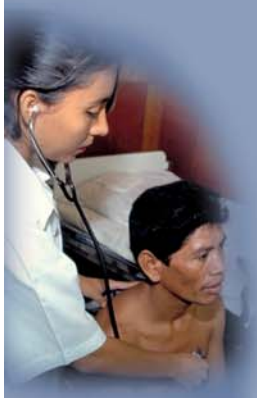

PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS

Towards an estimate of the environmental burden of disease

EXECUTIVE SUMMARY

World Health Organization

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PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS

Towards an estimate of the environmental burden of disease

A. Prüss-Üstün and C. Corvalán

World Health Organization

PREFACE

HOW MUCH DISEASE CAN BE PREVENTED THROUGH HEALTHIER ENVIRONMENTS?

This question lies at the heart of our global efforts to address the root causes of ill health through improved preventive health strategies - using the full range of policies, interventions and technologies in our arsenal of knowledge.

Previous World Health Organization studies have examined the aggregate disease burden attributed to key environmental risks globally and regionally, quantifying the amount of death and disease caused by factors such as unsafe drinking-water and sanitation, and indoor and outdoor air pollution.

Building from that experience, this present study examines how *specific diseases and injuries* are impacted by environmental risks, and which regions and populations are most vulnerable to environmentally-mediated diseases and injuries.

This report confirms that approximately one-quarter of the global disease burden, and more than one-third of the burden among children, is due to modifiable environmental factors. The analysis here also goes a step further, and systematically analyzes how different diseases are impacted by environmental risks... and by 'how much.' Heading that list are diarrhoea, lower respiratory infections, various forms of unintentional injuries, and malaria. This 'environmentally-mediated' disease burden is much higher in the developing world than in developed countries - although in the case of certain non-communicable diseases, such as cardiovascular diseases and cancers, the per capita disease burden is larger in developed countries. Children bear the highest death toll with more than 4 million environmentally-caused deaths yearly, mostly in developing countries. The infant death rate from environmental causes is 12 times higher in developing than in developed countries, reflecting the human health gain that could be achieved by supporting healthy environments.

This analysis details the health impacts of environmental risks across more than 80 diseases and injuries. Findings are particularly relevant to health care policymakers and practitioners. Our evolving knowledge about environment-health interactions can support the design of more effective preventive and public health strategies that reduce corresponding risks to health.

These estimates involved not only a systematic literature review in all of the disease categories addressed, but also a survey of more than 100 experts worldwide. As such, this analysis represents the result of a systematic process for estimating environmental burden of disease that is

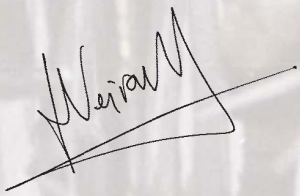
unprecedented in terms of rigor, transparency and comprehensiveness. It incorporates the best available scientific evidence on population risk from environmental hazards currently available. While not an official WHO estimate of environmental burden of disease, as such, it is an important input. More immediately, findings can be used to highlight the most promising areas for immediate intervention, and also gaps where further research is needed to establish the linkages and quantify population risk (burden of disease) for various environmental risk factors.

Many measures can indeed be taken almost immediately to reduce this environmental disease burden. Just a few examples include the promotion of safe household water storage and better hygiene measures, the use of cleaner fuels and safer, more judicious use and management of toxic substances in the home and workplace. At the same time, actions by sectors such as energy, transport, agriculture, and industry are urgently required, in cooperation with the health sector, to address the root environmental causes of ill health.

There is good news in this report, however. These findings underline the fact that environment is a platform for good health that we all share in common.

Acting together on the basis of coordinated health, environment and development policies, we can strengthen this platform, and make a real difference in human well-being and quality of life.

Coordinated investments can promote more cost-effective development strategies with multiple social and economic co-benefits, in addition to global health gains, both immediate and long term. Repositioning the health sector to act more effectively on preventive health policies, while enhancing intersectoral partnerships, is thus critical to addressing the environmental causes of disease and injury, meeting the Millennium Development Goals, and achieving better health for all.



Dr. Maria Neira
Director
Public Health and Environment
World Health Organization

Air pollution exposure/UNEP/Shihua Zhao/TopFoto.co.uk

EXECUTIVE SUMMARY

PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS

This global assessment provides quantitative estimates of 'burden of disease' from environmental factors across the major categories of reported diseases and injuries.

By focusing on the disease endpoint, and how various kinds of diseases are impacted by environmental influences, the analysis forges new ground in an understanding of interactions between environment and health. The estimates, in effect, reflect how much death, illness and disability could realistically be avoided every year as a result of reduced human exposures to environmental hazards.

Specifically considered here are "modifiable" environmental factors realistically amenable to change using available technologies, policies, and preventive and public health measures. These environmental factors include physical, chemical and biological hazards that directly affect health and also increase unhealthy behaviours (e.g. physical inactivity).

