



Environment and health risks: the influence and effects of social inequalities

Report of an expert group meeting

**Bonn, Germany
9–10 September 2009**



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ABSTRACT

Significant social inequalities exist in the environmental burden of disease, both between and within countries. A framework model developed by WHO describes the mechanisms through which social inequalities may affect exposure to and the health outcomes from environmental risks.

To support policy-makers in Member States of the WHO European Region, and as part of the preparatory process for the Fifth Ministerial Conference on Environment and Health in 2010, WHO has accumulated the available evidence on risk of injury, air pollution, inadequate living and working conditions and poor waste management, in order to assess the current knowledge. Further evidence reviews were carried out for vulnerable groups (children and gender-related) and for the expected effects of climate change. A group of expert advisers convened by WHO was asked to review and discuss the compiled evidence and produce a set of technical and policy recommendations on possible countermeasures.

The expert group concluded that social determinants can significantly affect individuals' exposure to environmental risk and that – although evidence is available only for certain countries– this can be considered a general issue for all Member States. Addressing this challenge, the expert group developed summary conclusions addressing the main issues and made recommendations for policy, technical and research-related action.

Keywords

ENVIRONMENTAL HEALTH
ENVIRONMENTAL EXPOSURE
RISK FACTORS
SOCIOECONOMIC FACTORS
EUROPE

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Meeting rapporteur: Teresa Lavin
Language editor: Frank Theakston

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Background and introduction

There are significant social inequalities¹ in exposure to and disease from adverse environmental conditions. These inequalities exist at many levels, between countries, within countries and within communities. It is well-known that the worldwide environmental burden of disease is disproportionately borne by poor people (1,2). Factors such as age, gender, ethnicity and being part of a minority group can modify the relationship between socioeconomic status, environment and health, or can directly affect exposure to environmental and health-related inequalities. Sufficient evidence is available that social determinants affect health which has recently been confirmed by a major review carried out by the WHO Commission on Social Determinants of Health (3). What remains less clear is the relative importance of socially determined exposure to environmental risk factors.

The subject of social variation in environmental risk exposure and environmental health outcomes is of increasing concern to environmental health as well as social actors at international, national and subnational levels. Interest was triggered by the final report of the WHO Commission on Social Determinants of Health (3) and an increasing awareness among Member States of the relevance of social inequalities, and further enhanced by the growing interest in the concept of environmental justice in several European countries.

This development is reflected in the work of WHO and the decision to make social inequalities and environmental health a major item to be addressed at the Fifth Ministerial Conference on Environment and Health, taking place in Parma, Italy, on 10–12 March 2010. In preparation for the Ministerial Conference, and to support policy-makers in Member States of the WHO European Region, the WHO Regional Office for Europe, through its European Centre for Environment and Health (Bonn Office), has accumulated and assessed the available evidence on the influence and effects of social inequalities on environment and health. This included:

- collecting and synthesizing existing evidence, quantifying the magnitude of the issue and identifying vulnerable groups; and
- identifying and sharing policy approaches, interventions and tools to address inequalities.

This report presents the discussions, conclusions and recommendations of the expert consultation and provides short summaries of the evidence reviews that were developed as working documents for the meeting. The full text of the evidence reviews will be made available as background documents at the Ministerial Conference.

This meeting was supported by funds provided by the Federal Ministry of Environment.

Methods and approaches

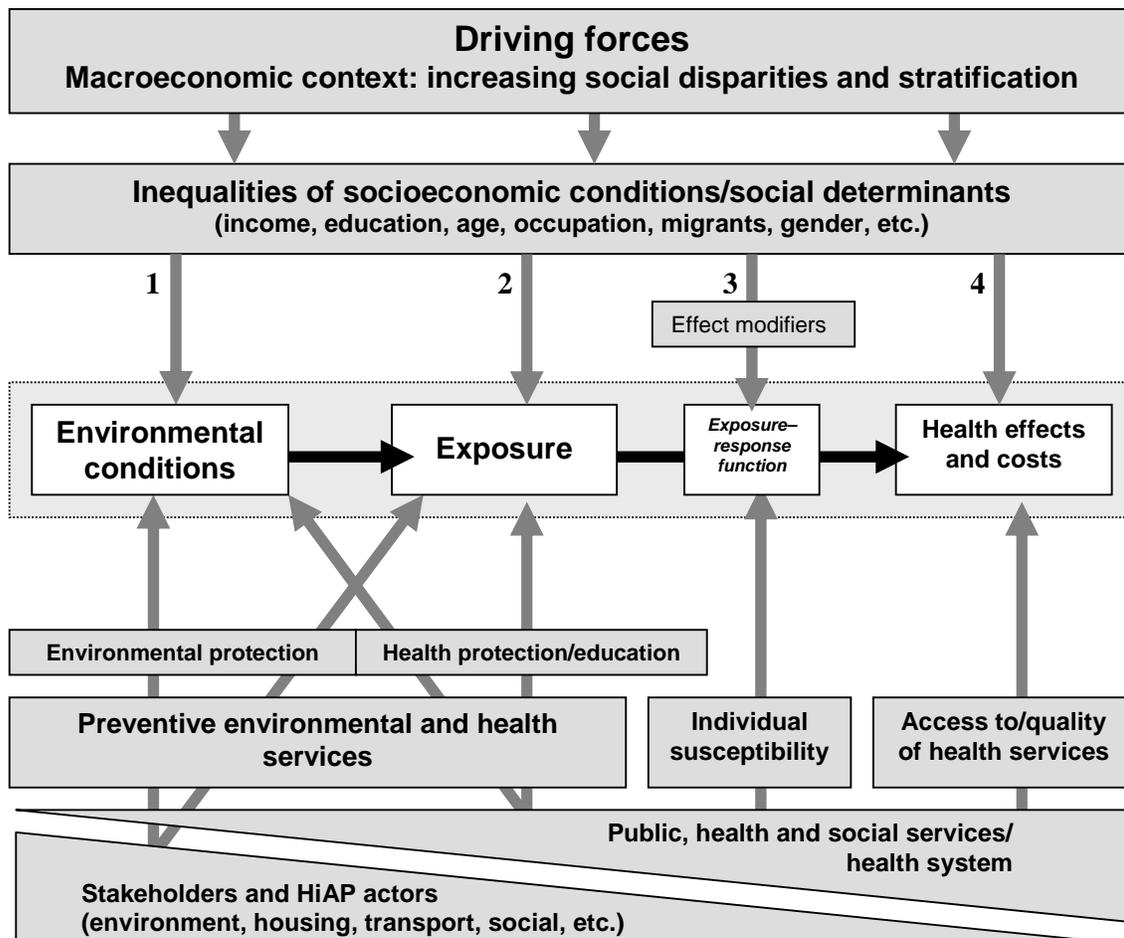
Contextual framework

WHO has developed a contextual framework model (see Fig. 1) to structure and identify the potential pathways through which social inequalities may influence exposure to and health outcomes from environmental risks. The framework suggests four major pathways:

¹ Inequalities represent differences and disparities in general terms without distinguishing whether they are due to natural or unavoidable circumstances such as consequences of age or to avoidable or unfair circumstances such as discriminatory systems or policies. The latter are sometimes referred to as inequities but, since this term is inconsistently used in the literature, the term inequality has been selected for use throughout this report. Therefore, many of the inequalities presented here should be interpreted as avoidable by appropriate government or social action. The term social inequalities is used in this report to collectively describe inequalities in environmental risk exposure or environmentally triggered health outcomes caused by social determinants.

- *Arrow 1.* There is a relationship between social determinants and environmental conditions. Disadvantaged groups may live and work in, or be surrounded by, less favorable environmental conditions than the general population.
- *Arrow 2.* Factors attributed to social inequalities (such as knowledge and health behaviour) compound exposure. Given the same environmental conditions, disadvantaged groups may be more exposed than the general population.
- *Arrow 3.* Factors attributed to social inequalities (such as health status and biological sensitivity) influence the exposure–response function. Given the same exposure, disadvantaged groups may be more vulnerable to adverse health effects than the general population.
- *Arrow 4.* Social inequalities have a direct impact on health outcomes, which may operate through many mechanisms – some environmental, some independent of environmental factors. However, given the same exposure–response situation, disadvantaged groups may also be more vulnerable to adverse health effects than the general population (e.g. inadequate insurance, reduced health services use, reduced access to services, etc.)

Fig. 1. The WHO framework model on social inequalities and environmental risks



Source: WHO Regional Office for Europe (4).

Arrows 1 and 2 together represent the exposure differential, describing the increased exposure risk, while arrow 3 represents the vulnerability differential accounting for an increased translation of environmental exposure conditions into negative health effects.

As the model describes, the meeting focused on the mechanisms through which social inequalities affect exposure and vulnerability to harmful environmental conditions. The provision of healthy environments and reduction of adverse health effects - presented in the lower part of the framework model - is not exclusively a task for environmental agencies or health care services but a common responsibility of all sectors and stakeholders, as proposed in Health in All Policies (HiAP) approaches.

Meeting preparation and objectives

The expert meeting represents part of the preparatory process towards the Fifth Ministerial Conference on Environment and Health and therefore aimed at covering a variety of subjects. Authors of the evidence reviews were identified in the spring of 2009 and contributed with their reports during the summer. Prior to the meeting, these background documents and other related information were made available to the meeting participants through a restricted-access web page. The background documents contained a series of individual reports in a range of topic areas (Housing and residential conditions, Air quality, Unintentional injuries among children, Waste management, Work environment and Climate change) and selected population groups (Children and adolescents and Gender). In addition, summary reports on environmental inequalities were received from five national and international survey projects and data sets (The German Environmental Survey for Children, the European Working Conditions Survey, the European Quality of Life Survey, the European Injury Database and the WHO LARES² survey). Finally, a review on social determinants and environmental inequalities in the Russian Federation was provided.

The expert meeting in Bonn was the first of three meetings focusing on inequalities in preparation for the Ministerial Conference. Other meetings in this area were the WHO/Health Behaviour in School-aged Children Forum, in Siena in October 2009 and the Forum on Gender Inequalities on Health and Environment in Madrid in November 2009. Building on the evidence reviews provided by the expert meeting in Bonn, these meetings will discuss case studies and national action, and subsequently suggest technical and political actions and interventions in relation to gender and child-related inequalities. However, despite the major focus on evidence, the Bonn meeting also discussed recommendations and policy implications.

Process

The meeting was attended by 31 Temporary Advisers, including experts from 19 Member States of the WHO European Region and the United States of America, representatives of the European Public Health Alliance, the Regional Environmental Center for Central and Eastern Europe and the WHO Regional office for Europe, and observers from various backgrounds. Annex 1 presents a full list of meeting participants. Professor Nikoloz Pruidze chaired the meeting on the first day and Professor Denis Zmirou-Navier on the second day. Ms Teresa Lavin acted as the meeting rapporteur.

The participants reviewed the evidence in a series of plenary sessions and smaller working groups. On the first day of the meeting, each working group used the available evidence as well as its own knowledge and expertise to develop draft recommendations. These were presented in plenary on the morning of the second day, following which working groups reconvened to incorporate the wider group's observations into their recommendations. At the end of the meeting, draft conclusions and recommendations were agreed in plenary by consensus. The meeting report developed by the rapporteur and the WHO secretariat was then sent out for comments, which have been considered and incorporated into this report.

