



**World Health
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REGIONAL OFFICE FOR **Europe**



Environmental health inequalities resource package



A tool for understanding
and reducing inequalities
in environmental risk



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ABSTRACT

Environmental conditions are a major determinant of health and well-being but are not distributed equally across the WHO European Region. Higher levels of environmental risk are often found in disadvantaged population subgroups, leading to a need for targeted environmental and intersectoral action to protect these groups and achieve environmental justice.

This resource package aims to generate awareness of the concept of environmental health inequalities and to support action against disparities in exposure to environmental risks at the national and subnational levels. It sets out the various dimensions of environmental health inequality; presents relevant methods and approaches for monitoring and assessment; and suggests ways to use this evidence for action. It also provides information on a range of tools and guidance documents that may be helpful for national and local actors tackling environmental inequalities and striving to improve health and health equity.

KEYWORDS

ENVIRONMENTAL HEALTH, ENVIRONMENTAL EXPOSURE, HEALTH STATUS DISPARITIES, SOCIOECONOMIC FACTORS, RISK FACTORS, RISK ASSESSMENT, EUROPE

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1. Introduction and objective

The relevance of equity for environment, health and well-being

Health equity is a key objective for national public health action – ensuring that all population groups are adequately served. The relevance of equity is reflected in the United Nations Agenda for Sustainable Development, with its focus on “leaving no one behind” (United Nations, 2015), as well as Health 2020, WHO’s European policy for health and well-being, which features equity as a central component (WHO Regional Office for Europe, 2013).

Any action to achieve equal health outcomes must first consider how to achieve equity in health determinants and avoid an unequal distribution of risk. This is most relevant for environmental risk factors, as they can vary significantly between different population groups and locations. Given that environmental conditions are an important determinant of health – globally, 23% of mortality is attributable to environmental risk factors – prevention and reduction of environmental health inequalities would be a significant contribution to health equity. The relevance of equity considerations is also reflected by the Ostrava Declaration on

Environment and Health, in which Member States in the WHO European Region committed to “consider equity, social inclusion and gender equality in our policies on the environment and health” (WHO Regional Office for Europe, 2017a).

This resource package aims to present the concept of environmental health inequality and highlight how unequal distribution of environmental risks can be mitigated. It provides information on:

- definitions, measurement, monitoring and assessment of environmental health inequality;
- causes and determinants that shape environmental health inequality and need to be monitored;
- tools and resources available to support work on inequalities in general, and environmental health inequalities in particular; and
- guidance for policy-makers, planners, stakeholders and researchers to advance understanding of environmental health inequality and the role they can play in reducing it.

No one left behind: preventing inequality nationally and locally

The Agenda for Sustainable Development represents a commitment by countries to ensure equal chances for health and well-being for all, at all ages, and makes specific reference to the reduction of diseases triggered by environmental conditions. The equity focus is explicitly documented in Sustainable Development Goal (SDG) 1 on poverty mitigation and SDG 10 on reducing inequalities within and among countries, but it is also embedded in many other SDGs that relate to access to and provision of environmental resources. It is important that this notion of equity is not only considered at the national and international levels but also reflected and implemented at regional and local levels, where environmental conditions are shaped and managed.

Supporting awareness and action at the national and subnational levels, this resource package has been developed as an information source for:

- national, regional and local policy-makers involved in environmental measures, health protection and social cohesion and equity;
- actors involved in environmental, urban and infrastructural planning and management at regional and local levels (including nongovernmental and civil society organizations); and
- researchers interested in how social, economic, environmental and health issues overlap and interact.

A summary of the potential roles and activities that could be undertaken by different actors and professions is set out in Annex 1.

Terminology and definitions

This publication uses the following terminology.

“Equity” reflects the political goal of achieving equal conditions and equal opportunities, referring to equity in health outcomes as well as (environmental and other) health risks and determinants.

“Inequality” reflects any differences and disparities¹ in relation to environmental health inequality. It signals differences in exposure to environmental health risks and related health outcomes.

For further details on key terms, please see the glossary. All terms explained in the glossary are printed in ***bold italics*** the first time they appear in the publication.

¹ The standard term “inequality” also includes “inequity”, which is defined as an unfair and avoidable inequality that can and should be mitigated. As the term “inequity” requires a value judgment, which depends on the given national or local context, it is not applied as a general term in this publication. It must be noted, however, that most environmental health inequality examples presented are likely to represent inequities, which are often also referred to as “environmental injustice”.

2. Why environmental inequality has a critical effect on human health

Low socioeconomic status is associated with a reduction in life expectancy of 2.1 years between the ages of 40 and 85 years (Stringhini et al., 2017). This is a substantial impact (compared to 0.5 years for high alcohol intake, 1.6 years for hypertension, 2.4 years for physical inactivity, 3.9 years for diabetes and 4.8 years for current smoking). Income and social protection have also been identified as the strongest single contributors to **health inequality** within the European Union (EU), with 35% of inequalities in self-reported health and 46% of inequalities in mental health attributable to social status (WHO Regional Office for Europe, 2019a). This evidence shows the influence of **social determinants of health**. The term “**upstream determinants of health**” is also applied to denote that health status is caused and influenced by these determinants.

As with social conditions, environmental factors have a huge influence on health and well-being and affect human health both positively and negatively. This impact can be short term (such as sudden exposure to a chemical compound or a heat wave) or long term (such as inadequate housing conditions or ambient air pollution). **Environmental quality**, and its underlying factors can also be described as continuous (for example, everyone experiences a certain sound/noise level) or discrete (for example, the population affected lives near waste sites or is at risk of flooding).

Many environmental factors have been found to have a strong impact on health and well-being, including:

- air pollution
- noise levels
- weather extremes and flooding
- distance to waste, incineration and pollution sites
- road traffic injuries
- drinking-water quality and sanitation
- inadequate housing and indoor pollution
- harmful energy sources
- access to environmental resources such as green or blue spaces.

It is estimated that 23% of all global deaths (and 26% of deaths among children under 5 years old) are due to modifiable environmental factors (Prüss-Ustün et al., 2016), but the distribution of environmental risks and benefits is far from equal. In many cases, there is evidence that this impact has a proportionally greater burden on the most deprived population groups in society, as they tend to be more strongly exposed to environmental threats. In many cases, disadvantaged population groups are affected by at least five times higher risk exposure levels. A few selected examples give an idea of the potential magnitude of **environmental inequality** in the WHO European Region, and its implications for health equity.

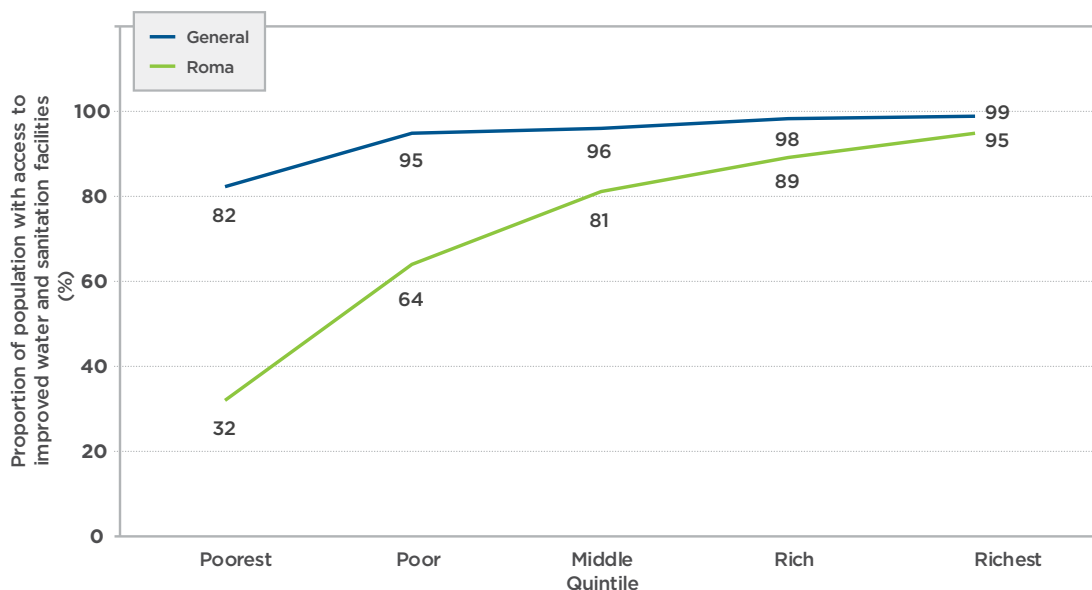
Example 1. Water supply and sanitation

Water supply and sanitation are basic human rights, but even in highly developed and affluent countries socially disadvantaged groups can face problems with water and sanitation access, affordability and quality. In Balkan and Caucasian countries, inadequate water and sanitation problems are much more apparent and affect significant parts of the population with low socioeconomic status and/or those in rural areas. The second WHO report on environmental health inequalities in the European Region shows that in some countries basic drinking-water supplies are only accessible to less than 70% of the rural population in the lowest wealth **quintile**, compared to 98–100% of

urban households in the highest wealth quintile (WHO Regional Office for Europe, 2019b).

Fig. 1 shows intra-country inequalities in Bosnia and Herzegovina, indicating that only 82% of the population in the poorest wealth quintile had access to improved water and sanitation services (improved indicating safe service levels) in 2010. Further, only 32% of the poorest Roma households had access to improved services. This demonstrates that inequalities within a country can be very strong, and that socioeconomic patterns can be observed in different population groups.

Fig. 1. Improved water and sanitation coverage by wealth quintile for the general population and Roma ethnic group, Bosnia and Herzegovina, 2010



Source: WHO & UNICEF (2014).

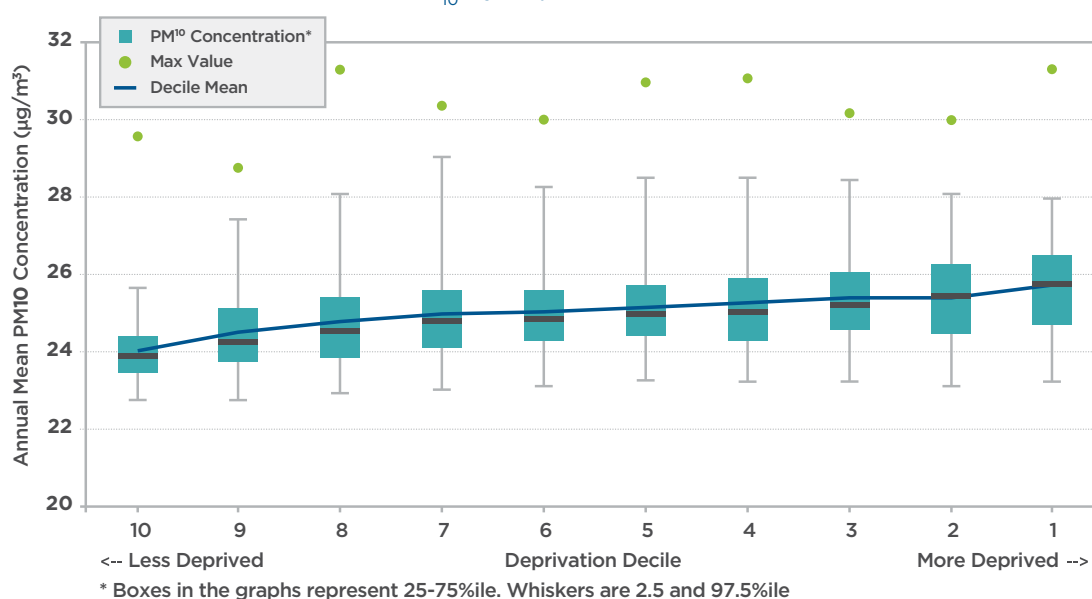
Example 2. Air pollution

WHO estimates that air pollution kills 500 000 people each year in the European Region, making it the most important environmental threat in the Region (WHO Regional Office for Europe, 2018). Air pollution is especially high in areas with industrial use and intense transport activities, which often overlap with socially deprived areas. Numerous European studies have shown that air quality tends to be worst in the areas where the most deprived populations live. For

example, recent research shows the distribution of particulate matter of 10 μm or less (PM_{10}) levels in London by deprivation decile (Fig. 2).

This is also reflected by disparities of $\text{PM}_{2.5}$ levels across Europe: the most polluted regions have mean concentration levels more than twice as high as the least polluted regions, with significantly higher exposure levels in socially disadvantaged areas (WHO Regional Office for Europe, 2019b).

Fig. 2. Pollution concentrations of PM_{10} by deprivation decile, London, 2013



Source: Brook & King (2017).

