WORLD HEALTH ORGANIZATION
EUROPE

ENVIRONMENTAL HEALTH INDICATORS FOR EUROPE

A PILOT INDICATOR-BASED REPORT

ENVIRONMENTAL HEALTH INDICATORS FOR EUROPE

A PILOT INDICATOR-BASED REPORT

June 2004

E82938

ABSTRACT

The Environment and Health Information System (EHIS) is a valuable tool for monitoring and evaluating the implementation and modification of policies. The crucial element of a harmonized EHIS is a set of indicators that allows for the monitoring of public health and its determinants. This report is the product of a pilot study completed within the WHO process of developing a methodology for a pan-European EHIS. It illustrates the application of indicators for integrated public health assessment and reporting in four topic areas: air pollution, noise, transport accidents, and water and sanitation. The report provides an insight into effective methods for integrating information from environmental monitoring and health surveillance, using the scientific knowledge of exposure–response associations. These methods can both help in answering key questions on the effect of policies on health and the environment, and provide guidance on future policies and actions. The report also demonstrates the limitations of routinely collected data and outlines the need for strengthening cooperation between international agencies and the Member States.

Keywords

ENVIRONMENTAL HEALTH
ENVIRONMENTALEXPOSURE
HEALTH STATUS INDICATORS
INFORMATION SYSTEMS
ENVIRONMENTAL MONITORING - METHODS
EUROPE

Address requests about publications of the WHO Regional Office to:

- *by e-mail* publicationrequests@euro.who.int (for copies of publications)
  permissions@euro.who.int (for permission to reproduce them)
  pubrights@euro.who.int (for permission to translate them)
- *by post* Publications
  WHO Regional Office for Europe
  Scherfigsvej 8
  DK-2100 Copenhagen Ø, Denmark

CONTENTS

CONTRIBUTORS

Nune Bakunts [a]
State Hygienic and Anti-epidemic Inspection, Yerevan, Armenia

Hristina Mileva [a]
Ministry of Health, Sofia, Bulgaria

Ružena Kubínová [a]
National Institute of Public Health, Prague, Czech Republic

Vladimíra Puklová [a]
National Institute of Public Health, Prague, Czech Republic

Hans-Guido Mücke [a, b]
Federal Environmental Agency (WHO collaborating centre), Air Quality Management, Berlin, Germany

Angela Queste [c]
Institute for Hygiene and Public Health, University of Bonn, Bonn, Germany

Jürgen Thelen [a]
Federal Environmental Agency (WHO collaborating centre), Air Quality Management, Berlin, Germany

Mihály Kádár [a]
National Institute of Environmental Health, Budapest, Hungary

Tibor Málnási [a]
National Institute of Environmental Health, Budapest, Hungary

Anna Páldy [a]
National Institute of Environmental Health, Budapest, Hungary

Piero Borgia [a]
Public Health Agency of the Lazio Region, Rome, Italy

Sara Farchi [c]
Public Health Agency of the Lazio Region, Rome, Italy

Aida Laukaitiene [a]
State Public Health Centre, Vilnius, Lithuania

Ingrida Zurlytè [a]
State Public Health Centre, Vilnius, Lithuania

Diane Houweling [a, c]
National Institute of Public Health and the Environment (RIVM), Bilthoven, Netherlands

Kees Huijsmans [a]
National Institute of Public Health and the Environment (RIVM), Bilthoven, Netherlands

Anne Knol [a]
National Institute of Public Health and the Environment (RIVM), Bilthoven, Netherlands

Brigit Staatsen [a, b]

National Institute of Public Health and the Environment (RIVM), Bilthoven, Netherlands

Øystein Solevåg [c]
Bergfald & Co., Eidsnes, Norway

Dorota Jarosinska [c]
Institute of Occupational Medicine and Environmental Health, Sosnowiec, Poland

Bogdan Wojtyniak [b, c]
National Institute of Hygiene, Warsaw, Poland

Alexandra Cucu [a]
Ministry of Health, Bucharest, Romania

Adriana Galan [a]
Institute of Public Health, Bucharest, Romania

Milada Estokova-Mikulčikova [a]
Public Health Institute, Bratislava, Slovakia

María José Carroquino [a, b ,c]
Instituto de Salud Carlos III (CISATER), Madrid, Spain

Luis Soldevilla Benito [a]
Instituto de Salud Carlos III (CISATER), Madrid, Spain

Antonis Georgellis [b, c]
Occupational and Environmental Health, Stockholm County Council, Stockholm, Sweden

Mats Rosenlund [b]
Occupational and Environmental Health, Stockholm County Council, Stockholm, Sweden

Sonja Kahlmeier [a]
Institute of Social and Preventive Medicine, Basel University, Basel, Switzerland

David Kay [c]
University of Wales, Ceredigion, United Kingdom

Maya Sadeh [a]
London School of Hygiene & Tropical Medicine, London, United Kingdom

Paul Wilkinson [b, c]
London School of Hygiene & Tropical Medicine, London, United Kingdom

Project coordination and management

Dafina Dalbokova
Rokho Kim
Michal Krzyzanowski
WHO European Centre for Environment and Health, Bonn, Germany

[a.] National pilot study team or assistance
[b.] Drafting group
[c.] Editorial group

FOREWORD

Information is an essential tool for public health policy- and decision-making. WHO, and its Regional Office for Europe in particular, is making a substantial effort to help Member States in improving and sharing information on health and its determinants. This is an important way of assisting countries to select policy options that best suit their needs and to monitor the effectiveness of their actions. The policy-relevance, availability and comparability of information on environment and health still need to be improved in the Region. This is why the Regional Office, together with the Member States and several international organizations, is working towards a comprehensive European environment and health information system that will allow priorities to be set on the basis of evidence, thus enhancing access to information and facilitating communication with the public.

This document presents examples of the application of environmental health indicators, which are important components of the information system. They are based on data from several Member States and on knowledge of causal chains between health and selected environmental factors and actions affecting environmental determinants of health. A large group of experts from the Member States, coordinated by the team from the Regional Office, prepared this document. I am most thankful for their contributions. I hope that this work, and the further dynamic development of the environment and health information system, will strengthen our capacity for action in improving the health of the European population.

Marc Danzon
WHO Regional Director for Europe

EXECUTIVE SUMMARY

This report is the result of a pilot study of the WHO project on environmental health (EH) indicators for the WHO European Region and, in particular, of the illustrative application of the indicators in four topic areas: air pollution, noise, transport accidents, and water and sanitation. Using a standardized approach to describe complex EH problems and policy responses, this analysis demonstrates the usefulness of indicators for assessment and reporting. It also demonstrates the limitations of routinely collected data.

The pilot study is part of the process of developing an Environment and Health Information System (EHIS) by the WHO Regional Office for Europe in collaboration with a number of Member States, the European Environment Agency and the European Commission (EC). The process comprises various activities, from the selection of policy-relevant issues and the development of indicator methodology to feasibility and pilot testing, resulting in the selection of a core set of indicators that reflect the links between health and the environment and can be applied using existing data. Analysis and reporting methods have also been developed throughout the process, together with tools and methods for extracting relevant information from existing national statistical, monitoring and surveillance systems. The core set of indicators focuses on 10 thematic environmental areas of relevance to health and uses the DPSEEA (driving forces–pressures–state–exposure–effects–actions) model as a conceptual framework.

On each of the selected topics, the report provides a brief overview of the problem, assesses the potential for health benefits from policies and interventions, and gives a short explanation of the core indicators. Temporal trends and intercountry variability of environmental indicators relevant to health are assessed in a structured way, providing information on the EH situation and key environmental determinants, public health policy and interventions, and the potential impact on health. Case studies illustrate the effects of selected interventions on reducing morbidity and mortality. The information is presented graphically whenever possible to facilitate communication with different user groups.

Analysis of indicators of the effects on health of exposure to air pollution demonstrates the potential for a significant improvement in health from a reduction in air pollution. The core set of indicators covers most of the links in the DPSEEA chain, ranging from energy consumption, intensity of motor transport, pollutant emissions and ambient air pollution concentrations to health effects, and includes action indicators. This extent of the information is useful in drawing conclusions relevant to policy-making.

Analysis of noise-related indicators suggests the need for better harmonization of assessment methods among Member States. A case study from the Netherlands shows that the ability to track certain information on environmental noise and its determinants has been used to support decision-making for reducing the adverse effects on health.

Intercountry differences in the definition of basic data can also make difficult the direct comparison of indicators related to transport accidents. Nevertheless, assessing trends can provide a valuable indication for use in policy-making. Joint analysis of several indicators gives insights into the links between health and determinants of traffic intensity, pointing to the role of actions in preventing accidents and related injuries.

Analysis of the set of core indicators for water and sanitation shows that they are useful in monitoring the links between water supply/sanitation and public health across Europe. They convey information that can be used to support national policies and that is useful in international comparisons. The added value of indicators is recognized in monitoring the effectiveness of EC Directives as well as national laws and regulations aimed at improving water management. Joint analysis of the indicators suggests that the true incidence of waterborne diseases is underestimated in the participating countries.

This report shows that indicators are powerful communication tools for policy-makers, experts and the general public. When fed into the policy-making process, they can evaluate and demonstrate the effectiveness of environment and health policies, thus facilitating the setting of priorities among competing policies. If implemented throughout Europe, they would provide evidence that could be used alongside published epidemiological research to inform policy development at national and international levels.

The report suggests that the level of comparability of indicators across Europe is currently limited, often because of deficiencies in surveillance and reporting methodologies in some countries. The value of EHIS and its ability to support environment and health decision-making can be increased by progressive development and harmonization of data collection and processing, aiming at improving comparability of information among the Member States. The analysis demonstrates the need for cooperation between international agencies and the Member States if that objective is to be attained.

1. INTRODUCTION

The Fourth Ministerial Conference on Environment and Health, to take place in Budapest in June 2004, is a continuation of the process of integrating environment and health initiated by the WHO Regional Office for Europe. The Conference will review progress made on environment and health in Europe since the first conference in 1989, with special attention to the current situation in the newly independent states of the former USSR. The Conference will address issues of increasing concern for health, such as housing and energy policies, and indicate the way forward through the adoption of a Children's Environment and Health Action Plan for Europe. A significant part of the Conference will be devoted to strengthening the policy-making base through harmonized tools and approaches for the entire European Region of WHO. The Environment and Health Information System (EHIS) is one of the crucial policy tools that will be presented for political endorsement.

This report is the product of a pilot study within the WHO project to develop environmental health (EH) indicators for the European Region. The aim of the pilot study was to test the feasibility and demonstrate the usefulness of WHO indicators as a tool for EH decision-making throughout Europe. This report illustrates the application of indicators in four topic areas: air pollution, noise, transport accidents, and water and sanitation.

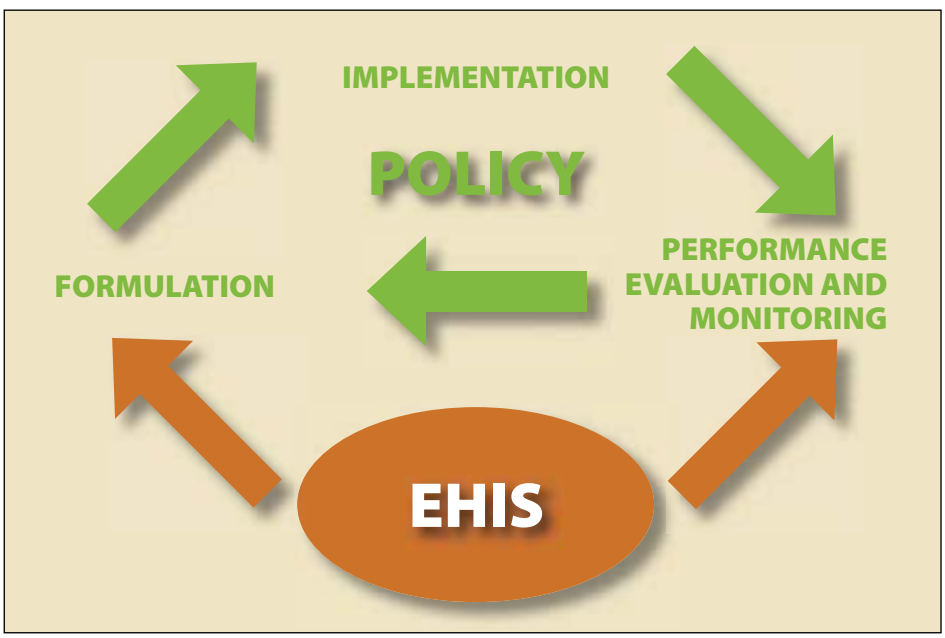


Fig. 1.1. Contribution of EHIS to policy formulation and evaluation

1.1 THE NEED FOR EHIS IN POLICY-MAKING

EHIS is regarded as a valuable tool for monitoring and evaluating the implementation and modification of policies, by providing systematically collected and analysed evidence (Fig. 1.1). The objective is to develop a harmonized and evidence-based information system that will serve policy-makers at European, national and local levels and be accessible by the media and the general public. In addition, EHIS will contribute to an integrated assessment of progress within the broader objective of reporting on sustainable development in Europe.

1.2 THE APPROACH OF THE REGIONAL OFFICE

Crucial to developing a pan-European EHIS is a set of indicators to measure the situation and changes over time. Traditional indicators often show only effects on health or the environment. To be policy-relevant, indicators must monitor the linkages between environmental changes and human health effects and be based on scientific evidence. The indicators must also ensure effective monitoring of policies and actions and evaluation of their potential effects on health.

The Regional Office's approach to this specification was to adopt the DPSEEA (driving forces–pressures–state–exposure–effects–actions) model (Box 1.1). The detailed methodology for individual indicators was developed by experts and reviewed at working group meetings involving a wide range of multidisciplinary expertise and several Member States. A set of "core" EH indicators in 10 thematic areas was evaluated for feasibility by 15 countries (see Annex 1).

1.3 THE PROCESS OF DEVELOPING EH INDICATORS FOR EUROPE

The main tools and methods for EH indicators were developed and tested through internationally coordinated work, in the framework of the Regional Office projects on EH indicators. The work was carried out in collaboration with several Member States, the European Environment Agency (EEA) and the Health and Consumer Protection Directorate-General of the European Commission (EC) within the framework of the development of EH indicators for European Union (EU) countries. Between 1999 and 2003, project activities aimed at combining diverse results, experiences and analyses into a comprehensive and practical framework. Several countries[1] provided active input and partnership throughout the pilot project. Experts in specific EH areas from many countries are also contributing to developing the methodology.

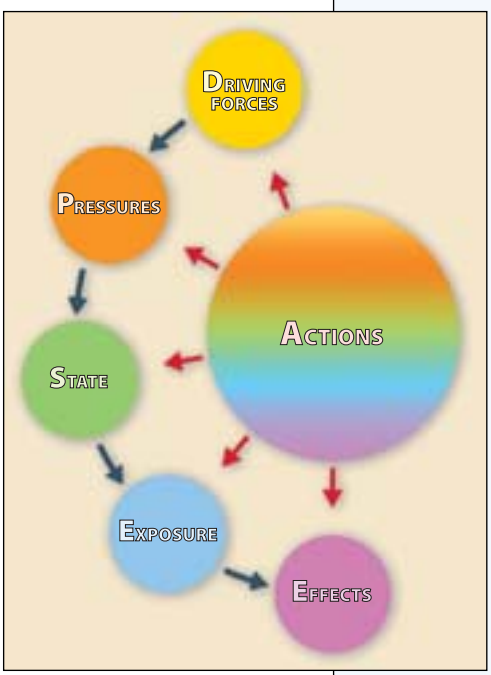
Project activities include the development of a methodology for the indicators following a review of national environment and health action plan (NEHAPs), a feasibility study to reach consensus on a "core" set of indicators, and pilot testing of the indicator set coupled with analysis and reporting methods. Fifteen countries evaluated the overall feasibility and usefulness of the proposed methodology (see Annex 1). Within the continuing project on the development of EH indicators for EU countries, implemented in partnership with 11 of them,[2] the indicators were also checked for compatibility vis-à-vis EC legislation. Software tools to facilitate data collection and a prototype of a web tool for organizing and publishing the EH

[1] Albania, Armenia, Bulgaria, Czech Republic, Estonia, Finland, Germany, Hungary, Latvia, Lithuania, Netherlands, Poland, Romania, Russian Federation (Sverdlovsk Region), Slovakia, Spain, Switzerland.

[2] Austria, Belgium, Denmark, France, Finland, Germany, Italy, Netherlands, Portugal, Spain, Sweden.

indicators, such as EuroIndy and ENHIS (see Annex 2) were developed and utilized. The overall process of developing EH indicators is shown in Fig. 1.2. Further information is available at http://www.euro.who.int/EHindicators.

Box 1.1.
The DPSEEA model



The DPSEEA model is useful in designing a system of EH indicators within the decision-making context. It has been proposed to describe and analyse the links between health, the environment and development, and has been used in analysing the global situation related to these. Within the DPSEEA framework, the driving forces component refers to the factors that motivate and push the environmental processes involved. These result in the generation of pressures on the environment. In response to the pressures, the state of the environment is often modified. Deterioration in the state of the environment, however, poses risks to human well-being only when there is interplay between people and the hazards in the environment. Exposure is therefore rarely an automatic consequence of the existence of a hazard: it requires that people are present both at the place and at the time that the hazard occurs. Exposure to environmental hazards, in turn, leads to a wide spectrum of health effects, which may be acute or chronic. Some hazards may have a rapid effect following exposure, whereas others may require a long time to produce an adverse health effect.

Within the DPSEEA framework, exposure and health effect components appear most significant from an environmental and public health perspective. The concept of exposure is best developed in relation to pollutants in environmental media: they can penetrate the human body by different routes, such as inhalation, ingestion or dermal absorption. The amount of the pollutant absorbed, i.e. the "dose", depends on the duration and intensity of the exposure. In the face of environmental problems and consequent health effects, society may attempt to adopt and implement a range of actions. These may take many forms and be targeted at different points within the environment–health continuum. Actions may be taken to reduce or control the hazards concerned, such as by limiting emissions of pollutants or introducing flood control measures. The most effective long-term actions, however, are those that are preventive in approach, aimed at eliminating or reducing the forces that drive the system.

For further information see: Corvalán C, Briggs D, Zielhuis G. *Decision-making in environmental health: from evidence to action*. London, E & FN Spon, 2000 on behalf of the World Health Organization.

