



**Economic and Social
Council**

Distr.
GENERAL

ECE/AC.21/2004/6
EUR/04/5045236/6
22 January 2004

Original: ENGLISH

**ECONOMIC COMMISSION FOR EUROPE
WORLD HEALTH ORGANIZATION**
Regional Office for Europe

HIGH-LEVEL MEETING ON TRANSPORT, ENVIRONMENT AND HEALTH
THE PEP Steering Committee
(Second session, 29 and 30 March 2004,
agenda item 4.A(iii))

**TRANSPORT RELATED HEALTH IMPACTS – COSTS AND BENEFITS
WITH A PARTICULAR FOCUS ON CHILDREN**

Introductory note by the WHO/Europe and UNECE secretariats

1. The present document has been prepared by Austria, France, Malta, the Netherlands, Sweden and Switzerland for consideration by the Steering Committee of the Transport Health and Environment Pan-European Programme (THE PEP) at its second session, 29-30 March 2004, under agenda item 4.A(iii) on “Implementation of THE PEP programme of work 2003 - 2005 – Progress report on the implementation of current activities”.
2. The document contains information on the progress achieved and further steps to be taken in the context of the transnational project jointly launched by the above countries, in cooperation with WHO/Europe and UNECE, focusing on transport related health impacts, costs and benefits, in particular as regards children.
3. The project contributes to the implementation of priority activities included in THE PEP Work Plan, namely “Promotion, implementation and review of policies designed to internalize the

health and environmental externalities (external costs) generated by transport activities”, as well as “Special care for groups at high risk”. It also provides input to the European Children’s Environment and Health Action Plan for Europe (CEHAPE), to be adopted by the Fourth Ministerial Conference on Environment and Health (Budapest, 23-25 June 2004), as well as to the development of WHO guidelines for the assessment of health costs and benefits of transport-related policies and interventions.

4. The document presents the main outcomes of a series of four workshops undertaken in the context of the project¹, namely:

- (a) Review on the state of the art on transport related health impacts, their costs and benefits;
- (b) Gaps identified in research and implementation;
- (c) Recommendations on political implementation strategies.

5. At its first session, on 10-11 April 2003, the Steering Committee welcomed and endorsed the project proposal, and expressed the view that, to the extent possible, the scope of the project should be extended to cover the whole pan-European region.²

6. At its second session, the Steering Committee is invited to provide its views regarding progress achieved so far and possible future directions of work. The Steering Committee is invited also to provide comments on a draft brochure presenting a synthesis of the project results, to be distributed at the 4th Ministerial Conference on Environment and Health. The draft brochure will be tabled at the meeting.

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¹ Full papers and presentations can be downloaded from: <http://www.herry.at/the-pep/agenda.htm>.

² ECE.AC.21/2003/6 - EUR/03/5040828/6, para. 20.

Progress Report - January 2004

(Compiled by HERRY Consult, Transnational Coordinator of the project)

“TRANSPORT RELATED HEALTH IMPACTS - COSTS AND BENEFITS WITH A PARTICULAR FOCUS ON CHILDREN”

1. Background

The background of this project refers to an impact assessment project of Austria, France and Switzerland as a contribution to the 3rd WHO Ministerial Conference on Environment and Health, London 1999. The main tasks of the trilateral project “Health Costs due to Road Traffic related Air Pollution” were to evaluate the exposure due to (road traffic related) air pollution. For this, an evaluation of the exposure-response relationship between air pollution and health impacts has been provided as well as economic valuation of the road traffic-related health impacts. The main results in brief are stated below (for more details please refer also to www.euro.who.int/transport/HIA/20021107_3):

Air Pollution Attributable Health Outcomes in Austria, France and Switzerland (1996)		
Total Mortality (adults >= 30 y)	Annual Attributable Cases	Annual Costs
total air pollution	40,000	49,700 million EUR
road traffic related air pollution	22,000	26,000 million EUR

