



Fact Sheet EURO/05/04
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Study on environmental burden of disease in children: key findings

The Environmental Burden of Disease study is the first attempt to assess the overall impact of the environment on child health in the WHO European Region.¹ Its hitherto unavailable evidence indicates that in the European Region about one third of all childhood ill health from birth to 19 years can be attributed to unsafe and unhealthy environments. This emphasizes the urgent need for policy interventions to reduce children's exposure to outdoor and indoor air pollution, unsafe water, and lead, and to prevent injuries. Such action could result in substantial public health gains.

Since patterns of death and disability vary across the European Region, the analyses were performed separately for three European subregions, according to a classification used by WHO.

- **EURO A: very low adult/very low child mortality**
Andorra, Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, San Marino, Slovenia, Spain, Sweden, Switzerland, United Kingdom.
- **EURO B: low adult/low child mortality**
Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Georgia, Kyrgyzstan, Poland, Romania, Serbia and Montenegro, Slovakia, Tajikistan, The former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Uzbekistan.
- **EURO C: high adult/low child mortality**
Belarus, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine.

Outdoor air pollution

In children, outdoor air pollution is associated with acute lower respiratory tract infections, asthma, low birth weight, and impaired lung function. The most significant health effects of outdoor air pollution are associated with particulate matter (PM).

¹ For details on the methodology used, see Annex.

1. Up to 13 000 deaths per year among children aged 0–4 years are attributed to PM outdoor air pollution in the European Region².
2. Of these deaths, up to 10 000 (7.5% of the total deaths in 0–4-year-olds) are in EURO B countries and up to 3000 (5.8% of total deaths in 0–4-year-olds) in EURO C.
3. If pollution levels (measured as PM¹⁰ concentrations) could be decreased to the European Union guideline level of 40 µg/m³ set for 2005, up to 3217 lives of children aged 0–4 years would be saved in EURO B and up to 1788 in EURO C annually.

Table 1. Burden of deaths attributable to outdoor air pollution in the European Region, applying the relative risk to all-cause mortality, children 0–4 years of age, in 2001^a

Subregion	Deaths	% of deaths	
		from all causes	Deaths per 10 000 children
EURO A	178	0.8	0.1
EURO B	10 617	7.5	5.9
EURO C	3 001	5.8	2.6
Total	13 796	6.4	2.7

^aAssuming the current PM¹⁰ concentration is the level derived from World Bank country estimates and 20 µg/m³ is the target PM¹⁰ concentration as set by the European Union for 2010.

Indoor air pollution

As European infants and young children in general spend up to 90% of their time indoors, they are likely to have very high exposure to indoor sources of air pollution even at relatively low air concentrations. Worldwide, solid fuel use is the largest source of indoor air pollution. Several diseases have been linked to exposure to solid fuel use, including acute lower respiratory tract infections in young children and asthma in school-aged children.

1. Over 50 000 children aged 0–4 years are estimated to have died (37.5% of all deaths) and over 1.75 million years of healthy life (or DALYs³) to have been lost from acute lower respiratory tract infections in the European Region.
2. Household solid fuel use accounts for about 10 000 deaths in this age group. Over 90% of these deaths are estimated to occur in the EURO B countries, where about two fifths of households use this type of fuel.
3. An estimated 9000 lives or more could be saved each year if households could climb the so-called “energy ladder”, shifting from solid fuels to cleaner liquid or gas fuels.

Table 2. Burden of acute lower respiratory tract infections attributable to household solid fuel use in the European Region, children 0–4 years of age, in 2001

Subregion	Deaths			DALYs		
	Deaths	% of deaths from all causes	Deaths per 10 000 children	DALYs	% of DALYs from all causes	DALYs per 10 000 children
EURO A	0	0	0	0	0	0
EURO B	9 289	6.6	5.2	321 483	5.0	178.9
EURO C	556	1.1	0.5	19 335	0.7	17.0
Total	9 845	4.6	1.9	340 818	3.1	66.1

² Study estimates vary from almost 4000 deaths among children aged 0–4 years due to acute respiratory infections (ARI) only and over 13 000 to ARI plus all other causes.

³ Disability-adjusted life years (DALYs) are a comprehensive measure of health effects. For a given cause, DALYs are calculated to include both years of life lived with disability and years of life lost (deaths).