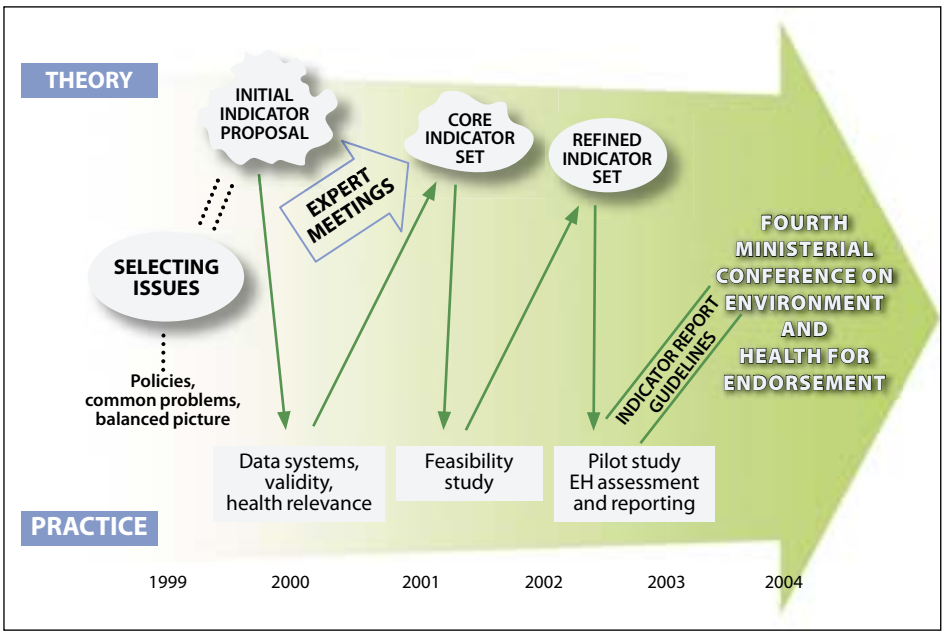


Fig. 1.2.
The process of developing EH indicators

Eleven countries[3] volunteered to apply the methodology developed in order to create and manage, on a pilot basis, the full core EH indicator set on ten issues, together with the underlying databases and mechanisms of reporting information. The present indicator-based report is thus the product of coordinated data collection, information analysis and methods for communicating and reporting indicators. Mainly to provide a model framework for integrated EH assessment, the report is limited to a few key thematic chapters dealing predominantly with the urban environment. It focuses on trends in indicators over time and on international comparisons. Pilot study team members of the 11 countries and invited experts in specific areas contributed to drafting and editing the report. A number of international information sources and databases were also used.

Together with this report, national and international fact sheets (see Annex 3 for an example) are produced using the uniform methodology in the pilot study. These will serve as the foundation for future indicator-based reports. Both types of document will be disseminated as background to the Fourth Ministerial Conference in June 2004.

[3] Armenia, Bulgaria, Czech Republic, Germany, Hungary, Lithuania, Netherlands, Romania, Slovakia, Spain, Switzerland.

2. FORMAT OF THE REPORT

The aim of this report is to demonstrate the potential of EHIS as a tool for EH decision-making throughout Europe. A coherent approach was applied to reporting indicators on each of the four environmental issues of health relevance – air pollution, noise, transport accidents, and water and sanitation. This enabled us to translate the scientific knowledge on exposure–response relationships into a measure of EH status, while at the same time showing how a health problem can be handled effectively.

Air pollution	Passenger transport demand by mode of transport	Driving forces
	Road transport fuel consumption	Driving forces
	Emissions of air pollutants	Pressures
	Exposure to ambient air pollutants (urban)	Exposure
	Years of life expectancy lost in one year	Effects
Noise	Population annoyance from noise	Effects
	Application of regulations, restrictions and noise abatement measures	Actions
Transport accidents	Mortality from transport accidents	Effects
	Road accident injuries	Effects
Water and sanitation	Urban wastewater treatment	Pressures
	Drinking-water exceedences of microbiological guidelines	State
	Microbiological quality of recreational waters	State
	Access to piped, regulated drinking-water	Exposure
	Outbreaks of waterborne diseases	Effects

Box 2.
Indicators and associated DPSEEA links

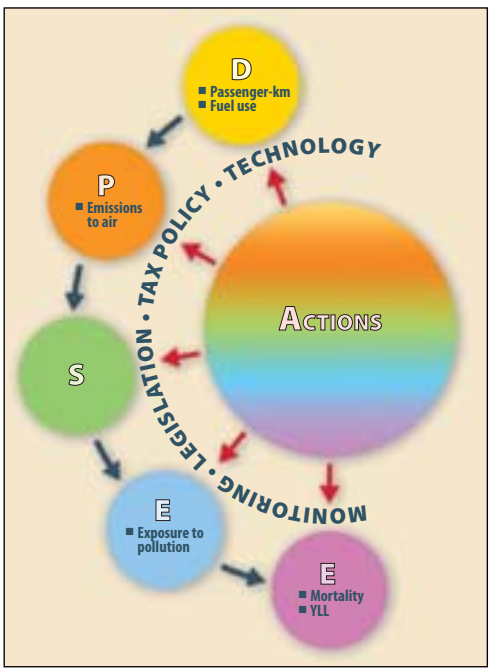
Each of the four chapters dealing with the environmental issues mentioned above begins with a brief overview of the problem and a short explanation of the core indicators within the DPSEEA model, accompanied by a figure illustrating the links in the causal chain on the topic. This is followed by a summary of the potential for health benefits from environmental policies, covering the environmental burden of diseases, the amenability of the problems and a few examples of successful interventions. Indicators of health effects are presented first, followed by those of the environmental determinants in the causal chain. Trends and international comparisons are illustrated with tables and charts. This is the essential part of the indicator-based report, demonstrating the usefulness and added value of applying the core indicators for communication to policy-makers and the public. Each chapter concludes with an evaluation of the effects and potential for improvements resulting from public policies at national and international levels. The concluding section presents a case study of environment and health policy in reducing morbidity and mortality.

The indicators presented in this report and their corresponding links in the DPSEEA chain are shown in Box 2.

3. AIR POLLUTION

3.1 CAUSAL CHAIN AND INDICATORS

The air we breathe contains varying levels of pollutants derived from motor vehicles, industry, housing and commercial sources. They are mainly produced by the combustion of fossil fuels. Despite efforts to reduce pollution levels, they continue to pose risks to human health throughout Europe (*1*). Concern has focused on particulate matter (especially PM_{10} [4] and $PM_{2.5}$ [5]) but other pollutants and pollutant combinations are also implicated, including sulfur dioxide, oxides of nitrogen, ozone, carbon monoxide and volatile organic compounds such as benzene. Epidemiological evidence shows that various health effects, including illness and death from respiratory and cardiovascular diseases, are causally associated with such air pollutants. There is thus a "chain of causality" that links our dependence on high-energy consumption and motorized transport with pollutant emissions, ambient air pollution concentrations and effects on health. The core set of indicators shows the trends in the elements of this causal chain.



3.2 POTENTIAL FOR HEALTH BENEFITS FROM LOWERING POLLUTION

There is now convincing evidence that air pollution at current levels in European cities is responsible for a significant burden of deaths, hospital admissions and exacerbation of symptoms, especially in relation to cardiorespiratory disease.

The annual burden of disease attributable to urban outdoor air pollution in Europe [6] has been estimated to be 107 000 deaths and 725 000 disability-adjusted life years (DALYs) (*2*). If policies can achieve reductions in human exposure, the potential health benefits may therefore be substantial. Those policies may operate through a range of mechanisms.

A recent example (from outside the European Region) reveals health benefits following legislation to limit the sulfur content of fuel oil (*3*). Within Europe, the 1990 ban on coal sales in Dublin led to an appreciable lowering of pollutant levels and mortality (Box 3.1) (*4*).

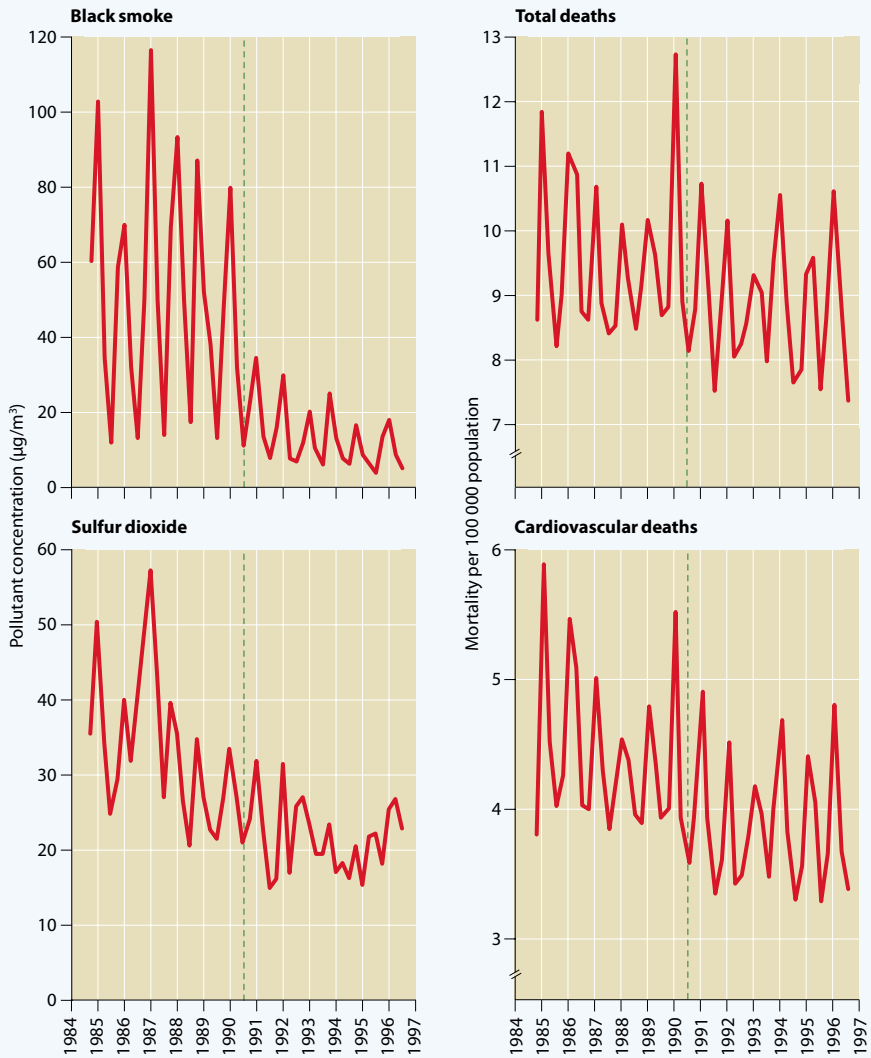
Initiatives that contribute to reducing air pollution may include taxing polluting fuels, setting and enforcing emissions standards and promoting cleaner technology. A useful case study of taxation policy is described in section 3.4.

[4] Particulate matter with a mass median aerodynamic diameter < 10 μm.

[5] Particulate matter with a mass median aerodynamic diameter < 2.5 μm.

[6] These estimates are based on the health effects attributable to pollution above the theoretical minimum levels of 15 $\mu g/m^3$ for PM_{10} and 7.5 $\mu g/m^3$ for $PM_{2.5}$.

Box 3.1.
The health benefits of a ban on coal sales in Dublin



Source: Clancy et al. (*4*); reproduced with permission from Elsevier.

In 1990, the Irish Government introduced a ban on the marketing, sale and distribution of bituminous coal within the city of Dublin. A study of this, published in *The Lancet*, examined the change in concentrations of air pollutants and death rates for 72 months before and after the ban, adjusting for weather, season and changes in population structure. It showed that black smoke concentrations were reduced by two thirds and sulfur dioxide concentrations by a third. Total non-trauma death rates were reduced by 5.7%, deaths from cardiovascular diseases by 10.3%, deaths from respiratory causes by 15.5% and other deaths by 1.7%. The authors concluded, "the ban on coal sales within Dublin County Borough led to a substantial decrease in concentration of black smoke particulate air pollution, a reduction of 243 cardiovascular deaths and 116 fewer respiratory deaths per year".

3.3 TRENDS AND INTERNATIONAL COMPARISONS

Health impacts

Estimates of the burden of ill-health related to air pollution in pilot countries are shown in Table 3.3.1. The measure of health impact used here is years of life expectancy lost in one year per 100 000 population. The estimates used local pollution data and evidence from published epidemiological studies, and they represent the health effects attributable to exposures to $PM_{2.5}$ above 7.5 μg/m^3.

Country	Population-weighted $PM_{2.5}$ concentration (μg/m^3)	Years of life expectancy lost in one year per 100 000 population (95% CI)
Czech Republic	19.1	837 (220–1455)
Germany	17.3	700 (184–1216)
Hungary	16.1	830 (218–1444)
Israel	24.7	711 (187–1232)
Netherlands	19.7	773 (203–1343)
Romania	23.5	1140 (300–1979)
Spain	21.2	861 (226–1494)
Switzerland	17.0	552 (145– 959)

Table 3.3.1. The health effects of exposure to $PM_{2.5}$ in countries participating in the pilot study

Source: EuroIndy and the EEA air quality information system (AirBase)

The loss of life expectancy depends not only on pollution levels but also on the underlying prevalence of cardiorespiratory disease and the age distribution of the population. Although the estimated burdens for each country are imprecise, the figures indicate in broad terms the scope for improving health through air pollution measures and the general relationship between ambient concentrations and health burden.

Population exposure to airborne particles and its determinants

Trends in air pollution and its determinants over recent years – particularly vehicle and fuel use and emission levels – have been generally mixed or disappointing (Fig. 3.3.1–3.3.4). The situation can be summarized as follows.

The number of passenger-kilometres by private vehicles has increased steadily in most countries (Fig. 3.3.1) while passenger-kilometres by bus and train are showing mixed trends.

Total consumption of diesel fuel and consumption by road transport are increasing across Europe (Fig. 3.3.2).

Although particulate emissions from energy and industry are generally decreasing, transport-related emissions (usually more important for the exposure of people in urban settings) show a mixed picture (though a significant fall in Germany) (Fig. 3.3.3).

Sulfur dioxide emissions and air concentrations have decreased in all countries apart from Israel. This is partly due to the implementation of abatement measures, such as a reduction in the sulfur content of fuel, and partly to a reduction in pollution from the burning of coal and lignite. Ambient levels are generally below the WHO guideline level of 50 µg/m3.

Fig. 3.3.1.
Passenger-kilometres by private car by country
Source: EuroIndy.

Fig. 3.3.2.
Diesel fuel consumption by country
Source: EuroIndy.

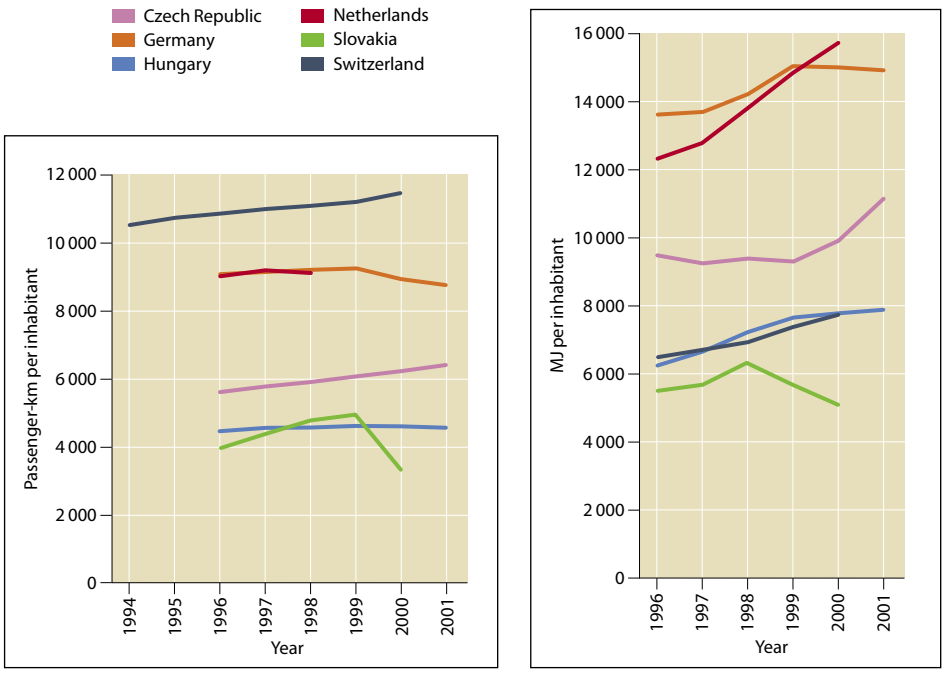
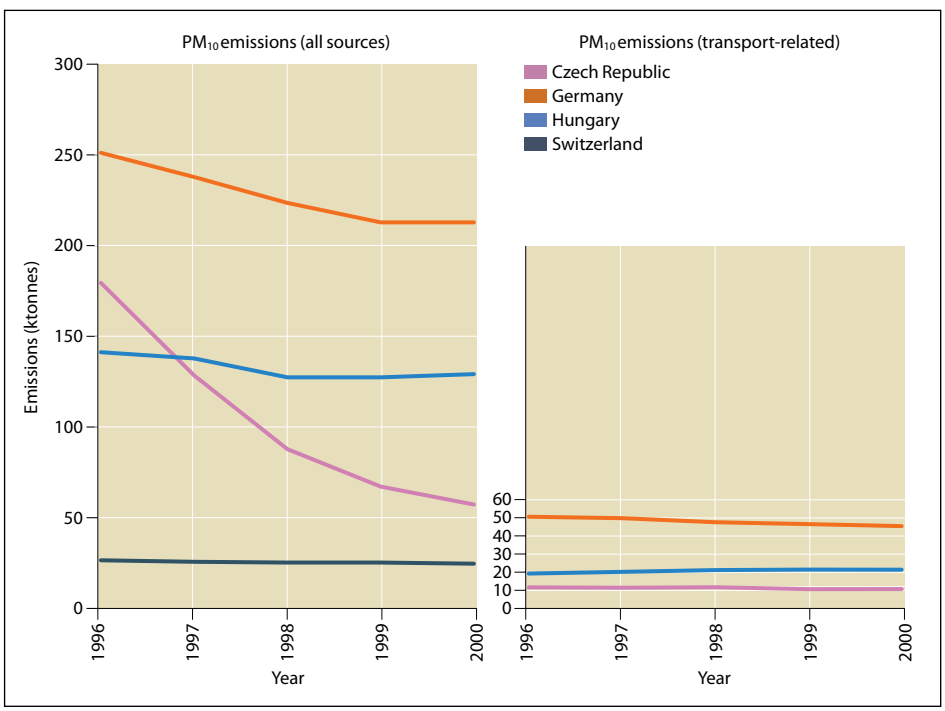


Fig. 3.3.3.
Total and transport-related trends in emissions of primary PM_{10} by country
Source: EuroIndy.