² LARES: Large Analysis and Review of European housing and health Status.

Plenary presentations

The meeting was opened by the Acting Head of the WHO European Centre for Environment and Health (Bonn Office), Dr Michal Krzyzanowski and Dr Srdan Matic, Unit Head, Noncommunicable Diseases and Environment at the Bonn Office. The participants were welcomed and the context and relevance of the meeting were outlined with reference to the Fifth Ministerial Conference on Environment and Health. After the opening, a short intervention was made by the WHO secretariat to present the meeting objectives, the timetable and the working groups and their specific tasks.

A series of presentations was made in the opening plenary session, presenting the key messages of the evidence review papers. Short summaries of these presentations can be found in Annex 2. Additional presentations were made on the status quo of environmental inequalities in two countries (the Russian Federation³ and the United States), followed by an invited presentation to summarize all evidence contributions.

Presentations

Social inequalities in environmental risks associated with housing and residential location (*Jon Fairburn*)

Most research identified people from lower socioeconomic groups as being more at risk of exposure to environmental hazards, both within the dwelling (environmental tobacco smoke (ETS), biological and chemical contamination, noise, temperature, sanitary equipment) and in the residential environment (lack of urban amenities and public safety, proximity to polluted areas, traffic related air pollution). More affluent groups may, however, be at higher risk of exposure to specific compounds such as polychlorinated biphenyls (PCBs), terpenes and DDT.

Social inequalities resulting from health risks related to ambient air quality (*S  verine Deguen*)

There is a variable relationship between exposure to air pollution and socioeconomic status. In some cases, more affluent groups may be at higher risk but overall those in lower socioeconomic groups are more likely to be vulnerable to poor air quality. Factors affecting this include differential housing affordability in different geographical areas (and especially in relation to traffic emissions), cumulative exposures and pre-existing health conditions.

Social inequalities in health risks related to unintentional injuries among children (*Lucie Laflamme*)

Unintentional injuries include traffic-related incidents, falls, recreational injury and burns, and poisoning. They have the steepest social gradient of all causes of childhood mortality, and socioeconomic disparities exist at all levels of injury severity. There is also an age differential: small children are at greater risk of injury within the home owing to, for example, falls, burns and poisoning, while older children are at greater risk of injury from traffic-related incidents.

Inequalities and environmental justice in waste management and health (*Marco Martuzzi*)

The evidence on waste and health is not univocal and for the most part is suggestive rather than conclusive. Most of the studies do not explore the difference in risk across social groups but instead relate to the general population, addressing health impacts of long-term, low-level exposure to a mix of contaminants (persistent organic pollutants, heavy metals) through air,

³ Although this review was not on a specific environmental risk factor, a short summary is provided in Annex 2.

water, food and soil. Regarding social inequalities, in some countries, waste facilities tend to be disproportionately often located in areas in which most of the residents are from ethnic minorities or of low socioeconomic status. Nevertheless, some studies have found that the risk decreases when health effects of exposure to waste are standardized for socioeconomic status, suggesting that socioeconomic status is a confounding factor.

Social inequalities in the working environment and work-related health risks **(Harvey Brenner)**

Occupational skill level is strongly correlated with age-standardized mortality rates in records dating back to the 1840s. There is evidence that the level of skill influences injuries, infections and chronic disorders through both physical and psychosocial mechanisms. Aspects of employment include: grade of employment (measure of economic status), job control, job demands and economic rewards (especially for men). However, the relationship between occupational skill level and health is modified by education and income as well as other factors such as unemployment, immigration status, ethnicity and gender.

Climate change (Sari Kovats)

Climate change will have direct effects on environmental exposures and also indirect effects via changes in environmental policies. There is some epidemiological evidence for inequalities in current health effects from heat, cold and floods. Poor pre-existing levels of water, sanitation and hygiene may be exacerbated by future water scarcity caused by climate change. With regard to heat-related mortality, there is little evidence to suggest that current income level modifies outcomes; this may change, however, as those with higher incomes will be better able to cope with warmer summers. Evidence also suggests that migrant workers may be at higher risk of occupational heat stress. In some countries, low-income groups are more likely to be the most vulnerable to adverse outcomes from coastal flooding. At the policy level, both mitigation and adaptation policies will influence health.

Environmental inequalities among children and adolescents in Europe (Gabriele Bolte)

Children are more vulnerable than adults to environmental hazards. This is due to a range of factors, including different and unique exposures (such as breastfeeding, exploratory behaviour and increased energy, water and air intake), developmental physiology, lower awareness of risk and less control over the environment. While patterns vary between and within countries, the overall evidence shows that children living in adverse social circumstances suffer more from multiple and cumulative exposures and are more susceptible to a variety of environmental toxicants than children of the general population. Low socioeconomic status is associated with increased exposure of children and adolescents to inadequate housing and residential conditions and fewer opportunities for physical activity. Children from low socioeconomic groups are also more likely to be exposed to traffic-related air pollution, noise, lead and ETS and to suffer unintentional injuries.

Gender inequalities in environment and health (Lourdes Cantarero)

Social (gender) and biological (sex) factors affect the way in which environmental factors influence health, including sensitivity to such factors. Further, gender interacts with ethnicity, race and other social stratifications. Gender inequalities have been identified with regard to safe water and adequate sanitation, secure human settlements, clean air and safe working environments. Girls and women with low SES are particularly affected by poor access to water and sanitation in parts of eastern Europe, as they are largely responsible for collecting water. From the age of 1–2 years, however, boys are more likely to be injured than girls. Prenatal and childhood exposure to chemicals remain a great concern. An important gender difference in relation to such exposure is that women tend to have a higher body fat percentage

than men, which has been associated with a larger storage of lipophilic chemicals. Up to 300 synthetic chemicals have been found in body fat and breast milk and many have been shown to be cancerous or toxic to the brain and nervous system.

Social inequalities and environmental health in the Russian Federation (*Boris Revich*)

Social inequalities are much more evident in the Russian Federation than in many other European countries. The percentage of the population living below the subsistence level differs significantly between rural and urban dwellers, between men and women and between the general population and pensioners, with the latter group being more vulnerable in all three comparisons. At the same time, the general population suffers from higher exposure to environmental hazards than elsewhere in Europe. For example, 1 in 14 people consumes water that does not meet international sanitary standards, while the air pollution is highly polluted in many cities. There are low-technology hot spots, where dirty enterprises pose environmental threats directly and indirectly by contaminating the local food chain. Consumption of food grown in contaminated soil is a cause of significant health inequality. There is also a strong correlation between low income and a body mass index (BMI) below 18.5. Finally, there is limited research available on environmental inequalities among minority groups. In particular, northern indigenous populations are likely to suffer even greater health effects in the future owing to climate change.

Environmental health inequalities in the United States (*Sharunda Buchanan*)

According to a 1994 Presidential Order, each federal agency is required to make environmental justice one of its objectives, by reducing environmental risk for all. Asthma prevalence rates vary according to age (more prevalent in children than adults), gender (higher among females) and ethnicity (highest among Black population, followed by White and Hispanic populations). Across the country, the prevalence of obesity is highest among Black populations, followed by Hispanic and White populations. The prevalence of diabetes is highest among Black populations. Populations most likely to suffer adverse health effects of climate change vary according to the particular weather event. For example, those most likely to be affected during heat waves include the very young, the elderly, athletes and people with poor respiratory function. Hurricanes, tornados and flooding are more likely to cause injuries and drowning among those living in coastal and low-lying areas, especially people in lower socioeconomic groups.

Summary of the evidence and discussion

This section provides an overview of the discussion that took place in plenary following the summary presentations. To begin the discussion, Dr Hanneke Kruize presented key points framed around the following issues:

- priority issues and burden of disease inequality (what health dimension?)
- key mechanisms (why and how do inequalities appear?)
- affected populations (who is most affected and where?)
- countermeasures (how can the inequalities be mitigated?)
- gaps in the evidence.

Priority issues and burden of disease inequality

Evidence was presented from a range of perspectives including toxic substances (e.g. air pollution), sources (e.g. housing) and health outcomes (e.g. injuries). Overall, it was clear that inequalities play a role in exposure to and outcomes from a range of environmental hazards.

Inequalities in the adverse effects of hazardous substances in air (both indoor and outdoor) have been well-studied. Regarding toxic substances in soil and food, inequalities between countries could be inferred from the focus on this issue in the Russian Federation, though not elsewhere. The absence of presented evidence on toxic substances in water and sanitation, contrasted with discussion on the topic, suggests that exposures here may also vary significantly among countries. Evidence was also presented on inequalities in sources of toxic substances such as housing, traffic, working environment, climate change and waste management. There is some good evidence from an exposures perspective, such as the role of affordability in ventilating and heating homes and the siting of waste facilities in areas of high social deprivation. The evidence is less clear on inequalities in the health outcomes of some exposures, particularly waste, when competing factors such as behaviour are taken into account. From a health outcomes perspective, the available evidence on unintentional injuries among children shows clear differences according to age, gender and socioeconomic status. There is some evidence of an effect of inequality on psychological health from both the exposure and the outcome perspective.

Key mechanisms

In attempting to understand the mechanisms by which inequalities affect health outcomes, a number of issues need to be considered. First, how and to what extent do differences in age, gender, socioeconomic status and membership of a minority group influence exposure to one or more environmental hazards? Taking the example of traffic on residential streets as an injury hazard, from an age perspective, children and the elderly are most likely to be exposed to the hazard while from a socioeconomic perspective, children from lower socioeconomic groups may be more exposed (this finding is not consistent across all countries). From a gender perspective, boys may be more exposed to risk of injury because of a higher level of risk-taking. Second, how and to what extent do these differences affect vulnerability to adverse health outcomes from the exposure? Continuing the example of traffic on residential streets, from an age perspective, the elderly and very young are biologically more vulnerable to injury while from a socioeconomic perspective, health outcomes may be adversely affected among lower socioeconomic groups owing to inadequate access to health care. Thus, in this case, inequalities in exposure to the hazard may be compounded by inequalities in vulnerability. An overarching consideration is how and to what extent different experiences according to age, gender, socioeconomic status and membership of a minority group are driven by political, economic and sociocultural factors. Taking the same example, there may be differences in the volume of (high-speed) traffic on residential streets owing to legislative, structural or cultural factors or there may be differences in the demographic profile in high-risk residential areas owing to planning, economic and cultural factors.

Affected populations

While two presentations focused explicitly on children and a third on gender, much of the evidence considers inequalities primarily from a socioeconomic perspective. For the most part, those in lower socioeconomic groups bear a disproportionate burden of exposure; they also experience higher risks, owing both to this greater exposure and to vulnerability factors. A large body of evidence takes an age perspective, within which the very young and (for specific exposure situations) the elderly appear to be most at risk. From a gender perspective, the evidence is mixed, males being at higher risk (for both biological and social reasons) for some issues and females for others. The evidence on minorities is largely focused on ethnicity and migrants, with specific ethnic groups and migrants facing a higher risk of environmental exposure. Finally, it was noted that urban and rural dwellers may experience different levels of exposure in some areas.