The analysis builds upon the Comparative Risk Assessment coordinated by WHO in 2002, which looked at the total burden of disease attributable to some of the most important environmental hazards, and upon other quantitative surveys of health impacts from the environment. When quantitative data were too scarce for meaningful statistical analysis, experts in environmental health and health care provided estimates. More than 100 experts from around the world contributed with reference to 85 categories of diseases and injuries. Estimates are quantified in terms of mortality from the attributable environmental fraction of each disease condition, and in terms of 'disability adjusted life years' (DALYs) – a weighted measure of death, illness and disability. While there are gaps in the reporting of many diseases at country level, this analysis makes use of the best available data on overall disease burden, globally and regionally, as reported by WHO (World Health Report, 2004).

The results and conclusions of this assessment are of particular relevance to the health-care sector, where policies and programmes generally address specific diseases or injuries. A better understanding of the disease impacts of various environmental factors can help guide policymakers in designing preventive health measures that not only reduce disease, but also reduce costs to the health-care system. The findings also are highly relevant to non-health sectors, whose activities influence many of the root environmental factors – such as air and water quality, patterns of energy use, and patterns of land use and urban design – which affect health and behaviour directly and indirectly.

Along with reducing disease burden, many of the same health sector and non-health sector measures that reduce environmental risks and exposures also can generate other co-benefits, e.g. improved quality of life and well-being, and even improved opportunities for education and employment. Overall, then, an improved environment also will contribute to achieving the Millennium Development Goals. A brief summary of specific findings is presented below, in terms of key questions that were explored.

1. HOW SIGNIFICANT IS THE IMPACT OF ENVIRONMENT ON HEALTH?

An estimated 24% of the global disease burden and 23% of all deaths can be attributed to environmental factors.

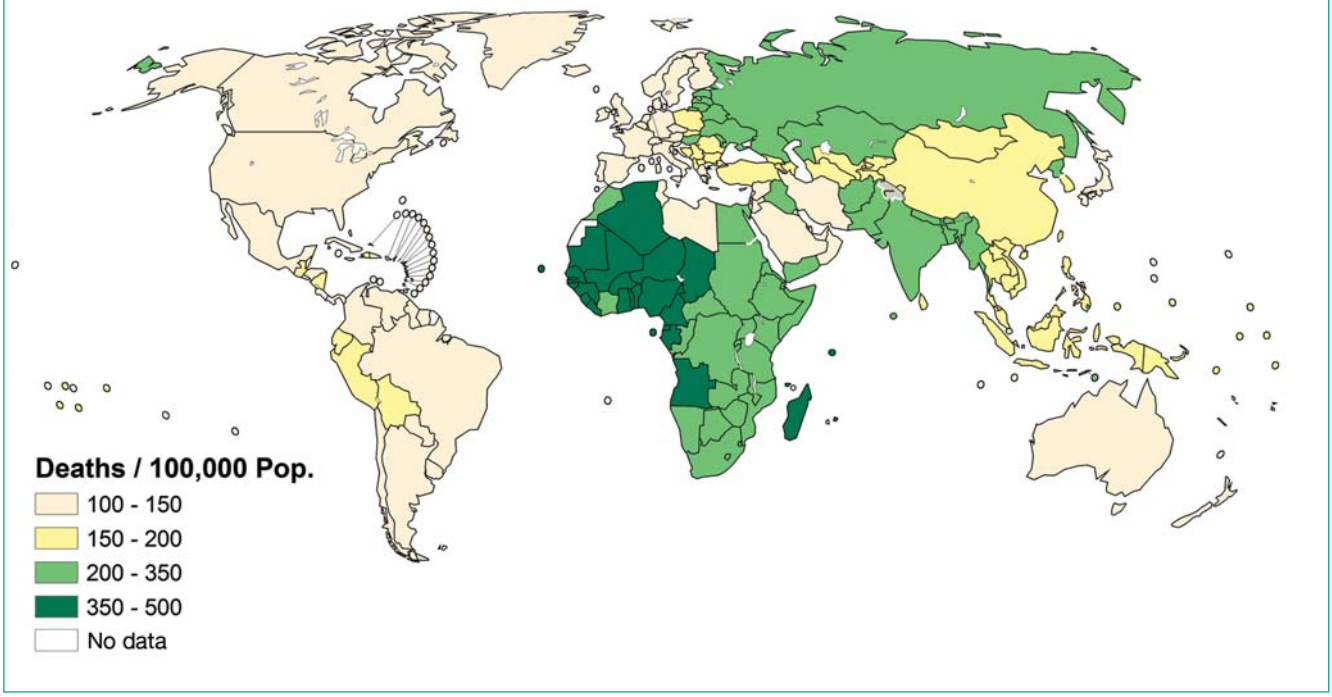
Of the 102 major diseases, disease groupings and injuries covered by the *World Health Report* in 2004, environmental risk factors contributed to disease burden in 85 categories. The specific fraction of disease attributable to the environment varied widely across different disease conditions.