There has been no clear trend in ambient PM10 concentrations among the pilot countries in recent years, but more than 20% of the population continues to be exposed to levels of PM10 above 40 µg/m3 (the EC target limit for 2005).

3.4 POTENTIAL IMPACT OF PUBLIC HEALTH POLICY

For the eight countries (population 194 million) involved in this pilot study, an annual total of 1 555 400 years loss of life expectancy can be attributed to exposure to a $PM_{2.5}$ concentration >7.5 µg/m^3. In reality, national and local policy interventions alone can achieve only modest reductions in pollution levels and hence in pollution-related mortality. Among the many reasons for this are the intrinsic dependence of modern economies on fossil fuels and the multiple and complex sources of particulate pollution, which include natural sources and the mass transport of anthropogenic emissions from distant sources.

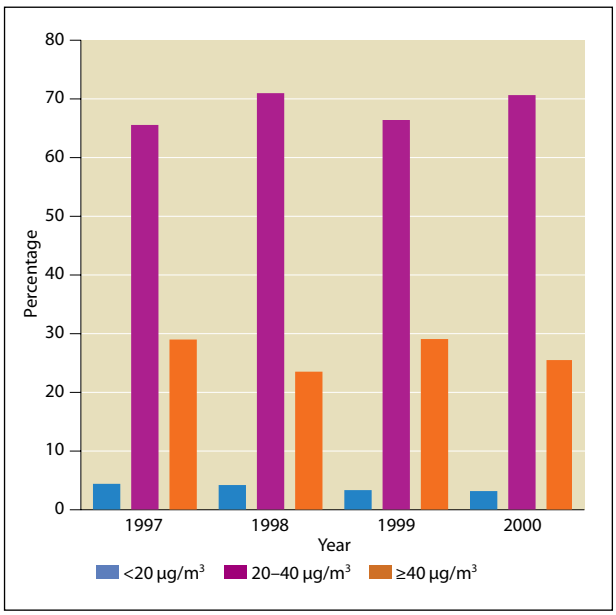


Fig. 3.3.4. Distribution of population exposure to ambient PM_{10} in pilot countries, 1997–2000
Source: EuroIndy.

The gains in life expectancy that could theoretically result from a 10% reduction in $PM_{2.5}$ are shown in Fig. 3.4.1.

Implementation of a range of policy initiatives could achieve important reductions in population exposure and associated health impacts. Such measures might include:

- differentiated transport taxes and charges, such as the German ecological taxation policy (Box 3.2);
- transport policies that promote greater use of public transport (a Norwegian study has shown greater use of public transport and less use of cars when fares are reduced and when accessibility to and the frequency of public transport are increased); and

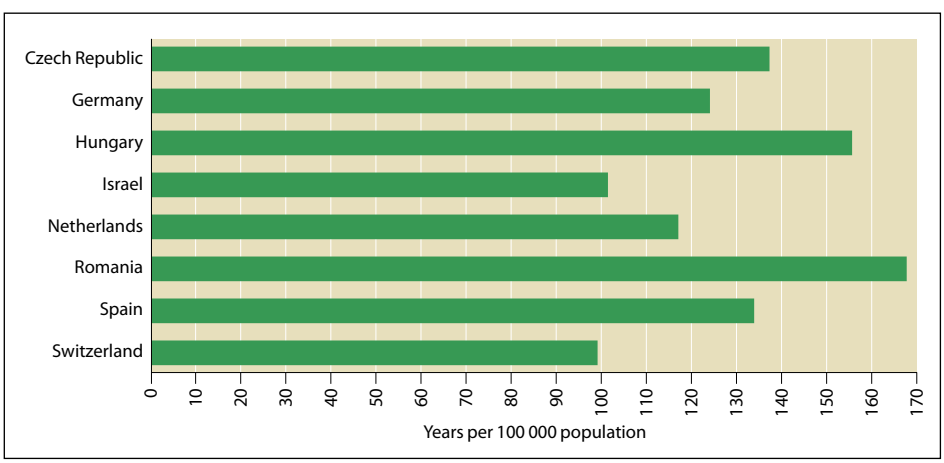


Fig. 3.4.1. Loss of life expectancy theoretically preventable in one year by a 10% reduction in $PM_{2.5}$
Source: EuroIndy and the EEA air quality information system (AirBase)

Box 3.2.
Case study: impact of fuel taxation policy in Germany

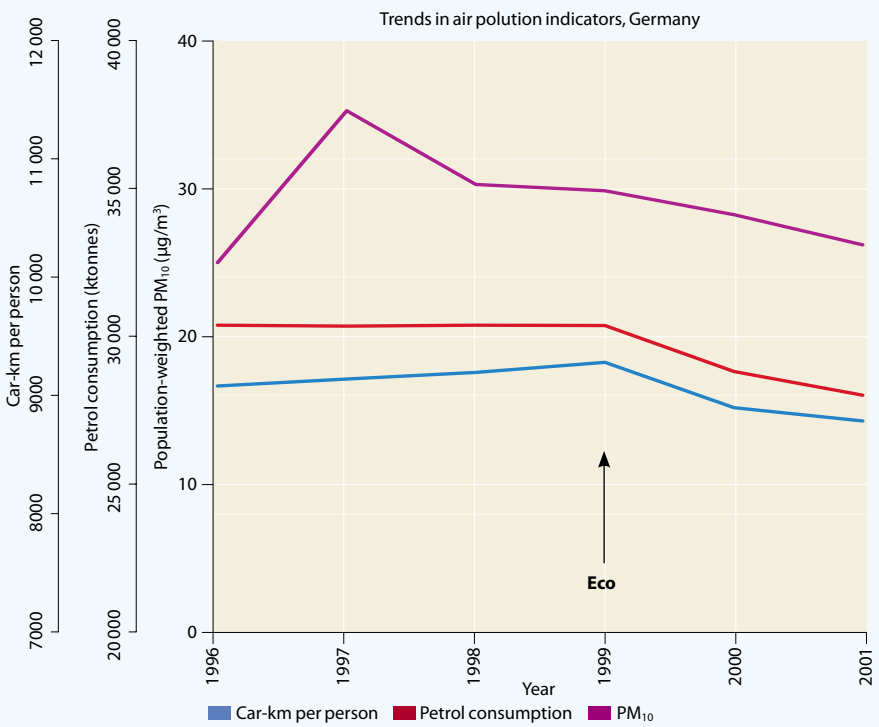
On 1 April 1999, the German Government introduced a differential tax system on petrol and other fuels as part of its ecological tax reform, aimed at encouraging greater energy efficiency and the use of renewable energy sources. By promoting a reduction in the use of fossil fuels, this measure is also likely to benefit health by helping limit emissions and concentrations of air pollutants.

The change over recent years in some key indicators is as follows.

- Against a previously rising trend, the number of passenger-kilometres travelled by car declined as from 1999.
- Previously static petrol consumption fell slightly.
- The trend in particulate air pollution (PM_{10}), though more difficult to interpret, also showed evidence of decline from 1999.

Preliminary data on PM_{10} for more recent months suggests that the downward trend may not have continued, but the underlying pattern is difficult to gauge at this stage because of the variability of weather conditions over the period in question. Further monitoring will provide clearer evidence.

Similar reductions of traffic volumes and fuel consumption were also observed during the oil crises of 1973–1974 and 1981–1982, when world fuel prices rose.



Source: EuroIndy, EEA AirBase and German national statistics on mineral oil and transport.

- promotion of low- or ultra-low-sulfur fuels to facilitate the introduction of advanced nitrogen oxide abatement ($DeNO_x$) and particulate filters.

The EU has set targets of a mean PM_{10} of 40 μg/m^3 for 2005 and 20 μg/m^3 in 2010. Achievement of these targets will require implementation of a range of policy measures. The most recent WHO assessment pointing to the health significance of fine fraction particulate matter ($PM_{2.5}$) emphasizes the role of combustion-related pollution, including that derived from transport. Future policies will need to focus on these pollution sources.

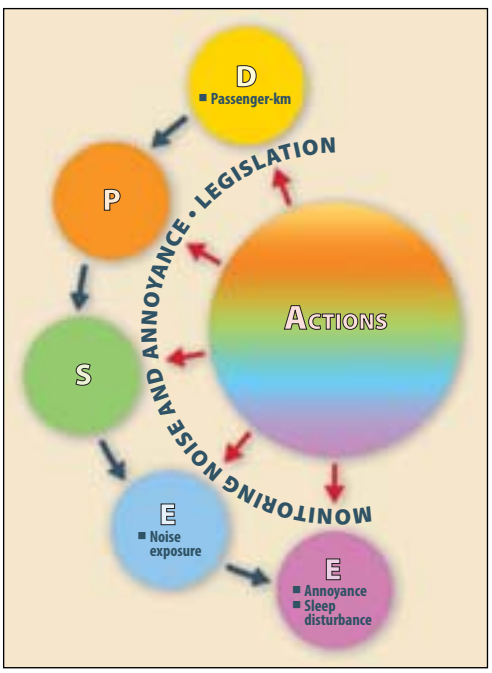
REFERENCES

1. *Europe's environment: the third assessment*. Copenhagen, European Environment Agency, 2003 (Environmental Assessment Report No. 10).
2. Ezzati M et al. Selected major risk factors and global and regional burden of disease. *Lancet*, 2002, 360:1347–1360.
3. Hedley AJ et al. Cardio-respiratory and all-cause mortality after restrictions on sulfur content of fuel in Hong Kong: an intervention study. *Lancet*, 2002, 360:1646–1645.
4. Clancy L et al. Effect of air-pollution control on death rates in Dublin, Ireland: an intervention study. *Lancet*, 2002, 360:1210–1214.

4. NOISE

4.1 CAUSAL CHAIN AND INDICATORS

Community noise is a widespread environmental problem. In Europe, transport is the most important source of community noise. Exposure to noise causes annoyance, sleep disturbance, stress and adverse effects on cognition. Cardiovascular diseases, including elevated blood pressure, are also associated with exposure to noise. Children are more vulnerable with regard to cognition and adults with regard to annoyance. There is a chain of causality that links the increase in traffic with exposure to noise and effects on health. Owing to the limited possibilities of obtaining indicators for noise, core indicators were restricted to health effects (annoyance and sleep disturbance) and action (regulations, restrictions and noise abatement measures). However, in the pilot study, indicators of driving force (annual passenger-kilometres by mode of transport) and exposure (population exposure to noise) were also considered.



4.2 POTENTIAL FOR HEALTH BENEFITS FROM REDUCING NOISE EXPOSURE

It has been estimated that around 120 million people in the EU or some 30% of the population are exposed to levels of road traffic noise >55 dB(A), the target value for residential areas. Around 13% are exposed to levels >65 dB(A) (Lday-night)[7] *(1)*. At night, more than 30% are exposed to equivalent sound pressure levels >55 dB(A). At these levels many people feel annoyed and their sleep is disturbed.

The effects can be reduced by lowering emissions at the source, preventing exposure (zoning), reducing exposures (noise barriers, insulation measures) and changes in traffic management or even the behaviour of drivers. Depending on the conditions in a particular country, one could envisage various types of measure at different sites on the causal chain from source to population health effects. In practice, noise management consists of different policy instruments and measures such as:

- eliminating unacceptable levels through the imposition of a legal limit;
- conserving and extending quiet (residential and natural) areas through policy measures; and
- improving acoustic quality in residential areas through noise barriers, traffic measures and zoning.

[7] A descriptor of noise level based on the energy-equivalent noise level (Leq) over the whole day (24 hours) with a penalty of 10 dB(A) for night-time noise (22:00–07:00).

A few successful interventions in relation to children are described in a recent review (*2*):

- In New York City, the installation of rubber pads on railway tracks and sound-absorbing ceilings in schools reduced noise levels in classrooms by 6–8 dB(A) and improved reading ability among children in classrooms facing railway tracks (*3*).
- The Los Angeles Airport Study showed that noise levels were reduced by 7 dB(A) in classrooms subject to noise-abatement measures, resulting in some small improvements in cognitive performance and motivation but not in reading scores (*4*).
- Closure of the old Munich Airport resulted in a reduction in noise levels from 68 to 54 dB(A) and an improvement in children's long-term recall and reading, whereas the reverse occurred in children living near the new airport. Acoustic treatment of classrooms that reduced background noise by 5–7 dB(A) resulted in improved speech and word intelligibility among schoolchildren (*5*) and better cognitive performance among children of preschool age (*6,7*).

There are considerable differences in annoyance levels between countries.

4.3 TRENDS AND INTERNATIONAL COMPARISONS

Because most information on the various aspects of noise is available from the Netherlands, data from that country are used as examples throughout this chapter. When available, international information derived from EuroIndy and other sources is presented.

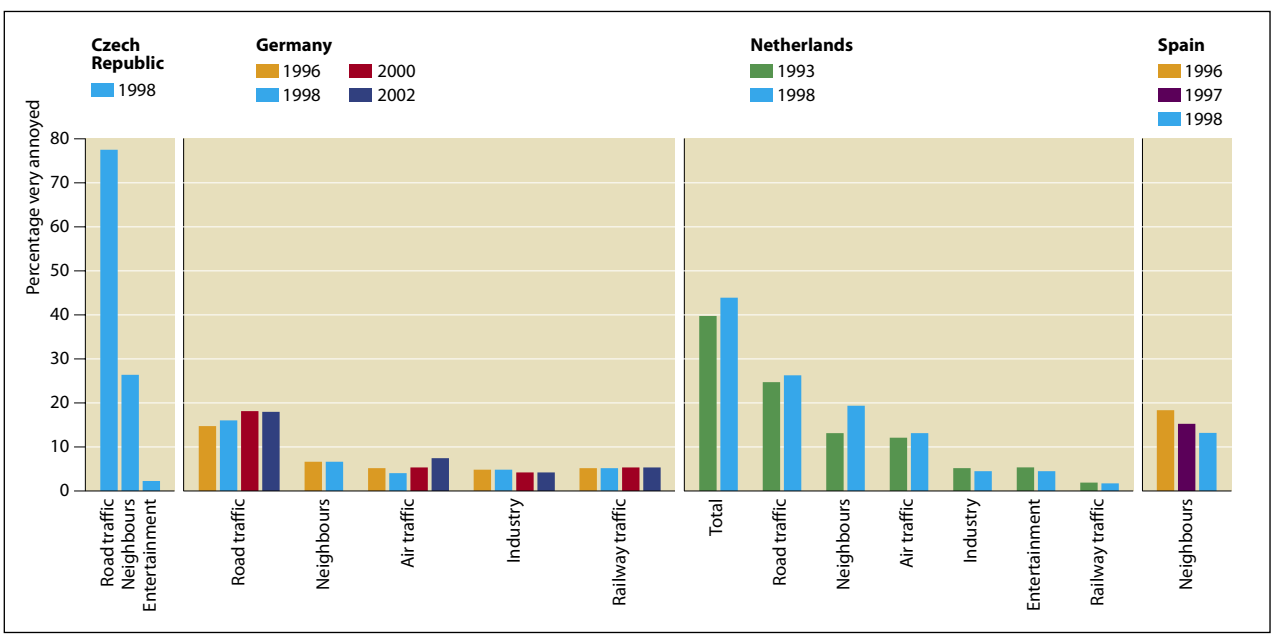
Health effects

The main sources of noise annoyance are transport, neighbours and air traffic (Fig 4.3.1). A problem in comparing national data is the use of different questions

Fig. 4.3.1. Percentages of the population highly annoyed by noise in the Czech Republic, Germany, the Netherlands and Spain

Source: EuroIndy.

Note: The methods used in the Czech Republic differ from those used in other countries; this at least partly explains the high percentage of the population annoyed by noise.



to assess annoyance. The recently published ISO technical specification ISO/TS 15666:2003 provides a basis for further harmonization of annoyance assessment.

Transport noise is and will remain a major problem in the European Region owing to the persistent growth in traffic (especially road and air).

Environmental determinants

Driving forces

Transport noise is and will remain a major problem, owing to the enormous growth in traffic (especially road and air) and the 24-hour economy. The Organisation for Economic Co-operation and Development predicts an increase in motor vehicle-kilometres of 40% in the next 20 years. Fig. 3.3.1 (page 12) shows the increase in passenger-kilometres by private car between 1994 and 2001 in various countries.

Exposure

No indicator for noise exposure has so far been included in EuroIndy, and thus the information given below is derived from another source (*8*). Different methodologies used in countries preclude comparison of the noise situation. Differences in noise exposures between countries reflect only partly the actual situation, as differences in methodologies used may lead to artefacts of the order of 10–15 dB(A). This has to be considered in intercountry comparisons of noise exposure. The EU guidelines on the harmonization of noise indices and calculation methods, once implemented, will facilitate comparative analysis. Information on noise exposure can be derived from noise level maps. According to the EU Environmental Noise Directive, member states are obliged to make noise maps for high-risk areas. Table 4.3.1 shows the distribution of traffic noise exposure in the EU. A more detailed noise map of the Netherlands (Fig. 4.3.2) illustrates the close relationship between exposure and underlying driving forces, mainly transport and habitation.

Table 4.3.1.
Traffic noise exposure distribution in the EU
Source: Roovers et al. (*8*).

EU population	Noise level							
	<55dB(A) ($L_{day\text{-}night}$)		55–65 dB(A) ($L_{day\text{-}night}$)		65–75 dB(A) ($L_{day\text{-}night}$)		>75 dB(A) ($L_{day\text{-}night}$)	
	%	No. (millions)	%	No. (millions)	%	No. (millions)	%	No. (millions)
371 602 000	68	251.3	19	71.2	11	41.4	2	7.7

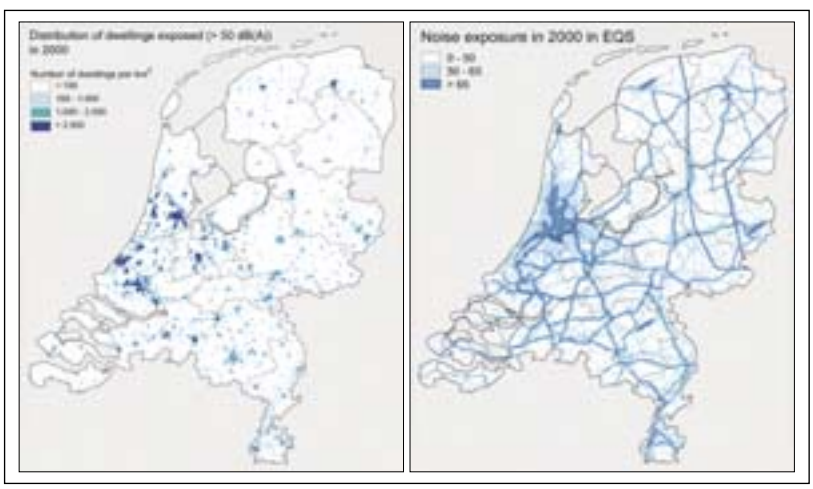


Fig. 4.3.2.
National noise map of the Netherlands serving as an indicator of exposure
Source: RIVM (*9*).

