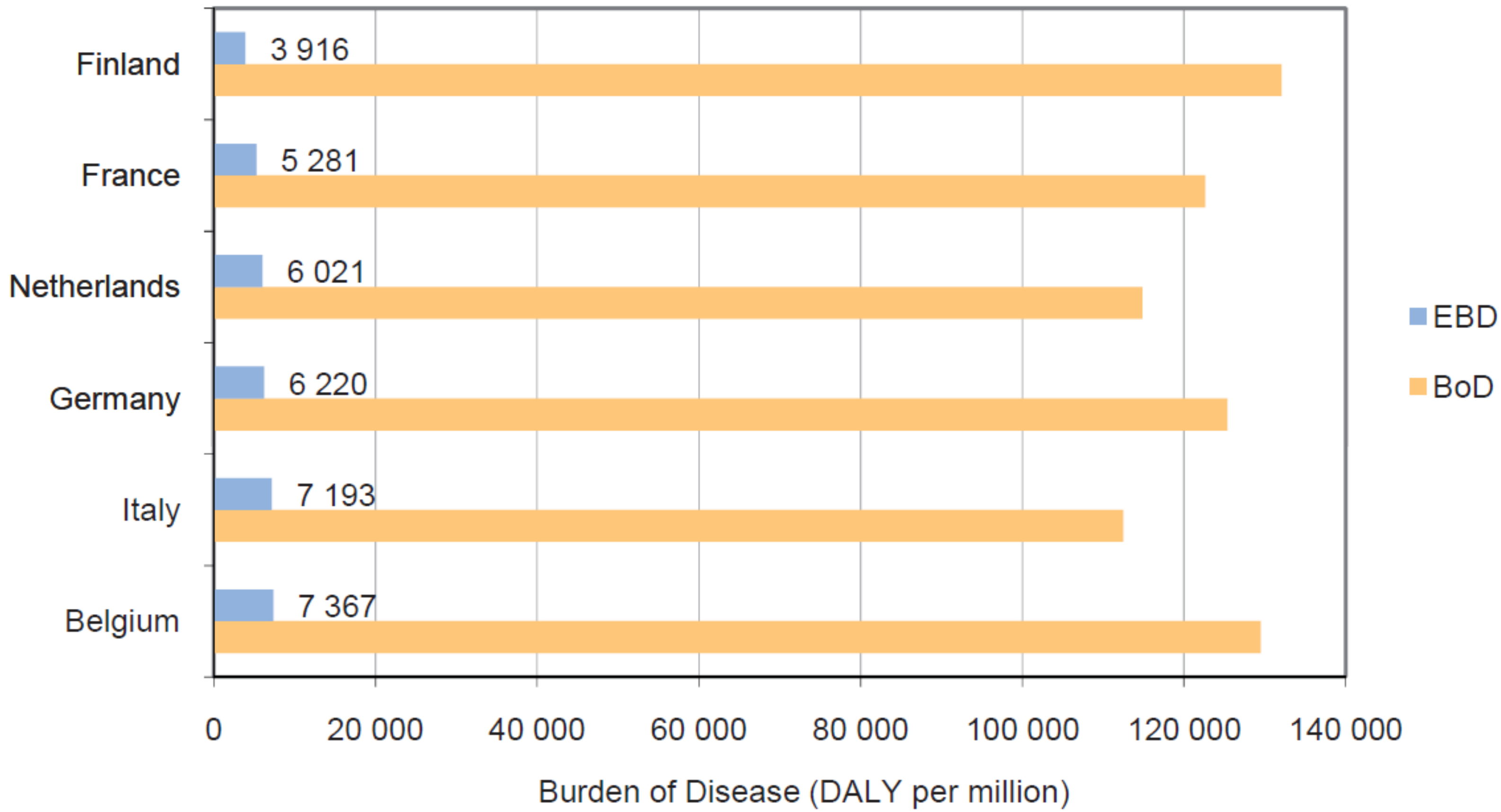
Figure 2-1: four models to estimate the environmental burden of disease. Model 1b is not used in EBoDE.

EBoDE Overall stressor comparison - 6 countries (BE, DE, FI, FR, IT, NL)



