



World Health Organization  
Regional Office for Europe  
Copenhagen



# Transport, environment and health

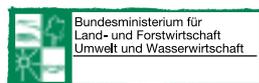
The World Health Organization was established in 1948 as a specialized agency of the United Nations serving as the directing and coordinating authority for international health matters and public health. One of WHO's constitutional functions is to provide objective and reliable information and advice in the field of human health, a responsibility that it fulfils in part through its publications programmes. Through its publications, the Organization seeks to support national health strategies and address the most pressing public health concerns.

The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health problems of the countries it serves. The European Region embraces some 870 million people living in an area stretching from Greenland in the north and the Mediterranean in the south to the Pacific shores of the Russian Federation. The European programme of WHO therefore concentrates both on the problems associated with industrial and post-industrial society and on those faced by the emerging democracies of central and eastern Europe and the former USSR.

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# Transport, environment and health

edited by  
Carlos Dora  
and  
Margaret Phillips



WHO Library Cataloguing in Publication Data

Transport, environment and health / edited by  
Carlos Dora and Margaret Phillips

(WHO regional publications. European series ; No. 89)

1.Environmental health 2.Transportation  
3.Environmental policy 4.Accidents, Traffic  
5.Vehicle emissions – adverse effects I.Dora, Carlos  
II.Phillips, Margaret III.Series

ISBN 92 890 1356 7 (NLM Classification: WA 810)  
ISSN 0378-2255

*Text editing:* Mary Stewart Burgher

*Design & layout:* Susanne Christensen, In-House

*Cover photo:* © Christina Piza Lopez

ISBN 92 890 1356 7  
ISSN 0378-2255

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PRINTED IN AUSTRIA

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# Acknowledgements

This review was prepared and produced with the support of the Regional Office for Europe of the United Nations Environmental Programme (UNEP), the European Environment Agency (EEA) and the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.

The WHO Regional Office for Europe thanks all countries, organizations and people that have supported and contributed to this work. In particular, WHO thanks the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, especially Robert Thaler, head of its Transport, Mobility, Regional Planning and Noise Division, for providing resources. Jutta Molterer, of the Ministry's Transport, Mobility, Regional Planning and Noise Division, and Maria Teresa Marchetti, of the Rome division of the WHO European Centre for Environment and Health, provided invaluable managerial and administrative support, and Francesca Racioppi, also of the Rome division, contributed to the revision of the manuscript. Thanks are also due to Professor John Adams, of the Geography Department, University College London, United Kingdom; Mr David Gee, of the Integrated Assessment Programme, European Environment Agency, Copenhagen, Denmark; and Professor John Whitelegg, Managing Director, Ecologica Ltd, United Kingdom.

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# Foreword

*Many countries in Europe are concerned with the numerous effects of transport policies on health, and governments want to ensure that these are addressed in the most effective and efficient way. Very good evidence shows that some transport policies bring benefits to health and the environment, while others are harmful. The challenge is to select the policies with the most overall benefits to society. The urgency of the need to respond to this challenge is vividly demonstrated by the massive increases in motor vehicle traffic and by the strong public reaction against the noise, air pollutants and congestion that make cities unliveable.*

*The countries of the WHO European Region came together to prepare a Charter on Transport, Environment and Health that identifies their concerns, defines health targets for transport policies and provides a plan of action to achieve them. In the negotiations, ministries of transport, of health and of the environment worked together for the first time to find a common language and to agree on collaborative actions. The Charter was adopted at the Third Ministerial Conference on Environment and Health in June 1999.*

*This book brings together the scientific evidence on the main effects of transport on human health and the environment. It sets the conceptual framework for future analyses of the health burden and health gains from transport policies. It outlines how these health concerns have been reflected in policy tools such as impact assess-*

*ment, regulation and economic analysis, and identifies the areas where action is most needed.*

*Discussions of the environment and health effects of transport need to be communicated in a way that is relevant for policy-makers and easily understood by non-scientists. That is the aim of this book, which summarizes the results of extensive reviews of the issues prepared by groups of prominent international experts. It is also planned to release the reviews themselves, to give a more detailed account of the scientific evidence.*

*The WHO Regional Office for Europe is grateful for the support of the Austrian Ministry of Agriculture, Forestry, Environment and Water Management, which brought the expert groups together, facilitated the production of the resulting publications and led the negotiations that resulted in the adoption of the Charter. The Regional Office is also thankful for the support and creative collaboration provided by the United Nations Environment Programme and the European Environment Agency.*

*This book makes an important contribution to stronger collaboration between health, transport and environment professionals and administrations. This should ultimately lead to the achievement of transport systems that are sustainable for health and the environment.*

Marc Danzon  
WHO Regional Director for Europe

# Foreword

*No sector is developing in such an unsustainable way as the transport sector. From 1970 to 1995, motor traffic in the European Union doubled, while the share of walking, cycling and public transport fell drastically. This trend is predicted to continue and gain further strength if business continues as usual.*

*WHO deals intensively with the negative consequences of transport on human health and environment and proposes measures for improvement. In the Charter on Transport, Environment and Health, WHO Member States have formulated a set of strategies to reduce environmental pollution and health risks. For the first time transport, environment and health have been dealt with in an integrated way. Austria has gladly followed the invitation of WHO and actively supported this new policy approach. The plan of action as a key element of the Charter is therefore a major milestone on the road towards making transport in Europe sustainable for environment and health.*

*A well founded basis for this approach was provided by the scientific substantiation documents, elaborated by expert teams for WHO. They were developed with the support of Austria and are now summarized in this book, which underlines the need to support and extend cooperation on transport, environment and health policies on the national and European levels.*

Wilhelm Molterer  
Austrian Federal Minister of Agriculture, Forestry,  
Environment and Water Management

# Introduction

Many countries in Europe face the apparently conflicting needs of transport policies. Transport facilitates access to jobs, education, markets, leisure and other services, and has a key role in the economy. On the other hand, concern is mounting about the detrimental impact on the environment of current transport policies, and many people question the policies' social sustainability.

In addition, the effects on human health of transport and land-use strategies are increasingly widely recognized. While injuries and annoyance from traffic noise have long been identified as important consequences of certain patterns of transport activities, evidence of a direct effect of air pollutants on mortality and respiratory and cardiovascular diseases has emerged only in the last few years. The wide range and seriousness of the anticipated health effects of climate change are increasingly evident. Further, sedentary lifestyle, one of the two most important risk factors for noncommunicable diseases and early mortality in populations in western countries, is associated with the use of motor vehicles. It is now acknowledged that strategies to address it require physical activity to accomplish daily chores, notably through walking and cycling for transport.

Each of these transport-related risks imposes a considerable burden on public health. Even if average death rates for road accidents have been gradually decreasing, traffic accidents still cause 120 000 deaths a year in the WHO European Region, a third of them in people under 25. There is an eightfold difference between the countries with the highest and lowest rates. In addition, current levels of air

pollutants in Europe are estimated to have a major impact on mortality, resulting in 40 000–130 000 deaths a year in urban adults. Most human exposure from air pollutants comes from traffic, and evidence is emerging of a direct link between respiratory problems and residence near busy roads, or roads with much heavy-vehicle traffic.



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Traffic threatens health.

Around 65% of the people in the Region are exposed to levels of noise leading to sleep disturbance, speech interference and annoyance, and road traffic provides most human exposure to noise.

So far, no one has quantified the impact of the restricted opportunities for cycling and walking brought about by cur-

rent policies on urban land-use planning and transport, but the effect of sedentary lifestyles on heart disease is similar to that of tobacco. Half the adult population in developed countries is sedentary or does minimal physical activity. One could therefore speculate that barriers to physical activity might have the greatest impact of all traffic-related health risks.

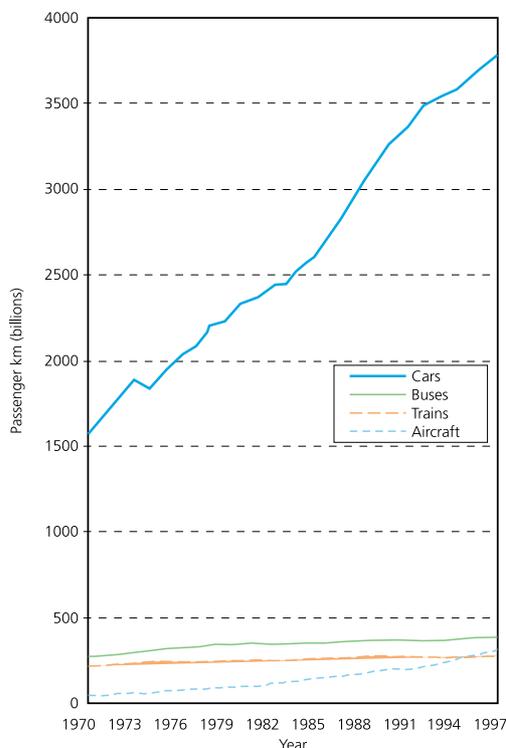
Attempts to assess the concomitant effects of several transport-related risks have been incomplete. For example, the calculations have not considered the health gains from strategies that increase walking and cycling.

Certain transport and land-use policies protect the environment and promote public health. These interactions need to be identified and emphasized; they are often overlooked. The effectiveness of interventions is often assessed on the basis of a single health

outcome. In view of the wide range of possible effects, some beneficial, some not, such narrow assessments may give misleading results. For example, some policies improve one health aspect to the detriment of another. Lowering speed limits may reduce accidents but increase pollution. The legal requirement for cyclists to use helmets in Australia reduced head injuries, but also reduced the number of cyclists to a point that net health losses are expected. Motorways are safer than smaller roads, but the high speed that they allow has a spillover effect, increasing risks on smaller roads.

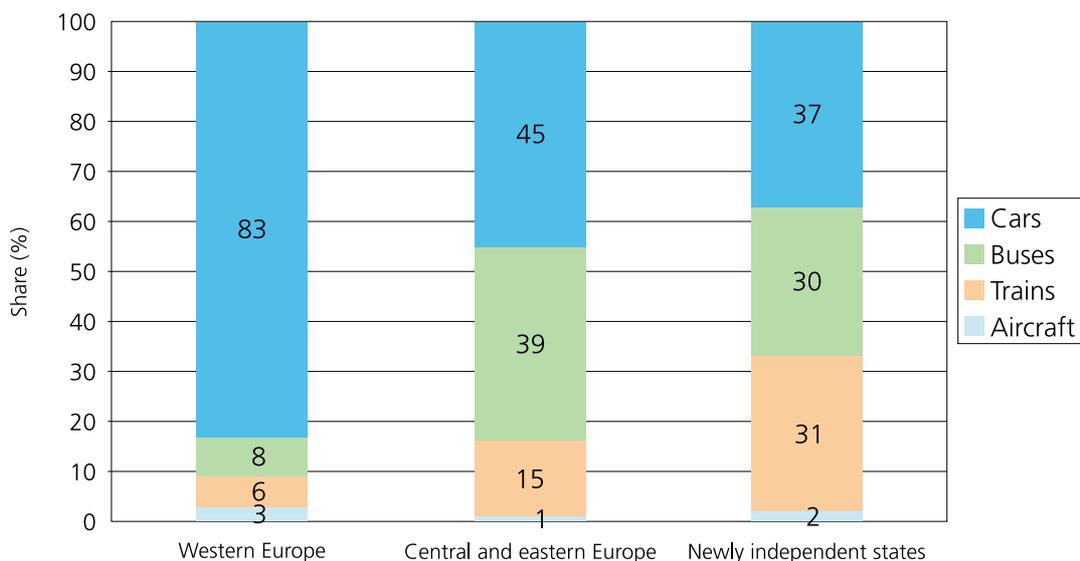
The continuing expansion of motorized transport in Europe today (Fig. 1) raises crucial questions about the efficiency and the environmental and social implications of land-use and transport policies (1). For example, in the countries of central and eastern Europe, public transport still satisfies a relatively large share of the transport demand (Fig. 2), but the sharp increase in the use of private cars raises concerns about the sustainability of transport systems in these countries (2,3). Health arguments are central to this debate, but these are often articu-

**Fig. 1. Increasing use of cars in Europe compared with other modes of transport, 1970-1997**



Source: *Europe's environment: the second assessment* (1).

**Fig. 2. Modes of passenger travel in Europe, 1995**



Source: *Transport in figures: site on transport data for the Member States* (2).

lated in very limited ways. Public policies, such as transport and land-use policies, clearly need assessment with a wide public health perspective.

The challenge is to promote healthy and sustainable transport alternatives to prevent the negative effects of transport systems on human health. An important way to do this is to ensure that health issues are clearly on the agenda when transport decisions are being made and policies formulated. One reason this has not always happened is that the analytical tools required have been unavailable, inadequate or poorly understood. Methodologies need to be developed, promoted and used to make integrated assessments, monitor progress, account fully for social and environmental costs and identify the strategies with the greatest net benefits. The integration of health, environment and other social concerns into transport policies requires high-level political commitment to intersectoral cooperation, and to a change in current strategies towards full consideration of the implications of transport policy for development, the environment and health.

This book contains some of the key facts that substantiate the political commitment and momentum

for action to support transport that is sustainable for health and the environment. This commitment is set out in the Charter on Transport, Environment and Health (Annex 1), adopted at the WHO Third Ministerial Conference on Environment and Health, in London in June 1999. The Charter includes quantitative health targets for transport systems for the WHO European Region, strategies to achieve them and mechanisms for monitoring progress.

A major purpose of this book is to alert policy analysts, decision-makers and politicians to current knowledge about the health effects of transport and the means to reduce them. It summarizes the latest scientific evidence on the impact of transport-induced air pollution, noise and accidents on physical health, barrier effects (changes in behaviour in reaction to transport risks) and effects on mental health. This book highlights the considerable potential health benefits from non-motorized forms of transport. It is based on extensive reviews commissioned for the London Conference, which include not only the reviews but also a historical analysis of transport-related health policies, case studies from European cities and a discussion of equity implications.

# 1. Transport noise: a pervasive and underestimated ambient stressor

Transportation is the main source of noise pollution in Europe, and road traffic, the major cause of human exposure to noise, except for people living near airports and railway lines. Ambient sound levels have steadily increased, as a result of the growing numbers of road trips and kilometres driven in motor vehicles, higher speeds in motor vehicles and the increased frequency of flying and use of larger aircraft. Noise is a problem in Europe; it is the only environmental factor for which complaints have increased since 1992 (4).

The scientific evidence on the health effects of noise is growing. After its first scientific review of this evidence in 1980, WHO convened an international task force that assessed new evidence (5) and set the basis for this summary and the WHO guidelines for community noise (6).

## The health effects of noise

Good evidence shows the adverse effects of noise on communication, school performance, sleep and temper, as well as cardiovascular effects and hearing impairment.

### Impaired communication

Speech is 100% intelligible with background noise levels at 45 dB LAeq. Above 55 dB LAeq background noise (the level of an average female voice) the voice has to be raised. Such background levels interfere with concentration and the raised voice becomes less



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Noise impairs communication.

intelligible. In classrooms and meeting rooms used by elderly people, hearing-impaired individuals or children (who are especially sensitive to the health impacts of noise), background noise should be 10 dB LAeq below that of the speaker.

### Disturbed sleep

Noise can cause difficulty in falling asleep, reduction in deep resting sleep, increased awakenings during sleep and adverse after effects such as fatigue and decreased performance. These effects are avoided if noise levels are kept below 30 dB LAeq continuous noise or 45 dB LAm<sub>ax</sub> indoors. (LAeq values refer to steady-state continuous noise. LAm<sub>ax</sub> values refer to noise events.)

### Difficulties with performance

Children chronically exposed to aircraft noise show impaired reading acquisition, attention and prob-

lem-solving ability. Noise can interfere with mental activities requiring attention, memory and ability to deal with complex analytical problems. Adaptation strategies, such as tuning out and ignoring noise, and the effort needed to maintain performance have been associated with high blood pressure and elevated levels of stress hormones.

### Annoyance

Annoyance response broadly increases with sound level, with most people being moderately annoyed at 50 dB LAeq and seriously annoyed at 55 dB LAeq (Fig. 3). Only one third of variation in annoyance is due to sound levels; a number of other factors affect the response to noise. The most annoying types of noise come from aircraft, have low-frequency components or are accompanied by vibration, and interfere with social and economic activity. In addition, geographic factors affect vulnerability to noise; in the Alps, for example, topography, background levels of noise and acoustic factors of the slopes all influence the effect of a given level of noise.

### Increased aggression

Loud noise increases aggressive behaviour in pre-disposed individuals, and levels above 80 dB LAeq reduce helping behaviour (people's willingness and availability to help others).

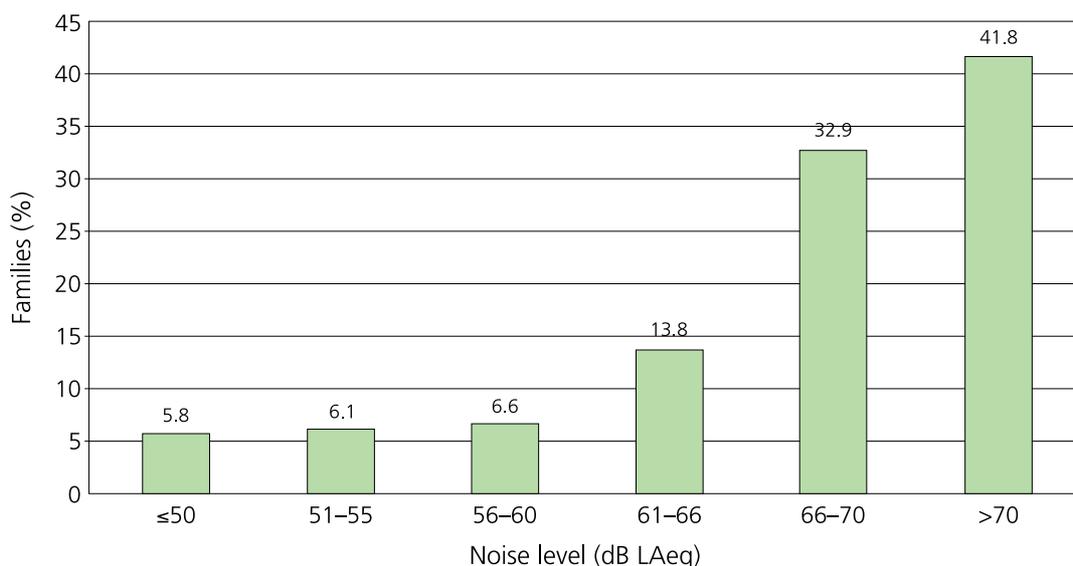
### Heart disease and hypertension

The increasing evidence on ischaemic heart disease and hypertension points to an effect of noise at around 65–70 dB LAeq. The effect is small but, since a large percentage of the population is exposed to such levels, it could be of great public health significance.

### Hearing impairment

Loud noise can cause hearing impairment, although the risk is considered negligible in the general population for noise levels below 70 dB LAeq over 24 hours over a period of 40 years.

**Fig. 3. Families severely annoyed by daytime noise in Basle, Switzerland, 1980s**



Source: *Lärm und Gesundheit*. Brig/Zürich, Ärztinnen und Ärzte für Umweltschutz, 1995.

## Guideline values and how Europe matches up

Since the environment, time of day and context influence the impact of noise, a variety of different guideline values for community noise exposure have been proposed (5); WHO values are summarized in Table 1.

A very high and increasing proportion of the population of the WHO European Region is exposed to unacceptable levels of noise. The proportion exposed to noise levels greater than 65 dB LAeq over 24 hours has risen from 15% in the 1980s to 26% in the 1990s (7). About 65% of the European population (450 million people) is exposed to sound levels (55–65 dB LAeq over 24 hours) that cause serious annoyance, speech interference and sleep disturbance (6,8).

Some Member States are already monitoring noise and setting limits on noise pollution in sensitive areas. The European Union (EU) is developing a framework directive for noise that takes account of the evidence on health impacts and the available technology.

The proposed WHO community noise guideline levels provide a useful intermediate target for countries. Adherence to these guidelines would give direction and focus to countries' efforts to address the important problem of traffic-induced noise.