Note: EQS = Environmental quality standard.[8]

[8] The EQS converts exposure to noise from a range of sources to the 24-hour value for road traffic that would cause as much nuisance as the exposure in question. This standard was introduced because surveys showed that the level of nuisance experienced varies for identical exposures to noise from different types of source.

Actions

Most pilot countries reported clear and, in most cases, fully implemented legislation on the prevention of noise in relation to new roads, railways and airports, as well as building regulations that require insulation between houses. In most pilot countries local authorities are obliged to deal with noise complaints, and in many this is implemented or enforced. Noise annoyance is regularly monitored in one third of the reporting countries, while in others current regulations are partially enforced. Improvement grants for existing dwellings with high noise loads are available in one third of the pilot countries. Fig. 4.3.3 shows the application of noise control measures in the pilot countries.

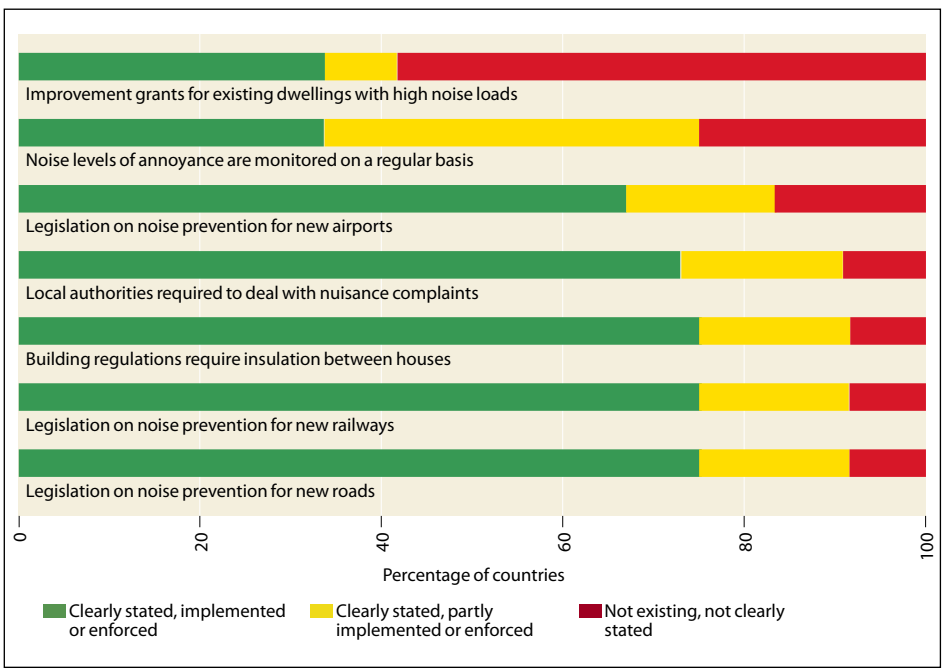


Fig. 4.3.3. Application of regulations, restrictions and noise abatement procedures (composite index) in pilot countries[a]

Source: EuroIndy.

[a]Albania, Armenia, Bulgaria, Czech Republic, Germany, Hungary, Lithuania, Netherlands, Poland, Slovakia, Spain and Switzerland.

Almost all reporting countries have policies in place and partially enforced to prevent, restrict and abate noise pollution.

4.4 POTENTIAL IMPACT OF PUBLIC HEALTH POLICY

The links between noise indicators can be used in the development of policies to improve public health. One difficulty in determining the potential health effects of noise abatement measures is that annoyance depends not only on noise exposure levels. Examples of non-acoustical factors are individual noise sensitivity, fear with respect to the source, attitudes towards the source, perceived control over the situation, and perceived economic or societal advantages of the noise-generating activity. Interventions on these factors can also succeed in reducing noise annoyance.

In 2002, an important step towards improving the comparability of data and monitoring of noise throughout the EU was taken by the European Parliament in the form of Directive 2002/49/EC. The Directive aims, inter alia, at harmonizing noise indices and noise calculation methods. The indices L_{den}[9] and L_{night}[10] are the harmonized noise indices, to be used throughout the EU for all modes of trans-

[9] Day–evening–night noise level based on the energy-equivalent noise level (Leq) over the whole day (24 hours) with a penalty of 5 dB(A) for evening-time (19:00–23:00) noise and of 10 dB(A) for night-time (23:00–07:00) noise (Directive 2002/49/EC).

[10]Night noise level based on the energy-equivalent noise level over the night-time period (23:00–07:00).

port. Member states are obliged to make noise maps for all agglomerations with more than 250 000 inhabitants and for all main roads (those with more than 6 million vehicle passages a year), railways with more than 60 000 train passages a year and major airports. Furthermore, the Directive proclaims the development of a common noise calculation model, and designates for the time being so-called interim methods (the French method for road traffic noise, the Dutch method for railway noise and the European Civil Aviation Conference method for aircraft noise). Nevertheless, as long as they "do not differ too much from the interim methods" national methods may still be used for noise assessment and for reporting to Brussels. Thus in the near future noise exposure assessments will most likely still be made using the different national methods. The EU noise policy, besides harmonizing indices and calculation methods, sets and periodically tightens the emission limits on tyres, cars and international trains.

If the noise indicators were expanded to cover the entire causal chain, they could serve to monitor potential improvements in terms of noise exposure and associated annoyance resulting from the implementation of Directive 2002/49/EC throughout Europe. Moreover, they could provide countries with appropriate information for making national or international comparisons and for monitoring the effectiveness of national policies.

An example of an effective noise abatement policy in the Netherlands is presented in Box 4.1.

REFERENCES

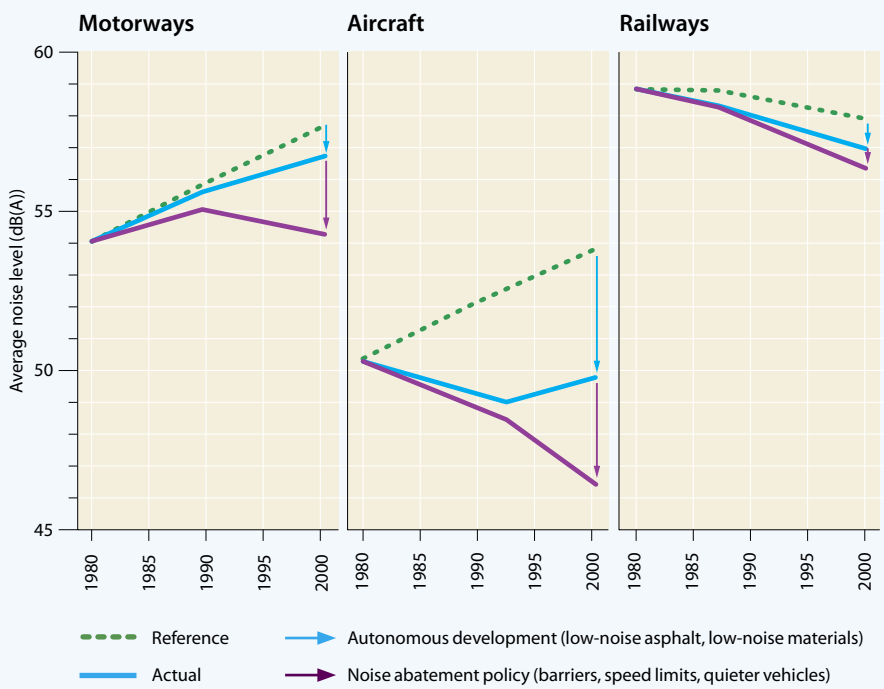
1. *Environment in the European Union at the turn of the century*. Copenhagen, European Environmental Agency, 1999 (Environmental Assessment Report No. 2).
2. Bistrup ML. Prevention of adverse effects of noise on children. *Noise Health*, 2003, 5(19):59–64.
3. Bronzaft AL. The effect of a noise abatement program on reading ability. *Journal of Environmental Psychology*, 1981, 1:215–222.
4. Cohen S et al. Aircraft noise and children: longitudinal and cross-sectional evidence in adaptation to noise and the effectiveness of noise abatement. *Journal of Personality and Social Psychology*, 1981, 40:331–345.
5. Mackenzie DJ, Airey S. *Classroom acoustics: a research project*. Edinburgh, Heriot-Watt University, 1999.
6. Maxwell LE, Evans GW. Interior noise exposure and reading readiness among preschool children. In: Carter N, Job RFS, eds. *Noise Effects '98: 7th International Conference on Noise as a Public Health Problem, Sydney, Australia*. Sydney, Noise Effects '98 Pty, 1998, 1:373–376.
7. Maxwell LE, Evans GW. The effects of noise on preschool children's pre-reading skills. *Journal of Environmental Psychology*, 2000, 20:91–97.

Box 4.1.
Case study: Dutch noise abatement policy

Exposure to noise from motorway, rail and air traffic in the Netherlands has slightly declined since 1980, despite a doubling of traffic volume. The erection of noise barriers, the use of low-noise asphalt and quieter goods vehicles have together contributed to reducing average motorway noise levels in residential areas.

To maintain this trend, however, an effective noise abatement policy will still be needed in the future because the volume of the traffic is expected to continue to rise. Renewal of the aircraft fleet and optimization of runway use and flight paths have reduced average levels of aircraft noise in residential areas, despite a quadrupling of the number of flights. The noisiest aircraft are no longer permitted to use Schiphol Airport.

Although noise abatement policies are having an effect, a considerable number of homes in the Netherlands still experience high levels of noise and annoyance levels are not decreasing (see Fig. 4.3.1 and 4.3.2). In particular, city centre traffic noise has not been reduced at all. Noise levels estimated at the facades of 40 000–60 000 residential buildings in the Netherlands exceed 70 d(B)A, the limit value for 2010 laid down in the Fourth National Environmental Policy Plan. Extra measures are needed to meet this limit value. Low-noise asphalt and reduced speed limits are more cost-effective than erecting noise barriers; instead of just solving local problems they can reduce noise levels throughout a wider urban area (*10*).



Sources of noise in residential areas

Source: RIVM (*10*).

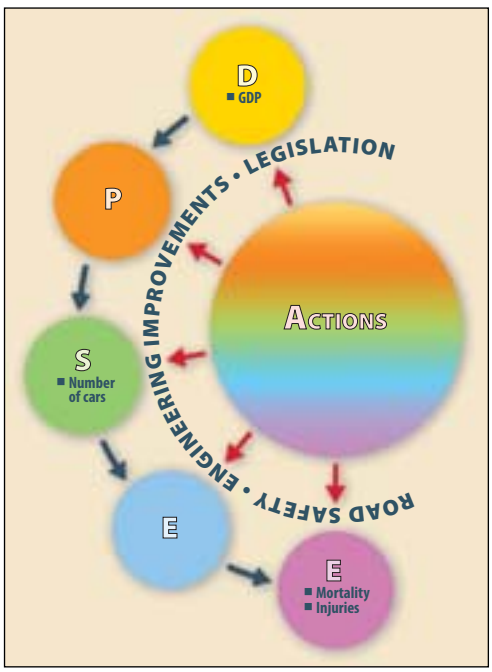
Note: The dotted "reference" line is the expected trend based on growth in traffic volume only, assuming no measures were taken; the blue line illustrates the effects of measures taken for other reasons than noise abatement (e.g. low-noise asphalt to improve road safety); the purple line shows the actual trend due to all measures that have had an effect on noise.

8. Roovers C, van Blokland G, Psychas K. Road traffic noise mapping on a European scale, In: *Inter-Noise 2000: 29th International Congress and Exhibition on Noise Control Engineering, Nice, France, 27–30 August 2000*. Paris, Société Française d'Acoustique, 2000, 6:3587–3590.
9. *Milieubalans 2001* [Environmental balance 2001]. Bilthoven, RIVM, 2001.
10. *Milieubalans 2002* [Environmental balance 2002]. Bilthoven, RIVM, 2002.

5. TRANSPORT ACCIDENTS

5.1 CAUSAL CHAIN AND INDICATORS

Injuries caused by road traffic accidents in Europe continue to be a major public health problem. Road traffic accidents are the most important cause of death among young people, especially males, and are a major cause of physical disability, especially among the youngest. The total cost to society is enormous in terms of economic loss as well as of quality of life. Two indicators of health effects, the mortality and injury rates for road traffic accidents, were proposed as core indicators because of the limited feasibility of other indicators. To better describe the links within the DPSEEA causal chain model, two "driving forces" related to economic growth are also considered in this chapter. The respective indicators are the number of cars per unit population and the gross domestic product (GDP). This chapter covers more countries[11] than those involved in the EH indicator pilot study and gives a better overview of the situation in Europe.



5.2 POTENTIAL FOR HEALTH BENEFITS FROM IMPROVED ROAD SAFETY

Traffic accidents cause about 36 000 deaths and 1.5 million injuries per year. It has been estimated that the total cost to society is higher than €160 billion per year or approximately 2% of the GNP of the EU (*1*). The most vulnerable groups are young people between 15 and 24 years of age, pedestrians, motorcyclists, cyclists and moped riders.

Reducing the number of traffic accidents and resulting injuries and deaths is a priority throughout Europe. It is particularly urgent in the countries of central and eastern Europe (CCEE), where improvements in traffic infrastructure and driver behaviour are not in line with the rapidly growing traffic density.

There is sufficient evidence of the effectiveness of interventions aimed at reducing traffic accidents. Moreover, the shift to more environment-friendly modes of transport (e.g. public transport) is accompanied by positive effects on road traffic safety. A recent review (*2*) of the effectiveness of interventions aimed at reducing road traffic accidents describes the most effective actions as:

- health promotion campaigns for the prevention of childhood injury
- efforts to increase helmet use by cyclists and motorcyclists
- promotion of the use of children's car seats and seat belts

[11] Armenia, Bulgaria, Czech Republic, Denmark, Germany, Finland, Hungary, Ireland, Italy, Lithuania, Netherlands, Portugal, Romania, Slovakia, Spain, Switzerland, United Kingdom.

- traffic calming measures
- specific legislation against drink-driving.

5.3 TRENDS AND INTERNATIONAL COMPARISONS

Health effects

Despite an overall reduction, road accident mortality is still high with markedly different trends in eastern and western Europe.

Despite a downward trend, mortality from road traffic accidents is still high in the European Region with 9.8 deaths per 100 000 inhabitants in 2000, a reduction of 6% since 1996. The overall reduction in mortality rates in recent years can be attributed principally to the western European countries, while the CCEE are still experience increasing trends (Fig. 5.3.1).

The changes in injury rates over time show a different pattern (Fig. 5.3.2). The overall injury rate of 431 per 100 000 inhabitants has been rather stable since 1996

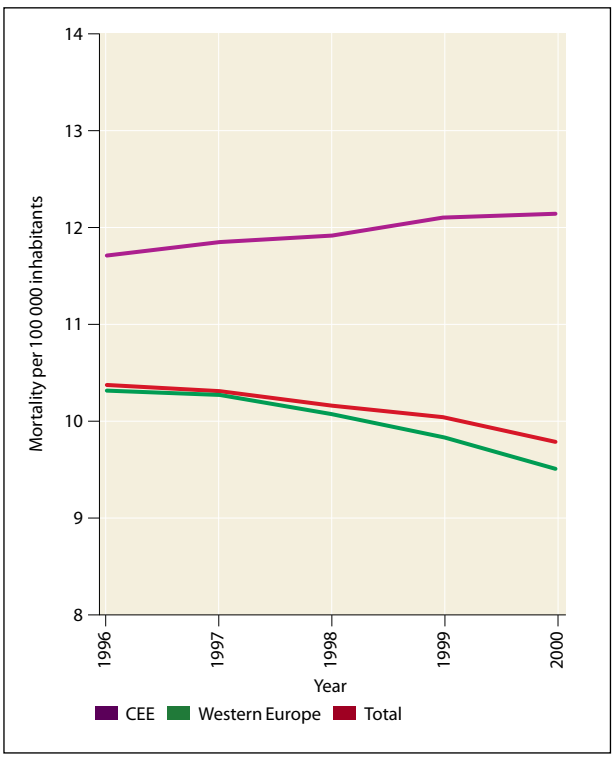


Fig. 5.3.1
Age-standardized road accident mortality rates in the CCEE and western Europe, 1996–2000
Source: Health for all database, WHO Regional Office for Europe.

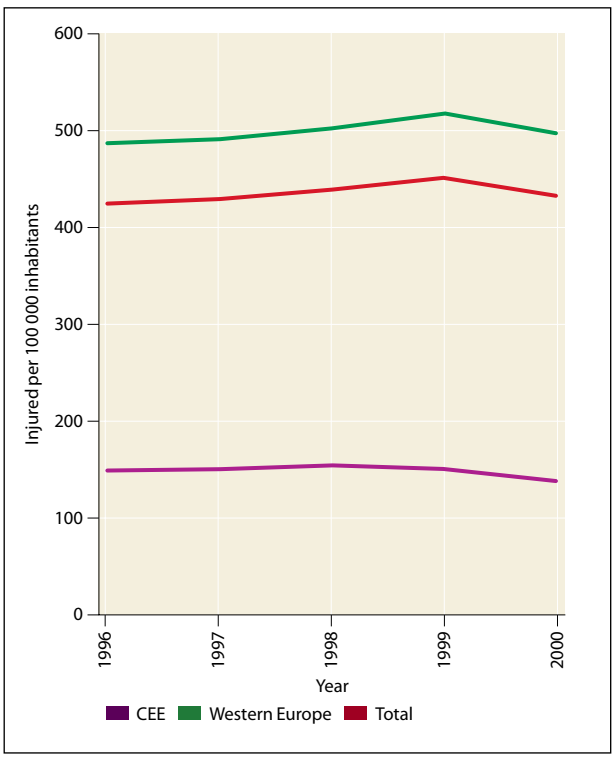


Fig. 5.3.2.
Road accident injury rates in the CCEE and western Europe, 1996–2000
Source: EuroIndy and national statistics for Denmark, Ireland, Italy, Portugal and the United Kingdom.

with a slight (2%) increase over the period 1996–2000. This can be explained partly by an effective reduction in mortality (resulting in more injured persons) and partly by improvements in the quality of information. The lower injury rates reported in the CCEE than in western European countries may be due to underreporting. The CCEE, with the exception of Armenia and Bulgaria, have a higher than average mortality rate, whereas the western European countries, with the exception of

Italy, Portugal and Spain, are below the average (Fig. 5.3.3). A large (41%) reduction in mortality from road traffic accidents was observed in Portugal between 1996 and 2000.

