Towards Integrated Reporting on Transport, Health and the Environment: Environment and Health Indicators

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ABSTRACT

Integrated reporting on transport, health and the environment is exemplified using ENHIS – the European Environment and Health Information System developed through a joint effort by the Member States, the European Commission and the WHO Regional Office for Europe in the framework of the environment and health in Europe process. The system is based on a set of environment and health indicators and uses health impact assessment methods, with a focus on priority issues identified by the Children's Environment and Health Action Plan for Europe. Indicator-based assessment for five core indicators is reported to address key transport, health and environment pathways. Information gaps are pointed out where harmonization or new data are needed for health and environment aspects to be taken into account comprehensively in transport policies. Two examples of sectoral assessments highlight approaches for improving the integration of public health concerns into informed decision-making on transport. Some lessons learned during the development of information support of environment and health policies in Europe are presented.

BACKGROUND AND OBJECTIVES

The transport sector affects people's lives in many ways. The access to services and goods possible as a result of contemporary transport technology is an important driver of economic development. Owing to its flexibility, but also to externalization of a part of its costs, road transport is the main mode of transport in Europe. In addition, cars are object of desire and pride in many societies. Unfortunately these positive aspects often do not take into account the related negative consequences: consumption of non-renewable energy, air pollution, noise, road traffic injuries, use of space and often urban developments that hinder physical activity. These risks pose a disproportionate threat to the most vulnerable population groups, such as children and elderly people, and they raise important questions about social inequalities.

A move towards environmentally sustainable transport requires that environment and health (EH) considerations are comprehensively integrated, based on evidence, into policy action taken at each step of the chain of causality driven by transport demands and activities. It also requires the setting up of a mechanism for monitoring and reporting on transport, public health and the environment.

Within the European EH process, priority is increasingly being given to the establishment of a well-coordinated mechanism for EH monitoring and reporting. The Fourth Ministerial Conference on Environment and Health, held in Budapest in 2004, adopted the Children's Environment and Health Action Plan for Europe (CEHAPE) *(1)*. To support policy development, including for CEHAPE, Member States of the WHO European Region

committed themselves to joint action with WHO, the European Commission (EC) and other international organizations in building a supporting information base. The WHO Regional Office for Europe was asked to lead this process, focusing on children's health as underlined by the main focus of the Budapest Conference.

With the support of the Directorate-General for Health and Consumer Protection of the European Commission and contributions from many Member States, the Regional Office for Europe has carried out a series of projects with the aim of designing and establishing an information system, while at the same time strengthening countries' capacities in this area. In response to these needs, the European environment and health information system (ENHIS)[1] was created. This is based on a set of indicators to measure the situation regarding public health and the environment and progress in that area and to enable the policy effects on health to be assessed.

This paper presents examples of integrated transport, health and environment reporting based on ENHIS and the European EH indicators with a focus on children's health.

METHODS

A methodology for the set of EH indicators was developed to include the rationale, definition, required data elements, calculation method, data sources, interpretation and policy relevance.[2] A set of 26 core EH indicators was selected in a process involving multiple working groups and consultations, using the criteria of scientific credibility, a focus on children's EH and relevant policy action, and feasibility. An information base has been created for those indicators using international databases, case studies based on surveys in selected countries and examples of child-specific policies. Reporting methods and tools for indicator fact sheets and periodic indicator-based assessments have been designed for decision-makers, and fact sheets for the 26 indicators created and integrated into the information-base *(2)*.

The following indicators from the core set address transport, health and environment issues:

- Air quality
  - population exposure to outdoor airborne particulate matter (urban)
- Chemicals
  - blood lead levels in children
- Safe mobility
  - road traffic injuries in children and young people
  - policies to promote safe mobility and transport
  - physical activity in children

Concise facts about the situation in the European Region in the first half of the current decade are reported for each indicator together with presentation of the relevant data and a key message.

The following six indicators from the extended set address transport, health and environment issues:

- Safe mobility
  - injury rate due to road traffic accidents
  - children using different forms of transport to travel to school

[1] ENHIS – European Environment and Health Information System [web site]. Copenhagen, WHO Regional Office for Europe, and Brussels, European Commission, 2008 (http://www.enhis.org, accessed 7 April 2008).
[2] The ENHIS methodology [web site]. Copenhagen, WHO Regional Office for Europe, and Brussels, European Commission, 2008 (www.enhis.org/object_class/enhis_about_indicators.html, accessed 7 April 2008).

o	Air quality	• population exposure to outdoor air ozone (SOMO35)[3]
		• children living in proximity to heavily trafficked roads
o	Traffic noise	• population living in dwellings exposed to traffic noise
		• children exposed to transport noise in schools

Only rationale and data-flow status are given for the indicators from the extended set as they require further harmonization and new data collection.