Globally, an estimated 24% of the disease burden (healthy life years lost) and an estimated 23% of all deaths (premature mortality) was attributable to environmental factors. Among children 0–14 years of age, the proportion of deaths attributed to the environment was as high as 36%. There were large regional differences in the environmental contribution to various disease conditions – due to differences in environmental exposures and access to health care across the regions. For example, although 25% of all deaths in developing regions were attributable to environmental causes, only 17% of deaths were attributed to such causes in developed regions. Although this represents a significant contribution to the overall disease burden, it is a conservative estimate because there is as yet no evidence for many diseases. Also, in many cases, the causal pathway between environmental hazard and disease outcome is complex. Where possible, attempts were made to capture such indirect health effects. For instance, malnutrition associated with water-borne diseases was quantified, as was disease burden related to aspects of physical inactivity attributable to environmental factors (e.g. urban design). But in other cases, disease burden was not quantifiable even though the health impacts are readily apparent. For instance, the disease burden associated with changed, damaged or depleted ecosystems in general was not quantified.

Diseases with the largest absolute burden attributable to modifiable environmental factors included: diarrhoea; lower respiratory infections; 'other' unintentional injuries; and malaria.

- **Diarrhoea.** An estimated 94% of the diarrhoeal burden of disease is attributable to environment, and associated with risk factors such as unsafe drinking-water and poor sanitation and hygiene.
- **Lower respiratory infections.** These are associated with indoor air pollution related largely to household solid fuel use and possibly to second-hand tobacco smoke, as well as to outdoor air pollution. In developed countries, an estimated 20% of such infections are attributable to environmental causes, rising to 42% in developing countries.

Environmental disease burden by WHO subregion (2002) [a]

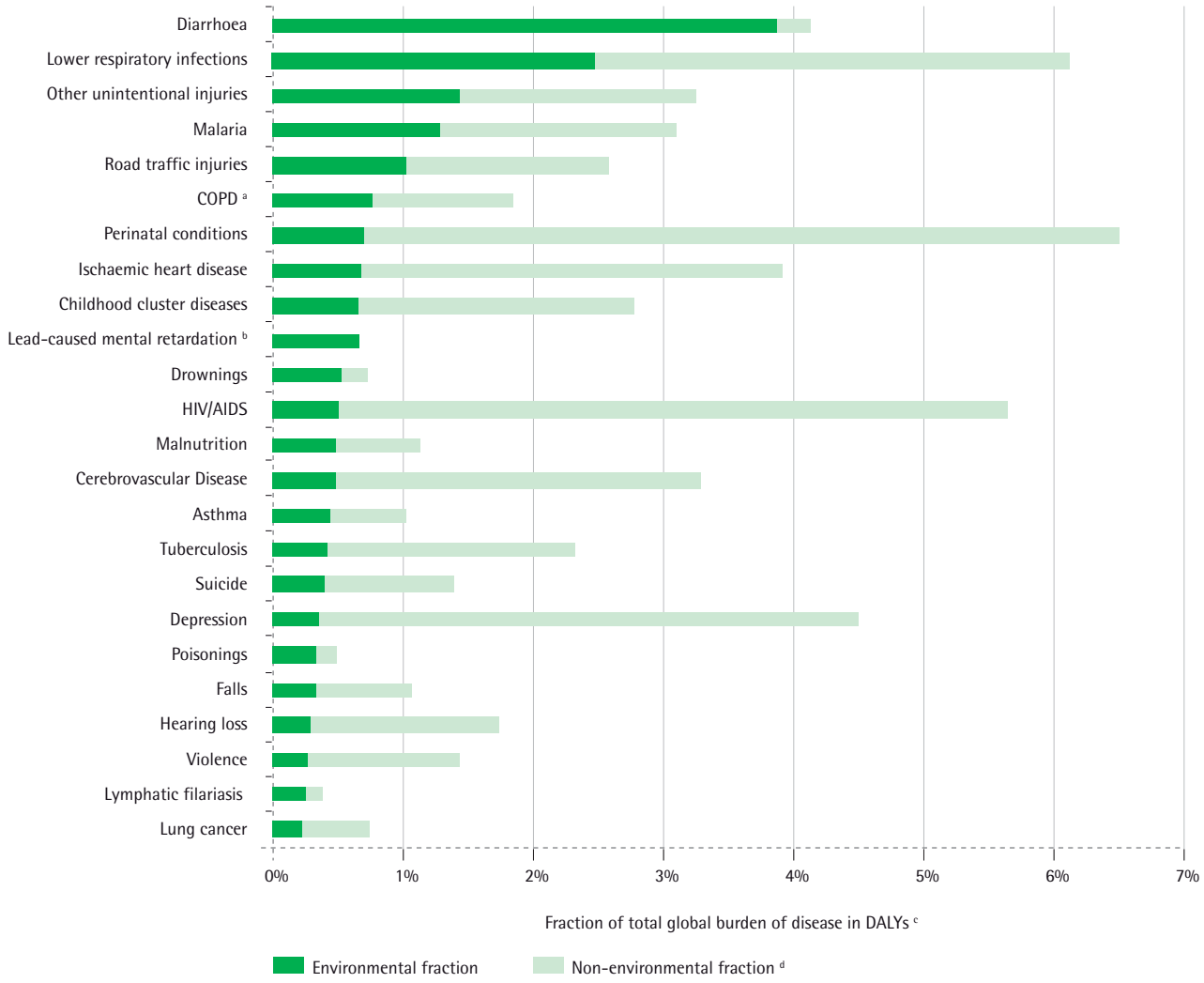


[a] The disease burden is measured in deaths per 100 000 population for the year 2002. See Annex 1 in the full report for a list of the countries in each WHO subregion.