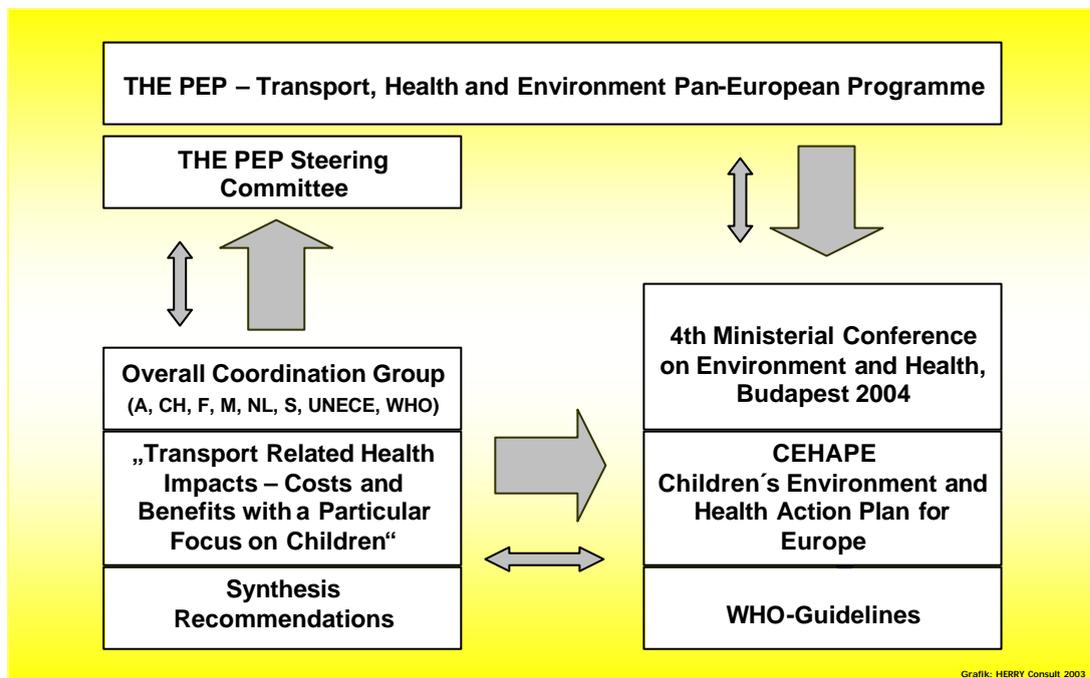
2. Aim of Project

The transnational project jointly launched by Austria, France, Malta, the Netherlands, Sweden and Switzerland in cooperation with WHO and UNECE aims at the integration of environmental and health aspects into policies and decisions on transport on the way to achieve sustainability in particular providing a viable future for our children. A review will be provided on the state of the art on transport related health impacts, their costs and benefits. Gaps in research and implementation will be identified and recommendations on political implementation strategies will be developed. This project will also be a contribution to the UNECE – WHO/Europe Transport, Health and Environment Pan-European Programme (THE PEP) and in particular to the following PEP-priorities:

- Promotion, implementation and review of policies designed to internalize the health and environmental externalities generated by transport activities;
- Special care for groups at high risk, in particular children;

- Contribution and input to the 4th WHO Ministerial Conference Environment and Health “The Future for Our Children” Budapest 2004.

As a result of this project, a synthesis report on the transport related health impacts and costs in particular for children will be developed, and an input to WHO-guidelines for the assessment of health costs and benefits of transport, environment and health related policies and interventions under the specific focus on children will be provided. Furthermore, an input to the Children’s Environment and Health Action Plan for Europe (CEHAPE) will be provided. The results of this project will be presented to THE PEP Steering Committee, as well as at the 4th Ministerial Conference on Environment and Health in Budapest 2004.



The audience for the exercise are those involved in estimating transport-related health costs, such as economists, epidemiologists, and experts in transport planning departments. The exercise will summarize and critically review available methods for the assessment of transport-related health costs, point out the limitations of present tools, make recommendations for choice of methods, provide practical guidance for their implementation, and give examples of good practice. The results will be published and disseminated.

3. Structure

The participating countries have agreed to take a leading role for the development of work concerning:

Austria: Overall project co-ordination; psychological and social impacts

France: Air pollution

Sweden: Methods for the monetarization of different transport-related health costs

Switzerland: Physical activity

The Netherlands : Noise

In addition, **Malta** has expressed the interest to participate in the project by hosting the final workshop.

As there have not been additional volunteering countries to participate by taking the lead on the topics Climate Change and Road Safety, these aspects will be covered by contributions from WHO/Europe.

For the topics of Air Pollution, Noise, Physical Activity and Psychological and Social Aspects, the major tasks have been to discuss the following aspects:

1. Exposure data/levels in children
2. Health impacts in children
3. Exposure-response functions to be recommended for HIA
4. What can we learn from existing case-studies/HIA exercises? If these are lacking for children, what can we learn from good example studies of HIA in adults, can results be extrapolated?
5. Results of economic valuation in children or (if data are lacking) recommended methodology. Can results in adults be extrapolated?
6. Gaps in knowledge/research recommendations
7. Policy recommendations.

The project is being developed through a series of reviews and workshops. The output of this project is based on four workshops. Within each workshop, each topic described above is treated.

Workshop I: *“Transport Related Health Impacts - Review of Exposures and Epidemiological Status”*

Host/Date: Austria/Vienna, 24-25 April 2003.

Workshop II *“Economic Valuation of Health Effects due to Transport”*

Host/Date: Sweden/Stockholm, 12-13 June 2003.

Workshop III *“Health Impacts of Transport on Children”*

Host/Date: The Netherlands/The Hague, 16-17 October 2003.

Workshop IV *“Synthesis and Policy Recommendations”*

Host/Date: Malta/Sliema, 19-20 February 2004.

