



World Health  
Organization

REGIONAL OFFICE FOR **Europe**



# Environmental health inequalities in Europe

Second assessment report







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## ABSTRACT

Environmental conditions are a major determinant of health and well-being, but they are not shared equally across the population. Higher levels of environmental risk are often found in disadvantaged population subgroups. This assessment report considers the distribution of environmental risks and injuries within countries and shows that unequal environmental conditions, risk exposures and related health outcomes affect citizens daily in all settings where people live, work and spend their time.

The report documents the magnitude of environmental health inequalities within countries through 19 inequality indicators on urban, housing and working conditions, basic services and injuries. Inequalities in risks and outcomes occur in all countries in the WHO European Region, and the latest evidence confirms that socially disadvantaged population subgroups are those most affected by environmental hazards, causing avoidable health effects and contributing to health inequalities.

The results call for more environmental and intersectoral action to identify and protect those who already carry a disproportionate environmental burden. Addressing inequalities in environmental risk will help to mitigate health inequalities and contribute to fairer and more socially cohesive societies.

## KEYWORDS

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

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# Foreword

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*A long-term strategic objective of the WHO Regional Office for Europe is stronger equity and better governance for health. The Health 2020 European policy framework outlines the various dimensions of this goal, and is based on the evidence that many health inequalities can be effectively addressed through action on the social and environmental determinants of health. Inequalities in health are also a major challenge for both development and overall progress in achieving the transformation required for the 2030 Agenda for Sustainable Development.*

*Inequalities in people's exposure to environmental factors exist in all countries across the WHO European Region, contributing to health inequalities. In 2012 WHO published a first assessment report on environmental health inequalities in Europe, prepared by the WHO European Centre for Environment and Health in Bonn, Germany. That report provided a baseline assessment of the magnitude of environmental health inequalities within countries in the Region.*

*Spurred on by developments in the Region and the renewed commitment of all Member States in the declaration of the Sixth Ministerial Conference on Environment and Health held in Ostrava, Czechia, in 2017, I am proud to present the second assessment, reporting the status and evolution of environmental health inequalities in Europe and using an extended set of inequality indicators.*

*The evident reduction of many environmental health risks indicates that environmental governance and regulations in the Region are generally effective in protecting our population. However, this progress is marred by inequalities when we look at the detail: we can see we still have a long way to go to ensure that improved environmental conditions benefit us all. All countries have some communities at greater risk than others of experiencing harmful environmental conditions. This report shows that within-country inequalities in environmental exposure and injury mortality often persist or have even increased, putting disadvantaged population groups at much higher exposure levels than advantaged groups.*

*The good news is that inequalities in environment and health can also improve. National patterns of inequalities vary greatly, but country-specific strategies can help to mitigate these inequalities. Such strategies should be based on a clear identification of the most affected people and the national priorities for action.*

*Significant and avoidable health inequalities are not acceptable. With this report, we aim to support countries in the WHO European Region to identify the areas that can be tackled through environmental and intersectoral remedial actions. By striving to integrate health equity considerations into all national policies, it is our hope that countries can generate the political will needed to address these inequalities and provide environmental justice for all.*

Dr Zsuzsanna Jakab  
WHO Regional Director for Europe

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# Contributors<sup>1</sup>

---

**Ricardo Almendra**, Centre of Studies in Geography and Spatial Planning, University of Coimbra, Portugal (*chapter author*)

**Gabriele Bolte**, Institute of Public Health and Nursing Research, University of Bremen, Germany (WHO Collaborating Centre for Environmental Health Inequalities) (*chapter author, systematic review, meeting participant*)

**Jurgen Buekers**, VITO Flemish Institute for Technological Research, Belgium (*chapter author*)

**Christiane Bunge**, German Environment Agency, Germany (*meeting participant*)

**Séverine Deguen**, Pierre Louis Institute of Epidemiology and Public Health, EHESP French School of Public Health, France (*chapter author, meeting participant*)

**Chantal Demilecamps**, United Nations Economic Commission for Europe, Switzerland (*chapter author*)

**Anja Dewitz**, German Environment Agency, Germany (*chapter author, meeting participant*)

**Sani Dimitroulopoulou**, Environmental Hazards and Emergencies Department, Public Health England, United Kingdom (*chapter author, meeting participant*)

**Stefanie Dreger**, Institute of Public Health and Nursing Research, University of Bremen, Germany (WHO Collaborating Centre for Environmental Health Inequalities) (*chapter author, systematic review*)

**Jon Fairburn**, Staffordshire Business School, Staffordshire University, United Kingdom (*chapter author, systematic review, meeting participant*)

**Catherine Ganzleben**, Programme on Health and Sustainable Resource Use, European Environment Agency, Denmark (*chapter author, meeting participant*)

**Evanthia Giagloglou**, Research Division, Institute of Occupational Medicine, United Kingdom (WHO Collaborating Centre for Occupational Health) (*chapter author*)

**Alberto González Ortiz**, Health and Sustainable Resource Use Programme, European Environment Agency, Denmark (*chapter author*)

**Vijoleta Gordeljevic**, Health and Environment Alliance, Belgium (*meeting participant*)

**Richard Graveling**, Research Division, Institute of Occupational Medicine, United Kingdom (WHO Collaborating Centre for Occupational Health) (*chapter author*)

**Lisa Karla Hilz**, Institute of Public Health and Nursing Research, University of Bremen, Germany (WHO Collaborating Centre for Environmental Health Inequalities) (*systematic review*)

**Aleksandra Kaźmierczak**, Climate Change, Energy and Transport Programme, European Environment Agency, Denmark (*chapter author*)

**Stylianos Kephelopoulos**, European Commission Joint Research Centre, Italy (*meeting participant*)

---

<sup>1</sup> Affiliations at the time of involvement in the project



- Hanneke Kruize**, National Institute for Public Health and the Environment, Netherlands (*chapter author, meeting participant*)
- Lucie Laflamme**, Department of Public Health Sciences, Karolinska Institutet, Sweden (*chapter author, systematic review, meeting participant*)
- Merel Leithaus**, Department of International Health, Maastricht University, Netherlands (*chapter author, systematic review*)
- Ilse Loots**, Department of Sociology, University of Antwerp, Belgium (*chapter author*)
- Firmino Machado**, Faculty of Medicine, Porto University, Portugal (*chapter author, meeting participant*)
- Daniela Marsili**, Department of Environment and Health, National Institute of Health, Italy (WHO Collaborating Centre for Environmental Health in Contaminated Sites) (*systematic review*)
- Benedetta Mattioli**, National Centre for Global Health, National Institute of Health, Italy (WHO Collaborating Centre for Environmental Health in Contaminated Sites) (*systematic review*)
- Christina Mitsakou**, Environmental Hazards and Emergencies Department, Public Health England, United Kingdom (*chapter author*)
- Bert Morrens**, Department of Sociology, University of Antwerp, Belgium (*chapter author*)
- Roberto Pasetto**, Department of Environment and Health, National Institute of Health, Italy (WHO Collaborating Centre for Environmental Health in Contaminated Sites) (*chapter author, systematic review, meeting participant*)
- Ariela Pochet**, Health Determinants and Inequality Unit, European Commission, Luxembourg (*meeting participant*)
- Birgit Reineke**, Institute of Public Health and Nursing Research, University of Bremen, Germany (WHO Collaborating Centre for Environmental Health Inequalities) (*data support*)
- Paula Santana**, Centre of Studies in Geography and Spatial Planning, University of Coimbra, Portugal (*chapter author*)
- Milan Ščasný**, Charles University, Czechia (*meeting participant*)
- Dennis Schmiede**, Centre for Development Research, University of Bonn, Germany (*chapter author, meeting participant*)
- Greet Schoeters**, VITO Flemish Institute for Technological Research, Belgium (*chapter author*)
- Steffen Schüle**, Institute of Public Health and Nursing Research, University of Bremen, Germany (WHO Collaborating Centre for Environmental Health Inequalities) (*systematic review, meeting participant*)
- Mathilde Sengoelge**, Department of Public Health Sciences, Karolinska Institutet, Sweden (*systematic review*)
- Tamara Steger**, Department of Environmental Sciences and Policy, Central European University, Hungary (*chapter author, meeting participant*)

**Kerttu Valtanen**, German Environment Agency, Germany (*chapter author*)

**Kihal-Talantikite Wahida**, Image, the City and Environment Laboratory, University of Strasbourg, France (*chapter author*)

## WHO Regional Office for Europe

**Majd Al Ssabbagh**, Student intern, WHO European Centre for Environment and Health, Germany

**Matthias Braubach**, Urban Health Equity, WHO European Centre for Environment and Health, Germany (*project lead*)

**Chris Brown**, WHO European Office for Investment for Health and Development, Italy

**James Creswick**, Communications, WHO European Centre for Environment and Health, Germany

**Frank George**, Environmental Health Economics, WHO European Centre for Environment and Health, Germany

**Dorota Jarosinska**, Living and Working Environments, WHO European Centre for Environment and Health, Germany

**Ingu Kim**, Student intern, WHO European Centre for Environment and Health, Germany

**Marco Martuzzi**, Environmental Health Impact Assessment, WHO European Centre for Environment and Health, Germany

**Pierpaolo Mudu**, Environment and Health, WHO European Centre for Environment and Health, Germany

**Niranjan Mukherjee**, Student intern, WHO European Centre for Environment and Health, Germany

**Julia Nowacki**, Health Impact Assessment, WHO European Centre for Environment and Health, Germany

**Friederike Reichel**, Student intern, WHO European Centre for Environment and Health, Germany

**Oliver Schmoll**, Water and Climate, WHO European Centre for Environment and Health, Germany (*chapter author*)

**Roman Perez Valezquez**, Air Pollution, WHO European Centre for Environment and Health, Germany

## WHO headquarters

**Francesco Mitis**, Water, Sanitation and Hygiene Unit

# Abbreviations

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<b>EEA</b>	European Environment Agency
<b>EQLS</b>	European Quality of Life Survey
<b>EU</b>	European Union
<b>EU-SILC</b>	Eurostat Statistics on Income and Living Conditions
<b>GDP</b>	gross domestic product
<b>ICS</b>	industrially contaminated sites
<b>ILO</b>	International Labour Organization
<b>JMP</b>	Joint Monitoring Programme
<b>NUTS</b>	nomenclature of territorial units for statistics [classification]
<b>PM</b>	particulate matter
<b>RTI</b>	road traffic injury
<b>SDG</b>	Sustainable Development Goal
<b>UNECE</b>	United Nations Economic Commission for Europe
<b>UNICEF</b>	United Nations Children's Fund
<b>WASH</b>	water, sanitation and hygiene

# Executive summary

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Safe environments are a prerequisite for health and well-being. Environmental risk factors, however, account for at least 15% of mortality in the WHO European Region. Further, environmental conditions are not the same everywhere and for everyone; in fact, disparities in distribution of and exposure to environmental risks occur both between and within countries. The uneven distribution of environmental risks within societies and the related impacts on health and health equity are therefore of increasing concern.

This report provides a second assessment of environmental health inequalities in the Region. It updates and expands on the evidence base provided by the baseline assessment report of 2012, and aims to:

- quantify the magnitude of environmental health inequalities within countries in the Region, using international databases;
- assess the temporal trends of inequalities in environmental risk exposure and injury by comparing current data with the 2012 baseline assessment; and
- identify the most significant inequalities and the most affected population groups for follow-up at the national or local level.

The report uses data from international databases, stratified by socioeconomic, demographic or spatial variables, to highlight differences in environmental exposure or injury outcomes between population subgroups within the same country.

The assessment considers various environmental settings and presents 19 environmental health inequality indicators, categorized into five domains:

- **housing-related inequalities**
  - lack of a flush toilet
  - lack of a bath or shower
  - overcrowding
  - dampness in the home
  - inability to keep the home adequately warm
  - inability to keep the home adequately cool in summer
- **basic service inequalities**
  - lack of access to basic drinking-water services
  - lack of access to basic sanitation services
  - energy poverty
- **inequalities related to urban environments and transport**
  - exposure to air pollution
  - self-reported noise annoyance
  - fatal road traffic/transport injuries
  - lack of access to recreational or green areas
  - chemical exposure
  - contaminated sites
- **work-related inequalities**
  - work-related injuries and mortality
  - risks in working environments
- **injury-related inequalities**
  - fatal poisoning
  - fatal falls

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The assessment findings indicate that:

- environmental health inequalities occur in all countries, irrespective of the level of development and the environmental or economic status;
- the occurrence of environmental health inequalities has tended to persist or even increase over time, despite the improvement of environmental conditions observed in most countries in the WHO European Region;
- inequalities can often be significant, with some population subgroups exposed or affected five times more than others;
- higher levels of environmental or injury risk are most often associated with – and are partly explained by – socioeconomic deprivation (notably poverty and low income) or other forms of disadvantage, such as those related to demographic or spatial determinants;
- in some cases, environmental exposure may also be higher among affluent or socially advantaged population subgroups;
- the lack of data on inequalities in environmental conditions restricts a broad assessment in many countries and therefore represents a major concern.

Differential exposure to environmental risks translates into health inequalities, but the available environmental monitoring data do not allow an accurate quantification of these.

In addition to the uneven distribution of environmental pressures, however, variable vulnerability of different population subgroups can further amplify the resulting health outcomes and inequalities, through synergistic effects.

Individual countries show different patterns of environmental health inequalities, indicating that countries may have somewhat different priorities for national review and follow-up action. Nevertheless, some challenges are shared across the Region: inequalities related to energy poverty, thermal comfort, damp homes and noise perception have increased in most countries, representing a common challenge to be tackled by many national and local governments.

The report's findings underline the importance of environmental disparities for health and health equity, and provide warning signals about environmental and injury inequalities that require follow-up at the national level. Using more detailed national data to assess and contextualize the reported disparities, national and local actors can identify those inequalities that are systemic and unfair and call for policy action. Such evidence on the magnitude and occurrence of environmental health inequalities will support policy-makers' efforts to reduce health inequalities through environmental interventions and enable informed decision-making to identify and protect those who already carry a disproportionate burden of environmental risk. Addressing inequalities in environmental risk will thus help to prevent avoidable health inequalities, and contribute to fairer and more socially cohesive societies.