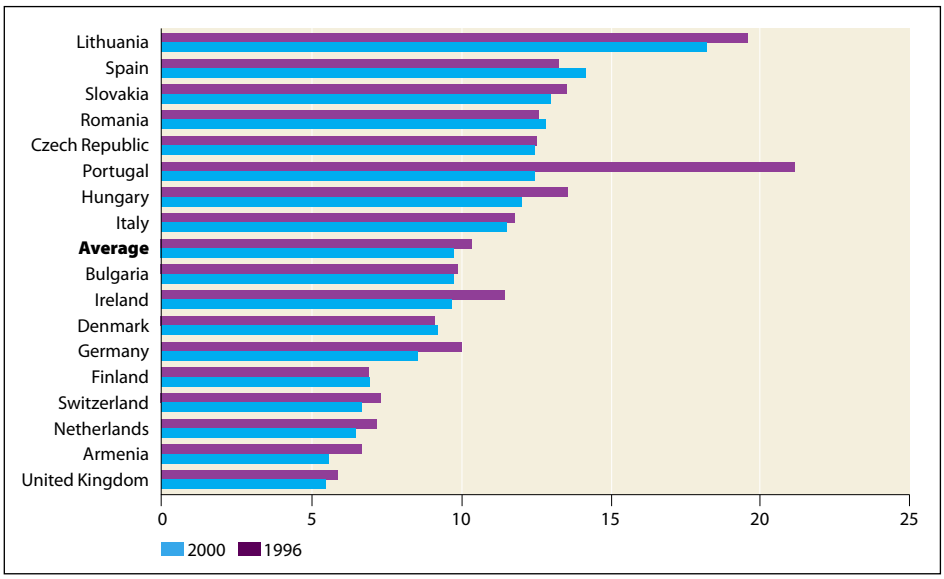


Fig. 5.3.3.
Road accident mortality per 100 000 in some European countries, 1996 and 2000

Source: Health for all database, WHO Regional Office for Europe.

Country ranking on injuries differs considerably from that on mortality. It is quite difficult to compare injury rates among countries because sources of data, definitions of injury and the quality of information vary. The criteria under which the police decide to report an injury and the willingness of people to report minor traffic accidents to the police varies among countries. Moreover, the practice in some countries, such as the Netherlands, of retaining only high-quality health statistics in the information system makes international comparison even more complicated.

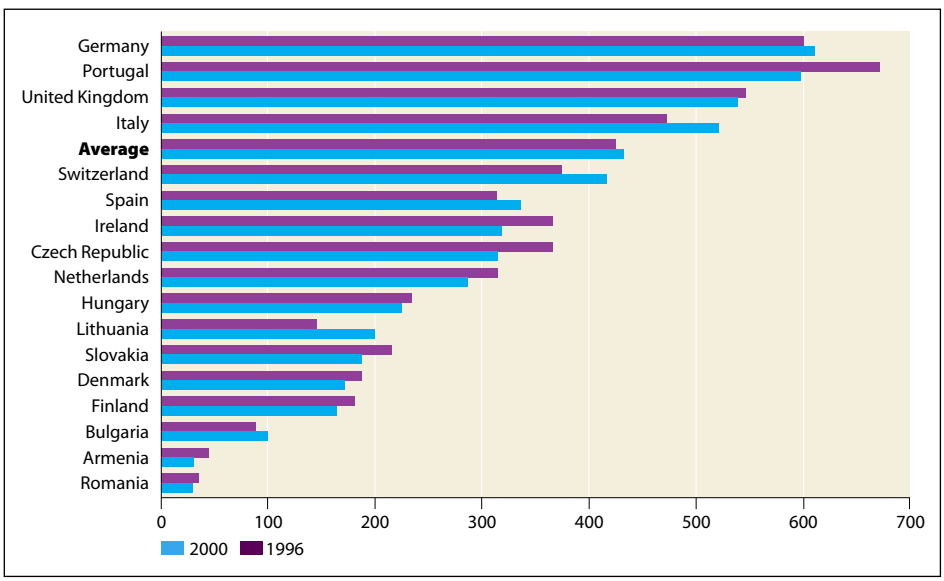


Fig. 5.3.4.
Road accident injuries per 100 000 in some European countries, 1996 and 2000

Source: EuroIndy and national statistics for Denmark, Ireland, Italy, Portugal and the United Kingdom.

Trends in injury rates between the countries were compared, assuming that the national reporting system did not change over time (Fig 5.3.4). From 1996 to 2000, a marked reduction in injury rates was observed in the Czech Republic and Slovakia (–14%), Ireland (–13%), Portugal (–11%), and Denmark and Finland (–9%). The opposite trend was observed in Italy (+10%), Switzerland (+11%) and Lithuania (+37%).

Environmental determinants

The widespread use of cars instead of healthier modes of transport results in increased air pollution and noise annoyance and a higher risk of road traffic accidents, both for pedestrians and for car occupants.

An increasing number of cars corresponds to an increasing number of injuries.

There is a linear relationship between the number of cars in circulation and the injury rate. This relationship also holds true when only those countries are compared for which data quality, underreporting and definitions of injury rate are comparable (Fig. 5.3.5).

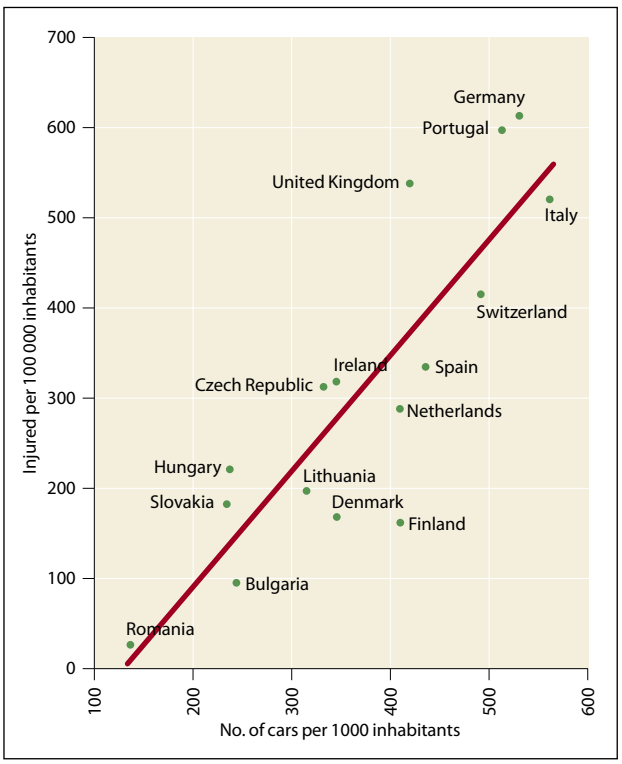


Fig. 5.3.5. Number of cars per 1000 inhabitants and injury rates in some European countries, 2000

Source: EuroIndy and the International Road Traffic and Accident Database (IRTAD).

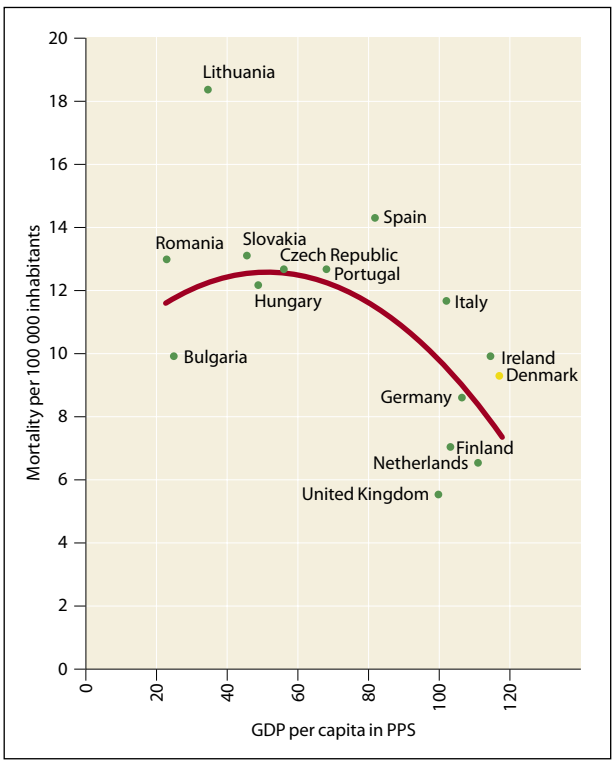


Fig. 5.3.6. Road accident mortality rates and GDP per capita in some European countries, 2000

Source: Health for all database, WHO Regional Office for Europe and the Statistical Office of the European Communities (Eurostat).

Traffic is an important economic sector and a part of the lifestyle of contemporary Europe. The car industry and freight transport are essential components of economic growth and stability in Europe. The volume of passenger and freight traffic

is associated with growth in national GDP. Developments in GDP can thus be seen as a proxy indicator for the driving forces affecting traffic volumes at national and international levels (Fig. 5.3.6). Nevertheless, the relationship between traffic accident mortality and economic growth is not linear: economic development first leads to a growing number of traffic-related deaths but later becomes protective. It appears that increasing wealth leads to a rapid growth in the number of motor vehicles and increased mobility, resulting in higher mortality rates. At a certain level of prosperity, however, measures are taken to improve the traffic infrastructure, to prevent accidents and to provide medical care for the injured.

5.4 POTENTIAL IMPACT OF PUBLIC HEALTH POLICY

The beneficial impact of good public health policy is demonstrated by the relationship between injury rates and the minimum legal age for buying alcohol (Fig. 5.4.1). Countries are grouped according to the minimum legal age for buying alcohol and the frequency of random breath testing. The chart shows that the lowest injury rates are associated with those countries in which the minimum legal age for buying alcohol is 18 years and random breath testing is carried out frequently. The highest injury rates correspond to countries in which the minimum legal age is 16 years, regardless of how breath testing is carried out.

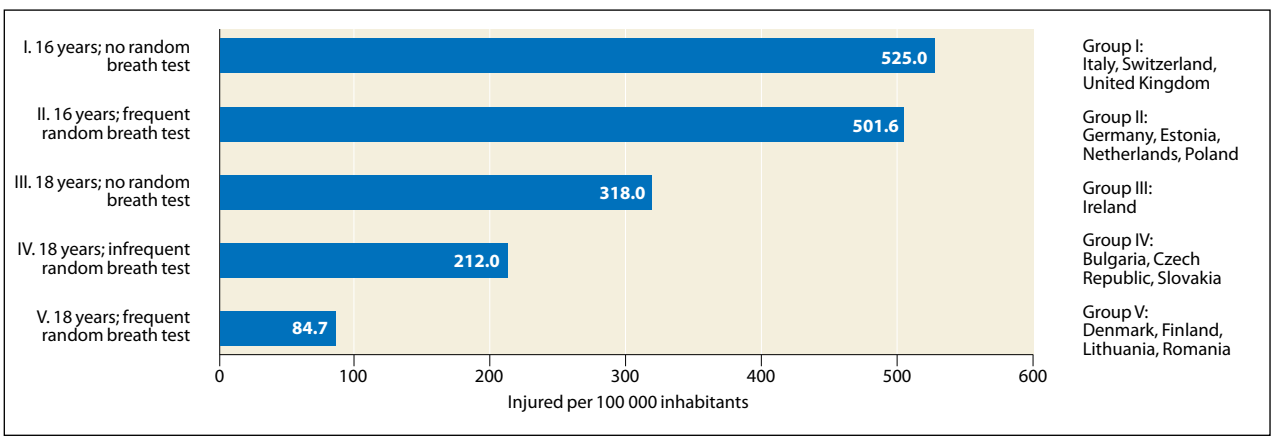


Fig. 5.4.1. Injury rates according to breath testing policy and minimum legal age for buying alcohol, 2000

Source: EuroIndy and the Alcohol Control Database of the WHO Regional Office for Europe.

In 2001 the EC issued its White Paper on European transport policy (*1*) with the aim of halving the number of road deaths by 2010. The Commission plans to improve action programmes aimed at encouraging road users to modify their behaviour, to make vehicles safer and to improve the highway infrastructure. One of the EC's specific objectives is to identify and disseminate knowledge on best practices, and to improve the collection and analysis of data on accidents and physical injuries.

The countries acceding to the EU are also planning various activities aimed at improving road safety. For example, in the last few years the Ministry of Transport and Communication in the Czech Republic has prepared and implemented, with the support of the Transport Research Centre, legislation on road safety as part of a massive effort to comply with EU standards.

As an example of good practice, the benefits of a comprehensive road safety policy in the United Kingdom are presented in Box 5.1.

Box 5.1.
Case study: improving road safety saves the lives of child pedestrians and cyclists in the United Kingdom

The urban safety project carried out in five towns in England (*3*) is an example of effective intervention. It was designed to evaluate the impact of traffic calming or area-wide engineering measures on traffic-associated injuries. It included a wide range of measures to redistribute traffic, improve the safety of individual sections of road or reduce speed. The study design was a controlled trial without randomization, and five pairs of localities (one area of intervention and one control area) were selected in each of the five towns involved (Bradford, Bristol, Nelson, Reading and Sheffield). The outcome of the study was measured, using police statistics, five years before and two years after implementation. An evaluation was also made of the costs of each of the traffic schemes in the different towns.

Overall, road traffic accidents were reduced by 13% but there were great variations between schemes. Slight accidents declined proportionately more than fatal and serious ones. Injuries to pedestrians were particularly reduced in one centre (Sheffield) and there was a general reduction in casualties among child cyclists. Measures that protected two-wheel vehicles were particularly successful. A longer-term assessment showed that child pedestrians and cyclists particularly benefited. Each scheme cost £250 000, and first-year rates of return indicated considerable cost savings. This shows that if the core indicators of transport accidents are reported at national and local levels, one could demonstrate the effectiveness of road safety policies on reducing road accident mortality and injuries.

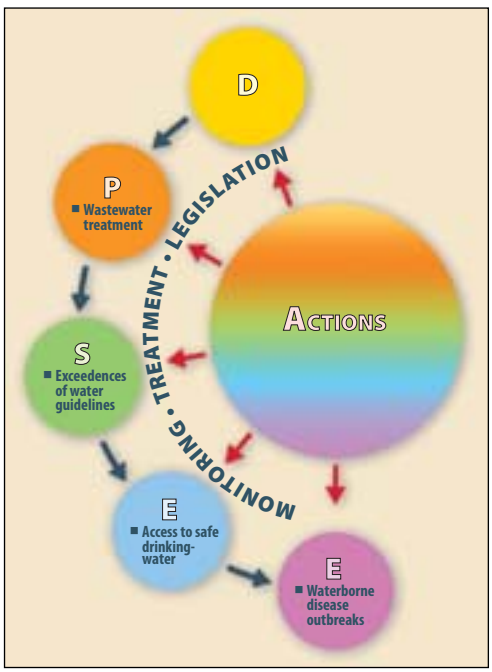
REFERENCES

1. *White paper – European transport policy for 2010: time to decide*. Brussels, European Commission, 2001 (http://europa.eu.int/comm/energy_transport/library/lb_texte_complet_en.pdf).
2. Morrison DS, Petticrew M, Thomson H. What are the most effective ways of improving population health through transport interventions? Evidence from systematic reviews. *Journal of Epidemiology and Community Health*, 2003, 57(5):327–333.
3. Towner E. et al. *What works in preventing unintentional injuries in children and young adolescents? An updated systematic review*. London, Health Development Agency, 2001 (http://www.hda-online.org.uk/documents/prevent_injuries.pdf).

6. WATER AND SANITATION

6.1 CAUSAL CHAIN AND INDICATORS

Public health cannot advance without access to an adequate supply of clean water. The principal public health concern is microbial contamination, which can affect large numbers of people. Chemical contamination of drinking-water may also have effects on health, although in general these tend to be chronic. The core indicators of water and sanitation describing the pressure (wastewater treatment coverage), state (exceedences of water guideline values), exposure (access to safe drinking-water and sanitation) and health effects (outbreaks of waterborne diseases) are comprehensive, and can monitor varied elements in the causal chain illustrated by the DPSEEA framework.



6.2 POTENTIAL FOR HEALTH BENEFITS FROM SAFE WATER

Worldwide, it is estimated that insufficient water quality and supply, sanitation and hygiene account for 5.7% of the total disease burden or 84 million years of life lost per year expressed as DALYs (*1*). In the WHO European Region, 120 million people do not have a regular supply of safe drinking-water and even more have no access to sanitation. Therefore, outbreaks of water-related diseases continue to occur in Europe, especially in the east of the Region. Over 10 000 children under five years of age die of diarrhoea annually. In addition, microbiological contamination of bathing waters, mostly in the Mediterranean region, is responsible for an estimated two million or more cases of gastrointestinal diseases annually (*2,3*). Health effects related to chemically contaminated water tend to be chronic, but acute effects have also been experienced where major episodes of pollution have occurred (*2*). There is good evidence that over 30 million cases of water-related diseases could be avoided annually by a better management of water and sanitation in the European Region (*3*).

6.3 TRENDS AND INTERNATIONAL COMPARISONS

Health effects

The real burden of waterborne disease is not known.

According to EuroIndy data collected from six European countries with a population of about 92 million, in the period 1996–2000 there were 480 outbreaks of waterborne disease affecting 63 949 people. Country trends in disease outbreaks are presented in Fig. 6.3.1. A number of factors make these estimates unreliable, however, and it is likely that the true incidence of gastrointestinal diseases in the

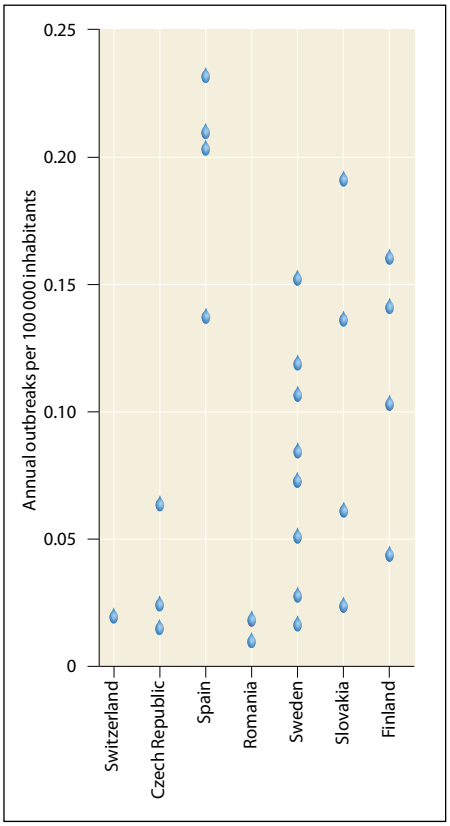


Fig. 6.3.1. Outbreaks of waterborne disease in seven countries during 8 year period, 1995–2002

Source: EuroIndy.