## Intervention

### Emission control

Technological improvements, such as low-noise road surfaces and vehicles (particularly tyres on cars), have the potential to help manage the traffic noise problem. The technology is available and has been evaluated, but needs appropriate promotion, regulation and enforcement through, for example, the inclusion of spot and yearly testing of noise as part of tests of vehicle road worthiness, and taxes on noisy vehicles or aircraft. Controls on speed – through

the establishment and policing of speed limits and traffic-calming measures, for example – are another way to control noise emissions at source.

### Changing traffic

Unfortunately, reliance on emission control alone in the last few decades has not reduced sound levels. Instead, the growth and spread of traffic have offset these technological improvements (9,10), and road, air and rail traffic are all forecast to continue increasing. Reducing the overall amount of traffic or at least its growth is almost certainly necessary to control the health effects of noise emissions from traffic. This will be particularly important in populated areas located near zones of very heavy traffic, such as airports, highways, high-speed-train tracks and heavy-vehicle transit routes.

In addition, measures to alter the composition and timing of traffic (such as restrictions during nights and weekends, zoning and flight corridors) and its location in relation to people (such as the use of flyovers, tunnels, rerouting, green spaces and road barriers) can mitigate the impact of traffic noise. Who experiences the noise, and where and when are crucial in determining its health impact.

### Insulation

Further, the impact of noise can be modified through noise insulation in the construction and design of buildings. Examples include using particular types of windows and roofs and the locating of bedrooms at the rear of buildings, away from noise sources.

### Intervention effectiveness

Many of these approaches have been practised, though not systematically. With the exception of emission control technologies, they have rarely been evaluated. Evaluations should examine not just acoustically measured noise but also health out-

**Table 1. Guideline values for community noise in specific environments**

Environment	Critical health effect(s)	Time base	LAeq (dB)	LAm <sub>ax</sub> , fast (dB)
<b>Dwellings</b>				
Indoors	Speech intelligibility and moderate annoyance, daytime and evening	16 hours	35	–
Inside bedrooms	Sleep disturbance (night-time)	8 hours	30	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	8 hours	45	60
<b>Schools and preschools</b>				
Classrooms indoors	Disturbance of speech intelligibility, information extraction and message communication	During class	35	–
Preschool rooms indoors	Sleep disturbance	Sleeping time	30	45
Playground outdoors	Annoyance (external source)	During play	55	–
<b>Hospitals</b>				
Wards/Rooms indoors	Sleep disturbance (night-time)	8 hours	30	40
	Sleep disturbance (daytime and evenings)	16 hours	30	–
Treatment rooms indoors	Interference with rest and recovery		As low as possible	
<b>Other</b>				
Outdoor living area	Serious annoyance, daytime and evening	16 hours	55	–
	Moderate annoyance, daytime and evening	16 hours	50	–
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	24 hours	70	110
Ceremonies, festivals and entertainment events	Hearing impairment (from attending < 5 times/year)	4 hours	100	110
Public addresses, indoors and outdoors	Hearing impairment	1 hour	85	110
Music through headphones/earphones	Hearing impairment (free-field value)	1 hour	85	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	–	–	120 <sup>a</sup>
	Hearing impairment (children)	–	–	140 <sup>a</sup>
Outdoors in parkland and conservation areas	Disruption of tranquillity			Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low.

<sup>a</sup> Peak sound pressure (not LAm<sub>ax</sub>, fast), measured 100 mm from the ear.

Source: Berglund et al. (6).

comes. A rare example of such an approach is Bronzaf's study (11) of the effect of a noise abatement programme on reading ability. Acoustic meas-

ures are much easier to make, but interpreting their significance is difficult because their relationship to health is complex.

## Policy considerations

All measures taken to abate noise and reduce exposure and related health effects need to consider the following dimensions:

- specific environments where people function, such as schools, playgrounds, homes and hospitals, all of which have special and somewhat different requirements for noise limits that vary with time (night, weekends, holidays and evenings are particularly sensitive periods in some environments);
- environments with multiple noise sources or with conditions that amplify the effects of noise, which require land-use and transport planning to be carried out with special care; and
- groups at high risk of health effects from transport noise, such as children and people who are elderly, hearing impaired or ill.

Well directed research, monitoring and information dissemination are urgently needed to accompany action for traffic noise reduction. Substantial improvements are needed in knowledge of human exposure to noise in various environments: both the levels of noise and the effects of exposure on health.

Monitoring of human exposure needs to be routine and to use standard methods to facilitate compari-

sons. Sound levels should be available for dwellings, schools, hospitals, workplaces, playgrounds and parkland. Groups at higher risk of noise effects should be addressed specifically. Special attention should be given to monitoring populations exposed to more than one noise source. Night-time as well as daytime values should be measured. (At present, night-time levels of ambient noise are particularly poorly documented. There is a danger that proposed shifts of heavy volumes of freight or aircraft traffic to the night could produce considerable health effects that current monitoring procedures would not capture.)

Surveillance and periodic evaluations should be carried out of noise-related adverse health effects (such as reduced speech intelligibility, sleep disturbance and annoyance) in areas where these can be expected. The information gained should be used, in conjunction with noise exposure data, to assess the effectiveness of noise reduction measures.

Data on exposure and health effects should be made available in formats useful for policy-making. For example, maps to identify areas with greater exposure can be made; these can then be used in environmental health impact assessments to influence decisions on transport and land-use planning.

## 2. Transport accidents and injuries

### Levels, trends and risks

Society tolerates a disturbingly high level of risk from motorized transport. In 1995, around 2 million road traffic accidents with injuries were reported in the WHO European Region, resulting in about 120 000 people killed and 2.5 million injured; road traffic accidents were responsible for about 44 000 deaths and 1 500 000 casualties in the EU (12,13).

Road accidents account for the most significant share of all transport accidents, in terms both of the number of deaths and of death rates per kilometre travelled. In the EU, almost 50 times as many people die on the roads as in rail accidents (44 000 and 936 deaths, respectively, in 1995 (13)). This is only partly explained by the higher passenger kilometres (p-km) travelled by road: death rates are about three times higher for road than for rail transport (11.1 versus 3.4 deaths per 1 billion p-km) (13).

The number of deaths by air or sea travel is much lower. Air accidents involving scheduled flights world-wide resulted in a total of 916 fatalities in 1997, corresponding to 0.4 fatalities per 1 billion p-km; the figure for sea travel was 690 in 1996 (2).

According to the health for all database of the WHO Regional Office for Europe, mortality caused by road transport in the European Region shows more than an eightfold difference between countries with the lowest and highest rates per head of population. The Baltic countries, the Russian Federation and some southern countries (Portugal and Greece) report the highest figures, thus indicating the greatest potential for improvement. Within the EU, there is an approximately fourfold difference between countries with the lowest and highest death rates.

Across the Region, mortality rates for traffic accidents fell in the 1990s, but this decline obscures the sharp increase in mortality in the eastern countries in the early 1990s (Fig. 4), following very substantial increases in road traffic and the number of new and inexperienced drivers. In spite of some improvements in more recent years, average rates in the newly independent states of the former USSR are still about 1.5 times those in the EU.

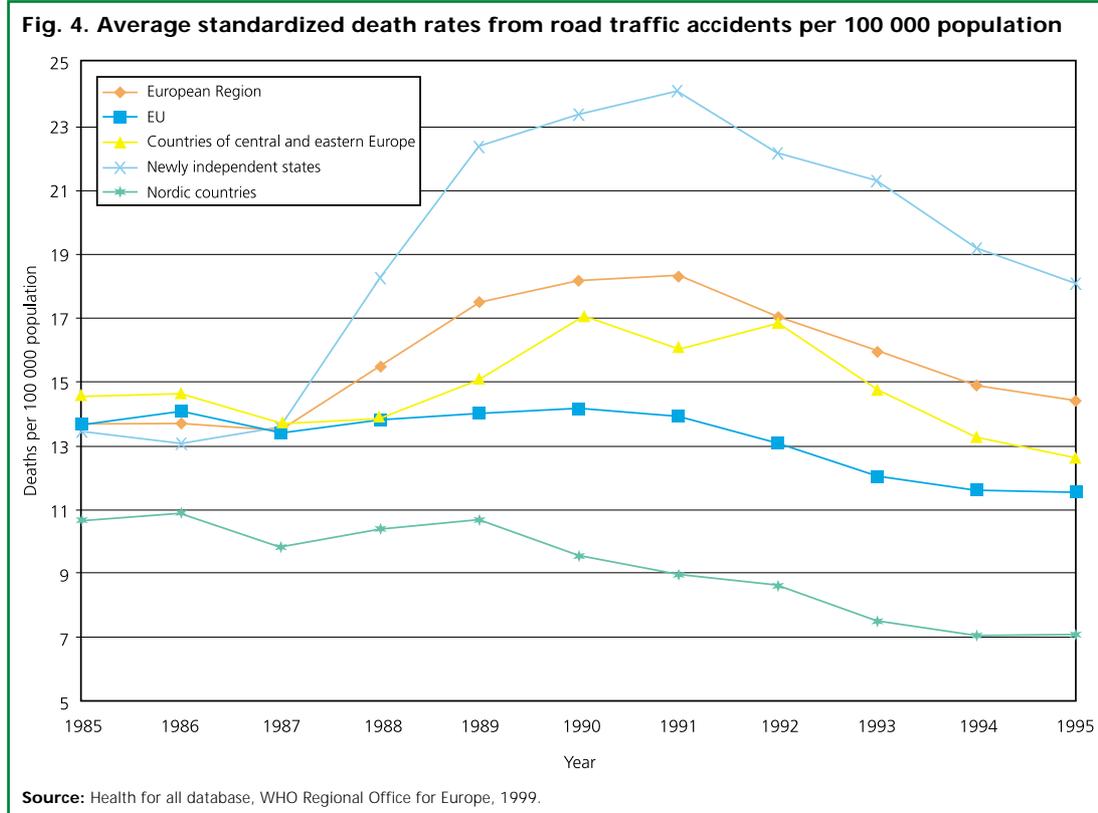
### Interpreting risks

Accident rates are usually expressed in terms of p-km or vehicle kilometres. There is, however, a case for replacing these with an indicator based on the rate of accidents per trip. Securing access to goods, services, jobs, other people and amenities is, after all, the function of transport. Interestingly, the number of trips and the time spent travelling have remained quite constant over time in most countries. What has changed is the distance and speeds travelled per trip; both have increased. Using indicators of risk per kilometre thus gives the misleading impression that the accident risk of road travel is decreasing faster than it actually is.

Moped riders suffer high death rates from accidents.



© Cristina Piza Lopez



## Victims of traffic accidents

Although the drivers and occupants of motor vehicles comprise over 60% of the people killed or injured on the road (14), others suffer a very significant proportion of deaths and injuries. Pedestrians account for around 25–30% of deaths and 13% of injuries, and cyclists, 5–6% of deaths and 7–8% of injuries (12,14). Cyclists suffer more fatal accidents than pedestrians in countries, such as the Netherlands, where cycling is common (15). The severity of accidents (the number of deaths per total number of accidents with injuries) is almost twice as high for pedestrians as for car occupants (12,14). The term “vulnerable road users” all too accurately describes those who cycle and walk (see Chapter 6).

The absolute number of pedestrian fatalities has decreased over the last three decades (15,16), but this is probably less a function of reduced risk for pedestrians than a consequence of a fall in expo-

sure; pedestrians walk less often and less far than before. For example, the United Kingdom has reported a 17% decline in miles walked between 1975/1976 and 1994 (16), probably due in part to the fear of accidents.

Of all vehicle occupants, moped riders and motorcyclists report the highest death rates, both per million vehicles and per p-km (14,16). British statistics for 1983–1993 show that, on average, death rates per p-km were around 24 times higher for motorcyclists than for car occupants (16).

One in every three people killed on the road is younger than 25 years (17). The risk of being involved in a light or serious accident is five times higher for learner drivers aged 18–19 years than for experienced drivers older than 25 years (18). Alcohol and drug use are factors that further increase the risk in young drivers (19).

## Where accidents happen

The risk of accidents varies, depending on the type of road, the traffic mix, the time of day and climatic conditions, and the speed and mass of vehicles involved. On average, around 65% of road accidents happen in built-up areas, 30% outside built-up areas and around 4–5% on motorways. In most countries, however, the risk of dying in accidents occurring on motorways is two to three times higher than those on other roads (12,14), very often because of the higher speed driven on motorways.

Roads near houses and schools are high-risk areas for children, and restrict their activity, including cycling and walking. Parents report the fear of accidents as the main reason for escorting children to school (20). The areas of highest risks for vulnerable road users such as pedestrians and cyclists are minor roads and their intersections with arterial roads (15).

Roads are high-risk areas for children.



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of accidents (21–23). Speed also affects accident severity, particularly for vulnerable road users: the risk of death for a pedestrian is about eight times higher in a collision at 50 km per hour than one at 30 km (24). Allowing faster speeds on some roads appears to have a spillover effect elsewhere; the average speed of the entire road system increases, thereby further increasing the risk of accidents (25).

## Alcohol

Several studies have demonstrated that increased blood alcohol concentration is related to an increase in the relative risk of accidents (26,27). Any detectable level of alcohol in the blood results in a higher risk of accident involvement. This risk is about 40% higher at a blood alcohol concentration of 0.5 g/litre than at zero; with concentrations over 1.0 g/litre, there is about a tenfold increase (28).

## Dose-response relationships

### Speed

Average speeds have a strong link with accident rates. In general, a 1-km per hour reduction in average speed results in about a 3% reduction in the number

## The effectiveness of preventive strategies

Current strategies to prevent traffic injuries have reduced traffic mortality where implemented, and further progress could be achieved by introducing

**Table 2. Effectiveness of various measures to prevent traffic injuries**

Risk factor	Measure	Estimated effect
Alcohol	Control of blood alcohol concentration while driving	Prevention of 5–40% of deaths if blood alcohol concentrations were never greater than 0.5 g/litre
	Enforcement strategies to reduce alcohol-related accidents	20% reduction in deaths from the introduction of highly visible random breath testing (evidence from New South Wales, Australia)
Speed	Average speed reduction by 5 km per hour	25% reduction in deaths (estimates for EU countries)
	Widespread use of speed cameras	50% reduction in relevant accidents
	Use of local and variable speed limits	30% reduction in accidents resulting in severe injuries (evidence from Germany)
Use of safety devices	Speed reduction measures in residential areas	Accident reductions of 15–80% (experience in EU countries)
	Increased wearing of seat belts	15% reduction in deaths of car occupants estimated if best compliance levels were matched across the EU (95% use)
Vehicle design	Increasing use of motorcycle and cycle crash helmets	50% reduction in injuries/head injuries
	Day-running lights	5% reduction in deaths
	All cars constructed to the best level of passive safety in their size category	15% reduction in deaths (estimates for EU)
	Introduction of pedestrian-friendly car designs	A further 7% reduction in deaths

Source: A strategic road safety plan for the European Union (17) and European Commission (29).

or improving the enforcement of several low-cost and cost-effective measures. Table 2 summarizes information on the effectiveness of several preventive measures (17,29).

Other measures can also be effective. For example, road design is important, and such features as appropriately placed roundabouts, traffic calming in residential areas and cycling paths can all help in reducing accident rates (30). In addition, the occupational health standards for the duration of working shifts and rest hours of professional drivers could be more strictly applied.

## Setting targets for road safety

International experience shows that setting quantitative targets in road safety programmes can lead to

better programmes and more effective use of resources (31). WHO has a regional health target to reduce deaths and injuries from road traffic accidents by at least 30% by the year 2020 (32). The EU second community action programme on road safety (1997–2001) (29) aims to achieve a 30% reduction of traffic fatalities above the results expected following a business-as-usual approach (equivalent to a reduction of nearly 60% from 1995 figures). Employing the assumption that avoidance of one fatal accident in the EU would save ECU 1 million, it identifies a number of cost-effective measures affecting vehicle safety, road infrastructure and driver behaviour to help achieve these goals.

Several countries in the Organisation for Economic Co-operation and Development (OECD) have set targets for the reduction of road accidents (31). Sweden's long-term goal is that nobody be killed or

seriously injured in the road system. This “Vision Zero” is based on the principle that society should no longer accept deaths and permanent injuries from road accidents. This goal will determine the maximum speeds in the system (33).

## Conclusions for policy

Far too many people die and are injured on the roads. The effective policies carried out in some countries clearly demonstrate that this can change. What is needed, first and foremost, is the political will to implement and enforce effective preventive measures. This requires a radical change in culture, from one of acceptance of road traffic accidents as an unavoidable effect of development towards one of no tolerance towards deaths and serious injuries from accidents.

Information, education and communication strategies have an important role in supporting the public participation, attitudes and behaviour that are essential for the success of new policies. Communication and education, however, are no substitutes for other measures, which might include legislation and its necessary adjunct, policing. No matter how well trained, informed or motivated, human beings are prone to error. The design of the environment plays an important part in moderating inappropriate behaviour.

The implementation of measures to reduce deaths and injuries on the road will almost certainly require a combination of these strategies. To reduce speed on the roads, for example, it would probably be necessary to lower speed limits (limits of 30 km per hour in urban areas, 80 on rural roads and 100

on motorways have been proposed), improve police enforcement, use speed cameras widely and employ speed-reducing road construction such as roundabouts and traffic-calming measures.

A narrow approach that aims solely at reducing the accident rates (sometimes to the detriment of air and noise quality, for example) needs to change to the pursuit of strategies that also benefit the environment, improve the quality of life and give greater overall health benefits (34).

Increasing the safety of vulnerable road users – including cyclists, pedestrians, children and very old people – should be a priority. Measures should be taken to ensure that accident risk is no longer a deterrent to cycling and walking by, for example, improving infrastructures and creating conditions for safer cycling.

The burden of traffic deaths and injuries can probably be significantly reduced only if the amount of road traffic is reduced. This can be achieved through both “push” measures designed to deter motor vehicle use (such as restricting the numbers of parking spaces) and “pull” measures designed to make other modes more attractive (such as establishing pedestrian areas to increase the safety of walking, and improving rail and public transport services and people’s access to them).

The nature of and need for mobility, the structure of the transport sector and patterns of road and land use need radical rethinking. Policies in keeping with such an approach are more likely to emerge as viable options in cost–benefit terms if health effects are valued appropriately and the full range of health implications (that is, pollution and noise as well as accidents) are also taken into account.

## 3. Serious health impact of air pollution generated from traffic

### Pollutants and effects

Serious health effects occur at levels of exposure to air pollutants that are common in European countries.

term mortality (36,37), increases in respiratory diseases and reduced lung function.



Traffic-generated air pollution.

### Particulate matter

Short-term increases in respirable particulate matter – particles that are less than 10 millionths of a metre ( $\mu\text{m}$ ) across and small enough to get into the lungs ( $\text{PM}_{10}$ ) – lead to increased mortality, increased admissions to hospital for respiratory and cardiovascular diseases, increased frequency of respiratory symptoms and use of medication by people with asthma, and reduced lung function (35). In addition to these acute effects, evidence shows that recurrent cumulative exposure increases morbidity and reduces life expectancy; follow-up studies have found that particulate matter is associated with higher long-

term mortality (36,37), increases in respiratory diseases and reduced lung function. Particulate matter itself is a mix of organic and inorganic substances. It is not clear whether its health effects are linked to one or more of these substances, or to the number, surface area or mass of the particles (particle mass concentration is the indicator used in many epidemiological studies, in guidelines and standards). Growing evidence indicates that smaller respirable particulate matter (less than  $2.5 \mu\text{m}$  –  $\text{PM}_{2.5}$ ) may be more relevant to health than the larger  $\text{PM}_{10}$ . More recently, ultra-fine particles (below  $0.1 \mu\text{m}$ ) have been associated with stronger effects on lung function and symptoms in asthmatics than either  $\text{PM}_{10}$  or  $\text{PM}_{2.5}$ .

### Which component is responsible?

The association of particulate matter with health effects has been determined in environments with complex mixtures of highly correlated pollutants, making it difficult to disentangle individual effects. The effects attributed to particulate matter could therefore be interpreted as indicating the effects of the pollutant mixture as a whole. The evidence on the health effects of sulfur, and nitrogen dioxide (NO<sub>2</sub>) and other pollutants resulting directly from the combustion of fossil fuels is similarly unclear. The effects may actually represent the impact of fine particles that are not usually monitored. The estimates of health impact for each pollutant should therefore take account on the complexity of the situation.