# 1. Introduction

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**Matthias Braubach, Friederike Reichel, Marco Martuzzi**

Environmental conditions are a central foundation for health and well-being and account for at least 15% of mortality in the WHO European Region (WHO Regional Office for Europe, 2018a). Such conditions are not universal, however, as wide disparities in distribution of and exposure to environmental risks occur both between and within countries. This report is concerned with the distribution of environmental risks and injuries within countries.

Unequal environmental conditions, exposures and outcomes affect citizens daily in all settings where people live, work and spend their time. Home location and the quality and size of the dwelling closely depend on the financial capacities of households and individuals; these capacities therefore influence spatial and housing-related risk factors that residents are exposed to every day. Connected to this housing dimension is the provision of basic services (such as water supply, sanitation and energy), which may be more or less adequate or affordable and can also have a significant impact on health. Urban conditions and transport can provide environmental services and benefits (such as recreational and green areas or mobility) but may also give rise to a range of environmental risks (such as noise or air pollution) that affect certain areas more than others and thus provide unequal environmental exposure for residents. Work settings may

also present different levels of environmental conditions and risk exposures according to the type of occupation. Finally, focusing on injury risks, inequalities appear both in setting-specific (such as occupational or transport-related) injuries and those occurring across settings (such as falls or poisonings).

For any of these environmental conditions and health risks, exposure levels can vary substantially and translate into marked environmental inequalities, often correlated with socioeconomic status and other forms of social or demographic disadvantage. The combination of various forms of environmental inequality with other adverse health pressures, typically affecting disadvantaged people through multiple mechanisms, can thus potentially create an “environmental underclass” – in conflict with social and environmental policy frameworks calling for equal conditions and equal opportunities for all. Such environmental health inequalities occur in all countries in the WHO European Region, posing a triple challenge: reduction of social inequalities, mitigation of environmental inequalities and prevention of health inequalities. The interconnectedness of these challenges, however, offers opportunities to achieve multiple benefits through environmental or social interventions, especially as a single intervention can have an impact on more than one dimension of inequality.

## 1.1 Equity as a key challenge for the WHO European Region

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Health equity and the provision of adequate health conditions for all has always been a mandate and priority for WHO, as stipulated in the WHO Constitution, which states that “enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition” (WHO, 1946). Nevertheless, inequalities in health remain a challenge, and the unequal distribution of health determinants has been identified as a priority for health and well-being, as well as a requirement for sustainable development and social cohesion. The 2008 final report of the WHO Commission on Social Determinants of Health presented strong

evidence on health inequalities at the global scale and showed how the conditions in which people live can affect the risk of ill health and premature death (CSDH, 2008). Acknowledging the relevance of social justice and health equity, Health 2020, WHO’s European policy framework for health and well-being, was established in 2012. This includes the strategic objective of improving health for all and reducing health inequalities (WHO Regional Office for Europe, 2019a).

Leaving no one behind is the key theme of the United Nations 2030 Agenda for Sustainable Development, which aims to connect social and environmental dimensions of sustainability,

and commits to the reduction of inequalities on a global scale as well as in countries and at the local level (United Nations, 2019). This is a key framework for action on equity and addresses a wide range of basic conditions for a healthy life. The lack of fulfilment of the Sustainable Development Goals (SDGs) has direct and indirect consequences for health and well-being, through both social disadvantage (such as poverty, lack of decent employment, low levels of education and gender inequality) and environmental problems (such as lack of access to water and sanitation, climate impacts, urban and housing conditions and pollution levels). Clearly, full implementation of all SDGs is necessary to achieve SDG 3, which calls

for health and well-being for all as precondition for sustainable development.

The WHO Regional Office for Europe has intensified its efforts to promote health equity, given the relevance of equity for health and well-being, and the relevance of healthy societies for sustainable development. Health equity is increasingly understood as a facilitator of development for the Region, creating the conditions for all people to prosper and flourish in health and in life. The opportunities associated with health equity, and the key policy areas for equity action, will be presented in the first WHO European Health Equity Status Report (WHO Regional Office for Europe, forthcoming).

## 1.2 Inequalities in environmental health – a cross-cutting agenda for the Region

The burden of disease of environmental conditions is not equally distributed, as certain population groups – in most cases those with some form of disadvantage – have higher levels of risk exposure and are therefore likely to suffer from a higher share of the associated health outcomes. Environmental inequalities are therefore a direct contributor to health inequalities, and the provision of safe and adequate environments for all could significantly reduce the disparities in health currently observed. This is especially important in places where overall progress is observed for both health status and environmental conditions but does not benefit all population groups equally.

Acknowledging the increasing relevance of unequal distribution of environmental risks, environmental health inequalities have been recognized as a cross-cutting challenge for the European Environment and Health Process, as highlighted at the 2010 and 2017 Ministerial Conferences on Environment and Health. In the conference declarations, Member States stressed the need to address environmental justice, and committed to:

- act on socioeconomic and gender inequalities in environment and health and tackle health risks to children and other vulnerable groups posed by poor environmental, working and living conditions (WHO Regional Office for Europe, 2010); and

- consider equity and social inclusion in environmental and health policies and prevent inequalities related to environmental pollution and degradation (WHO Regional Office for Europe, 2017a).

These commitments provide a mandate for WHO to address environmental inequalities and reduce health inequality through environmental action; they call for cross-cutting and intersectoral approaches, as inequalities occur across all environmental domains. To provide an initial overview of the status of environmental health inequalities in the WHO European Region, a baseline assessment report (WHO Regional Office for Europe, 2012) was published as a follow-up to the Fifth Ministerial Conference on Environment and Health of 2010. This compiled statistical data to describe and quantify the magnitude of inequalities in environmental risk and in injuries, and established the first systematic assessment of environmental health inequalities within countries in the Region. Two years after the Sixth Ministerial Conference on Environment and Health, this second assessment report aims to update the 2012 report, providing recent data and insights into the current presence and magnitude of environmental health inequalities. In doing so, this report also takes up the Conference theme – “Better Health. Better Environments. Sustainable Choices” – acknowledging that better environments are yet to be achieved for the most disadvantaged in society, and that better health and sustainable choices can only be realized when fundamental requirements such as adequate environmental conditions and access to basic services are implemented for all.



## 1.3 Benefits of environmental health inequality assessments for action

Action to tackle inequalities needs to be informed by evidence on the population groups most affected and disadvantaged by the unequal distribution of environmental risks and opportunities. High-quality evidence on the magnitude of such inequalities and adequate identification of the specific target groups can therefore help to make interventions more effective. Table 1 indicates the potential benefits of using evidence on environmental health inequalities for policy action and interventions, suggesting that such actions can be taken in various sectors, focusing on societal structures and processes, universal environmental policies, targeted interventions, social welfare measures, urban planning and increased intersectoral collaboration.

Since transformation of the societal structures and social exclusion that cause environmental disadvantage may be a long-term objective, reduction of environmental health inequalities specifically requires short-term interventions to reduce the exposure levels of the most affected population subgroups. In this context, Table 1 indicates that in many cases the decision will be

between two separate approaches: interventions ensuring environmental conditions for all or targeted interventions tackling environmental conditions specific to most affected population groups or geographical areas. Although both approaches can often be combined to achieve the best outcome (Dahlgren and Whitehead, 2006; Carey, Crammond & De Leeuw, 2015), either the universal or the targeted approach can be justified according to the relevant inequality situation.

Inequality assessments are essential to inform the decision-making process and provide guidance on the most appropriate way forward, which can be identified based on the findings. When inequalities are not strong and also affect a relevant proportion of the “advantaged” population, universal actions may be most appropriate. Conversely, targeted measures may be the first choice when disadvantaged subgroups have a marked increase in environmental risk exposure that distinguishes them from all others and/or more advantaged subgroups have none or very little of that exposure.

**Table 1.** Benefits of environmental inequality data for effective action

Inequality evidence	Policy actions
Evidence on societal structures and mechanisms leading to environmental inequalities	<ul style="list-style-type: none"> <li>• Review and learn from examples of good/equitable societal practices.</li> <li>• Formulate equitable policy options on environmental protection.</li> <li>• Improve public participation in planning and decision-making processes affecting people’s local environment.</li> <li>• Incorporate environmental and health equity issues into economic, social and infrastructural regulations, strategies and plans.</li> </ul>
Evidence on differential exposure to environmental health risks	<ul style="list-style-type: none"> <li>• Enforce environmental standards where they are exceeded.</li> <li>• Implement appropriate interventions to improve environmental conditions for the whole population.</li> <li>• Target action on pollution hot spots and population subgroups with the highest exposures.</li> <li>• Shift attention to policies that assure environmental protection and population health.</li> <li>• Support intersectoral action and extend Health in all Policies approaches.</li> <li>• Review the equity impacts of regulations directly or indirectly affecting environmental conditions (such as urban and infrastructure planning, taxation and social welfare) and their implementation.</li> </ul>
Evidence on differential vulnerability to environmental health risks	<ul style="list-style-type: none"> <li>• Ensure that adequate environmental and infrastructural services and conditions are accessible for all.</li> <li>• Provide environmental resources and social benefits to compensate for the influence of environmental risks or social stressors.</li> <li>• Increase targeted protection measures in areas or settings with a high density of vulnerable, sensitive or disproportionately affected populations.</li> <li>• Improve environmental standards in the vicinity of child care centres, schools, hospitals, nursing homes and similar.</li> </ul>

Source: based on WHO Regional Office for Europe (2012).

## 1.4 Health impact of environmental inequalities

Environmental conditions have a strong impact on health and well-being. Studies have estimated that air pollution, for example, causes nearly 500 000 deaths in the WHO European Region each year, while inadequate housing conditions cause more than 100 000 deaths and significant morbidity (WHO Regional Office for Europe, 2018a; 2011). At least 1 million healthy years of life are lost every year from traffic-related environmental noise in western Europe alone, and inadequate water, sanitation and hygiene conditions cause 14 diarrhoea deaths each day within the Region (WHO Regional Office for Europe, 2018b; 2019b). Injuries, which often have an environmental component, caused around 400 000 deaths in the Region in 2015 (WHO Regional Office for Europe, 2017b).

Differences in exposure to environmental risks contribute not only to environmental injustice but also to health inequalities. The magnitude of health impacts caused by environmental inequalities is difficult to quantify, however, as it requires detailed information on specific population groups, their different levels of risk exposure and health outcomes. In addition, information is needed to adjust for confounding factors that may influence the relationships between personal characteristics, exposure and health outcome.

The environmental inequality indicators presented in this assessment report have been confirmed as health risks in a large number of studies, which show that a lack of provision (such as energy or

water supply) or inadequate conditions (such as low-quality housing or environmental pollution levels) are likely to cause impacts on physical and mental health. In the available databases used for this report, however, health information is often missing or, when available, affected by methodological limitations (such as self-reported health data or health outcomes that are not specific to the relevant environmental risk). For injury-related inequalities, the opposite applies, as the available data are restricted to demographic information on the person suffering the injury, while data on the socioeconomic or environmental context of the injuries are scarce. The inequalities described in this report are therefore based on reporting of environmental exposure differences or injury outcomes, but cannot provide an assessment of the health impacts associated with different levels of environmental or injury risk.

Box 1 lists selected studies and reports that have compiled the necessary data to identify the health consequences of environmental inequalities, showing how different levels of environmental risk exposure can translate into variation in health outcomes. Although this report cannot reliably calculate the health impacts of the documented exposure differences, policy-makers should note that environmental inequalities are likely to increase health inequalities within the population, and that environmental mitigation and protection measures can therefore be a very effective tool for promotion of public health and reduction of health inequalities.

### Box 1. Examples of health impacts of environmental inequalities

- Differences in living conditions explain 29% of the inequalities in self-reported health in European Union (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. 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, forthcoming).
- A study in the United Kingdom showed that income deprivation-related inequality in circulatory disease mortality was lower among populations who live 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 than the least deprived, while in the greenest areas the most deprived population had only 1.5 times higher incidence rates – suggesting a compensating and health-promoting effect of green spaces (Mitchell & Popham, 2008).
- In a study from the Basque Country autonomous community 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 with difficulties paying for housing expenses than in those without financial problems. Among households reporting indoor cold, prevalence of diagnosed cold or throat illness was higher (45%) for households challenged by housing costs than for those with no financial problems (36%). This indicates that health impacts of energy deprivation are more pronounced for less affluent households (WHO Regional Office for Europe, 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 materially deprived. Deprivation thereby showed the highest association with injury prevalence, followed by being single (odds ratio 1.5:1) and higher alcohol consumption (odds ratio 1.4:1) (Vikhireva et al., 2009).
- Researchers in the United Kingdom found that multiple environmental deprivation is associated with income deprivation but also 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 with all others across the country (Pearce et al., 2010).

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# 2. Objective and overview of the report

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**Matthias Braubach, Marco Martuzzi**

## 2.1 Report objective and target audience

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This second assessment report on environmental health inequalities in Europe aims to establish an evidence base across the WHO European Region by:

- quantifying the magnitude of environmental health inequalities within countries in the Region, using international databases;
- assessing the trends of inequalities in environmental risk exposure or injury outcomes over time by comparing current evidence with the data from the first environmental health inequalities report (WHO Regional Office for Europe, 2012); and
- identifying the most significant inequalities and the most affected population groups for follow-up at the national or local level.

The report addresses national and local decision-makers in various sectors, reflecting the nature and origin of environmental inequalities and their impact on health and social cohesion. The information is of relevance for actors and stakeholders in public health, environmental planning and regulation, urban planning and social

welfare services. This report may also provide valuable information for health experts, civil society organizations and researchers.

The report's findings will help to improve understanding of the importance of environmental disparities for health and health equity, and their overall impact on social cohesion and societal stability and sustainability. Evidence on the magnitude and occurrence of environmental health inequalities will support policy-makers and enable informed decision-making to identify and protect those who already carry a disproportionate burden of environmental risk.