Integrated sector-specific assessments are powerful tools for informed decision-making enabling projection of health benefits from implementing a policy or regulatory action as well as valuing the associated economic costs. Two examples of integrated assessments are given.

The first is the economic valuation of health benefits of physical activity, particularly from cycling and walking. The calculation of cost–benefit ratios is an established practice in transport planning, but the health effects of transport interventions are rarely taken into account in such analyses. In recent years, a few countries (e.g. the Nordic Council) have carried out pioneering work in trying to assess the overall costs and benefits of transport infrastructures taking health effects into account, and have developed guidance for carrying out these assessments. However, important questions remain to be addressed regarding the type and extent of health benefits which can be attained through investments in policies and initiatives that promote cycling and walking. WHO has, therefore, launched a project *(3)* aimed at:

a) reviewing recent approaches to cost–benefit analysis of transport-related physical activity; and
b) developing guidance on approaches to including health effects through transport-related physical activity in economic analyses of transport infrastructure and policies for the Member States.

The project was developed by a core group with the support of an international advisory group consisting of economists, experts in health and physical activity and experts in transport. The products, a guidance document and an illustrative tool with its user guide, have been developed through a systematic review of the relevant published literature and a comprehensive consensus-building process.

The second example of integrated assessment presents a case study from Germany on the impact on health of road traffic noise. Details about the methodology can be found on the Health Impact Assessment page of the ENHIS web site (http://www.enhis.org/object_class/enhis_healthimpactassessment.html, accessed 7 April 2008).

RESULTS

Indicator-based reporting

- Population exposure to outdoor airborne particulate matter in urban areas

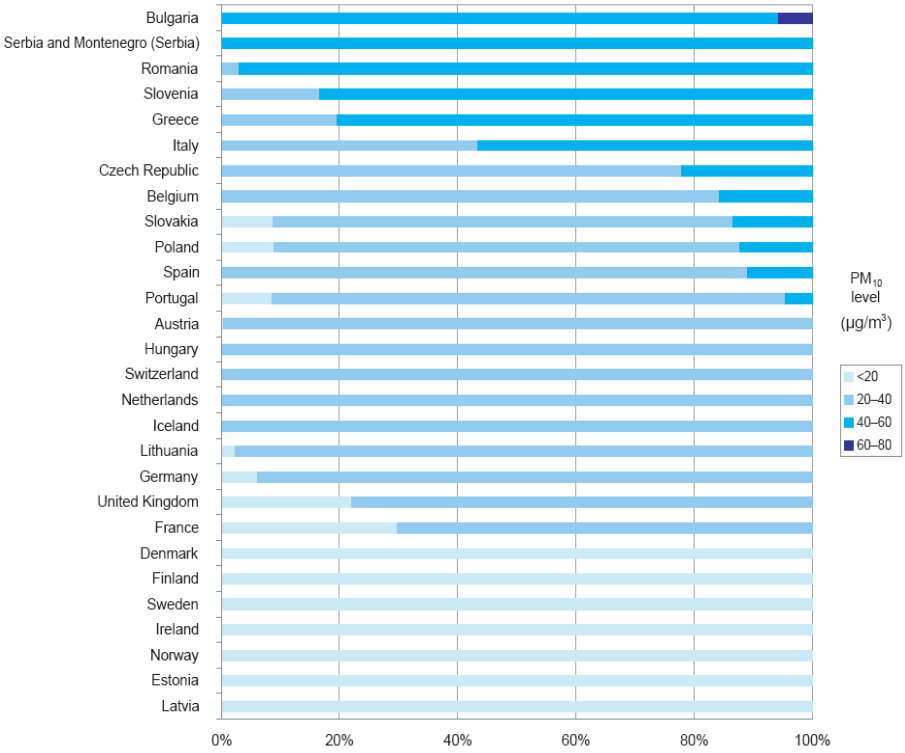
Among air pollutants, particulate matter (PM) is widely present and people are exposed where they live and work. To a great extent, PM is generated by human activities such as transport, energy production, domestic heating and a wide range of industries. Concentrations of

[3] The population-weighted annual sum of a maximum daily eight-hour mean of ozone concentrations exceeding 70 μg/m^3 (35 ppb).

ambient PM_{10} (particles with a diameter of up to 10 µm, which are small enough to pass into the lungs) are a good approximation of population exposure to PM from outdoor sources. The value of this is supported by numerous epidemiological studies, conducted in Europe and in other parts of the world, which show links between various indicators of children's health and outdoor PM_{10}. Importantly, effects are seen on health at PM levels currently observed in European cities.