Water, sanitation and hygiene

Although over 90% of the Region's population is estimated to be covered by an improved water supply, in many of the countries of the former USSR, the infrastructures of water and sanitation systems need to be developed or have been disrupted owing to poor maintenance for the last two decades

1. An estimated 2 million people or more in the European Region do not have access to clean water, thus exposing children to a high risk of diarrhoeal diseases.
2. The burden of diarrhoeal disease attributable to poor water, sanitation and hygiene is estimated at 5.3% of all deaths and 3.5% of all DALYs, in children aged 0–14 years in the European Region. The largest contribution to the burden of disease comes from EURO B countries with over 11 000 deaths and almost 500 000 DALYs.
3. This suggests that high potential savings in deaths and DALYs could be made by the development of infrastructures and better personal hygiene. For instance, in EURO B, giving the entire child population access to a regulated water supply and full sanitation coverage, with partial treatment for sewage, would save about 3700 lives and 140 000 DALYs.

Table 3. Indirect estimates of the burden of diarrhoeal disease attributable to water, sanitation and hygiene in the European Region, children 0–14 years of age, in 2001

Subregion	Deaths			DALYs		
	Deaths	% of deaths from all causes	Deaths per 10 000 children	DALYs	% of DALYs from all causes	DALYs per 10 000 children
EURO A	63	0.2	0.01	25 946	0.8	3.71
EURO B	11 876	7.5	2.01	446 763	5.2	75.75
EURO C	1 609	2.4	0.36	77 231	1.6	17.04
Total	13 548	5.3	0.77	549 940	3.5	31.53

Lead

Lead is still the single most important chemical toxicant for children and is probably the best known example of a neurotoxicant to which children are particularly vulnerable. Effects are particularly severe during the early development of children's neurodevelopmental system, equivalent to the first 2–3 years, causing several specific brain dysfunctions, in particular neurodevelopmental impairment, learning disabilities, attention, motor coordination, visuospatial and language disorders, and anaemia.

1. In the European Region, the estimated burden of disease due to lead poisoning in children under 5, is around 150 000 DALYs, corresponding to 1.4% of DALYs from all causes in the Region.
2. EURO C is the most significant contributor to the total burden of disease in the Region. The three subregions show much more homogeneity, however, in the health effects of lead exposure than in those due to other environmental factors, such as indoor air pollution or water, sanitation and hygiene.

Table 4. Burden of mild mental retardation attributable to blood lead in the European Region, children 0–4 years of age, in 2001^a

Subregion	DALYs	% of DALYs from all causes	DALYs per 10 000 children
EURO A	14 092	0.8	6.3
EURO B	54 711	0.9	30.4
EURO C	87 816	3.1	77.4
Total	156 619	1.4	3.0

^a *Global burden of disease estimates 2001*. Geneva, World Health Organization, 2001 (http://www3.who.int/whosis/menu.cfm?path=evidence,burden,burden_estimates,burden_estimates_2001&language=english, accessed 14 June 2004).

Injuries

Although the child mortality rate from injury has declined in many European countries in the last decades, injury remains the leading cause of death among children and adolescents from birth to 19 years across the European Region. Unintentional injuries include road traffic accidents, poisonings, falls, and drowning. Intentional injuries include self-inflicted injuries, violence and war.

1. In the European Region, injuries account for 23% of deaths from all causes and 19% of DALYs from all causes in the age group 0–19 years, although the highest proportion of deaths is seen among teenagers (15–19 years). The burden of injuries in children in the European Region is primarily due to unintentional injuries.
2. In EURO A, injuries are responsible for about 13 000 deaths in children aged 0–19 years, corresponding to 30% of all deaths in that age group in the subregion, and 895 000 DALYs. In EURO B, injuries are responsible for about 19 000 deaths in children aged 0–19 years, which corresponds to 11% of all deaths and 1 528 000 DALYs. In EURO C, they cause almost 43 000 deaths, 39% of all deaths in the subregion, and 2 371 000 DALYs.
3. Road traffic accidents have the highest incidence in EURO A. Fire deaths, drowning, and poisonings among children aged 0–4, and drowning among those 5–14, are more common in EURO C.

Table 5. Burden of injuries in the European Region, children 0–19 years of age, in 2001

Subregion	Deaths			DALYs		
	Deaths	% of deaths from all causes	Deaths per 10 000 children	DALYs	% of DALYs from all causes	DALYs per 10 000 children
EURO A	13 450	30.2	1.4	894 947	14.9	94.2
EURO B	18 933	10.7	2.4	1 528 037	13.8	192.5
EURO C	42 776	38.8	6.6	2 370 573	29.1	365.6
Total	75 159	22.6	3.1	4 793 557	19.0	200.4

ANNEX

Assessing and comparing children's environmental health in the WHO European Region: the burden of disease approach

The novelty

The Environmental Burden of Disease study is the first specific assessment of the overall risks to children from environmental threats in the WHO European Region.