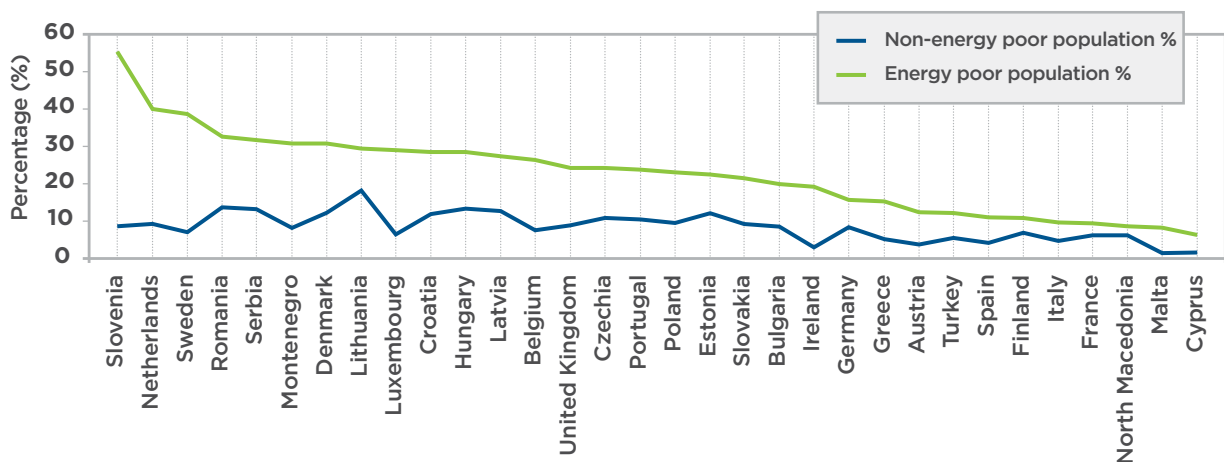
Example 3. Inadequate housing and fuel poverty

Access to and cost of energy has become a major problem in many countries; in particular, low-income households often cannot afford to heat their homes adequately or have problems paying their energy bills. In the EU, on average, 19% of households in poverty have problems paying energy bills, compared to only 6% of non-poor households. In the countries most affected, more than 50% of poor households face energy cost challenges or rely on unhealthy solid fuels (WHO Regional Office for Europe, 2019b). Apart from the **environmental justice** dimension of fuel poverty, data show that there is also a potential

contribution to health inequalities, as – across all EU countries – prevalence of poor health is significantly higher within the energy-poor population (Fig. 3). Although this does not confirm a causal relationship – poor health status may be caused by other social circumstances that also affect health – it is obvious that energy and related costs are an additional (and largely avoidable) challenge that more vulnerable population groups face.

Box 1 provides further examples of the potential health impacts of environmental inequality.

Fig. 3. Prevalence of poor health in the energy-poor versus non-energy-poor population



Source: Thomson, Snell & Bouzarovski (2017).

Box 1. Examples of health impacts of environmental inequalities

- Differences in living conditions explain 29% of the inequalities in self-reported health in EU countries (controlling for age and sex). Of this gap, over 70% is explained by differences in housing quality and fuel poverty, highlighting the impact of material deprivation on self-reported health. A further 20% of the gap relates to lack of green space, unsafe neighbourhood conditions and air pollution, showing the influence of environmental deprivation (WHO Regional Office for Europe, 2019a; 2019b).
- A study in the United Kingdom showed that income deprivation-related inequality in circulatory disease mortality was lower among populations living in the greenest areas than among those with less exposure to green space. In the least green areas, the incidence rate was 2.2 times higher among the most socially deprived population groups than among the least deprived; in the greenest areas, the incidence rate was 1.5 times higher among the most deprived groups, suggesting a compensating and health-promoting effect of green spaces (Mitchell & Popham, 2008).
- In a study from the Basque Country region of Spain, the most economically deprived neighbourhoods were six times more likely to be close to air-polluting industries than the least deprived. The mortality risk associated with proximity to polluting industries tended to increase in more deprived areas, suggesting that the combined effect of environmental exposure and economic deprivation may be more than additive (Cambra et al., 2012).

Box 1 contd.

- A WHO study of eight European cities reported that the prevalence of indoor cold in winter was more than twice as high in households that had problems paying for housing expenses than in those without financial difficulty. Among households reporting indoor cold, prevalence of diagnosed cold or throat illness was higher (45%) for those that had problems with household costs than for those without (36%). This indicates that the health impacts of energy deprivation are more pronounced for less affluent households (Braubach & Savelsberg, 2009).
- A survey of 45–69-year-old men and women in eight cities in Czechia, Poland and the Russian Federation showed a clear social gradient for non-fatal injuries. For the most materially deprived individuals, the odds of non-fatal injury were 1.6 times higher than for the least deprived. Deprivation showed the highest association with injury prevalence, followed by being single (odds ratio 1.5:1) and higher alcohol consumption (1.4:1) (Vikhireva et al., 2009).
- Researchers in the United Kingdom found that multiple environmental deprivation is both associated with income deprivation and related to health outcomes. Environmental deprivation levels had an effect on health that persisted after controlling for age, sex and socioeconomic status. Regions with the poorest physical environments had 18% more deaths than expected (controlling for age and sex) compared to all others across the country (Pearce et al., 2010).

3. Defining the issue: key concepts and terminology

Understanding the root causes of **environmental health inequality** is the foundation for action to mitigate these inequalities and provide health and well-being for all. This section aims to provide a general overview of some of the key terms and concepts used in the field. A full glossary – covering many additional terms and keywords – is provided at the end of the report.

Equality is a descriptive measure that refers to the general absence of differences between groups of people. For example, equality would mean that all individuals have the same level of exposure to environmental risks, the same prevalence of diseases and the same life expectancy.

Equity is the absence of avoidable or remediable differences among groups of people, and therefore includes a value judgement. For example, differences in mortality by age group are natural and may not qualify as an equity issue. However, significant differences in mortality or environmental risk exposure between low- and high-income groups would be considered unfair and avoidable, and therefore represent an equity challenge. Fig. 4 demonstrates the difference between equity and equality.

Environmental health inequality refers to unfair, unjust and avoidable differences in exposure to environmental health risk factors, and to unfair, unjust and avoidable differences in health status caused by environmental conditions.

Environmental health inequality represents differences in exposure to environmental health

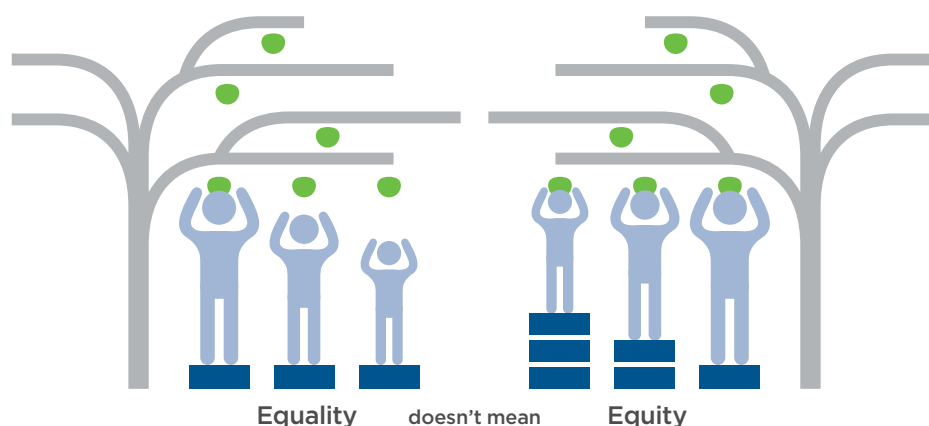
risks and related health outcomes. These can relate to individuals who are more or less exposed, certain population groups that are being disadvantaged, or spatial areas that are affected by higher levels of environmental pollution.

Environmental justice represents a fair and equitable distribution of environmental risks and benefits within society, and equal treatment and involvement of all population groups in environmental decision-making.

Vulnerability relates to the fact that disadvantaged population groups may be more likely to develop a disease (or a more severe expression of a disease) in response to an environmental exposure. Increased vulnerability can be due to cumulative burdens, pre-existing diseases or malnutrition, for example, but it can also be caused by lack of knowledge or capacities. In epidemiological terms, vulnerability leads to an effect modification by social disadvantage. The **vulnerability differential** refers to social or demographic differences in vulnerability to the effects of environmental risks.

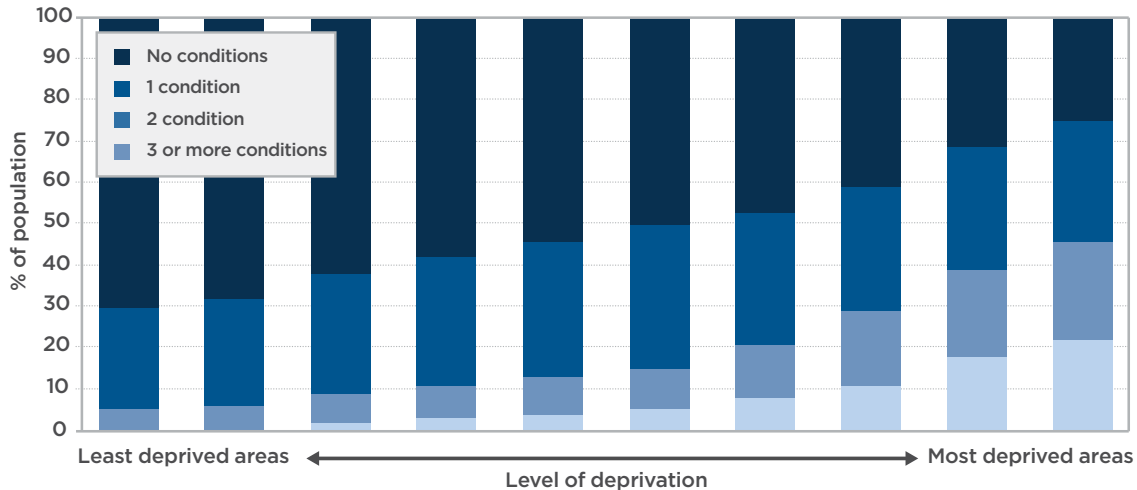
Social gradient indicates that population groups with lower social status and power tend to be more affected by risk exposure or health problems. It is important to note that it does not compare the extremes (e.g. the poorest versus the richest) but runs right across society: it affects individuals or population groups that cannot be considered poor or disadvantaged but that still show higher risk exposure or worse health status than the most advantaged. Such a gradient is often found for exposure to environmental risks, showing that

Fig. 4. Equality and equity



Source: Based on Saskatoon Health Region (2017), © 2017, Saskatchewan Health Authority.

Fig. 5. Populations living in areas with, in relative terms, the least favourable environmental conditions, 2001-6



Number of poor environmental conditions related to: river water quality, air quality, green space, habitat favourable to biodiversity, flood risk, litter, detritus, housing conditions, road accidents, regulated sites (e.g. landfill)

Source: Based on Allen & Balfour (2014).

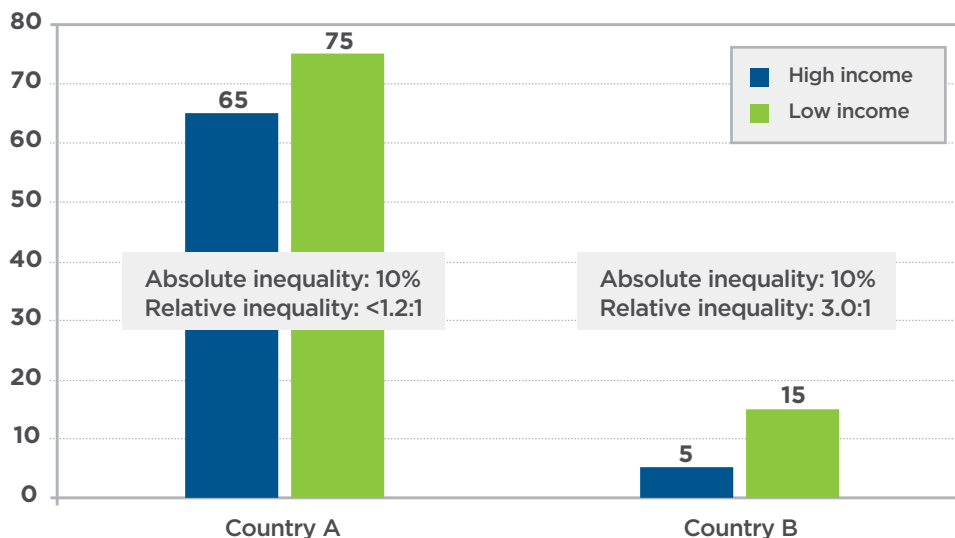
environmental deprivation is not only apparent in the most disadvantaged population groups. Fig. 5 gives an example of the social gradient, using the United Kingdom’s indicators of social deprivation and environmental conditions, showing that exposure to environmental problems accumulates across the deprivation scale.