Fig. 1 shows population exposure to PM_{10} (as an average annual concentration) in various European cities in 2004 (or the last available year). This is expected to approximate to the exposure in children, assuming children comprise similar proportions of the cities' populations *(4)*. The average exposure to PM_{10} varied from 13–14 µg/m^3 (Finland, Ireland) to 53–56 µg/m^3 (Bulgaria, Romania and Serbia and Montenegro (Serbia)[4]). Within some countries, a three-fold variation in the exposure level of children was observed. There have been no substantial changes in average exposure levels over the last few years in urban areas of the Region.

Fig. 1. Percentage of children living in cities with various PM_{10} levels, 2004

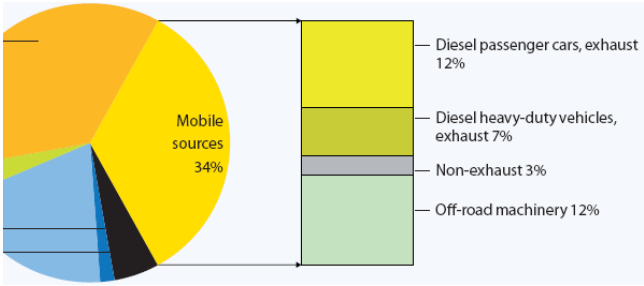


Of people living in European cities where PM_{10} is monitored, the vast majority (89%), including children, are exposed to levels exceeding the WHO air quality guideline level of 20 µg/m^3 *(5)*. This gives rise to a substantial risk to children's health. For 14% of people, the higher European Union (EU) limit value of 40 µg/m^3 is exceeded. Finally, it should be remembered that no PM data from regular monitoring are available for 31 countries in the Region (with 43% of the total population). An approximate assessment indicates that the pollution levels and corresponding health risks may be even higher in many of these countries.

[4] Serbia and Montenegro became two separate Member States of WHO in September 2006. In this paper the data refer to the period before 2006 and relate to the then one country of Serbia and Montenegro (Serbia).

Among the major contributors to urban air pollution, road transport is becoming ever more important. Traffic contributes to a range of gaseous air pollutants and to suspended PM of different sizes and composition. Tailpipe emissions of primary particles from road transport account for up to 30% of $PM_{2.5}$ in urban areas *(6)* (Fig. 2). Other emissions, such as those from re-suspended road dust or resulting from worn tyres and brake linings, are the most important source of coarse PM. People of all ages experience high levels of exposure to traffic-related air pollutants when they live near busy roads, travel on roads or have to spend a long time on roads. Epidemiological and toxicological studies indicate that transport-related air pollution contributes to an increased risk of death, particularly from cardiopulmonary causes, as well as to an increased risk of respiratory symptoms and diseases *(7)*. The exposure of children to traffic-related air pollutants such as PM has a considerable impact on their health and well-being *(8)*.

Fig. 2. Transport sector contribution to primary $PM_{2.5}$ emissions, EU15,[a] 2000

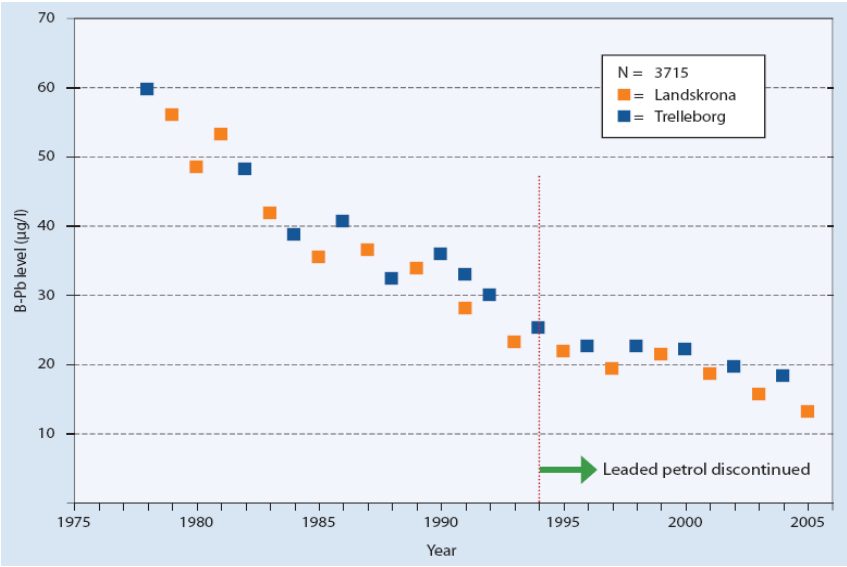


[a] Countries belonging to the EU before May 2004.