4. Topic Specific Intermediate Results

AIR POLLUTION

Traffic related air pollution indicators

One major aspect of the discussions on traffic related air pollution health impact assessment relates to recommendations on the best traffic indicator. In a French case study, PM10, beside NO₂, has been selected as an indicator and remains as a good general indicator for air quality. A recent study in the Netherlands has also shown that PM10 expressed in mass is less correlated with traffic proximity than other indicators, such as: reflectance/absorbency of the PM10 or PM2.5 filter (which is a measure of Elemental Carbon), Benzo[a]pyrene, total PAH, Benzene or total VOC. On the other hand, to use those new indicators of traffic air pollutant emissions there is a need to know Exposure Response Functions (ERF) that relate the indicators to health outcomes. Latest results from the APHEA 2 study on acute effects of particulate air pollution on respiratory admission show that black smoke (which is absorbency on total particulate matter) gives a smaller and less precisely association with emergency hospital admissions for asthma, chronic obstructive pulmonary disease (COPD) and all respiratory disease. Until today, there do not exist other epidemiological studies that provide ERFs for those new indicators. For this, further research is needed on indicators of traffic air pollutant emission, to encourage PM2.5 elemental carbon, PAH and VOC monitoring in the European city air quality network. For an HIA and monetarization of health impact due to air pollution it has been concluded to use PM10 and NO₂, since ERFs are well established for adults and some ERFs exist for children.

Furthermore, a more extensive use of GIS (Geographical Information System) is recommended to evaluate accurately the population living near main streets, roads and freeways. Distance from the residential address to the main traffic road gives a good indication on the exposure to traffic related air pollutants. Hence, it should be kept in mind that distances have to be transformed to “predicted” concentrations with a numerical factor established on the basis of local data from an air monitoring network. As not all European countries already have access to GIS data, this recommendation concerns a research gap and not a policy decision.

What can we learn from other HIA studies

There exist two different methodologies for Health Impact Assessment. The first one is based on ERFs from epidemiological studies and single indicator of air pollution (e.g. tri-national or APHEIS study). The second one is based on dose-response functions from both animal and/or epidemiological study and includes a lot of individual pollutants (e.g. ExterneE study). The two HIA approaches are not opponents, they are designed to answer different questions (different purposes à different approaches). The first approach will give a more global valuation of the air pollution impact. It may be more appropriate for general transportation policy planning at a national or

European level. The second one offers more opportunities to understand or assess the effects of specific measures like prescription of fuel quality and engine or exhaust technology. For health impact of traffic related air pollution on children, the APHEIS methodology is recommended.

What is the pertinent health outcome in children

At one workshop (WS 3 “Health Impacts of Transport on Children”), international experts have been confronted with a list of criteria aiming to select health outcomes for children. In the “state of the art” on epidemiological knowledge an inventory of health outcomes has been made. The idea was to apply the criteria to the health outcomes stock list to obtain a set of selected outcomes for a HIA in children.

Some experts suggested, as an alternative procedure, to select health outcomes based on expert judgement. It was not decided which procedure should finally be adopted.

List of criteria for children health outcomes selection:

1. The health outcome is "linked" (causality?) or associated with air pollution
2. Avoid multiple counting of the same impact (Intra Uterine Growth Rate and Low Birth Weight?)
3. Health outcomes which allow monetary valuation (exclusion of lung function reduction, immune response or growth rate...)
4. Availability of baseline frequency data

List of criteria for ERF selection:

1. Use ERFs derived from European studies
2. Use ERFs expressed for an increase in air pollutant concentration (linear function?)

According to the US-EPA and economists, mortality costs dominate morbidity costs by far. For this, mortality is the main health outcome for children to be selected for a HIA. Unfortunately, epidemiological evidence on mortality due to air pollution in children is still deficient. Only two studies (Brazilian and Czech) have investigated the association between particulate matter and/or NO₂ exposure during pregnancy and on intrauterine mortality and stillbirths. The results are limited, they are not homogeneous and do not exhibit a clear exposure-response relationship. Two European studies state that exposure to PM is more strongly associated with excess post-neonatal deaths than exposure to NO_x. These effects seem to be stronger in the post-neonatal period (1-12 months) compare to the neonatal period (< 1 month) and specific for respiratory causes. Results of two studies in the United States and Mexico are consistent with European studies, indicating that PM₁₀ may be associated with increased risk of post-neonatal mortality. Two Brazilian studies suggest a possible positive relationship between air pollution exposure (PM, NO₂) and mortality in young children (< 5 years), especially respiratory mortality. There exist no European data concerning the association between exposure to air pollutants before 5 years and mortality. This frail evidence is not enough to demonstrate the causal role of air pollutants on children's mortality. For the Budapest

Conference it is recommended to implement an epidemiological study on children mortality in relation to air pollution. Strong hypotheses supporting this recommendation are:

1. Air pollution is a causal factor of death in elderly and it could be the same at the early age
2. Air pollution has health effects that can conduct to death (asthma attack, restricted pulmonary function, low birth weight).

It has been decided, even if evidence is weak, to select post-neonatal mortality as the mortality outcome in the French case study. This will authorize estimation of impact and costs in the hypothesis of a causal role of air pollution on children mortality.