It is important to distinguish two different dimensions (absolute and relative) to express inequality (Fig. 6). **Absolute inequality** relates to absolute differences in environmental exposure between population groups. Using the absolute perspective, the inequality between air pollution exposure levels of 65% and 75%, and the inequality between air pollution exposure levels of 5% and 15%, is 10% in both cases and therefore similar.

Relative inequality refers to the relative differences between exposure levels and is often expressed by ratios. In the relative perspective, air pollution exposure levels of 15% are considered three times higher than air pollution exposure levels of 5% (ratio of 3.0:1), while the relative inequality between air pollution exposure levels of 65% and 75% is much lower and represents a ratio of less than 1.2:1 (Fig. 6).

Both dimensions of inequality can be used to define and quantify the **exposure differential**, which describes differences in exposure between different groups or individuals. Understanding both inequality dimensions is especially important when evaluating progress on reducing inequality, as a reduction in absolute inequality may not automatically cause a reduction in relative inequality as well.

Fig. 6. Absolute versus relative inequalities



4. Monitoring and acting on environmental health inequalities

This section provides practical information about how to work to address environmental health inequalities. It focuses on the needs of planners, investigators and decision-makers when responding to environmental health inequality questions, and covers key aspects of and approaches to gathering and presenting data, analytical methods and the design of targeted measures. The information relates to the **distributive justice** approach, considering the factual distribution of environmental risks and threats and whether certain population groups are more or less exposed.

Any assessment of environmental inequalities and their potential health impacts needs to follow a series of steps, starting with identification of the environmental health risk to be examined, the environmental standards or regulations to be observed and population groups that may be most exposed and therefore most affected by environmental health inequalities.

Overall, four steps need to be addressed to assess environmental health inequalities (Table 1). These are discussed below, with a specific focus on step 3 and the different approaches to identifying and assessing inequalities and unfair distributions of environmental risk.

Table 1. Steps to assess environmental health inequalities

Step 1	Be aware of the environmental standards that should be in place and check whether standards and limit values are significantly exceeded.
Step 2	Gather the environmental data needed to describe the existing situation and exposure patterns.
Step 3	Carry out equity-sensitive analysis of exposure patterns and identify the population groups most affected.
Step 4	Use the evidence for action to prevent, reduce and compensate environmental health inequalities.

Step 1. Checking environmental standards

Inequality in environmental risk exposures is often caused by unequal distribution of environmental risks and the fact that disadvantaged groups often tend to reside or work in places where exposure levels are higher. Thus, one intervention to tackle environmental health inequality is formulation and consistent and equitable implementation of environmental regulations and standards.

The sources for these standards can be:

- international standards, guidelines or recommendations by United Nations or other international governmental bodies;
- national standards or limit values;
- recommendations identified by academic research but not adopted by government actors.

In many cases, international bodies or national governments have set legally binding standards that need to be observed or applied as a guidance

level. In the absence of clear and applicable standards, local community concern and issues raised by local initiatives and civil society organizations could also be used to identify environmental conditions to be tackled.

The call for adequate and fully implemented environmental regulations provides an important mandate for public authorities at the local, regional and national levels. It also requires the actors involved to consider environmental and other regulations (for example, in the social sector, transport and urban planning, construction and the labour sector) from a health perspective, and to analyse how they contribute to promote and/or protect health and well-being.

Guidance and guidelines from health authorities and other public health actors need to be considered and embedded in any decision-making process affecting environmental conditions to ensure that they are at the highest possible level. In

the context of environment and health, WHO has produced a wide range of publications indicating environmental standards and guideline values that represent no health risk to the population (listed in Annex 2). Several of these provide specific guidance to address vulnerable population groups.

Irrespective of the selected standard and threshold values, the equity contribution will mostly depend on the equitable implementation and

enforcement of existing environmental regulations and the degree to which all population groups, independent of their location and socioeconomic position, would benefit from it. In this context, it is likely that consistent implementation of existing regulations across a country or city would have positive equity impacts, as disadvantaged groups tend to be exposed more often to environmental risks and would therefore benefit more strongly from environmental regulations.

Step 2. Gathering environmental data

Based on available data sources, environmental conditions and baselines can be reported and assessed, using the relevant guidance and guidelines as a reference framework. The key challenge is to compile environmental data from as many sources as possible to generate a complete and reliable assessment of exposure levels and patterns. Key sources of information for this exercise are as follows.

- At a local or regional level, departments of planning, environment, social policy, health or economics may have plenty of data available.
- National data such as census information, **indices of multiple deprivation** (Fairburn, Maier & Braubach, 2016) or environmental surveys may also be accessible.

If it is possible for these data to be spatially tagged and categorized, it will increase the quality of the analysis and provide better data for targeting the required interventions.

The availability of data on environmental inequality is a major challenge, as it requires regular collection of environmental data through surveillance systems, monitoring networks and population surveys; the ability to stratify these data by socioeconomic, demographic or spatial determinants; and access to the raw data to enable equity-sensitive analysis and calculation as noted above. National data sets exist in some countries, held either by government departments or by regulatory bodies such as health or environmental agencies. Currently 46 states and the EU are signatories to the **Aarhus Convention**, which provides rights for access to environmental information and participation in the environmental decision-making process (UNECE, 1998; 2005).

Scale is an important consideration, as analysis can be done at national, regional or local levels.

Local and regional authorities will often have good datasets for their regions, and these may well sit within a geographical information system, which would add a very useful spatial aspect to the data. Ideally, data sources should incorporate information on both environmental and equity dimensions. In many countries, however, and particularly in many regional and local authorities, such environmental data are often unavailable or may not even exist.

Within every country, different data will be available through national monitoring systems. Potential data sources for environmental assessments and related inequalities at national or subnational levels are:

- national environmental surveys and monitoring programmes;
- national census and statistical office data;
- government reports on living conditions, environmental quality and/or social cohesion and inequality issues;
- national reporting under the European Social Charter (COE, 2019);
- reports by national and subnational civil society organizations;
- databases and reports by regional or local authorities.

To some extent, international databases can provide information on intra-country differences, but as their purpose is targeted at international reporting, assessment of inequalities within countries is usually restricted. This especially affects the provision of data at local and regional levels, which are usually not covered in international databases. Annex 3 provides an overview of international data sources within the WHO European Region that can be explored to assess environmental inequality.

Step 3. Undertaking equity-sensitive analysis of exposure

From the equity perspective, adequate analysis of environmental health disparities is the most significant work step as it allows the most affected population groups to be identified, which may lead to quantification of the magnitude of inequality. Depending on the available data and its formats, this can be done by:

- carrying out equity-sensitive data analysis that stratifies results for different population groups (defined by socioeconomic, demographic or spatial determinants) and identifies exposure-related differences and inequalities; or
- preselecting target groups and carrying out comparative and subgroup analysis, with a focus on these groups.

Identification of the most exposed or affected groups (or the most polluted territories) is the starting-point for any equity action.

Stratification of data

To detect and assess inequalities in environmental risk, it is paramount that data on environmental exposure and related health outcomes are available for different subgroups. This stratification enables data on environmental exposure or environmental health impacts to be broken down by, for example, socioeconomic, demographic or geospatial dimensions, enabling identification of the distribution of exposure patterns for different population groups. An example is provided below, showing the stratification of fuel poverty in England, United Kingdom, by income, employment, ethnicity and urbanization (Fig. 7).

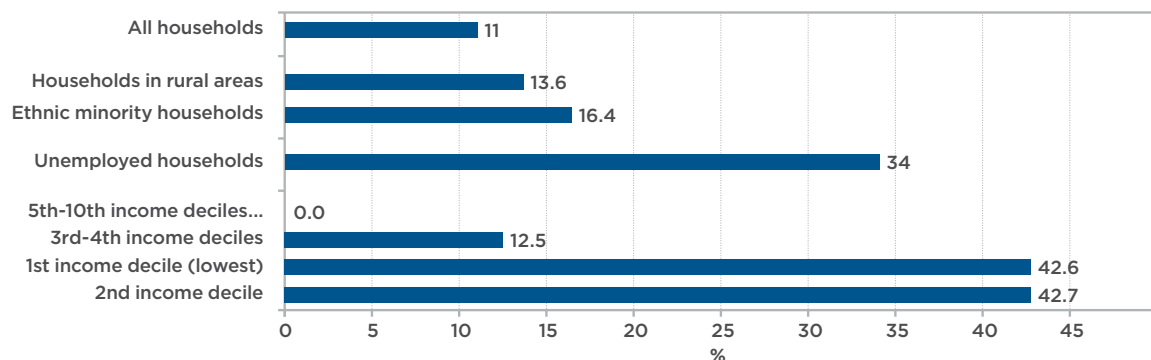
It can be difficult to identify the most suitable stratification, as inequalities are most often reflected in more than one of the three inequality dimensions (socioeconomic, demographic and geospatial). It also depends on the environmental risk or health outcome considered, but the WHO Commission on the Social Determinants of Health (CSDH) recommends the best stratifiers to be considered for health equity surveillance (Box 2). Notably, the recommended stratification covers a wide range of inequality, considering sex,² socioeconomic aspects, ethnicity-related aspects and spatial dimensions, but also referring to the importance of both relative and absolute expressions of inequality. The recommendation is equally valid for reporting of environmental inequalities.

Monitoring inequalities and presenting data

Availability of reliable and detailed environmental monitoring data is the basic requirement for any surveillance and assessment of inequality. It is therefore crucial to maintain and expand existing monitoring systems to become more equity-sensitive and go beyond the mere observation of environmental conditions by also collecting data on affected populations and exposure differences. The lack of adequate data on exposure distributions and potential inequalities within the population could even be considered an environmental inequality in itself, as it jeopardizes any attempt to document, assess and mitigate existing inequalities.

The presentation of inequalities depends greatly on the available data and whether environmental

Fig. 7. Proportion of households living in fuel poverty, England



Source: Department for Business, Energy and Industrial Strategy (2017).

² "Sex" is applied throughout this resource package to indicate the binary categorization male/female, which is most often used. In the context of social inequalities, "gender" as multidimensional construct of social dimensions (and an important social determinant of health) also needs to be addressed.

Box 2. Stratifiers for health equity surveillance

A health equity surveillance system should include information on:

- health outcomes stratified by:
 - sex;
 - at least two socioeconomic stratifiers (education, income/wealth, occupational class);
 - ethnic group/race/indigeneity;
 - other contextually relevant social stratifiers;
 - place of residence (rural/urban and province or other relevant geographical unit);
- the distribution of the population across the subgroups;
- a summary measure of relative health inequity (e.g. the rate ratio, the relative index of inequality, the relative version of the population attributable risk and the concentration index);
- a summary measure of absolute health inequity (e.g. the rate difference, the slope index of inequality and the population attributable risk).

Source: based on CSDH (2008).

exposure or health outcome information can be stratified by few or many socioeconomic, demographic or geospatial variables. In addition, if time series data are available, changes in patterns of inequality could be monitored over time, enabling the evaluation of interventions or policies in the recent past.

A variety of approaches are available, showing how diverse the assessment and reporting of inequalities can be. The applicability of the approach depends greatly on the possible stratifications of the environmental data, however.

1. Time series

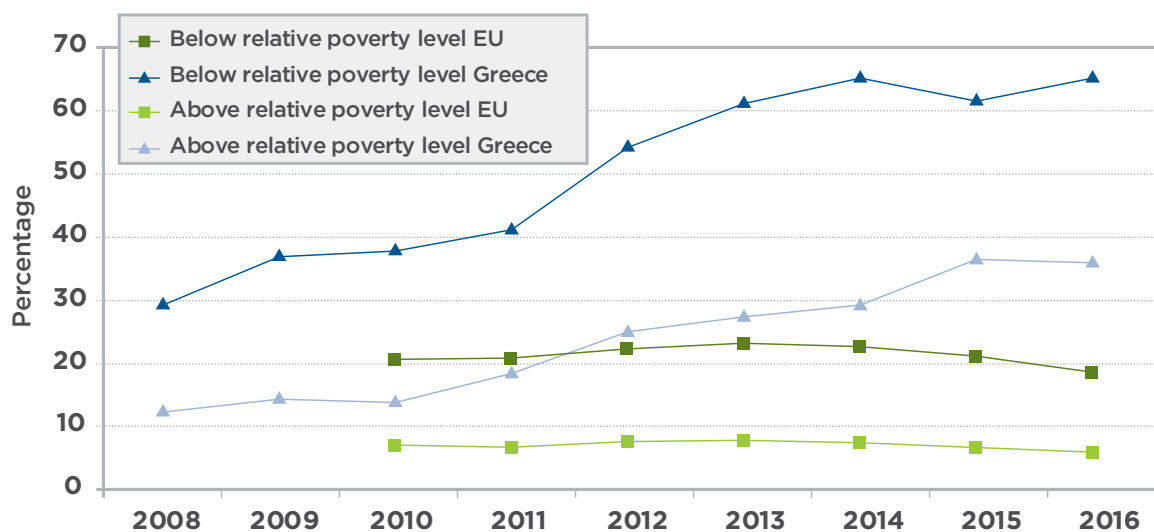
Time series data can be used to provide an overview of the trends of inequalities, as in the example in Fig. 8 of households facing problems paying for

water and energy supply, represented by arrears on utility bills in the EU and Greece. The time series shows that in Greece, which was hit very hard by the economic crisis in 2008/2009, arrears on utility bills rose significantly for both low-income and higher-income households, peaking at 65% of low-income households reporting problems paying their bills in 2014.