- Blood lead level in children

Lead is a well-known neurotoxin: impairment of neurodevelopment in children is the most critical effect. In many Member States there have been major decreases in blood lead levels in children in recent decades, mainly because of the uptake of unleaded fuels. Nevertheless, case studies *(9)* such as the one shown in Fig. 3 demonstrate that residual exposure to re-suspended lead disappears only after complete elimination of leaded petrol from the market.

Fig. 3. Blood lead levels in children, Sweden, 1978–2005

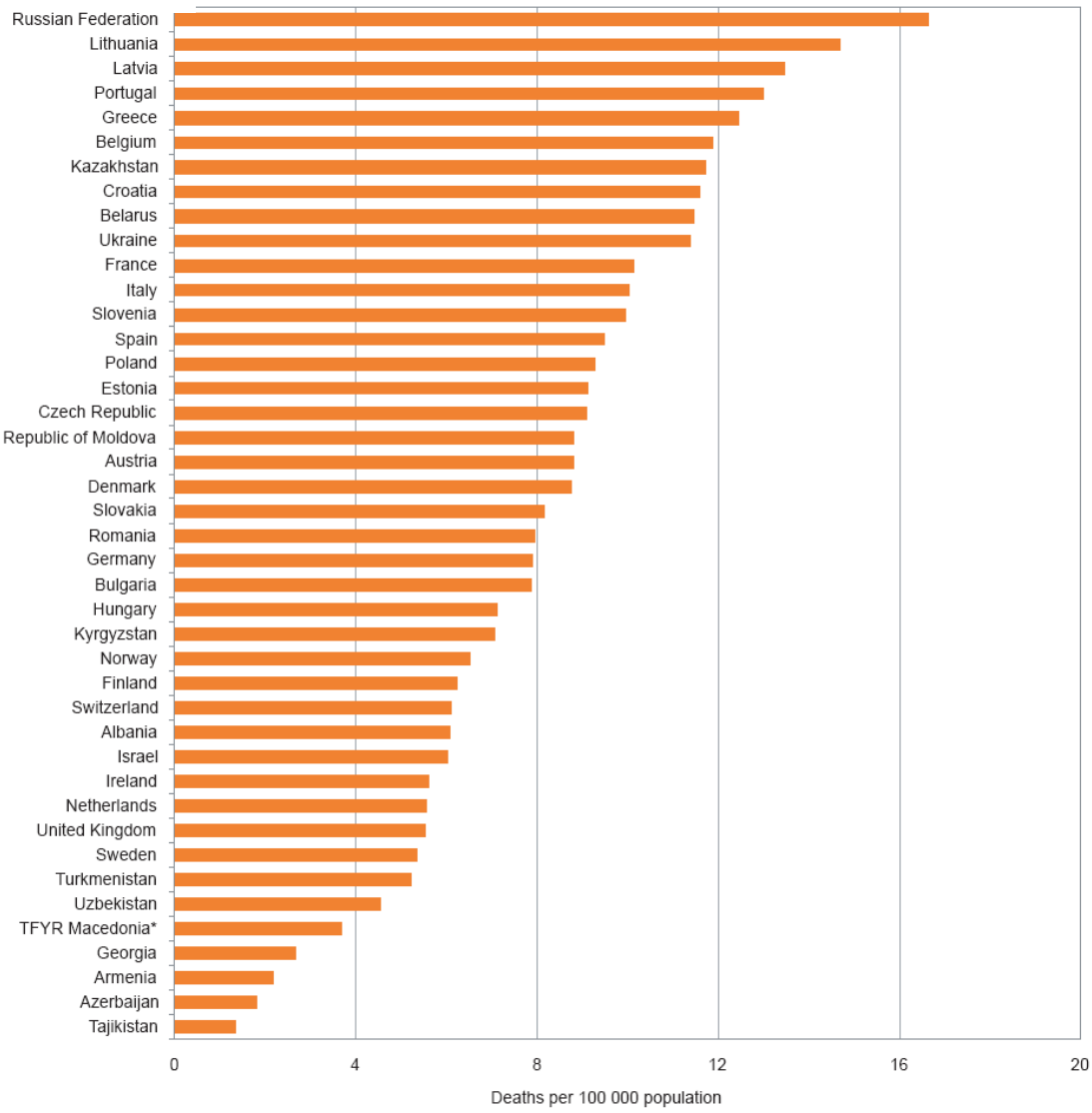


- Road traffic injuries

Each year 32 000 people aged under 25 years in the European Region lose their lives to road traffic injuries (RTI), making this the third leading cause of deaths. Deaths are only the tip of the iceberg, and RTI are also a leading cause of hospital attendance and disability and high costs to society.