Before action can be taken, however, the inequalities described should be further analysed, using more detailed data from national sources, and interpreted and evaluated within the national context – especially as full equity in environmental conditions will be rare, and not every observed difference will require action. Such national follow-up would identify whether the inequalities identified represent disparities due to variability, or unfair and avoidable inequities that need to be addressed.

## 2.2 Background information

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This report is the result of a two-year project coordinated by the WHO European Centre for Environment and Health in Bonn, Germany, which brought together a wide range of experts from various European countries in two expert meetings and one editorial review meeting. The project included two work packages – one focused on compilation and analysis of statistical data to assess environmental inequalities based on inequality indicators; the other focused on a systematic review of published academic papers on environmental health inequalities. Both work packages are outlined in more detail below.

### 2.2.1 Compilation and analysis of statistical data for the indicators

This assessment report is based on data from international databases. A requirement for the choice of data was that they had to enable stratification by socioeconomic, demographic or spatial determinants to identify differences in environmental exposure or injury outcome between population subgroups within the same country. To ensure comparability with the baseline assessment report, the same indicator methodology was applied as far as possible. For some indicators, however, changes in

methodology and indicator calculation were necessary. In addition, this second assessment report includes some new indicators not covered in the 2012 report. Details of the indicator sources and calculation methods are provided in Annex 1.

The data were compiled centrally by WHO in early 2018 and transferred into figures and tables, which were reviewed and used by the authors of the individual indicator sections. Based on a comparison of data from the 2012 baseline assessment report (which presented data from reporting years 2006–2009) with the most recent data available at the time of compilation (mostly from 2016), trends and changes in environmental health inequalities were calculated for the different inequality indicators. Information on changes over recent years was also used to develop country profiles, showing the increase or decrease in environmental health inequalities for each country. These profiles will be made available as a supplement to the second assessment report via the report website (WHO Regional Office for Europe, 2019).

## 2.2.2 Systematic review of academic research on environmental health inequalities

Evidence on environmental health and injury inequalities published in scientific journals was also reviewed. In practice, the review was an update of *Environment and health risks: a review of the influence and effects of social inequalities*, published as a background document to the Fifth Ministerial Conference on Environment and Health in 2010 (WHO Regional Office for Europe, 2010).

The review was carried out by a network of academic researchers, based on an aligned search strategy using three journal databases (PubMed, SCOPUS and Web of Science). Papers published in 2010 and later were eligible for inclusion. Four systematic reviews have been published as open access papers in the topical collection “Achieving environmental health equity: great expectations” of the *International Journal of Environmental Research and Public Health*; two further reviews are forthcoming. Table 2 shows the review topics, lead authors and publication status. Short summaries of the papers are provided in Annex 2.

**Table 2.** Publication status of systematic reviews

Inequality topic	Lead author	Affiliation	Publication status
Noise exposure	Stefanie Dreger	University of Bremen, Germany	Published
Environmental resources (green and blue space)	Steffen Schüle	University of Bremen, Germany	Published
Injuries	Mathilde Sengoelge	Karolinska Institutet, Sweden	Published
Contaminated sites	Roberto Pasetto	National Institute of Health, Italy	Published
Air pollution	Jon Fairburn	Staffordshire University, United Kingdom	In preparation
Chemicals	Gabriele Bolte	University of Bremen, Germany	In preparation

## 2.3 Content and coverage of the report

### 2.3.1 Environmental health inequality indicators

This second assessment report on environmental health inequalities covers 19 indicators, reflecting the status of inequalities in five domains: housing, basic services, urban environments and transport, work settings and injuries. It includes new inequality indicators on access to basic sanitation services, energy poverty, air pollution, chemical exposure and contaminated sites not present in the 2012 baseline assessment report. Specific emphasis was placed on water and sanitation

and air pollution, reflecting environmental health priorities. These sections benefit from the availability of recent international survey data, although some restrictions exist on availability of data for all countries and reporting of inequalities at an individual level.

Table 3 presents an overview of all 19 environmental health inequality indicators, with the stratifications used to report the inequalities, reporting years and data sources.

**Table 3.** Overview of environmental health inequality indicators

Indicator	Stratification	Reporting year	Source
<b>Housing-related inequalities</b>			
Lack of a flush toilet	Income quintiles, poverty status and household type	2016	Eurostat
Lack of a bath or shower	Income quintiles, poverty status and household type	2016	Eurostat
Overcrowding	Income quintiles and household type	2016	Eurostat
Dampness in the home	Income quintiles and household type	2016	Eurostat
Inability to keep the home adequately warm	Income quintiles, poverty status and household type	2016	Eurostat
Inability to keep the home adequately cool in summer	Income quintiles and degree of urbanization	2012	Eurostat
<b>Basic service inequalities</b>			
Lack of access to basic drinking-water services	Urban-rural residence and wealth quintiles	2015	WHO and United Nations/Children's Fund (UNICEF) Joint Monitoring Programme (JMP)
Lack of access to basic sanitation services	Urban-rural residence and wealth quintiles	2015	WHO and UNICEF JMP
Energy poverty	Urban-rural residence, wealth quintiles, income quintiles and poverty status	2016 and various years	Eurostat and UNICEF
<b>Inequalities related to urban environments and transport</b>			
Exposure to air pollution	Regional income level, regional education level and urban-rural location	various years	European Environment Agency (EEA) and WHO
Self-reported noise annoyance	Income quintiles, poverty status and urban-rural location	2016	Eurostat
Fatal road traffic/transport injuries	Age, sex and national income level	various years	WHO
Lack of access to recreational or green areas	Income quartile, difficulty paying bills, sex and education level	2016	Eurofound
Chemical exposure	Education level	2011-12	DEMOCOPHES project
Contaminated sites (national example)	Area deprivation	2001	National census
<b>Work-related inequalities</b>			
Work-related injuries and mortality	Age, sex, migrant status and economic activity	2013-2016 and various years	Eurostat and International Labour Organization (ILO)
Risks in working environments	Age and sex	2013 and 2014	Eurostat
<b>Injury-related inequalities</b>			
Fatal poisoning	Age, sex and national income level	various years	WHO
Fatal falls	Age, sex and national income level	various years	WHO

Table 3 shows that many of the inequality indicators rely on data compiled through surveys and monitoring projects coordinated by the EU, reflecting a lack of data for most non-EU countries for these indicators. Indicators that rely on surveys and databases coordinated by the United Nations are available for all or almost all countries in the WHO European Region. As no national data sources were used for this Region-wide assessment, it is possible that some data

available at the national scale are not reflected in the report.

### 2.3.2 Country groupings into subregions

All indicator data are provided as intracountry data, showing inequalities in environmental exposure and injury outcomes within countries. They are also provided at subregional levels to categorize the data by four geographical subregions within the WHO European Region (see Table 4).

**Table 4.** Countries included in the four subregions

Subregion	Country coverage	Countries included
Euro 1 (21 countries)	All countries belonging to the EU before May 2004 and western European countries on comparable developmental level (such as Norway and Switzerland)	EU countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom Non-EU countries: Andorra, Iceland, Monaco, Norway, San Marino, Switzerland
Euro 2 (13 countries)	All countries joining the EU after May 2004	Bulgaria, Croatia, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia
Euro 3 (12 countries)	All countries belonging to the former Soviet Union (except the Baltic states)	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan
Euro 4 (7 countries)	All countries in the south-east of the WHO European Region including the Balkans, Turkey and Israel	Albania, Bosnia and Herzegovina, Israel, Montenegro, Serbia, North Macedonia, Turkey

### 2.3.4 Coverage of inequality dimensions

Inequalities can be quantified as absolute and relative inequality dimensions; both are important for an accurate assessment. For example, the absolute inequality between two population groups may be 10% between poor households with an exposure rate of 15% and rich households with an exposure rate of 5%. In this case, the relative inequality would be represented by a ratio of 3:1. When the exposure rate is 12% for poor households and 2% for rich households, however, the same absolute inequality of 10% is valid but the relative inequality doubles to a ratio of 6:1, showing a much stronger relative inequality between household types. This assessment report therefore aims to present both the absolute and relative inequality dimensions to provide a better understanding of the magnitude of inequalities. The ratios are labelled accordingly, showing, for example, income ratios (inequalities between

lowest and highest income groups) and sex ratios (inequalities between females and males), which are added to the figures as a second y-axis with a separate scale and legend.

Owing to the available data on environmental health inequalities, this report is limited to assessing differentials in environmental risk exposure or injury outcome. Unfortunately, no data could be compiled to enable an assessment of the vulnerability differential, which is very important as vulnerable groups can react more strongly to environmental conditions and develop more severe health impacts. Vulnerable groups include children, elderly people, pregnant women and people with pre-existing health limitations, among others. Similarly, socially disadvantaged population subgroups may be more vulnerable due to, for example, psychosocial stress or fewer resources to cope with an environmental burden.

## 2.4 Report structure

Chapters 3–7 of this report present detailed data on intracountry environmental health inequalities, categorized into five main functional or setting-based domains:

- Chapter 3: housing-related inequalities;
- Chapter 4: inequalities related to basic services;
- Chapter 5: urban environment and transport inequalities;
- Chapter 6: inequalities related to work settings;
- Chapter 7: injury-related inequalities.

Chapter 8 presents an overview for the WHO European Region of the changes and trends in environmental health inequalities, showing the environmental health inequalities that have tended to decline or increase in most countries in the Region in recent years.

Finally, Chapter 9 offers conclusions on the current state of environmental health inequalities in the Region, clustered around a set of 10 key messages.



The annexes include a detailed methodology section (Annex 1) and short summaries of the published systematic reviews (Annex 2).

As a supplement to the second assessment report, country profiles on environmental health inequalities will be made available via the report website (WHO Regional Office for Europe, 2019).

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### 3. Housing inequalities

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Shelter and housing are basic human rights and foundations for health and well-being. Housing conditions affect everyone and provide the physical and social settings where individuals and families spend most of their time.

Adequate housing conditions are especially relevant for vulnerable population groups that already suffer from health problems and diseases, and therefore need a safe and healthy place to live that does not provide further stress and health risks. The same applies to children and elderly people, who may not have the capacities to cope with inadequate housing conditions.

At the same time, housing is often a challenge for households with social disadvantages which, owing to lower financial resources, often live in a country's low-quality housing segment. This may be associated with less adequate living conditions in terms of building quality, equipment and amenities, thermal efficiency and floor space.

Housing conditions and exposure to housing-specific health risks are not only high priorities

for public health; they are also high priorities for health equity and environmental justice because of their profound impact on people's everyday lives. This section provides an overview of health-relevant inequalities in housing conditions, focusing on the physical features and performance of the residential dwelling, through five indicators:

- inequalities in lack of a flush toilet in the dwelling;
- inequalities in lack of a bath or shower in the dwelling;
- inequalities in overcrowding;
- inequalities in dampness in the home;
- inequalities in inability to keep the home adequately warm; and
- inequalities in inability to keep the home adequately cool in summer.

Unfortunately, many of these indicators cannot be reflected for countries in the eastern part of the WHO European Region, where equity-sensitive data on housing conditions could not be identified from international databases.

## 3.1 Inequalities in lack of a flush toilet in the dwelling

Séverine Deguen, Wahida Kihal-Talantikite

### Status

Inequalities in lack of an indoor flush toilet are a particular issue among Euro 2 countries. Socioeconomically disadvantaged households are most affected.

### Trend

The social gradient observed between the low-income and high-income quintiles has decreased in recent years in Euro 2 countries but remains significant.

#### 3.1.1 Introduction and health relevance

Although the United Nations has declared that access to sanitation constitutes a basic human right, it remains a major public health issue: about 2.3 billion people worldwide do not have basic sanitation facilities (WHO, 2018). In the WHO European Region the Millennium Development Goal target 7C on sanitation was not reached, as about 62 million citizens had no access to adequate sanitation facilities – including functioning toilets and safe means to dispose of human faeces – in 2015 (WHO Regional Office for Europe, 2018).

The literature demonstrates a significant link between the proportion of the population with inadequate sanitation and hygiene (as well as drinking-water) and the income level of the country: low-income countries are more frequently affected by this issue (Prüss-Ustün et al., 2014).

Beyond socioeconomic inequalities, the burden of inadequate sanitation disproportionately affects the most vulnerable populations, such as children. A recent pooled analysis revealed an increased prevalence of diarrhoea among children aged under 5 years who share toilet facilities (Fuller et al., 2014). More precisely, focusing on a few eastern European and eastern Mediterranean countries, the analysis showed that the prevalence ratio increased by about 20% when comparing children who share a toilet with more than five households and those who share with fewer than five households. In low- and middle-income settings, improving sanitation facilities would reduce diarrhoea morbidity by 28% (Prüss-Ustün et al., 2014).

In addition, a lack of sanitation – including a flush toilet in the dwelling – also has economic implications. A global study assessed the

impacts of health and time losses associated with inadequate sanitation and valued the costs in low- and middle-income countries at 1.5% of gross domestic product (WHO, 2012).

Little research has investigated in depth the socioeconomic inequalities of access to a flush toilet in the dwelling in the WHO European Region. Nevertheless, a recent analysis of data on the social determinants of health collected by the European Social Survey considered lack of an indoor flush toilet as one of seven variables characterizing housing quality (Huijts et al., 2017). It found that prevalence of problems with housing (including lack of a flush toilet in the dwelling) is higher for women than men and revealed wide geographical variation in such prevalence, from around 8–9% for Switzerland and Ireland to more than 20% in France and Spain.

#### 3.1.2 Indicator analysis: inequalities by poverty level, household type and income level

Data on the presence of flush toilets inside dwellings are available from the Eurostat Statistics on Income and Living Conditions (EU-SILC) survey, which includes some western European and Balkan non-EU countries (Eurostat, 2018). For countries not covered by EU-SILC, no equity-sensitive data were identified.