### Other independent effects

Ozone (O<sub>3</sub>) has been independently associated with reductions in lung function, increased bronchial reactivity and admissions to hospital. It has also been associated with day-to-day variations in mortality in studies in Europe, though not in North America. This might be explained by the more common use of air conditioning, normally accompanied by closed windows, in North America.

Recent studies have also suggested an independent effect from low levels of carbon monoxide (CO) on admissions to hospital for and mortality from cardiovascular diseases (38).

The negative impact of lead on neurocognitive function in children is well demonstrated and, in countries where leaded petrol is still used, it is an important source of exposure (see Chapter 4).

### Carcinogens

While traffic-related air pollution contributes most to morbidity and mortality from cardiovascular and respiratory diseases, several components of diesel and petrol engine exhausts are known to cause cancer in

animals (39) and there is evidence of an association between exposure to diesel and cancer in human beings. A recent analysis of many studies showed a 40% increase in lung cancer risk for long-term, high-level occupational exposure to diesel. On that basis, the California Environmental Protection Agency adopted, in August 1998, the legal definition of “toxic air contaminant” for particles emitted from diesel engines (40). Two large longitudinal studies of exposure to ambient air pollutants found an increase in the risk of developing lung cancer for the general population, of a similar magnitude to the risk for cardiopulmonary diseases. Smoking and occupational exposure may make this effect more powerful.

In addition, some evidence suggests an increased risk of childhood leukaemia from exposure to vehicle exhaust, where benzene may be the responsible agent. In view of the higher background incidence rate of lung cancer, the impact of engine exhaust (particularly diesel) exposure on the population is likely to be much greater for lung cancer than for leukaemia, especially after factoring in occupational exposures.

The present evidence of cancer risks justifies the precaution of avoiding any increase in exposure to suspected carcinogens.

### Climate change

The anticipated health effects of climate change induced by air pollution, notably carbon dioxide (CO<sub>2</sub>), include direct effects such as deaths related to heat waves, floods and droughts. Other effects will result from disturbances to complex physical and ecological processes, such as changes in the amount and quality of water and in the patterns of infectious diseases. Some of the health effects will become evident within a decade and others will take longer to appear.

## Role of traffic-generated air pollution

### Fraction of air pollutants from traffic

Motor vehicle traffic is the main source of ground-level urban concentrations of air pollutants with recognized hazardous properties. In northern Europe it contributes practically all CO, 75% of nitrogen oxides (NO<sub>x</sub>), and about 40% of the PM<sub>10</sub> concentrations. Traffic contributes disproportionately to human exposure to air pollutants, as these pollutants are emitted near nose height and in close proximity to people.

One quarter of the CO<sub>2</sub> emissions in EU countries comes from traffic, and the contribution of traffic fumes to the formation of tropospheric O<sub>3</sub> is substantial and expected to increase. The predicted health consequences of climatic change can therefore be directly linked to road traffic in Europe, although they will be experienced around the world.

### Trends in traffic-related pollution exposure

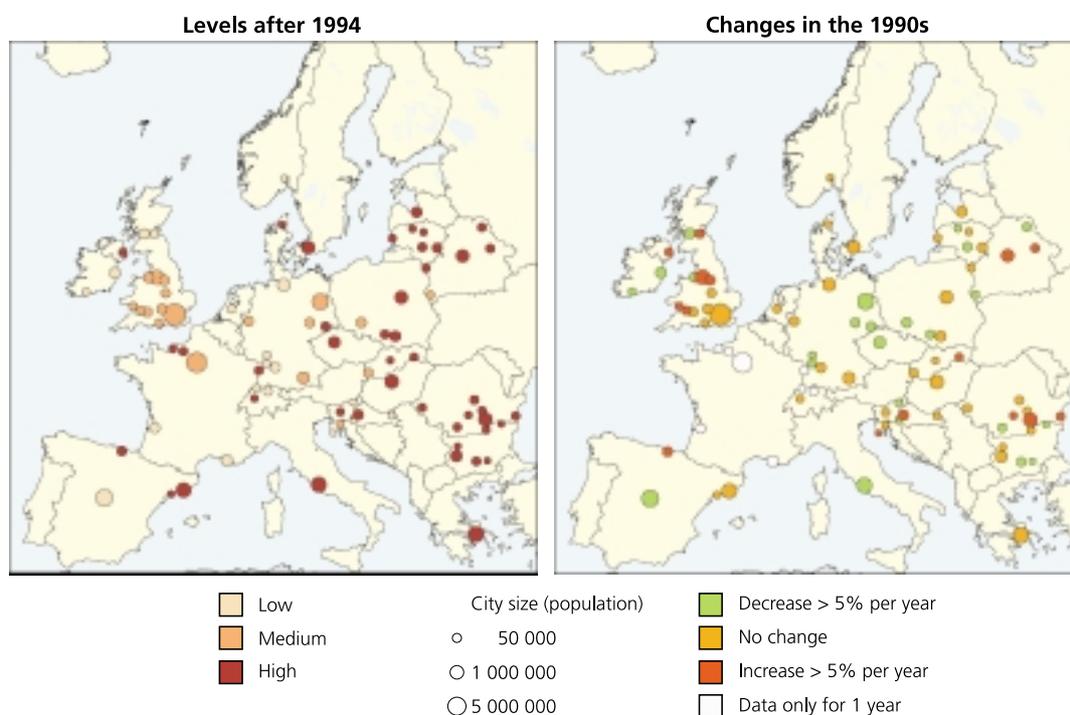
Data collected from systems monitoring urban ambient pollutants in the WHO European Region over the last decade (41) show that:

- levels of particulate matter have decreased in most cities, but increased in some very polluted cities in central and eastern Europe (Fig. 5);
- NO<sub>2</sub> and O<sub>3</sub> levels have not changed; and
- sulfur dioxide (SO<sub>2</sub>) levels have decreased substantially.

These data have some limitations, especially with respect to the monitoring of particulate matter.

An assessment of the environment in the EU reports that emissions in countries have been declining overall, but those from transport, such as NO<sub>x</sub>,

**Fig. 5. Levels and changes in concentrations of suspended particulate matter in European cities, 1990s**



Source: Overview of the environment and health in Europe in the 1990s (40).

are increasing, as growth in the number of cars offsets the benefits from technical improvements (1).

Effective strategies for emission reductions and declines in industrial activity have resulted in important reductions in SO<sub>2</sub> and lead over the last decade. Improving urban air quality and reducing tropospheric O<sub>3</sub> now pose the main challenges, and will require important shifts from business-as-usual scenarios.

### Human exposure

A substantial proportion of the human exposure to air pollution generated by road traffic occurs in urban areas, where most of the European population lives; people are exposed indoors, inside cars or on the roadside. People spend most of their time indoors, but outdoor air pollution is the main determinant of indoor air quality (except in homes where people smoke). CO and particulate matter enter indoors quite freely, while O<sub>3</sub> reaches relevant concentrations indoors only when windows are opened.

Levels of CO and benzene inside cars are around 2–5 times higher than at the roadside, and car users are exposed to more pollutants than pedestrians, cyclists or users of public transport sharing the same road (42).

### Determinants of traffic-generated air pollutants

The levels and composition of pollutants in the air depend not only on the number of vehicles but also on their age, engine type and condition, and the type of fuels used, as well as on meteorology, the shape of the urban environment and the way traffic is organized. While much is being done to improve the technology, a few issues relevant to health also need attention.

Heavy vehicles are major polluters. For example, when compared to a car with a catalytic converter, a

diesel truck produces 50–100 times more fine and ultra-fine particles per km travelled. Modern diesel engines may emit less PM<sub>2.5</sub> but a larger number of ultra-fine particles than older engines. If ultra-fine particles or the number of particles, rather than particle mass, are the cause of health effects, as now suspected, the new diesels cause more harm than the old ones.

The contribution of mopeds with two-stroke engines to air pollution and related health impacts is not known, although there are indications that they produce several times more CO and hydrocarbons than cars with catalytic converters. Mopeds are used to make a large proportion of urban trips in southern Europe, and many have such engines.

In addition, the flow of old cars into eastern Europe in the 1990s has been associated with increases in particulate matter in large cities.

### Estimates of the impact on health

Exposure–response relationships from epidemiological studies and data from ambient air monitoring specific for the population of interest can be used to estimate the health effects of air pollutants. There is much uncertainty about these estimates, and results depend on such factors as:

- whether the estimates of dose and response come from studies of daily variation in mortality or of long-term impacts (estimates in the latter are 3–6 times higher);
- which level of particulate matter exposure is defined as the baseline over which an added burden will be calculated; and
- whether estimates are made for the whole population or only for the subgroup similar (in age and gender, for example) to participants of the exposure–response studies.

Nevertheless, using the best available information and making adjustments for potential sources of error, good, cautious indications can be derived of the magnitude of the burden of disease associated with air pollutants for a given population.

For example, about 36 000–129 000 adult deaths a year can be attributed to long-term exposure to air pollution generated by traffic in European cities. This assumes that around 35% of the deaths attributed to particulate matter pollution are due to traffic air pollution (a conservative estimate of the fraction of particulate matter coming from traffic in urban areas). The estimated annual number of deaths in the WHO European Region attributed to total air pollution is 102 000–368 000 (40). This is based on applying a conservative estimate of exposure–response found in the follow-up studies of adults in the United States to estimates of particulate matter exposure in European cities. The same analysis also estimates that particulate matter accounts for 6000–10 000 additional admissions to hospital for respiratory diseases in European cities every year.

An application of the same United States exposure–response results to the population of the Netherlands, whose circumstances are comparable to those of the original studies, concluded that an increase of 10  $\mu\text{g}/\text{m}^3$   $\text{PM}_{2.5}$  would reduce life expectancy by over one year (43). When the results were applied to the United States population, it was concluded that the levels of variation in air pollution observed in the studies (10–30  $\mu\text{g}/\text{m}^3$ ) could conceivably be associated with a change in life expectancy of the order of several years (44).

A recent estimate of the health effects of air pollutants from traffic in Austria, France and Switzerland and their related costs, using comparable methods, found that air pollution caused 6% of total mortality in the three countries, or over 40 000 deaths per year (45). About half of all mortality caused by air pollution was attributed to motorized traffic. This corresponds to about twice the number of deaths

due to traffic accidents in these countries. In addition, traffic-related air pollution accounted for: more than 25 000 new cases of chronic bronchitis in adults, more than 290 000 episodes of bronchitis in children, more than 500 000 asthma attacks and more than 16 million person-days of restricted activity (45).

### **Direct link between proximity to heavy traffic and ill health**

A number of studies have recently shown an association between respiratory disease and proximity to roads that are busy and those travelled by a high number of heavy vehicles or trucks (46). Children living near roads with heavy vehicle traffic are at greater risk of respiratory disease. Most studies suggest an increased risk of around 50%. These studies may have captured the effects of actual mixtures of pollutants and they strengthen the case for traffic-generated air pollutants' affecting health.

### **Policy implications**

The magnitude and seriousness of the health effects of air pollution, a significant part of which can be attributed to traffic, call for further reductions in traffic-related emissions of air pollution.

Technological improvements, such as the introduction of unleaded petrol and catalytic converters, have already had a positive impact. In moving forward, however, a holistic approach should be adopted. Focusing efforts on reducing one pollutant may be ineffective, since the effect associated with that pollutant may well be a proxy for the effect of the pollutant mix, and this mix should be addressed.

Tackling individual pollutants in isolation could even be counterproductive if it leads to increases in another pollutant component. Attempting to lower  $\text{CO}_2$  emissions through the promotion of so-called new diesel vehicles, for example, would lead to an

increased number of ultra-fine particles, which seem themselves to be a cause of concern. Similarly, in selecting actions to reduce emissions of greenhouse gases, those that also reduce other air pollutants, such as particulate matter, should have priority. The effect on the pollution mix as a whole must always be considered in designing interventions.

Even the best designed technological responses to the reduction of emissions from vehicles may not be enough to compensate for traffic volume, which is increasing throughout Europe. Controlling the growth in traffic, especially in urban areas, will be essential if further traffic-induced harm to the health of European populations is to be avoided.

It has not been possible to identify a threshold for  $PM_{10}$  below which no health effects are observed. Indeed, serious health effects occur at pollutant concentrations that are well below existing air quality

guidelines and standards. WHO argues for lowering these in the case of  $O_3$  and particulate matter, and some national and international bodies have done so. WHO does not give a guideline level for  $PM_{10}$ , but provides information about the additional risk of adverse health effects associated with increased levels.

Research needs to move forward on a number of fronts: the components and sources of particulate pollution (including the effect of ultra-fine particles); the link between traffic volumes/mixes and health effects such as childhood respiratory disease and cancer; the effects of air pollution exposure within cars and while bicycling and walking; the carcinogenic effects of diesel and petrol in populations; and the identification of cost-effective technological and economic strategies for responding to the problem of transport-generated air pollution.

## 4. The effects of transport on mental health and wellbeing

Wellbeing is an integral part of the WHO definition of health, which makes clear that good health is more than the absence of physical health burdens and includes such things as having social support, being free of threats of violence, not being anxious or fearful, being in a good temper and feeling empowered (47). The psychological and physical aspects of wellbeing are difficult to disentangle: physical damage provokes mental responses (pain, anguish, distress) and psychological disturbances can lead to physical ill health. Much of the discussion of health consequences in earlier chapters already touches to some extent on the psychological. This chapter draws attention to some of the elements that have not yet been specifically addressed.

### Effects of lead

One well known mental effect from transport is that caused by lead emissions from petrol on the cognitive development of children. The neurotoxic effects of lead have been known for a long time, but research in the 1980s and early 1990s demonstrated neurobehavioural effects at much lower exposure levels than before: levels often prevalent in the environment (48). Recent prospective studies have related deficits in neurobehavioral function in children to blood lead concentrations as low as 0.5  $\mu\text{mol/litre}$  (100  $\mu\text{g/litre}$ ) (49).

Most of the early studies on developmental lead neurotoxicity described the adverse effects in terms of IQ results (48). More recent studies suggest that lead affects several specific brain functions, particularly attention, motor coordination, visuospatial function and language. Some follow-up studies of teenagers have shown cognitive dysfunction to be

long lasting, affecting functional abilities and academic progress (50,51).

Children are particularly vulnerable. They not only have greater intakes of lead than adults (35 times higher, when adjustments are made for differences in weight) but also absorb and retain greater amounts of the lead to which they are exposed. Their higher sensitivity is reflected in the fact that the lowest level at which adverse effects are observed in adults is estimated to be 40  $\mu\text{g/dl}$ ; that for children is 10  $\mu\text{g/dl}$ .

In western countries of the European Region, effective laws on the level of lead in petrol control some of the problem posed by lead emissions. The problem remains, however, in eastern countries.

### Posttraumatic stress from accidents

The number of motor vehicle accidents and the physical injuries and deaths resulting from them are closely monitored in most countries. This is not true of the long-term psychological effects commonly experienced by survivors of motor vehicle accidents, even when they have minimal or no physical injury. Studies have found that 14% of survivors have diagnosable posttraumatic stress disorder (52) and 25% have psychiatric problems one year after an accident, and one third have clinically significant symptoms at follow-up 18 months after an accident (53). Posttraumatic stress disorder is a debilitating condition that involves such symptoms as:

- re-experiencing the trauma through nightmares, flashbacks or uncontrollable, intrusive recollections;

- adopting avoidance techniques including keeping away from situations that trigger recollections of the event, blocking feelings and becoming detached and estranged from others; and
- excessive arousal resulting in sleep difficulties, poor concentration and memory, and being hyperalert and easily startled (54).

Governments and funding agencies neglect the disorder, and it is rarely taken into account in assessments of the health costs of traffic accidents.

A study in the United Kingdom found that one in three children involved in road traffic accidents suffered from posttraumatic stress disorder when interviewed 22 and 79 days afterwards, while only 3% of children from the general population (studied in a similar way) were found to have the disorder (55). Neither the type of the accident nor the nature and severity of the physical injuries were related to the development of the disorder; the child's perception of the accident as life threatening was the most important determinant. The study found that the psychological needs of the children involved remained unrecognized, and none had received any professional help.

## Effects of traffic

### Aggression and nervousness

As documented in Chapter 1, traffic noise has been shown to induce nervousness, depression, sleeplessness and undue irritability, but other aspects of transport also cause irritation and frustration. Regular exposure to traffic congestion impairs health, psychological adjustment, work performance and overall satisfaction with life (56). Congestion constrains movement, which increases blood pressure and frustration tolerance. This phenomenon not only reduces the wellbeing of those experiencing it but can also lead to aggressive behaviour and increased likelihood of involvement in a crash (57).

Aggressive behaviour on the road is common and appears to be increasing. Marsh & Collett (58) found that 25% of young drivers aged 17–25 would chase another driver if they had been offended, and Joint (59) reported that 60% of study participants behaved aggressively while driving. The car has been described as an instrument of dominance, with the road as an arena for competition and control. The car also symbolizes power and provides some protection, which makes drivers less restrained (60).

### Reduced social life

Excessive automobile use has affected people's social lives. The car has enabled them to move away from cities and to settle in suburban areas. Many of these areas have been developed around the car, however, and without considering people's psychological needs. Close-knit communities have given way to neighbourhoods that do not encourage social interaction, and this has resulted in increased social isolation (61). These new areas very rarely include local schools, small stores or other places where people could interact. Instead, shopping amenities have moved to large, impersonal out-of-town centres.

In addition, the growth in the use of the car has affected social contact through the so-called community severance effect: the divisive effects of a road on those in the locality. A seminal study of the impact of traffic on three streets in an area of San Francisco illustrates how traffic volumes and speed influence the way people use streets for non-traffic functions (62). Three streets were studied, similar in all aspects except traffic volume: 2000 vehicles per day in one street (referred to as Light Street), 8000 in another (Moderate Street), and 16 000 in the third (Heavy Street). Residents were asked about their perceptions of their neighbourhood. The study observed a variety of behaviour, including pedestrian delay times; numbers of closed windows, drawn blinds, parked cars and flower boxes; and amount of litter.

Those living on Light Street had three times as many friends and twice as many acquaintances among their neighbours as those living on Heavy Street (Table 3). Light Street was perceived to be friendly, and families with children felt relatively free from traffic dangers. In contrast, Heavy Street had little or no pavement activity and was “used solely as a corridor between the sanctuary of individual homes and the outside world” (62). The decline of environmental quality on Heavy Street had led to a process of environmental selection and adaptation in the street’s residential make-up, which had changed significantly over the years as a result of the hostile traffic environment. Residents kept very much to themselves and had withdrawn from the street environment. There was little sense of community (62).

### Constraints on child development

High traffic density affects children’s development. Fewer and fewer children are being allowed to walk or cycle even short distances, because parents are worried about accidents (Fig. 6). Indeed, several studies point out that the space within which children can move freely shrinks significantly as street traffic increases in the immediate environment (20). Children have become more dependent and less physically active, while parents have less time to spare. This reduction in levels of physical activity not only has longer-term effects on physical wellbeing (as documented in Chapter 5) but can also affect children’s stamina, alertness at school and academic performance.