The rates range from 1.4 per 100 000 in Tajikistan to 16.6 per 100 000 in the Russian Federation. In general, child mortality from RTI is highest in the countries of the former Soviet Union and lower in countries in the western part of the Region, particularly in the Netherlands, Sweden and the United Kingdom (Fig. 4). Some countries, such as the Caucasian countries, report very low death rates. These results may be related to socioeconomic factors, proportionally fewer motor vehicles and, in part, to poorer reporting *(10)*.

Fig. 4. Standardized death rates for road traffic injuries in children and young people aged 0–24 years in the WHO European Region: averages for 2002–2004 or the most recent three years



* The former Yugoslav Republic of Macedonia.

Children and adolescents are particularly vulnerable to RTIs due to their limited capacity to concentrate on traffic. They are considered particularly vulnerable when motor traffic is heavy or fast, visibility is limited or a driver's attention is diverted. This may be reflected by the fact that in the group aged 0–14 years nearly 50% of deaths due to RTIs involve child pedestrians. In contrast, road deaths among 15–24-year-olds are primarily in cars (59%) or on motorcycles (19%) *(11).*

RTI are largely preventable: three out of four deaths can be averted if all countries had the same death rate for RTI as Sweden. To counteract this significant health impact, policies on safe mobility and transport are increasingly being developed at European and national levels.

- Policies to promote safe mobility and transport

The indicator gives a snapshot of the existence, implementation and enforcement of specific national policies to promote safe mobility and transport for children in the Region, as assessed by national experts in 27 countries. The policy data encompass legislative, licensing and educational activities. Fig. 5 shows the combined level of implementation of traffic legislation aimed at creating safer mobility for children in the 27 countries *(12)*. The legislation most often reported as enforced and implemented is that covering the use of seatbelts in vehicles and safety helmets on motorcycles. Data regarding legislation on the use of bicycle helmets and on rear-facing seats for children up to three years old were less frequently reported as implemented or were poorly enforced. Quite high levels of implementation were reported for traffic safety education as a part of school curricula and for graduated driving licensing systems.

Data from the comparison of policies reflect the earlier creation of road safety traffic laws and acts in the countries belonging to the EU before May 2004 (EU15) compared to other areas in the Region and show that there are wide differences between countries.

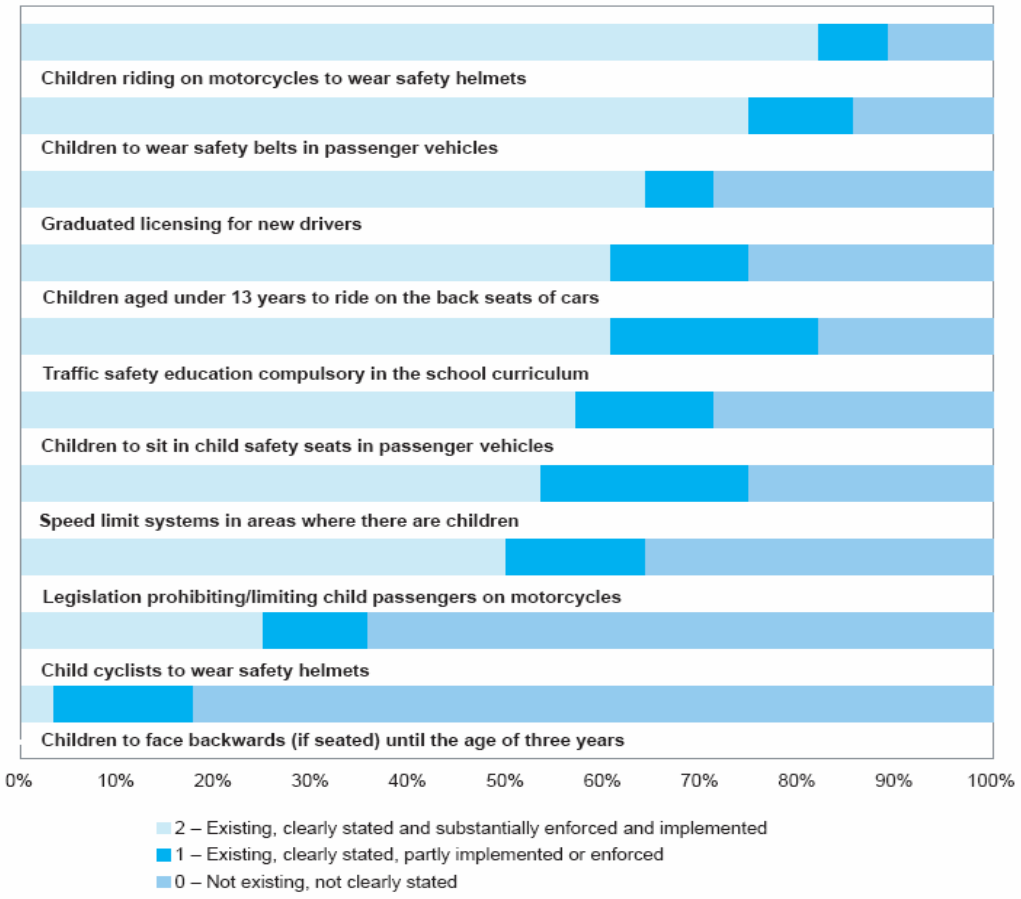
In addition to creating safer transport conditions, there should be a focus on healthier mobility and preventing obesity through promoting physical activity.