Countermeasures

Countermeasures suggested by the authors of the evidence reviews helped to shape plenary and working group discussions and subsequently contributed to the conclusions and recommendations from the meeting. Key messages include the following.

- Focus on the driving forces of power, money and resources in order to ensure that actions are sustainable.
- Achieve a balance between, on the one hand, better environmental conditions and reduced exposures for all and, on the other, targeted action for vulnerable groups.
- Support work to reduce vulnerability from the ground up by empowering people and communities.

Authors also made a number of recommendations in their areas of expertise, as outlined below.

Housing

A number of potential solutions were offered: tougher building regulations for new houses; increased renovation for existing stock, especially in the social housing sector; greater availability of affordable quality housing; stronger links between the health authorities and local municipalities; realistic assessment of what area-based measures can achieve; and better spatial planning, including distribution studies of multiple impacts.

Air quality

This presentation concluded that policy-makers need to tackle these issues at their root, i.e. in urban planning. Within this it was felt that two principles are paramount: multipolarity, i.e. multiple urban clusters with an array of amenities; and diversity, i.e. the widest appropriate range of activities should be available within each urban cluster. Such an urban structure can reduce motorized transportation and encourage other, healthier mobility options. It was also felt that there was a need to focus more on childhood exposures and responses to air pollution.

Injuries in children

It should be noted that not all injured children are from low socioeconomic groups, nor do all children from these groups suffer unintentional injury. Therefore, population-wide safe practices and use of safety equipment should also be advocated. Potential solutions offered include: reducing differential vulnerability by promoting safe practices in the home and assuring affordability and readability; reducing differential exposure by controlling hazards and creating safety-promoting options; promoting multiple and concerted actions; and implementing "safety-for-all" as well as targeted safety practices.

Work environment

Evidence suggests that improvements in environmental and occupational health regulations benefit workers from the lowest socioeconomic groups the most, since it is they that are usually subject to the greatest exposure. Similarly, improving educational levels and minimizing poverty would contribute to increasing the level of occupational skills.

Climate change

There is need for more epidemiological evidence on the determinants of weather-related mortality and more integrated assessments in sensitive subgroups. Adaptive responses to climate change may not reduce health inequalities. Interventions that are not universal can increase inequalities, while self-interested adaptation by populations with more resources could increase the health gap. Mitigation policies have the potential to reduce or increase inequalities.

For example, the congestion charge in London has been shown to benefit deprived groups the most; however, increased energy costs will disproportionately affect poorer households.

Gender

Overall, there needs to be more visibility and better understanding and sensitivity in identifying and tackling these inequalities. Specific suggestions include: collecting and analysing sex-disaggregated data systematically; incorporating gender analysis into national health surveys; studying interactions between sex, gender, socioeconomic status and ethnicity; identifying and specifically addressing gender inequalities in health policies and programmes; developing gender-sensitive indicators; promoting the use of available gender tools developed by WHO, such as the gender tool for child and adolescent health and development.

Gaps in the evidence

A common theme among the presenters was the dearth of evidence outside a few countries in northern Europe, North America and Australasia. This has implications for the extrapolation of research findings to areas where exposure risk may differ substantially across a range of environmental hazards. Within topic areas, some issues are more studied than others: for example, in the area of unintentional injuries among children, more research has been conducted on traffic-related incidents than on burns or poisoning. Across all topic areas, most research on inequalities has focused on socioeconomic status, while other factors such as gender, age and membership of a minority group have been less frequently studied. Moreover, there can be a gender bias in research when gender equality is (wrongly) assumed in exposure and/or response to environmental hazards.

The health outcomes of social inequality in risk or exposure have been infrequently studied.⁴ Many studies focus either on environmental justice concepts, looking at exposure disparities but not assessing the health consequences, or on health inequality concepts, describing variations in health while not identifying the health determinants. Assessing the magnitude of health inequality directly associated with environmental inequalities is therefore almost impossible with the available evidence.

Further, the role of competing risk factors, such as tobacco or diet, in influencing health outcomes is not well-differentiated, even though different behavioural patterns according to gender, age and socioeconomic status have been documented in many countries. In addition, they may modify the individual vulnerability of a person to a certain environmental risk factor. More sophistication is needed in techniques used to look at health outcomes of exposure from a range of hazards, in order to quantify the likely impact of each. Moreover, the cumulative effect of multiple exposures needs to be carefully considered. Multiple exposures can be interpreted as behavioural and environmental, as outlined above, but also as exposure from more than one environmental hazard or exposure to one hazard in multiple settings.

A lack of research in issues regarding environmental justice was noted. This was particularly highlighted in the area of waste, where it was suggested those most exposed to waste are unlikely to contribute most to its production at national and international level. In many Member States, there is fundamental lack of studies and data to assess the magnitude of social inequalities and their impact on environmental risk exposure and/or health.

⁴ Owing to the lack of studies directly linking inequalities in exposure to inequalities in health outcome, the evidence reviews prepared for the expert consultation focused on inequalities in exposure and vulnerability. Thus the currently available data linking exposure inequalities to health outcome cannot be assessed in this report.

Lack of data was frequently cited as a barrier to research, preventing the analysis of exposure by social determinants. This includes lack of socioeconomic indicator data at small-area level, lack of data on ethnicity or other minority groups, and lack of spatial data that could be used in geographical information systems. Difficulties in obtaining data in some high-risk areas, such as working conditions for children and illegal immigrants, were particularly noted.

Finally, even where research has been conducted, there is a lack of methodological consensus to explore the issue of inequalities. Difficulties arise for a number of reasons: different methods are used to assess exposure to the pollutant, geographical scales vary (for example, British census wards comprise 5000 people compared to the French census block of 2000 people) and different indicators of inequality are used. A more fundamental issue is the lack of methodologically precise studies to assess which of the three measures of socioeconomic status (occupation, income and education) contributes most to differences in mortality and morbidity.

Working groups

The participants were divided into three working groups to facilitate further detailed discussion of the evidence and the mechanisms that actually lead to the expression of inequalities. The working groups were charged with addressing the following topics:

- working group A: socioeconomic mechanisms
- working group B: gender and age-related mechanisms
- working group C: mechanisms related to marginalized groups/minorities.

The conclusions of each working group are presented below.

Working group A: socioeconomic mechanisms

The 19 members of working group A, chaired by Professor Matti Jantunen, were given the task of reviewing the evidence on the influence and effects of socioeconomic status on environment and health risks. Following a general discussion, smaller groups were formed, each focusing on a specific topic: green space, housing, air quality, psychological stress (work- and neighbourhood-related), and water and sanitation.

General conclusions

- Any action that helps to reduce the risk due to environmental hazards in the lowest socioeconomic group will benefit the whole society.
- All policies should be developed and implemented in an accountable way. They should include cost–benefit analysis, policy impact models and measurable policy objectives, implementation feedback monitoring, and policy modification mechanisms to respond to the monitoring results.
- Socioeconomic status is often a strong feature in the rural/urban divide. In some countries, people from lower socioeconomic groups are more likely to be rural dwellers while in others the opposite is true.

Summaries of subgroup discussions and conclusions

Green space

Densely built neighbourhoods with little or no green space are correlated with an increased risk of cardiovascular disease through a variety of mechanisms, including psychological stress, personal behaviour, air pollution and environmental noise. People from lower socioeconomic groups are more likely to live in such neighbourhoods, for a number of reasons that include lower affordability and personal preference or the value they attach to green space.

- Urban planning should ensure a social mix in any given area.
- Green space is as much an issue of quantity as it is of quality. Consequently, where the quantity of green space is limited, more attention should be focused on its quality.

Housing

Housing is associated with a wide range of physical, chemical, biological and psychological exposures. Inequalities in each of these exposures are usually but not always higher in lower socioeconomic groups. A summary of the evidence is provided in Table 1. Overcrowding (more than two people per room) is a key issue in some countries and, throughout Europe, affects

around 5 million people. There is a lack of information on further socioeconomic modification of the dose–response relationships. However, plausible mechanisms could be postulated, such as those related to education. Lack of housing is also a determinant of inequality that should be included within this framework (e.g. homeless persons and travellers). A key issue in reducing inequalities is the lack of income for households to obtain better-quality housing, although lack of education and/or awareness may also be a barrier in relation to some exposures (e.g. chemicals and ETS).

- Urban planning should ensure a social mix in any given area.
- Housing policies should, as a matter of priority, address the elimination of overcrowding.
- Social support for housing should strike a careful balance to ensure that it does not drive up the overall market value of housing.

Table 1. Summary of the evidence on housing

Exposure (chemical, physical, biological)	Inequalities in exposure	Inequalities in vulnerability	Caused by lack of income	Caused by lack of education/awareness
Mould	Yes	Maybe	Sometimes	Yes
Cold/lack of heating	Yes (but inconsistent)	Maybe	Sometimes	No
Physical hazards/burns	Yes	?	Yes	Yes
Physical hazards/falls	Yes	?	Yes	Yes
Indoor air pollution/chemicals	May be higher in high income groups	Yes	Maybe	Yes
Indoor air pollution/combustion	Yes	Maybe	Sometimes	Yes
Pesticides	Maybe	Maybe	?	Yes
Flooding	Maybe	Yes	?	?
ETS	Yes	Maybe	No	Yes
Noise	Yes	Yes	Maybe	Yes
Home grown/local food	Yes	Maybe	Maybe	Yes
Lack of sanitation	Yes	Yes	Yes	Unlikely

Air quality

Overall, populations in large urban and industrial areas and near major traffic routes are most likely to be exposed to poor ambient air quality. Air pollution of local industrial origin is more clearly associated with socioeconomic stratification. However, differential exposure to ambient air pollution by socioeconomic status varies considerably between and within countries across Europe therefore no generalization is possible. On the other hand, indoor air pollution (especially ETS) shows a clearer socioeconomic pattern, those in lower socioeconomic groups being more likely to be exposed. In western Europe, personal exposures are strongly socioeconomically determined for men but are much less clear or consistent for women. Women from lower socioeconomic groups living in rural areas of eastern Europe are more likely to be exposed through the use of solid fuels for cooking and heating (although it should be noted that much of the evidence concerning these exposures comes from studies conducted elsewhere, such as rural China, Latin America and South Africa). There are few studies that consider children’s exposure from a socioeconomic perspective, although children are disproportionately exposed to ETS. The mechanisms by which socioeconomic inequalities occur can be seen in both exposure and vulnerability to health outcomes. From an exposure perspective, those in higher socioeconomic groups may be better able to protect the air quality within their homes from ambient air pollution through better ventilation systems and may be less exposed while commuting (if travelling in an air-conditioned car instead of by moped, for example). From a vulnerability perspective, those in lower socioeconomic groups may have reduced protective factors such as diet, underlying health status and access to health care,

limited knowledge about protective behaviour (or the possibility of applying such knowledge) and other competing and contributing risk factors.

- Urban planning should ensure a social mix in any given area.
- Data should be compiled on the total impact of traffic-related air pollution on population health risks, both at home and during transport.
- New research is needed on ambient air pollution in rural locations, and on indoor air.