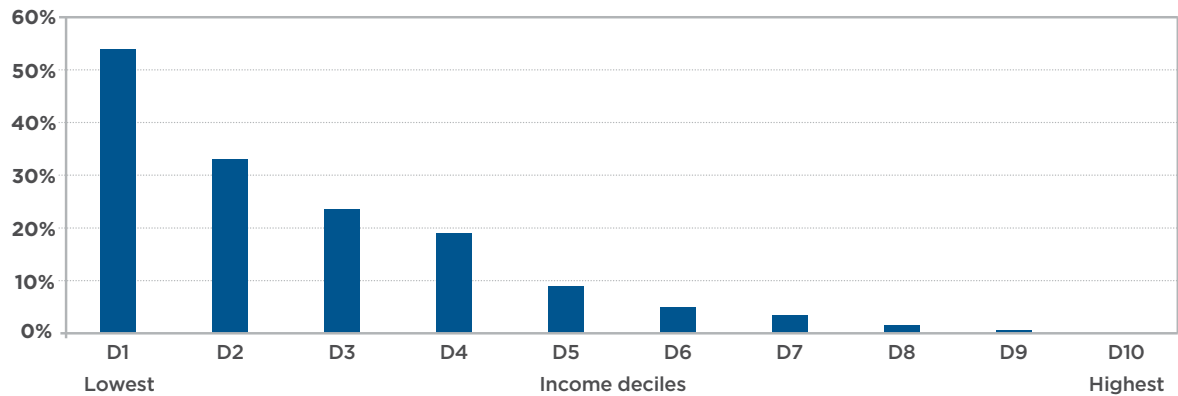
Time trends require that the definition of the respective inequality indicator (utility bills) and the stratifier (relative poverty threshold) remain consistent over time so that observed changes are not attributable to methodological changes.

Time series data can help shed light on the dynamics of inequality patterns over time. They are useful to put inequality data into context, as

Fig. 8. Arrears on utility bills in the EU and Greece by poverty level, 2008-16



Source: WHO Regional Office for Europe (2019b).

Fig. 9. Proportion of households in energy poverty, by equalized income decile, Belgium

Source: Delbeke & Meyer (2017).

it is possible to assess trends for a given entity over time, rather than just comparing it to other entities.

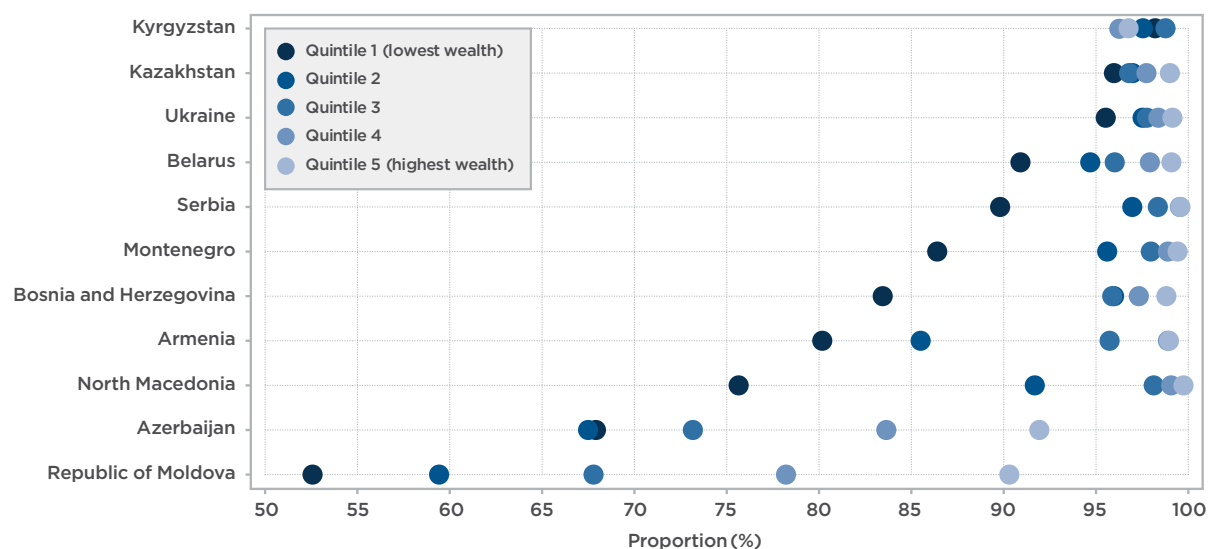
2. Percentile approaches

Percentile approaches show the presence and distribution of an environmental condition across various population groups. These groups are categorized independently of their social status: no identification of a certain socioeconomic threshold is used to categorize the population into more or less advantaged groups. Instead, the percentile approach takes population groups of similar size (such as five quintiles, each covering 20% of the population, or ten deciles, each covering 10%) which are sorted by the selected inequality stratifier, which could be age or income, for example. The relevant environmental exposure situation is then calculated for each percentile.

Percentile approaches are most suitable for presenting gradients across population groups, but they require information on the stratifier and the environmental condition at an individual level. The example below shows energy poverty in Belgium by income decile (Fig. 9).

3. Equiplots

Equiplots are created to show social gradients of inequality across various population groups or categories. They provide detailed insight into the patterns and magnitudes of inequality and are often based on the percentile approach discussed above. The example in Fig. 10 shows the wealth disparities in use of basic and safely managed sanitation services – the two highest service levels – in selected countries, using equiplots based on income quintiles.

Fig. 10. Proportion of population using basic or safely managed sanitation services by wealth quintile

Note: year of reporting ranges from 2006 to 2014.

Source: WHO Regional Office for Europe (2019b).

4. Dichotomous comparison

Depending on the data source, social gradients and percentile approaches may not be possible (for example, with binary categories such as differences between males and females or urban and rural contexts). In such case, dichotomous data can be presented as in Fig. 11, showing the differences between only two population groups. Dichotomous comparison is often the preferred mode of presentation when the aim is to showcase the total magnitude of inequality (such as between richest and poorest, rather than across income groups).

5. Multiple deprivation and multiple exposure

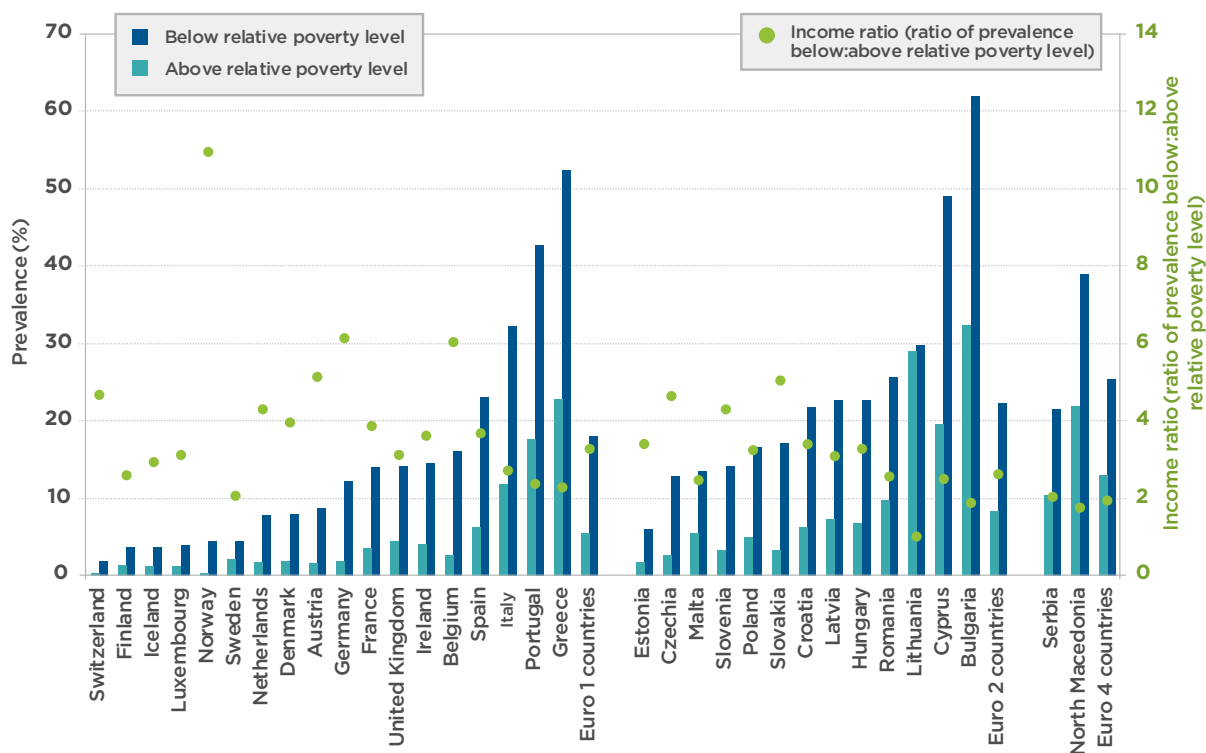
Social and environmental disadvantage is - in most cases - not restricted to the presence of just one problem. Looking at the determinants of health inequality, the most affected population groups are often disadvantaged by more than one dimension. For example, they may be single parents of foreign nationality with low education level, which combines three levels of disadvantage and strongly increases the risk of environmental or health inequality.

Documenting the increase in inequalities caused by combining multiple layers of disadvantage is very useful to understand the magnitude of

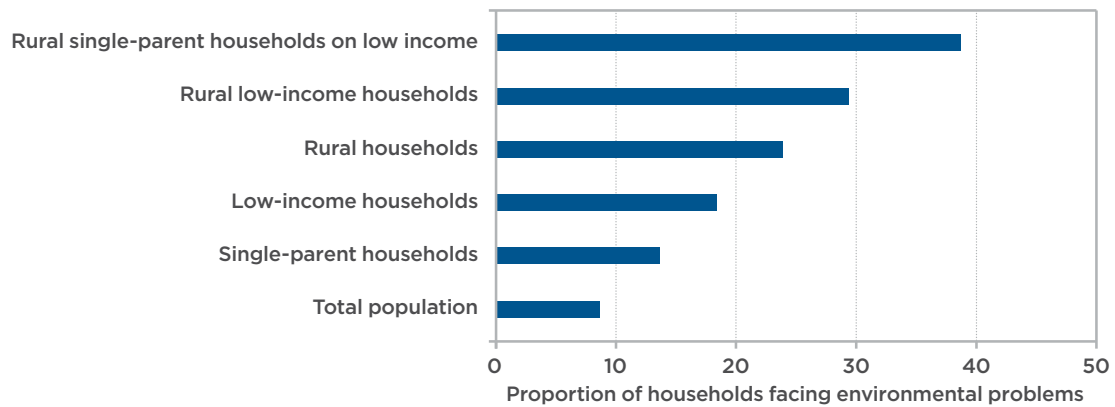
inequality that remains hidden when assessments are only done separately for individual stratifiers. In Fig. 12, the prevalence of a given environmental problem is significantly increased for single-parent households, low-income households and households in rural areas, but the respective increases are much higher for households combining two or all three disadvantages. It is therefore important to be aware that the highest levels of inequalities are usually found in population groups suffering from multiple deprivation, and that monitoring systems should be designed to allow identification of such unequal distributions.

Similarly, disadvantaged population groups may be affected by various environmental risks in parallel. Low-income households may find themselves exposed to inadequate housing conditions that combine indoor problems (low quality of insulation, insufficient space, mould and similar) and outdoor problems (air pollution, noise, lack of access to green spaces and so on) that create an exposure cocktail with a strong impact on health and well-being. These inequalities related to **multiple exposures** can only be identified when environmental exposure data are combined and stratified, but this is rarely done, so these most extreme inequalities often go unnoticed.