Some experts also pointed out that reduction in lung function is correlated to reduction in life expectancy. This could be a way for taking mortality into account. But this approach will spread strong uncertainty since there are two successive links to be quantified:

- 1) The ERF for PM and pulmonary function decreases with exposure (well established for children),
- 2) The ERF for pulmonary decrease and years of live lost (not so well known). Moreover, death will concern the elderly not the children. Based on these uncertainties, more study on decrease of pulmonary function and life expectancy is recommended.

Economists say that cost of all (excepted immune response) morbidity end points listed in the epidemiological inventory can be estimated. If European data are missing they could be completed with US-EPA data for: school absenteeism, cancer, asthma attack and respiratory admissions. Hence, avoiding double count and availability of baseline frequencies there should be more selective criteria for morbidity outcomes. Taking this into account seven health outcomes were left to be assessed:

- Intra Uterine Growth Rate or Low Birth Weight or Growth rate;
- Asthma attacks or Asthma hospitalization or Respiratory hospitalization or Emergency visits;
- Pre-term birth;
- Bronchitis;
- Cancer;
- School absenteeism (baseline frequency?);
- Eye irritation (baseline frequency?).

Economic valuation

In terms of costs due to air pollution, infant mortality has been found far more important than all the morbidity impacts combined, just like the corresponding and now well-known result for adults. The costs of infant mortality can be estimated with the simple rule of thumb, justified by recent contingent valuation studies, that the death of an infant should be valued at approximately twice the usual “value of statistical life”. Monetary values can also be estimated for some other end points, for instance hospitalization.

To make sure that the morbidity end points will not be neglected despite their small contribution to the total cost, they should be presented in terms of physical impacts, e.g. number of asthma attacks attributable to air pollution.

Gaps in knowledge/research recommendations

Research needs in the field of children exposure to traffic related air pollution are:

1. With regard to engine and fuel characteristics (diesel/petrol) and monitoring needs, it appears very important to better know what are the best indicators for exposure to traffic related air pollution in Europe: PM10, PM2.5, Ultra Fine particulate, Black Smoke, Elementary Carbon, NO₂, NO_x, CO, benzene, PHA, VOC...? These questions need specifically dedicated studies.
2. More researches are needed in order to better understand if the proxy indicators in local situation (distance, traffic intensity or combined approach) are transferable to any European country? And what is the correlation with air pollutant measurements?
3. Respective sources contribution to air pollution should be more studied and the way to include their contribution into HIA studies have to be more clearly defined.
4. Studies may also investigate the difference in air pollution exposure between children and adults. This difference, if any, should be taken into account by epidemiologist in order to give specific Exposure Response Function for children.
5. If possible, Geographic Information System should be developed in European countries in order to better understand spatial distribution of population and their proximity to road or any others sources of environmental pollution.
6. Studies coupling GIS and Air Quality Monitoring Network (AQMN) should be developed.
7. Estimates based on GIS and AQMN have to be assessed by individual measurement comparison. The representativeness of the AQMN stations should also be assessed.

Policy recommendations

The following recommendations are based on an important starting point: Children health and social cost impact of the traffic related air pollution are very large, if you protect children you protect everyone:

1. Give priority to primary action as recommended in the Vienna Declaration and London Charter on Transport Environment and Health (1999), e.g. Europe-wide and sustainable reduction of

precursors of O₃ is more important than local traffic limitations and warning of parents/children after exceeding limit values.

2. Set quantitative objective for each action and evaluate the impact after implementation,
3. First implement policy measures that are cost-effectiveness.
4. Harmonize representativeness and indicators to traffic related air pollution use in European air quality monitoring network (AQMN).
5. Assess the need for new air pollution indicator measurement in the existing AQMN.
6. Promote public transport and environmentally sustainable modes (e.g.: build safe cycling road in domestic urban area).
7. Promote intervention studies on traffic and child's health, but give priority to the management of traffic-related health risks already established.
8. Develop transport policy that include environmental protection and emission limitations in urban commuting plan.

NOISE

Health impacts in children

With respect to noise, two factors are crucial in the children's development: their cognitive development and their sleep. The effects of noise are small, however, it acts as a long term aggressor. It is difficult to separate noise from other stressors, the effect is cumulative.

The results of studies on noise in children indicate that children do not seem to be more vulnerable to noise than other age groups with regard to awakenings. The experts attending the noise session, however, argue that children are indeed more vulnerable than adults because they live longer and therefore have a longer exposure time. Also, they are exposed at susceptible stages of their development (learning period).

The few studies on children that are available mainly focus on the impacts of aircraft noise. However, it is expected that road traffic noise causes similar effects. It is also expected that railway (freight) noise at night will increase in the coming years. This development might lead to more effects, e.g. on sleep. Railway noise in schools is very rare. Only a few studies carried out in France, Japan and the United States deal with the effects of railway noise in schools.