Psychological stress

Stress occasioned by any contextual factor may act as an effect modifier, meaning that those who are stressed (whatever the reason) are more likely to succumb to disease, given a comparable exposure to a toxic agents. Psychological stress, whether occasioned by social or physical circumstances, is more likely to be associated with low socioeconomic status. A work environment wherein individuals experience a lack of control, fear and reduced self-esteem will result in elevated stress levels, leading possibly to psychological impairment and mental illness but also to physical pathologies such as heart disease or cancer. Those in low-status, low-income jobs (usually people from low socioeconomic groups) are most likely to experience these symptoms of stress. The additional effects on health of coping mechanisms for stress, such as smoking, excessive alcohol consumption or violence, need to be considered. Perceptions of the neighbourhood environment, such as a low aesthetic value or a reduced opportunity for physical activity and outdoor living owing to lack of safety and appropriate outdoor spaces, can affect levels of psychological stress. People in lower socioeconomic groups are more likely to suffer higher levels of stress because of a perceived lack of control over their environment.

- Involve residents in assessing, planning and developing the neighbourhood, as well as more distant developments that could have a significant impact on the neighbourhood.
- Provide all areas of the city with the same level of crime prevention and investigation, and apply the same minimum standards of street cleaning, building maintenance (paint, graffiti removal, broken window replacement) and greenery management in all areas of the city.
- Review existing research and reports on the relationships between stress symptoms and resident participation, crime levels and prevention, and environmental management.

Water and sanitation

While the topic area of water and sanitation was not included in the set of background documents or presentations in plenary, group members considered this was an important area of socioeconomic inequality. There are affordability issues regarding the purchase or modification of housing to meet water supply and sanitation standards. This may also be a community-wide issue, with some (usually wealthier) communities being better serviced. Discrimination may be a factor against some social groups; for example, neighbourhoods with a large ethnic minority population may not be given priority for investment in water and sanitation facilities. There is good evidence that education and financial resources can ameliorate the risk of ill-health due to poor water quality and sanitation. People from higher socioeconomic groups are also less vulnerable to the adverse health outcomes of poor sanitation, as they are more likely to start with a higher level of health, are more likely to have better access to or ability to pay for health care, and are more likely to be in jobs with paid sick leave.

- Expand the public waterworks and pipeline networks to areas currently served by small local water plants and private wells, particularly those with low socioeconomic status.
- Identify, assess and report all water-related epidemics and summarize them regionally and/or annually into broader levels of analysis.

Working group B: gender- and age-related mechanisms

The 12 members of working group B, chaired by Dr Kieron Stanley, were given the task of reviewing the evidence on the influence and effects of gender and age on environment and health risks. The influences of gender and age were discussed according to exposure and vulnerability (biological and sociocultural) and some actions were suggested.

Exposure

As a general point of departure, the working group agreed that all societies have gender-specific structures to a certain extent. This indicates that gender is a matter of education, economic resources, power, etc. and therefore an independent social determinant.

Exposure to environmental hazards varies by gender and age for a number of reasons. These are explored below.

Settings

The home

People in some age groups, such as young children, women and the elderly, are more likely to spend more time in the home. Exposures in the home are therefore more relevant for these groups and may lead to increased exposure to:

- ETS (especially in children);
- household products such as cleaning agents, detergents, household chemicals and cosmetics (especially in women and to some extent children); and
- any building-related environmental threat, be it mould, indoor air pollution, cold, unsafe design or outside factors such as air pollution and noise.

In addition, diet and nutrition depend on the home and family traditions in relation to social and cultural factors and position. The affordability, quality and availability of food also play a major role and may particularly affect children in relation to BMI and overall fitness and health status. Food-related concerns may cause additional mental stress, and possibly more so in women.

Outside the home

In the residential setting, the main point of interest was considered to be the provision of adequate transport options and infrastructure. Those most vulnerable were considered to be children, mothers with babies, people with functional limitations and the elderly, i.e. those that depend most on transport services. The main consequences were restrictions on social activity.

In relation to the general problem of residential locations near to busy roads, which are more relevant for population groups spending more time at home, the main consequences were environmental exposures such as noise and air pollution triggered by traffic flow (see the previous section).

There is also evidence of an increased risk of injury to young people using bicycles, motorcycles and cars.

The workplace

People of working age are likely to spend longer periods of time in a work setting. Where work conditions do not account for gender differences, women are more likely to be adversely affected.

Work at home is mostly carried out by women but little information is available regarding potential risks and inequalities.

Illegal work mostly affects vulnerable and marginalized populations such as immigrants or people with a low level of education, and is often shaped by social determinants unrelated to age and gender. However, child labour may be a major issue, as well as inadequate working conditions and the level of demand placed on both men and women. In general terms, illegal work must be considered a major source of environmental and health inequalities, as it does not respect national standards regarding safety, hygiene and working conditions.

Tasks/behaviour

Environmental hazards also vary according to the type of work undertaken and may enhance the degree of inequality in exposure. For example:

- men may be more likely than women to be employed in higher-risk jobs;
- women may be more exposed than men to chemical hazards in home cleaning and cosmetic products;
- boys may be more likely than girls to engage in higher-risk games; and
- young children may engage in higher-risk activity if not appropriately supervised, and the safety and suitability of toys for children may vary with social status.

Vulnerability

Biological differences

A range of biological differences are related to sex and age and directly or indirectly affect vulnerability to specific risk factors in the environment. Many of these differences depend on age, and suggest children as the major risk group because of their lower body weight (intake of hazardous substances can quickly be critical), their ongoing development (of the immune system, for example) and their inability to assess risks. However, the fact that exposure studies for chemical compounds are usually done on young males may also have an effect, as there is little knowledge of the effect of such substances in the elderly or in women.

Sociocultural differences

Differences unrelated to human biology mostly relate to behaviour, awareness, capacity and culture. For example, older people and young children may be more susceptible to injuries in the home owing to their behavioural characteristics, while young adults may be more at risk of injury from road traffic incidents.

It is important to note that poor access to and representation in decision-making processes often constitute social injustice. Women and children, and to some extent the elderly, may be more vulnerable owing to their being less involved in decision-making. Also, income, employment and educational opportunities are not always equal for males and females and this affects social position. It was agreed that the available evidence suggests that education, particularly for women, had commensurate positive health outcomes. For example, level of education is often associated with the likelihood of taking up occupations with an increased level of health risks and stressors (such as shift work, physically demanding work, or work in settings with high levels of environmental stressors).

Actions

The working group identified the following general actions to reduce inequalities related to gender and age, and to increase awareness regarding the relevance and existence of such inequalities.

- Address in greater detail the different needs and susceptibilities of men and women.
- Specify the particular vulnerabilities related to age (and the main age-related risk groups of children and older people) in research policy and regulation.
- Ensure tools such as WHO's gender mainstreaming tool are adopted.

Furthermore, the group recognized and valued the recommendations of the WHO Commission on Social Determinants of Health (3) which, in its final report, made specific gender- and age-related policy recommendations, including the following.

- Improve the well-being of girls and women and the circumstances in which their children are born, put major emphasis on early child development and education for girls and boys, improve living and working conditions and create social protection policy supportive of all, and create conditions for a flourishing older life. Policies to achieve these goals will involve civil society, governments, and global institutions.
- In order to address health inequities, and inequitable conditions of daily living, it is necessary to address inequities – such as those between men and women – in the way society is organized. This requires a strong public sector that is committed, capable, and adequately financed.
- Address gender biases in the structures of society – in laws and their enforcement, in the way organizations are run and interventions designed, and the way in which a country's economic performance is measured.
- Develop and finance policies and programmes that close gaps in education and skills, and that support female economic participation.

Working group C: mechanisms related to marginalized groups/minorities

The nine members of working group C, chaired by Dr Alexandra Cucu, were given the task of reviewing the evidence on the influence and effects of being part of a minority group on environment and health risks. The group members drew up a list of types of minority group: the Roma population, refugees (including internally displaced persons), migrants and ethnic minorities. They considered the quality of the evidence on the health effects of particular environmental conditions and concluded that such evidence is limited in the case of minority groups. Most evidence is informal or from case studies, while evidence at the national level is rare. Some good qualitative studies have been conducted by nongovernmental organizations, but there are gaps in the quantitative evidence. Overall, the evidence is scattered and fragmentary and there is little opportunity for comparison. Some issues are highlighted in Table 2. A number of key mechanisms were identified and actions suggested at the international and national levels.

Table 2. Potential health effects of selected environmental conditions among marginalized groups / minorities

	Environmental condition	Health effect
Dwelling	Sanitation Access to drinking water and water Overcrowding Poor insulation Indoor air pollution Unstable structures Dampness Flooding	Respiratory disease Allergic reactions and asthma Gastrointestinal infections and waterborne/foodborne diseases Vector-borne diseases Tuberculosis and hepatitis Chemical poisoning Domestic injuries Drowning Lead poisoning Reproductive health effects (low birth weight, perinatal mortality, prematurity, congenital anomalies) Cancer
Neighbourhood and residential area	Toxic waste Household waste Exposure to ambient air pollution (traffic, industry) High residential density levels	Respiratory and cardiovascular health symptoms/diseases Tuberculosis Reproductive health effects (low birth weight, perinatal mortality, prematurity) Skin diseases
Working conditions	Lower-skilled jobs Illegal work Informal work	Accidents and injuries Occupational diseases

Key mechanisms

Driving forces were identified as key mechanisms at both macro and micro level. Other mechanisms at the micro level include exposures and effect modifiers. These are listed below.

Driving forces at the macro level were identified as:

- transitional economies and industrial collapse

- lack of clear data on the dimension of the problem
- failure to register legal status
- liberalization of social policy
- decentralization
- discrimination against minorities
- radicalization of nationalistic political movements
- lack of community organization
- unemployment
- low levels of education.

Driving forces at the micro level were identified as:

- residential segregation
 - substandard housing
 - poor amenities
 - poor schools
 - hazardous locations (traffic, industry, waste)
 - lack of affordability
- poor access to health and social services
- higher occupational exposure.

Exposures at the micro level were identified as:

- cumulative exposure
- low access to information, poor knowledge and lack of awareness of risks
- lack of trust among different ethnicities or authorities
- cultural isolation
- language barrier
- unhealthy behaviour.

Effect modifiers at the micro level were identified as:

- limited affordability of healthy food
- poorer health
- low rate of immunization
- unhealthy behaviour
 - eating habits
 - smoking
 - alcohol consumption
 - violence
 - absence of preventive health care.

Actions

A number of actions are suggested at the international and national levels. Specific actions are suggested in the areas of housing, education, employment and health care.

Actions at international level

- Encourage mechanisms to address the consequences of lack of legal status and registration (such as difficulty in accessing education, employment, housing and the health and social services).
- Put in place mechanisms and policies to aid the recognition and registration of minority groups where relevant.
- Incorporate environmental justice (highlighting minority groups) into sustainable development strategies and other environmental policies.
- Ensure relevant data is collected on minority groups.
- Encourage further research on environmental health from the perspective of minority groups through the creation of funding and other mechanisms.