- **'Other' unintentional injuries.** These include injuries arising from workplace hazards, radiation and industrial accidents; 44% of such injuries are attributable to environmental factors.
- **Malaria.** The proportion of malaria attributable to modifiable environmental factors (42%) is associated with policies and practices regarding land use, deforestation, water resource management, settlement siting and modified house design, e.g. improved drainage. For the purposes of this study, the use of insecticide-treated nets was not considered an environmental management measure.

Environmental factors, such as inadequate pedestrian and cycling infrastructures, also make a significant contribution to injuries from road traffic accidents (40%). However, health impacts of certain longer term changes in urban geography and mobility patterns are yet to be measured. An estimated 42% of chronic obstructive pulmonary disease (COPD), a gradual loss of lung function, is attributable to environmental risk factors such as occupational exposures to dust and chemicals, as well as indoor air pollution from household solid fuel use. Other forms of indoor and outdoor air pollution – ranging from transport to second-hand tobacco smoke – also play a role. A list of the 24 diseases with the largest environmental contribution to overall burden is noted in the following figure. Detailed description of environmental factors and impacts on all diseases considered is provided in subsequent chapters, as are statistical tables and annexes covering global, and regional disease burden, as well as special sub-groups such as children.

DISEASES WITH THE LARGEST ENVIRONMENTAL CONTRIBUTION



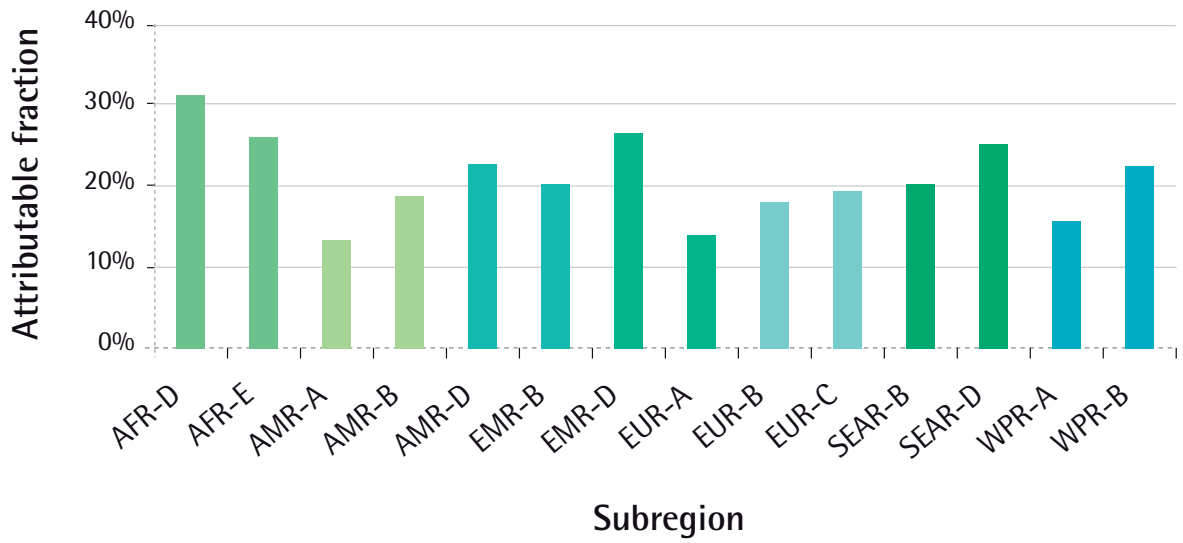
[a] Abbreviations: COPD = Chronic obstructive pulmonary disease.
[b] Lead-caused mental retardation is defined in the WHO list of diseases for 2002, accessed at: www.who.int/evidence.
[c] DALYs represent a weighted measure of death, illness and disability.
[d] For each disease the fraction attributable to environmental risks is shown in dark green. Light green plus dark green represents the total burden of disease.

2. IN WHICH REGIONS OF THE WORLD IS HEALTH MOST AFFECTED BY ENVIRONMENTAL FACTORS, AND HOW?

Developing regions carry a disproportionately heavy burden for communicable diseases and injuries.

The largest overall difference between WHO regions was in infectious diseases. The total number of healthy life years lost per capita as a result of environmental factors was 15-times higher in developing countries than in developed countries. The environmental burden per capita of diarrhoeal diseases and lower respiratory infections was 120- to 150-times greater in certain WHO developing country subregions as compared to developed country subregions. These differences arise from variations in exposure to environmental risks and in access to health care.

Environmental disease burden, by WHO subregion [a]



[a] The burden of disease is measured in DALYs. See Annex 1 in the full report for country groupings within WHO subregions.

No overall difference between developed and developing countries in the fraction of non-communicable disease attributable to the environment was observed.