- Physical activity

Physical activity benefits young people's health by, among other things, improving aerobic fitness; positively affecting blood pressure, blood lipids and skeletal health; and benefiting psychological well-being. European guidelines suggest that young people should take 60 minutes or more of at least moderate intensity physical activity on five or more days a week, and a part of this could be achieved by walking or cycling to school *(13)*. Beyond this, physical activity provides more than direct health benefits; it also improves the well-being of communities, offers protection to the environment and invests in future generations.

Fig. 6 shows the proportion of children aged 11 and 15 years undertaking sufficient physical activity in the Region in 2001/2002. Despite the benefits, over 50% of the children were not sufficiently active, with considerable variations among countries.

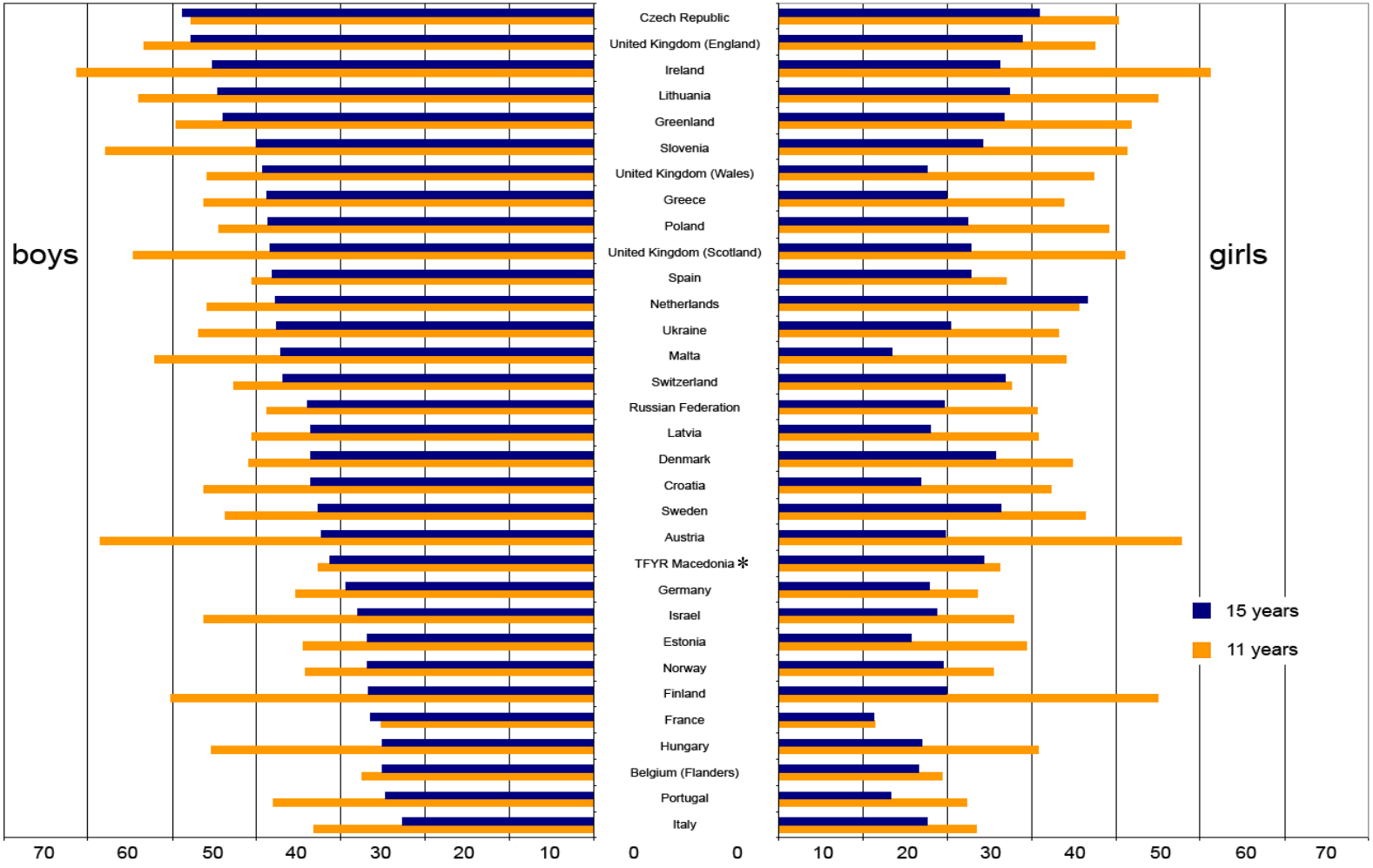
Fig. 5. Implementation of 10 policies aimed at preventing road traffic injuries in children and young people in selected European countries, 2006