Actions at national level

- Implement relevant international actions.
- Encourage political representation for minority groups.
- Consider issues relevant to minority groups in the implementation of the Aarhus Convention.
- Ensure that minorities are appropriately considered in the relevant sections of the regulation impact assessment procedure.
- Ensure that effective antidiscrimination policies are in place.

Actions related to housing

- Address the issue of social segregation in housing.
- Ensure that appropriate levels of social housing are available at city level.

Actions related to education

- Enhance access to a proper educational system.
- Target specifically girls and young mothers regarding the issue of leaving school early.

Actions related to employment

- Encourage entrepreneurial programmes that stimulate employment and income generation.
- Address issues related to informal work sector activities.

Actions related to health care

- Improve collaboration between the social and health sectors in addressing issues of minorities.
- Put in place health promotion and disease prevention programmes tailored to the needs of minority groups.
- Ensure that access to preventive and curative services within the health system is culturally sensitive and appropriate, irrespective of the legal status of the clients.
- Ensure the availability of basic occupational health services for minorities.
- Focus on health education for mothers at prenatal and early childhood stages.

Conclusions

The expert group identified a set of key conclusions in relation to the current evidence on socially determined environmental inequalities. It should be noted that evidence reviewed for this report is based on studies conducted in a limited number of countries. Therefore, extrapolation to the WHO European Region as a whole is difficult and the data presented must be considered as an indication rather than as a comprehensive European evidence base.

Widening social inequalities adversely affect environmental health

Social inequalities in exposure to and health outcomes from environmental risks are evident in all countries where research has taken place. Moreover, there appears to be a trend towards continuing segregation and widening social disparities, which may potentially be further enhanced by the recent global economic crisis.

Disadvantaged groups

The evidence shows that – irrespective of where the studies have been carried out – social inequalities in environmental risk were consistently found in relation to low-income population groups, and individuals / households with low socio-economic position. For more specific risks, inequalities have been found in relation to gender, age and other determinants such as nationality, employment, education or migrant status.

Variation among countries

Stark differences exist among countries in both the nature and the magnitude of environmental hazards. The level of technological sophistication across industrial, commercial and residential settings, as well as national environment and social policies, influences exposure at a population level.

Social and environmental justice

In many situations, those most exposed and vulnerable to environmental hazards are least culpable in the production of the hazard.

Impact of population-wide measures on disadvantaged groups

Disadvantaged groups are likely to benefit most from interventions to provide a safer environment, yet are least likely to be in a position to bring about the necessary change. This applies across all levels: local, national and international.

Particularly vulnerable groups

Individuals not registered as workers or residents in a particular location, such as illegal immigrants, may be particularly exposed and vulnerable to environmental risks through a range of mechanisms that includes limited income, hazardous or unprotected work and poor housing quality.

Link with sustainable development and cost-effectiveness

Addressing only the consequences of social inequalities in environmental health risks is unsustainable and costly.

Recommendations

The international evidence shows that significant inequalities exist both between and within countries. There is also wide variation in the nature of inequalities seen, including differences in environmental conditions, differences in the scale and severity of exposure and differences in affected population groups. In recognition of this diversity, it is unrealistic to expect to draw up policy, technical and research recommendations that can be applied equally to all countries within the European Region. Thus, the focus of the recommendations agreed on will be at the strategic level, while more detailed responses need to be formulated at the national and/or local level.

Policy issues

Countermeasures to mitigate inequalities must take into account driving forces behind such inequalities. Thus action must be taken at multiple levels:

- in the short to medium term, by slackening the connection between social and environmental inequalities by addressing direct exposure mechanisms; and
- in the medium to long term, by reducing, stopping and reversing this trend by addressing the root causes of social inequalities.

The three overarching recommendations from the report of the WHO Commission on Social Determinants of Health (3) should form the basis for any governmental action to reduce social inequalities in environmental health risks:

- improve daily living conditions;
- tackle the inequitable distribution of power, money and resources; and
- measure and understand the problem and assess the impact of action.

Issues of environmental and social justice should be given careful consideration. Disadvantaged groups are likely to benefit most from interventions to provide a safer environment, yet are least likely to be in a position to bring about the necessary change and depend on public authorities to do so on their behalf. Technology is available in most areas to provide safe environments, yet implementation depends to a large extent on the availability of social capacities and material resources, including costs. Applying the "polluter pays" principle to preventive action may be beneficial.

Where registration is not appropriate or possible, such as when people do not have legal entitlement to reside in a particular location, other mechanisms must be put in place by authorities to protect these vulnerable groups.

Technical issues

Health system

Not all inequalities can be mitigated or prevented and will inevitably lead to a higher exposure and disease burden in disadvantaged population groups. Adequate primary health care services and infrastructure are therefore an essential component of diagnosing and addressing social inequalities in environmental determinants of health. However, many health care professionals currently lack the necessary knowledge and skills to incorporate environmental determinants of health into their assessment and treatment plans. We suggest that consideration be given to ensuring that all community health professionals receive adequate and appropriate training in the environmental determinants of health and health inequalities, and be sensitized to the

specific needs of vulnerable population groups. Further, the presence and availability of primary health care services are an essential part of the social network at community level. Thus in many countries there needs to be further investment in human resources, financial resources and tools to ensure that an appropriate primary health care services infrastructure is in place.

Urban and environmental planning

Health equity and a fair distribution of health risks should be an integral part of planning and sustainable development. This may be achieved in a number of ways, including the integration of health/health impact assessment into environmental impact assessment and other statutory planning processes, and the systematic consideration of the equity and distribution dimension of infrastructural developments and location processes. Environmental justice, including issues of distributional justice, should be incorporated into sustainable development strategies. The evidence strongly suggests that mixed land use, incorporating principles of multipolarity and diversity, can be beneficial for health and for the reduction of health inequalities.

The trend towards residential segregation – be it by socioeconomic or ethnic mechanisms – is considered a major cause of inequalities as it clusters population groups with very different abilities to preserve their environment and protect their health, and with different access to education and to social and health services. A proper social mix can reduce social inequalities and contrasts in exposure. Care needs to be taken, however, that state or local authority input does not artificially cause prices to rise, which can have the opposite effect to that planned.

Research issues

Data access and monitoring

The lack of data on (inequalities in) environmental health risks in many countries could in itself be considered a measure of inequality. Deducing national inequality conditions from local studies is unlikely to give an accurate reflection of the situation, owing to the differences that may exist even between local areas, as described above. If there is no way to identify inequalities, weaker groups become even more marginalized and possibly are at even higher risk. Thus, it should be a primary duty at national and local levels to collect and make available relevant data specifying factors such as ethnicity, socioeconomic status, age and gender. Attention should also be paid to different exposure settings and perceptions of exposure.

Minority groups

With regard to research on minority groups, this should be interpreted as all groups whose members face greater risk of exclusion because they belong to that group. This includes not just ethnic and cultural groups such as Roma and immigrants but also, for example, minorities of sexual or religious groups and disabled people. Further research may be warranted on other groups who routinely experience animosity. This may include research on the cultural factors that influence access to and delivery of services.

Data consistency

Even where data are collected, they may not be comparable across different systems, such as the economy, the environment and health. Further, different indicators may be used in different countries, making comparison difficult at this level. The issue of comparability should be considered when setting up new data systems and amending existing ones. Development of an international consensus on a protocol on inequalities would also be of value. In addition, international projects collecting data on inequality at the local, regional or national scale for various countries could pave the way towards a better understanding of inequalities vis-à-vis the different national systems. Partly because of the data available, research methods can vary considerably, allowing little comparability of studies. To address this, there should be an agreed

structure and potentially a shared protocol on research methods that would consider a range of issues, including differences in spatial scales, time scales, policy domains, disciplines and actors.

Data transferability

With regard to the transferability of research findings, it is acknowledged that much of the research has been conducted in a limited number of countries and therefore may not provide a sound evidence base on the European level or for other countries. Where such research is being applied in other countries, it should be done with caution and with due consideration to demographic, policy, legislation and other factors that may differ among countries.

Policy development and review

There is insufficient evidence of what works with regard to policy implementation, including cost-effectiveness. Further research should take account of project evaluation measures to identify what works, and careful consideration should be given to what has worked elsewhere when implementing policy. Mechanisms such as health impact assessment can help to structure such work. Furthermore, all policies should be developed and implemented in an accountable way (also in terms of socioeconomic status), including cost-benefit analysis, policy impact models and measurable policy objectives, implementation feedback monitoring and policy modification mechanisms to respond to the monitoring results.

Cumulative exposures

Most evidence focuses on single elements of disadvantage (individual environmental risks, etc.) while only a few (not always explicitly) include multiple elements represented by exposure to more than one source of nuisance. In addition, the potential triggers of increased risks may also be multidimensional. Further research is needed to better understand the cumulative and synergistic health impacts of exposure to more than one environmental condition and/or in more than one setting.

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Annex 1. Participants

Temporary Advisers

Professor Alexios Antypas
Centre for Environment and Security, Central European University
Budapest
Hungary

Dr Robert Bauer
Kuratorium für Verkehrssicherheit, Bereich Heim, Freizeit & Sport
Vienna
Austria

Dr Gabriele Bolte
Department of Environmental Health
Bavarian Health and Food Safety Authority
Oberschleissheim
Germany

Professor Harvey Brenner
Department of Social and Behavioral Sciences
University of North Texas Health Science Center
Fort Worth, TX
USA

Dr Sharunda Buchanan
Director, Environmental Health Services Branch
Emergency and Environmental Health Services Division
Centres for Disease Control and Prevention
Atlanta, GA
USA

Mrs Christiane Bunge
Environmental Hygiene, Environmental medicine, Health Effects Assessment
Federal Environment Agency
Berlin-Dahlem
Germany

Ms Lourdes Cantarero
Consultant , Women's Health Observatory
Ministry of Health and Social Policy
Madrid
Spain

Dr Krunoslav Capak
Head, Environmental Health Ecology Service
National Institute of Public Health
Zagreb
Croatia

Dr Alexandra Cucu
Institute of Public Health
Bucharest
Romania

Dr Séverine Deguen
Department of Occupational and Environmental Health
EHESP School of Public Health
Rennes
France

Dr Jon Fairburn
Institute for Environment, Sustainability and Regeneration,
Staffordshire University
Stoke-on-Trent
United Kingdom

Professor Claudia Hornberg
Department of Environment and Health
Bielefeld School of Public Health
Bielefeld
Germany

Professor Matti Jantunen
Department of Environmental Health
National Institute of Health and Welfare
Kuopio
Finland

Dr Marike Kolossa-Gehring
Toxicology, Health-related Environmental Monitoring
Federal Environment Agency
Berlin-Dahlem
Germany

Dr Sari Kovats
Lecturer, Public and Environmental Health Research Unit
London School of Hygiene & Tropical Medicine
London
United Kingdom

Dr Hanneke Kruize
Researcher on Environment and Health
Centre of Environmental Health Research
National Institute for Public Health and the Environment (RIVM)
Bilthoven
Netherlands

Dr Maria Kvakova
School of Health Care and Social Work
Trnava University
Trnava
Slovakia