Cognitive effects and annoyance

There is sufficient evidence that noise has an effect on children's annoyance and cognition. Preliminary results from the RANCH study show that a relatively small increase in aircraft noise results in a few months up to half a year difference in reading. This means that due to noise exposure children have up to half a year less opportunity time to learn, which may affect their level of secondary education. The effects found in the RANCH study could be related to social

economical status. This will be analysed further. Interventions resulting in reduced noise levels in the school environment have been proven to reduce the negative effects on cognitive functions. Since these effects are reversible it is effective to take measures. To prevent these effects enormous costs are involved e.g. moving or insulating schools.

Effects during sleep

Sleep is very important for recovery of the body and thus for our health. Daytime quality depends on sleep quality. Effects of noise on sleep are vegetative and cannot be controlled. Children, in contrast to adults, are not aware of these effects. In general, they are less reactive; they do not wake up from noise at night and they show no effects on subjective sleep disturbance.

Results of a laboratory study on traffic noise and sleep in children (8 subjects, 6-12 years of age) show, that children were exposed during their sleep to a background noise level of 35 dB(A) with various peak levels (loudest was 65 dB(A)). Several sleep parameters such as EEG and cardiovascular response (heart rate) were measured. The study showed that for most parameters the children's reaction to the night-time noise was less compared to the reaction in young adults. However, the cardiovascular response (heart rate) was higher. The results indicate a different kind of reactivity in children; although they do not wake up from the noise they show a strong physiological reaction. In the long term, these reactions do not adapt and might lead to cardiovascular problems at an older age. Therefore, protection of children against noise exposure during the night is necessary. For example they should not sleep in a noisy room facing the street.

In the Swedish RANCH study data on wrist actimetry and sleep logs are collected in eighty children and adults exposed to road traffic noise. Preliminary results show that body motility is higher in children than in adults.

Although children appear to be less disturbed during their sleep than adults (with respect to awakenings and sleep quality) there is evidence for 'hidden effects' occurring during sleep (e.g. cardiovascular and hormonal responses). These effects do not seem to change/diminish (adaptation) and in the long term might cumulate, adding to the risk for e.g. cardiovascular diseases of hypertension.

Exposure/response functions for HIA

If data for children are not available, it is not recommended to extrapolate the curves for adults to children. For the assessment of annoyance and cognitive effects final exposure-response relations from the RANCH study can be used. RANCH is a very recent study (final report will be published in 2004) and the study includes several European countries. However, until now mainly effects of aircraft noise are studied because exposure to road traffic noise is not very well defined (aggregation level of the noise data is too high).

The Swedish RANCH study will provide more insight into the association of road traffic noise and sleep in children. Additional studies on traffic noise and sleep in children are needed to replicate the results found in the past.

Thresholds

The WHO-guidelines for noise with respect to the protection of children have been discussed. Threshold levels for schools exist (35 dB(A) LAeq, in the schools). These levels can be used and are based on scientific research. A problem, however, is how to reach these relatively low levels. For nighttime noise, the WHO guidelines leave too much room for undesirable situations. It is recommended to pay more attention to peak levels; do not use only equivalent noise levels but also SEL or LAm_{ax} values. Also separate recommendations for aircraft noise should be considered. It is proposed to use national standards (where existing) or WHO-guidelines for a HIA as these specify noise levels for different settings, activities and times. Besides a scientific discussion on the existing WHO guidelines, development of new thresholds based on (new) research should be supported. Threshold levels could be evaluated when the final results of the RANCH study are available.

Economic valuation in children

Economic valuation of the effects of noise on children has not been done yet. It is recommended to explore the possibility of calculating the costs of loss in cognitive function. This will be done in a case study by the Netherlands.

Gaps in knowledge/research recommendations

There are only a few studies that measured the attitudes of children towards noise. To do so might give an interesting and new view on the problem.

It is recommended to:

- Support further research on the effects of traffic noise on sleep in children. However, it will be difficult or even impossible to study the effects of noise on sleep in children because the methodology for such a study is not available. Moreover, ethically, experiments on children are forbidden. When it is not possible to get more insight into the effects of noise on children, we need to apply the 'precautionary principle' and avoid exposure of children to traffic noise during the night.
- Support scientific reviews on evidence and consensus building on 'safe' noise threshold levels for different settings, activities and daytimes (update WHO-guidelines).

Policy recommendations

- Distinguish between existing and new situations, since they might be different with respect to the measures that are feasible. In new situations exposure should be avoided whereas in existing situations effort should be put into reducing the traffic noise level.

- Give priority to interventions that would also address other transport related health effects, as these allow for economic efficiencies and synergies. For example, measures which reduce the volume of traffic around schools and residential areas will also reduce the noise, air pollution and improve safety.
- Give priority to measures which reduce outdoor noise levels compared to levels which only reduce inside levels (like insulation).
- Promote establishment of quiet areas in residential areas and schools to allow children to recover from noisy situations. For example, there have been experiments with quiet shells in the classroom where children could recover from a noisy environment. Children liked to use these shells.
- Raise awareness among child care-givers (e.g. parents, school teachers) about the effects of noise on children, including the hidden effects.
- Measures should be taken to reduce noise exposure in children during their sleep in consideration of the potential long-term effects of the physiological stress response.
- Policy makers should be aware of emerging issues related to a “24 hours” economy like increase in railway (freight) transportation during night time. Quiet times should be protected by, for instance decreasing the number of trucks during the night and weekends and inhibiting aircraft and train noise at night. One should, however, be aware of the side effects these noise measures could cause on other pollutants. When a decrease in trains for instance leads to a loss of market share for this railway transport in favour of road transport this will increase air pollution.