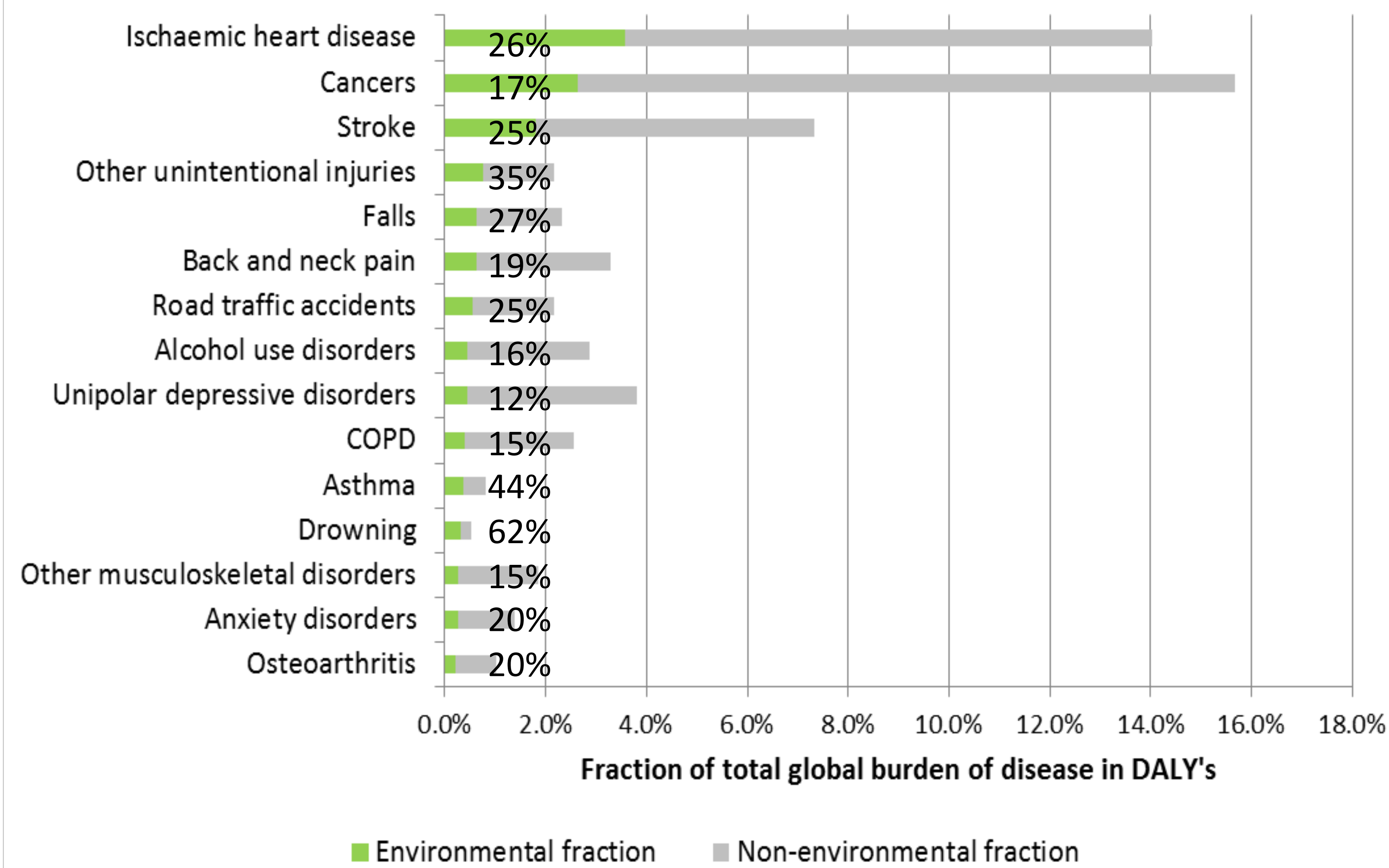


EBoDE- Hanninen et al.



Range: 3% (Finland) – >6% (Italy)

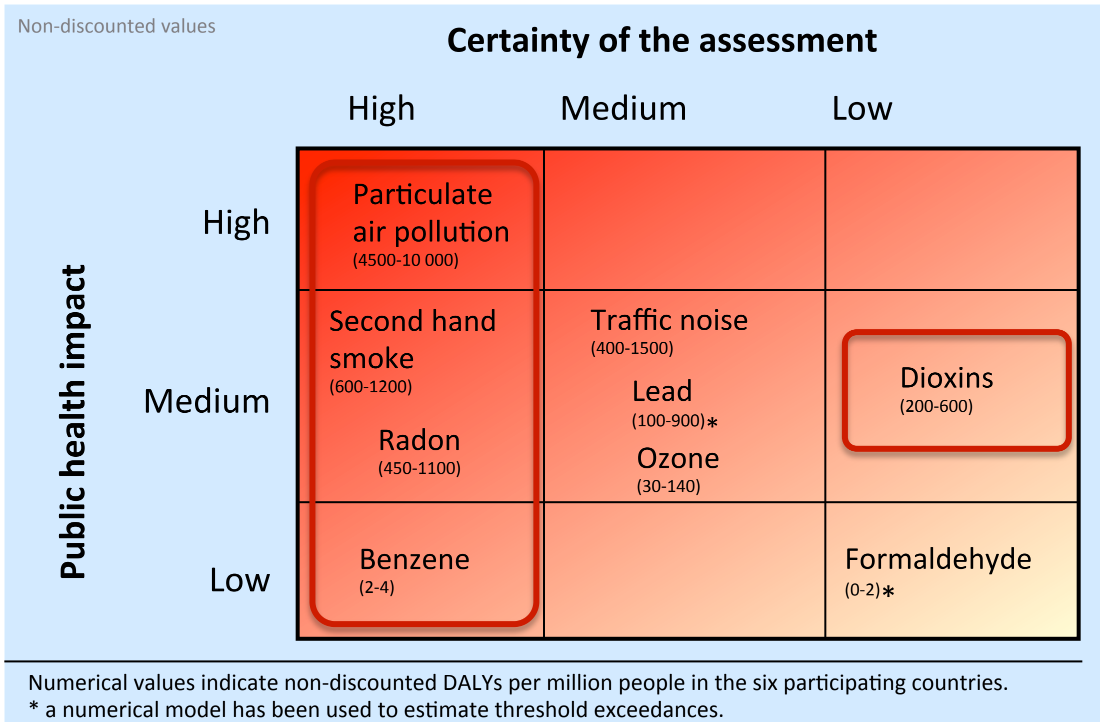
Environmental burden of disease, Eur, 2012 (in DALYs)