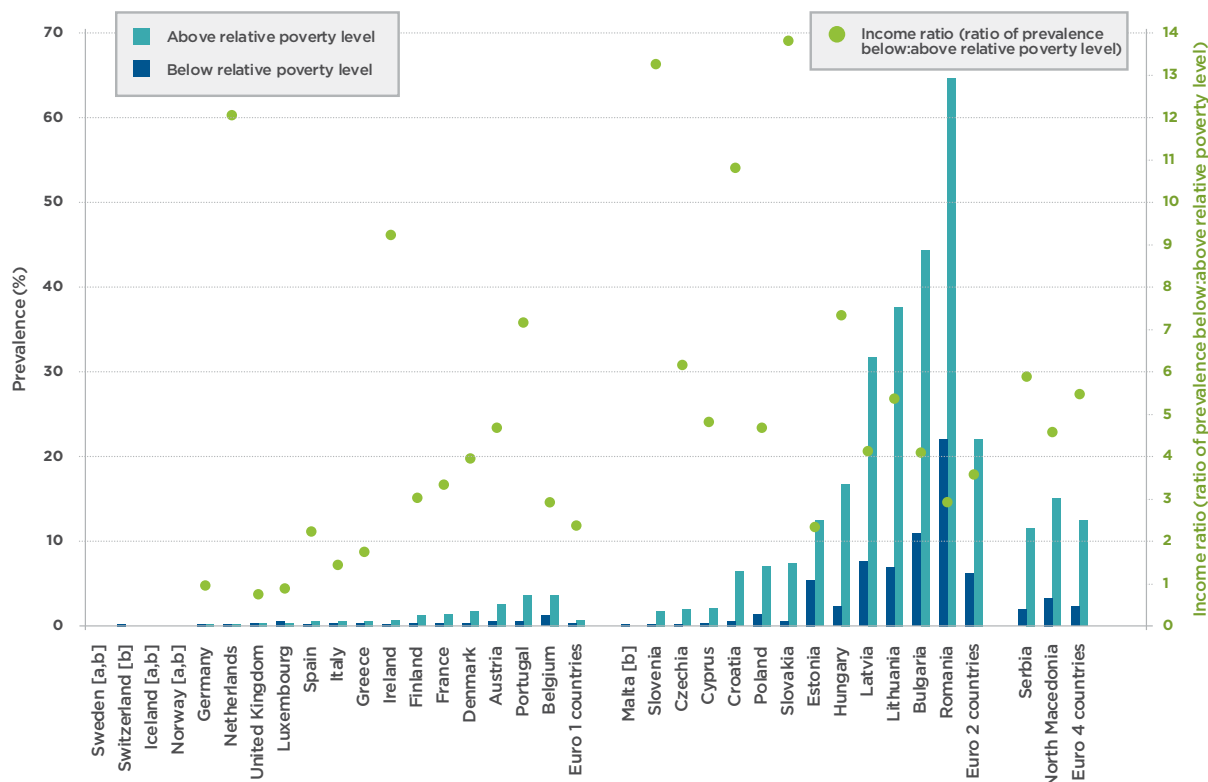
Fig. 1 shows the prevalence of lack of a flush toilet in the dwelling, stratified by poverty level. Lack of a flush toilet at home is not a major issue for Euro 1 countries, where the average prevalence is less than 1% even among households below the relative poverty level. By contrast, in Euro 2 countries the prevalence is much higher and shows wider variation between countries. The highest proportions of households below the poverty

threshold lacking a flush toilet in the dwelling are observed in Bulgaria (44.1%) and Romania (64.2%).

All countries have an income ratio greater than 1 except Germany, Luxembourg and the United Kingdom. This means that the prevalence of lack of a flush toilet in the dwelling is higher among households living in relative poverty. This ratio

varies among countries from 0.8:1 for the United Kingdom to 12:1 for the Netherlands (in the Euro 1 countries) and from 2.3:1 for Estonia to 13.7:1 for Slovakia (in the Euro 2 countries). The two Euro 4 countries with reported data have ratios of 4.6:1 and 5.9:1, indicating that average inequality in this subregion could be even higher than in the others, although the data are lacking.

**Fig. 1. Prevalence of lack of a flush toilet in the dwelling by relative poverty level (2016)**



Notes: [a] full coverage with flush toilets in households above the relative poverty level; [b] full coverage with flush toilets in households below the relative poverty level.

Source: Eurostat (2018).

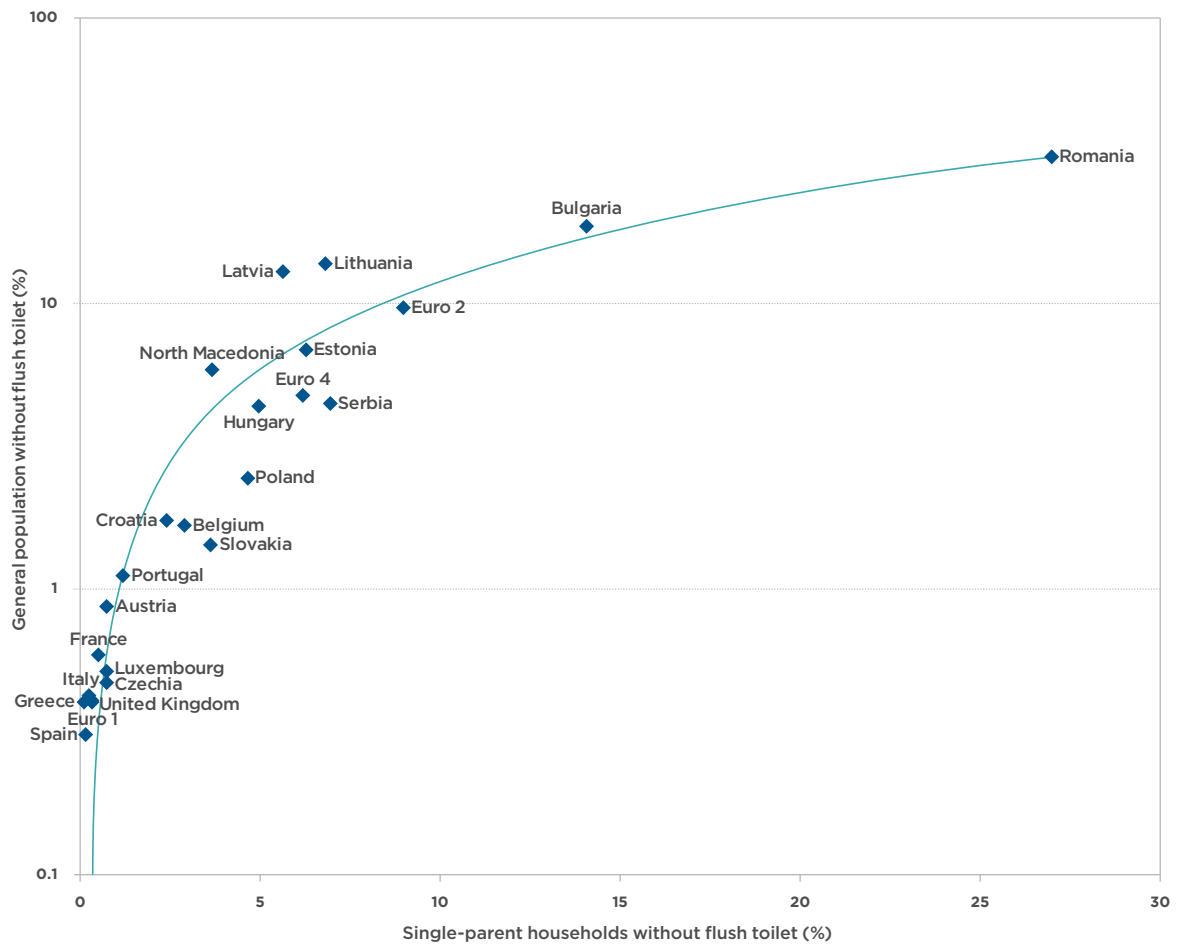
The relationship between lack of a flush toilet in the dwelling among single-parent households and among the general population was plotted on a logarithmic scale (Fig. 2). The analysis excludes countries where the entire population has a flush toilet inside the home. The linear regression quantifies the strength of the association between the lack of a flush toilet in the dwelling among single-parent households and among the general population: about 91% of the variability of one variable is explained by the second.

The regression coefficient is 0.74, revealing that, on average, the proportion of single-parent households living in a home without a flush toilet is lower than that of the general population. However, exceptions can be detected: prevalence

is higher among single-parent households than in the general population in Poland (2.5% of the general population reported lack of a flush toilet at home compared to 4.6% of single-parent households) and in Slovakia (1.4% versus 3.6%).

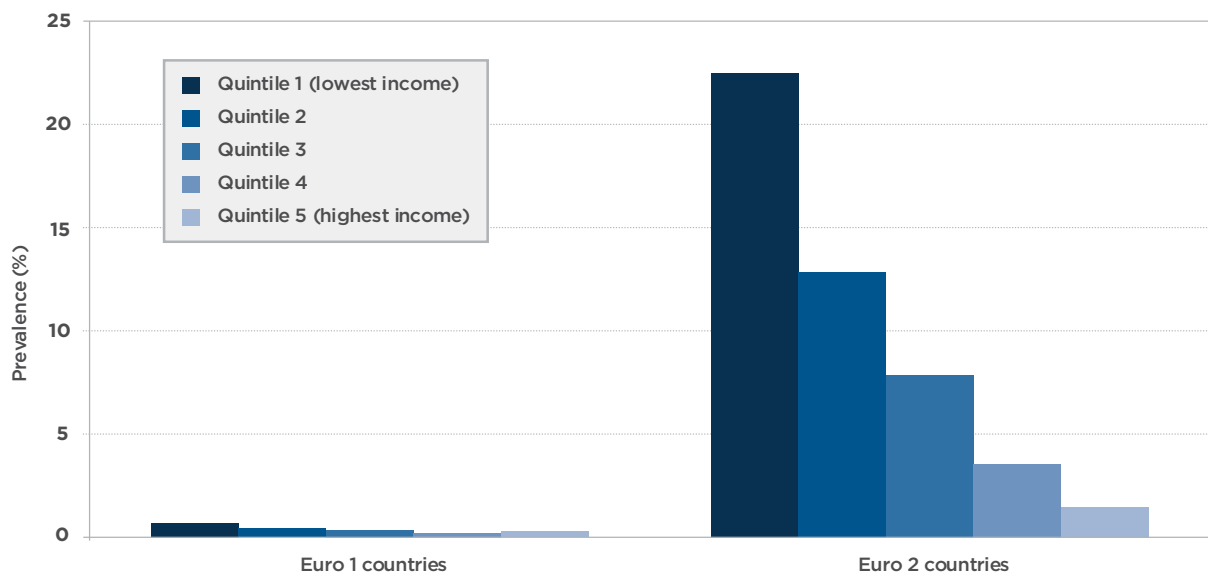
Fig. 3 shows the prevalence of lack of a flush toilet in the dwelling by income quintile and subregion. It reveals a clear social gradient among Euro 2 countries: the prevalence of lack of a flush toilet decreases from 22.51% in the lowest-income population to 1.47% in the highest-income, reflecting a relative inequity of factor 15. The prevalence of lack of a flush toilet is close to zero among Euro 1 countries in all income quintiles; although there is also a social gradient, it is expressed rather weakly (factor 3).

**Fig. 2.** Prevalence of lack of a flush toilet among single-parent households versus the general population (2016)



Source: Eurostat (2018).

**Fig. 3.** Prevalence of lack of a flush toilet in the dwelling by income quintile (2016)



Note: as data are only available for two countries in the subregion, Euro 4 averages are not displayed.  
 Source: Eurostat (2018).

### 3.1.3 Conclusions and suggestions

The data show that lack of a flush toilet in the dwelling remains an issue in many countries, especially within the Euro 2 subregion. For Euro 3 and 4 countries the lack of reporting makes it impossible to draw a conclusion, but the data reported by Serbia and North Macedonia suggest that the problem is even greater there. Socioeconomically deprived households are most affected in general, but in Euro 2 countries the analysis identified the largest inequalities between socioeconomically privileged

and disadvantaged populations. Furthermore, being a single-parent household constitutes an additional factor of vulnerability. Owing to the social inequality gradient observed, lack of a flush toilet in the dwelling is a major public health equity problem that needs to be tackled, mainly in Euro 2 countries; data are needed for the Euro 3 and 4 subregions. To improve equity in access to good sanitation conditions, therefore, targeted policies are needed that consider the socioeconomic level of the population.

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#### Suggested mitigation actions are:

- ensuring that all new residential buildings – private or public – have a flush toilet in each dwelling;
  - promoting public housing programmes that provide affordable housing (including social housing and affordable private rentals) to encourage accessibility to adequate housing for low-income populations and the most vulnerable groups;
  - providing targeted financial support for vulnerable groups (such as low-income or single-parent households) to facilitate access to affordable housing with a flush toilet;
  - ensuring rehabilitation measures for existing buildings without a flush toilet – either by making plans that provide targeted public intervention to the most vulnerable households or by offering financial support to disadvantaged populations.
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## 3.2 Inequalities in lack of a bath or shower in the dwelling

S  verine Deguen, Wahida Kihal-Talantikite

### Status

Inequalities in lack of a bath or shower are particularly prevalent among socioeconomically disadvantaged households: prevalence increases significantly among low-income and single-parent households.

### Trend

The social gradient observed between the low-income and high-income quintiles has decreased in recent years in Euro 2 countries but remains significant. Nevertheless, taking relative poverty into account greatly increases the difference between figures for single-parent households and for all households with dependent children, compared with 2009 data.

#### 3.2.1 Introduction and health relevance

At the EU level, lack of a bath or shower in the dwelling is not a big issue but appears rather as an additional characteristic of severe housing deprivation (Eurofound, 2016). More precisely, lack of a bath or shower is one of the nine items in the European Quality of Life Survey that measure the level of housing inadequacy. In 2015 about 2.4% of the EU population did not have access to basic sanitary facilities (either lacking a bath or shower or lacking an indoor flush toilet).

Despite improvement across the WHO European Region in terms of quality of indoor environments, a range of health risks remains owing to the lack of hygiene linked to the absence of adequate sanitation equipment (including lack of a bath or shower). One recent study estimated that in 2012 in Europe (low- and middle-income countries), the burden of diarrhoea linked to inadequate hand hygiene and to inadequate water, sanitation and hand hygiene amounted to 1972 and 3564 deaths, respectively (Pr  ss-Ust  n et al., 2014). In addition, a recent meta-analysis estimated that handwashing would reduce the risk of diarrhoeal disease by 23% (Freeman et al., 2014).