Professor Lucie Laflamme
Department of Public Health Sciences
Division of Global Health
Karolinska Institute
Stockholm
Sweden

Ms Teresa Lavin
Public Health Development Officer
Institute of Public Health
Dublin
Ireland

Professor George Morris
Consultant in Ecological Public Health
Public Health Science
NHS Health Scotland
Glasgow
United Kingdom

Dr Anna Paldy
Deputy Director-General
National Institute of Environmental Health
Budapest
Hungary

Mr Rifat Pamuk
Ministry of Health
Sihhiye Ankara
Turkey

Professor Nikoloz Pruidze
Deputy Minister
Ministry of Labour, Health and Social Affairs
Tbilisi
Georgia

Dr Anne Reneflot
Norwegian Institute of Public Health
Oslo
Norway

Professor Boris Revich
Head, Laboratory of Environmental Health
Russian Academy of Sciences
Moscow
Russian Federation

Dr Tuulia Rotko
Senior Researcher
National Institute of Health and Welfare
Helsinki
Finland

Dr Kieron Stanley
Environment Agency
Bristol
United Kingdom

Mrs Viktorija Voolfson
Chief Specialist, Public Health Department
Ministry of Health
Vilnius
Lithuania

Dr Dragana Vujanovic
Office for Sustainable Development of Insufficiently Developed Areas
Belgrade
Serbia

Dr Bogdan Wojtyniak
Head, Centre of Monitoring and Analysis of Population Health and Health Care System
National Institute of Public Health
National Institute of Hygiene
Warsaw
Poland

Professor Denis Zmirou-Navier
Research Unit
EHESP School of Public Health
Rennes
France

Representatives of International Organizations

Ms Monika Kosinska
Secretary-General, European Public Health Alliance
Brussels
Belgium

Dr Raquel Asencios-Angulo
Global Expert on Environmental Health and Inequalities
Regional Environmental Center for Central and Eastern Europe
Szentendre
Hungary

Observers

Dr Charles Price
Unit C4 Health Determinants
Directorate General for Health and Consumer Protection
European Commission
Luxembourg

Mr Jonas Savelsberg
Bonn
Germany

Mrs Imke Thieme
Desk Officer Div. 332, Basic Issues of Prevention, Self-help and Environmental Health Protection
Federal Ministry of Health
Bonn
Germany

Mrs Chariklia Tzimas
Adviser, Multilateral Cooperation in the Field of Health
Federal Ministry of Health
Bonn
Germany

Dr Birgit Wolz
Head of Division IG II 2, Environment, Health and Consumer Protection
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Bonn
Germany

World Health Organization

Dr Srdan Matic
Unit Head, Noncommunicable Diseases and Environment
WHO Regional Office for Europe, Copenhagen

Dr Michal Krzyzanowski
Regional Adviser
WHO European Centre for Environment and Health

Dr Marco Martuzzi
Scientific Officer, Health Impact Assessment
WHO European Centre for Environment and Health

Dr Rokho Kim
Manager, Occupational Health
WHO European Centre for Environment and Health

Mr Matthias Braubach
Technical Officer, Living Environments and Health
WHO European Centre for Environment and Health

Ms Geraldine McWeeney
Technical Officer, Environment and Health in South East European Region
WHO Country Office, Serbia

Mr Francesco Mitis
Technical Officer
WHO European Centre for Environment and Health

Ms Leda Nemer
Technical Officer, Children's Health and Environment
WHO European Centre for Environment and Health

Ms Maura Alexandra Beaton
Student Intern
WHO European Centre for Environment and Health

Mr Daniel Grünes
Student Intern

Ms Angelika Nöcker
Secretarial Assistant
WHO European Centre for Environment and Health

Ms Deepika Sachdeva
Secretarial Assistant
WHO European Centre for Environment and Health

Annex 2. Summary reports from the evidence reviews provided to the meeting as background documentation

Full versions of the reviews will be made available as background documents to the Fifth Ministerial Conference on Environment and Health, Parma, Italy, 10–12 March 2010.

1. Social inequalities in health risks related to ambient air quality
2. Social inequalities in environmental risks associated with housing and residential location
3. Social inequalities in health risks related to unintentional injuries among children
4. Inequalities, inequities and environmental justice in waste management and health
5. Social inequalities in working environment and work-related health risks
6. Environmental inequalities among children and adolescents
7. Gender inequalities in environment and health
8. Climate change and health inequalities
9. Social inequalities and environmental health in the Russian Federation

Social inequalities in health risks related to ambient air quality

Séverine Deguen¹ & Denis Zmirou-Navier¹

¹ EHESP School of Public Health, Rennes, France.

Evidence of social inequalities in health is now well-established in most developed countries. Environmental nuisances, including ambient air pollution, have recently been suspected of contributing to social inequalities in health. In spite of improvements in air quality over the last few decades in developed countries, air pollution remains a major field of investigation and action for improving public health. It may still represent a strong factor of social inequality in health. Based on a literature review, we identified two major mechanisms, acting independently or in synergy, by which air pollution can contribute to social inequalities in health: (a) disadvantaged groups are recognized as often bearing a disproportionate share of poor air quality (exposure differential); and (b) disadvantaged groups may also be more susceptible to the resulting health effects (susceptibility differential). Children from poor social categories could be affected in the same two ways.

In contrast with American and Canadian studies, the results from European studies on environmental inequality are more mixed: effect modification of air pollution by socioeconomic status may in some cases result in the poorer being at greater risk; inversely, the richer are sometimes reported at greater risk in other studies. As an example, an epidemiological study conducted in Oslo showed that, irrespective of the neighbourhood socioeconomic indicators that were used, the most deprived areas were exposed to higher levels of fine particulate matter. In Rome, in contrast, an inverse association was revealed: households of higher social class were more likely to be located in areas with high traffic emissions. By comparison with environmental equity studies, fewer studies have been published on the role of socioeconomic status on the air pollution : health relationship. Nevertheless, the general pattern of the current evidence is that deprived populations, though not always more exposed, experience greater harmful effects of air pollution.

To our knowledge, no European study has formally explored this relationship among children. Poverty and deprivation in early childhood influence both health and the development of children and may have adverse consequences throughout life. Studies concentrating on children, in particular follow-up studies, are needed to assess social inequalities related to air pollution and to better understand mechanisms through which health inequalities could arise later in life.

Several suggested pathways and mechanisms have been identified. Susceptibility factors, including poor health status (obesity, diabetes and other chronic diseases, for example), addiction (e.g. alcohol consumption and smoking), multiple pollutant exposure (passive smoking, occupational exposure and indoor poor air quality) and poorer access to good-quality health care, could partly explain the effect modification by socioeconomic status. The housing market biases land-use decisions and may explain why some subgroups suffer from both low socioeconomic status and high exposure to air pollution. Some of the current data may be based on inaccurate exposure assessment, calling for more research. In particular, cumulative exposures should be taken into account in order to explore health problems more accurately.

The issue of exposure and health inequalities in relation to ambient air quality is complex and calls for global appraisal. There is no single pattern. Policies aimed at reducing the root causes of these inequalities could be based on urban multipolarity and diversity, two attributes that require long-term urban planning.

Social inequalities in environmental risks associated with housing and residential location

Jon Fairburn¹ & Matthias Braubach²

¹ Staffordshire University, Stoke-on-Trent, United Kingdom.

² Living Environments and Health, WHO European Centre for Environment and Health, Bonn, Germany.

Good evidence exists across several European countries – though mostly the European Union (EU) Member States – that, in general, poorer people experience poorer-quality housing and residential environments affecting both their physical health and mental well-being. A wide range of environmental factors have been studied, including housing conditions (thermal comfort, dampness, indoor pollution and sanitation) and neighbourhood quality (air quality, noise, location of industrial and waste sites, and risk of flooding).

Housing conditions

Large income-related inequalities exist in the affordability of heating, with households in relative poverty often reporting twice as often that they cannot afford to heat their homes adequately. Similarly, French data show that (especially elderly) residents in low-quality and deprived homes were more often affected by the heat wave of 2003.

Income-related variation can also be found for the problem of dampness in the home, with an increasing degree of socioeconomic disadvantage in the eastern European Member States of the EU, and some national studies have found strong associations between dampness and mould growth.

Inequalities in exposure to indoor pollution have been reported for ETS, benzene and lead (with higher exposure levels for poorer population groups), while German studies also identify increased exposure for well-off households in the case of terpenes and PCBs. An increasing concern in the European Region is the use of solid fuel for heating and cooking, which is especially frequent in the eastern European countries but is also an alternative energy source for poor households in more developed countries.

Finally, studies indicate that the lack of a toilet for the private use of the household is still an issue for the poorer population groups. The largest problems of sanitation are faced by countries in eastern Europe and central Asia, where a lack of adequate water and sanitation facilities can affect more than half of the poor population groups.

Residential conditions

At the neighbourhood level, perceptions of poor-quality neighbourhoods are predictive of poor self-reported health. This effect is still significant even after adjusting for individual socioeconomic characteristics. In the United Kingdom, poor people are more likely to live in poor-quality neighbourhoods.

Air quality research in England, Germany and Scotland shows that poor areas experience the worst air quality. In general, there is a clear social gradient between air quality and socioeconomic status, i.e. the poorer you are the more likely you are to experience poor air quality. Studies in Germany, the Netherlands and Switzerland also found higher noise levels or perceived higher levels in poorer areas.

The siting of industry shows very strong social gradients in England, France, the Netherlands and Scotland, with such sites being far more likely to be found in poor areas or those with large concentrations of immigrants. In large parts of eastern Europe, we have no idea where many of the old abandoned waste sites are. Discrimination against the Roma in eastern Europe often results in their being pushed on to marginal areas near, for example, waste sites or floodplains.

Where good-quality spatial data exist and have been made available, such as in France, the Netherlands and the United Kingdom, significant new insights have been made into the distribution of environmental quality among groups in the population. Lack of data (or more often lack of access to data) continues to be a problem in many countries. Changes in the planning systems in several countries will be needed (particularly around the siting of industrial sites) if inequalities are to be reduced.

Social inequalities in health risks related to unintentional injuries among children

L. Laflamme,¹ M. Hasselberg¹ & S. Burrows²

¹ Department of Public Health Sciences, Division of Global Health, Karolinska Institute, Stockholm, Sweden.

² National Institute of Public Health, Montreal, Quebec, Canada.

Injuries constitute both one of the major causes of premature death and disability and one of the causes of childhood mortality with the steepest socioeconomic gradient. Research on socioeconomic disparities in childhood injuries indicates the following.

Lower socioeconomic status – greater risks. Children from households with low socioeconomic status and from less affluent geographical areas tend to die by injury or get injured to a greater extent than others. This has been observed for most causes of injury (e.g. traffic, falls, poisoning and burns).

Disparities at all levels of morbidity. Socioeconomic differences arise for various injury severity measures (e.g. hospitalization, emergency department visits, long-bone fractures and head injuries). Some – but not all – studies indicate that the more severe the injury, the greater the socioeconomic differences.