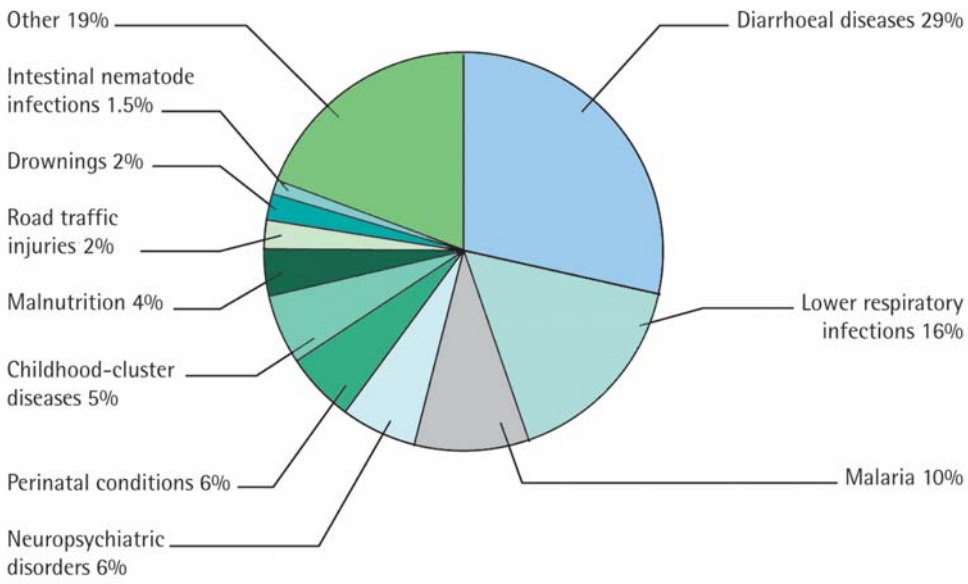
... However, in developed countries, the per capita impact of cardiovascular diseases and cancers is higher.

The number of healthy life years lost from cardiovascular disease, as a result of environmental factors, was 7-times higher, per capita, in certain developed regions than in developing regions, and cancer rates were 4-times higher. Physical inactivity is a risk factor for various non-communicable diseases including ischaemic heart disease, cancers of the breast, colon and rectum, and diabetes mellitus. It has been estimated that in certain developed regions such as North America, physical inactivity levels could be reduced by 31% through environmental interventions, including pedestrian- and bicycle-friendly urban land use and transport, and leisure and workplace facilities and policies that support more active lifestyles.

.....Developing countries, meanwhile, carry a heavier burden of disease from unintentional injuries and road traffic injuries attributable to environmental factors.

In developing countries, the average number of healthy life years lost, per capita, as a result of injuries associated with environmental factors, was roughly double that of developed countries; the gap was even greater at the subregional level. For road traffic injuries, there was a 15-fold difference between the environmental burden of disease in the best performing and worst-performing subregions, and a 10-fold disparity for 'other' unintentional injuries.

MAIN DISEASES CONTRIBUTING TO THE ENVIRONMENTAL BURDEN OF DISEASE AMONG CHILDREN 0-14 YEARS [a]



[a] The environmental disease burden is measured in disability-adjusted life years, a weighted measure of death, illness and disability (DALYs).

The results suggest that an important transition in environmental risk factors will occur as countries develop. For some diseases, such as malaria, the environmental disease burden is expected to decrease with development, but the burden will increase from other noncommunicable diseases, such as chronic obstructive pulmonary disease (COPD), to levels approximate with those seen in more developed regions of the world.

3. WHICH POPULATIONS SUFFER THE MOST FROM ENVIRONMENTAL HAZARDS TO HEALTH?

Children suffer a disproportionate share of the environmental health burden.

Globally, the per capita number of healthy life years lost to environmental risk factors was about 5-times greater in children under 5 years of age than in the total population. Diarrhoea, malaria and respiratory infections all have very large fractions of disease attributable to environment, and also are among the biggest killers of children under five years old. In developing countries, the environmental fraction of these three diseases accounted for an average of 26% of all deaths in children under five years old. Perinatal conditions (e.g. prematurity and low birth weight); protein-energy malnutrition and unintentional injuries – other major childhood killers – also have a significant environmental component, particularly in developing countries.

On average, children in developing countries lose 8-times more healthy life years, per capita, than their counterparts in developed countries from environmentally-caused diseases. In certain very poor regions of the world, however, the disparity is far greater; the number of healthy life years lost as a result of childhood lower respiratory infections is 800-times greater, per capita; 25-times greater for road traffic injuries; and 140-times greater for diarrhoeal diseases. Even these statistics fail to capture the longer term effects of exposures that occur at a young age, but do not manifest themselves as disease until years later.

4. WHAT CAN POLICYMAKERS AND THE PUBLIC DO ABOUT ENVIRONMENTAL RISKS TO HEALTH?

Public and preventive health strategies that consider environmental health interventions can be very important. Such interventions are cost-effective and yield benefits that also contribute to the overall well-being of communities.

Many environmental health interventions are economically competitive with more conventional curative health-sector interventions. Examples include phasing out leaded gasoline. Mental retardation due to lead exposures in general was estimated to be nearly 30 times higher in regions where leaded gasoline was still being used, as compared with regions where leaded gasoline had been completely phased out.