Access to safe drinking-water is high in many western European countries.

Fig. 6.3.2. Urban population with access to piped, regulated drinking-water in six countries, 1996–2000

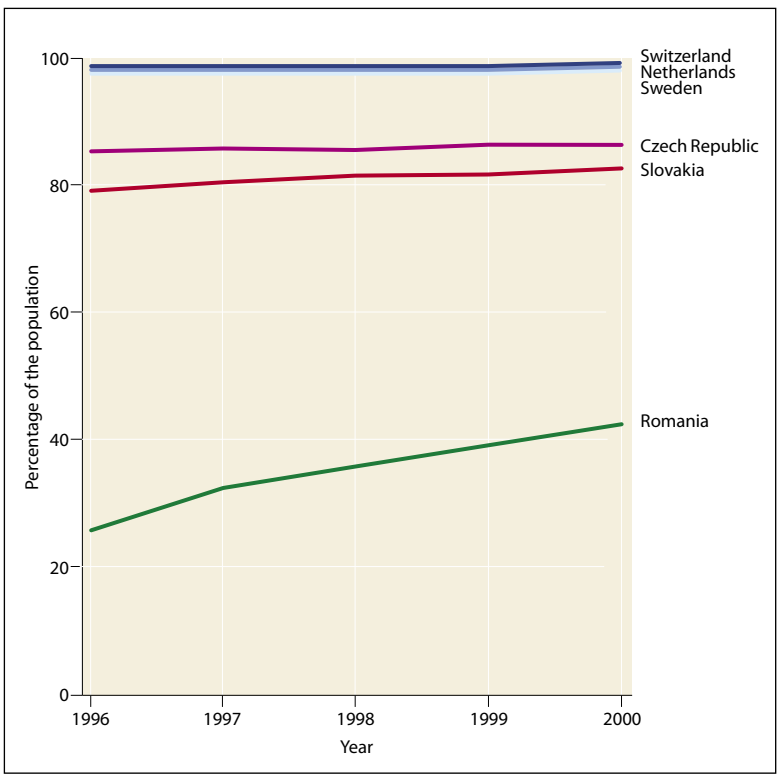
Source: EuroIndy.

The percentage of the population with access to safe drinking-water in the eastern part of Europe is low and needs considerable improvement.

reporting countries is underestimated. For example, during this 5-year period no outbreaks were reported from Bulgaria, Germany, Lithuania or the Netherlands. This may indicate that existing national surveillance systems vary dramatically between the countries and thus do not produce comparable data.

Environmental determinants

The proportion of the population with access to safe drinking-water is high in the western European countries and it is also increasing in the CCEE, such as Romania (Fig. 6.3.2). Nevertheless, access to safe drinking-water in the eastern part of Europe needs considerable improvement. These "urban" data may not characterize the rural areas, which, in many countries, comprise around 50% of the total population.



Drinking-water quality is still of concern throughout Europe, with significant microbiological contamination of supplies in eastern Europe, the Caucasus and central Asia, where the proportion of samples exceeding the faecal indicator standards ranges from 5% to 30%. Time trends indicate that drinking-water quality, as measured by exceedence of the WHO drinking-water guidelines for microbiological parameters, improved in some countries but deteriorated in others between 1996 and 2000 (Fig. 6.3.3).

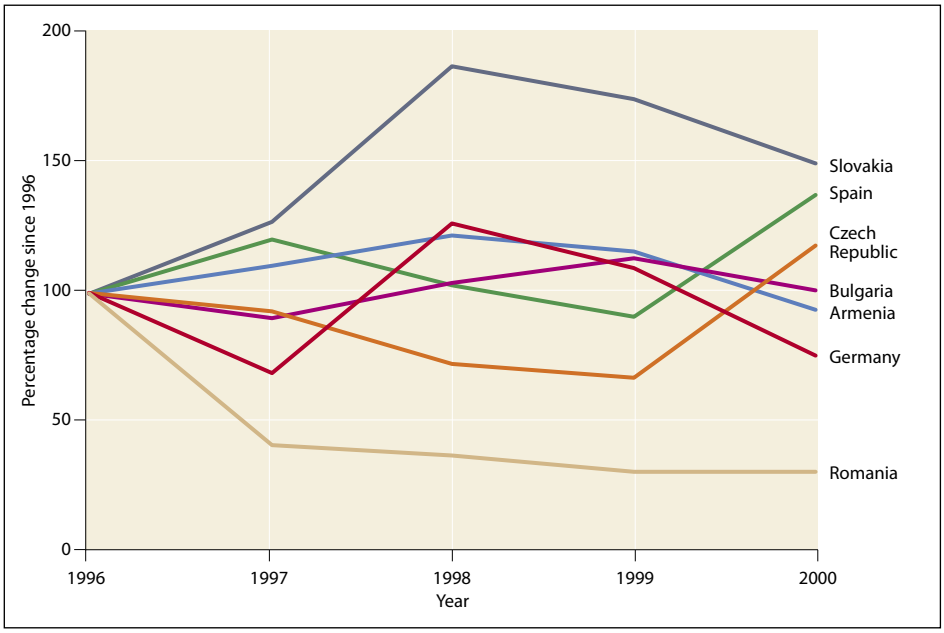
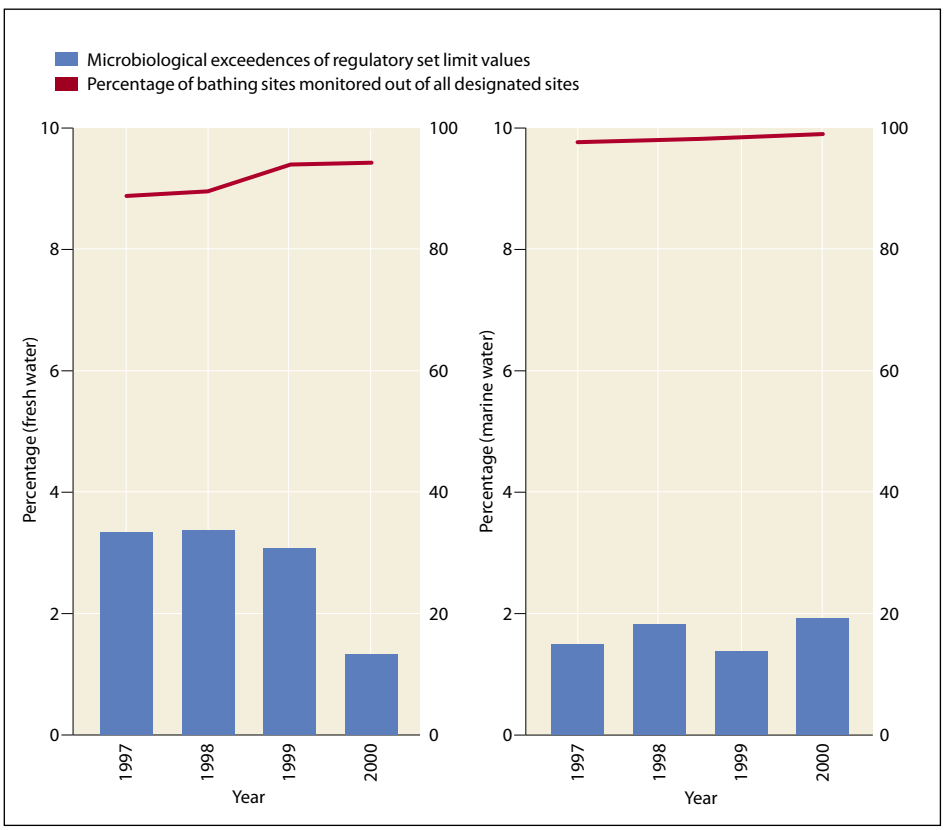


Fig. 6.3.3. Change over time (1996–2000, 1996 = 100%) in drinking-water exceedences for microbiological parameters, by country

Source: EuroIndy.

As shown in Fig. 6.3.4 and 6.3.5, the quality of recreational waters, along with effective monitoring, improved during the period 1997–2001.



The proportion of samples of fresh water used for bathing that exceeded the guideline values for microbiological parameters decreased during the period 1997–2001.

Fig. 6.3.4. Change in monitoring coverage and microbiological quality in fresh water over time

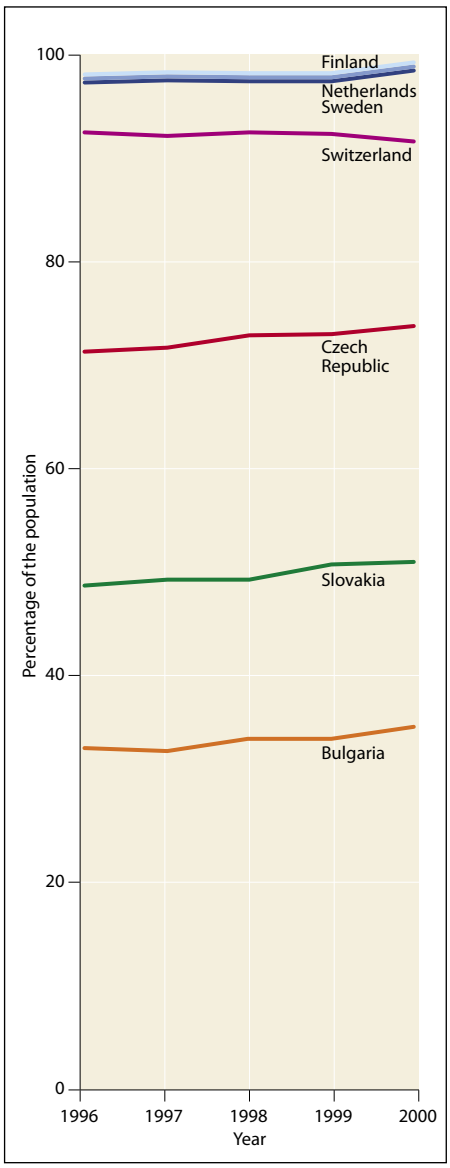
Source: EuroIndy: microbiological quality data from Bulgaria, Germany, Lithuania, Netherlands and Slovakia; monitoring coverage data from Bulgaria, Germany, Netherlands and Spain, comprising 2268 designated recreational freshwater sites and >145 million population.

Fig. 6.3.5. Change in monitoring coverage and microbiological quality in marine water over time

Source: EuroIndy: data from Bulgaria, Germany, Netherlands and Spain, comprising 2199 designated recreational marine water sites and >145 million population.

The coverage and quality of wastewater treatment in western, central and eastern Europe has significantly improved since the 1970s. Nevertheless, the percentage of the population provided with wastewater treatment, although increasing, is still relatively low in the CCEE as well as in the Caucasus region and central Asia. Moreover, there are still many large cities, such as Bucharest, where discharged wastewater is largely untreated (*4*). Data from EuroIndy also show that there are considerable differences between countries in the proportion of the population served by wastewater treatment (Fig. 6.3.6).

Fig. 6.3.6.
Population covered by advanced secondary wastewater treatment in seven countries, 1996–2000
Source: EuroIndy.



Coverage by advanced wastewater treatment in the eastern part of the European Region is low and requires significant improvement.

In summary, the set of core indicators for water and sanitation that has been selected for pilot implementation has proven to be a powerful instrument for monitoring the status of water and sanitation across Europe. Moreover, it could provide countries with appropriate information for comparing their performance with that of other countries and for facilitating the planning of national policies.

6.4 POTENTIAL IMPACT OF PUBLIC HEALTH POLICY

Although improvements have been made over the past decade, coordinated efforts are still needed to ensure that Europe's population is supplied with wholesome and clean drinking-water and has access to safe recreational water. Specific examples of successful policy actions and interventions resulting in improvements in both water quality and public health are shown in Boxes 6.1 and 6.2.

In recognition of the significance for health of water and sanitation, a number of initiatives within the WHO European Region (e.g. EC Directives, WHO guidelines and national laws and regulations) exist that aim to promote the protection of human health by improving water management. Two very important milestones in this process are the Protocol on Water and Health and potentially the Water Framework Directive (Box 6.3).

Box 6.1.
Improvement of bathing water as a result of effective interventions

Within the EU several directives covering bathing water, drinking-water, nitrates, dangerous substances and urban wastewater have resulted in significant improvements on water quality. The table below shows how effective interventions under the Bathing Water Directive produced significant improvements in recreational waters between 1992 and 2002.

Percentages of bathing areas that do not comply with mandatory values in the EU

Year	Coastal zones	Freshwater zones
1992	9.9	23.2
1997	5.4	11.7
2002	1.9	4.4

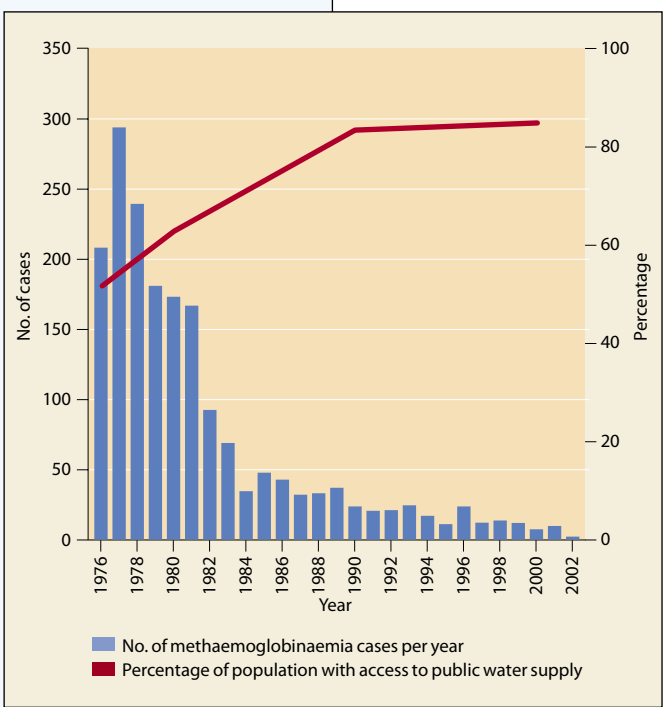
Source: European Commission (*5*).

Box 6.2.
Case study: impact of interventions on exposure to nitrates in Hungary

Nitrates in drinking-water are of concern because high nitrate concentrations are associated with methaemoglobinaemia (blue baby syndrome) which, in some cases, can be fatal. The syndrome has historically been endemic in Hungary. Effective interventions, however, including extending the public water supply to improve drinking-water quality and health service management measures, have resulted in a significant reduction in methaemoglobinaemia in Hungary.

A network of district nurses devoted to the prevention of methaemoglobinaemia was established by the Ministry of Health in 1967. The nurses make home visits to all pregnant women and the source of drinking-water is investigated. If the water is found to be unsuitable for feeding babies (i.e. the nitrate concentration is >40 mg/l), bottled water is provided for the preparation of infant feed until the child is 2 years old. Advice is also given to the mother on how to avoid the use of any unknown water for baby feeding.

Connection to the public water supply has been expanded from under 25% of the population in 1960 to 85% in 2000. As from the beginning of the 1990s, more than 97% of the population in Hungary is supplied with water complying with the limit value for nitrate (<50 mg/l).



Source: National Institute of Environmental Health, Budapest.

Box 6.3
Highlights of the Protocol on Water and Health and the Water Framework Directive

The **Protocol on Water and Health** to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (*3*) is the first major international legal approach to the prevention, control and reduction of water-related diseases in Europe. The Protocol was adopted on 17 June 1999 at the Third Ministerial Conference on Environment and Health and was signed by 36 countries. By adopting the Protocol, the signatories agreed to take all appropriate measures towards achieving:

- adequate supplies of wholesome drinking-water;
- adequate sanitation of a standard that sufficiently protects human health and the environment;
- effective protection of water resources used as sources of drinking-water, and their related water ecosystems, from pollution from other causes;
- adequate safeguards for human health against water-related diseases; and
- effective systems for monitoring and responding to outbreaks or incidents of water-related diseases.

The Protocol also places great emphasis on the international aspects. In fact, implementation of the provisions of the Protocol and progress made in the control of water-related diseases can only be assessed and evaluated through standardized international databases and harmonized data collection structures.

The **Water Framework Directive** (*6*) offers the potential for integrating daughter Directives with public health significance, such as the Bathing Water Directive of October 2002. It expands the scope of water protection to all waters and sets clear objectives, based on the requirement that a "good status" must be achieved for all European waters by 2015 and that water use should be sustainable throughout Europe. The Directive represents an ambitious and innovative approach to water management. Key elements of the legislation include:

- the protection of all waters – rivers, lakes, coastal waters and groundwater;
- the setting of ambitious objectives to ensure that all waters meet "good status" by 2015;
- the requirement of cross-border cooperation between countries and all involved parties;
- ensuring the active participation of all stakeholders, including nongovernmental organizations and local communities, in water management activities;
- the requirement of water pricing policies and ensuring that the polluter pays; and
- balancing the interests of the environment with those who depend on it.

REFERENCES

1. *Water, sanitation and health electronic library: a compendium of WHO information on water, sanitation and health [electronic resource]*. Geneva, World Health Organization, 2003.
2. *Water and health in Europe: a joint report from the European Environment Agency and the WHO Regional Office from Europe*. Copenhagen, WHO Regional Office for Europe, 2002 (WHO Regional Publications, European Series, No. 93).
3. *The Protocol on Water and Health: what it is, why it matters*. Copenhagen, WHO Regional Office for Europe, 2002 (http://www.euro.who.int/document/wsn/watprot/index.html).
4. *Europe's environment: the third assessment*. Copenhagen, European Environment Agency, 2003 (Environmental Assessment Report No. 10).
5. *Bathing water quality. Annual report, 2002 bathing season, Europe*. Brussels, European Commission, 2002 (http://europa.eu.int/water/water-bathing/report.html).
6. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. *Official Journal of the European Communities*, 2000, L 327:0001–0073 (http://europa.eu.int/comm/environment/water/water-framework/index_en.html).

7. CONCLUSION

Indicators are one central element of EHIS. To be policy-relevant, indicators must be based on evidence that links environmental quality and human health. There is also a need to analyse and assess the impact of environment and health policies by monitoring changes in population exposure and related effects associated with these actions.

Indicators are powerful communication tools for policy-makers, experts and the general public. When integrated with the policy-making process, they can demonstrate the effectiveness of environment and health policies, thus facilitating the setting of priorities among competing policies. They provide a strand of evidence to be used alongside epidemiological information to inform policy development at national and international levels in Europe.