Cost of PM2.5 air pollution in Europe, 2010

- US $ 1.6 trillions: 1,574,649,000,000
- >10% GDP in 22 countries (of 48)
- Mix of regulation, investment and pricing needed

EBoDE: Magnitude of public health impact vs. uncertainties



Stressors with cancer relevance

Figure 2. Contribution of the nine selected environmental stressor risk factors to the burden of disease (DALY/M) as population weighted average over the six countries.

Hänninen & Knol, 2011
Hänninen et al. 2014

Going back to our example on landfills

arpae emilia-romagna

Example 2: Use of large routine data

Example on Waste-related exposure:

how calculate EBD related to exposure to landfills in Europe

- Yesterday
- Number of exposed people using European databases
  - GIS approach to exposure assessment

•**Today**

•Use RR from literature and

•Calculation of AC (Attributable Cases)

•Combination of different health outcomes in one analysis using DALYs

Outline

Example on how calculate EBD related to exposure to landfills in your country

- Use RR from literature and
- Number of exposed people using European databases
  - GIS approach to exposure assessment
- Calculation of AC (attributable cases)
- Combination of different health outcomes in one analysis using DALYs

ATTRIBUTABLE CASES

General formula for the calculation of attributable cases:

$$AC = AFexp * Ratepopgen * Popexp$$

where:

AC = attributable cases;

AFexp = attributable fraction in exposed people (RR – 1) / RR;

Ratepopgen = background population incidence rate (proxy of rate in unexposed people)

Popexp = exposed people

DALYs

- Disability Adjusted Life Years

$$DALYs = AC * DW * L$$

where:

- AC = attributable cases;
- DW=Disability Weight
- L= disease duration

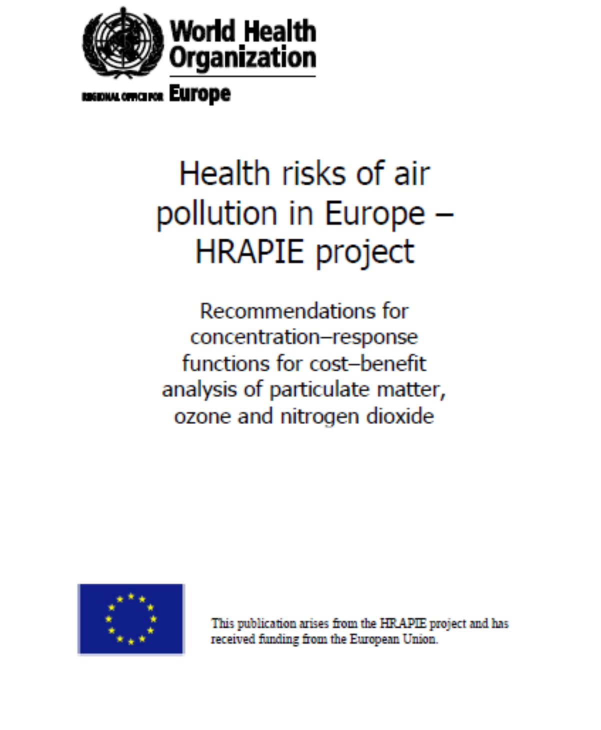
***

Mortality=1
Cancer=0.44/12.6 y
Respiratory symptoms=0.08
Low Birth Weight = 0.106/ 79.6 years
Congenital Anomalies = 0.17 / 79.6 years
Annoyance = 0.03

**source: Victorian Burden of Disease*

Data collection

- Location of plants
- Population database
- European health statistics
- Relative risks