Fig. 11. Prevalence of inability to keep the home warm by relative poverty level (2016)



Source: WHO Regional Office for Europe (2019b).

Fig. 12. Example on increasing inequality levels caused by multiple environmental exposure

Step 4. Using evidence for action

Knowledge of the magnitude and distribution of environmental inequalities, and identification of the most affected populations groups, is essential for action: it suggests where to target actions (and at what target group). It also provides better understanding of the root causes of inequality, identifying economic, social, cultural or other determinants as the respective drivers to be tackled. Depending on the inequality assessment findings, a decision can be made about the most suitable approach.

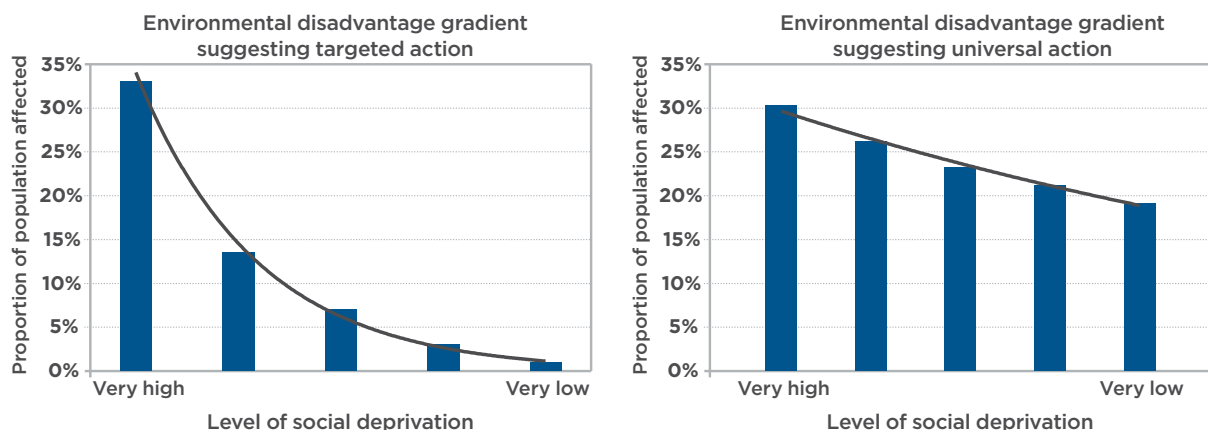
A need for universal action

Universal action can be considered when inequalities are not very strong and the most advantaged population groups also have significant exposure to the environmental risk considered. In such cases, all population groups would benefit from universal action, aiming at the overall improvement of environmental conditions in general. In many situations, this may proportionately benefit those with the highest exposure levels, but this effect is not necessarily the case.

A need for targeted action

While universal approaches are more concerned with lowering the general level of exposure across all groups, **targeted action** aims to reduce the excessive environmental burden in the most affected group. Despite the adequate and consistent implementation of environmental regulations, inequalities in risk exposure persist – especially when they are shaped by socioeconomic disadvantage or marginalization. In such situations, disadvantaged population groups with higher levels of exposure to environmental risk have to be considered target groups for specific action to reduce risk exposure and avoid health impacts in those most affected subgroups. Equity-sensitive data should provide information about the most important target groups to be addressed, the main interventions to be implemented and the desired level of risk exposure aimed for.

Fig. 13 shows examples of two gradients in environmental disadvantage by social deprivation: one calling for targeted action as there is a steep gradient and a very high level of inequality, and

Fig. 13. Social gradients and their relevance for policy-making and interventions

one suggesting universal action as the inequality is less strong and the problem is also relevant in less deprived population groups.

A call for proportionate universalism

Proportionate universalism approaches merge targeted and general action. They aim to improve the situation for all population groups, but place stronger efforts on action for those most affected or most vulnerable. Intervention efforts and investment costs would thus be proportionate to the respective exposure situation of a given population group, hoping to achieve the strongest environmental improvements for the most exposed people, but not neglecting those that are less exposed. Such an approach would thus

reduce both the overall level of exposure and the inequality between population subgroups.

Finally, it must be acknowledged that environmental actions most often have a spatial component, as they aim to improve environmental conditions in a given area. It may thus be difficult to improve environmental conditions only for specific population groups, as all residents of a given area would benefit from such efforts (for example, with reduction of air pollution). It is therefore important not only to consider the mitigation of environmental inequalities at the individual or household level but also to address deprived neighbourhoods or city districts where environmental conditions may be worst – irrespective of the social status of the residents.

5. Guidance and tools on monitoring, assessment and governance

Every day, national, regional and local authorities make decisions that affect the environmental and living conditions of the population. How these decisions are made, and whether equity-specific effects and the distribution of environmental consequences is acknowledged in the decision-

making progress, is a matter of **procedural justice**. This section introduces selected international reports and policy frameworks that should guide national and local processes and decision-making on environment and health, and protect vulnerable population groups.

Key work on environment and health, with a focus on urban settings

WHO has produced a range of publications that quantify the health impacts of inadequate environments and provide suggestions for action and possible solutions.

- *Healthy environments: why do they matter, and what can we do?* (WHO, 2019). This publication presents an overview of sectoral action that can be taken by various stakeholders at the national and subnational levels to create healthier environments – covering priority environmental risks and settings for action.
- *Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks* (Prüss-Ustün et al., 2016). This comprehensive global assessment shows that premature death and disease can be reduced to a significant degree through healthier environments. The report covers more than 100 diseases and injuries, and indicates that people in low-income countries bear the
- greatest disease burden, with the exception of noncommunicable diseases.
- Fact sheets on environment and health priorities (WHO Regional Office for Europe, 2017b). This series of fact sheets, prepared by the WHO Regional Office for Europe for the 6th Ministerial Conference on Environment and Health, provides a short overview of the relevance of a range of different environmental risks and potential interventions to address them.
- *Environment and health for European cities in the 21st century: making a difference* (Carmichael et al., 2017). With more than 80% of the European population expected to live in urban areas by 2030, cities play a pivotal role in promoting and protecting health and well-being. This publication reviews the key drivers for change in the European urban environment, highlights the burden of disease in European cities and discusses opportunities for and barriers to action.

Key work on environmental health and inequality

A wide range of projects and reports provide examples of how environmental justice can be promoted, assessed and monitored. A selection of publications representing international work with an equity focus are listed below.

- *Transforming our world: the 2030 Agenda for Sustainable Development* (United Nations, 2015). The SDGs are strongly based on equity principles and aim to ensure healthy lives and promote well-being for all at all ages – with a
- specific reference to a reduction in diseases triggered by environmental conditions. The equity focus is further documented in SDG 1 and SDG 10, which focus explicitly on poverty mitigation and reduction of inequalities within and among countries, and is embedded in many other SDGs that require access to and provision of basic environmental resources for all. Thus, many SDG indicators include the requirement to stratify indicator values by sex and age or other social determinants of health.

- *Health 2020: a European policy framework and strategy for the 21st century* (WHO Regional Office for Europe, 2013). Health 2020 is the health policy framework for the WHO European Region. It aims to support action across government and society to significantly improve the health and well-being of populations, reduce health inequalities, strengthen public health and ensure people-centred health systems that are universal, equitable, sustainable and of high quality. One priority area of Health 2020 is creating supportive environments and resilient communities, with a specific focus on determinants of health and urban conditions.
- *Closing the gap in a generation: health equity through action on the social determinants of health. Final report of the Commission on Social Determinants of Health* (CSDH, 2008). The CSDH report, launched in 2008, summarizes the impact of social conditions on health and well-being and discusses how health equity can be achieved through action on these social determinants. It concludes that in countries at all levels of income, health and illness follow a social gradient (the lower the socioeconomic position, the worse the health). One of the key recommendations was to improve daily living conditions through action on environmental and social health determinants.
- *Review of social determinants and the health divide in the WHO European Region: final report* (UCL Institute of Health Equity, 2013). This review of health disparities between and within countries across the 53 Member States in the WHO European Region finds that health inequalities persist between and within countries, and suggests action to tackle the root causes, including environmental health dimensions such as natural environments, housing, transport, water and sanitation, urban planning and working conditions. The report also recommends including health equity assessments for current and future generations in environmental policies at all levels, and focusing environmental health programmes on reducing the social gradient in risk exposure.
- *Healthy, prosperous lives for all: the European Health Equity Status Report* (WHO Regional Office for Europe, 2019a). Despite overall improvements in health and well-being in the WHO European Region, inequalities within countries persist. The Health Equity Status Report presents the magnitude of disparities in health status for the Region, and identifies five essential conditions needed to create and sustain a healthy life for all: good quality and accessible health services; income security and social protection; decent living and environmental conditions; social and human capital; and decent work and employment conditions. The Report also considers the drivers of health equity – namely the factors fundamental to creating more equitable societies: policy coherence, accountability, social participation and empowerment. It provides evidence of the indicators driving health inequalities in each of the 53 Member States in the Region as well as the solutions to reduce these inequalities.
- Environmental health inequalities in Europe assessment reports (WHO Regional Office for Europe, 2012; 2019b). These WHO reports, published in 2012 and 2019, summarize available country data on environmental health inequalities within the Member States in the WHO European Region. The first report compiled 14 and the second report compiled 19 environmental health inequality indicators related to housing conditions, basic services, injuries, work settings and urban environmental quality. Both assessments concluded that socioeconomic variables (such as income, employment, occupation and education) are very strong determinants of environmental health risks, while demographic conditions (such as age, sex and ethnicity) and location (deprived areas, urban versus rural residence) also affect environmental health inequality.
- *Progress on household drinking water, sanitation and hygiene 2000–2017: special focus on inequalities* (UNICEF & WHO, 2019). Since 2000, billions of people have gained access to basic drinking-water, sanitation and hygiene services, but many countries still have a long way to go to fully realize the SDG ambition to achieve universal access for all. This report assesses the progress made at the national, regional and global levels in reducing inequalities in household water, sanitation and hygiene services for 2000–2017 and identifies the populations most at risk of being left behind.

Tools, manuals and capacity-building resources

A range of guidance documents and tools provide information on how to identify, assess and respond to inequalities (Table 2). As there is a scarcity of guidance documents and tools focusing on environmental inequality, those listed mostly

refer to health inequality and its monitoring, but the concepts presented are also applicable to environmental health and exposure-related inequality.

Table 2. Tools and manuals related to inequalities in environment and/or health

Title	Description	Coverage
The Health Equity Dataset of the WHO European Health Equity Status Report Initiative (HESRI) (WHO Regional Office for Europe, 2019c)	This dataset provides country-specific health equity data, enabling better understanding of the magnitude of health inequality and the root causes that contribute to the inequalities. The database provides information on inequality in health status and the unequal distribution of a range of health determinants, including housing and environmental conditions and working conditions. Many health outcomes and determinants can be stratified by various dimensions, such as age, sex, income or education.	Data for countries in the WHO European Region
Handbook on health inequality monitoring with a special focus on low- and middle-income countries (WHO, 2013)	This handbook provides an overview for health inequality monitoring within low- and middle-income countries and acts as a resource for those involved in spearheading, improving or sustaining monitoring systems. It was principally designed to be used by technical staff of ministries of health to build capacity for health inequality monitoring in WHO Member States, but it may also be of interest to public health professionals, researchers, students and others.	Global, focusing on low- and middle-income countries
Engagement and participation for health equity (Boyce & Brown, 2017)	A core principle of Health 2020 is reducing health inequalities across the population, recognizing the importance of participation and responsiveness, with the full engagement of people. This report describes theoretical concepts and practical examples on how participation and engagement can be promoted and used to generate benefits for health equity, considering aspects of communication, policy-making, literacy, social economy, resilience and technology.	European, focusing on national engagement examples
The Innov8 approach for reviewing national health programmes to leave no one behind: technical handbook (WHO, 2016)	The Innov8 approach supports the operationalization of the SDG commitment to leave no one behind and the progressive realization of universal health coverage and the right to health. It does this by identifying ways to take concrete, meaningful and evidence-based programmatic action to tackle in-country inequalities and other shortfalls in the realization of human rights and gender equality, and to address the wider social determinants of health.	Global, focusing on national implementation
Urban Health Equity Assessment and Response Tool (Urban HEART) (WHO & WHO Centre for Health Development, 2010)	Urban HEART is a user-friendly guide for local and national officials to identify health inequalities and plan actions to reduce them. Using evidence from WHO's CSDH, Urban HEART encourages policy-makers to develop a holistic approach in tackling health inequality. Officials in nearly 50 countries had been trained on using Urban HEART by 2011.	Global, focusing on local-scale implementation

Table 2 contd.