**Table 3. Road traffic and networks of social support**

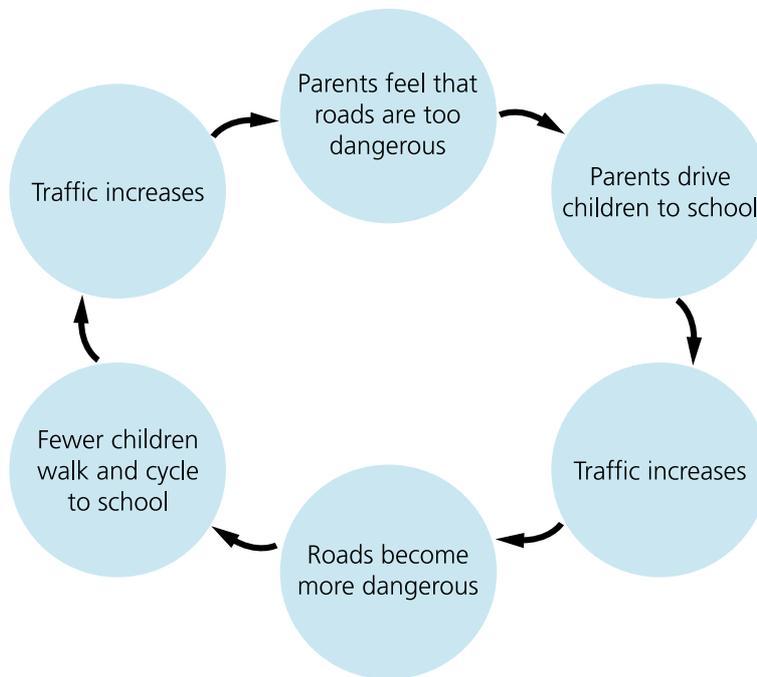
Traffic levels	Contacts living on the same street	
	Friends	Acquaintances
Light traffic (200 vehicles at peak hour)	3.0	6.3
Moderate traffic (550 vehicles at peak hour)	1.3	4.1
Heavy traffic (1900 vehicles at peak hour)	0.9	3.1

Source: adapted from Appleyard & Lintell (62).

Measures that reduce the severance effects of motor traffic are important because of the protective effect on health of social support networks, which work either directly by promoting health or by buffering the adverse effect of stressors. Low levels of social support have been linked to increased mortality rates from all causes: people with few social contacts may be at more than twice the risk of those with many contacts. Good social support networks appear to be most important for vulnerable groups such as elderly people and children. Evidence indicates that lack of social support can increase mortality from coronary heart disease by up to four times (63).

Further, these conditions withhold an important kind of experience from children, hindering their personal development, as well as limiting their contact with their peers. A study by Hüttenmoser (63) investigated two contrasting groups of 5-year-olds. The children in group A were raised in surroundings permitting them to play both unhindered by street traffic and without the presence of adults. Children in group B could not leave their homes unaccompanied by adults. The study found a clear connection between the time that children spent outside and the dangerousness and perceived attractiveness of their living environments. When children in group B played in their neighbourhood,

**Fig. 6. The effects of ever-increasing traffic on children's freedom of movement**



Source: Sustrans. *Safety on the streets for children*. Bristol, Sustrans, 1996 (Information sheet FF10).

adults accompanied them and the time they spent outside was considerably shorter, since adults were not prepared to supervise for more than 1–2 hours. Social contact with other children in the immediate neighbourhood was half of that of the children in group A. The same was true for the adults (65).

Hüttenmoser (64) showed that unsuitable living surroundings considerably hinder children's social and motor development and put a heavy strain on parents. Deficient motor skills often have social and psychological consequences, such as difficulties interacting with other children and coping with street traffic.

The use of lower traffic speeds on main streets and walking speeds in residential areas appears to be of decisive importance for the development of children. Where lower speeds are engineered through traffic calming, evidence suggests some perceived improvements in quality of life or livability, including im-

proved safety for pedestrians and cyclists, benefits for families with children, and greater independent mobility for children, especially for those aged 7–9.

## Mental health benefits of exercise

Chapter 5 illustrates how a switch to physically active modes of transport can make a significant difference to physical wellbeing. The psychological benefits of such a shift have also been documented. Research shows that people who are physically active or have higher levels of cardiorespiratory fitness have better moods, higher self-esteem and better cognitive functioning than those who are physically less fit.

A survey of about 4000 respondents across Canada (65) found that people who reported higher levels of total daily leisure-time energy expenditure had

more positive moods. The authors also found an inverse relationship between physical activity and symptoms of depression, even at moderate exercise levels. A cross-sectional study made secondary analyses of two surveys in Canada and two in the United States, conducted between 1971 and 1981 (66); it associated physical activity with fewer symptoms of anxiety and depression and with better moods and general wellbeing. These associations were strongest among women and among people aged 40 and over.

## Conclusion

Much remains to be discovered about the nature, significance and prevalence of the psychological effects of transport. This might help to explain why there has been so little monitoring of these effects. Nevertheless, beginning to develop a better database of relevant psychological outcomes is the only way to begin to understand how widespread and serious the problems are and what kind of approaches to ameliorating them are likely to be most successful.

Ignoring the psychological effects of transport probably leads to significantly underestimating the detrimental health effects of motorized transport. This is particularly serious because many of the psychological effects have the important characteristic of being external: that is, effects imposed on others and not considered by those generating them. This externality provides much of the justification for government involvement.

Psychosocial variables should become an integral part of impact assessments. This can only happen once appropriate indicators have been identified and methods developed to measure and analyse them. Collaboration with those already involved in carrying out social impact assessments will be crucial.

Neither a comprehensive or detailed picture of the problem of the psychological effects of traffic nor a well developed menu of strategies to deal with them is available. Societies are more likely to be moving in the right direction, however, if they pursue a vision of people-friendly, liveable environments.

## 5. Cycling and walking for transport

Cycling can benefit human and environmental health.



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Choosing to walk or cycle for one's daily transport needs offers two important kinds of benefits. The first, discussed in earlier chapters, includes those associated with the reduced use of motorized transport – noise, air pollution and accident rates – would all fall. The second is the benefits to health from regular physical exercise. These are likely to be very substantial but have been largely overlooked. If adequately accounted for, they could completely change the cost–benefit ratios of transport policy decisions.

### Effects of cycling and walking on health

Convincing scientific evidence now shows the substantial health benefits of physical activity (67,68). In 1996, the US Surgeon General produced a com-

prehensive report on these health benefits (67), similar to the 1964 report on the negative effects of tobacco. This is both a tribute to the credibility of the evidence and a reflection of the significance attached to the findings. It is hoped that a concerted response to the physical activity report is less slow than was the case with smoking.

Walking and cycling to work have been shown to meet metabolic criteria for achieving health benefits from exercise (69). The health benefits of regular sustained physical activity include (70):

- a 50% reduction in the risk of developing coronary heart disease (a similar effect to not smoking);
- a 50% reduction in the risk of developing adult diabetes;

- a 50% reduction in the risk of becoming obese;
- a 30% reduction in the risk of developing hypertension;
- a 10/8-mmHg decline in blood pressure in people with hypertension (a similar effect to drugs);
- reduced osteoporosis;
- relief of symptoms of depression and anxiety; and
- prevention of falls in the elderly.

Health risks are associated with cycling and walking, too, the most serious of which are accidents involving cars. Nevertheless, preliminary analysis in the United Kingdom shows that on balance the benefits to life expectancy of choosing to cycle are 20 times the injury risks incurred by that choice (71). Further evidence in different settings is required.

## How much physical activity is required for health gains?

A total of 30 minutes of brisk walking or cycling a day, on most days, even if carried out in ten- to fifteen-minute episodes, reduces the risk of developing cardiovascular diseases, diabetes and hypertension, and helps to control blood lipids and body weight (72). This evidence is mostly from studies in middle-aged, white males, but the few studies in women, young people and the elderly point in the same direction.

This is new evidence and especially useful for public health, as it was previously thought that only vigorous, uninterrupted exercise, such as jogging, could provide such benefits (73). While the benefits of physical activity increase with the intensity and frequency of exercise, the greatest come when people who have been sedentary or minimally active engage in moderate activity. In addition, moderate physical activity is a more realistic goal for most

people and carries a lower risk of cardiovascular or orthopaedic complications than vigorous activity. It is therefore safer to recommend for the general population.

## Trends in cycling and walking

The number of cycling and walking trips in Europe remains small. On average 5% of all trips in EU countries were made by bicycle in 1995 (2). Cycling habits vary widely. Cycling is much more common in northern countries; in Denmark and the Netherlands, for example, people make 18% and 27% of trips, respectively, by bicycle, and cycle on average 850 km per year. In Mediterranean countries, by contrast, only 1–4% of trips are made by bicycle and average annual cycling distances are 20–70 km.

Daily cycling trips among adults in six European countries with more detailed information range from about 1 in the Netherlands to as low as 0.1 in the United Kingdom (15). Although these are the countries in Europe with the most cycling and walking, cars are used to make 30–65% of short trips (under 5 km).

In Europe the average trip taken on foot (to reach work or for leisure or shopping) is currently about 2 km and the average cycling trip is about 3–5 km (74). Each takes around 15 minutes, enough to provide the above-mentioned health benefits.

Walking is declining as a means of transport. In the United Kingdom, miles walked fell 20% between the early 1970s and the early 1990s; the decline was larger among children (16). In Finland during the same period, the number of trips on foot dropped from 25% to around 10% and cycling trips from 12% to 7%, while trips by car increased from 45% to 70% (75).

## Potential health benefits from increasing cycling and walking

Half of the adult population in the western world is sedentary or minimally active, and levels of physical activity are declining. Obesity is increasing in western countries in spite of a decrease in calorie intake, and this is mostly due to increasingly sedentary lifestyles. Physical inactivity is now more prevalent than tobacco smoking, and together these risk factors account for the greatest number of deaths and years of life lost in developed countries (76).

In Finland it was estimated that a 3–7% reduction in deaths from coronary heart disease could be expected if another 8% of the working population chose to walk or cycle to work (77). The Finnish transport ministry estimated that savings worth about US \$80–235 million a year would result from the doubling of cycling distances travelled (78). Policies favouring walking and cycling in York, United Kingdom led to a 40% reduction in road casualties (compared with a 1.5% reduction in the country for the same period) (16).

Cycling and walking are forms of physical exercise accessible to the vast majority of the population, regardless of income, age and location: it is estimated that over 96% of citizens can walk, and over 75% can ride a bicycle (79).

## Policy issues

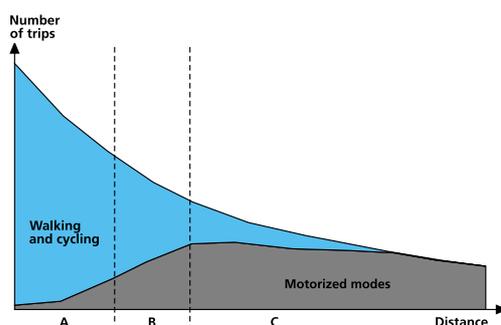
### Promoting physical fitness through cycling and walking for transport

The public health efforts to increase physical activity have so far focused largely on education and skill development in individuals, and on physical activity as leisure. Rarely have they considered environmental determinants of people's choice of and ability to maintain regular physical activity, and built on these to design interventions to promote physical activity. Factors such as the availability of public transport, high housing density and street connec-

tivity have all been shown to be associated with higher levels of physical activity. In addition, evidence shows that people are more likely to take up activities that are easy of access, take place in a pleasant and safe environment (for example, in clean air and green areas), fit easily into the daily schedule and have reasonable cost. Fear of accidents and street violence and the barrier effect created by congested roads and the priority given to cars deter people from cycling and walking.

Policies promoting a shift towards more walking and cycling as transport modes should concentrate on the trips for which motorized modes are often used but whose length easily permits their completion on foot or by bicycle; this applies to many trips shorter than 5 km (zone B in Fig. 7) (79).

**Fig. 7. Number of trips made by different means of transport over different distances**



Source: *Walking and cycling in the city* (79).

### Including the health benefits of cycling and walking in assessment of transport policies

For policy-makers the barriers to promoting cycling and walking have mostly derived from a lack of appreciation of the extent of benefits involved. This is reflected in the absence of these effects from impact assessments and economic valuations of transport policies (80). The health sector needs to ensure that scientific evidence on health implications is made available in a way that facilitates cost–benefit analyses and policy decisions. It should reanalyse avail-

able data sets to respond to questions concerning, for example, the balance between the health benefits (on noncommunicable diseases) and costs (in injuries and deaths) of promoting active transport.

Methods for the economic valuation of these health effects should be adapted and made widely available, and effects and related costs should be documented for locations across the European Region.

### **Improving monitoring of physically active transport**

Data collection on cycling and walking across Europe is not systematic or standardized. Report-

ing is irregular, with different definitions and range of values. The monitoring of physically active modes of transport should be improved.

## **Conclusion**

Public and non-motorized transport offer opportunities for regular physical activity, integrated into daily life at minimal cost, for large segments of the population. Modal shifts to physically active transport are likely to bring major benefits to public health, the environment and quality of life, and to decrease congestion. Strategies designed to engineer such shifts should be energetically pursued, especially in urban and suburban areas, and their effects monitored and evaluated.

## 6. Groups at higher risk of the damaging health effects of transport

The health effects of transport fall disproportionately heavily on certain groups of the population. The areas they live, work or travel in may have traffic of higher volumes or speeds, or specific geographical, topographical or settlement characteristics that intensify levels of air pollutants and noise, and increase the risk of accidents. Owing to their age, illness or disability, some people are more sensitive to any given traffic risk. Others use modes of transport associated with greater risks, such as motorcycles. Many of the health risks from transport accumulate in the same communities, often those that already have the worst socioeconomic and health status.

### Greater health risks in urban areas

Most of the European population (70%) lives, works, and spends most of its travel time in towns and cities. Not surprisingly, much of the health impact from road transport is experienced in these urban environments. Most injuries to pedestrians and cyclists occur in urban areas (15), as do cases of pollution-induced illness and noise annoyance.

Across Europe, the health impact of transport is concentrated in inner-city districts and along busy roads – areas where traffic density is particularly high and many people live and work. The result is increased risk of injury for pedestrians and cyclists, exacerbation of the severance effect of traffic, and noise and air pollution levels that are higher than in suburban, peri-urban and rural areas (81). Analysis of air pollution data in England, for example, has

shown that many central districts in cities, especially in London, record levels of NO<sub>2</sub> that exceed the maximum limits agreed by the government. Several recent studies have reported that children living near busy roads or roads with heavy diesel-vehicle traffic are exposed to particularly high levels of particulate matter and have a higher incidence of respiratory symptoms (82–84), increased hospital admissions for asthma and a higher prevalence of wheezing and allergic rhinitis (85,86).

Nevertheless, transport also affects health in rural areas. Communities living in rural alpine valleys, for example, have been shown to be exposed to high local concentrations of traffic-related air pollution and noise (87). Given the low level of exposure relative to urban environments, rural areas suffer a disproportionate number of road traffic fatalities, probably owing to the higher vehicle speeds (15).

### Greater suffering for the less affluent

#### Traffic injury

The burden of transport-induced ill health borne by the poor has been most closely studied in relation to risks of traffic injury. Pedestrian casualties in Scotland, for example, are disproportionately drawn from the poorer socioeconomic groups (88). In Europe more generally, road traffic casualties are known to be higher among manual workers and their children and the unemployed than in professionals (15).

The results of studies on children most clearly illustrate the association between social deprivation and road casualty rates. Children living in deprived areas have high casualty rates and these have a dose-response relationship with the degree of deprivation (89,90). In the United Kingdom, the pedestrian death rate for unskilled workers' children is over four times that of professionals' children.

The extent to which living in a more hazardous environment explains the higher accident rates observed in lower socioeconomic groups is not clear. Traffic volumes and the proportion of vehicles exceeding speed limits are higher in poorer than in more affluent areas (91,92). Car ownership appears to explain some of the association between social class and injuries. Certainly children from families without cars have been observed to cross greater numbers of roads than those from car-owning households (93), and are therefore more exposed to the risk of accidents.

### **Traffic and exercise**

The picture with respect to exercise is not as clear. Although the poor are less likely to own cars and travel by car, there are few data to show how this influences levels of exercise. Data suggest that poorer groups are less physically active in general, but what role transport-related exercise plays in this is not certain.

### **Air pollution**

As mentioned, poorer groups in Europe also appear to suffer more than affluent groups from air pollution. The reason is probably the environments in which they live and work, even though poorer people are less likely to drive and motor vehicle occupants are often exposed to higher levels of air pollution than cyclists and walkers (94,95). Car occupants are likely to spend significantly less time in polluting traffic than the poor spend exposed to emissions from busy roads in their localities.

In addition, good evidence shows both that the poor are less healthy and that ill people (particularly those with respiratory and coronary illnesses) are more vulnerable to the effects of air pollution (96,97). For example, some studies show children with pre-existing respiratory disease with more reduced lung function than healthy children in reaction to air pollution episodes (98). Further, the poorer health of the economically disadvantaged may be worsened by the relative inaccessibility to them of services such as large supermarkets and shopping centres (with their cheaper and healthier foods) and health care facilities. With urban sprawl, services and amenities have moved to outskirts of cities, and are only readily reached by car.

### **Noise**

The poor are often exposed to elevated noise levels from traffic, to which some limited and indirect evidence interestingly suggests they may have reduced sensitivity. Spanish research suggests that better educated people (who usually live and work in areas with relatively low noise levels) are more sensitive to traffic noise than those with poorer education (99). Perhaps poor people living in areas with high traffic volumes become accustomed to the gradually increasing noise levels. Certainly research has found that people experiencing gradual increases are less irritated than those confronted with a step change in noise levels (100). The noise levels to which people become accustomed, however, are not good for their mental or physical health. As mentioned in Chapter 1, some of the adaptation strategies lead to elevated stress hormone levels and blood pressure.

### **Residence as a factor**

To some extent, residence can explain the relationship between transport-related health effects and socioeconomic status described in this section. The poor often live in inner-city areas with particularly

high exposure to accidents and noise and air pollution. In fact this may be one reason why they are clustered in these areas; the high noise and air pollution levels and disturbance from traffic are likely to drive real estate values down and the more affluent out. In Norway, for example, people with higher incomes are significantly less disturbed by road traffic noise than those who earn less. The former use their income to buy homes in better environments and thereby avoid such disturbance (101).

## Risks depending on gender and age

### Women

Women are disproportionately represented among the poorer socioeconomic groups. They are also less likely than men to be car occupants and more likely to walk; the number of trips on foot is higher for women than for men across OECD countries (15).

Interestingly, however, women in Europe are in general less likely than men to be injured or killed as pedestrians. Research in the United Kingdom has linked this partly with women walking more often than men on familiar roads within about 1 km of their homes; the study has also found, however, that older female pedestrians have two and a half times the risk of injury of males of the same age for the same distance walked or number of roads crossed (102). Nevertheless, research suggests that in general males take more risks than females in the traffic environment, as has been found among children (103), cyclists (104) and car drivers (105).

Poor women in inner cities do not have good access to services such as hospitals and supermarkets. Even public transport does not always serve women well. It is usually geared to the needs of workers, and thus the scheduling of the most frequent services does not always suit women with young children.

### Children

Children are a particularly vulnerable group. In many European countries, traffic-related injuries are the most common single cause of hospital admission among those aged 5–15 years. Most of these casualties take place on urban streets. In 1990 pedestrian and cyclist fatalities were the single largest cause of death in children aged 0–14 in OECD countries (15). One in every three road traffic deaths involves a person younger than 25 years (17).

As mentioned in Chapter 4, the barriers to physical activity created by heavy traffic are especially restrictive for children. Children are becoming habituated to a sedentary lifestyle (106). This is particularly alarming in view of the evidence that cardiovascular risk factors (including obesity) tend to track from childhood to adulthood. Establishing good physical activity patterns in childhood is a key to reducing cardiovascular diseases (107).

### Elderly people

Elderly people comprise an important and growing group in society with multiple sensitivities to the negative health effects of transport. They show a gradual decrease in their abilities to cope with difficult traffic. Traffic regulation and infrastructure design make little allowance for this; pedestrian lights, for example, allow insufficient time for elderly people comfortably to cross roads. Moreover, most people with hearing difficulties are elderly, and traffic noise can compound their communication problems and hence reduce their readiness to make contacts and interact socially. Aware of their difficulties, most elderly people tend to disengage from traffic and become less mobile. The perceived dangers and threats of traffic can lead to insecurity, anxiety and stress, and thus to social isolation, distrust of others and reduction in social and neighbourhood networks of support (108), as well as the loss of important opportunities for regular physical activity.

Despite this self-restriction and even though people over 65 years make up less than 15% of the population, the elderly comprise roughly half of the pedestrians killed in Europe each year (109). Hillman (110) estimates the fatality rate for younger pensioners per kilometre walked to be about twice as high as that among children and the rate for older pensioners, about ten times as high.