A key target of the Millennium Development Goals (MDG-7) is halving the proportion of people without sustainable access to safe drinking-water and sanitation by 2015. Globally, WHO has estimated that the economic benefits of investments in meeting this target would outweigh costs by a ratio of about 8:1. These benefits include gains in economic productivity as well as savings in health-care costs and healthy life years lost, particularly as a result of diarrhoeal diseases, intestinal nematode infections and related malnutrition.

Providing access to improved drinking-water sources in developing countries would reduce considerably the time spent by women and children in collecting water. Providing access to improved sanitation and good hygiene behaviours would help break the overall cycle of faecal-oral pathogen contamination of water bodies, yielding benefits to health, poverty reduction, well-being and economic development.

Reducing the disease burden of environmental risk factors will contribute significantly to the Millennium Development Goals.

Many Millennium Development Goals (MDGs) have an environmental health component; key elements are highlighted below.

GOAL 1 ERADICATE EXTREME POVERTY AND HUNGER

Minimizing exposures to environmental risk factors indirectly contributes to poverty reduction, because many environmentally mediated diseases result in lost earnings. Also, disability or death of one productive household member can affect an entire household. With respect to hunger, healthy life years lost to childhood malnutrition is 12-times higher per capita in developing regions, compared with developed regions. There was a 60-fold difference in WHO subregions with the highest and lowest malnutrition rates.

GOAL 2 ACHIEVE UNIVERSAL PRIMARY EDUCATION

Providing safe drinking-water and latrines at school (particularly latrines for girls) will encourage primary school attendance. Interventions that provide households with access to improved sources of drinking-water and cleaner household energy sources also improve student attendance, saving time that children would otherwise spend collecting collecting water and/or fuel. The same interventions can save children from missing school as a result of illness or injury.

GOAL 3 PROMOTE GENDER EQUALITY AND EMPOWER WOMEN

Particularly in developing countries, access to improved drinking-water sources, cleaner household energy sources, and more generally, reduction of environmentally-attributable burden of childhood diseases, can save time women now spend in collection of fuel, water, and care for children who become sick. Time thus saved also can be invested by women in income-generating activities and education, thus contributing to the MDG goal of empowering women and promoting gender equality.

GOAL 4 REDUCE CHILD MORTALITY

The mortality rate in children under five years of age from environmentally-mediated disease conditions is 180 times higher in the poorest performing region, as compared with the rate in the best performing region. In terms of just diarrhoea and lower respiratory infections, two of the most significant childhood killers, environmental interventions could prevent the deaths of over 2 million children under the age of five every year, and thus help achieve a key target of this MDG – a two-thirds reduction in the rate of mortality among children in that age category.

GOAL 5 IMPROVE MATERNAL HEALTH

Environmental interventions can contribute to this MDG by providing a safe home environment, which is of great importance to the health of children and pregnant mothers. Conversely, a contaminated home environment is a threat to the mother and her unborn child. Childbirth, for example, requires safe water and sanitary conditions.

GOAL 6 COMBAT HIV/AIDS, MALARIA AND OTHER DISEASES

Results of this analysis indicate that over half a million people die every year from malaria, and over a quarter of a million people die from HIV/AIDS, as a result of environmental and occupational causes. A large proportion of malaria, in particular, may be attributable to readily modifiable environmental factors, such as land use, irrigation and agricultural practices.

GOAL 7 ENSURE ENVIRONMENTAL SUSTAINABILITY

Diarrhoeal diseases associated with a lack of access to safe drinking-water and inadequate sanitation result in nearly 1.7 million deaths annually. Household use of biomass fuels and coal by over one-half of the world's population, results in 1.5 million deaths a year from pollution-related respiratory diseases. Enhancing access to improved sources of drinking-water, sanitation, and clean energy are therefore key environmental interventions that can reduce pressures on ecosystems from water and air-borne contamination, and also improve health. Residents in fast-growing cities of the developing world may be exposed to the combined health hazards of unsafe drinking-water, inadequate sanitation, and indoor and outdoor air pollution. Reductions in such environmental exposures will both improve the health and the lives of urban slum dwellers – one of the key targets of MDG-7.

GOAL 8 DEVELOP A GLOBAL PARTNERSHIP FOR DEVELOPMENT

The underlying message of this study is that both the health sector and non-health sector actors can, and need, to take joint action to effectively address environmentally-mediated causes of disease. To do this global partnerships are essential. Many such alliances already exist in the field of children's environmental health; occupational health; in joint health sector and environment sector linkages; and in actions in the water, chemical and air pollution sectors. Such global partnerships need to be strengthened and reinforced, harnessing the full range of policy tools, strategies and technologies that are already available – to achieve the interrelated goals of health, environmental sustainability, and development.