Title	Description	Coverage
Equity in Health in All Policies: WHO flagship course (WHO Regional Office for Europe, 2016)	This flagship course has been developed to build capacity in the soft skills required to bridge policies and sectors for greater health equity and well-being. Key content areas relate to knowledge and skills in agenda-setting, stakeholder analysis and negotiating with a wide range of actors who influence policy-making. It also provides information on how to frame health equity in different political and policy arenas, how to build alliances and how to manage competing and hostile interests.	European, focusing on local-scale implementation
Guidance note on the development of action plans to ensure equitable access to water and sanitation (WHO Regional Office for Europe & UNECE, 2016)	This aims to help countries translate the priorities identified through self-assessment into actions. Specific equitable access action plans are needed to guide country (or subnational entity) efforts to achieve equitable access to water and sanitation by identifying priority actions to be implemented and ways of implementing them. The guidance note describes the content of action plans and their development process, as well as use of a score-card on equitable access.	European, supporting national and local implementation
Governance for health equity (WHO Regional Office for Europe, 2014)	This report analyses why policies and interventions to address the social determinants of health and health inequalities succeed or fail. It presents a systems checklist for governing for health equity as a whole-of-government approach. It is intended for further discussion and as a framework to support countries in strengthening governance for health equity in practice, through action on the social determinants of health.	European, focusing on national implementation
Monitoring health inequality (WHO, 2015a; 2015b)	This report describes fundamental concepts of inequality and provides examples and guidance on how to monitor health inequalities, using data on reproductive, maternal and child health. Some information is also provided in video format.	Global, focusing on general concepts
Health Equity & Environmental Public Health – through an equity lens (BC Centre for Disease Control, 2019)	<p>The British Columbia Centre for Disease Control publishes resources for professionals on health equity and environmental public health, including:</p> <ul style="list-style-type: none"> • a handbook collecting several resources and tools for health equity in environmental public health; • five short videos to give environmental health officers and health protection leaders an overview of health equity concepts; • workshop materials that are ready to use and others that could be customized; • a fact sheet on supporting health equity through the built environment. 	Canadian context, but with potential relevance globally
Health Equity Policy Tool: a framework to track policies for increasing health equity in the WHO European Region (WHO Regional Office for Europe, 2019d)	This tool is set to support Member States and partners in implementing commitments and strategies to reducing barriers to health equity, tackling vulnerability and increasing solidarity for health. It aims to do so by monitoring and promoting policies in five action areas: health services, income security and social protection, living conditions, social and human capital, and employment and working conditions.	European, focusing on national and local implementation
Evidence and resources to act on health inequities, social determinants and meet the SDGs (WHO Regional Office for Europe, 2019e)	This tool aims to support Member States and partners to strengthen policy coordination across SDGs for better health and reduced health inequalities by providing evidence on key social determinants of health and their links to SDGs. It primarily targets ministries of health, government departments and partner organizations to ensure that SDG policy actions increase health equity, and that health is seen as a contributing factor for development and growth and is well integrated across the SDGs.	European, focusing on national implementation

6. Environmental health action areas and municipal processes

This section focuses on work areas and the opportunities of national and local authorities to provide environmental justice through their local

decisions on urban planning and environmental protection.

Environmental health action areas and related interventions

Environmental conditions have diverse links with inequality and social exclusion, especially as some relate to the situation of population groups and affect individuals or households (such as drinking-water, housing conditions and indoor air pollution) while others relate to spatial and regional characteristics and affect larger groups of populations (such as transport, air pollution, noise and climate change). The integration of

equity aspects in environmental health work may therefore differ according to the environmental factor addressed (Table 3). Further, equity interventions can be undertaken at different levels, as some can be implemented locally while others – especially those related to regulation and standards – are beyond the scope of local authorities and need to be considered by national governments.

Table 3. Examples of inequality aspects in environmental health action areas

Topic	Main dimensions of inequality	Settings for action
Water, sanitation and hygiene services (access to clean water and safe sanitation practices)	Inequality relates to quality and quantity of service provision, and is often associated with urban/rural differences, income, poverty and social exclusion.	Equity interventions can target underserved households and areas disconnected from water and sanitation services, as well as individual schools and day care centres, workplaces, public facilities and private homes with inadequate service provision.
Housing (adequate housing, sufficient space, affordable energy supply, protection from outside conditions, adequate indoor air quality, safe neighbourhood conditions)	Inequality is often associated with income and poverty, household composition (large, single-parent, elderly) and other determinants such as ethnicity or migrant status. It is also affected by access to and the quality of social housing.	Equity interventions can target inadequate housing through regulations and standards, through financial support and incentives for rehabilitating buildings and through improved social housing policies.
Residential environment conditions (levels of pollution, access to open/green spaces, public safety, access to public services, active lifestyle options)	On a neighbourhood scale, inequality is often associated with poverty, social deprivation and ethnic segregation.	Equity interventions can target deprived neighbourhoods through urban planning measures, or can provide financial support for rehabilitating low-quality urban areas.
Air pollution (level of exposure to air pollutants such as PM, nitrogen dioxide and similar)	Inequality is often associated with residential locations close to roads and industrial areas (affected by income, poverty and social exclusion).	Equity interventions can target local or regional air quality conditions and most affected areas.

Table 3 contd.

Topic	Main dimensions of inequality	Settings for action
Noise (level of exposure to noise levels during the day and night)	Inequality is often associated with residential location close to roads, rail tracks, airports and industrial areas (affected by income, poverty and social exclusion).	Equity interventions can target local noise conditions and small-scale actions can target individual properties (schools, hospitals).
Exposure to chemicals (risk of exposure to harmful compounds in consumer products and food items)	Inequality is often associated with economic status and education, which affect the purchase of products and food.	Equity interventions can focus on product standards to avoid increased chemical exposure risk from low-cost products (such as toys, clothes and furniture but also food items).
Harmful working conditions (exposure to risks at the workplace)	Inequality is often associated with education and employment status, which affect the type of work undertaken and associated risks.	Equity interventions can target specific occupational settings and enforcement of related laws and regulations.
Waste and contaminated sites (exposure to waste and toxic materials disposed in public areas and contaminating air, soil, water and the food-chain)	Inequality is often associated with the distance to landfills and contaminated sites, with highest exposure found for contamination hotspots.	Equity interventions can focus on fair distribution of waste disposal sites and incineration plants to avoid pollution hotspots, and prevention and environmental remediation of illegal dumpsites and industrially contaminated areas.
Transport (exposure to transport-related emissions, traffic congestion, injury risks and access to safe and active transport means)	Inequality is often associated with deprived or disconnected areas with high levels of air and noise pollution, greater risk of injury on the road network and unequal access to safe and healthy transport modes (public transport, cycling and walking).	Equity interventions can focus on the development of sustainable, environment-friendly, inclusive and safe transport modes, while reducing the mobility disparities of vulnerable groups and those living or working in disconnected or underserved areas.
Climate change (being affected by climate-associated risks such as flooding or temperature extremes)	Inequality exists on a global scale (rich countries contribute more to climate change, but suffer less from the consequences than poor countries) and a local scale, as disadvantaged population groups are more likely to live in areas affected by climate-related events and less likely to be protected from them.	Equity interventions can be implemented in the area of mitigation (reducing greenhouse gas emissions) in many sectors – such as transport, production and consumption – and in the area of adaptation (protecting from climate change impacts), with a focus on the most affected and vulnerable groups and areas.

Municipal processes and mandates to achieve environmental equality

Environmental inequalities are often most apparent at the local level, and local authorities face the challenge of assuring adequate environmental conditions for all their citizens. This section identifies some processes coordinated by local or regional governments that can be used to tackle environmental inequalities.

Urban planning

Urban planning relates to the planning and establishment of physical infrastructure and built environment structures – making long-term decisions about the use and functions of urban areas. Urban masterplans provide information on infrastructure and locations for housing and residential use, roads and public transport networks, supply and distribution networks for water and energy – as well as water and waste disposal – public spaces such as parks and leisure areas, locations for industrial functions and potentially harmful sites such as waste disposal or incineration plants. Urban planning is tasked with implementing environmental standards related to noise and air pollution thresholds, for example, and tries to protect facilities such as day care centres, schools and hospitals from urban and environmental impacts. It can thus be a very useful tool to mitigate environmental risks in disadvantaged areas and to ensure balanced distribution of environmental burden across a city, avoiding the accumulation of environmental deprivation and pollution hotspots in specific areas.

Community participation

Participation of local residents is essential for political decision-making and local planning at the municipal level. Community participation aims to facilitate the involvement of local residents who may be affected by political decisions, and is based on the belief that those who are affected have the right to be involved in the decision-making process. Thus, many urban planning processes include a public consultation phase in which local residents can submit comments on planned projects and their anticipated consequences. Such participation by residents often addresses environmental conditions and impacts of urban and infrastructural interventions, and can therefore be applied to identify and mitigate public concerns about planned projects – especially in socially and/or environmentally deprived areas.

Transport planning

Transport is an essential part of modern life but can also cause a significant burden on health, environment and national economies. The benefits and negative impacts of transport are not evenly spread across societies, and citizens in more deprived urban areas in particular may have limited access to public transport and to safe infrastructure for active mobility. Adequate transport planning aims to assure that all city quarters are well connected; that public transport is healthy, inclusive, accessible, affordable, safe and environmentally friendly; and that infrastructure for active mobility is developed. A sustainable transport system will not only reduce road traffic injuries, congestion, air and noise pollution in general but also mitigate health and mobility disparities in society and improve social interactions, liveability and amenity values.

Open space/green space planning

Open space is a public resource in cities and covers any open space, but is often used as a synonym for natural and green spaces. The planning of public and accessible open and natural spaces is a specific element of urban planning and aims to provide environmental, social and health benefits through nature and ecosystem functions, recreational and cultural functions, and provision of social gathering and meeting spaces. Urban green and open space planning is a standard element of redevelopment in former industrial areas and brownfield sites, and can be a tool to upgrade the quality of stigmatized neighbourhoods and avoid deprived areas becoming stigmatized.

Pollution control and environmental protection

Local authorities implement national environmental protection regulations and have strong influence on local pollution control and management. This is especially relevant for industrial activities and waste management sites, which can pollute water, soil and air significantly, but also affects the planning and management of transport networks (affecting noise and air pollution) or housing stock emissions (especially related to energy supply choices). Zoning approaches and functional restrictions, promotion of active and public transport choices, clean energy programmes and careful siting and control of hazardous activities and polluting industries are examples of actions

that local managers and environmental authorities can take to safeguard environmental quality for all, and avoid accumulation of environmental threats in specific areas.

Climate change adaptation and mitigation strategies

Public authorities can do a lot to support the reduction of greenhouse gas emissions (mitigation) and adjust living conditions and urban infrastructures to cope better with climate impacts (adaptation). Mitigation relates to aspects of resource consumption (energy, water, land use, emissions) and can be affected by local actors to some extent within the own jurisdiction area, in parallel with sustainable urban planning and environmental protection approaches. Adaptation strategies seek to make urban structures and systems less vulnerable to climate change impacts (such as flooding, bushfires, heatwaves and rising sea levels). Priority areas are critical infrastructure such as the health system, energy networks, transportation, supply chains and basic services (food, water, etc.), and the biggest needs are often found in deprived neighbourhoods with least protection from climate impacts.

Noise abatement strategies

Noise is an increasing public nuisance and a result of spreading urbanization and density levels. The prevention and reduction of noise is therefore another dimension of environment-sensitive planning and can be achieved by urban planning and zoning principles (finding adequate locations for noise-emitting sites). It also affects city-wide planning related to transport, recreation and leisure activities. Socially deprived areas tend to be close to noisy sites (airports, industrial zones, main

streets etc.), so adequate distribution of urban noise sources across the city and implementation of noise protection measures is a key challenge.

Urban/environmental monitoring

Environmental monitoring is necessary to guide identification of unequal risk distribution and enable informed decision-making. Monitoring should include a variety of environmental parameters and urban functions, such as air pollution, noise exposure, housing conditions, traffic density, water supply, waste disposal services, supply of basic services such as water and energy and access to environmental resources such as public transport or natural spaces. To support the identification of areas and residents with the highest exposure and vulnerability levels, the data should enable comparison of environmental conditions between different neighbourhoods and districts; it should also allow for stratification by, for example, sex, age, household size, income and employment.

Environmental impact assessments

In almost all countries, national regulations provide for the implementation of environmental impact assessments to predict and mitigate environmental consequences of infrastructure projects and urban policies. To maximize the benefit and value of the assessments, health impacts can be embedded in descriptions of the consequences the interventions would have on affected residents. As with urban monitoring schemes, it is important to enable equity-sensitive assessments that indicate which population groups, or which urban areas, would be most affected – helping decision-makers to avoid unintended consequences of projects and interventions.