In addition, the elderly have been found to be most at risk of pollution-related premature death in time-series studies of mortality, possibly because of the high rates of illness among this group. The United Kingdom Department of Health (110) has estimated that periods of high air pollution in Great Britain may hasten by a few days or weeks up to 24 100 deaths each year, mainly among older people and the sick, and 23 900 hospital admissions, as well as causing additional admissions.

## Vulnerable road users

Pedestrians and cyclists stand out as particularly vulnerable road users. Not only is the severity of accidents among pedestrians almost twice as high as that in car occupants, but cyclists and pedestrians are disproportionately involved in crashes, given both the amount of time they spend on the road and the relatively short distances they travel (12). Pedestrians and cyclists account for 45% of all road deaths in the United Kingdom and over 50% in Hungary. The proportion is substantially lower in western European countries: 17% in France, 20% in Germany and around 30% in Denmark and the Netherlands where cycling occupies a much higher modal share of journeys than, for example, in the United Kingdom.

In both absolute numbers and as a proportion of all road deaths, annual deaths of pedestrians and cyclists have fallen in most European countries where data are available. Notable exceptions, however, include the increased number of pedestrians killed in Greece. Deaths among cyclists increased in number

in the Czech Republic, eastern Germany and Hungary, but comprise a declining proportion of all road deaths, owing to absolute increases in the numbers of deaths among car drivers and passengers.

The reduced mobility of pedestrians and cyclists (especially children and the elderly) resulting from fear of road traffic may have helped to reduce the number of traffic casualties. To reduce the risks, elderly people living close to busy roads restrict their territorial range from home, and parents are increasingly restricting their children's independent mobility (111), reducing physical activity and opportunities for unsupervised interaction with other children (see Chapter 4). Damage to social and personal development, including alertness at school and academic performance, has been documented.

## Conclusion

Although transport-associated health risks have clear geographic patterns, these can change with demographic movements, and restricting attention to this dimension is simplistic in any case. To be useful, the definition of risk has to encompass income, age, illness and disability, and mode of transport used. As with health in general (112,113), the negative health effects of travel fall disproportionately on poorer socioeconomic groups, women, children and older people, which are precisely the groups least likely to benefit from the transport system, which limits their access to services, cheaper foods and other goods.

A package of measures is needed to protect those at higher risk from the health effects of traffic. First and foremost, a more precise picture is needed of these effects; monitoring mechanisms need to be established and appropriate indicators (of social class as well as geographic features, for example) identified and measured. A good monitoring system identifies areas where action is needed and permits the evaluation of the effectiveness of the action taken.

Action to assist most risk groups has to be well thought through and consider the wider picture. For example, much of the higher impact of transport on the poor is linked with where the poor live. Im-

proving traffic in those areas could well drive real estate prices up and drive residents out. Plans to protect the poor should incorporate traffic concerns with housing and access dimensions.

## 7. Policy framework

### Why governments need to intervene

Previous chapters have described the extent and nature of the health consequences of transport. The results are alarming, and public health specialists would probably seek whatever means are necessary to eliminate this unacceptable health burden. Lobbyists for cars or roads, on the other hand, would argue that transport has many very substantial benefits that significantly outweigh the costs, that the health burden is the price societies must pay for the mobility and convenience they enjoy.

The framework used by economists is helpful in considering these competing points of view. Economists would argue that society is unlikely to be willing to make the huge sacrifice required totally to eliminate the health burden associated with transport. They would also point out that the transport sector has important characteristics that mean that an inadequately regulated market will fail to deliver the socially optimal pattern and level of transport. In particular, the people involved in motorized transport do not fully bear all its costs. The external costs of transport – those borne by others – are known to be substantial; Table 4 summarizes those for the EU, Norway and Switzerland (114). No important external benefits have been identified.

The existence of external costs means that, with no intervention, levels of road use will be higher than is socially optimal because the costs to society exceed the costs to the individual road user. Most governments have recognized this point, but failed to act accordingly. As a result, although the benefits from road transport are large, they could be further increased if certain journeys were made by different means or not made at all.

### What governments could do

#### General principle: the cost creator pays

Taking account of health in transport decisions does not mean that health should dominate over other concerns. The many advantages of mobility and easy access to goods and services are clear. Nevertheless, governments should actively implement policies requiring those who generate transport costs to pay for them.

Ideally this would be achieved by taxing transport at a rate equal to the external costs generated by the individual road user. This would give people an incentive to reduce socially wasteful journeys; the costs are then said to be internalized.

**Table 4. The external costs of transport in the EU, Norway and Switzerland, 1995**

Effect	Cost		
	Total (billion euros)	Per person (euros)	Share of gross domestic product (%)
Accidents	155.6	406	2.3
Air pollution	134.3	350	2.0
Congestion	128.4	335	1.9
Climate change	121.8	318	1.8
Upstream processes	56.5	147	0.8
Noise	36.5	95	0.5
Landscape	16	42	0.2
Urban effects	8.9	23	0.1
<b>Total</b>	<b>658</b>	<b>1716</b>	<b>9.7</b>

Source: INFRAS AG and Institut für Wirtschaftspolitik und Wirtschaftsforschung (IWW) Universität Karlsruhe (114).

Governments  
should intervene.



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Unfortunately, such an approach is rarely practicable, since the marginal damage done by different road users depends intimately on the context in which the journey is made and the vehicle used. The approach depends on the government's ability to monitor individual road users in these different contexts. In reality, the most that can usually be achieved is to tax complementary activities (such as parking) and subsidize substitutes (such as public transport). An alternative is to use standards and command and control policies, although these risk imposing unnecessarily high costs upon some individuals.

### Pollution

Most governments have relied on the dual measures of vehicle excise duty and fuel duty, supplemented by a host of standards-based measures. Unfortunately, the use of fuel duty correlates with pollution problems very badly. It does not distinguish between the emission characteristics of vehicles, or vary with location and time of day. Further, even high fuel taxes are unlikely to cause much change.

The only pollution problem for which fuel taxes might be the appropriate measure is that of carbon emissions. In this case, the relationship between the amount of fuel used and the carbon emitted is constant; location characteristics of the pollutant are not important, and no technology is capable of removing carbon emissions from vehicle exhausts.

Vehicle excise duties are an even less satisfactory approach. Once paid, they give road users no incentive to restrain the use of their vehicles.

More appropriate strategies include:

- fuel switching through price differentials, to encourage the use of more health-friendly fuels (imposed through an explicit policy that creates incentives for research on so-called green fuels and their introduction into the market-place);
- annual vehicle inspections, roadside checks and vehicle scrapping, to reduce the problem of poorly maintained and older vehicles, which have far greater emissions per distance travelled than properly maintained or newer cars;

- setting emission standards for new vehicles (a widely employed approach in Europe, which has significantly reduced air pollution emission rates, although failing to provide the continuing incentive for the development of cleaner engines that would result from taxing the purchase of vehicles according to their environmental characteristics); and
- dealing with the spatial characteristics of air pollution problems by restricting motor vehicle access to certain parts of a city through, for example, cordon charging and road pricing and policies on parking and public transport.

## Accidents

Accidents generate external costs for two main reasons. First, there is evidence that additional road users raise the risks to other road users. Second, many countries do not charge people directly for medical treatment. As a result, individuals do not face the full cost of the accidents in which they are involved, and are likely to behave in a way that is socially sub-optimal.

The mandatory use of crash helmets by motorcyclists and seat belts by car occupants has reduced the costs of medical care (by reducing the need for it), although some people may behave more recklessly as a result of feeling protected.

Drink-driving laws, compulsory testing for drivers' licences and speed restrictions appear to be worth while, although good evidence on their costs and effectiveness is scarce. Drink-driving and speed-control laws should probably be strengthened.

One promising approach that has not been widely used is to make road users pay the full costs of both their own treatment and the damage they inflict on others. Individual road users differ significantly in skill, and radically increasing the damages that must be paid in the event of an accident could significantly deter aberrant drivers. Insurance companies

would foot the bill, but would have the incentive to raise premiums for people who are bad risks. Similarly, requiring road users to have insurance to cover the state's costs in the event of their having an accident would raise the cost of motoring, particularly to those who are a danger to themselves and others. Safe driving and the use (and therefore production) of safer cars would be financially rewarded (and dangerous driving penalized) in a way regulations alone could not do.

Some people misjudge the risks they face; surveys show that most people think they are safer than the average driver. Taxes may be required to compensate for this chronic underestimation of risk, and to encourage shifts to less risky modes of transport.

## Information to change preferences

A supplementary approach is to engage in measures intended to make people change their preferences in favour of particular forms of transport. The experience and knowledge of the general public and of decision-makers affect their attitudes towards certain forms of transport and land-use strategies. Change towards health promoting transport alternatives requires that people have access to the necessary information and means of participation in decision-making. The following are four elements of a strategy for working towards change.

First, opportunities could be created for practical and positive experiences of desirable means of transport. For example, the creation of privileged road space for safe cycling and walking in pleasant surroundings in cities would reduce air pollutants, noise and accident risk, promote physical activity and social interaction, and benefit the environment. This could be a powerful way to form public opinion about transport options.

Second, information, education and communication strategies could be developed to make the health and environmental implications of different trans-

port modes and alternative policies widely known and accessible to members of the public, including policy-makers. Similarly, beneficial effects might result from policy-makers' and stakeholders' reviewing and rethinking sustainable patterns of consumption in individual travel behaviour.

Third, decisions on transport and land-use projects, plans and strategies could include mechanisms to ensure wide consultation. This would prevent the domination and distortion of the decision-making process by lobby groups. People need to be informed, to have the opportunity to express informed opinions and to have these followed by appropriate action.

Finally, comprehensive assessments of the impact of policy options on health and the environment should be carried out and the results made widely accessible to the public.

## Government investment

Making transport users take more responsibility for the costs of the ill health they generate for others (the internalization of costs) is a key strategy for tackling transport externalities. Nevertheless, another important facet of reducing the external costs of transport is government investment on behalf of the public in reducing the total level of these costs. For example, governments have invested in noise barriers, quieter road surfaces, research into quieter, less polluting and safer cars, roads with more safety features for road users inside and outside of cars (such as speed humps), cycle paths in inhabited areas and urban plans that ameliorate the negative health consequences of associated transport systems. The lack of such investment does not result from poor results from cost-benefit analyses. Very often the reason is that such measures have received no active consideration, or have been considered but not properly evaluated.

For example, investment in cycling infrastructure is currently made on the basis of time savings and the

reduction of risks to existing cyclists. This ignores the fact that the creation of new infrastructure would generate additional trips. The number of extra trips might be substantial because the risks of accidents are a major part of the perceived costs of cycling. Earlier chapters have detailed the health benefits of cycling. Government departments need to add estimates of the health benefits to current and potential cyclists to their appraisals of cycling lanes.

## Investment in research and technology

While technology can and has reduced the effects of transportation on health and the environment, its use can lead to unexpected results and expectations of what it can deliver should be realistic. As mentioned, diesel engines with lower CO<sub>2</sub> emissions produce many more ultra-fine particles, which are being charged with responsibility for the health effects of particulate matter (after the development of so-called new diesel). Safer brakes in cars can lead drivers to take further risks, offsetting the intended benefit. Technological investments must be balanced against other types of preventive measures.

## Effects to be further clarified

Some of the effects of transport activities need further clarification. These include the impacts of transport infrastructure, of vehicle emissions, and of waste (such as batteries, tyres, etc.) and fuel spillage on the contamination of soil and groundwater, and the risk that this may in turn affect the quality of drinking-water and agricultural products.

In addition, a better understanding is needed of the risk-benefit relationship between transport activities and food distribution. For example, flexible, fast, inexpensive and reliable transport systems can increase the availability of healthy and varied diets, because fresh fruits and vegetables can be shipped throughout the year at affordable costs, reaching

places where normally they would not be available. The logistics of food distribution, however, help to increase transport-related health problems through emissions of air pollutants and noise, and increased risk of accidents.

## Health impact assessment

One important way to ensure that health issues are routinely taken on board in transport and land-use decisions is to require that they be subjected to adequate health impact assessments (HIAs). This is already formally required as part of environmental impact assessments, but in practice the extent and depth of these health assessments are limited.

HIAs tend to be incomplete. They should include outdoor as well as in-car air pollution, vibration as well as noise, direct as well as indirect effects, and long-term as well as short-term consequences. They need to address the sensitivity of various subgroups, to include threshold and non-threshold pollutants and possible chemical mixtures, and to consider all the various exposure pathways.

Best practice for HIAs includes transparency. The public should be encouraged to participate actively in decisions on the scope of concerns to be included, the choice of alternatives to be investigated and the acceptable levels of additional risk. Public perceptions have to be acknowledged, and findings communicated in a timely and straightforward way. Special effort needs to be devoted to communicating the underlying assumptions and methods used, as well as the results.

Adequate HIAs of transport and land-use initiatives are neither trivial nor impossible, as demonstrated by recent good examples at Schiphol airport in the Netherlands and at a highway planning project in Krefeld in North Rhine-Westphalia, Germany.

Developing mechanisms to ensure that the full health implications of any transport proposal are adequately considered is essential. Nevertheless, even

with such mechanisms in place, suboptimal decisions may be made. A great deal depends on ensuring that the efficient options are actually on the table in the first place. They cannot be chosen unless they make the shortlist.

Impact assessment is worthless if it is not used to guide the process of policy-making. An analysis of stakeholders could help identify when and how to make assessments.

## Valuing benefits in economic terms

Relegating health to assessments that only document health effects is not enough. Cost-benefit analysis will be a pivotal decision-making tool for most large transport and land-use decisions. Not to translate health effects into economic valuations runs the risk of marginalizing health as an issue, in favour of the financial implications of a project. For the predicted health outcomes to be an integral part of the calculus used in planning transport systems, every effort should be made to give them an economic value.

Economic valuation is about identifying individual preferences and translating them into a money measure, to create a common denominator for comparing the pros and cons. No matter how it is reached, any decision implicitly places a money value on health effects. The process of economic valuation makes these values explicit. Its approach to defining health costs is based broadly on the preferences of individuals and the effect on their welfare, and is measured by individuals' willingness to pay to avoid those costs.

A range of factors contributes to determining the size of individual willingness to pay to prevent health effects: lost wages, the costs of medical treatment, pain and inconvenience, and the increased probability of death. Naturally but unfortunately, estimates of transport-related health costs have often been restricted to more easily measured elements, such as medical treatment (cost-of-illness studies)

or lost wages (the human capital approach). They have often neglected less easily quantifiable elements, such as the cost of pain and grief, for example.

### The challenge of economic valuation

Undervaluing health impact can have profound practical implications for policy. For example, the value attached to the loss of one life in Europe is usually much lower than that suggested from the economics literature, because only the loss of wages is considered in some countries.

This systematic undervaluation has a dramatic effect on accidents, for example, discriminating against policies that would save lives. Taking the simple step of ensuring that appropriate valuations were used in every analysis of transport infrastructure and safety policies could have a major impact on reducing both the absolute numbers of casualties and the observed differences across European countries.

The valuation of the health effects of air pollution presents a particularly challenging set of problems. At the moment, deaths caused by air pollution are often still valued the same as those from road accidents. This is highly unlikely to be appropriate. The people at risk from the acute health effects of air pollution tend to be much older than the average accident victim, and would perhaps have died a few months later from already existing health conditions. Only recently have studies (114,115) begun to consider this aspect.

The need for more sophisticated valuation methodologies is highlighted by the growing interest of health professionals in much broader definitions of health. These encompass such phenomena as the isolation and social disjunction (barrier effect), fear and stress that road traffic can generate.

A further limitation of current approaches is that they focus on observable health events and out-

comes, observed consequences of the physical risk that is too costly or just too inconvenient to avoid. They do not take account of the cost of avertive behaviour (to reduce personal exposure to risk), which is much harder to value.

## Conclusions

Each country needs to identify and act on a package of measures suitable for its own setting by considering the costs and benefits of alternative policy measures.

In designing policies, a holistic approach is crucial, considering the various health consequences together, the health issues in combination with other factors and long-term consequences as well as immediate effects. Strategies may be beneficial for one health element but not others, for health as a whole but not for the environment, or for the short but not the long term. Numerous examples show the dangers of too narrow a perspective. Higher speeds over certain ranges reduce pollution but increase accident risks. New desulfurized fuels improve the particulate situation but generate more environmentally damaging CO<sub>2</sub>. Taking a holistic approach means rejecting some misleadingly attractive options.

Several initiatives designed to make the most of transport systems have already been taken. Policy-makers, relevant organizations and groups, and authorities at all levels must join forces and build on the relevant initiatives, learn from their experience, avoid duplication and maximize use of human resources. Political leadership, commitment, and the ability to negotiate, develop alliances and solve problems are essential requirements for people addressing these complex issues. Most of all, they must have vision and a clear understanding of what it takes to achieve the desired goals.

# Conclusions

How we travel, where through and how often all have major implications for the health of our communities. This book outlines the current understanding of the health consequences of transport:

- the heavy toll in deaths and serious injuries from accidents on the roads;
- the significant premature mortality and burden on hospital resources resulting from air pollution produced by traffic;
- the serious and pervasive annoyance induced by traffic noise and the learning difficulties and increase in risk of cardiovascular disease associated with it;
- the missed opportunities for many health benefits from improved physical activity through the failure widely to employ non-motorized forms of transport – cycling and walking; and
- the constraints on the development of children and neighbourhood support networks posed by heavy traffic.

These effects fall disproportionately heavily on some groups of the population. Some are more exposed because the areas they live, work or move in have higher levels of pollutants or other risks, or restrict cycling and walking. Some are more vulnerable to traffic risks, due to being very young or old, or ill or disabled. Others use modes of transport associated with greater risks. Various types of transport harm can pile up in the same communities, often those already the poorest in socioeconomic and health terms.

Societies will always need to make trade-offs: between convenience and safety, between access to services and clean air and between absolute freedom

to travel and better health. If we wish to travel, some kind of health price is always likely.

## Failure to integrate health considerations into transport decisions

The problem with the ill health currently generated by transport is not so much that it is substantial (though this may suggest that more research is needed to find appropriate technical solutions). It is that, given the knowledge, technology and resources available, the levels of such ill health are significantly higher than is compatible with maximal social wellbeing. The reason is that health issues are not sufficiently included in people's decisions about their lifestyle and travel or in governments' decisions about the way cities are organized and transport infrastructure is constructed.

Individuals' lack of consideration of the health consequences occurs in good part because a significant share of these consequences actually falls on others. The reasons for governments' failure in this regard are less clear. They lack understanding of the nature and severity of the health effects, and effective mechanisms for informing individuals and communities and identifying their concerns and priorities.

## Isolated responses

The administrative organization of governments and research institutions, which splits the responsibility for different aspects of transport and its effects, may reinforce the difficulty in producing comprehensive assessments and proposing holistic solutions.

Governments have acted to address some of the health effects of transport; unfortunately, this ac-

tion has been insufficient and has had certain characteristics limiting its effectiveness. For example, interventions have tended to focus on the people who generate the problem rather than those who suffer its consequences, on reducing rates rather than absolute levels, on risks rather than exposure, on health risks separately rather than as a whole, and on the environment or health, in isolation from each other. This gives rise to measures that emphasize driver safety rather than the protection of pedestrians and cyclists, that reduce noise and pollution emission rates or accident risk per kilometre rather than ambient pollution or accident level per trip, and that provide individual technological fixes rather than reductions in overall exposure to risks through systemic changes.

As a result, transport still inflicts substantial unnecessary damage on health. While gaps clearly remain in knowledge of the health impacts of transport, we know the direction and approximate size of the external costs to health and enough about some causal relationships to take action now.

## Strategies for change

Governments should adopt two important related strategies to address these issues:

- to internalize health externalities, which involves establishing policies to regulate or encourage more optimal use of existing transport systems; and
- to make decisions concerning transport infrastructure and urban development that take appropriate account of the health implications.

Making such decisions means establishing systems that routinely, accurately and comprehensively identify and measure the health consequences of present and planned transport and land-use strategies and projects. It also means developing and applying methods to measure the economic value of the whole range of these health consequences. Finally, it is

important to consider sufficiently broad and forward-looking options in planning transport systems or how land will be used, so that strategies that are sustainable for health and the environment have a chance to be considered and accepted.