PHYSICAL ACTIVITY

Health impacts and exposure response functions

The considerations for the importance of transport-related physical activity and health in children are fundamentally the same as in adults: Transport interventions are supposed to cause changes in transport patterns; those should reflect changes in physical activity behaviour. Changes in physical activity behaviour will result in changes in health outcomes that can then be economically valued. This overall causal relationship is well accepted: the importance of physical activity for health is well established, there is evidence for the effectiveness of a growing number of interventions, and there is general agreement about the fact that transport-related physical activity has great potential in the promotion of overall physical activity. However, the quantification of these relationships and effects still remains difficult, mainly due to methodological limitations in this still young field.

The measurement of physical activity in children represents several challenges, in particular with respect to transport and health. While a considerable number of studies exists on physical activity behaviour and on related parameters in children, internationally standardised instruments and an internationally standardised monitoring system are still missing.

Despite these limitations, a number of studies in different countries have addressed the issue of physical activity patterns in children. In general, they indicate high levels of inactivity in populations of young age and a tendency towards declining activity levels over age and time. There is clear evidence of a decrease in transport-related physical activity, for example when looking at school trips by foot or by bike. All recent studies which examined the pattern of overall physical activity from childhood to adolescence, confirmed a decline in active behaviour, which starts at puberty and continues through to young adulthood. There is a higher likelihood of physically active young people to be more active in later life as well (low to moderate tracking of physical activity), and though the number of studies is limited, there are indications that transport-related physical activity can make an important contribution to overall physical activity in children. A wealth of data exists on overweight and obesity which are also influenced by other factors, but can be seen, to a certain extent, as a correlate of physical activity behaviour. The prevalence of both conditions is high and rising in most of today's societies. Levels of activity are correlated with a number of socio-cultural parameters. In immigrant groups, both overall and transport-related physical activity seem to be lower than in other groups.

Gaps in knowledge/research recommendations

There is a clear need to develop more interventions to increase physical activity and more specifically transport-related physical activity and to assess their effectiveness. In order to build a wider knowledge base, research has to be combined with other fields and interests, such as tackling climate change, congestion and other health effects of traffic. Evidence should not only be used from formal intervention studies, but also inference from negative experiments, illustrative case studies and natural experiments (e.g. London congestion charge).

Conceptual model

A model was developed for health impacts of physical activity in children on three levels:

- Direct health effects are clearest and most easily quantifiable for obesity, other effects include osteoporosis, diabetes type II, cardiovascular disease and psychological effects.
- Tracking exists for physical activity, inactivity and obesity and can engender all health conditions associated with these in later life.
- Quality of life aspects include again psychological effects of physical activity, but also social effects, developmental effects and risk perception.

While all of these impacts are plausible, hard quantifiable data that can be translated easily into "cost of illness" estimates exists currently only for obesity. Osteoporosis, diabetes type II and cardiovascular disease are undoubtedly important endpoints, but they occur by definition mainly later in life. Developmental effects (fitness and motor skills) are difficult to measure, also due to the important genetic influence on these factors, and the quality of life aspects are not adequately reflected on 'cost of illness' estimates.

It there seems prudent to focus on the development of economic models for adults and to adapt them for children in a second step. The use of “willingness to pay” measures would doubtlessly be an important step forward.

Policy recommendations

There is a growing wealth of evidence for the importance of physical activity for health in both adults and children and for the important contribution transport-related physical activity can make to overall physical activity. Though a number of research questions are still unanswered, the alarming prevalence of physical inactivity in all industrialized countries and the declining trends in transport-related physical activity make clear that the time for action has come.

Strategies to increase walking and cycling:

In European countries, short stages up to 5 km make up more than two thirds of all trips but the vast majority of these trips is covered by car. These figures indicate that there is a potential for a relevant modal shift from motorized to active transport. However, there are many perceived and real obstacles for walking and cycling such as insufficient or poorly maintained infrastructure, safety considerations or a low social status of active transport.

Three levels of policy interventions are suggested:

- Walking and cycling within a sustainable transport policy: A policy to promote walking and cycling should be embedded into a policy to achieve sustainable transport and land use in general. Without a strong commitment for sustainable mobility as the guiding principle in transport and land use planning, it will be difficult to increase cycling and walking systematically and successfully.
- Collaborations between sectors and different political levels: The promotion of walking and cycling involves a considerable range of sectors (transport, land use and urban planning, health, physical activity and sports, environment, energy, education sector) and institutions on the national, regional and local levels. It is essential to define conditions and create a climate where collaborations between sectors and different political levels are possible and become the standard.
- Consideration of vulnerable groups' perspective and making a special case for children: The needs of vulnerable groups like children, the elderly and people with special needs have to be included in decision making processes regarding transport infrastructure. When focusing on children, their basic rights according to the WHO Convention on the Rights of the Child may serve as a guideline: Children have the right to live, the right for health, to right to play and the right for a optimum development also of their physical potential. Industrialized countries

have to recognize that a physical environment dominated by motorized transport can severely restrict these rights and that an effort for the case of the children must be done.