This report is based on a pilot study to explore the usefulness and added value of tracking environmental public health by applying a core set of indicators. A special focus was the potential of EHIS as a tool for EH decision-making throughout Europe. The participating Member States collected and reported data on the core indicators covering ten thematic areas. Of these areas, four (air pollution, noise, transport accidents, and water and sanitation) were selected for the report. The lessons learnt from the pilot study on applying indicators in policy-oriented reporting are as follows.

7.1 FEASIBILITY

The core set of indicators was chosen to minimize the additional burden of collecting and reporting data within the Member States. The experience in this pilot study suggests that regular indicator-based reporting of the proposed core set will not entail additional costs, because the suggested indicators will utilize the existing data sources. Nevertheless, a certain level of commitment by national policy-makers, administrators and experts will be essential in refocusing existing resources on the implementation of this system. Continued technical support from international agencies such as the Regional Office and EEA will be needed to enhance coordination and harmonization of the data collecting systems.

7.2 USEFULNESS AND ADDED VALUE

- **Indicators provide evidence for the potential benefits of policies**

By generating information on various points in the causal chain framework, such as on environmental risk factors and health effects, their determinants and the actions taken, the indicators shed light on the potential impact of environment and health policy on the health of the population. Analysis of the indicators across

time (years) and space (countries) facilitates assessment of the potential health and environmental benefits of policies in Member States.

Example 1. German ecological taxation, introduced in 1999 as an addition to the price of petrol and other energy sources, resulted in a noticeable reduction in passenger-kilometres travelled by car and population exposure to airborne particles. Reduction in PM_{10} exposure may have reduced associated mortality and morbidity, indicating the policy's potential benefit to health.

Example 2. In countries where the minimum legal age for buying alcohol is higher and random breath testing more frequent, there was a markedly lower injury rate from traffic accidents. Increasing the legal age for purchasing alcohol from 16 to 18 years could reduce injuries to one sixth of present values (from 501.6 to 84.7 per 100 000 population). Introducing frequent breath testing could reduce injuries to approximately a quarter (from 318.0 to 84.7 per 100 000 population) if the minimum age for buying alcohol was 16 years. The combination of both measures achieves the most beneficial impact.

- **Indicators support priority-setting for policy-makers**

Policy-makers need to set priorities in the area of environment and health to maximize the benefits of limited resources. Thus, by providing comparative information, feasible policy interventions can be prioritized based on the best evidence.

Example 1. In the CCEE, the policy-makers may place higher priority on preventing deaths due to transport accidents.

Example 2. In the period 1996–2000 there were 480 outbreaks of waterborne disease affecting 63 949 people in 6 European countries with a total population of about 92 million. According to epidemiological studies, the true incidence of gastrointestinal diseases could be much greater than these figures. The magnitude of the problem presented here demonstrates that public supplies of safe drinking-water should remain a high priority among environment and health policies in Europe.

- **Indicators identify examples of good practice**

This pilot study uncovered several examples of good practice among participating countries in terms of the effectiveness and efficacy of environment and health policies. If the suggested indicator system is implemented in all European Member States, success stories will be documented and examples of good practice shared among the countries. Several examples of good practice were identified.

- Banning coal sales in Dublin led to clear reductions in air pollution and mortality.
- Ecological taxation in Germany reduced exposure to PM_{10}.
- Noise reduction policy in the Netherlands reduced exposure to road noise despite a doubling of traffic volume.

– The Bathing Water Directive resulted in significant improvements in recreational water quality in the EU over the period 1992–2002.

- **Indicators help monitor general progress**

The indicators provide a uniform approach to tracking progress in environment and health status by monitoring time trends in individual countries or in a group of countries. If EHIS is implemented in all Member States of the European Region, the indicators will monitor general progress in the environment and health in Europe. This is a very important added value if the countries and international agencies are to introduce collaborative policies on environment and health in the near future.

Example 1. Although particulate emissions from energy and industry are generally decreasing, those from transport are generally increasing. A serious effort to reduce transport-related air pollution is needed in Europe.

Example 2. The proportion of the population with access to piped drinking-water is high in the western European countries. However, access to piped regulated drinking-water in the eastern part of the Region needs considerable improvement.

- **Indicators facilitate international comparisons**

One of the most straightforward uses of the indicators for both policy-makers and the public is intercountry comparisons. For instance, according to the figures Armenia, the Netherlands and the United Kingdom are among the countries with the lowest age-standardized mortality from traffic accidents. Comparative analyses should take account of country differences in respect of data collection methods and surveillance systems.

- **Indicators are flexible for use in the national context**

Countries will be able to select indicators based on policy needs, feasibility and scientific rationale. Even in the absence of a relevant policy, indicators may be combined with other evidence to describe the potential for interventions and improvements in public health practices, including surveillance programmes.

Example 1. Several countries, i.e. Belgium, Finland, Hungary, the Netherlands, Poland, Sweden and Switzerland, reported experience in EH assessment in the context of the NEHAPs process. Most of them viewed the indicators as useful for the evaluation and monitoring of NEHAPs.

Example 2. The process of implementing indicators for the first time was useful in highlighting required environment and health data issues, particularly in countries with limited resources.

7.3 FUTURE DEVELOPMENTS

Environmental information derived from obligations to report contained within existing legislation has mostly concerned compliance rather than policy-making. For instance, the reported number of days during which air quality targets are violated is of limited use for health-relevant assessments. When available information on the state of the environment is related to causes and effects through the appropriate methodology, environment and health indicators can evaluate potential health benefits from policies to reduce environmental pollution. Establishing, maintaining and facilitating access to such databases should therefore be further advanced through EHIS.

The value of EHIS would be optimized if data collection and processing were harmonized to improve comparability among countries. The preparation of periodical "indicator-based" reports could add to the harmonization of data collection by highlighting any lack of comparability in indicators. Nevertheless, because of the variety of political, economic, social, historical and cultural conditions among the Member States, it would be impractical to demand full comparability among all countries. When the indicators are used for monitoring, the consistency of data systems within an individual country might be more important than comparability between countries. The best solution for Member States and international agencies is collaboration and joint efforts to find pragmatic ways for the step-by-step implementation of EHIS throughout Europe.

ANNEX 1.
OVERALL FEASIBILITY RATING OF CORE INDICATORS*

COUNTRY	DATA AVAILABILITY AND INTERPRETABILITY												COMMENT
	Air pollution	Chemical accidents	Food safety	Housing	Noise	Radiation	Traffic accidents	Waste/contaminated land	Water-related health risks	Work/occupational health	FACT SHEET	REPORT AND ACTION PLAN	
Albania	Partly	Impossible	Partly		Impossible		Partly	Partly	Partly		Impossible		No resources; strengthening advocacy on political level
Armenia	Partly	Impossible	Partly	Partly	Partly	Partly	Partly	Partly	Good	Partly		Impossible	No resources; data do not correspond to definitions
Bulgaria	Partly	Partly	Partly	Good	Impossible	Good	Good	Partly	Partly	Good	Partly		
Czech Republic	Good	Partly	Partly	Good	Impossible	Good	Good	Partly	Partly	Good	Partly	Impossible	Resources: nine months per year; one state public health staff member
Estonia	Partly	Impossible	Good	Good	Impossible	Good	Good	Partly	Partly	Partly	Impossible	Impossible	
Finland	Partly	Partly	Partly	Good	Partly	Partly	Good	Partly	Good	Good	Impossible	Impossible	No resources
Germany	Good	Good	Partly	Good	Partly	Good	Good	Partly	Partly	Partly	Partly	Partly	Project-based funding (until December 2003); improve coordination between WHO, EEA and EC
Hungary	Good	Impossible	Impossible	Partly	Impossible	Good	Good	Partly	Partly	Good	Partly	Partly	
Lithuania	Partly	Partly	Partly	Partly	Impossible	Good	Good	Partly	Partly	Good	Partly	Partly	Resources: nine months per year; one state public health centre staff member
Netherlands	Good	Good	Partly	Partly	Good	Good	Good	Partly	Partly		Partly		
Romania	Partly	Impossible	Partly	Good	Partly	Good	Good	Partly	Partly	Good	Partly		
Slovakia	Partly	Partly	Good	Partly	Impossible	Good	Good	Partly	Partly	Good	Partly	Impossible	
Spain	Good	Partly	Partly	Partly	Impossible	Partly	Good	Partly	Good	Good	Good	Partly	
Sweden	Good	Good	Partly	Good	Good	Good	Good	Good	Good	Good			
Switzerland	Good	Impossible	Partly	Partly	Impossible	Partly	Good	Partly	Partly	Partly	Partly	Partly	Only project-based funding

Good Partly Impossible

* Prepared at the WHO Working Groups Meeting in Bonn, 16-17 October 2003

ANNEX 2.
SOFTWARE TOOLS: EUROINDY AND ENHIS

The present version of the software has been developed to support the pilot study. Experience gained with the processing, exchange and analysis of environmental and health data will be used in the further development of the infrastructure of the shared information system.

EuroIndy

The EH indicators tool, tentatively known as EuroIndy, is specialized software that enables the user to establish a database system on key EH statistics. EuroIndy is a necessary tool in setting up a harmonized data exchange system on health and the environment with multiple data providers at national and international levels.

A very important function of EuroIndy is the data exchange facility. A characteristic of EH information is that it is divided among different bodies and agencies and the pattern varies from one country to the other. The software has the necessary ability to import and export data easily (Fig. A2.1).

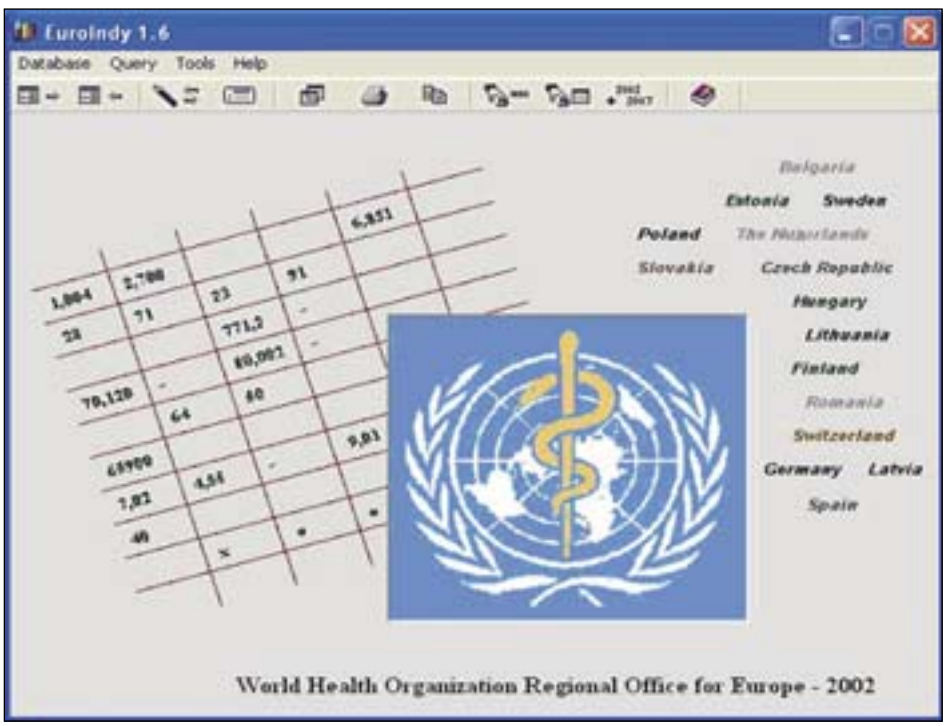


Fig. A2.1. EuroIndy software

Data are entered into a user-friendly data entry form field by field, or are tabulated and stored in a standard database structure. The user is asked for meta-data related to the data collection systems quality and comparability. The software also calculates the indicators and presents them as tables or simple graphs to illustrate trends over time.

The EuroIndy software allows users to integrate relevant data from existing environmental monitoring networks and health information systems at different geographical scales in a uniform way. It uses the Nomenclature of Territorial Units for Statistics (NUTS) classification system (for more details see http://europa.eu.int/comm/eurostat/ramon/nuts/home_regions_en.html).

EuroIndy contains as a default the three NUTS levels (1, 2 and 3) and also a level "0" for the country as a whole. For those countries for which NUTS level "1" is the national level, EuroIndy will contain two subnational administrative levels. All the names of the administrative levels as well as of the administrative units are kept in the original language. Ambient air quality data are gathered from monitoring networks in urban agglomerations. EuroIndy considers only cities with populations over 100 000.

EuroIndy can be consulted at http://www.antsz.hu/oki/euroindy.html.

ENHIS: Environmental health indicators on the web

ENHIS is a prototype web tool for organizing and publishing the EH indicators. It enables countries to "map" the indicators, which provide comparable informa-

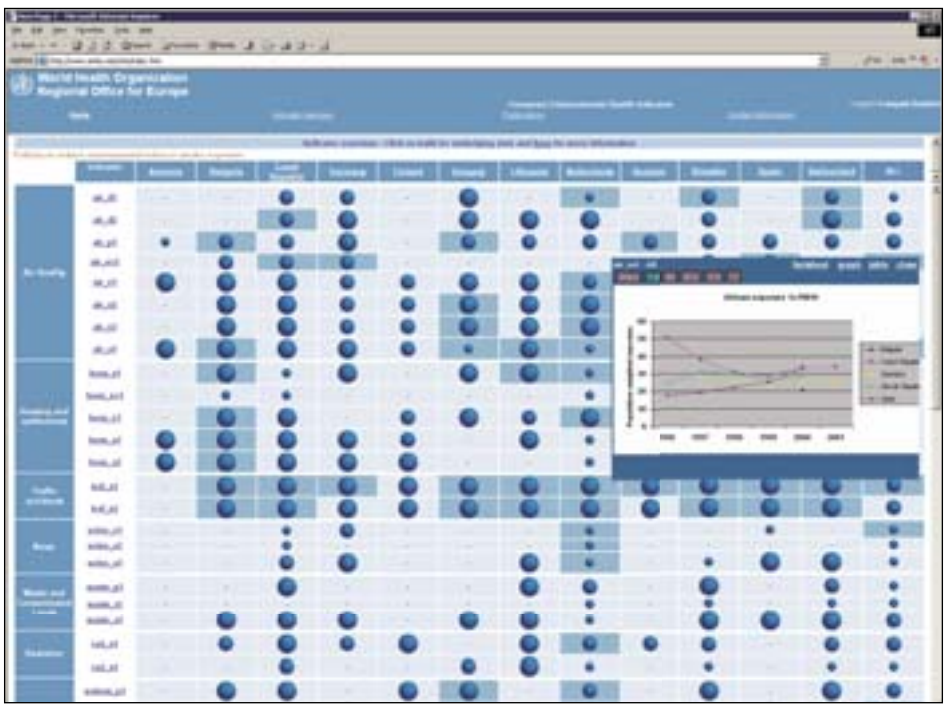


Fig. A2.2. ENHIS web site: overview of the EH indicators in participating countries

tion over the ten EH issues, as well as helping the preparation and optimization of national reporting. The web application provides an up-to-date representation of the core EH indicator set available in the pilot countries. With further development it can serve as an important vehicle for information exchange, dissemination of results and communication to the public.

The indicators are published for each individual country or across all countries. The information is structured in several "levels of detail". These include indicator trends over the last 5–8 years by country or across all countries, as well as the indicator fact sheet, i.e. the associated assessment and policy information. The national and international fact sheets use the same format (see Annex 3 for an example) and constitute the main reporting tool of EHIS. Each indicator is assigned a code and a summary of the methodology, i.e. underlying definitions and computation are available on-line. In addition, countries provide "remarks" on differences in national data systems from the WHO proposed methodology.

The indicator overview web page is shown in Fig. A2.2. The size of the circles indicates the availability of data for every indicator for a given country and for all countries together. The blue rectangles indicate the availability of fact sheets. When clicking on one of these circles, the underlying data is presented in graphs and tables, and links are provided to the relevant fact sheets. This provides a general overview of data availability, while in-depth information is only one click away! The ENHIS web is at http://www.enhis.net.