It appears that boys are more likely to meet the guidelines than girls, and levels of physical activity decrease as young people become older, particularly among girls. Environmental factors such as green areas, parks, safe infrastructure for cyclists and pedestrians and educational programmes, together with the presence of recreational areas and facilities for physical activity are linked to the proportion of children who are active. A shift in the paradigm of the road safety strategies towards healthy mobility and physical activity has the potential for large health gains. Ensuring appropriate urban landscapes and built environments would be a major achievement in combating the modern epidemics of excess weight and obesity and related chronic diseases.

Within the extended set of indicators the perspective for indicator-based reporting is as follows.

Fig. 6. Percentage of children and adolescents undertaking sufficient physical activity, 2001/2002



* The former Yugoslav Republic of Macedonia

- Injury rate due to RTI

The indicator is designed to give a better insight into the public health problem resulting from RTI, as fatalities are only part of the story: many people suffer severe long-term physical disability and psychological consequences. It is relatively easy to interpret as the cause–health effect link is explicit. Changes in the indicator should be due to reduction in total traffic volume, greater segregation of pedestrians from road traffic, and improvements in road infrastructure, traffic management, vehicle safety and environmental conditions. Data from EU countries are available in the Road Safety Observatory *(14)*, although data collection practices differ and there are limitations due to underreporting,

- Children using different forms of transport to travel to school

Since more than 50% of journeys undertaken by car are shorter than five kilometres and 30% are shorter than three kilometres, walking and cycling may often be feasible alternative forms of transport, including at times for adults travelling with children. Pedestrians and cyclists are, however, discouraged in many European cities by fear of traffic injuries and hostile road environments, with high volumes of traffic and lack of infrastructure for vulnerable road users. Investments in the development of safe pedestrian and cycling environments are likely to be returned through an increase in children choosing independent and safe physical activity.

The indicator measures the proportion of children who walk or cycle to school or go by car or public transport. It is based on the assumption that walking and cycling are health-enhancing and that public transport is a sustainable form of transport less polluting per capita than travelling by car. Data will be available in the future from the Health Behaviour in School-aged Children *(15)* study and on the local scale from the European common indicators.

- Population exposure to outdoor air ozone

Ozone and other photochemical oxidants are pollutants that are not directly emitted by primary sources. The precursors of ozone are nitrogen dioxide and non-methane volatile organic compounds (VOC), especially unsaturated VOCs. They are emitted from large urban centres and industrial areas. The indicator is defined as the population-weighted annual sum of a maximum daily eight-hour mean of ozone concentrations exceeding 70 $\mu g/m^3$ (35 ppb) (SOMO35). Data on ambient air pollution concentrations from national or local monitoring networks are submitted to and maintained by the European Environment Agency AirBase *(16)*. For countries belonging to the EU after May 2004 (EU25), the indicator is available at the Eurostat data portal sustainable development indicators *(17)*. The ENHIS indicator-based assessment will be available by the end of 2008.

- Children living in proximity to heavily trafficked roads

The indicator provides a useful general measure of the level of exposure of children to road traffic. A recent study conducted by the EC Joint Research Centre using GIS techniques and overlaying population density with the road network has shown that nearly 1 300 000 children under 15 years of age live within 50 m of roads in the EU15. Those children are at high risk from air pollution as well as noise and traffic accidents. Furthermore, they are restricted in normal children's activities such as playing, sports and being healthy mobile. The greatest problems are in big urban agglomerations with the highest concentrations of people. The indicator measures the proportion of children who live at a distance of 50 m, 200 m and 350 m from motorways, dual-lane national roads, national roads and other principal roads as

classified by Eurostat. When the same methodology and database were applied at city level, they disclosed a limitation of the road network database, namely that they do not include the big busy roads within the cities unless these are designated part of a national road. Further enhancement of the GISCO road database *(18)* and availability of population density within cities are needed before the indicator can be applied *(19)*.