PSYCHOLOGICAL AND SOCIAL EFFECTS

Conclusions on impact assessment

Psychological and socio-economic parameters are correlated both with exposure and with health outcome. The possible causal connections are manifold:

- Perceived exposure leads to psychological reactions (e.g. annoyance);
- Psychological stress causes bodily reactions and acts as effect mediator;
- Socio-economic status influences both load of exposure and health;
- Personal behaviour and community interactions are influenced by environmental stressors;
- Ill health has psychic and social consequences.

Thus psychological, social, and economic parameters should be monitored regularly in studies on the interaction of environment and health. Until now, this is done rather unsystematically because there is a lack of standardization of the parameter-set. Even the data monitored are difficult to interpret in the epidemiological context. It is not so clear if psychological and socio-economic parameters should be handled as confounders, co-factors, outcome variables, or indicators of exposure. Overmatching and under-controlling are both to be avoided.

Findings

- There is evidence that specific interrelations bridging the given different scientific languages and techniques are relevant not only for wellbeing, but for “serious health effects” too. So for instance Lercher (1995) reported a significant and relevant higher risk in children for Chronic Bronchitis, if their mothers report a higher rate of annoyance of traffic odours, but no significant correlation with the level of air pollutants caused by traffic (NO₂). Such results underline the epistemological limitations of the given approaches: Any science is only able to deal with aspects that are mirrored by its set of empirical methods, language, and models.
- While noise annoyance is mirrored by health effects (like stress related diseases), some important social effects are totally neglected when concentrating on conventional health measures. These include both beneficial and detrimental effects. Modern transport infrastructure provides improved facilities for the mobility of the majority of people (beneficial effect) but a large minority (children, elderly persons, poorer families, parents with their children, handicapped persons) in certain circumstances are hindered in their mobility at the same time.
- “Learned helplessness” due to fear of accidents conveyed to the children by their rightfully anxious parents is a key issue with psychological impacts in adult life. Age adjusted

independence in mobility (influencing the development of the cognitive and social behaviour) and the introduction of mobility habits that could last into adulthood should be introduced as influential preventive measures.

- Utilization of various modes of public transport and environmental friendly mobility should be seen as a marker of increased competence as compared to the stubborn use of only one mode of transport (e.g. motor-bike, car). Flexibility in the usage of various opportunities should really be rewarded with a positive image.
- Children are aware of the growing impact of our life style on the global environment (Grefe, 1992). They are willing to promote a change and even to teach their teachers and parents on a more sustainable way of living. Transport related issues and mobility patterns are good means to exemplify this new attitude on the individual and local level. Therefore, measures concerning the transport sector could have far-reaching consequences on other environmental sectors. Campaigns on mobility of school-children (most of them concentrating on the way to school) are under way. An evaluation of the direct health effects of a more independent and sustainable mode of mobility (going to school on foot or by bike in comparison to being brought there by car) was planned. It should also investigate the psychological effects because in many talks to teachers they told about their impression that pupils that are not dependent on their parents on their way to school are also more active and vigilant at lessons and can better concentrate. Unfortunately, our Ministry of Health was not willing to give money for this study which would have served as a motivating factor for more children to go to school on their own. In spite of preliminary data from a previous study (Moshammer, unpublished) that indicated a better health in “mobile” children the Ministry decided that such a study would not be feasible.
- Mobility teaching in schools still is often centred on telling children how to “behave” in motorized traffic thus conveying the impression that the children are weak and helpless and have to watch out fearfully. It is not astonishing that children therefore long to grow up and get a driving licence themselves.
- This is done in spite of the fact that in school age special role models are defined and attitudes and beliefs that are strengthened at young age take a long way to overcome in adulthood. British campaigns integrating children in decision-processes (e.g. “children’s parliament” in Bristol) brought good results and gave the children a feeling of competence and better self-esteem.
- Concentrating on motivation campaigns on children is also important because children are a sensitive age group concerning the negative impacts of environmental stresses. But we must keep in mind that (1) motivating the children and allowing the adults to toddle on along wrong paths would be highly unjust, and (2) that there are other sensitive subgroups to be considered but children (e.g. aged or handicapped persons, low socio-economic status, etc.).

Also “children” are not a uniform group of people. As in other parts of the population there are differences in susceptibility due to a lot of different causes.