World Health Organization
REGIONAL OFFICE FOR Europe

Health risks of air pollution in Europe – HRAPIE project

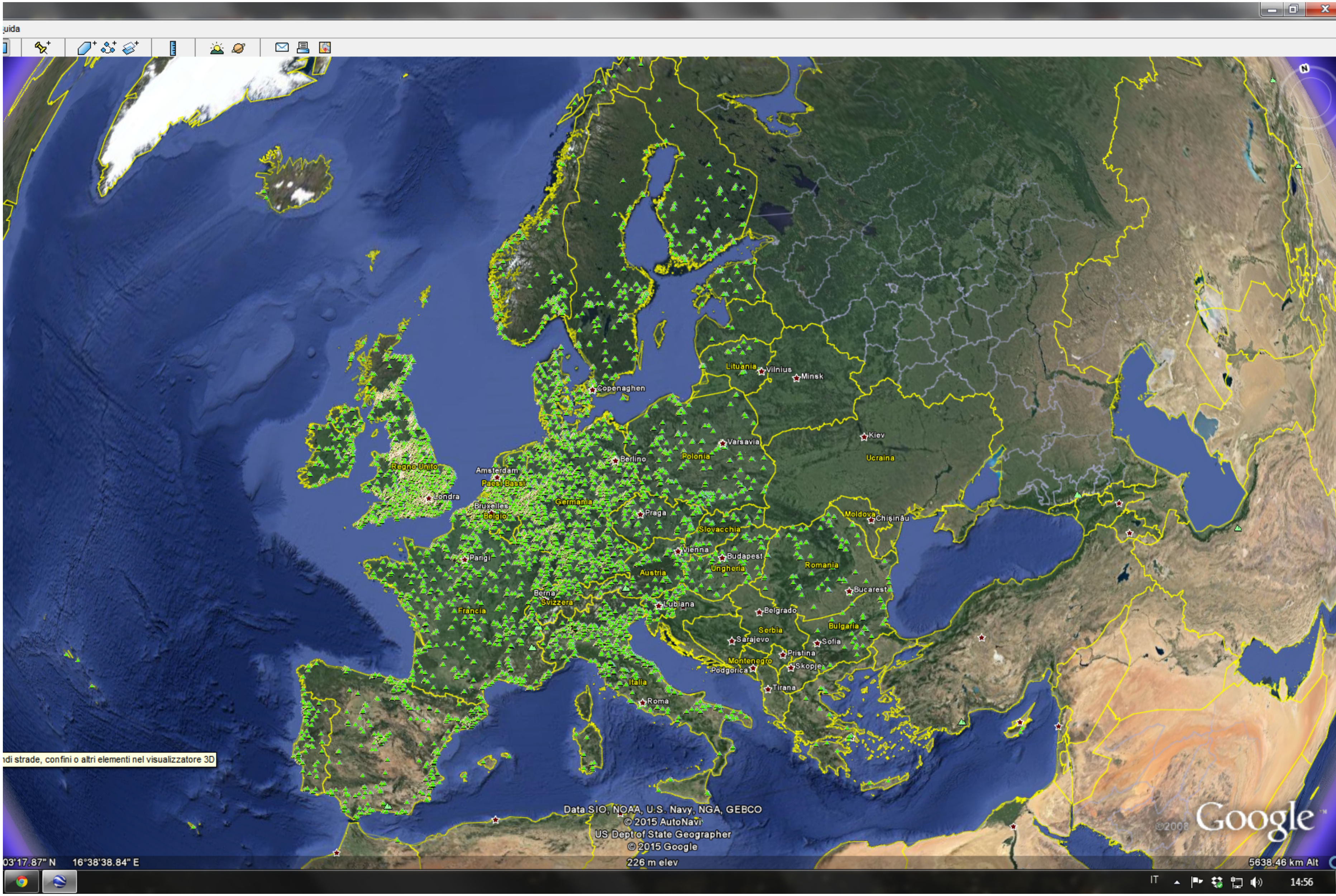
Recommendations for concentration–response functions for cost–benefit analysis of particulate matter, ozone and nitrogen dioxide

This publication arises from the HRAPIE project and has received funding from the European Union.

AF - data from literature

Exposure buffer	Exopsure index	Health outcome	Risk	Ref.
2 km	Distance	Congenital anomalies	RR=1.02 (99%CI=1.01-1.03)	Elliott et al. 2001
		Annoyance from odour	5.4%	Herr et al. 2003
		Low birth weight	1.06 (99%CI=1.052-1.062)	Elliott et al. 2001
5 km	H2S (model)	Respiratory diseases	1.09 (95%CI=1.00-1.19)	Golini et al. 2016