To perform these two essential tasks, governments need a good understanding of the values and priorities of the communities affected by transport and land-use policies. Communities need to have access to information and be involved in the decision-making process. Governments should pay special attention to groups at greater risk of transport-related health effects, including women, elderly people, children, the ill or disabled, the poor and people living or moving through areas with greater or cumulative exposure, or using vulnerable transport modes. Cooperation across sectors of government and between countries, and clearly identified medium- and long-term goals should support the implementation of this process for change. To support governments in this process, WHO and other international organizations should:

- collect and regularly update scientific and economic information on the health effects of transport in a way that facilitates policy decisions (for example, by producing an authoritative summary of the scientific basis for the health effects of transport, including limit values for risks and benefits, in a similar way to WHO guidelines on community noise and air and drinking-water quality);
- monitor the health consequences of current transport modes and policies at the local, country and international levels as part of health and environment information systems; and
- develop practical tools for the assessment of the health effects of transport and their costs.

Finally, international cooperation and coordination are needed to fill the gaps in knowledge on the health effects of transport. For example, this book has called



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**The future:  
healthy transport?**

for research on certain effects of noise, diesel fuels and respirable particles, and the overall health impact of increasing cycling and walking under different circumstances. These are some of the steps

needed if Europe is to reduce transport-related ill health and realize the potential for transport both to serve society's needs and promote people's health.

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# Annex 1.

## Charter on Transport, Environment and Health

### Preamble

We, Ministers and representatives of the European Member States of WHO<sup>1</sup> responsible for transport, environment and health:

1. ACKNOWLEDGE that transport activities play a significant part in life today. Transport provides us with access to goods and services, opportunities for individual mobility and better quality of life, and plays an important role in the economic and social development of our communities;
2. ARE CONCERNED that the impacts which decisions about transport have on health and the environment have so far not been fully recognized. We must ensure that the wellbeing of our communities is put first when preparing and making decisions regarding transport and infrastructure policies;
3. RECOGNIZE that:

Reliance on motorized transport, in particular road transport, continues to increase, resulting in adverse environmental and health effects. These effects may increase in the future if no effective preventive and structural actions are taken;

Increasing the safety of transport and reducing the health consequences of accidents need to be given high priority;

Policies on transport, environment and health need to be better coordinated, with a view to integrating them. The potential conflicts between transport and

environment and health policies will increase at all levels unless effective action is taken now. There is a need to enhance cooperation and coordination between different sectors in central and local governments, as well as between governments, the public and the private sector;

Until now, the health effects of transport have been dealt with separately and without regard for their cumulative effect. Further coordination with and within the health sector is needed;

Consideration of the health impacts of policies has to be better integrated into approval procedures, impact assessments, and evaluations of the costs and benefits of transport plans, land use planning, and infrastructure programmes and investments;

Motorized transport, and especially road and air transport users, usually do not face the full environmental and health-related costs, which can create adverse incentives and distortions in the transport market;

The public is generally not sufficiently informed of the adverse environmental and health effects from motorized transport and the importance of taking individual action to alleviate the problems.

We adopt this Charter, which was elaborated by ministries of transport, environment and health. This Charter sets out the principles, strategies and a plan of action to guide our policies towards achieving transport sustainable for health and the environment.

<sup>1</sup> Reference is made to the supportive statement of the European Commission (EC) in the Declaration of the Third Ministerial Conference on Environment and Health (EUR/ICP/EHCO 02 02 05/18 Rev.5).

## I. Why health is an issue in transport and environment policies: the concerns

We are concerned that current patterns of transport, which are dominated by motorized road transport, have substantial adverse impacts on health (as described in Annex 1).

1. In all Member States, traffic accidents, and in particular road traffic accidents, are a major cause of death and serious injury. However, success in reducing accidents in some countries demonstrates that it is possible to substantially reduce this massive health burden in all countries.
2. Road transport is a major contributor to human exposure to air pollution. Long-term exposure to air pollutants and levels exceeding air quality guideline values is associated with a number of adverse health impacts, including effects on cardiovascular diseases and on respiratory diseases in adults and children. Such exposure may reduce life expectancy. Some pollutants such as benzene and some types of particle, increase cancer risks.
3. A considerable number of people in Europe are exposed to levels of traffic noise that cause not only serious annoyance and sleep loss but also communication problems, and even learning problems in children. There is emerging evidence of an association between hypertension and ischaemic heart diseases and high levels of noise. Ambient noise levels continue to grow due to ever-increasing volumes of traffic.
4. Forms of transport that entail physical activity, like cycling and walking, separately or in conjunction with public transport, offer significant positive health gains; however, these transport modes have often been overlooked in planning and decision-making.
5. Heavy road traffic and major transport infrastructures can divide communities, reduce opportunities for social interactions, and worsen people's quality of life and can be associated with reduced interpersonal networks of support at local level.
6. Transport activities can contaminate soil, water and air, through accidents involving dangerous goods and contamination from transport infrastructures, or by heavy metals from vehicle exhausts, de-icing substances, fuel spillages, release of fuels and other pollutants from road and rail vehicles, ships and aircraft, etc.
7. Everyone is exposed to some degree of health risk from transport, but the adverse health effects fall disproportionately on the most vulnerable groups in our societies: people with disabilities or hearing or sight impairments; older people; the socially excluded; children and young people; and people living or working in areas of intensified and cumulative air pollution and noise.

## II. What has happened so far: the state of play

We are encouraged by the initiatives already taken through the adoption of a number of political declarations, conventions and protocols (as listed in Annex 2), and in particular WHO's policy on Health for All, the Helsinki Declaration on Action for Environment and Health in Europe, and the Vienna Declaration and Programme of Joint Action on Transport and the Environment adopted under the auspices of the United Nations Economic Commission for Europe (UN/ECE), as well as the EU legislation in this area. We reaffirm the commitments already made in the fields of transport, environment and health, and we acknowledge the steps already taken towards achieving transport that is sustainable for health and the environment. However, de-

spite these progressive steps we are concerned that the impacts which decisions about transport have on health and the environment have so far not been fully recognized.

8. We recognize the need to strengthen the enforcement of current road safety legislation.
9. We encourage the ratification of UN/ECE legally binding instruments relevant to transport, environment and health by Member States that have not yet done so.
10. We are concerned that more sustainable modes of transport, especially public transport and goods transport by rail, are losing market share to road transport in many countries. This trend is enhanced by the fact that the majority of transport infrastructure investment is allocated to road infrastructures, not least in the countries in transition.

We emphasize the urgent need to take the next step in adding value to efforts to achieve sustainable development in transport, by fully integrating health requirements and involving environment and health authorities in decision-making on transport, land use and infrastructure policies at transnational, national, subnational and local levels.

### **III. Where do we want to go: principles, approaches and guiding strategies for transport sustainable for health and the environment**

We have decided to incorporate the principles and approaches of sustainable development beneficial for health and the environment into our policies with relevance for transport (as described in Annex 3), in particular the following:

- sustainability;

- the precautionary principle;
- prevention;
- protection and promotion of health and safety;
- the “polluter pays” principle, including internalization of externalities;
- multisectoral integration of environment and health requirements and involvement of health authorities in decision-making on transport, land use and infrastructure policies;
- equity;
- public participation and public access to information;
- subsidiarity;
- efficiency.

Following these principles and approaches, we will incorporate guiding strategies for moving towards transport sustainable for health and the environment into our transport-related policies, in particular applying synergistic combinations of the following key strategy elements:

11. reducing the need for motorized transport by adaptation of land use policies and of urban and regional planning;
12. shifting transport to environmentally sound and health-promoting modes;
13. implementing best available technologies and best environmental and health standards;
14. applying strategic health and environmental indicators and impact assessments, with the involvement of environmental and health authorities;

15. relating the costs of transport more closely to mileage travelled and internalizing transport-related environmental and health costs and benefits;
16. raising awareness of transport and mobility sustainable for health and the environment, including efficient driving behaviour;
17. applying innovative methodologies and monitoring tools;
18. establishing partnerships at international, national, subnational and local levels;
19. promoting pilot projects and research programmes on transport sustainable for health and the environment;
20. providing information to the public and involving them in relevant decision-making processes.

#### **IV. How will the goals be achieved: a plan of action for moving towards transport sustainable for health and the environment**

Having decided to establish this plan of action in order to collaborate and cooperate on making transport sustainable for health and the environment and to further the UN/ECE Vienna Declaration and Programme of Joint Action on Transport and the Environment, following the principles, approaches and guiding strategies listed in section III,

WE WILL PERFORM the actions set out in this plan of action and incorporate the recommendations of WHO into our transport and transport-related policies; and

WE REQUEST the WHO Regional Office for Europe, in collaboration with other international

bodies, to perform the international actions as set out in this plan of action and undertake to support those WHO efforts, within the means available.

#### **A. Integration of environment and health requirements and targets in transport and land use policies and plans**

We will:

21. Pursue multisectoral cooperation and ensure that environment and health requirements are integrated and their authorities are both involved in transport-related decision-making processes, such as those on transport, water and land use planning, infrastructure investment programmes and policy decisions.
22. Establish the concepts and long-term goals of transport sustainable for health and the environment, building on the work already done in the relevant fora.
23. Adopt targets as listed in Annex 4, based on scientific knowledge and work and the guidelines of WHO and incorporate them into the relevant policies to reduce *inter alia*:
  - mortality, cardiovascular and respiratory problems and cancer risks and neuro-developmental problems from transport-related air pollution;
  - mortality and morbidity from transport accidents;
  - risk of cardiovascular and other diseases from lack of physical exercise;
  - human exposure to noise.
24. Develop measurement methodologies and data collection processes to monitor progress towards achieving the targets in Annex 4. Such monitoring should also underpin the devel-

opment of policies to reduce the adverse health and environmental impacts of transport.

25. Review and where necessary develop further strategies or introduce national action plans to ensure the proper integration of health and environment concerns into transport, and land use strategies, in particular, through the further development of National Environmental Health Action Plans (NEHAPs), and to promote similar actions at the sub-national and local levels.
26. Ensure that health authorities take full account of the impact on transport of their own policies.
27. Develop further or introduce policies to reduce air, soil and water pollution, accidents and noise, greenhouse gas emissions and the damaging of forests associated with transport and its infrastructures (airports, motorways, railways, terminals, harbours, petrol stations, etc.), in similar ways to other major industrial sources.
28. Ensure that synergistic effects are attained between strategies chosen to pursue the Kyoto targets for reduction of greenhouse gases and strategies for the reduction of other air pollutants of health concern, paying special attention to emissions from diesel engines.

We call on WHO, in cooperation with other international organizations, to:

29. Develop scientific guidelines for the attainment of transport sustainable for health and the environment, and in particular for the integration of environment and health requirements and targets into policies and plans, based on knowledge of the full and combined impacts of transport-related health risks, including the establishment of threshold values to protect public health, where possible.

## **B. Promotion of modes of transport and land use planning which have the best public health impacts**

We will:

30. Develop and implement policies to promote modes of transport which lead to health and environment benefits, aiming at a shift to modes of transport with lower specific emissions and accident risks. In particular, we will promote safe and environmentally friendly cycling and walking by providing safe infrastructure and networks, implementing measures for traffic management, enforcing speed controls and speed limits that are appropriate to local circumstances, and designing roads and settlements taking into account the needs of pedestrians and cyclists.
31. Reduce the need for motorized transport by adapting land use policies and urban and regional development plans to enable people to have easy access to settlements, housing and working areas, and shopping and leisure facilities by cycling, walking and public transport.
32. Raise the attractiveness of public transport, walking and cycling, and promote intermodality between them, not least by prioritizing public transport, walking and cycling in connection with the extension of infrastructure.
33. Provide incentives to use the best available technologies and encourage ambitious vehicle emission standards and fuel quality requirements, in order to improve safety and reduce air pollutants, noise and fuel consumption.

We call on WHO, in cooperation with other international organizations, to:

34. Assess and provide information about the public health impacts of different modes of transport, in terms of health benefits and disbenefits.

35. Quantify the consequences for public health of increasing levels of physically active modes of transport, notably walking and cycling.

### **C. Health and environmental impact assessments**

We will:

36. Assess the health and environmental impacts of policies, strategies, programmes, projects and legal measures with implications for transport and mobility, and ensure that public health authorities are involved in these assessments at all levels.
37. Support the implementation of these assessments as part of national and international procedures for making decisions about investments and infrastructure programmes.

We call on the World Bank, the European Investment Bank, the European Bank for Reconstruction and Development and other investment institutions to:

38. Carry out environmental and health impact assessments of infrastructure projects with implications for transport and land use planning supported by them.

We call on WHO to:

39. In cooperation with UN/ECE, the United Nations Environment Programme (UNEP) and other relevant international organizations, develop guidelines for making health impact assessments of policies, strategies, programmes, projects and legal measures with implications for transport.
40. Encourage the greater use and integration of health impact assessments with environmental impact assessments by disseminating tools and methods, sharing good practice, and providing education and expert training.

### **D. Economic aspects of transport, environment and health**

We will:

41. Consider the health cost implications of infrastructure investment and land use planning and their consequences in terms of transport and the need for mobility, taking account not only of direct health costs but also of the costs of not adopting health-promoting alternatives.
42. Promote, implement and review policies designed to internalize the health and environmental externalities (external costs) generated by transport activities. These policies will also include measures to ensure that transport costs more closely reflect marginal costs.
43. Ensure that policies introduced to promote transport that is sustainable for health and the environment are cost-effective, taking all costs into account.
44. Promote the progressive suppression of subsidies for polluting modes of transport.

We call on WHO, in cooperation with other international organizations, to:

45. Develop comprehensive guidance on methods and practical tools to estimate the costs and benefits of the health consequences of transport decisions.

### **E. Special care of groups at higher risk**

We will:

46. Identify groups, time periods, environments and areas at higher risk of experiencing the adverse health impacts of transport, taking into account criteria to be proposed by WHO, and monitor relevant health impacts among these groups as described below.

47. Develop, implement and monitor specific policies and measures to protect these groups at higher risk of experiencing the adverse health impacts of transport.

We call on WHO, in cooperation with other international organizations, to:

48. Develop methods for assessing and monitoring health effects in groups at higher risk of experiencing adverse transport-related impacts.
49. Provide information and develop guidance on transport-related health targets, threshold values and measures regarding populations at higher risk due to:
- (a) specific vulnerability (children, the elderly or people suffering from diseases, refugees and immigrants);
  - (b) higher exposure levels resulting from geographical and topographical conditions, settlement characteristics, travel and occupation;
  - (c) disability and social disadvantage as a result of lack of access to facilities, disruption of communities and greater exposure to accident risks.

## **F. Risks to public health not yet clearly quantified**

We will:

50. Promote international collaboration on research and standardized measurement programmes and promote the development of cost-effective measures against the adverse health effects of noise, pollutants and potential carcinogens, such as emissions from diesel engines and fine and ultrafine particles.

51. Promote international collaboration on measurement programmes at the point of exposure and support research into the links between transport indicators, exposures and health.

We call on WHO to:

52. Promote further investigation of the health effects of pollutants, pollutant mixes, noise and other hazards from transport where evidence is incomplete and human exposure is significant (e.g. diesel engine emissions, and especially fine and ultrafine particles), including their possible carcinogenic risk potential.
53. Propose guideline values where possible for ambient levels of and exposure to pollutants and noise, in particular for those pollutants for which guideline values are not yet available, with a view notably to informing the review of the European Community's air quality standards before 2005.
54. Promote investigation of the health effects of exposure to pollutant mixtures, noise and other hazards, including their combined effects inside motor vehicles, on pavements, on bicycles, and due to living and/or working near busy roads, and elaborate guidelines (including guideline values) for these exposure levels.
55. Further develop guidelines regarding the health risks of levels of exposure to fine and ultrafine particles based on assessment of their health effects, with particular attention to their number, mass, size, surface area and composition.
56. Assess the evidence for health risks from soil and water contamination due to transport and its infrastructures, and make recommendations regarding the possibility of establishing safe limits and the need to establish targets.

57. Promote investigation of the health and psychosocial effects of participation in modern traffic.

### **G. Indicators and monitoring**

We will:

58. Implement and, if needed, further develop systems for monitoring transport-related exposures and impacts on environment and health.

We call on WHO, in cooperation with other international organizations, to:

59. Develop indicators and guidelines for measuring and monitoring the health effects of transport on the general population and in groups and areas at higher risk, and assess the effectiveness of interventions to minimize those effects.

### **H. Pilot actions and research**

We will:

60. Promote research programmes and pilot projects and incorporate the results in our transport, environment, land use and health policies, especially in liaison with WHO.
61. Establish conditions for pilot projects where local measures are employed to reduce pollution and other negative impacts from transport, for example by promoting environmentally enhanced vehicles, restricting the circulation of high-polluting vehicles, and promoting cycling, walking and innovative public transport, local speed limits and parking restrictions.
62. Enhance our endeavours to bridge the gap which still exists between our knowledge of strategies that can be used to move towards transport sustainable for health and the environment, on the one hand, and current trans-

port, land use and infrastructure patterns, on the other.

We call on WHO, in cooperation with other international organizations, to:

63. Facilitate the development of a programme of research with a special focus on the adverse health effects of transport and the positive health effects of physically active modes of transport, notably walking and cycling, and promote pilot projects related to these issues.
64. Cooperate with countries on pilot testing health impact assessment methods, evaluating costs and benefits of policy interventions, and supporting training initiatives and information dissemination programmes.

### **I. Public participation, public awareness, information**

We will:

65. Ensure public access to health-related information on and participation in decision-making on transport projects, programmes, policies, plans and regulations, and ensure access to justice in these matters in accordance with the application of the provisions of the Århus Convention. This should apply notably to all actions taken under this Charter.
66. Promote the development and application of:
  - (a) information, education and communication campaigns, including those of international institutions, to raise the awareness among stakeholders and decision-makers of the need for transport sustainable for health and environment;
  - (b) information campaigns targeted at groups using the least environmentally friendly modes of transport.

67. Contribute to WHO's information dissemination efforts and provide and disseminate national and regional public information on transport's environment and health impacts, and on strategies and tools for transport sustainable for health and the environment, targeting specific population groups.

We call on WHO to:

68. Develop an information, education and communication strategy to increase public awareness of the different impacts of transport on human health and to facilitate the choice of modes of transport sustainable for health and the environment.
69. Establish a transnational WHO network for sharing information and disseminating good practice with regard to transport sustainable for health and the environment.

#### **J. Countries in transition and countries with severe problems concerning transport-related health effects**

We will:

70. Cooperate with and so far as possible support these countries in promoting transport sustainable for health and the environment.
71. Pay attention to meeting the challenges of integrating transport, environment and health in the economies in transition, in order to avoid and reduce the environmental health impacts of increasing transport.

We call on WHO, in cooperation with other international organizations, to:

72. Direct special guidance and support to these countries.

## **V. Implementation and follow-up process**

**We will implement** in partnership the plan of action set out in this Charter and make appropriate arrangements for its follow-up, so far as possible using existing mechanisms to follow up and monitor transport, environment and health decisions, such as the European Environment and Health Committee (EEHC), national environmental health action plans (NEHAPs), WHO's European ministerial conferences on environment and health, the UN/ECE Vienna Declaration and Programme of Joint Action on Transport and the Environment, the Organisation for Economic Co-operation and Development (OECD) Transport and Environment Working Group, and the Environment for Europe process.

We will:

73. Collaborate with other countries on transboundary and international issues, taking into account the guidelines and tools proposed by WHO and other international organizations.
74. Promote enhanced cooperation by WHO with other intergovernmental bodies such as UN/ECE, UNEP, the European Community and transnational bodies such as the Central European Initiative (CEI), OECD, the European Conference of Ministers of Transport (ECMT), the European Environment Agency (EEA), nongovernmental organizations (NGOs) and the private sector.
75. Encourage the public, NGOs and the private sector and support local authorities and relevant city networks to engage in efforts to attain transport sustainable for health and the environment that promote and actively contribute to implementation of the plan of action in this Charter.