A lack of capacity for washing and personal hygiene is also recognized as associated with various other hand-transmitted illnesses, including pneumonia – a form of acute respiratory infection that affects the lungs, responsible in Europe for 12% of all deaths in children aged under 5 years (WHO Regional Office for Europe, 2018). A meta-analysis estimated that improvements in hand hygiene resulted in reductions of 21% in respiratory illnesses (Aiello et al., 2008). In addition, a recent study suggested that large economic gains

relating to a reduction in diarrhoea and acute respiratory infection may result from an increase in handwashing (Townsend et al., 2017).

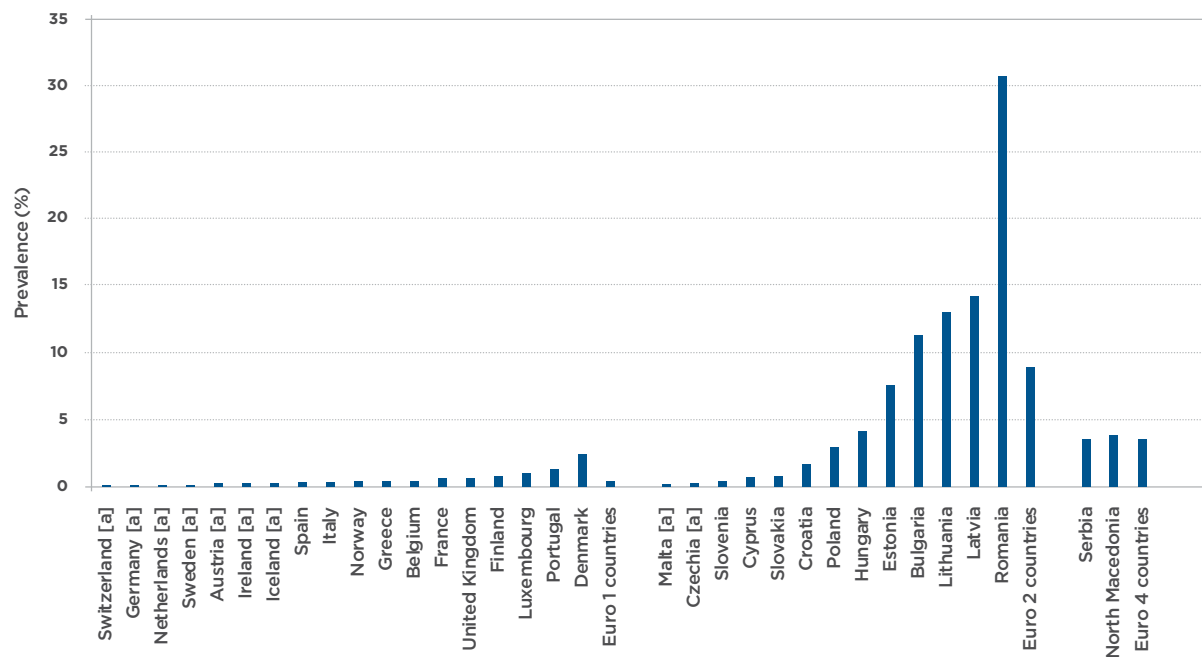
At the EU level, evidence is lacking on the relationship between socioeconomic conditions and the lack of a bath or shower. In southern European countries, however, inadequate housing is concentrated among the lowest-income households, compared to several northern and western European countries with good housing conditions (such as Denmark, Germany, the Netherlands and Sweden) (Norris & Winston, 2012).

#### 3.2.2 Indicator analysis: inequalities by country, income level and by poverty level

Data on the presence of a bath or shower inside dwellings are available from the Eurostat EU-SILC survey, which includes some western European and Balkan non-EU countries (Eurostat, 2018). For countries not covered by EU-SILC, no equity-sensitive data were identified.

Lack of a bath or shower in the dwelling is not a major issue among Euro 1 countries (Fig. 4): for the majority the average prevalence is lower than 1% and the highest is 2.4% (in Denmark). In Euro 2 countries the level is much higher, with an average prevalence of 8.8%, and large differences are observed between countries. Prevalence ranges from below 1% to 10% and above for Romania (30.5%), Latvia (14%), Lithuania (13%) and Bulgaria (11%). The two Euro 4 countries reported data of 3.5% and 3.7%, indicating that in this subregion the problem could also be significant, although the data are lacking.

**Fig. 4.** Prevalence of lack of a bath or shower in the dwelling by country (2016)



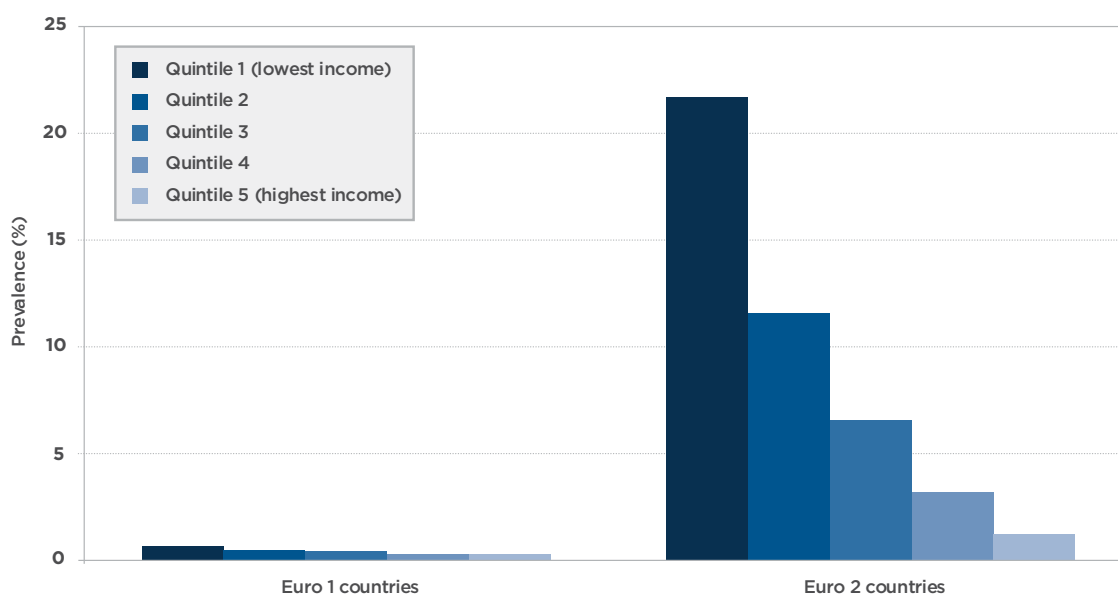
Note: [a] reported prevalence lower than 0.3%.

Source: Eurostat (2018).

Fig. 5 presents data on the prevalence of lack of a bath or shower in the dwelling by income quintile. It reveals strong inequalities in access to a bath or shower at home between the lowest and the highest income quintiles, especially among the Euro 2 countries. Here the variation shows a clear social gradient, ranging from 21.7% in the lowest

income quintile to 1.3% in the highest. Although the average prevalence of lack of a bath or shower in the dwelling is very low in the Euro 1 subregion, a social gradient is also visible there: prevalence decreases from 0.7% in the lowest income quintile to 0.3% in the highest.

**Fig. 5.** Prevalence of lack of a bath or shower in the dwelling by income quintile (2016)



Note: as data are only available for two countries in the subregion, Euro 4 averages are not displayed.

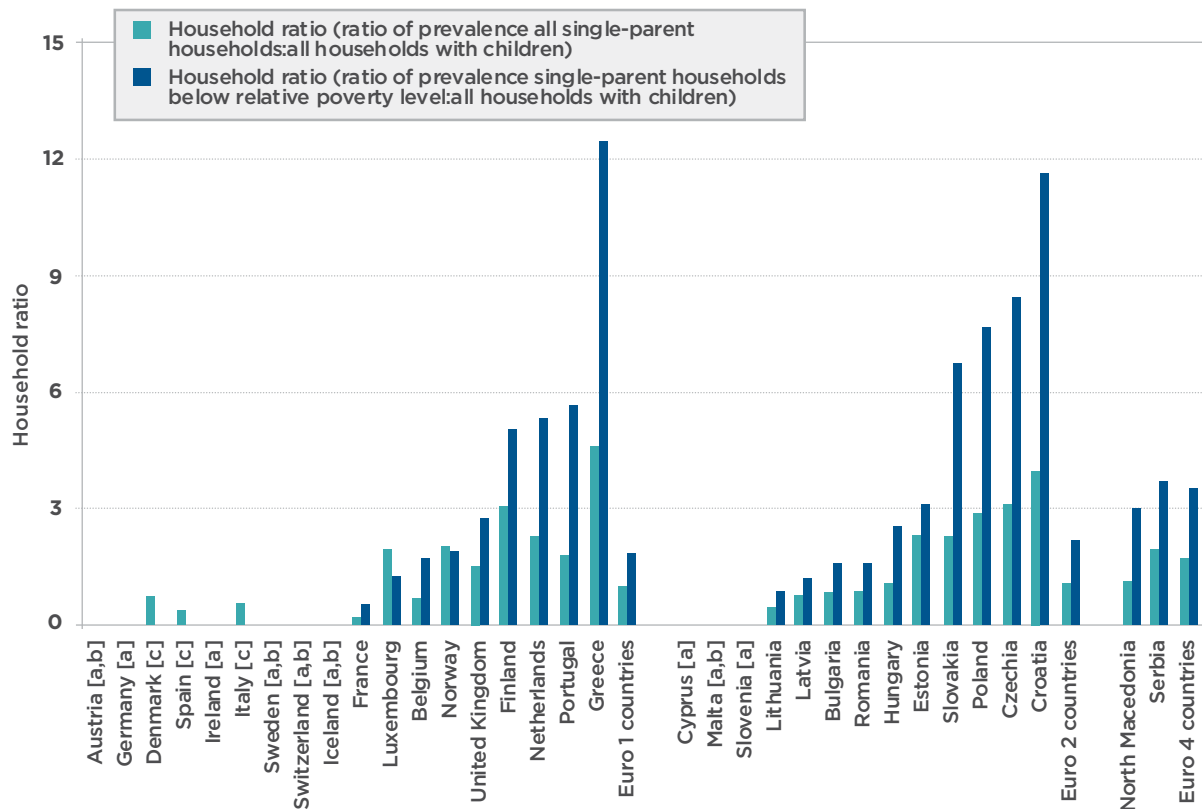
Source: Eurostat (2018).



Fig. 6 focuses on the influence of household composition and income on lack of a bath or shower for households with children. It presents data on the ratio of prevalence of lack of a bath or shower for all households with children compared to all single-parent households and to single-parent households below the poverty level. In many countries data show that single-parent households have a higher prevalence of lacking a bath or shower in dwelling compared to all households with dependent children. Across all countries, the ratio varies between 0.2:1 for France and 4.6:1 for Greece. However, the subregional averages for Euro 1 and 2 are balanced (ratios of 1.0:1) and only for Euro 4 there is an increase in lack of access (ratio of 1.7:1)

Stronger inequalities are detected in almost all countries when the poverty dimension is added. Comparing the prevalence for single-parent households in relative poverty with the prevalence for all households with children, the prevalence ratios go up everywhere, except for Luxembourg and Norway where the ratio is lower. The highest inequality is found for Greece and Croatia, where the inequality exceeds a ratio of 10:1 – indicating that poor single-parent households are more than 10 times more affected by lack of a bath or shower than all households with children. On average, the ratios roughly double when relative poverty is taken into account: from 1.0:1 to 1.8:1 in Euro 1, from 1.0:1 to 2.2:1 in Euro 2, and from 1.7:1 to 3.5:1 in Euro 4 countries, but some countries show a triple increase such as Portugal (1.8:1 to 5.6:1), Slovakia (2.3:1 to 6.8:1) or Croatia (3.9:1 to 11.6:1).

**Fig. 6.** Ratio of prevalence of lack of a bath or shower for single-parent households compared to all households, by poverty level (2016)



Notes: the category “all households with children” includes single-parent households; [a] countries reported full coverage with bath/shower for all single-parent households; [b] countries reported full coverage with bath/shower for all households with dependent children; [c] countries reported full coverage with bath/shower for single-parent households below the relative poverty level.

Source: Eurostat (2018).

### 3.2.3 Conclusions and suggestions

The data show that lack of a bath or shower in the dwelling remains an issue in many countries within the Euro 2 subregion. For the Euro 3 and 4 subregions the lack of reporting makes it impossible to draw a conclusion, but the data reported by Serbia and North Macedonia suggest that the lack of a bath or shower is also a problem. The indicator analysis identified inequalities between the most deprived and the most privileged populations living in the Euro 2 countries; single-

parent households are particularly vulnerable. Thus, reducing housing inequalities by improving home conditions could contribute to better hygiene practices and thereby reduce diseases caused by a lack of capacity for washing. Both housing conditions and the social environment need to be considered in housing policy strategies to provide homes that are affordable, of high quality and economically accessible for lower-income populations.

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#### Suggested mitigation actions are:

- ensuring that all new residential building – private or public – have a bath or shower in each dwelling;
  - promoting public housing programmes that provide affordable housing (including social housing and affordable private rentals) to encourage accessibility to adequate housing to low-income populations and the most vulnerable groups;
  - providing targeted financial support to vulnerable groups (such as low-income or single-parent households) to facilitate access to affordable housing with a bath or shower;
  - ensuring rehabilitation measures of existing buildings without a bath or shower – either by making plans that provide targeted public intervention to the most vulnerable households or by offering financial support to disadvantaged populations.
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## 3.3 Inequalities in overcrowding

S  verine Deguen, Wahida Kihal-Talantikite

### Status

Inequalities in overcrowding are a particular issue among Euro 2 countries. Socioeconomically disadvantaged – and especially single-parent – households are most affected.

### Trend

The strength of the social gradient between low-income and high-income quintiles has not changed much over recent years, although a reduction in overcrowding prevalence has been observed in Euro 2 countries.