7. Key messages on action and equitable policies

The most fundamental requirement for tackling inequality in exposure to environmental risks is the reduction of exposure disparities within populations (with a focus on those most exposed),

and the provision of healthy environments for all. As a first step towards the development of guidance on achieving environmental health equity, the following considerations may be useful.

Universal environmental protection is needed to ensure adequate environmental conditions everywhere.

In a similar manner to the concept of universal health care – which postulates that each and every person should have access to adequate health services, irrespective of their socioeconomic or individual status – there should be a call for universal environmental protection. This would require prevention and reduction of environmental risks through environmental legislation and environmental protection measures to be applied consistently and everywhere, for the benefit of all citizens. It would help in particular to reduce the background levels of pollution and environmental risk that affect the whole population, irrespective of social status.

Targeted implementation of environmental and planning policies is needed in disadvantaged areas and/or for disadvantaged population groups.

Universal environmental protection policies can prove ineffective in tackling inequality if they are not equally effective in all places. Especially in environmental hotspots, which show highest levels of environmental pollution, universal action may not be sufficient to establish healthy environments everywhere. More targeted and equity-sensitive implementation of environmental interventions and planning policies is needed to ensure that resources are allocated according to need, targeting areas and population groups that suffer most from environmental risks. This includes diversification of policies to allow different or more intense action in selected areas, rather than standardized implementation features. Local needs assessments should drive the policy responses, and policy objectives should be modified to include equity as one of the most important targets.

Harmonized tools, protocols and indicators are needed to support monitoring and assessment of environmental inequality.

Many reporting, surveillance and monitoring systems are equity-blind, meaning that they are often not able to assess inequalities across and within populations. This is most valid for environmental monitoring approaches, which often provide information on exposure averages but rarely allow population groups that are more or less exposed to be identified. Systematic integration of equity dimensions into environmental monitoring and health surveillance systems at the national and local levels would provide comparable and consistent information on inequality, inform policy-makers about potential priorities for action and help to decision-making on the suitability of universal or targeted policies.

8. Questions for further research and practice evaluation

Future research priorities

Many publications on environmental justice and environmental equity have documented that environmental determinants of health are not equally distributed within national and local societies. Most research findings suggest that disadvantaged, less wealthy and most vulnerable population groups tend to be more strongly exposed to environmental risks, although some findings also indicate that for some risks, and in some places, better-off groups can be more exposed.

A wide range of relevant questions remain to be answered, however. Future research is likely to provide relevant findings to suggest how inequality is generated and how it can best be tackled. Environmental, social and health equity researchers are therefore invited to consider the questions below and share their findings.

- How does social disadvantage translate into environmental disadvantage, and how can this be disconnected?
- How much of health inequality is explained by environmental factors?
- What is the comparative degree of variability of exposure to different environmental risk factors in countries and at the local level?
- To what extent is this variability determined by social factors?
- How can multiple environmental factors be accounted for?
- What can be done to address psychosocial concerns?
- How can the impact of different levels of vulnerability be measured and factored in during policy formulation?

Priorities for evaluation of local interventions and practical lessons

Local authorities and their planning departments have a direct and significant influence on the environmental and social situation within their jurisdictions. Hence, they have a wide range of opportunities to manage, reduce and prevent environmental inequalities and related health effects. Yet very little is known about how local actors tackle this challenge, and which policies or local actions are successful. Unlike in the academic world, there is much less communication and publication of projects and their results, and little evaluation of the methods applied.

It would therefore be highly relevant for local actors to document, evaluate and share their experiences of tackling environmental inequalities, to develop a sound compilation of practice and action steps that have proved to be effective. Local actors and authorities are therefore invited to consider the questions below and share their findings.

- How can local inequalities in environmental exposures be identified and assessed?
- How can projects be implemented and monitored to document the equity effects?
- How can equity projects be evaluated, and how can lessons be derived from them?
- How can equity-specific measures and targeted campaigns be justified and supported within city councils and local administrative bodies, given that they may only benefit specific population groups?
- How can equity-specific projects be funded?
- How can cross-sectoral collaboration between social, planning, environmental and health authorities be achieved?
- How can equity effects of local decisions on planning and infrastructural developments be observed?

Glossary

Aarhus Convention is the United Nations Economic Commission for Europe Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, which was signed in 1998 and came into force in 2001. 46 countries and the EU are currently signatories of the convention.

Absolute inequality relates to absolute differences in environmental exposure between population groups. Using the absolute perspective, the inequality between air pollution exposure levels of 65% and 75%, and the inequality between air pollution exposure levels of 5% and 15%, is 10% in both cases and therefore similar (see also **Relative inequality**).

Distributive justice refers to an equal distribution of environmental conditions between population groups and between spatial territories, covering the distribution both of environmental risks and hazards and of environmental goods and resources (such as green spaces) (see also **Procedural justice**).

Environmental health inequality refers to descriptive measures of difference in exposure to environmental health risk factors, and to differences in health status caused by environmental conditions (see also **Environmental health inequity**).

Environmental health inequity refers to unfair, unjust and avoidable differences in exposure to environmental health risk factors, and to unfair, unjust and avoidable differences in health status caused by environmental conditions (see also **Environmental health inequality** and **Environmental justice**).

Environmental inequality refers to descriptive measures of difference in environmental conditions (see also **Environmental inequity**).

Environmental inequity refers to unfair, unjust and avoidable differences in environmental conditions (see also **Environmental inequality**).

Environmental justice represents a fair and equitable distribution of environmental risks and benefits within society, and equal treatment and involvement of all population groups in environmental decision-making (see also **Environmental health inequity**).

Environmental quality differs from environmental factors, which can be described as good or bad in terms of their impact on human health. Environmental quality, however, can be continuous – in that it is present for everyone (e.g. ambient air quality) – or discrete – indicating that only a specific population group is affected (e.g. residents in the vicinity of a waste plant or households close to a flooded river).

Equality refers to the general absence of differences between groups of people. For example, equality would mean that all individuals have the same level of exposure to environmental risks, the same prevalence of diseases and the same life expectancy (see also **Equity**).

Equity refers to the absence of avoidable, unfair or remediable differences among groups of people, and therefore includes a value judgement. For example, differences in mortality by age group are natural and may not qualify as an equity issue. However, significant differences in mortality or environmental risk exposure between low- and high-income groups would be considered unfair and avoidable, and therefore represent an equity challenge (see also **Equality**).

Exposure differential indicates that a certain population group has a strongly increased prevalence of environmental risk exposure or is exposed to higher levels of environmental risk, which may occur due to unfavourable residential location or a socioeconomic or demographic disadvantage. Such an increased environmental burden is likely to have negative impacts on health and well-being (see also **Vulnerability differential**), and thus contribute to health inequality.

Health inequality is a descriptive measure of the differences in health between groups of people.

Health inequity is a difference in health status that is avoidable, unfair and unjust.

Indices of multiple deprivation merge a set of independent indicators to form a composite indicator that captures social disadvantage and deprivation at a general level. Most are available for small areas. Well known examples used for international and national research work on social and health equity are the Carstairs index and the Townsend index, which aim to capture social disadvantage levels in neighbourhoods to facilitate interpretation of survey findings. In some countries

they are an official policy tool used to deploy and target resources. Most indices of multiple deprivation focus on socioeconomic dimensions, but some also include environmental dimensions related to housing or local environmental quality. Deprivation indices are very suitable for equity studies, as they allow stratification of environmental and health equity data by the index values, to compare neighbourhoods with contrasting social status.

Multiple exposures relates to the multiple environmental factors to which humans are exposed. Many distribution studies examine and describe only one environmental factor at a time, and how these multiple factors may interact to affect health, especially over a long period, is still not fully understood.

Percentile relates to dividing the population up into percentage groupings. Commonly used measures are deciles (ten groups, with 10% of the population in each), quintiles (five groups, with 20% of the population in each) or quartiles (four groups with 25% of the population in each) (see also **Quartile/quintile**).

Procedural justice refers to equal opportunities for all population groups to influence the decision-making process affecting their close environment, including adequate integration in planning processes and access to and transparency of data and information (see also **Distributive justice**).

Proportionate universalism merges targeted and universal action approaches; it suggests that action should address all population groups and aim to improve the situation for everybody, while acknowledging that stronger efforts are needed for those most affected or most vulnerable. Efforts would thus be proportionate to the respective exposure situation or vulnerability level of a given population group, hoping to achieve the strongest environmental improvements for the most exposed people, but not excluding progress for those less exposed. Such an approach would thus reduce both the overall level of exposure and the inequality between population subgroups (see also **Targeted action** and **Universal action**).

Quartile/quintile refers to dividing the population into four (quartiles) or five (quintiles) groups, each covering a fourth or a fifth of the total population (see also **Percentile**).

Relative inequality refers to the relative differences between exposure levels and is often expressed by ratios. In the relative perspective, air pollution

exposure levels of 15% are considered three times higher than air pollution exposure levels of 5% (ratio of 3.0:1), while the relative inequality between air pollution exposure levels of 65% and 75% represents an increase of only a fifth (ratio of 1.2:1) (see also **Absolute inequality**).

Social determinants of health is a holistic model that considers not only medical but also societal factors – such as social, economic, cultural and environmental conditions – in the generation of health and disease. The model combines individual characteristics (age, sex, physical and mental constitution) with lifestyle factors; socioeconomic factors; and living and working conditions, such as housing, environmental services, health care services, education and employment.

Social gradient indicates that people with a lower socioeconomic status usually have a higher risk of serious illness and premature death (or environmental risk exposure) than those with higher socioeconomic status. The social gradient in health runs right across society; it affects individuals or population groups that can by no means be considered poor or disadvantaged, but still show less good health status than those most advantaged. The intensity of the social gradient can help to decide which action is appropriate (see also **Universal action** and **Targeted action**).

Targeted action represents measures to improve the environmental conditions for specific target groups, rather than measures that would benefit the whole population (universal action), but may not necessarily reduce the magnitude of inequality. A higher level of exposure to environmental risks in disadvantaged and marginalized population groups (or areas) is often used as an argument to call for targeted action. Detailed information on the inequality situation across the population is very helpful to support decision-making on the suitability of targeted action versus universal action (see also **Universal action** and **Social gradient**).

Universal action refers to actions, policies and interventions that are applied equally and consistently, without variations for different population groups or areas. Examples are most national laws and standards, social welfare regulations and environmental standards, as they apply to all citizens and in all cities equally. These do not automatically result in equal environmental or social conditions, however, as different areas and population groups may benefit differently from such policies and actions, and disparities in social conditions or environmental pollution levels

can still occur (see also **Targeted action** and **Social gradient**).

Upstream determinants of health relate to socioeconomic, demographic and environmental conditions located outside the health system. Inequality in health outcomes largely depends on the determinants of health and their distribution: which conditions keep people healthy and which make people sick. Many determinants of health and well-being are strongly affected by actions and decisions made within social, environmental, labour, transport, housing and urban development sectors. As these cannot be directly influenced by the health sector, but strongly affect the burden of disease, the resulting characteristics are defined as upstream determinants; these are not only the cause of health issues in general but are also at the root of health inequality. Working on upstream determinants is considered paramount to achieve health equity through fair and equal distribution of health determinants, including environmental health conditions.

Vulnerability refers to the general inability of a system or a person to withstand the effects

of a hostile environment. Environmental health literature contains many references to and definitions of vulnerable populations and individuals. In environmental health inequality, vulnerability relates to the fact that disadvantaged population groups may be more likely to develop a disease (or a more severe expression of a disease) in response to an environmental exposure. Increased vulnerability can be due to cumulative burdens, pre-existing diseases or malnutrition, for example, but it can also be caused by lack of knowledge or capacities. In epidemiological terms, vulnerability leads to an effect modification by social disadvantage.

Vulnerability differential refers to social or demographic differences in vulnerability to the effects of environmental risks. It can explain why certain individuals or population groups may show a stronger response (such as health impacts) to a given risk, even if their exposure level is not higher than for other individuals or population groups. The vulnerability differential is conceptually distinguished from the exposure differential, which is restricted to differences in risk exposure (see also **Exposure differential**).

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Annex 1. What actors and professions can do to tackle environmental health inequalities

Opportunities to tackle and reduce environmental inequalities and their health impacts differ according to professions and sectors. This annex sets out potential roles and activities that could be undertaken by different actors and professions. Please note that this is not an exhaustive list: it provides a range of examples that could be undertaken by the relevant actors.

Urban planners

Monitoring and assessment

- Identify areas with high environmental burden, make this mapping public and set strategies and priorities to reduce environmental health inequalities.
- Establish (or contribute to) local participatory and transparent monitoring and surveillance systems with a focus on bringing together social and environmental data.