We will, in cooperation with WHO and other international organizations:

76. Follow up the implementation of the decisions contained in this Charter by:

(c) using the national focal points established for the implementation of the UN/ECE Vienna Declaration and Programme of Joint Action on Transport and the Environment and designating additional contact points for health before the end of 1999;

(d) ensuring that these focal/contact points link effectively with the follow-up processes of WHO's European ministerial conferences on environment and health, the UN/ECE Vienna Declaration and Programme of Joint Action on Transport and the Environment and, nationally, with Habitat Committees;

(e) setting up a steering group of interested Member States and international organizations to push forward the implementation of this Charter and to facilitate cross-sectoral coordination and international cooperation of public and private institutions, and to coordinate and cooperate closely with the UN/ECE Joint Meeting on Transport and Environment (JMTE).

77. Support, where needed, WHO and the other agencies in compiling an overview of existing agreements and legal instruments in the field of transport, environment and health, as specified below, and consider the proposals on further needed action which they make based on this overview.

78. Regularly monitor the links between transport, environment, land use and health using available relevant information and report on the status of these links in the Region.

79. Monitor progress towards targets concerning transport sustainable for health and the environment and towards the integration of health and environment concerns into water, land use and transport policies, as part of existing international review processes (e.g. OECD and UN/ECE environmental performance reviews).

**We call on WHO to:**

80. Assist the steering group of interested Member States and international organizations within the framework of EEHC.

81. Disseminate information about new scientific evidence concerning the effects of transport on the environment and health, about methods of and experience with environmental health impact assessment, and about economic valuations of transport-related health effects.

82. Update targets, guidelines and other tools relevant to implementation of this Charter, and update Charter-related research priorities, in particular in liaison with the international platform on research.

**We call on UN/ECE JMTE to:**

83. Coordinate and closely cooperate with the steering group mentioned under sub-paragraph 4(c) above.

We call on WHO, jointly with UN/ECE and in cooperation with other international organizations, to:

84. Provide an overview of relevant existing agreements and legal instruments, with a view to improving and harmonizing their implementation and further developing them as needed. A report on this overview should be submit-

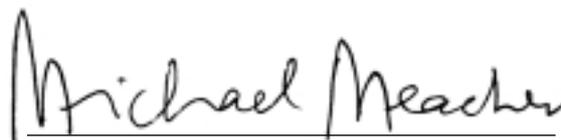
ted at the latest by spring 2000, recommending which further steps are needed. That report should cover the possibility of new non-legally binding actions and the feasibility, necessity and content of a new legally binding instrument (e.g. a convention on transport, environment and health), focusing on bringing added value to, and avoiding overlaps with, existing agreements.

London, 16 June 1999




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Rt Hon Tessa Jowell, MP  
Minister of State for Public Health  
United Kingdom



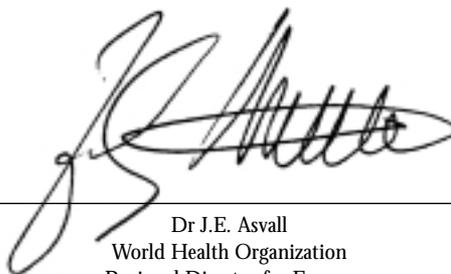

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Rt Hon Michael Meacher, MP  
Minister for the Environment  
United Kingdom




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Lord Whitty of Camberwell  
Parliamentary Under-Secretary of State  
Department of the Environment,  
Transport and the Regions  
United Kingdom




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Dr J.E. Asvall  
World Health Organization  
Regional Director for Europe

## Annex 1. Evidence for the links between transport, environment and health<sup>2</sup> – key facts and figures

### Transport accidents

Current yearly numbers of road traffic accidents in the WHO European Region are still unacceptably high, with around 2 million accidents with injuries, 120 000 deaths and 2.5 million injured people.

One in every three road traffic deaths involves a person younger than 25 years.

Road accidents account for most fatal transport accidents, both in terms of absolute number of deaths and of deaths per kilometre travelled. For example, in 1995, in the European Union 44 000 people were killed in road accidents, while 936 people died in railway accidents. Death rates per thousand million kilometres travelled were about three times higher for road than for rail transport (11 and 3.4 fatalities per thousand million kilometres, respectively). Worldwide statistics on air safety report that in 1997 there were a total of 916 fatalities in air accidents involving scheduled flights, corresponding to 0.4 fatalities per thousand million kilometres of travel worldwide. As for lives lost at sea, worldwide statistics report a total of 690 fatalities in 1996.

Traffic accident mortality rates have been falling over the past decade across the Region, but there is still an almost ten-fold difference between the highest and lowest rates.

Vulnerable road users such as pedestrians and cyclists account for 30–35% of deaths. The severity of accidents among pedestrians is almost twice as high as that in car occupants.

### Air pollution

It is estimated that in European cities around 80 000 adult deaths a year are related to long-term exposure to traffic-related air pollution, using the pro-

portion of ambient PM<sub>10</sub> concentration due to traffic as an indicator.

Both short- and long-term WHO air quality guideline values are frequently and considerably exceeded in the European Region, in particular for ozone, NO<sub>2</sub> and particulate matter.

New evidence is emerging that children living near roads with heavy vehicle traffic have about a 50% higher risk of suffering from respiratory symptoms than children living in areas with low traffic.

Car occupants have a significantly higher level of exposure to engine emissions than people outside vehicles.

In 1998, the California Air Resources Board identified diesel exhaust as a “Toxic Air Contaminant” based on a review of animal and epidemiological studies, which strongly suggest a causal relationship between occupational diesel exhaust exposure and lung cancer. Already in 1989, the International Agency for Research on Cancer (IARC) had concluded that diesel engine exhaust is “probably carcinogenic to humans” (Group 2A), while gasoline engine exhaust was classified as “possibly carcinogenic to humans” (Group 2B).

### Traffic noise

Transport and in particular road traffic, is the main cause of human exposure to ambient noise.

The proportion of the population in the European Region exposed to high noise levels (equivalent to 65 dBLA<sub>eq</sub> over 24 hours) increased from 15% to 26% between 1980 and 1990.

About 65% of the European population is estimated to be exposed to noise levels leading to serious an-

<sup>2</sup> The evidence provided in Annex 1 is based on expertise brought together by WHO, in particular through the work of the scientific experts who prepared the summary substantiation paper and the book “Transport, environment and health”, where a detailed discussion of the issues and literature references are presented. The summary substantiation paper and the book will be issued at the time of the Third Ministerial Conference on Environment and Health, and can be ordered from WHO. The summary substantiation paper can also be downloaded from the Internet at <http://www.who.dk/london99>.

noyance, speech interference and sleep disturbance (55–65 dBLA<sub>eq</sub> over 24 hours).

Children chronically exposed to loud noise (e.g. in the proximity of airports) show impaired acquisition of reading skills, attention and problem-solving ability.

Noise can interfere with mental activities requiring attention, memory and the ability to deal with complex analytical problems. Adaptation strategies (tune out/ignore noise) and the efforts needed to maintain performance have been associated with high levels of stress hormones and blood pressure.

There is emerging evidence of an association between hypertension and ischaemic heart diseases and high levels of noise.

### Physical activity

Lack of physical activity is one of the major risk factors for coronary heart disease, which is the leading cause of mortality in Europe. On the other hand, walking and cycling as daily activities can promote health by providing physical activity, decreasing noise and air pollution.

The health benefits of regular physical activity can be summarized as:

- 50% reduction in the risk of developing coronary heart diseases (i.e. a similar effect to not smoking);
- 50% reduction in the risk of developing adult diabetes;
- 50% reduction in the risk of becoming obese;
- 30% reduction in the risk of developing hypertension;
- 10/8 mm Hg decline in blood pressure in hypertensive subjects (i.e. a similar effect to that obtained from antihypertensive drugs).

Other effects include reduced osteoporosis, relief of symptoms of depression and anxiety, and the prevention of falls in the elderly.

A total of 30 minutes' brisk walking or cycling on most days of the week, even if carried out in 10–15 minute episodes, is effective in providing these health benefits.

The average trip by walking in Europe is about 1.5 km and the average cycling trip is about 3.5 km, each taking about 15 minutes to make: two such trips each day would be enough to provide the recommended “daily dose” of physical activity.

### Psychosocial effects

Certain patterns of transport have a broad range of effects on mental health, including risk-taking and aggressive behaviours, depression and post-traumatic psychological effects of accidents.

High levels of traffic can cause social isolation and limit interpersonal networks of support, factors which have been found to be associated with higher mortality and morbidity in the elderly.

Children who have the opportunity of playing unhindered by street traffic and without the presence of adults have been found to have twice as many social contacts with playmates in the immediate neighbourhood as those who could not leave their residence unaccompanied by adults due to heavy traffic.

The fear of accidents is reported by parents as being the main reason for taking children to school by car. This hinders the development of children's independence and reduces their opportunities for social contact. It also has an influence on children's attitudes towards car use and personal mobility in adulthood.

The lack of physical activity, including walking and cycling, is associated with mental ill health, including depression.

### Water and soil pollution

Transport accidents with dangerous goods can lead to localized environment and health risks from contamination of air, water and soil.

Transport infrastructures, heavy metals from vehicle exhaust and de-icing substances, vehicle waste (e.g. old cars, tires, batteries), fuel spillages, as well as tire and road abrasion, can cause contamination of soil and groundwater, which may affect the quality of drinking-water and of agricultural products.

Sewage released from ships can cause microbiological contamination of water and shellfish. Release of ballast water (i.e. water which fills empty oil tanks) leads to contamination of water by hydrocarbons.

### Groups at higher risk

The impacts of transport on health fall disproportionately on certain groups of the population. Some are more vulnerable to traffic risks, due to old or young age, to illness or disability. Others use modes of transport associated with greater risks (e.g. motorcycles). Some are more exposed because the areas they live, work or move in have higher levels of pollutants and noise (e.g. due to the intensifying effect of specific geographical and topographical conditions and settlement characteristics) or other risks, or restrict cycling and walking. Many disbenefits of transport can accumulate in the same communities, often those that already have the poorest socioeconomic and health status.

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## Annex 2. Relevant international actions – status as of March 1999

*(Note: This Annex is **not** a complete inventory of all international actions developed in the fields of Transport, Environment and Health. It has been developed as a “living document”, open to further improvements. It is meant solely to provide readers of the Charter on Transport, Environment and Health with a list of identified relevant references.)*

### Legally binding documents<sup>3</sup>

United Nations Economic Commission for Europe (UN/ECE)

#### *Air pollution*

The 1979 Convention on Long-range Transboundary Air Pollution and its Protocols, and:

- the 1984 Protocol on the Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of Long-range Transboundary Air Pollution

- the 1988 Protocol on the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes
- the 1991 Protocol on the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes
- the 1994 Protocol on Further Reduction of Sulphur Emissions
- the 1998 Protocol on Heavy Metals
- the 1998 Protocol on Persistent Organic Pollutants

#### *Environmental impact assessment*

The 1991 Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention)

#### *Public information and participation*

The 1998 Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Århus Convention)

<sup>3</sup> Turkey has a reservation on the Conventions and Agreements to which it is not a signatory party.

*Transport of dangerous goods*

The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), of 30 September 1957

Protocol amending Article 1 (a), Article 14 (1) and Article 14 (3) of the European Agreement of 30 September 1957 concerning the International Carriage of Dangerous Goods by Road (ADR), of 28 October 1993

Convention on Civil Liability for Damage caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels (CRTD), of 10 October 1989

*Transport of perishable foodstuffs*

Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage (ATP), of 1 September 1970

*Road traffic and road signs and signals*

Convention on Road Traffic, of 19 September 1949

Convention on Road Traffic, of 8 November 1968

Protocol on Road Signs and Signals, of 19 September 1949

Convention on Road Signs and Signals, of 8 November 1968

European Agreement supplementing the Convention on Road Traffic (1968), of 1 May 1971

European Agreement supplementing the Convention on Road Signs and Signals (1968), of 1 May 1971

European Agreement on the application of Article 23 of the Convention on Road Traffic (1949) concerning the dimensions and weights of vehicles permitted to travel on certain roads of the contracting parties, of 16 September 1950

European Agreement supplementing the Convention on Road Traffic (1949) and the Protocol on Road Signs and Signals (1949), of 16 September 1950

European Agreement on Road Markings, of 13 December 1957

Protocol on Road Markings, additional to the European Agreement supplementing the Convention on Road Signs and Signals, of 1 March 1973

Agreement on Minimum Requirements for the Issue and Validity of Driving Permits (APC), of 1 April 1975

*Road vehicles*

Agreement concerning the Adoption of Uniform Technical Prescriptions of Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals granted on the basis of these Prescriptions, of 20 March 1958. This includes the relevant technical regulations listed in the Agreement

Agreement concerning the Adoption of Uniform Conditions for Periodical Technical Inspection of Wheeled Vehicles and the Reciprocal Recognition of such Inspections, of 1997

Agreement concerning the Establishing of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles

*Transport infrastructures*

Declaration on the construction of main international traffic arteries, of 16 September 1950

European Agreement on Main International Traffic Arteries (AGR), of 15 November 1975

European Agreement on Main International Railway Lines (AGC), of 31 May 1985

European Agreement on Important International Combined Transport Lines and Related Installations (AGTC), of 1 February 1991

Protocol on Combined Transport on Inland Waterways to the European Agreement on Important International Combined Transport Lines and Related Installations (AGTC) of 1991, of 1997

European Agreement on Main Inland Waterways of International Importance (AGN), of 19 January 1996

#### *Working conditions*

European Agreement concerning the Work of Crews of Vehicles engaged in International Road Transport (AETR), of 1 July 1970

#### *Taxation*

Convention on the Taxation of Road Vehicles for Private Use in International Traffic, of 18 May 1956

Convention on the Taxation of Road Vehicles Engaged in International Passenger Transport, of 14 December 1956

Convention on the Taxation of Road Vehicles Engaged in International Goods Transport, of 14 December 1956

#### *Private law*

Convention on the Contract for the International Carriage of Goods by Road (CMR), of 19 May 1956

Protocol to the Convention on the Contract for the International Carriage of Goods by Road (CMR), of 5 July 1978

Convention on the Contract for the International Carriage of Passengers and Luggage by Road (CVR), of 1 March 1973

Protocol to the Convention on the Contract for the International Carriage of Passengers and Luggage by Road (CVR), of 5 July 1978

#### *Economic regulations*

General Agreement on Economic Regulations for International Road Transport, of 17 May 1954

#### *Inland navigation*

Convention relating to the Unification of Certain Rules concerning Collisions in Inland Navigation, of 15 March 1960

Convention on the Registration of Inland Navigation Vessels, of 25 January 1965

Convention on the Measurement of Inland Navigation Vessels, of 15 February 1966

Convention relating to the Limitation of Liability of Owners of Inland Navigation Vessels (CLN), of 1 March 1973

Protocol to the Convention relating to the Limitation of the Liability of Owners of Inland Navigation Vessels (CLN), of 5 July 1978

Convention on the Contract for the International Carriage of Passengers and Luggage by Inland Waterways (CVN), of 6 February 1976

Protocol to the Convention on the Contract for the International Carriage of Passengers and Luggage by Inland Waterways (CVN), of 5 July 1978

#### *Water protection*

Convention on the Protection and Use of Transboundary Watercourses and International Lakes, of 17 March 1992 (Helsinki)

#### *Rail transportation*

Convention Concerning International Carriage by Rail (COTIF), 9 May 1980 (Berne), including:

Uniform Rules concerning the Contract for International Carriage of Passengers and Luggage by Rail (CIV)

Uniform Rules concerning the Contract for International Carriage of Goods by Rail (CIM)

Regulations concerning the International Carriage of Dangerous Goods by Rail (RID)

## United Nations

### *Climate change*

Framework Convention on Climate Change, of 9 May 1992 (New York)

Kyoto Protocol to the Framework Convention on Climate Change, of 11 December 1997

## United Nations Environment Programme (UNEP)

### *Protection of the ozone layer*

Vienna Convention for the Protection of the Ozone Layer, of 22 March 1985

Montreal Protocol on Substances that Deplete the Ozone Layer, of 16 September 1987 and adjustments adopted in London (1990), Copenhagen (1992), Vienna (1995) and Montreal (1997)

### *Transboundary movements of hazardous wastes and chemicals*

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, of 22 March 1989

Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (PIC Convention), 1998 (Rotterdam)

## European Union (EU)

### *Environmental impact assessment*

Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment

Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment

### *Road safety*

Directive 70/156/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to type-approval of motor vehicles and their trailers, as amended

Directive 71/320/EEC of 26 July 1971 on the approximation of the laws of the Member States relating to the braking devices of certain categories of motor vehicles and of their trailers, as amended

Directive 74/408/EEC relating to the interior fittings of motor vehicles (strengths of seats and of their anchorages), as amended

Directive 76/115/EEC relating to anchorages for motor vehicle safety belts, as amended

Directive 77/541/EEC relating to safety belts and restraint systems for motor vehicles, as amended

Council Regulation 3820/85/EEC of 20 December 1985 on the harmonisation of certain social legislation relating to road transport

Council Regulation 3821/85/EEC of 20 December 1985 on recording equipment in road transport

Directive 89/459/EEC of 18 July 1989 on the approximation of the laws of the Member States relating to the tread depth of tyres of certain categories of motor vehicles and their trailers, as amended

Directive 91/671/EEC on the approximation of laws relating to compulsory use of safety belts in vehicles of less than 3.5 tonnes

Directive 92/6/EEC on the installation and use of speed limitation devices

Directive 96/53/EC of 25 July 1996 laying down for certain vehicles circulating within the Community the maximum authorized dimensions in national and international traffic and the maximum authorized weights in international traffic

Directive 96/96/EC of 20 December 1996 on the approximation of the laws of the Member States relating to roadworthiness tests for motor vehicles and their trailers

#### *Driving licences*

Council Directive 76/914/EEC of 16 December 1976 on the minimum level of training for some road transport drivers

Council Directive 91/439/EEC of 29 July 1991 on driving licences, amended by:

Council Directive 94/72/EC of 19 December 1994

Council Directive 96/47/EC of 23 July 1996

Council Directive 97/26/EC of 2 June 1997

#### *Air quality*

Directive 70/220/EEC on measures to be taken against air pollution by gases from positive ignition engines of motor vehicles, as amended, including:

Directive 74/209/EEC; Directive 77/102/EEC; Directive 78/665/EEC; Directive 83/351/EEC; Directive 88/76/EEC; Directive 88/609/EEC; Directive 89/458/EEC; Directive 91/441/EEC (the "Consolidated Directive"); Directive 94/12/EC; Directive 96/69/EC; Directive 98/69/EC

Directive 72/306/EEC on measures to be taken against emissions of pollutants from diesel engines for use in motor vehicles, as amended

Directive 75/716/EEC on the approximation of the laws of the Member States on the sulphur content of certain liquid fuels, as amended by Directive 87/219/EEC

Directive 78/611/EEC on the lead content of petrol

Directive 80/779/EEC on air quality limit values and guide values for sulphur dioxide and suspended particulates

Directive 82/884/EEC on limit values for lead in the air

Directive 85/203/EEC on air quality standards for nitrogen dioxide

Directive 85/210/EEC on the approximation of the Member States' legislation on the lead content of petrol, and the introduction of lead-free petrol

Directive 85/536/EEC of 5 December 1985 on crude-oil savings through the use of substitute fuel components in petrol, as amended

Directive 88/77/EEC on the approximation of the laws of the Member States relating to the measures to be taken against the emissions of gaseous pollutants from diesel engines for use in vehicles, as amended by Directive 91/542/EEC

Directive 89/427/EEC on limit values and guide values of air quality for sulphur dioxide and suspended particulates

Directive 92/55/EC on inspection and maintenance

Directive 92/72/EEC on air pollution by ozone

Directive 93/12/EEC on the quality of petrol and diesel fuels, as amended by Directive 98/70/EC

Directive 94/63/EC of 20 December 1994 on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations

Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management (Air quality framework directive), with its daughter directives

Council Decision 97/101/EC of 27 January 1997 establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States

#### *Noise*

Directive 70/157/EEC of 6 February 1970 on the approximation of the laws of the Member States regarding permissible sound levels and exhaust systems of motor vehicles, as amended by Directive 84/424/EEC