Jorgen Schytte / Still Pictures

ACKNOWLEDGEMENTS

This executive summary represents only a brief synthesis of key findings from this WHO study, involving extensive literature review and quantitative analysis. Complete references are cited in the full text document. In addition, we are very grateful to the experts who provided estimates of the attributable fractions for the diseases and risk factors, as well as to those who provided non-quantitative opinions::

- B.E. Ainsworth, San Diego State University, San Diego, USA.
- A. Aitio, World Health Organization, Geneva, Switzerland.
- G. Andrews, University of New South Wales, School of Psychiatry, Sydney, Australia.
- T. Armstrong, World Health Organization, Geneva, Switzerland.
- S. Ault, Pan American Health Organization, Brasilia, Brazil.
- L. Ayuso-Mateos, Hospital Universitario de la Princesa, Madrid, Spain.
- G.A. Baker, Clinical Science Centre for Research and Education, Liverpool, UK.
- K. Balakrishan, Sri Ramachandra Medical College and Research Institute, Chennai, India.
- J. Bartram, World Health Organization, Geneva, Switzerland.
- R. Beaglehole, World Health Organization, Geneva, Switzerland.
- J. Bertolote, World Health Organization, Geneva, Switzerland.
- L. Blanc, World Health Organization, Geneva, Switzerland.
- X. Bonnefoy, WHO European Centre for Environment and Health, Bonn, Germany.
- R. Bos, World Health Organization, Geneva, Switzerland.
- C.M. Branche, Centers for Disease Control and Prevention, Atlanta, GA, USA.
- C. Brewster, International Life Saving Federation, San Diego, CA, USA.
- N. Broutet, World Health Organization, Geneva, Switzerland.
- R.C. Brownson, Saint Louis University School of Public Health, St. Louis, MO, USA.
- N. Bruce, University of Liverpool, Liverpool, UK.
- R. Butchart, World Health Organization, Geneva, Switzerland.
- D. Campbell-Lendrum, World Health Organization, Geneva, Switzerland.
- J.M. Colford, University of California, Berkeley, CA USA.
- A. Correa, Centers for Disease Control and Prevention, Atlanta, GA, USA.
- J.R. Coura, Instituto Oswaldo Cruz, Rio de Janeiro, Brazil.
- C.L. Craig, Canadian Fitness and Lifestyle Research Institute, Ottawa, Canada.
- B. Cugier, Federal Institute for Occupational Safety and Health, Berlin, Germany.
- R. Dales, University of Ottawa, The Ottawa Hospital, Ottawa, Canada.
- I. de Bourdeaudhuij, Ghent University, Ghent, Belgium.
- M. de Onis, World Health Organization, Geneva, Switzerland.
- C. Dora, World Health Organization, Geneva, Switzerland.
- T. Farley, World Health Organization, Geneva, Switzerland.
- D. Farrington, University of Cambridge, Cambridge, UK.
- A.O. Filho, Universidade Federal do Rio De Janeiro, Rio de Janeiro, Brazil.
- E. Fondjo, Organisation de Coordination pour la lutte contre les Endémies en Afrique, Yaoundé, Cameroun.
- S. Forjuoh, Health Science Center, Texas A and M University, Temple, TX, USA.
- B. Gesch, University of Oxford, University Laboratory of Physiology, Oxford, UK.
- B. Giles-Corti, University of Western Australia, Crawley, Australia.
- O. Girardin, Centre Suisse de Recherches Scientifiques en Côte d'Ivoire (CSRS), Abidjan, Côte d'Ivoire.
- S.L. Hinde, Australian National University, Canberra, Australia.
- R. Hughes, University of Queensland, Brisbane, Australia.
- R. Jenkins, Institute of Psychiatry, King's College, London, UK.
- B.H. Kay, Royal Brisbane Hospital, Brisbane, Australia.
- D. Kay, University of Wales, Aberystwyth, UK.
- R. Kessler, Harvard Medical School, Boston, MA, USA.
- J. Keiser, Swiss Tropical Institute, Basel, Switzerland.
- N. Khaltaev, World Health Organization, Geneva, Switzerland.
- G. Killeen, Ifakara Health Research and Development Centre, Ifakara, Tanzania.
- T. Kjellstrom, Australian National University, Canberra, Australia.
- O. Kobusingye, WHO Regional Office for Africa, Brazzaville, Congo.
- M. Kramer, McGill University, Faculty of Medicine, Montreal, Canada.
- F. Laihad, Ministry of Health, Jakarta, Indonesia.
- P. Landsbergis, Mount Sinai Medical Center, New York, NY, USA.
- D. Lavanchy, World Health Organization, Geneva, Switzerland.
- A. Leenars, Ontario, Canada.
- Y. Li, School of Public Health, Fudan University, Shanghai, China.