#### 3.3.1 Introduction and health relevance

Overcrowding is defined as a condition in which the number of occupants exceeds the capacity of the dwelling space available – measured as rooms, bedrooms or floor area – resulting in adverse physical and mental health outcomes (WHO, 2018). Living in overcrowded housing or with a shortage of space is recognized in the EU to be the main characteristic of severe housing deprivation (Eurofound, 2016). A 2018 Eurostat report further highlighted variations in the distribution of overcrowding according to the degree of urbanization of EU countries: people in cities are more likely to live in overcrowded conditions than those in towns and suburbs or rural areas (17.6% versus 17.1% and 14.9%) (Eurostat, 2018a). Much less information is available on overcrowding or living space outside the EU, but a recent United Nations Economic Commission for Europe (UNECE) publication shows that floor space per person is significantly lower in countries in the Caucasus and central Asia than in EU countries – dropping from an average of over 40 m<sup>2</sup> per person in Austria and 24 m<sup>2</sup> in Poland to 18 m<sup>2</sup> in Kazakhstan, 15 m<sup>2</sup> in Uzbekistan and below 10 m<sup>2</sup> in Tajikistan (UNECE, 2015). Other data show that self-reported shortage of housing space is somewhat higher in Balkan countries (from 18% in Serbia to 43% in Albania, compared to an EU average of 17%) (Eurofound, 2018).

Overcrowding is known to have health consequences: it can affect quality of life and well-being and increase the level of stress, sleep disorders and mental health issues (WHO, 2018). The risk of infectious disease transmission also increases among people in overcrowded housing situations. A meta-analysis estimated that household overcrowding was associated with increased risk of gastroenteritis (odds ratio (OR): 1.13; 95% confidence interval (CI): 1.01–1.26) and pneumonia/lower respiratory tract infections (OR: 1.69; CI: 1.34–2.13) (Baker et al., 2013). Children are recognized to be more vulnerable to overcrowding, as it can

increase the risk of injury as well as infections such as tuberculosis and meningitis (NCB, 2016).

#### 3.3.2 Indicator analysis: inequalities by household type and income level

Overcrowding data are available from the Eurostat EU-SILC survey, which includes some western European and Balkan non-EU countries (Eurostat, 2018b). Within the survey, overcrowding is defined as relating to a household that does not have at its disposal a minimum number of rooms equal to:

- one room for the household;
- one room per couple in the household;
- one room for each single person aged 18 years or more;
- one room per pair of single people of the same gender between 12 and 17 years of age;
- one room for each single person between 12 and 17 years of age and not included in the previous category;
- one room per pair of children under 12 years of age (Eurostat, 2019).

Limited data on housing space are available for some Balkan, Caucasian and central Asian countries, but they are insufficient for an assessment of inequalities.

Fig. 7 shows the prevalence of overcrowding by household type. Overcrowding remains a major issue for around 10%, 38% and 54% of all households in Euro 1, Euro 2 and Euro 4 countries, respectively. The data show, however, that households with children, and especially single-parent households,<sup>1</sup> are – across all countries – much more likely to experience overcrowding. Among Euro 1 countries,

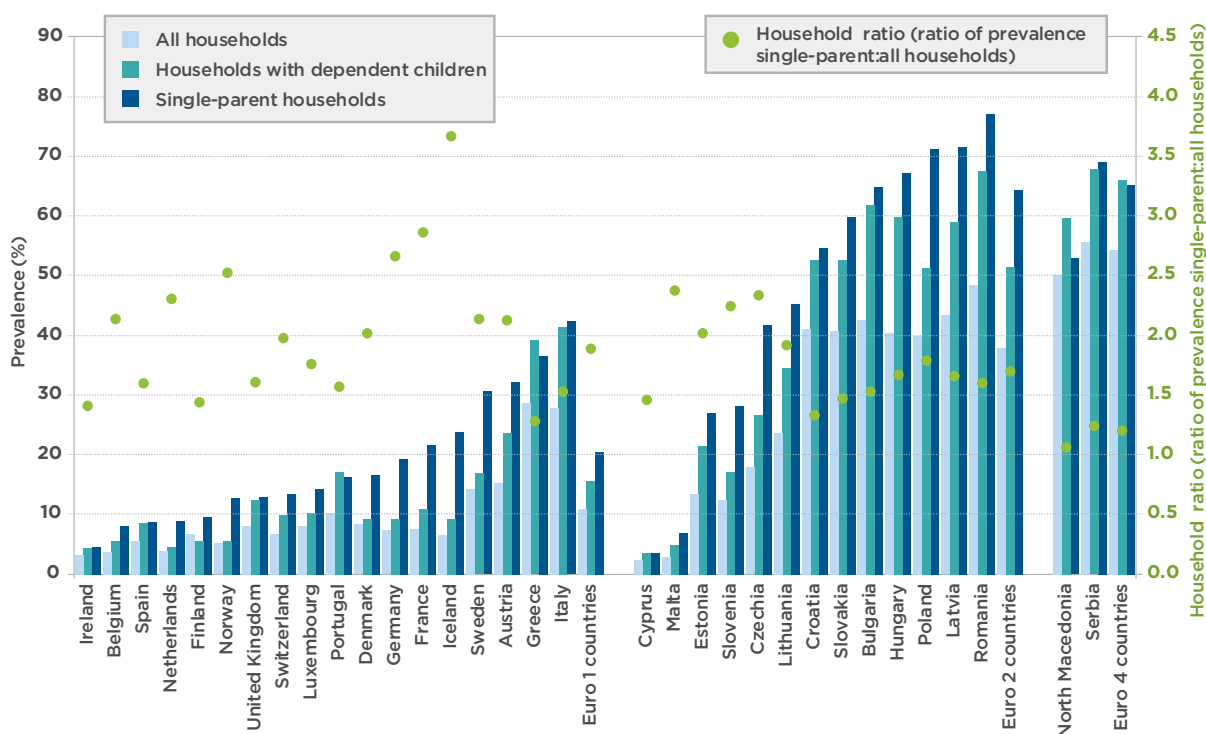
<sup>1</sup> Note that single-parent households with dependent children are predominantly headed by women, adding a gendered aspect to health risk inequalities when it comes to overcrowding.

the prevalence of living in an overcrowded house among single-parent households (20.5%) is almost double that among all households (10.8%). The lowest inequality between single-parent households and all households in Euro 1 countries is found in Greece, with a ratio of 1.3:1, while in Iceland the ratio is 3.7:1. Household inequalities are lower among Euro 2 countries, as the ratio of prevalence of overcrowding between single-parent households (64.3%) and all households (37.8%) is on average 1.7:1. Croatia has the lowest inequality ratio for these groups (1.3:1); Malta has the highest (2.4:1), despite

one of the lowest prevalence levels (6.8% among single-parent households). Lower levels of disparity exist among Euro 4 countries (ratio of 1.2:1 for these groups), but these data are from only two countries and are affected by the very high overcrowding levels (above 50%) for the total population.

It should also be noted that in three countries (Greece, North Macedonia and Portugal) the highest levels of overcrowding are found for all households with dependent children, rather than for single-parent households.

**Fig. 7. Prevalence of overcrowding by household type (2016)**

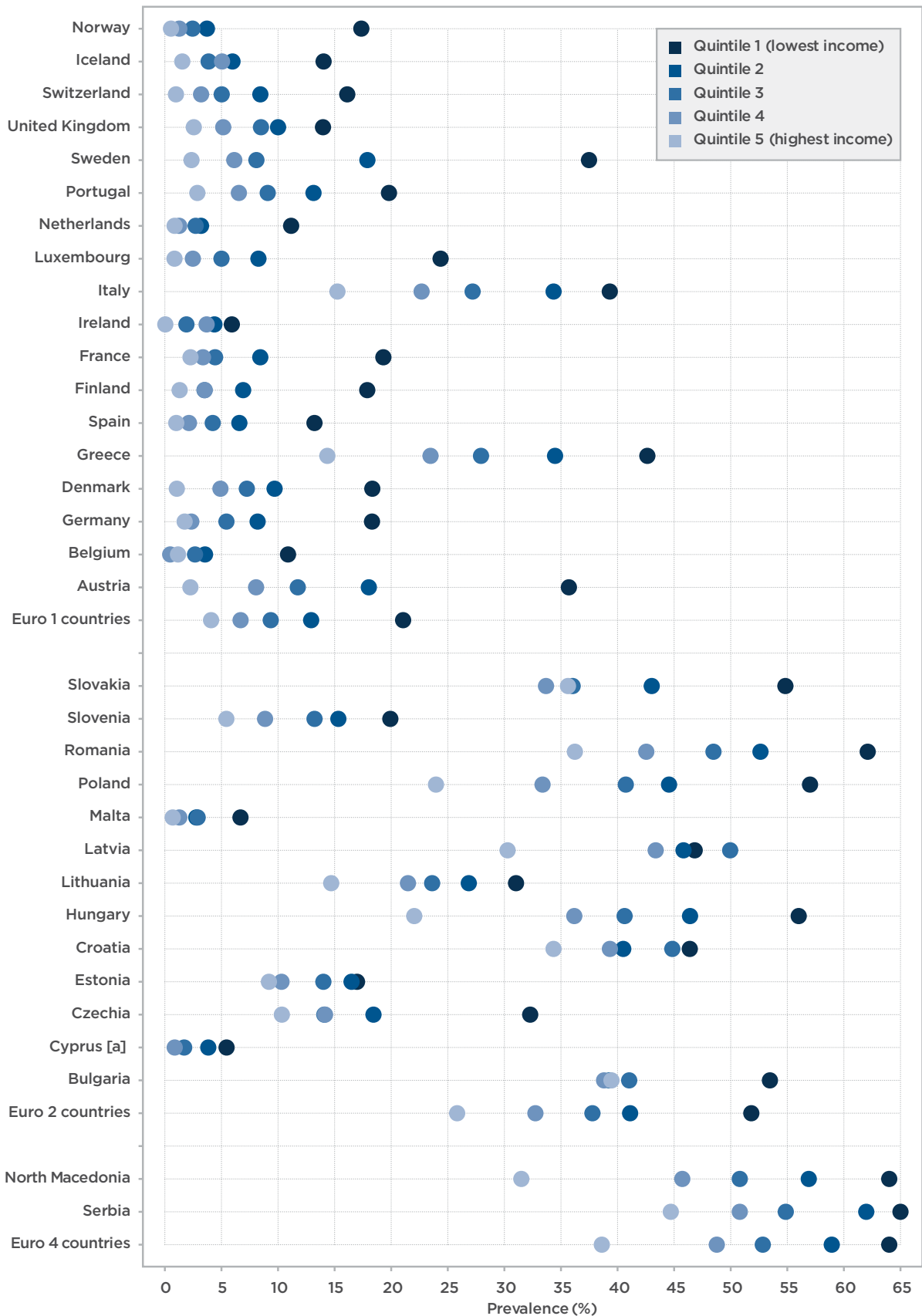


Source: Eurostat (2018b).

Fig. 8 shows the impact of income on overcrowding by country. Large variations of overcrowding prevalence by income quintile are clearly visible in almost all countries, although, on average, the relative inequality between the lowest and highest income quintiles is much stronger in Euro 1 (ratio of 5.2:1) than Euro 2 countries (ratio of 2.0:1). The inequality pattern is different, however: in most Euro 2 countries the social gradient of overcrowding is distributed across all income quintiles (with a consistent prevalence increase associated with reduction in income, as in Hungary, Lithuania and Romania). Nevertheless, the magnitude of relative inequality between the lowest and highest income quintiles differs greatly between countries (from a ratio of 1.4:1 in Bulgaria and Croatia to ratios of 3.7:1 in Slovenia and 9.6:1 in Malta). Conversely, in

Euro 1 countries the largest absolute differences often appear between the lowest quintile and the second-lowest quintile (indicating that the poorest households are by far the most disadvantaged). In many countries (including Germany, Spain and Sweden), the prevalence of overcrowding in the lowest income quintile is double than in the second-lowest income quintile. Belgium, Luxembourg and the Netherlands show a three times higher overcrowding prevalence, and in Norway the prevalence is almost 4.7 times higher in the lowest than in the second-lowest income quintile. Owing to rather low prevalence levels for the most affluent households, Euro 1 countries show some extreme inequality rates between the lowest and highest income quintiles, such as 32.0:1 in Norway, 28.6:1 in Luxembourg and 17.3:1 in Denmark.

**Fig. 8.** Prevalence of overcrowding by income quintile (2016)



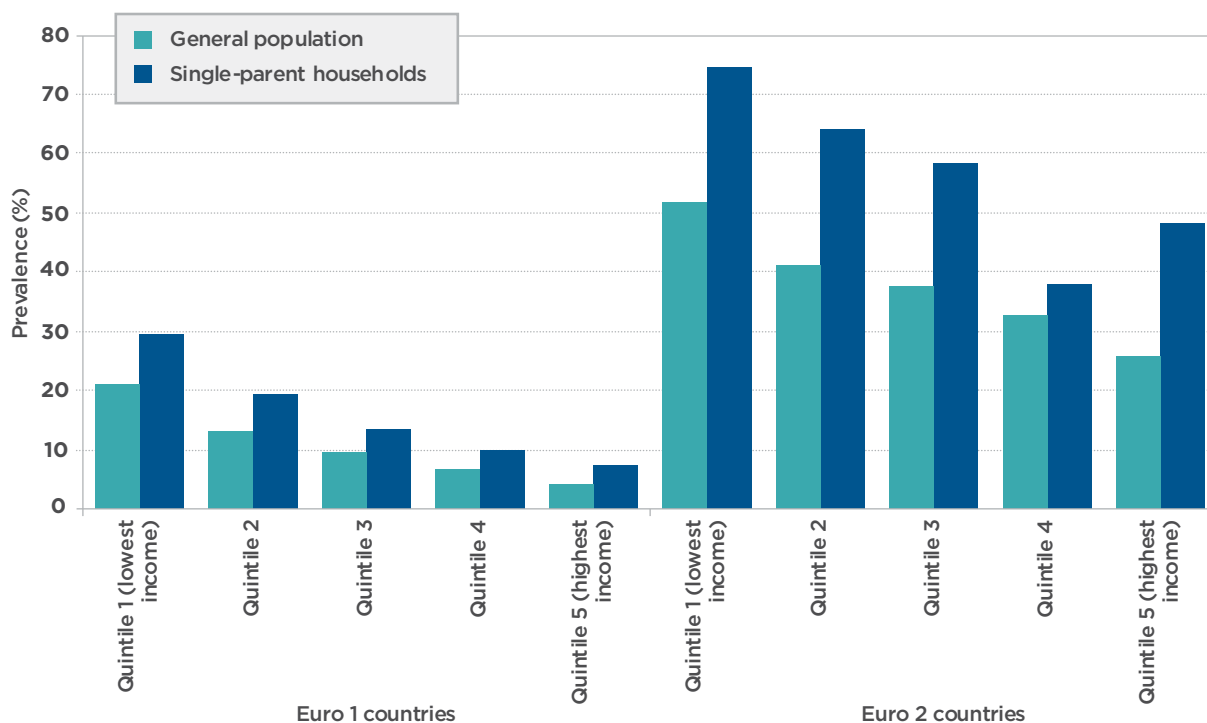
Note: [a] Cyprus reported zero overcrowding cases in the highest income quintile.