- Population living in dwellings exposed to environmental noise

Noise seriously harms human health and interferes with people's daily activities at school, at work, at home and during leisure time. Traffic noise alone today harms the health of almost every third European. The indicator is in line with the EU Environmental Noise Directive 2002/49/EC *(20)* which requires estimation of the number of people exposed to ranges of noise levels from different sources of environmental noise in urban areas and along major transport infrastructures. Data are expected from the WHO Member States during 2008, after which the indicator-based assessment will be developed.

- Children exposed to harmful noise at school

Impairment of early childhood development and education by environmental noise may have lifelong effects on academic achievement and health. The indicator measures the proportion of children at risk of experiencing cognitive delays in school due to excessive noise, i.e. above 55 dB (A) average during school hours. It represents the daily exposure to noise for school-age children. Data flows are expected after the full implementation of Directive 2002/49/EC.

Examples of integrated assessments

- Economic valuation of the health benefits of walking and cycling

Products developed by this project include guidance to quantify the health effects of cycling and walking *(3)* as well as an illustrative tool for cycling named *Health economic assessment tool for cycling* (HEAT for cycling) and its user guide.

Based on the available evidence that can be adapted to specific situations, this tool estimates the economic savings resulting from reduced mortality due to cycling, i.e. if x people cycle y distance on most days, what is the economic value of the improvements in their mortality rate? The results of this project are meant primarily for integration into comprehensive cost–benefit analyses of transport interventions or infrastructure projects, but can also serve for an assessment of the current situation or of investments made in the past. The only input data needed are the number of trips currently made by bicycle or projected to result from a particular intervention and their average length. This makes the tool attractive for transport planners who do not have a public health background.

Illustrative applications show that the public health benefits and potential economic savings from public health benefits are likely to be great, especially if inactive individuals can be reached through targeted interventions.

A number of Member States are currently considering the application of the tool and case studies will be available on the project website soon.

- Health impact assessment of traffic noise

A health impact assessment case study in children aged 0–14 years on health effects induced by road traffic noise has been conducted in two German cities in North Rhine-Westphalia, one small town (city A), the other a larger city in a highly compressed area (city B). It was estimated that 17–34% of the children in these cities were exposed to noise levels of more than 60 dB(A) during the day and 21–34% to more than 50 dB(A) at night.

The proportions of highly annoyed and highly sleep-disturbed children per 1000 in both cities were estimated for the current situation and for two scenarios: noise exposure not exceeding 60 dB(A) during the daytime and 50 dB(A) at night, and noise levels decreased by 5 dB(A).

The results showed a clear fall in negative health outcomes in both cities under the two scenarios. Preventive action to reduce exposure to traffic noise following the introduction of Directive 2002/49/EC should, therefore, be reinforced in Europe *(21)*.

CONCLUSIONS

These results show that EH indicator-based assessment and reporting could support the measurement of environmentally sustainable transport. Furthermore, they show that while the development of indicators is important, even more so is their regular use to inform decision-making and to facilitate public debate among different stakeholders. The use of indicators in policy-oriented monitoring implies a need for time-trends analysis and reporting, which requires the resolution of a number of feasibility issues and the maintenance and updating of the information base.

Indicators enable comparisons between countries to be made of progress towards targets set in the European policy action programmes. Lessons from ENHIS show the usefulness of such country comparisons in achieving peer-pressure effects and also in enabling the exchange of and learning from examples of good practice. Making explicit health concerns and, in particular, children's needs with regard to their environment the focus of transport policies should stimulate the development of accountable public policies that benefit both the environment and public health.

Finally, the implementation of indicator-based systems for assessment and reporting entails the establishment of a network of diverse partners as an important mechanism for maintaining data-flows and the relevance of the information. The assurance of some degree of institutional commitment represents both a challenge to, and the optimal solution for, the network and sustainability of the system.

As for ENHIS, the next steps include:

- periodic updates of the databases concerning new data points to allow the analysis of trends and expansion of country coverage, as well as updating the system's web site and fact sheets;
- expansion of the system to new policy areas, for example, to cover the health aspects of climate change and the built environment and to address high-risk groups in addition to children; and
- further integration and expansion of the policy analysis and health impact assessment tools and case studies.

Illustrative applications of the HEAT for cycling tool show that the public health benefits and potential economic savings from public health benefits are likely to be great, especially if inactive people can be reached through targeted interventions. The development of a similar

tool for valuing the health benefits from walking is foreseen in the next phase of the project. The interest of Member States in applying the tool to their national or local contexts shows that such practical guidance and tools can usefully support the integration of health concerns into transport policies and interventions.

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