- F. Liebers, Federal Institute for Occupational Safety and Health, Berlin, Germany.
- S.W. Lindsay, University of Durham, Durham, UK.
- A. Luttmann, Institute for Occupational Physiology at the University of Dortmund, Germany.
- R. Lucas, Australian National University, Canberra, Australia.
- S. Mendis, World Health Organization, Geneva, Switzerland.
- M. Merialdi, World Health Organization, Geneva, Switzerland.
- A. Mnzava, WHO Regional Office for the Eastern Mediterranean, Cairo, Egypt.
- D. Mohan, Indian Institute of Technology, New Delhi, India.
- A.J. McMichael, Australian National University, Canberra, Australia.
- J. Mercy, Centers for Disease Control, Atlanta, GA, USA.
- A.B. Miller, Toronto, Canada.
- D. Molyneux, Liverpool School of Hygiene and Tropical Medicine, Liverpool, UK.
- M. Nathan, World Health Organization, Geneva, Switzerland.
- F. Ndowa, World Health Organization, Geneva, Switzerland.
- L. Onyon, World Health Organization, Geneva, Switzerland.
- Y. Rubio-Palis, Instituto de Altos Estudios de Salud Pública "Dr. Arnoldo Gabaldon", Maracay, Venezuela.
- K. Palmer, WHO Western Pacific Regional Office, Manila, Philippines.
- L.R. Panganiban, University of the Philippines, Manila, Philippines.
- R. Pararajasegaram, World Health Organization, Geneva, Switzerland.
- P. Pisani, WHO International Agency for Research on Cancer (IARC), Lyon, France.
- G.P. Pokharel, World Health Organization, Geneva, Switzerland.
- V. Poznyak, World Health Organization, Geneva, Switzerland.
- A. Prata, Faculdade de Medicina do Trifngulo, Mineiro, Brazil.
- J. Pronczuk, World Health Organization, Geneva, Switzerland.
- F. Racioppi, WHO European Centre for Environment and Health, Rome, Italy.
- F. Rahman, Institute of Child and Mother Health, Dhaka, Bangladesh.
- E. Robert, Institut Européen des Génomutations, Lyon, France.
- W.H.J. Rogmans, Consumer Safety Institute, Amsterdam, The Netherlands.
- I. Romieu, Instituto Nacional de Salud Publica, Cuernavaca Morelos, Mexico.
- H. Rutter, Government Office for the South East, Guildford, UK.
- H.P.S. Sachdev, Vasant Vihar, New Dehli, India.
- G. Schmid, World Health Organization, Geneva, Switzerland.
- V.P. Sharma, Malaria Research Centre, Delhi, India.
- G.M. Shaw, March of Dimes Birth Defects Foundation, Berkeley, CA, USA.
- A.C. Silveira, Pan American Health Organization, Brasilia, Brazil.
- K. Smith, University of California, Berkeley, CA, USA.
- A. Spielmann, Harvard School of Public Health, Boston, MA, USA.
- K. Steenland, Rollins School of Public Health, Emory University, Atlanta, GA, USA.
- K. Straif, WHO International Agency for Research on Cancer (IARC), Lyon, France.
- D. Sutherland, World Health Organization, Geneva, Switzerland.
- S. Tarlo, University of Toronto, The Toronto Western Hospital, Toronto, Canada.
- H. Taylor, University of Melbourne, Melbourne, Australia.
- W.A. Temple, University of Otago, Dunedin, New Zealand.
- J. Tempowski, World Health Organization, Geneva, Switzerland.
- T. To, University of Toronto, Hospital for Sick Children, Toronto, Canada.
- Y. Touré, World Health Organization, Geneva, Switzerland.
- T. Ukety, World Health Organization, Geneva, Switzerland.
- B. Üstün, World Health Organization, Geneva, Switzerland.
- J. Utzinger, Swiss Tropical Institute, Basel, Switzerland
- P. Van Damme, University of Antwerp, Antwerp, Belgium.
- G. Viegi, University of Pisa, Pisa, Italy.
- M. Weber, World Health Organization, Geneva, Switzerland.
- WHO/UNAIDS Working Group on Global HIV/AIDS and STI Surveillance, Geneva, Switzerland.
- S. Wiersma, World Health Organization, Geneva, Switzerland.
- B. Williams, World Health Organization, Geneva, Switzerland.
- A. Wolf, Harvard Medical School, Boston, MA, USA.
- T. Woodruff, Environmental Protection Agency, San Francisco, CA, USA.
- A. Woodward, University of Auckland, Auckland, New Zealand.
- A. Wooler, Royal National Lifeboat Institution, Saltash, UK.
- D. Zalk, International Occupational Hygiene Association, Derby, UK.
- A. Zanetti, University of Milan, Milan, Italy.
- J. Zupan, World Health Organization, Geneva, Switzerland.

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Communications: Nada Osseiran

Editorial production: Elaine Fletcher

Graphic design:  www.paprika-annecy.com

Text editing: Kevin Farrell

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How much disease could be prevented through better management of our environment? The environment influences our health in many ways — through exposures to physical, chemical and biological risk factors, and through related changes in our behaviour in response to those factors. To answer this question, the available scientific evidence was summarized and more than 100 experts were consulted for their estimates of how much environmental risk factors contribute to the disease burden of 85 diseases. This report summarizes the results globally, by 14 regions worldwide, and separately for children.

The evidence shows that environmental risk factors play a role in more than 80% of the diseases regularly reported by the World Health Organization. Globally, nearly one quarter of all deaths and of the total disease burden can be attributed to the environment. In children, however, environmental risk factors can account for slightly more than one-third of the disease burden. These findings have important policy implications, because the environmental risk factors that were studied largely can be modified by established, cost-effective interventions. The interventions promote equity by benefiting everyone in the society, while addressing the needs of those most at risk.

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