Source: Eurostat (2018b), adapted.

Fig. 9 presents the prevalence of overcrowding by income quintile for the general population and for single-parent households. In Euro 1 countries 21% of the lowest-income population is affected by overcrowding versus only 4% of the highest-income, showing a strong impact of income levels. In Euro 2 countries the prevalence decreases from 52% for the lowest quintile to 26% for the highest, indicating that overcrowding is also a challenge for many affluent households. The trend of prevalence follows an approximately linear reduction from the first to the fifth quintiles among the general population in

both subregions. A similar social gradient is found for single-parent households, although in Euro 2 countries the prevalence of overcrowding is 10% lower in the fourth than in the fifth income quintile. The data reveal that single-parent households are more affected by overcrowding across all income quintiles for both Euro 1 and Euro 2 countries: the prevalence reaches 29.6% and 74.6% among single-parent households in the poorest quintile (an inequality ratio of 1.4:1 between single-parent households and the general population in both subregions).

**Fig. 9.** Prevalence of overcrowding by income quintile and household type (2016)



Note: as data are only available for two countries in the subregion, Euro 4 averages are not displayed.

Source: Eurostat (2018b).

Overall, the data confirm that the poorest population quintile suffers the greatest exposure to overcrowding, but also that the combination of socioeconomic and demographic dimensions (such as merging income and household type) triggers extreme inequalities: in Euro 1 countries the ratio between the prevalence level of the poorest single-parent households (29.6%) and the richest quintile of the total population (4.1%) is as high as 7.2:1, while it is 2.9:1 for Euro 2 countries. For Euro 2 countries, however, the increase in overcrowding exposure ranges from 26% of the high-income population to 75% of all low-income single-parent households.

### 3.3.3 Conclusions and suggestions

The data show that overcrowding is an equity-sensitive issue in many countries, with high absolute disparities, especially within the Euro 2 countries. The indicator analysis reveals that exposure inequalities not only exist among the most deprived households but show a social gradient across all income categories; being a single-parent household further increases social vulnerability to overcrowding. Among Euro 4 countries the lack of reporting makes it impossible to draw a conclusion, but the data reported by Serbia and North Macedonia suggest that the overcrowding challenge may be even stronger in Balkan countries, although it would have to be considered more as a public health than an equity challenge.

According to the social gradient observed, living in overcrowded housing is a major public health equity problem that needs to be tackled across the WHO European Region. Data are required for Euro 3 countries as no information is available on the distribution of overcrowding or living space

by socioeconomic or demographic determinants such as income or household type. To improve housing quality and reduce housing inequalities, housing policies and strategies need to provide affordable homes, especially for lower-income population.

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### Suggested mitigation actions are:

- ensuring that all new residential buildings and housing stock when renovated – private or public – provide a minimum proportion of dwellings for large households;
  - providing targeted financial support to the most vulnerable groups (poor or single-parent households) to facilitate access to dwellings of appropriate size;
  - encouraging public housing programmes that provide dwellings with an adequate number of rooms to reduce overcrowding, especially among low-income households and other vulnerable groups.
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## 3.4 Inequalities in dampness in the home

Anja Dewitz, Kerttu Valtanen

### Status

Almost one in six households in the EU are affected by dampness in the home. The prevalence is considerably higher for low-income and single-parent households.

### Trend

In recent years the overall prevalence has decreased very slightly. In particular, exposure in Euro 2 countries has fallen. Nevertheless, inequality between income groups still exists in all countries.

#### 3.4.1 Introduction and health relevance

Dampness and associated mould growth in dwellings is a problem that affects many households in the WHO European Region. Almost one in six households in the EU are affected. Dampness is understood as “any visible, measurable or perceived outcome of excess moisture that causes problems in buildings, such as mould, leaks or material degradation” (WHO Regional Office for Europe, 2009).

The sources of dampness are diverse. In general, dampness in homes is caused by insufficient insulation, ventilation and/or heating, or by damage to the building. Mould is an outcome of prolonged dampness, causing microbial growth and contamination of indoor spaces, which can have adverse health effects including allergies, respiratory infections and asthma (Wiesmüller et al., 2017). This is particularly relevant because adults spend approximately 80% of their time indoors and almost two thirds of their time at home (Pluschke & Schleibinger, 2018; Brasche & Bischof 2005).

Moreover, indoor dampness is responsible for about 15% of new childhood asthma cases in Europe (WHO, 2017). Children living in damp homes have a higher prevalence of asthma or cough than children living in drier, undamaged houses. Dampness is often associated with poor housing conditions, which in turn are affected by various factors, such as income (Kohlhuber et al., 2006). Among other factors, low income increases the risk of fuel poverty, which can lead to cold houses and thus enhance the development of dampness and mould (Boomsma et al., 2017).

#### 3.4.2 Indicator analysis: inequalities by household type and income quintile

Data on dampness in the home are available from the Eurostat EU-SILC survey, which includes some

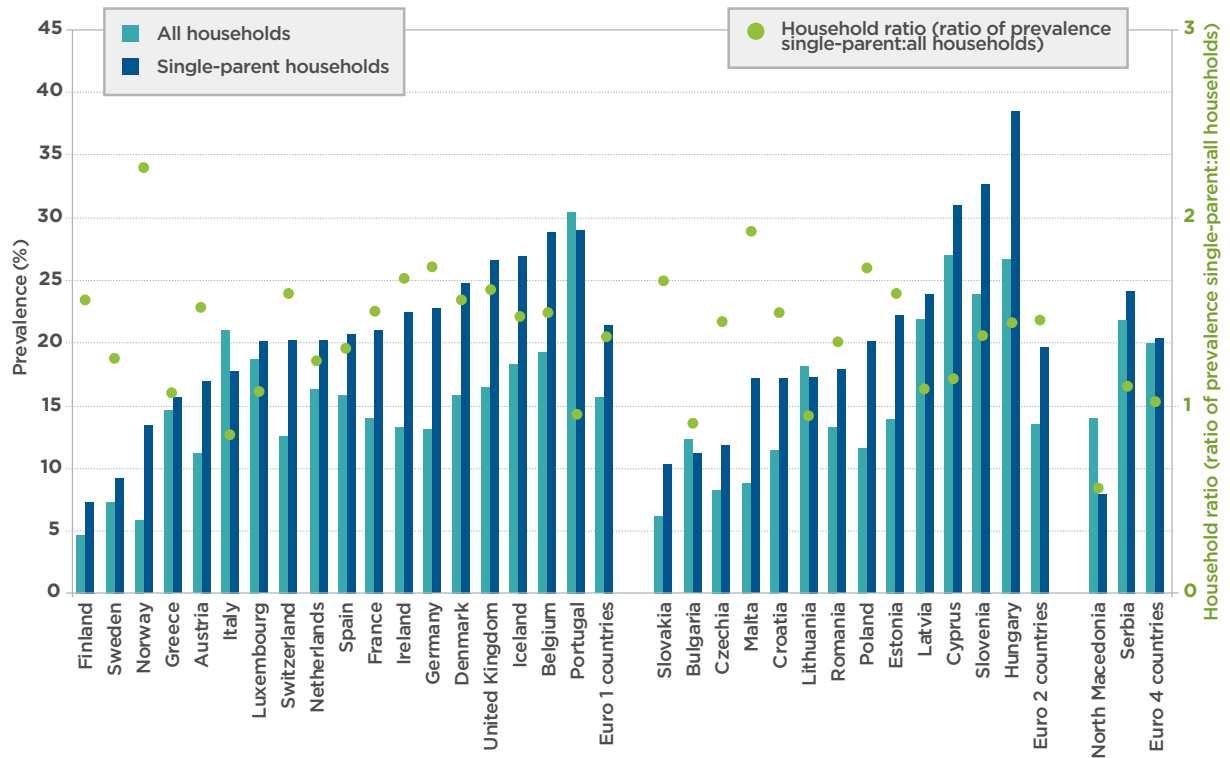
western European and Balkan non-EU countries (Eurostat, 2018). For countries not covered by EU-SILC, limited information may be available from housing statistics, but the data cannot be assessed from an equity perspective.

Dampness in the home is reported in all the Euro 1, 2 and 4 countries – varying only in prevalence and by household type (see Fig. 10). Prevalence varies between under 5% of all households in Finland and 30.5% of all households in Portugal. Single-parent households are often more affected by dampness: prevalence varies between 7.3% in Finland and 38.5% in Hungary. Nevertheless, in some countries all households have a higher reported prevalence of dampness than single-parent households, including Bulgaria, Italy, Lithuania, Portugal and North Macedonia.

The average prevalence of dampness in the home in Euro 1 countries is 15.7% for all households and 21.4% for single-parent households. The equity gap in the Euro 2 subregion is very similar, with 13.5% prevalence for all households and 19.7% for single-parent households.

The ratio of single-parent households to all households shows the relative magnitude of inequality: a value of one means there is no inequality. The highest household ratio is found in Norway, at 2.3:1. This means that single-parent households suffer 2.3 times more from dampness than all households. As noted, however, the ratio relates to relative magnitude, and the number of people in absolute terms who suffer from dampness in the home in Norway is lower than in most other countries. Most countries have an inequality ratio of between 1.3:1 and 1.7:1, irrespective of the absolute prevalence levels. The lowest inequalities are found in Lithuania (0.95:1), Portugal (0.95:1) and Greece (1.07:1).



**Fig. 10.** Prevalence of dampness in the dwelling by household type (2016)

Source: Eurostat (2018).

A comparison of prevalence of dampness in the dwelling by income quintile shows that all countries are affected by significant inequalities between the lowest and highest quintiles. The prevalence of dampness reported by households with the lowest income is 2.3 times higher in the Euro 1 subregion and almost four times higher (3.9) in the Euro 2 subregion (see Fig. 11). In most countries, households in the lowest quintile are at least twice as affected by dampness as households in the highest. The highest prevalence of dampness in households with the lowest income is found in Slovakia (45.9%) and Portugal (40.4%). In contrast, households with the highest income have a prevalence of dampness of 11.8% in Slovakia and 21.1% in Portugal.

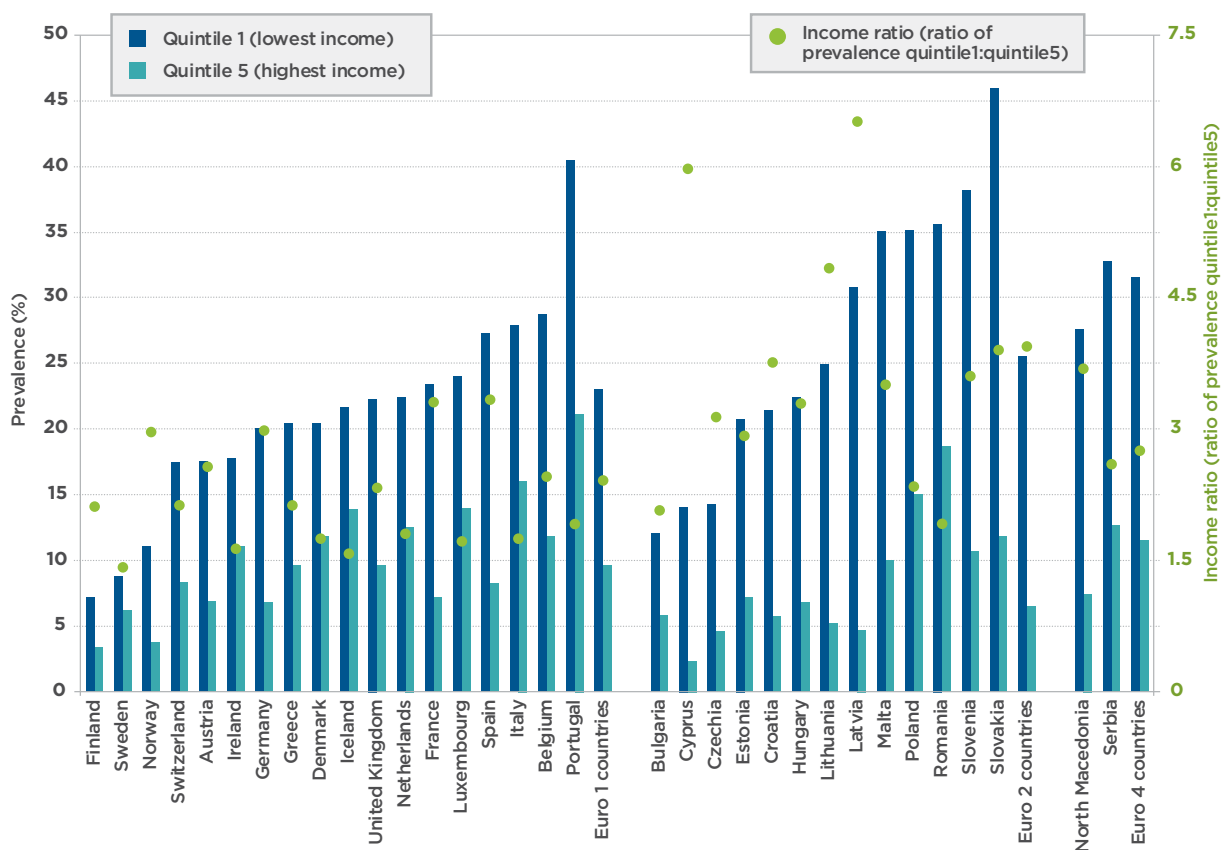
A comparison of the prevalence between the lowest and the highest income quintiles shows significant differences in the relative magnitude of inequality in some countries. The income ratio is 6.5:1 in Latvia and 6.0:1 in Cyprus, indicating that households with the lowest income are at least six times more affected than those with the highest. The lowest difference between the income quintiles is found in Sweden, with an income ratio of 1.4:1.