The rationale

The need for child-specific estimates of the burden of disease is critical for decision-making. The fundamentals of paediatrics – that children are not just “little adults” – have not traditionally been considered in policy-making, standard-setting or legislation. Children from pre-conception to adolescence are more vulnerable than adults to a variety of environmental factors because:

- children are growing, and their rapidly developing organ systems are particularly vulnerable;
- children behave differently from adults, and live and play “closer to the ground”;
- children have a longer life expectancy than adults, giving long latency agents time to work alone or in combination; and
- children have less control over their environment than adults.

The method

A burden of disease study aims to quantify the burden of premature mortality and disability from major diseases in a comparative and internally consistent way. WHO has developed a unique Global Burden of Disease framework⁴ that allows a wide body of scientific evidence to be used to assess in a comparable way the impact of different risks in the common currency of “lost years of healthy life” or DALY (disability-adjusted life year). A DALY is equal to the loss of one year of healthy life.

Risks that result in death reduce life expectancy; risks that result in short- or long-term morbidity mean that people stay alive, but not in full health. Healthy life expectancy (HALE) is, therefore, lower than life expectancy. For example, overall life expectancy in Japan is 84.7 years for women and 77.5 for men, whereas healthy life expectancy is 73.6 years for men and women.

Measuring DALYs allows for a comparison of losses occurring at different ages or from different causes of disease across geographical regions and different population groups. So it provides a framework for policy-makers and the public to estimate the impact of selected environmental and other risk factors on the health of the population.

⁴ The Global Burden of Disease (GBD) concept first published in 1996 is the most comprehensive and consistent set of estimates of mortality and morbidity yet produced (Murray CJL, Lopez AD, eds. *The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020*. Cambridge, MA, Harvard School of Public Health, 1996 (Global Burden of Disease and Injury, Vol. 1) and WHO now regularly develops GBD estimates at regional and global level for a set of over 135 causes of disease and injury (Prüss-Üstün A et al. *Introduction and methods: assessing the environmental burden of disease at national and local levels*. Geneva, World Health Organization, 2003 (WHO Environmental Burden of Disease Series, No. 1).

The Environmental Burden of Disease study

The Environmental Burden of Disease study focuses on four major environmental risk factors (1. outdoor air pollution; 2. indoor air pollution; 3. unsafe water; sanitation, and hygiene; and 4. lead) and injuries, representing together the main environmental risk factors globally.

The year 2001 was chosen as the reference year because it ensured a good balance between availability of data and timeliness. Age groups included in the analyses were 0–4, 5–14, and 15–19 years.

Analyses were performed separately for three European subregions, according to a classification used by WHO.⁵

Published studies, international databases, and reports from international governmental and nongovernmental agencies were reviewed, to obtain data on the prevalence of risk factor exposure in the study population. DALYs and deaths attributable to each factor were estimated by applying the potential impact fraction to the mortality and burden of disease estimates from the WHO Global Burden of Disease database.

Methodological challenges

The Environmental Burden of Disease study has several sources of uncertainty, as it involves taking into consideration not only the many risk factors in the disease process but also the setting in which these risks occur. For example, the WHO classification of subregions, based on adult and child mortality, may not always reflect differences in the health, economic and political structures that are important in determining the impact on children of the environment. While estimates for subregion EURO A are reasonably generalizable to all countries in that group, the same is not as true for the estimates for subregions EURO B and C.

Other uncertainties may have skewed the results towards those countries with the highest child mortality, absolute numbers of children and available data.

Also, some of the analyses required indirect calculation methods, such as using existing burden of disease estimates (reported in the *Global burden of disease estimates*) as a starting point. The validity of these results therefore also depends on the validity of those previous estimates.

Finally, since the Environmental Burden of Disease study draws conclusions about mortality and long-term health effects excluding estimates on short-term illnesses and injuries, the total impact tends to be underestimated.

Evidence for action

The Environmental Burden of Disease study is a first assessment of the burden of disease in children associated with major environmental exposures. Their complex nature means that successful interventions to reduce the environmental burden of disease must be multisectoral. The children's environment and health action plan for Europe (CEHAPE), which countries are expected to adopt in Budapest and implement in national plans, is the practical instrument through which policy-makers can integrate efforts to protect the future for our children.

⁵ See above for details.

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