E-PRTR data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Londra
Bruxelles
Belgio
Germania
Praga
Moldova
Chişinău
Slovacchia
Vienna
Budapest
Ungheria
Parigi
Austria
Romania
Bucarest
Berna
Svizzera
Lubiana
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Belgrado
Serbia
Bulgaria
Sarajevo
Sofia
Pristina
Montenegro
Podgorica
Skopje
Tirana
Italia
Roma
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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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US Dept of State Geographer
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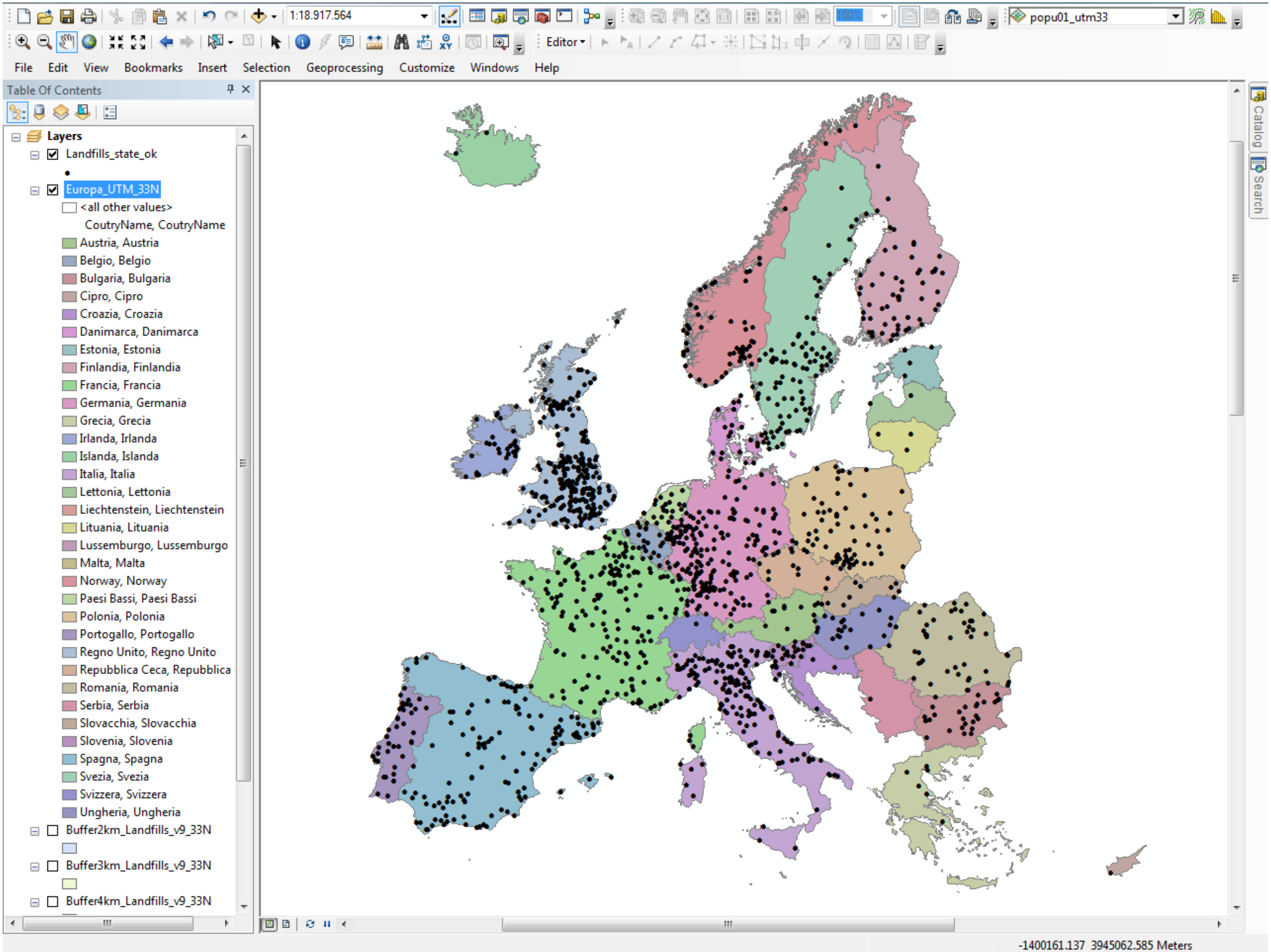
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Svezia, Svezia
Svizzera, Svizzera
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Buffer3km_Landfills_v9_33N
Buffer4km_Landfills_v9_33N
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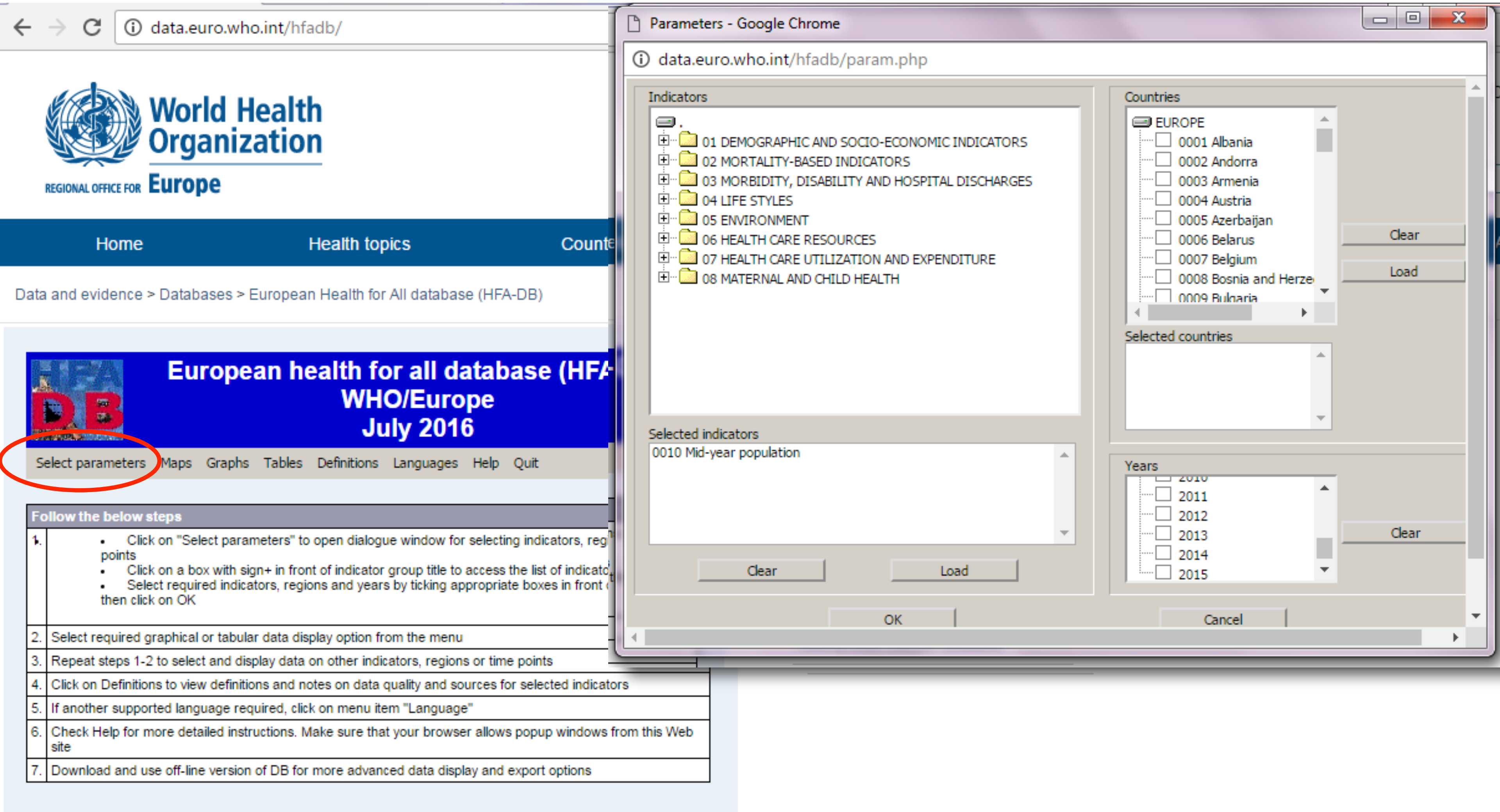
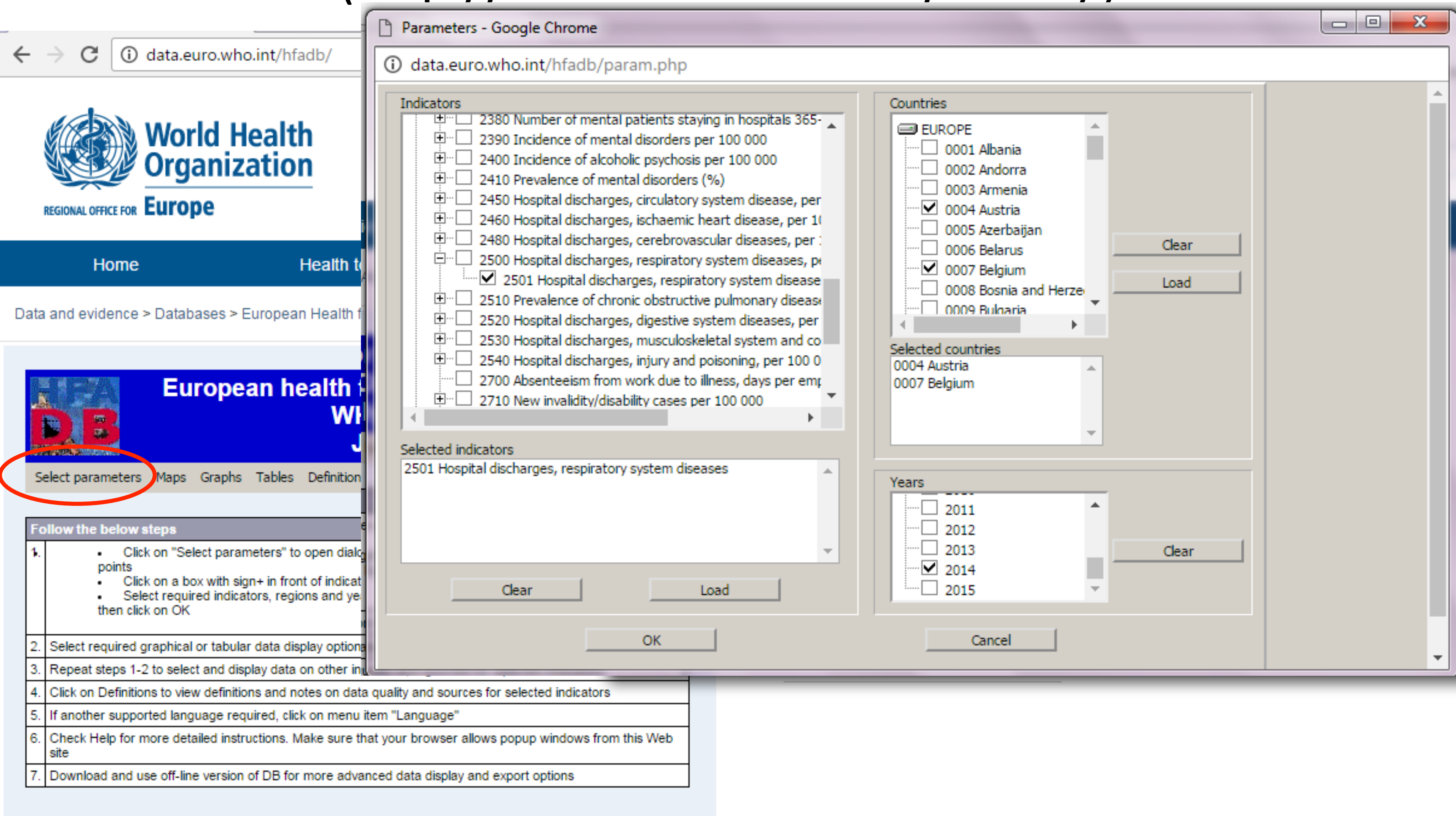
Health for All Database