Action

- Focus on reducing traffic and industrial emissions as a major source of air pollution and noise in deprived areas.
- Increase accessibility and access to green space and blue space in all urban neighbourhoods to provide environmental benefits for recreation and restoration.
- Capture both positive and negative health and equity impacts in socioenvironmental impact assessments of new developments and infrastructure.

Planning and policies

- Define health criteria in urban planning documents.
- Strengthen intersectoral collaboration for healthy urban planning and overall reduction of emissions.
- Consider interventions/practices and studies or recommendations on how to promote healthy environments for all (even small-scale initiatives can make a difference).
- Identify vulnerable groups and understand their use of the urban space.
- Include and engage with all population groups, and especially vulnerable groups, in urban planning and decision-making to ensure that their needs are met.
- Develop urban transformation and regeneration strategies with the target of reducing urban environmental inequalities between urban areas and groups of residents.
- Take health, age and gender inequalities into account at every step of planning/implementation (health equity in all policies).

Environmental authorities

Monitoring and assessment

- Cooperate with the urban planning/health/statistic departments more closely to identify areas and population groups with high environmental burden.
- Combine environmental, social and urban planning data to identify and assess environmental inequalities adequately, for example, by mapping environmental quality data against social vulnerability data.
- Monitor environmental conditions by district and possibly by time period (hour, day of the week, day/night, season).
- Evaluate environmental and equity impacts of urban interventions.
- Include health actors and health data in analyses of environmental conditions.

Action

- Engage with the population to set up and apply targeted measures and interventions to reduce existing inequalities.
- Build networks with health professionals and social workers and ensure mutual participation on environment, social and health issues within the local jurisdiction.
- Start from the needs of vulnerable groups when performing impact assessments for local projects.
- Integrate the needs of local residents with specific requirements or functional limitations.
- Communicate evidence on environmental quality to stakeholders and municipal decision-makers.
- Address social differences in environmental risk, and related health impacts, to define environmental standards at the local level.
- Use visual tools, such as maps and presentations of systemic processes, to present environmental, social and health inequalities to local decision-makers.

Social welfare or social protection authorities

Monitoring and assessment

- Collaborate with other authorities and exchange data to integrate social dimensions into local monitoring systems, while safeguarding the protection of personal data.
- Identify socially disadvantaged groups suffering most from environmental conditions; provide an assessment of their needs; and define the needs and opportunities for targeted interventions.

Action

- Push for local policies to consider equal environmental and living conditions as a core value.
- Promote socially cohesive policies, and advocate against policies and decisions that segregate urban districts or differentiate use of urban space by subgroups of the population, thereby increasing social and environmental inequalities.
- Provide targeted advice to socially deprived groups (or population groups with special needs) on the basis of their specific vulnerabilities/sensitivities/behaviours.
- Strengthen empowerment and environmental health literacy of socially deprived groups.
- Consider language and knowledge differences, and produce simple briefs on key topics.

Health authorities

Monitoring and assessment

- Expand health monitoring procedures to include social, spatial and environmental dimensions.
- Compile health reports and information obtained from doctors and social workers; analyse these by spatial distribution to identify areas with increased health needs prevalence.
- Compile and analyse data on health impacts of environmental conditions or events.

Action

- Strengthen sociospatial perspectives on health by understanding patterns and differences of health and health determinants in the jurisdiction area.
- Collaborate with social and environmental authorities to identify health determinants and map them against health outcomes, using local data and health surveys.
- Introduce or support information campaigns and interventions that address environmental health determinants and environmental hotspots.
- Communicate and provide information about environmental risks and healthy lifestyles, focusing on environmentally and socially deprived areas.

Doctors/medical practitioners

Awareness and education

- Ask patients about their living situations and environmental conditions as part of the diagnostic process.
- Be aware of environmental risks and their impact on health, and take inequality in risk exposure into account when making decisions on therapy and prevention.

- Educate people about environmental health risks/unhealthy behaviours and what they can do as individuals to mitigate environmental pollution, monitor the risks they are exposed to and improve their situations.
- Provide targeted advice for vulnerable people who may be more likely to be exposed to, or react to, environmental risks.

Action

- Inform local authorities about observed environmental issues, vulnerable population groups and hotspots of risk exposure, and suggest preventive and corrective measures.
- Communicate identified problems to professional organizations, policy-makers and the public.

Researchers

- Provide reviews of evidence as a basis for decision-making.
- Integrate social disparities as an aspect of data evaluation and analysis.
- Quantify exposure routes for environmental risks.
- Use real-life interventions at the local scale as a subject for research, and help local authorities to establish reliable monitoring systems and implement effective evaluation projects.
- Create and conduct quasi-experimental studies to evaluate (prospectively) the equity impacts of policies relevant for living conditions or environment.
- Build collaborative networks and help to deliver more consistent and comparative datasets, reflecting local situations.
- Clearly communicate equity-sensitive results to policy-makers and citizen groups in appropriate formats, and propose adequate interventions to tackle inequality.

Local, nongovernmental and civil society organizations

- Contribute to empowerment of socially disadvantaged groups and support their participation in decision-making processes.
- Implement projects to identify target groups that are suffering most.
- Use social and traditional media to disseminate information on environmental health inequalities.
- Push the agenda with national and local authorities and provide proposals for action.
- Raise awareness of environmental inequalities among vulnerable groups.
- Establish local forums to discuss and identify local challenges and needs concerning social deprivation and the related environment and health impacts.

Citizens

- Assess personal risk levels, including of those around you; remedy and prevent them as far as possible at the individual level.
- Adopt a healthy and sustainable lifestyle, reducing resource consumption and environmental emissions.
- Report risks to the local community and social media, as well as to local, national or supra-national authorities.
- Engage in local forums and organizations to advocate environmental equity action.
- Participate in public consultation phases of local planning projects and impact assessments.
- Contact local politicians to make them aware of local challenges and equity challenges, and push them to establish preventive and corrective actions.

Annex 2. WHO guidance documents on environmental conditions

WHO Guideline/recommendation	Environmental coverage	Equity coverage
Night noise guidelines for Europe. Copenhagen: WHO Regional Office for Europe; 2009 (http://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2009/night-noise-guidelines-for-europe)	Recommended maximum night noise levels	The guideline value incorporates the specific needs of vulnerable groups that may be more noise-sensitive.
Environmental noise guidelines for the European Region. Copenhagen: WHO Regional Office for Europe; 2018 (http://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2018/environmental-noise-guidelines-for-the-european-region-2018)	Recommended exposure levels for road traffic noise, railway noise, aircraft noise, wind turbine noise and leisure noise	The guidelines include equality as one of the parameters used to determine the strength of the recommendations.
Air quality guidelines – global update 2005. Geneva: World Health Organization; 2005 (https://www.who.int/airpollution/publications/aqg2005/en/)	Recommended exposure thresholds for a wide range of air pollutants (such as ozone, PM, nitrogen dioxide and sulfur dioxide)	Vulnerable populations were taken into consideration when guideline values were established.
Guidelines for indoor air quality: dampness and mould. Geneva: World Health Organization; 2009 (https://www.who.int/airpollution/guidelines/dampness-mould/en/)	Building characteristics that prevent the occurrence of adverse health effects associated with dampness or mould	The guidelines recommend prioritizing remediation of conditions that lead to adverse exposure to prevent an additional contribution to poor health in populations living with an increased burden of disease.
Guidelines for indoor air quality: selected pollutants. Geneva: World Health Organization; 2010 (http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2010/who-guidelines-for-indoor-air-quality-selected-pollutants)	Recommended exposure thresholds for benzene, carbon monoxide, formaldehyde, naphthalene, nitrogen dioxide, polycyclic aromatic hydrocarbons, radon, trichloroethylene and tetrachloroethylene	The guidelines pay attention to specific sensitive subgroups in the population.
Guidelines for indoor air quality: household fuel combustion. Geneva: World Health Organization; 2014 (https://www.who.int/airpollution/guidelines/household-fuel-combustion/en/)	Recommended emission rate targets for PM _{2.5} and carbon monoxide and recommendations on the use of coal and kerosene	The guidelines aim to inform stakeholders about addressing energy access inequalities.

WHO Guideline/recommendation	Environmental coverage	Equity coverage
Guidelines for drinking-water quality, fourth edition. Geneva: World Health Organization; 2017 (https://www.who.int/water_sanitation_health/publications/2011/dwq_guidelines/en/)	Guideline values for individual chemicals (naturally occurring, from industrial resources, from agricultural activities, used in water treatment or from materials in contact with drinking-water), guidance levels for radionuclides and guidance on radon	The guidelines draw attention to vulnerable groups.
Housing and health guidelines. Geneva: World Health Organization; 2018 (https://www.who.int/sustainable-development/publications/housing-health-guidelines/en/)	Recommended levels and conditions for indoor temperatures, living space, injury prevention and accessibility	The impact of housing conditions on equity and the increased vulnerability of selected population groups were considered when establishing the guideline recommendations.

Note: all websites accessed on 9 October 2019.

Annex 3. International data sources contributing to environmental inequality assessments

Data source	Environmental dimensions	Equity dimensions
<p>The Health Equity Dataset of the WHO European Health Equity Status Report Initiative (HESRI) Copenhagen: WHO Regional Office for Europe (https://who.europe.shinyapps.io/health_equity_dataset/)</p>	Data include green space access, access to public transport, drinking-water and sanitation, fuel deprivation, overcrowding, environmental pollution, air quality and housing deprivation.	Depending on the indicator, stratifications can be done for age, sex, income or other social or economic determinants.
<p>WHO/UNICEF Joint Monitoring Programme Geneva: World Health Organization and UNICEF (https://washdata.org/)</p>	Data include drinking-water, sanitation and hygiene services.	Depending on country, data are available for households, schools and health care facilities. Household data can be stratified by urban versus rural location, and – for selected countries – by wealth quintiles.
<p>EU Statistics on Income and Living Conditions (SILC) Luxembourg: Eurostat (https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions)</p>	Data include housing-related indicators water and sanitation, dampness, crowding, problems to heat or cool the dwelling, housing deprivation, noise, local pollution and housing costs.	Most data can be stratified by poverty level and sometimes income, by household composition, by age and by sex. Some can be stratified by urbanization level or by Nomenclature of Territorial Units for Statistics (NUTS) level 1 or 2.
<p>European Quality of Life Survey Dublin: Eurofound (https://www.eurofound.europa.eu/data/european-quality-of-life-survey)</p>	Data include living standards, housing, access to local services and neighbourhood quality (including, for example, perception of noise, air quality and access to green areas).	Data can be stratified online by age, sex, income and employment. The original dataset can be accessed for more detailed analysis.
<p>WHO Mortality Database Geneva: World Health Organization (https://www.who.int/healthinfo/mortality_data/en/)</p>	Data include injury mortality for external causes of injuries (transport injuries, poisoning, falls and occupational accidents).	Data can be stratified by age and sex, sometimes by injury context (such as means of transport, type of poison or occupational sector).
<p>Eurobarometer special surveys Brussels: European Commission (https://ec.europa.eu/environment/eurobarometers_en.htm)</p>	Eurobarometer special surveys focus on public opinion about a range of issues, including environmental topics. Recent Eurobarometer surveys have covered biodiversity, environmental protection, waste management and air quality.	Many Eurobarometer reports stratify findings by age, sex, socioeconomic status and urbanization level. National datasets can be accessed for various surveys.

Data source	Environmental dimensions	Equity dimensions
<p>European Commission regional statistics Luxembourg: Eurostat (https://ec.europa.eu/eurostat/cache/RCI)</p>	<p>Data include health, population and transport data, among others.</p>	<p>Data are provided by city and by NUTS region, enabling spatial comparison between regions and settlements.</p>
<p>OECD database on cost from exposure to environment-related risks Paris: Organisation for Economic Co-operation and Development (https://stats.oecd.org/)</p>	<p>Data include various indicators on health burden and related cost measures of air pollution, lead, radon, water and sanitation, occupational risks and second-hand smoke exposure.</p>	<p>National data can be stratified by sex and age.</p>

Note: all websites accessed on 9 October 2019.

The WHO Regional Office for Europe

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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Environmental conditions are a major determinant of health and well-being but are not distributed equally across the WHO European Region. Higher levels of environmental risk are often found in disadvantaged population subgroups, leading to a need for targeted environmental and intersectoral action to protect these groups and achieve environmental justice.

This resource package aims to generate awareness of the concept of environmental health inequalities and to support action against disparities in exposure to environmental risks at the national and subnational levels. It sets out the various dimensions of environmental health inequality; presents relevant methods and approaches for monitoring and assessment; and suggests ways to use this evidence for action. It also provides information on a range of tools and guidance documents that may be helpful for national and local actors tackling environmental inequalities and striving to improve health and health equity.

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