Directive 78/1015/EEC of 23 November 1978 on the approximation of the laws of the Member States regarding permissible sound levels and exhaust systems of motor-cycles, as amended by Directive 89/235/EEC; Directive 92/97/EEC

Directive 80/51/EEC of 20 December 1979 on the approximation of the laws of the Member States regarding permissible sound levels of subsonic airplanes

Directive 89/629/EEC of 4 December 1989 regarding permissible sound levels of subsonic airplanes for civil aviation

Directive 92/14/EEC of 2 March 1992 regarding limitations to the exploitation of airplanes, relevant to Annex 16 of the Convention on International Civil Aviation, volume 1, second part, chapter 2, second edition (1988), as amended by Directive 98/20/EC of 30 March 1998

Directive 96/20/EC of 27 March 1996 to adapt in the light of technical progress Directive 70/157/EEC of 6 February 1970 on the approximation of the laws of the Member States regarding permissible sound levels and exhaust systems of motor vehicles

#### *Two- or three-wheel motor vehicles*

Directive 97/24/EC of 17 June 1997 on certain components and characteristics of two- or three-wheel motor vehicles

#### *Inland waterways*

Directive 76/135/EEC of 20 January 1976 on reciprocal recognition of navigability licences for inland waterway vessels

Directive 82/714/EEC of 4 October 1982 laying down technical requirements for inland waterway vessels

#### *Maritime safety and protection of the marine environment*

Directive 79/115/EEC of 21 December 1978 concerning pilotage of vessels by deep-sea pilots in the North Sea and English Channel

Regulation (EEC) No. 613/91 of 4 March 1991 on the transfer of ships from one register to another within the Community, as amended by Commission Regulation (EEC) No. 2158/93

Council Decision 92/143/EEC of 25 February 1992 concerning radio navigation systems for Europe

Directive 93/75/EEC of 13 September 1993 concerning minimum requirements for vessels bound for or leaving Community ports and carrying dangerous or polluting goods, as amended by Directive 96/39/EC of 19 June 1996; Directive 97/34/EC of 6 June 1997; Directive 98/55/EC of 17 July 1998; Directive 98/74/EC of 1 October 1998

List of competent authorities designated by Member States to which the information and notifications provided for in Council Directive 93/75/EEC of 13 September 1993 concerning minimum requirements for vessels bound for or leaving Community ports and carrying dangerous or polluting goods, shall be addressed (OJ No. C 65 of 1 March 1997, p.3, and modification of the list in OJ No. C 150 of 16 May 1998, p.3)

Council Regulation (EC) No. 2978/94 of 21 November 1994 on the implementation of IMO resolution A.747(18) on the application of tonnage measurement of ballast spaces in segregated ballast oil tankers

Directive 94/57/EC of 22 November 1994 on common rules and standards for ship inspection and survey organizations and for the relevant activities of maritime administrations, as amended by Commission Directive 97/58 of 26 September 1997

Commission Decision 96/587/EC of 30 September 1996 on the publication of the list of recognized organizations which have been notified by Member States in accordance with Directive 94/57/EC, as amended by Commission Decision 98/403/EC of 12 June 1998

Commission Decision of 22 April 1998 on the recognition of the Hellenic Register of Shipping in accordance with Council Directive 94/57/EC

Directive 94/58/EC of 22 November 1994 on the minimum level of training of seafarers, as amended by Directive 98/35/EC of 25 May 1998

Directive 95/21/EC of 19 June 1995 concerning the enforcement, in respect of shipping using Community ports and sailing in the waters under the jurisdiction of the Member States, of international standards for ship safety, pollution prevention and shipboard living and working conditions (port State control), as amended by Directive 98/25/EC of 27 April 1998; Directive 98/42/EC of 19 June 1998

Directive 96/40/EC of 25 June 1996 establishing a common model for an identity card for inspectors carrying out port State control

Council Regulation (EC) No. 3051/95 of 8 December 1995 on the safety management of roll-on/roll-off passenger ferries (ro-ro ferries), as amended by Commission Regulation (EC) No. 179/98 of 23 January 1998

Directive 96/98/EC of 20 December 1996 on marine equipment, as amended by Directive 98/85/EC of 11 November 1998

Directive 97/70/EC of 11 December 1997 setting up a harmonised safety regime for fishing vessels of 24 metres in length and over

Directive 98/18/EC of 17 March 1998 on safety rules and standards for passenger ships

Directive 98/41/EC of 18 June 1998 on the registration of persons on board passenger ships

### **International Civil Aviation Organization (ICAO/OACI)**

Convention on International Civil Aviation, signed at Chicago on 7 December 1944, and relevant protocols and agreements, and in particular its Annex 16 on Environmental protection

### **International Maritime Organization (IMO)**

#### *Maritime safety*

International Convention for the Safety of Life at Sea (SOLAS), 1960 and 1974

International Convention on Load Lines (LL), 1966

Special Trade Passenger Ships Agreement (STP), 1971

International Regulations for Preventing Collisions at Sea (COLREG), 1972

International Convention for Safe Containers (CSC), 1972

Convention on the International Maritime Satellite Organization (INMARSAT), 1976

The Torremolinos International Convention for the Safety of Fishing Vessels (SFV), 1977

International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978

International Convention on Maritime Search and Rescue (SAR), 1979

International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (STCW-F), 1995

#### *Marine pollution*

International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL), 1954 (replaced by the MARPOL Convention)

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LDC), 1972

International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION), 1969

International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990

#### *Liability and compensation*

International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969

International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND), 1971

Convention relating to Civil Liability in the Field of Maritime Carriage of Nuclear Materials (NUCLEAR), 1971

Athens Convention relating to the Carriage of Passengers and their Luggage by Sea (PAL), 1974

Convention on Limitation of Liability for Maritime Claims (LLMC), 1976

International Convention on Liability and Compensation for Damage in connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS), 1996

#### *Other subjects*

Convention on Facilitation of International Maritime Traffic (FAL), 1965

International Convention on Tonnage Measurement of Ships (TONNAGE), 1969

Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (SUA), 1988

Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf (SUAPROT), 1988

International Convention on Salvage (SALVAGE), 1989

## **Not legally binding documents**

### **World Health Organization (WHO)**

European Charter on Environment and Health (1989)

Helsinki Declaration on Environment and Health (1994)

Environmental Health Action Plan for Europe (1994)

HEALTH21 – Health for All Policy Framework for the European Region for the 21st Century (1998)

*Air quality guidelines* (1998)

Guidelines for drinking-water quality (1993)

Community noise guidelines (forthcoming)

Guidelines for safe recreational water environments (forthcoming)

The Athens Declaration for Healthy Cities (1998)

Resolution on Healthy Cities – Strengthening action for health for all at local and city levels in the European Region of WHO (EUR/RC48/R3)

### **European Union (EU)**

Communication from the Commission: “The future development of the common transport policy – A global approach to the construction of a Community framework for sustainable mobility”, Supplement 3/93 to the Bulletin of the European Communities, drawn up on the basis of COM (1992) 494 final

“Towards sustainability – A European Community programme of policy and action in relation to the environment and sustainable development”, OJ No. C138/5, 17 May 1993

“Community Action Programme for Accessible Public Transport” – Report from the Commission to the Council concerning the actions to be taken in the Community regarding the accessibility of transport to persons with reduced mobility, 26 November 1993

“The citizens’ network – Fulfilling the potential of public passenger transport in Europe”, European Commission Green Paper, 1996

Communication from the Commission: “Promoting road safety in the European Union: the programme for 1997–2001”, COM(1997) 131 final of 9 April 1997

Communication from the Commission: “A strategy for integrating environment into EU policies”, Cardiff, June 1998, COM(1998) 333 final of 27 May 1998

Conclusions of the European Council, Cardiff, June 1998

Conclusions of the joint Transport and Environment Council, Luxembourg, June 1998

Communication from the Commission: “The common transport policy – Sustainable mobility: Perspectives for the future”, COM(1998) 333 final of 25 May 1998

### **International Union of Railways (UIC)**

Relevant regulations concerning safety and environmental matters in the UIC Code

### **European Civil Aviation Conference (ECAC)**

Manual of ECAC Recommendations and Resolutions relating to Facilitation and Security Matters, ECAC Doc. No. 30 (7th ed.), April 1998 – Section 5: Facilitation of the transport of persons with reduced mobility

### **International Maritime Organization (IMO)**

Recommendation on the design and operation of passenger ships to respond to elderly and disabled persons’ needs, 24 June 1996

### **European Conference of the Ministers of Transport (ECMT) Resolutions**

No. 94/6 On the Promotion of Combined Transport

No. 97/6 On the Development of Combined Transport

No. 97/3 Comprehensive Resolution on Transport for People with Mobility Handicaps

No. 66 On Transport and the Environment

No. 98/1 On the Policy Approach to Internalising the External Costs of Transport

No. 34	On Pedestrian Safety (1975)	<b>United Nations Economic Commission for Europe (UN/ECE)</b>
No. 39	On the Road Safety of Children and Young People	The Vienna Declaration and the Programme of Joint Action adopted by the UN/ECE Regional Conference on Transport and the Environment at the Ministerial Level, November 1997
No. 43	On Monitoring Compliance with Speed Limits and Traffic Lights	
No. 44	On Making Cycling Safer	Århus Declaration on the Phase-out of Added Lead in Petrol, adopted on 24 June 1998 in Århus (Denmark)
No. 50	On Road Safety of Children	
No. 90/4	On Access to Buses, Trains and Coaches for People with Mobility Handicaps	<b>United Nations Conference on Environment and Development (UNCED)</b>
No. 91/3	On the Improvement of Road Safety for the Elderly	Agenda 21: Programme of Action for Sustainable Development, United Nations Conference on Environment and Development (UNCED) (1992)
No. 92/3	On Decentralised Road Safety Policies	
No. 93/5	On Drink as a Factor in Road Accidents	
No. 97/5	On Cyclists	<b>United Nations Centre for Human Settlements (UNCHS)</b>
No. 68	On Transport for People with Mobility Handicaps	HABITAT Agenda on Human Settlements (1996)
No. 91/8	On Information and Communication	
No. 94/2	On Access to Taxis for People with Reduced Mobility	<b>Central European Initiative (CEI)</b>
	Comprehensive Resolution on Persons with Mobility Handicaps, 21 April 1997	Ministerial Declaration of the Central European Initiative (CEI): "Towards sustainable Transport in the CEI Countries" (1997)
	Declaration on "Vulnerable" Transport Users, 21 April 1997	<b>United Nations Environment Programme (UNEP)</b>
	Resolution on Phasing Out Lead in Petrol (forthcoming)	UNEP International Declaration on Cleaner Production (1998)
	<b>Organisation for Economic Co-operation and Development (OECD)</b>	<b>European Sustainable Cities and Towns</b>
	Vancouver Principles for Sustainable Transport (1996)	Charter of European Cities and Towns Towards Sustainability (The Ålborg Charter) (1994)

## Annex 3. Description of principles, approaches and guiding strategies for transport sustainable for health and the environment

### Principles and approaches<sup>4</sup>

*Sustainability.* Transport activities shall be managed so that the needs of the present generation are met without compromising the ability of future generations to meet their own needs.

*The precautionary principle.* Action to prevent, control or reduce the release of transport emissions harmful to health and the environment should not be postponed on the ground that scientific research has not fully proved a causal link between those emissions at which such action is aimed, on the one hand, and their potentially harmful impact on health and the environment, on the other.

*Prevention of transport-related adverse health effects.* This entails reducing air, soil and water pollution, accident risks and noise, greenhouse gases emission and damaging of forests below harmful levels, and assessing and managing the risks from hazardous substances, technologies or processes so that their harmful effects are minimized, including not bringing them into use or phasing them out as soon as possible.

*Protection and promotion of health.* This covers the physical, mental and social wellbeing and safety of all people, paying particular attention to those groups of the population who are more likely to be harmed by the effects of transport, such as children and women, the elderly, the disabled and those with impaired hearing, as well as to the population most exposed to transport risks such as those living in urban or “sensitive” areas, where pollution and noise are intensified due to geographic and topographic circumstances.

*The “polluter pays” principle, including the internalization of externalities,* by virtue of which the costs

of pollution prevention, control and reduction should be borne by the polluter. The full health and environmental costs of transport should be borne by the polluters as far as possible.

*Multisectoral integration.* Environment and health requirements shall be properly integrated into transport, water and land use policies, infrastructure programmes and investments and other transport-related planning activities. Environment and health authorities shall be fully involved in all levels of decision-making, and international cooperation on sustainable and health-promoting transport shall be encouraged.

*Equity.* The health benefits from transport shall be accessible to all, and the disbenefits shall not fall disproportionately on certain groups of the population, in particular children and women, the disabled and the socially excluded, certain generations or certain regions.

*Public participation and information.* Public access to the relevant information on transport-related health and environmental risks and broad dissemination of this information shall be ensured at an early stage. The public, NGOs, the private sector, municipalities and regions shall be encouraged to participate in taking environment- and health-related transport decisions.

*Subsidiarity.* Decisions and actions to manage activities relevant for transport should be taken at the adequate administrative level and as closely as possible to the citizens.

*Efficiency.* Efficient use of transport should be promoted through economic instruments and awareness-building measures.

<sup>4</sup> These definitions have been developed specifically for the purpose of this Charter.

## Guiding strategies

Reduce the need for motorized transport and car dependency, by orienting land use policies and urban and regional planning towards shortening transport distances and providing easier access to health-promoting modes of transport, on the one hand, and towards making fuller use of existing capacities, on the other.

Shift transport volumes to environmentally sound and health-promoting transport, by promoting those modes which are linked with high levels of physical activity, can be the safest, cause the lowest specific emissions and noise, and best conserve resources, and in parallel by discouraging the use of modes of transport and technologies which damage health and the environment.

Implement the best available technologies and best environmental and health standards, best planning methods and best practices for transport involving all relevant sectors and scientific approaches, e.g. transport and land use planners, technologists, and environmental, public health and communication experts.

Apply health and environmental indicators and impact assessments as a basis for transport, water and land use policies, urban and regional development planning, location decisions, infrastructure planning and investment programmes, with the full involvement of environmental and health authorities.

Resolve market distortions by: internalizing transport-related environmental and health costs and benefits; bringing the costs of transport into relation with the mileage travelled; implementing economic instruments to stimulate health-promoting

mobility behaviour and shifts in use of different modes of transport.

Raise awareness of health-promoting transport and mobility, consumption and production patterns, communicating the benefits of healthy transport through public relations activities and information campaigns and the dissemination of information on transport-related health impacts to the public, important target groups and stakeholders.

Develop and apply innovative methodologies such as “backcasting” and impact assessment, as well as indicators and other tools for monitoring the health and environmental impacts of transport, thus providing objective guidance to policy-makers and stakeholders.

Establish partnerships at international, national, subnational and local levels between governmental and intergovernmental bodies, the public, environmental, health and transport NGOs, industry, the private sector, etc., ensuring that synergistic actions are taken and that measures at one level do not increase transport-related adverse effects at other levels. In particular, intensify cooperation with economies in transition, with the aim of fostering good practices related to health-promoting transport.

Launch and promote pilot projects and research programmes on transport sustainable for health and the environment.

Provide broad public information on the environmental health impacts of transport and promote public participation in decision-making processes with relevance to transport, land use and infrastructure policies and planning.

## Annex 4. Health targets for transport, environment and health

As soon as possible, and at the latest by the year 2004, each Member State will define national quantitative or, where technically not feasible, qualitative health targets to make progress towards attainment of the regional health targets set out below. When defining these targets, Member States will take due account of their existing international obligations and relevant ongoing international work in other fora. Member States will also take account of cost-effectiveness and practicability.

### Air quality

To reduce emissions of and human exposure to air pollutants from transport, as a contribution to achieving levels safe for human health, in compliance with WHO's *Air quality guidelines*

- (f) To reduce as much as possible transport emissions of and human exposure to air pollutants identified in WHO's *Air quality guidelines* as having no safe limits. These include particles, identified hazardous volatile organic compounds (VOCs) like benzene, and persistent organic pollutants such as polyaromatic hydrocarbons, dioxins, furans and polychlorinated biphenyls.
- (g) To reduce emissions of and human exposure to CO, NO<sub>2</sub> and SO<sub>2</sub> where transport is a major contributor.
- (h) To lower ambient ozone concentrations by reducing emissions of VOCs and NO<sub>x</sub> from transport.

To reduce exposure to fine and ultrafine particles from transport by setting targets that take into account recommendations to be developed by WHO regarding the number, mass, size, surface area and composition of these particles.

To reduce human exposure to transport-related lead emissions by phasing out leaded petrol, in line with the Århus Declaration.

### Traffic deaths and serious injuries

Without delay, to strive to reduce the rate of death and serious injuries from transport, in particular road traffic accidents, to match or improve on existing best performance in the European Region. Member States should set demanding intermediate quantitative targets to help attain this goal.

Without delay, to strive to reduce rates of death and serious injuries from transport, in particular road traffic accidents among pedestrians and cyclists, while at the same time encouraging an increase in the amount of walking and cycling.

### Promoting cycling and walking for physical activity

To contribute towards the reduction of several common and serious diseases (notably cardiovascular diseases) and functional deterioration through substantial increases in regular physical exercise and through physically active modes of transport, notably walking and cycling.

To create supportive environmental conditions, settlement patterns, land use planning conditions and public transport infrastructures and services that permit and stimulate a substantial increase in the number of short trips undertaken by these physically active modes of transport.

### Noise

To improve human health and wellbeing by reducing exposure to noise from transport, by:

- (i) introducing targets that take into account recommendations contained in WHO guidelines on noise (1980, 1993, 1999), including concern for specific environments where quietness should prevail (residential areas, schools, hospitals), environments where the noise of transport activities should be reduced (areas within range of airports, highways, railways, terminals, petrol stations) and sensitive time periods (nights, evenings, weekends);
- (j) reversing the trend towards an overall increase in noise pollution through a combination of noise emission and noise immission control measures;
- (k) keeping night-time sound levels in residential areas within WHO recommended night-time values and, where these values are currently exceeded, striving to reduce them to recommended sound levels;
- (l) protecting existing quiet parkland and conservation areas and promoting quietness in such areas, by keeping down the ratio of noisy

transport activities relative to background sound levels in these areas.

The need for a session on transport at the Third Ministerial Conference on Environment and Health was identified in a questionnaire survey by WHO in 1996 of Member States in its European Region. The European Environment and Health Committee endorsed that need and proposed the development of a charter; Austria agreed to act as lead country. The text of the charter was negotiated at a series of intergovernmental meetings attended by representatives of ministries of transport, the environment and health of Member States in WHO's European Region, international organizations, the European Commission and nongovernmental organizations. The drafts discussed at those meetings were prepared by drafting groups established at the first intergovernmental meeting.

#### **Acknowledgements**

WHO gratefully acknowledges the support provided by the governments of Austria, Denmark and Malta, the European Environment Agency and the United Nations Environment Programme.

Transport eases access to jobs, education, markets, leisure and other services, and has a key role in the economy. Nevertheless, road users generate excessive costs to themselves, other individuals and society – through noise, pollution and accidents – in the form of illness, injuries, deaths and damage to mental health and social relationships. The continuing expansion of motorized transport in Europe today raises crucial questions about the efficiency and the environmental, health and social implications of land-use and transport policies. Too often, such policies disregard these implications.

The challenge is to promote healthy and sustainable transport alternatives to prevent the negative effects of transport systems on human health. Meeting this challenge requires commitment and action from governments. The Member States in the WHO European Region expressed their commitment by adopting the Charter on Transport, Environment and Health the WHO Third Ministerial Conference on Environment and Health, in London in June 1999.

This book summarizes the key facts on which countries based their decision. Developed from a document prepared for the London Conference, it summarizes the latest scientific evidence on the impact of transport-generated air pollution, noise and accidents on behaviour and physical and mental health. The book also highlights the considerable potential health benefits from non-motorized forms of transport, such as cycling and walking.

This book can alert policy analysts, decision-makers and politicians to current knowledge, and point the way to action for sustainable transport. It calls for policies that require the creators of transport-related costs to pay for them, and take proper account of environment and health implications in decisions on transport infrastructure and urban development. These and other steps are needed if Europe is to reduce ill health and realize the potential for transport to serve society's needs and promote people's health.