ANNEX 3.
EXAMPLE OF A FACT SHEET

WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR EUROPE
WELTGESUNDHEITSORGANISATION
REGIONALBURO FÜR EUROPA

ORGANISATION MONDIALE DE LA SANTÉ
BUREAU REGIONAL DE L'EUROPE
ВСЕМИРНАЯ ОРГАНИЗАЦИЯ ЗДРАВООХРАНЕНИЯ
ЕВРОЙСКОЕ РЕГИОНАЛЬНОЕ БЮРО

BONN OFFICE

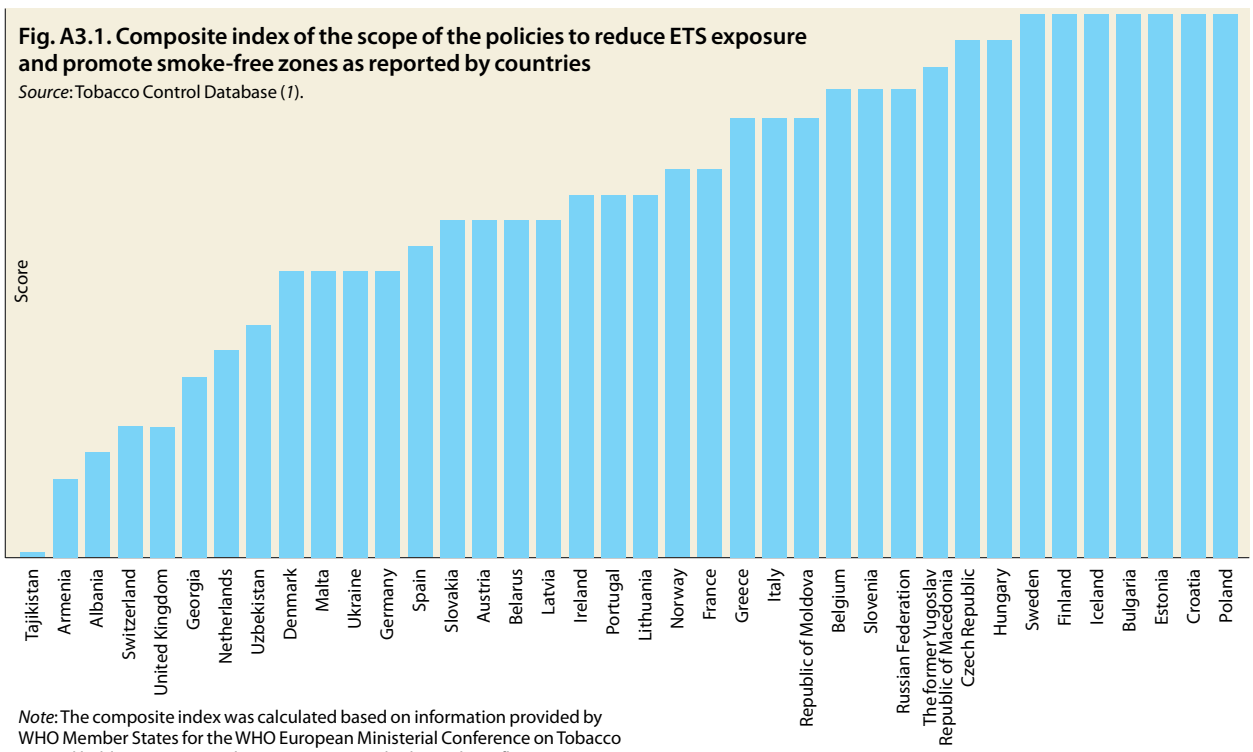
EUROPEAN CENTRE FOR ENVIRONMENT AND HEALTH

Policies to reduce environmental tobacco smoke exposure

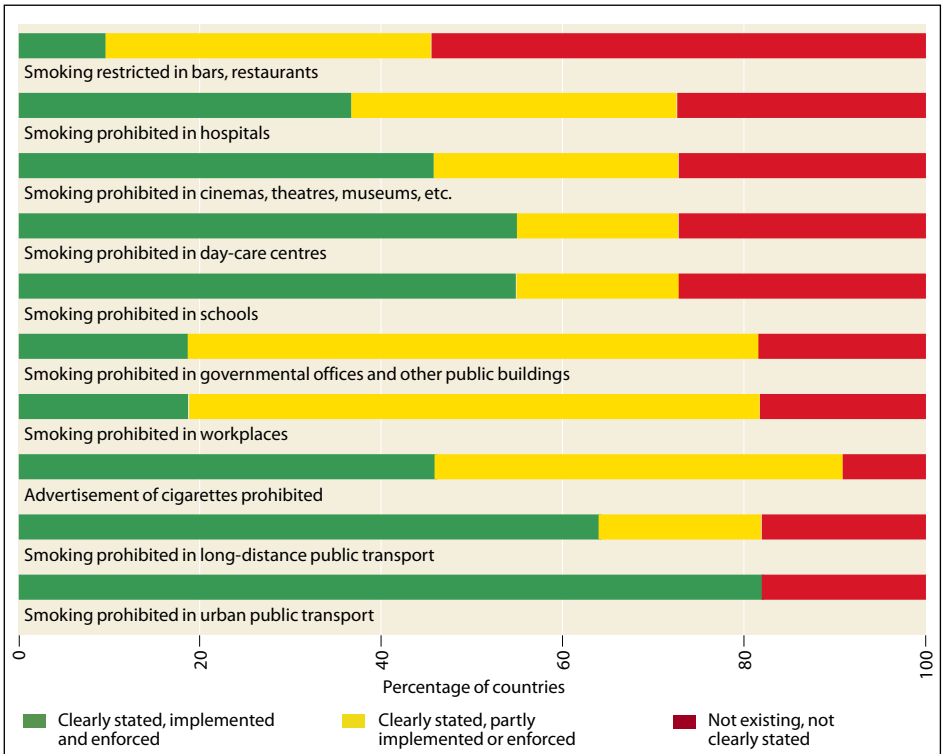
Implementation of policies to reduce exposure to environmental tobacco smoke in the public indoor environment varies among European countries and is not sufficient. Further enforcement of comprehensive policies is needed in public places, especially the workplace, public buildings, restaurants and bars.

Fig. A3.1. Composite index of the scope of the policies to reduce ETS exposure and promote smoke-free zones as reported by countries

Source: Tobacco Control Database (*1*).



Note: The composite index was calculated based on information provided by WHO Member States for the WHO European Ministerial Conference on Tobacco Control held in Warsaw in February 2002 (*2,3*). A higher index reflects a more extensive scope and comprehensive policies in place.



Source: Indicator pilot project countries: Albania, Armenia, Bulgaria, Czech Republic, Finland, Germany, Hungary, Lithuania, the Netherlands, Poland, Romania, Slovakia, Spain and Switzerland (*4,5*).

Fig. A3.2. Degree of implementation of 10 ETS policy components in the pilot countries

RESULTS AND ASSESSMENTS

Environmental health context

Environmental tobacco smoke (ETS) is a complex indoor air pollutant composed of over 4000 gaseous and particulate chemicals and has a major impact on public health. Exposure to second-hand tobacco smoke occurs in the indoor environment in homes, workplaces, public places and vehicles. WHO's *Air quality guidelines for Europe* (*6*) concludes that exposure to ETS is hazardous for non-smokers exposed at typical environmental levels, and that the pattern of health effects is consistent with those observed in active smokers.

ETS is a known **human carcinogen**. A causal relationship is well established with lung cancer, and most probably with the cancer of the nasal sinus. Some 9–13% of all cancers can be attributed to ETS in a non-smoking population of whom 50% are exposed to ETS (*6*).

Second-hand tobacco smoke also increases the risk of morbidity and mortality from **cardiovascular diseases** in non-smokers, especially in the case of chronic exposure. The burden of ETS-related heart disease might be an order of magnitude larger than that from lung cancer.

ETS also causes **irritation** of the eyes, nose, throat and lungs, leading to coughing, excess phlegm, chest discomfort and reduced lung function. For the majority of non-smokers, ETS is a source of annoyance and discomfort.

Exposure to ETS at home continues to be a public health concern, especially for **vulnerable groups** such as infants, young children and the elderly.

Children whose parents smoke are among the most seriously affected by exposure to second-hand smoke, being at increased risk of lower respiratory tract infections such as pneumonia, bronchitis and middle-ear infection. Some 15–26% of lower respiratory illness in infants is estimated to be attributable to ETS exposure, assuming that 35% of mothers smoke at home. In asthmatic children, ETS increases the severity and frequency of asthma attacks (*6*). Smoking by parents exposes children as early as the prenatal and neonatal period. Both active smoking by mothers and ETS increase the risk of low birth weight. ETS is also associated with the sudden infant death syndrome.

Policy relevance

This indicator provides a general measure of the capacity to implement policies to reduce exposure to ETS and to promote smoke-free areas in WHO European Member States. The framework for national tobacco control policies aiming at a reduction of ETS exposure is set by legislative measures to prohibit or restrict smoking in indoor public places, as well as by normative acts regulating the advertising of tobacco products.

On the European scale, Member States have adopted a European Strategy for Tobacco Control, based on the recommendations of the Ministerial Conference for a Tobacco-free Europe (*2,7*). The Strategy provides the framework and guidance for national action and for international cooperation aiming to promote and facilitate the adoption of comprehensive, evidence-based tobacco control policies reflected in national action plans and legislation (*7*).

The structure and content of the Strategy are consistent with the recently endorsed WHO Framework Convention on Tobacco Control, whose objective it is to protect present and future generations from the devastating consequences of tobacco consumption and exposure to tobacco smoke (*8*). In signing the Convention, countries express their political support and good faith to abide by its principles.

The environmental tobacco smoke component of the European Strategy on Tobacco Control will be reviewed at the Fourth Ministerial Conference on Environment and Health, in Budapest in June 2004, where the specific strategy targets to be achieved in the WHO European Region by 2007 will be set.

Policy context

Policies to restrict smoking in the public indoor environment and prohibit tobacco advertisement are implemented in Member States within national tobacco control action plans, public health programmes and national environment and health action plans (NEHAPs) (*4*).

Regulatory approaches towards ETS policies in specific public indoor environments vary among European countries. Most of the policy instruments are based on national legislation, while some are based on executive orders or other regulations at subnational level, especially in countries with a federal structure. In Germany, workplace smoking regulations are set out in federal law, while many other aspects are the competence of the federal states or even the local authorities (*4*). In Switzerland, smoking restrictions in educational and health care facilities, government offices and other public buildings are based mainly on voluntary agreements at cantonal level (*4*).

Protection of non-smokers in **the workplace** is subject to national laws in all Member States. Current laws in principle guarantee the right to a smoke-free workplace for most employees while failing to protect others, including some office workers and employees in bars and restaurants (*2,7*).

As recognized in the WHO Framework Convention, there are no effective **reporting mechanisms** for assessing the implementation and effectiveness of policies on ETS. The quality and methodology of existing surveys are not sufficiently reliable to interpret and monitor the dynamics of tobacco use. European countries lack suitable reporting mechanisms and surveillance systems. A harmonized and reliable monitoring system is needed to allow the evaluation of ETS-related policies within and across countries and to facilitate exchange of comprehensive information. At present, in the EU countries, the implementation of legislation and other effective measures to limit exposure to ETS is not subject to mandatory reporting (*8*).

Under the WHO Framework Convention, countries will work with WHO and other international and intergovernmental organizations towards establishing national surveillance systems, and cooperate with WHO in the development of guidelines for defining the collection, analysis and dissemination of tobacco-related surveillance data (*9*).

Assessment

As assessed for the WHO European Ministerial Conference on Tobacco free Europe (*2,7,10*) almost 80% of the Member States have bans or restrictions on smoking in public places and workplaces, although the degree of implementation varies widely. Tobacco control policies lack sustainability and comprehensiveness and are not high on the policy agenda in many European

countries. In addition, insufficient coordination and inadequate funding and monitoring reduce the effectiveness of national action.

A lack of harmonized tools to assess policy effectiveness affects the comparability of information on the implementation of ETS policies in different countries. Data collection and reporting methods are not consistent among countries, and harmonized assessment instruments are needed.

Most consistently, European countries report satisfactory implementation of ETS-related policies in **public transport**, especially in urban settings.

Much effort is still needed to strengthen policies to protect employees and customers from ETS in **bars and restaurants**; the lowest policy coverage is reported for this indoor environment. More than half of the reporting countries have no regulations in this respect. Simple measures, such as designation of non-smoking areas, or even separating smokers and non-smokers within the same space, may reduce (though not eliminate) involuntary exposure. Efforts to improve policy implementation pertain to the need to protecting both customers, including minors, and employees, who are excluded from ETS workplace regulations in many countries. As levels of exposure in bars and restaurants are much higher than in other occupational settings, the development of effective policy instruments to ensure a smoke-free workplace should be further promoted (*4*). A recent survey of the owners and employees of bars and restaurants in five European countries indicate that most of them (78%) are aware of the health risks of ETS exposure. A similar number agree that smoke-free areas protect the health of customers and workers, while at the same time responding to public demand (*11*).

All but 2 of the 14 Member States considered have legal instruments to protect non-smokers from ETS in **the workplace**. These policies can reduce ETS exposure of workers provided they are effectively implemented. As for now, ETS remains common in the workplace in many European countries, and is strongly influenced by the type of smoking policy and the level of enforcement. An unsatisfactory level of policy implementation is consistent with the reported high proportion of annoyance and exposure to ETS in the workplace. According to a recent survey in Lithuania (*4*), 17% of adults are exposed to ETS for more than five hours daily, and only one third have never been exposed to ETS at work. In Switzerland, almost one quarter of working respondents reported being annoyed by ETS at the workplace, although this had decreased from 35% in 1990. In 1996, 50% of participants in a Swiss study claimed to be confronted with conflicts at work owing to ETS (*4*). In Germany, exposure to ETS is widespread at the workplace, in restaurants and during social occasions. About three million employees are regularly exposed to ETS at their place of work, the extent of exposure depending on the type of workplace. Half of the non-smoking employees and trainees in Germany are

exposed to ETS in occupational settings (*4*). A review of the major European studies shows that the proportion of adults exposed regularly to ETS at the workplace exceeds 10% in most Member States, and may be as high as 50% (*12*).

Efforts must be continued to strengthen the enforcement of existing policy instruments aiming at completely smoke-free workplaces. Restrictive measures, such as the designation of specific areas or improved ventilation, are not sufficient to ensure smoke-free air. Policies to prevent exposure to second-hand smoke at work should ultimately apply to all indoor places of employment.

Less than 40% of the reporting countries claim full implementation of a smoking ban in **hospitals**. The legal measures to prohibit smoking in **theatres and museums** are assessed as fully implemented in less than half of participating Member States. Almost one third of them have no policies for these indoor settings.

It is worth noting that, even though most of the countries have regulations on smoking restrictions in **governmental offices and public buildings**, only 20% report full policy implementation. Such levels of implementation can reflect insufficient coordination and enforcement in many countries. In Switzerland, 37% of participants in a survey reported to be at least sometimes annoyed by ETS in public buildings and places such as cinema foyers (*4*).

More than half of the 14 countries declare full implementation of ETS policies in **day care centres and schools**; in almost 30% there are no policies for public settings where children stay.

Regulatory measures, such as eliminating smoking in schools, day cares and public places, do not address the **main source of child exposure** to ETS – the home. As legislation to ban smoking at home is unlikely, other initiatives must be put in place. Specific interventions to reduce the exposure of children and young people to ETS should be the well defined objectives of national and international initiatives focusing on children's health and the environment.

Efforts are needed **to educate and raise awareness on the particular vulnerability of children** to ETS, including during the prenatal period. Targeted interventions should address the age-related differences in ETS exposure conditions: for infants and young children parental smoking at home is the main source of exposure, while for older children and adolescents other settings, including schools and certain public places (clubs, shops, discos, etc.) may significantly contribute to their exposure to ETS. In Switzerland, in 2000, two thirds of study participants with children in the household reported restricting smoking to certain parts of the home, and 18% stated that they only smoked outside. On the other hand, the study revealed that around 50% of

schoolchildren in 2000 were still exposed to ETS at home, a figure that had not changed significantly over the previous 10 years. In 1999, 15% of pregnant women were smoking (*4*).

Policy efforts are needed to target the gender, age and socioeconomically related risk groups for exposure to ETS. For example, in Germany, the proportion of smokers among female single parents is twice as high (45.8%) as in a reference group (23.6%) and exposure of children to ETS is related to socioeconomic status of the household. In over 36% of families of low socioeconomic status with small children there is more that one smoker, compared with 16% in higher socioeconomic groups (*4*).

Regulations on the **advertisement of tobacco products** exist in all but one of the 14 countries. Nevertheless, in almost 55% of the countries they are not sufficiently enforced. In some countries advertising is prohibited, while in others, such as Germany and Switzerland, it is restricted. In Switzerland, two referenda on a complete ban on tobacco advertising (in 1979 and 1993) have already been rejected (*4*).

With policies to promote **a smoke-free public indoor environment** in place, the level of enforcement of existing legislation is still incomplete and exposure to ETS in European countries remains unacceptably high. As shown by the recent survey in Germany, a total of 55% of all non-smokers state that they are exposed to ETS (*4*). With an adult smoking prevalence of 30–50% in developed societies, an estimated 50% or more of homes are occupied by at least one smoker, leading to a high prevalence of ETS exposure among children and other non-smokers. As shown in the review of the European studies, the average proportion of children exposed to second-hand smoke at home exceeds 40% (*4,10,12*).

REFERENCES

1. WHO Tobacco Control Database (http://data.euro.who.int/tobacco, accessed 22 March 2004).
2. *The European report on tobacco control policy. Review of implementation of the Third Action Plan for a Tobacco-free Europe 1997–2001*. Copenhagen, WHO Regional Office for Europe, 2002 (document EUR/01/5020906/8) (http://www.euro.who.int/Document/E74573.pdf, accessed 29 March 2004).
3. *Warsaw Declaration for a Tobacco-free Europe, 2002* (http://www.euro.who.int/eprise/main/WHO/AboutWHO/Policy/20020422_1, accessed 26 March 2004).
4. National fact sheets from Albania, Armenia, Bulgaria, Germany, Lithuania, Netherlands, Poland, Romania, Slovakia, Spain and Switzerland.
5. *Environmental health indicators for the WHO European Region: update of methodology May 2002*. Copenhagen, WHO Regional Office for Europe, 2002 (document EUR/02/5039762) (http://www.who.dk/document/E76979.pdf, accessed 22 March 2004).
6. *Air quality guidelines for Europe*. Copenhagen, WHO Regional Office for Europe, 2000 (WHO Regional Publications, European Series, No. 91) (http://www.euro.who.int/air, accessed 23 March 2004).
7. *European Strategy for Tobacco Control*. Copenhagen, WHO Regional Office for Europe, 2002 (document EUR/02/5041354 (http://www.euro.who.int/document/e77976.pdf, accessed 23 March 2004).
8. Council Recommendation of 2 December 2002 on the prevention of smoking and on initiatives to improve tobacco control (2003/54/EC). *Official Journal of the European Communities*, 2002, L 22/31.
9. *WHO Framework Convention on Tobacco Control* (http://www.who.int/tobacco/fctc/text/en/fctc_en.pdf, accessed 23 March 2004).
10. *Policies to reduce exposure to environmental tobacco smoke*. Copenhagen, WHO Regional Office for Europe, 2002 (document EUR/00/5020495) (http://www.euro.who.int/document/e70610.pdf, accessed 23 March 2004).
11. Watson R. Smoke free areas do not harm profits, survey shows. *British Medical Journal*, 2003, 326:1232.
12. *Exposure to environmental tobacco smoke in Europe: a review*. Technical Report, WHO European Centre for Environment and Health, Bonn (unpublished).

META-DATA

Data source
Environmental Health Indicators project – pilot data collection (data available in the project database - EuroIndy).
Pilot national indicator fact sheets.
WHO Tobacco Control Database: http://cisid.who.dk/tobacco.

Description of data
Temporal coverage and frequency of data collection/update: most recent data provided – current regulations.

Quality of information
Qualitative assessment of the extent of application and enforcement of regulations to reduce ETS exposure. Evaluation made by common observations and expert judgement. No harmonized evaluation methods; possible subjective judgement.

Data strengths and weaknesses
Legal regulations to implement policies; possible subjective judgement.

The Environment and Health Information System (EHIS) is a valuable tool for monitoring and evaluating the implementation and modification of policies. The crucial element of a harmonized EHIS is a set of indicators that allows for the monitoring of public health and its determinants. This report is the product of a pilot study completed within the WHO process of developing a methodology for a pan-European EHIS. It illustrates the application of indicators for integrated public health assessment and reporting in four topic areas: air pollution, noise, transport accidents, and water and sanitation. The report provides an insight into effective methods for integrating information from environmental monitoring and health surveillance, using the scientific knowledge of exposure–response associations. These methods can both help in answering key questions on the effect of policies on health and the environment, and provide guidance on future policies and actions. The report also demonstrates the limitations of routinely collected data and outlines the need for strengthening cooperation between international agencies and the Member States.

World Health Organization
Regional Office for Europe

Scherfigsvej 8,
DK-2100 Copenhagen Ø,
Denmark

Tel.: +45 39 17 17 17
Fax: +45 39 17 18 18

E-mail: postmaster@euro.who.int
Web site: www.euro.who.int

E82938