Gaps in knowledge/research recommendations

Psychological and social factors (annoyance, anxiety, performance, quality of life, environmental justice and socio-economic status, attitudes and expectations, traits and coping styles) are important regarding transport related health impacts. They can take the role both of indicators of exposure and of health impact. This ambiguous nature makes it difficult to fully recognize their potential in scientific studies. The scope ranges from questions concerning mental health to the optimal strategies in risk communication.

“Psychological and social effects” are not different from the effects of noise, air pollution, etc. The psychological and social approach is rather another way of looking at the transport related impacts. It is a bundle of methods to study subtle effects of low-level exposure. We do not only look into health effects but also psychological effects (like annoyance, performance), and economic effects, all interacting with each other.

We should look at groups at higher risks. This includes special age groups (e.g. children, but also aged and handicapped persons), but also groups according to sex, SES, and psychological traits that lead to special sensitivity.

Another important aspect is positive effects. Also, from the pedagogical point of view, concentrating solely on negative effects is detrimental. Advertise the positive effects of walking, give positive role models, etc.!

Approaches to monetarization applying the DALY-concept (BUWAL, 2002) indicate that “soft” effects of noise are more important than “hard” effects. In the discussions in Vienna an experimental approach was suggested: Increase prices for unwanted modes of transport – and you will see the “real” price.

Policy recommendations

- Create research and action programmes that promote physical active modes of transport like cycling, walking and inline skating.
- Build bridges between the fields of health, traffic safety and environmental concern and promote research on life quality, life style and mobility patterns.
- Initiate action programmes at a local or regional level and when networking with schools, driving schools, parents and firms.

- Encourage further technical advances that reduce energy consumption and emission of noise and pollutants but that also help drivers with their learning processes of economical and ecological driving style (e.g. cars with board computers to give a feedback on actual and average fuel consumption, etc.).
- Rely on multiplying effects that stem from field experiments with the social sciences approach. Discussing own experiences with groups of driving teachers, teachers, parents - and also with journalists, policemen and professional drivers - in one's own social surroundings influences other persons, e.g. in trying and cultivating eco-driving by "intelligent.fahren".
- Provide better/safer opportunities to walk, especially concerning the way to school. Let the children articulate their needs themselves. This would both improve planning processes and their self esteem and their social competence.
- Economic evaluation is an important issue. But do not wait until this process is finished!
- Better estimates on costs and benefits will help to fine-tune certain measures. But even now the negative impacts of an uncontrolled growth of motorized transport are evident.

5. Intermediate Experiences from a Policy Point of View

The following main aspects can be stated:

- Clear evidence on negative health effects for children caused by transport is confirmed in particular air pollution, noise and injuries;
- Need for children impact assessment;
- Children are different – physiologically, economically, psychologically (e.g. perception of traffic);
- New issue: positive health effects of physical activity is confirmed (e.g. walking and cycling);
- New issue on transport related psychological and social effects was recognized in particular in combination with noise and cumulative effects, perception of transport, segregation effects;
- Need for transparency on methods and assumptions, as well as (international) harmonization and need for improvement of data and their comparability;
- Closing of research gaps and data gaps needed;
- The occurrence of effects that can not be valued currently should be emphasized, too (e.g. psychological and social aspects);
- Health effects and its costs and benefits to be included into policy making and instruments of CBAs on transport infrastructure investments;
- Lack of economic valuations on children - further research needed.

As there now exists evidence that "children are different", more emphasis should be laid to the question if our policy strategies/measures/actions/instruments are appropriately different! In particular as regards policy objectives and targets, plans and programmes, thresholds/limit values

regulations and directives, economic evaluations (CBA etc.), planning and infrastructure standards. As sustainability calls for children's needs at first a focus has to be set on:

- A better integration of children's needs and differences in policy through adaptation of existing policies and/or new actions (→ WHO-CEHAPE, EU-Env&Health Strategy);
- Children Impact Assessment (CIA): exposures, epidemiological status, economic valuation - nationally/regionally/locally assessing health impacts, costs and benefits, recommending policy actions and implementation tools;
- Promotion of internalization of externalities and integration into policy instruments like health impact assessments and economic evaluations (CBA).

6. Contribution to the Children's Environment and Health Action Plan for Europe (CEHAPE)

Comments on the CEHAPE Ministerial Document and its annexed Table of Actions have been finalized at the Overall Coordination Group Meeting of the project in December 2003. The comments were focused in particular on the Regional Priority Goals set within the document as well as on its child-specific actions. These elaborated comments have been approved - nearly completely - by the WHO Working Group at the Brussels Meeting on 15-16 Dec 2003.

7. Next Steps within the Project

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- At the final workshop "Synthesis and Policy Recommendations", on 19-20 February 2004, a synthesis will be provided and the elaborated topic specific policy recommendations will be discussed in order to develop an interdisciplinary and more harmonized approach.
 - Finalization and publication of deliverables.
 - Synthesis Report and brochure of main results for dissemination.
 - Presentation of results at the 4th Ministerial Conference on Environment and Health, 23-25 July, Budapest 2004, during the Session on Follow Up of the London Declaration and THE PEP.

Additional information on this project can also be found on the web at www.herry.at/the-pep.