Disparities in several environments. Injuries sustained in the road traffic environment have been extensively studied. The bulk of the evidence indicates that children from less affluent backgrounds are at greater risk as pedestrians, cyclists and car occupants. Disparities in injuries occurring in and around the home (e.g. falls, burns and poisoning), often sustained among younger children, are far less researched but there is supportive evidence that they too may be overrepresented among the less well-off.

Age and setting may interact. The manner in which socioeconomic disparities fluctuate with increasing age in different settings and geographical areas suggests that this pattern is not only a matter of individual development but also an environmental one. Child pedestrian injuries, for instance, are associated with very strong social gradients in the United Kingdom (area-based study) and with negligible ones in Sweden (individual-based study).

One description does not fit all. Not all children with lower socioeconomic status or from deprived areas get injured, and not all injured children come from a deprived family or environment.

Few countries contribute evidence. Within Europe, the bulk of the evidence at hand stems from high-income countries and, most often, countries from the north of Europe.

Socioeconomic differences in injury are neither unavoidable nor irreversible. Although numerous interventions have been evaluated and promoted as effective, few that have been conducted assess whether those interventions are equally effective in all socioeconomic groups (or areas) or if they help reduce differences between those groups.

Avenues of prevention discussed in the chapter are:

- safety-oriented legislation or regulation that determines minimum standards and conditions under which a number of activities cannot be performed, or imposes safe behaviour and practices that would not be largely adopted on a voluntary basis.
- levelling up the safety of the physical environment through “passive” safety measures by means of engineering and product development: a matter of “modifying”, “isolating”, “separating” or “eliminating” the sources of danger;
- community-based prevention programmes that intend to tackle the safety level of communities by combining strategies such as behavioural and environmental changes, in some instances together with enforcing legislation and subsidies;
- home safety education and home visit programmes aimed at promoting safe practices in the home and also at preventing both unintentional and intentional injuries; and
- creating attractive places for recreation, since the fewer off-street play areas that are offered the more the street environment becomes not only an area for traffic but also one for recreation.

In conclusion, the contribution of injuries to social–health differentials in childhood is considerable in very many countries, and prognoses show that their importance is on the increase. Socioeconomic differences in wealth need not be reflected in differences in safety. For health targets to be reached and sustained, both safety-for-all and equity-oriented policies and strategies are imperative. These can be initiated by the health sector but are likely to require multisectoral commitments and concerted action.

Inequalities, inequities and environmental justice in waste management and health

Marco Martuzzi,¹ Francesco Mitis² & Francesco Forastiere³

¹ Health Impact Assessment Methods and Strategies, WHO European Centre for Environment and Health, Rome, Italy.

² Violence and Injury Prevention, WHO European Centre for Environment and Health, Rome, Italy.

³ Local Health Authority, Rome, Italy.

The scientific evidence on the effects on health of exposure to waste is not univocal. Epidemiological studies on populations living near landfills and incinerators do not demonstrate that exposure to waste causes cancer or reproductive outcomes such as congenital anomalies and low birth weight. Socioeconomic factors have been considered, mainly as confounders, in few studies only. Differential exposure to waste by socioeconomic status is often documented, but the interplay between environmental and social factors that is crucial for policy-making is not well-known.

In this review, which aims at investigating the role of health inequalities in waste management, grey and peer-reviewed literature from Europe and the United States was analysed, beginning in the 1980s. Grey literature was searched using Google Scholar and by obtaining key references listed in the peer-reviewed articles. In particular, it is of great interest to clarify what proportion of health inequalities (i.e. general differences in health status and in exposure levels due, for example, to age or individual predisposition) can be regarded as inequalities (i.e. avoidable differences, for example in access to health care services, that prevent individuals from attaining their full health potential and carry a negative ethical judgement).

United States literature provides consistent indications that waste facilities are disproportionately sited in areas with more residents from ethnical minorities or low-income classes. Similar results were found in European studies: international and national studies by research agencies and nongovernmental organizations have shown that hazardous sites are located mainly in areas where more deprived people live. In eastern Europe there is growing anecdotal evidence of Roma, ethnic minorities and refugees living close to hazardous waste sites.

In studies considering health effects (mainly from Europe), risks were estimated with standardization for socioeconomic status, typically using socioeconomic deprivation indices. Such standardization always reduces the risk for several cancers and reproductive outcomes. However, effect modification was not investigated in these studies.

The patterns of association between waste-related environmental pressures and socioeconomic status suggest that some of the observed inequalities in exposure and health represent environmental injustice, as they are the result of social processes and may be at least partly prevented. In fact, evidence indicates that more deprived populations tend to live close to hazardous sites and to be more exposed to their emissions. However, disentangling the possible health effects remains difficult, owing to limitations in the methodology. This is due to several reasons: (a) not all the studies analysed socioeconomic status; (b) socioeconomic status is considered in several studies but unadjusted estimates are not published; (c) adjustment is often made together with other confounders and the effect of socioeconomic status is not

distinguishable; and (d) in no case were interactions between socioeconomic status and waste exposure studied.

It seems important to address some further questions and investigate whether disadvantaged people are more vulnerable, i.e. whether risks differ in different social groups living in the same area. Notwithstanding these open questions, public health officers and decision-makers should identify and develop waste management policies to minimize their potential health impacts and their unequal distribution. This should take place through participatory processes whereby the interests of all stakeholders are taken into consideration.

Social inequalities in working environment and work-related health risks

Harvey Brenner¹

¹ Department of Social and Behavioral Sciences, School of Public Health, University of North Texas Health Science Center, Fort Worth, TX, USA.

Since 1841, occupational skill level has been the traditional rank-order designation of socioeconomic status in epidemiology in the United Kingdom. It specifies the formal level of technical skill and authority over other workers (i.e. managerial skills) required to perform at a given ordinal level in the employment hierarchy of economic or government organizations. From the mid-nineteenth to the mid-twentieth century, this basic principle was understood to prevail in northern European countries and the United States. The assumption was that there were attributes (physical, environmental, infectious, microbiological, etc.) of the occupations themselves that represented the link between occupational skill level and many illnesses (which were understood to be “occupational” in nature).

In the 1950s in the United States, and thereafter in northern European countries, a new paradigm was developed that viewed socioeconomic status as a consolidated phenomenon – including occupation, education and income. The socioeconomic status measure became a powerful analytical tool. The most pervasive finding in epidemiology at present is that socioeconomic status is a principal source of inequality in morbidity and mortality.

This is a report on a literature search covering the period 1990–2009 on working conditions/occupational health to find those studies that explicitly focus on how the relation between occupational grade/working conditions and socioeconomic status is affected by educational and income levels. The studies reviewed are among the most methodologically advanced in attempting to unravel this problem.

The research literature has been consistent in finding – for the last century and a half in England and Wales and since the Second World War in other industrialized countries – that occupational skill level is strongly inversely related to morbidity and mortality rates. This is the case for the great majority of diagnoses and especially for working-age populations, and seems to be stronger for men than for women. Separately, both education and income have been shown to relate in a similar manner inversely to health status measures. Further, it is well-established that educational level and income level, as well as immigrant status and minority ethnicity, are correlated with the occupational skill level of employees.

The fact that occupational grade, education and income are separately inversely related to many sources of morbidity and mortality has led to the generalization that these three factors are “indicators” (“measures”, “markers”, “proxies”) of the generalized phenomenon of socioeconomic status, and that several dimensions of socioeconomic status are jointly key to understanding inequalities in morbidity and mortality. In the past, we have not had large enough samples, sufficiently sophisticated research designs or multi-variable statistical analyses to know whether all three factors are jointly – and perhaps equally – responsible for health outcomes. Perhaps just one of these factors is principally responsible for the social gradient in occupational, infectious and chronic disease outcomes.

In the literature on socioeconomic status in relation to health, the skill level attributed to different occupations has been linked to exposure to deleterious working conditions, the greatest exposures being found among the least skilled (i.e. comparing professional, managerial, skilled, semi-skilled and unskilled occupational grades). Mechanisms of these relationships include exposure to physical, chemical and microbiological toxins, as well as a lack of worker autonomy leading to psychosocial stress. Education, income, immigration, ethnicity and gender influence the determination of which populations obtain low-skilled occupations and are exposed to environmental risks.

Viewed macro-economically, technological development and economic growth are the main sources of occupational structure and health. The international recession portends potential damage to occupational and environmental health through losses in employment and income, and loss of financial capacity to protect workers' health through the use of new technology.

Environmental inequalities among children and adolescents

Gabriele Bolte,¹ Martina Kohlhuber,¹ David O. Carpenter² & Giorgio Tamburlini³

¹ Department of Environmental Health, Bavarian Health and Food Safety Authority, Oberschleissheim, Germany.

² Institute for Health and the Environment, University at Albany, Rensselaer, NY, USA.

³ Institute for Child Health IRCCS Burlo Garofolo and Centro per la Salute del Bambino ONLUS, Trieste, Italy.

During the past decade, the impact of socioeconomic inequalities in the living environment and in exposure to environmental pollution has increasingly been recognized as a major contributing factor to the production of health inequalities. Likewise, awareness of the importance of children's environmental health has increased. A large proportion of the burden of disease among children in Europe is attributable to environmental factors. Consequently, protecting children from undesirable environmental exposures by taking socioeconomic conditions into account has been identified as a priority area for policy in Europe.

The current state of knowledge on environmental inequalities among children and adolescents in Europe was assessed by a systematic literature search. Sources of information comprised reviews and original studies published in peer-reviewed journals since 2000, reports by WHO, the EU and other organizations, and topical review papers prepared for the WHO expert meeting in 2009. Results were summarized according to the conceptual model that socioeconomic factors may affect environmental health by exposure variation and effect modification.

Most of the available evidence shows that low socioeconomic status is associated with an increased exposure of children and adolescents to inadequate housing and residential conditions and fewer opportunities for physical activity. At the community level, hazardous waste and illegal waste disposal sites are often disproportionately located in more deprived areas. Socially disadvantaged children are more likely to be exposed to (mainly traffic-related) air pollution, noise, lead and ETS. There is clear evidence that children from low socioeconomic backgrounds and from less affluent areas tend to sustain or die from injury to a greater extent than others.

For most topics and exposures reviewed here, there were no studies investigating the modification of the exposure–response function by socioeconomic factors. Therefore, the question as to what extent disadvantaged children, besides being disproportionately exposed to environmental risks, are also more vulnerable to its impacts cannot comprehensively be answered.

Owing to the variety of methodological approaches and studies on the one hand and a lack of data for many topics and countries or European regions on the other, it was not possible to produce an overall assessment and to quantify the magnitude of environmental inequalities among children and adolescents in Europe.

In conclusion, although patterns of environmental inequality may vary across populations and countries, the overall pattern based on the available fragmentary data is that children living in adverse social circumstances suffer from multiple and cumulative exposures, are more

susceptible to a variety of environmental toxicants, and often lack environmental resources or access to quality health care to reduce the health consequences of environmental threats. Action is needed along the whole causal pathway of the social divide in environmental hazards. Specific action to reduce socially determined differences in children's exposure, susceptibility and health consequences should be combined with upstream policy measures aimed at removing socially determined differences in environmental conditions. A child-focused equity dimension should be incorporated in environment and health information systems and IEC (information, education, communication) strategies.