(http://data.euro.who.int/hfadb/)



Health for All Database

(http://data.euro.who.int/hfadb/)



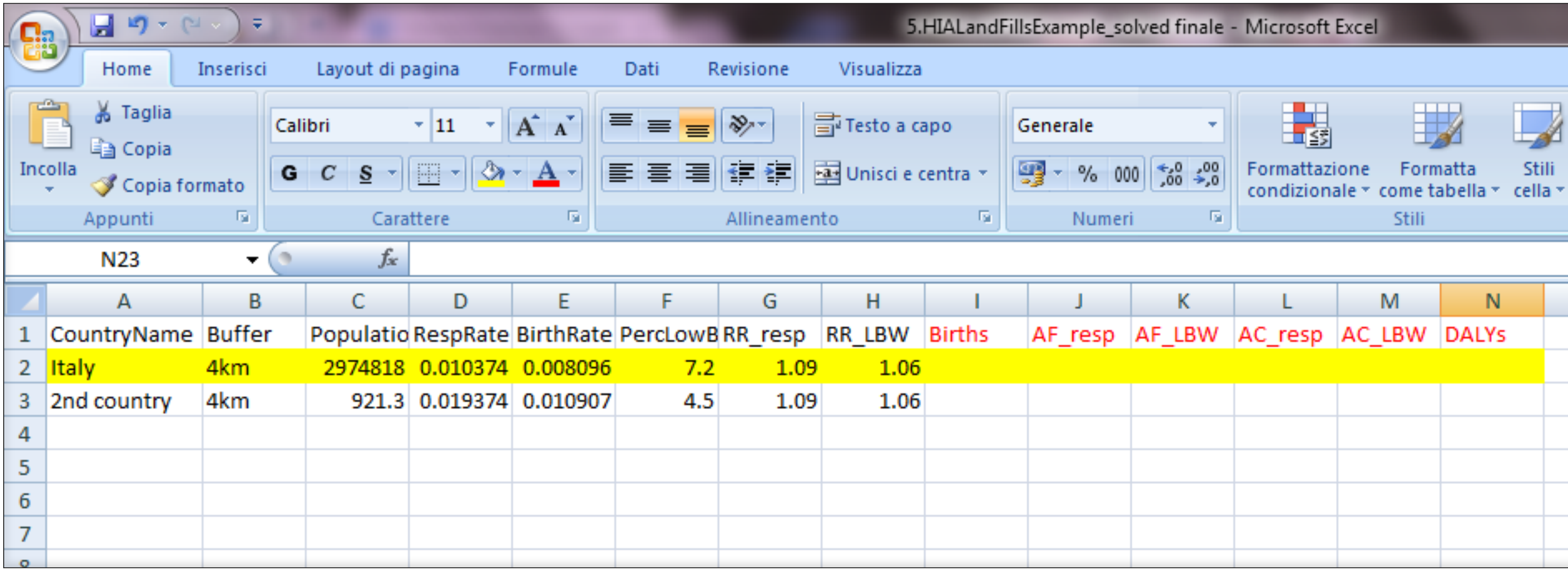
Final dataset for exercise

- Each row represent a member State

Variables in columns:

- *CountryName*: name of the country;
- *Buffer*: radius of the buffer used to calculate exposed population
- *Population*: total population living within buffers (eg 4 km)
- *RespRate*: background population respiratory disease rate
- *Birthrate*: rate of births on total population
- *Perc_LBW*: percentage of low birth weight on total births
- *RR_resp*: relative risk for respiratory diseases
- *RR_LBW*: relative risk for low birth weight

Input file



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	CountryName	Buffer	Populatio	RespRate	BirthRate	PercLowB	RR_resp	RR_LBW	Births	AF_resp	AF_LBW	AC_resp	AC_LBW	DALYs
2	Italy	4km	2974818	0.010374	0.008096	7.2	1.09	1.06						
3	2nd country	4km	921.3	0.019374	0.010907	4.5	1.09	1.06						
4														
5														
6														
7														

Instructions for exercise

- Work on Italy row and another country row
- Create a new column and calculate total births, using information on birth rate
- Calculate AF using RR column
- Create new columns for AC_lbw and AC_resp
- Calculate AC_lbw and AC_resp using the formula:

$$AC = AFexp * Ratepopgen * Popexp$$

- Create new columns for DALYs
- Calculate DALYs using the formula:

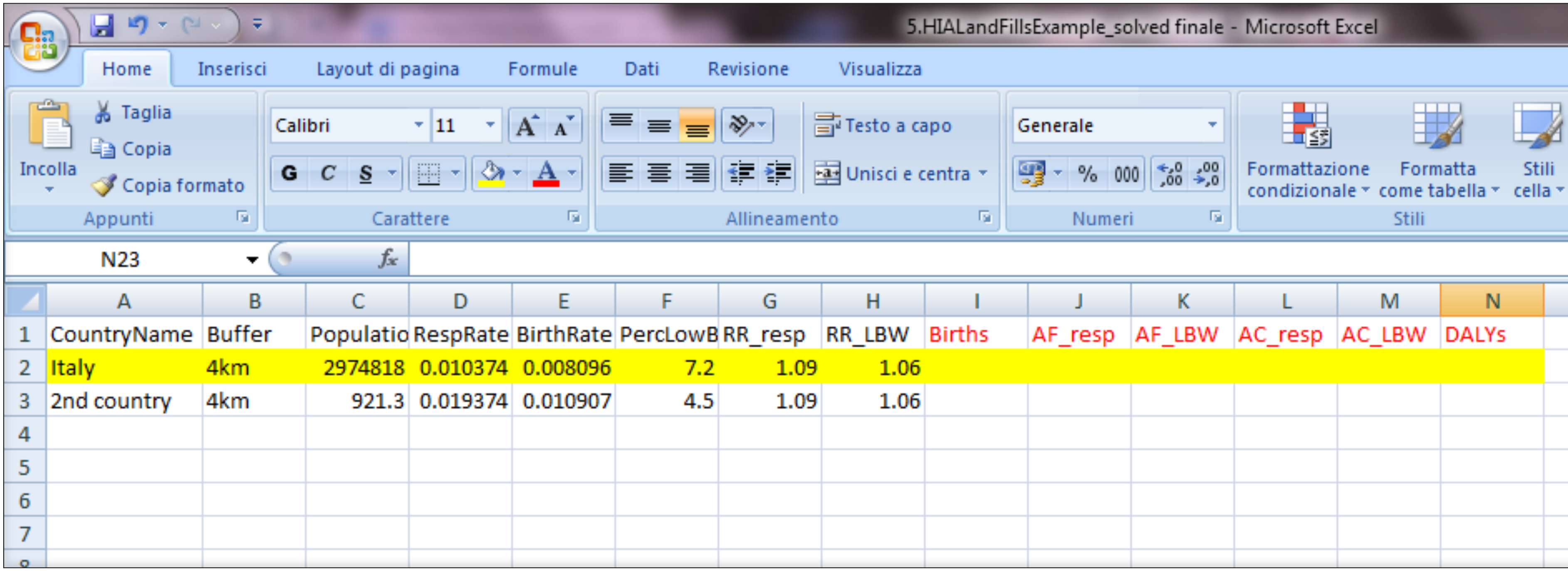
$$DALYs = AC * DW * L$$

20 minutes for…

Variables you have to create

Decription	Formula
Births: exposed people for LBW outcome (number of births)	total population * birth rate
AF_resp: attributable fraction for respiratory disease	(RR_resp – 1)/RR_resp
AF_LBW: attributable fraction for low birth weigth	(RR_LBW – 1)/RR_LBW
AC_resp: attributable cases for respiratory diseases	AF_resp*Resprate* population
AC_LBW: attributable cases for low birth weight	AF_LBW*(perc_LBW/ 100)*Births
DALYs: total number of DALYs for both health outcomes	$\sum_{i}^{resp,lbw} AC_i * DW_i * L_i$ Resp: DW=0.08 ;L=1 LBW: DW=0.1 06;L=79.6

Output file



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	CountryName	Buffer	Populatio	RespRate	BirthRate	PercLowB	RR_resp	RR_LBW	Births	AF_resp	AF_LBW	AC_resp	AC_LBW	DALYs
2	Italy	4km	2974818	0.010374	0.008096	7.2	1.09	1.06						
3	2nd country	4km	921.3	0.019374	0.010907	4.5	1.09	1.06						

Exp_LBW	AF_resp	AF_LBW	AC_resp	AC_LBW	DALYs
24083	0.082569	0.056604	2548	98	1032

Table 1 Risks, disability weights and duration of disease for four health outcomes used in calculations of the health impacts associated with landfill sites from Ranzi et al (7)

Health outcome	Relative risk	Disability weight	Duration
Low birth weight	1.06 (99% CI: 1.052 − 1.062)	0.106	79.6
Congenital anomalies	1.02 (99% CI: 1.01 − 1.03)	0.17	79.6
Respiratory diseases	1.05 (95% CI: 1.01 − 1.08)	0.08	1.00
Annoyance from odour	5.4%	0.03	1.00

Table 2 Estimated health impacts (excess cases and DALYs) for four health outcomes: medians and 95% intervals from Monte Carlo simulations.

Health outcome	ACs	DALYs
Low birth weight	1,239	10,192 (9,371 – 11,030)
Congenital anomalies	70	958 (496 – 1,437)
Respiratory diseases	33,039	2,688 (0 – 5,106)
Annoyance from odour	1,582,624	47,505 (43,666 – 51,621)
Total	1,616,972	61,325 (56,618 – 66,265)

DISCUSSION

- Strenghts

- Weakness