Gaps in research should be filled in order to be able to assess the magnitude of environmental inequalities among children in Europe and the interaction between socioeconomic position, multiple and cumulative environmental hazards, and community stressors. Research on social inequalities in exposure and susceptibility to hazardous environments should be complemented with research on social inequalities in environmental salutogenic resources and a community-based participatory research strategy.

Gender inequalities in environment and health

Lourdes Cantarero¹ & Isabel Yordi²

¹ Observatory of Women's Health, Ministry of Health and Social Policy, Spain.

² Gender and Health, WHO Regional Office for Europe, Copenhagen, Denmark.

Emerging evidence from all over Europe suggests that, because of sociocultural (gender) and biological (sex) differences, men and women are affected by environmental factors in different ways and their levels of sensitivity differ. Gender norms and values drive men and women into types of behaviour that affect their exposure to environmental risk in different ways. Societies assign to men roles and division of labour that promote risk-taking behaviour and cause them to neglect their health. In many societies still, women have less access to health information, care, services and resources to protect their health. Further, gender interacts with race, ethnicity and other social strata, resulting in unequal benefits among various social groups and between men and women. When these differences are unfair, unjust or avoidable, we talk about gender inequalities in environment and health. The evidence available in relation to gender inequalities in environment and health shows marked differences both in exposure and vulnerability among men and women.

Water and sanitation

Because of the impact on girls' education and the on health across generations, gender inequalities in water supply and sanitation deserve special attention. This is especially relevant for the rural populations of eastern Europe and, to a great extent, the Caucasus region and central Asia. The still-persistent division of labour within households dictates that women and young girls are responsible for fetching drinking-water. Beyond the household, income inequality interacts with wider inequalities (rural–urban, regional and group divides) to reinforce deep gender inequalities. Young girls, particularly after puberty, are also less likely to attend classes if the school does not have suitable hygiene facilities. As adults, educated girls are more likely to have smaller, healthier families; their children are less likely to die and are more likely to receive an education than the children of less-educated mothers.

Injuries

Persistent gender inequalities in exposure to injuries and risk-taking behaviour continue to affect boys' health. Boys from various ethnic backgrounds living in western Europe are more at risk of injury than boys with a European background. Evidence from all over Europe shows that from the age of 1–2 onwards, reported injury rates are higher for boys than for girls. These differences are consistent over time and continue throughout adulthood and into old age. Evidence also shows that boys are more active than girls and it has been suggested that the male excess in injury rates is, at least in part, attributable to this. There is also clear evidence that adolescence is a period of heightened vulnerability to injury, and that the gap between the risk of injury in boys and girls widens during this time. There is evidence from both human and primate studies for a biological basis for male risk-taking behaviour. There is also evidence that boys and girls are differently socialized, which could result in gender differences in risk perception and behaviour.

Air quality

Differences in vulnerability interact with gender inequalities to affect female respiratory function. The Swedish National Environmental Health Survey 2007 shows that women report

ailments in the form of allergies and respiratory or skin hypersensitivity to a greater extent than do men. In Bordeaux, the effects of air pollution were greater for women than for men among the elderly and in Barcelona, older women were at greater risk of dying as a result of exposure to black smoke than were men. On the other side of the European Region, Armenian women report that, owing to a prolonged scarcity of fuel, many urban dwellers took to burning municipal waste for cooking and house heating. Burning of plastic, bleached paper and many other modern types of household waste exposed them to high levels of dioxin-like substances, polycyclic aromatic hydrocarbons and heavy metals. Depending on the type of housing, fuel, stove, ventilation and cooking patterns, exposure to the particulates and gases found in biomass and coal smoke can be very high.

Chemicals

Prenatal and childhood exposure to chemicals remains of greatest concern. Apart from differences in hormonal status, sex-related differences in sensitivity to toxic substances might be due to differences in detoxifying activity. Animal research indicates a five times higher detoxifying capacity in males than in females. There may also be variations in ability to absorb chemicals (children absorb lead twice as fast as adults) and in susceptibility to damage (greater vulnerability of the fetus to many toxic and mutagenic compounds). An important difference is that women usually have a higher percentage of body fat than men, and this has been associated with a larger storage of lipophilic chemicals. Up to 300 synthetic chemicals have been found in body fat and breast milk, many of which have been shown to be cancerous or toxic to the brain and nervous system.

Climate change and health inequalities

Sari Kovats,¹ Paul Wilkinson¹ & Bettina Menne²

¹ Centre on Global Change and Health, London School of Hygiene & Tropical Medicine, United Kingdom.

² Global Change and Health, WHO European Centre for Environment and Health, Rome, Italy.

Climate change is a complex environmental problem that acts over large spatial and temporal scales. Some warming has already occurred, but the key concern is the effects that are anticipated to develop in the coming century if appropriate policy measures are not implemented. In the absence of studies that directly observe the impact of climate change in the recent past (or project into the future), the attributing of health impacts to climate change must be indirect. The future impact of climate change on health inequalities in Europe must therefore be inferred from a wide range of evidence.

Epidemiological studies provide some evidence for inequalities in current climate-related health effects (hot periods/heat waves, cold periods, floods, windstorms and wildfires). The majority of the literature is from western European countries, and indeed many papers relate to the major heat waves of 2003. Several papers have looked at socioeconomic determinants of heat-related mortality, but there is no evidence of difference in risk by population income group in western European countries. The elderly are most affected by hot weather, but there is little evidence for effects on children. There is some evidence for inequalities in cold-related mortality, and this relates to housing quality, which varies significantly between and within countries. Literature on the health effects of flooding is extremely limited, but it has been shown that exposure to flooding (flood risk) is not evenly distributed, with many examples of deprived populations having a higher risk of flooding. In some countries, such as the United Kingdom, coastal flood risk is greater in low-income groups, while river flood risk is greater in high-income groups. Climate change is anticipated to increase the frequency of heat waves and reduce the frequency of cold periods. It is also likely to increase the risk of coastal and riverine flooding in certain areas of Europe.

Other potential health effects of climate change are more complex and are difficult to assess. Health problems associated with lack of water, sanitation and hygiene demonstrate significant inequalities among countries. The highest burden of disease due to inadequate access to water and sanitation is in the central Asian republics and Kazakhstan, although the effect of climate change on health via this mechanism is extremely unclear. Climate change is likely to significantly increase water stress in the Mediterranean and central Asian regions, but the implications for health and for health inequalities are uncertain as they will depend on local water management, governance and other socioeconomic factors.

In addition to the direct effects of climate on health, policies introduced to address climate change may have important implications for income and inequalities in Europe. Adaptation policies (to address climate change) may reduce or increase inequalities. There is a concern that inequalities may increase because higher-income groups will be better able to afford adaptation measures. Mitigation policies (to reduce greenhouse gas emissions) also have the potential to increase health inequalities by, for example, increasing domestic energy costs. Reducing inequalities must remain a priority for adaptation and mitigation planning.

Social inequalities and environmental health in the Russian Federation

Boris Revich¹

¹ Department of Environmental Health, Russian Academy of Sciences, Moscow, Russian Federation.

Social inequalities

Social inequalities are much more evident in the Russian Federation than in many other European countries. The Gini index, which measures inequality between the richest and the poorest people in the country, is much higher, with some 18% of the Russian population living below the poverty line. In small industrial towns with under 100 000 inhabitants, the proportion of poor people is twice that of cities with over 1 million inhabitants. The proportion of the population living below the poverty line is generally higher in rural areas and among women and retired people. Low income levels have been associated with a low BMI (under 18.5).

Life expectancy

Compared to the top ten developed countries, life expectancy in the Russian Federation is 15–19 years lower for men and 7–12 years lower for women. Among countries with comparable per capita GDP, life expectancy is still lower by 3–11 years for men and by 1–5 years for women. The mortality rate is higher than that in western European countries, especially among people of working age: by 3–5 times for men and by 2 times for women. Mortality risks are considerably higher among marginal social groups such as the unemployed (by 55–70%) and unskilled workers (by 20–30%). For these groups, the share of mortality by injuries, intoxications and cancer is exceptionally high in 20–39-year-olds, while for socially well-integrated people of that age the mortality rate is much lower. Poor housing has a negative impact on life expectancy. Males suffer from unsuitable living conditions more often than females.

Air pollution

Annual mean concentrations of total suspended particulates (TSP) in the air of Russian cities reach 100–130 $\mu\text{g}/\text{m}^3$, and often 150 $\mu\text{g}/\text{m}^3$ in cities in the Asian part of the country. The input of TSP-related deaths to total mortality in the urbanized coal-heated regions is 17% compared with whereas the national average of only 2%, a total of some 40 000 additional deaths per year.

Drinking-water

One in 14 people in the Russian Federation drinks unsafe water. The availability of safe drinking-water varies greatly among the regions, being it is lowest in the poorest south-eastern regions. Despite the country's advanced health care system, the links between social conditions and acute intestinal infections are quite obvious in these regions. The incidence of dysentery also varies between poor and rich regions: a four-fold rise in regional GDP is associated with a fall in dysentery rates by a factor of 5.2 and with a two-fold decrease in the incidence of acute intestinal infections

Local food

In a number of cities, local food products contain high levels of lead, mercury, and persistent organic pollutants. Epidemiologists have assessed the joint impact of social and environment factors on public health and identified environmental pollution hot spots – mainly industrial towns where enterprises pose both direct and indirect threats to health through

bioaccumulation along food chains. The consumption of local agricultural products, which grow on contaminated land, causes significant health inequality. Intake of local food products led to an increase in the risk of breast cancer. Raised concentrations of dioxin-like compounds in the blood serum of 8–9-year-old boys generally were associated with dietary habits, such as consumption of fish and local meat products.

Ethnic minority groups

The socioeconomic situation of the indigenous peoples in the Russian Arctic (160 thousand people) is sensitive. Significant problems in their living conditions are caused by poor water supply and sewerage systems.

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. 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 conditions of the countries it serves.

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Uzbekistan

Significant social inequalities exist in the environmental burden of disease, both between and within countries. A framework model developed by WHO describes the mechanisms through which social inequalities may affect exposure to and the health outcomes from environmental risks.

To support policy-makers in Member States of the WHO European Region, and as part of the preparatory process for the Fifth Ministerial Conference on Environment and Health in 2010, WHO has accumulated the available evidence on risk of injury, air pollution, inadequate living and working conditions and poor waste management, in order to assess the current knowledge. Further evidence reviews were carried out for vulnerable groups (children and gender-related) and for the expected effects of climate change. A group of expert advisers convened by WHO was asked to review and discuss the compiled evidence and produce a set of technical and policy recommendations on possible countermeasures.

The expert group concluded that social determinants can significantly affect individuals' exposure to environmental risk and that – although evidence is available only for certain countries– this can be considered a general issue for all Member States. Addressing this challenge, the expert group developed summary conclusions addressing the main issues and made recommendations for policy, technical and research-related action.

**World Health Organization
Regional Office for Europe**

Scherfigsvej 8, DK-2100 Copenhagen Ø, Denmark

Tel.: +45 39 17 17 17. Fax: +45 39 17 18 18. E-mail: postmaster@euro.who.int

Web site: www.euro.who.int