### 3.4.3 Conclusions and suggestions

Dampness-induced mould in dwellings can cause adverse health effects like allergies, asthma and respiratory infections. Inadequate heating, ventilation and/or insulation, as well as damage to the building, often cause dampness.

Dampness affects many households in the EU: in some countries every third to fourth household is affected. Differences between countries may have various causes, including climate and housing conditions or socioeconomic factors. Nevertheless, the data clearly show a significant increase in reported dampness in households with decreasing income. Inequalities also exist between different household types in most countries. Single-parent households report a higher prevalence of dampness than all households. One reason may be that single-parent households are more likely to have lower incomes.

Two approaches need to be considered for the interventions required to tackle inequalities in exposure to dampness. On the one hand, there is a need to combat dampness in all homes, as it affects a significant proportion of the population – including affluent households – in many countries. On the other hand, households with low incomes should be supported through targeted measures, as they clearly represent a specific risk group.

**Fig. 11.** Prevalence of dampness in the dwelling by lowest and highest income quintile (2016)


Source: Eurostat (2018).

Collection of exposure data and information on the health burden of the population caused by dampness (and mould) should be improved through more specific epidemiological studies, including visible and hidden damage. Moreover, knowledge about the health effects of dampness

and mould must be extended through studies on unspecific adverse health effects, including effects of long-term exposure to low doses of harmful substances and particles that occur in damp dwellings.

### Suggested mitigation actions are:

- making regulatory provisions for all new residential building projects – private or public – to ensure adequate thermal insulation and ventilation, as well as protection of building structures against water ingress and high air humidity, including during the construction process;
- educating responsible authorities about dampness and mould and the investigations and renovations required for affected houses/homes;
- ensuring that the problems of dampness and humidity and the necessary ventilation are considered when renovating existing and especially low-cost housing stock;
- providing targeted financial support to disadvantaged populations and those groups most exposed to damp homes due to specific housing circumstances;
- providing adequate housing conditions and affordable heating to economically disadvantaged and vulnerable larger households, since overcrowded living conditions and indoor cold both contribute to dampness.

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## 3.5 Inequalities in inability to keep the home adequately warm

Tamara Steger

### Status

In the EU 54 million people cannot keep their homes warm enough, especially in poor households and those inhabited by single parents with dependent children or one person over the age of 65 years.

### Trend

The proportion of European households experiencing energy poverty decreased between 2009 and 2016, largely due to improvements made in eastern European countries. Income-related inequalities, however, increased within many eastern European countries.

#### 3.5.1 Introduction and health relevance

One in 11 EU households are unable or struggling to maintain an adequate level of warmth in the home (Eurostat, 2018a) – representing 54 million EU citizens (UNECE, 2014). This is mainly due to energy prices, income levels and the poor quality and inefficiency of residential structures and heating facilities. Many of these households are in the lowest income quintile; they are often occupied by single parents (predominantly mothers) with dependent children or by elderly or disabled people. While the overall prevalence has declined across Europe since 2009, households in southern and eastern Europe remain disproportionately unable to maintain adequate warmth in the home due to accelerated energy prices and poverty levels (Bouzarovski & Tirado Herrero, 2017). Conversely, the proportion of households unable to keep the home warm in some northern and western European countries is among the lowest in Europe. This is attributed to general economic standing (including economic performance and income levels), housing quality and capacity to target and support those in need (Bouzarovski & Tirado Herrero, 2017).

An adequately warm home with temperatures above at least 18 °C is essential to life expectancy and to mental and physical well-being (WHO, 2018). It reduces excess winter deaths and health risks associated with cardiovascular and respiratory diseases. The burden of disease associated with indoor cold was estimated at 38 200 excess deaths per year for 11 European countries (WHO Regional Office for Europe, 2011) as well as resulting health care costs associated with medications and hospital admissions. For elderly people in particular, the risk of strokes and heart attacks associated with changes in blood

pressure increases with even small deviations below adequate temperatures (Regional Public Health Group in the South East, 2007). Indoor air pollution – often associated with energy poverty and inadequate fuel choices for heating the home – involves further health risks (see section 4.2 on energy poverty), particularly in countries with households that increasingly rely on firewood and coal (Bouzarovski & Tirado Herrero, 2017).

#### 3.5.2 Indicator analysis: inequalities in inability to keep the home adequately warm by relative poverty level, household type and income level

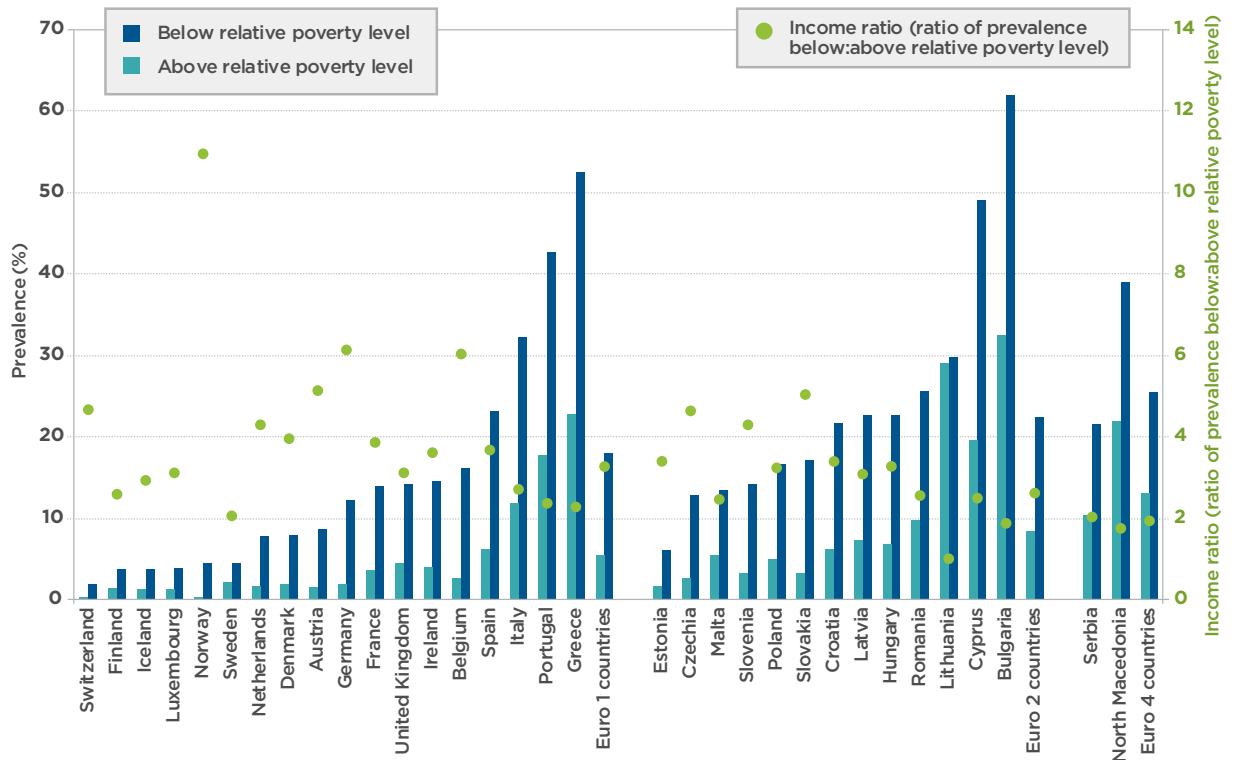
Thermal comfort data are available from the Eurostat EU-SILC survey, which includes some western European and Balkan non-EU countries (Eurostat, 2018b). For countries not covered by EU-SILC, no equity-sensitive data on thermal comfort in winter time could be compiled.

Households below the relative poverty level are consistently less able to maintain warmth in the home (Fig. 12), disproportionately subjecting them to related health risks. This trend has endured since the 2012 WHO report on environmental health inequalities in Europe (WHO Regional Office for Europe, 2012), in which the 2009 data revealed similar results. Euro 2 countries are especially affected: 8.5% of households above the relative poverty level are unable to keep the home adequately warm, but this rises to 22.4% of households in relative poverty. While Euro 1 countries are comparatively better able to maintain adequate household warmth both above and below relative poverty levels (5.4% versus 18%, respectively), poor households reported 3.3 times more difficulty than non-poor households.

In the two Euro 4 countries that reported data, 13% of households above the relative poverty level

reported difficulties maintaining warmth in the home.

**Fig. 12.** Prevalence of inability to keep the home warm by relative poverty level (2016)



Source: Eurostat (2018b).

In six countries the prevalence of reported problems with keeping the home warm exceeds 30% for households below the relative poverty level, while 32.5% of households above the relative poverty level in Bulgaria also report problems. The highest inequality ratios by income are found in Euro 1 countries, with Belgium, Germany and Norway reporting income-related inequalities beyond a ratio of 6:1. The lowest inequality is found in Lithuania, where households both below and above the relative poverty level practically equally struggle to keep their homes adequately warm. Overall, the prevalence of inability to maintain indoor warmth among households both above and below relative poverty levels is highest in Bulgaria and Greece.

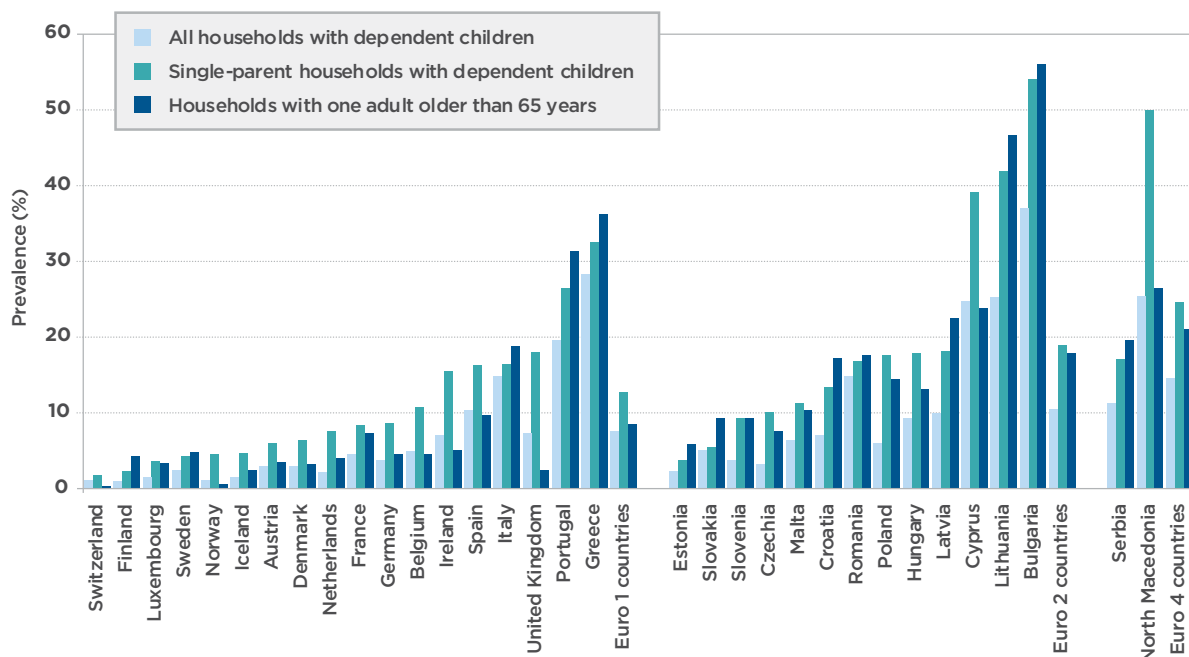
When it comes to household type and inability to keep the home adequately warm, Euro 2 and Euro 4 countries are more affected than Euro 1 countries (Fig. 13). Single-parent households with dependent children<sup>2</sup> fare worst across all countries

but especially in eastern European countries (more than 50% of single-parent households in Bulgaria and North Macedonia, and around 40% in Cyprus and Lithuania). Single-parent households also represent a major risk group in Euro 1 countries such as Belgium, Ireland, Norway and the United Kingdom, where the prevalence is notably higher than for other household types.

The prevalence of inability to maintain warmth in households containing one adult over the age of 65 years is twice as high or more for Euro 2 (17.8%) and Euro 4 countries (21.1%) compared to Euro 1 countries (8.5%). It is exceptionally high in Bulgaria, Greece, Lithuania and Portugal (more than 30% generally but above 50% for Bulgaria). In many countries, significant household heating problems among households below the relative poverty level (see Fig. 12) coincide with an increased proportion of households with elderly residents (in Bulgaria, Czechia, Estonia, Greece, Italy, Norway, Portugal and Switzerland).

<sup>2</sup> Note that single-parent households with dependent children are predominantly headed by women, adding a gendered aspect to health risk inequalities when it comes to maintaining warmth in the home.

**Fig. 13.** Prevalence of inability to keep the home warm by household type (2016)



Source: Eurostat (2018b).

Fig. 14 depicts – by country and subregion – the income-related inequality gradients in keeping the home warm across income quintiles. It shows that the top 20% wealthiest households in each country reported the fewest problems with keeping the home warm with the exception of Iceland, where the prevalence is lower among quintile 2 than quintile 5 households. Nevertheless, even the highest-income households in some eastern European and Balkan countries such as Bulgaria (20.1%), Lithuania (25.4%) and North Macedonia (17.3%) are often unable to keep their homes sufficiently warm.

In general, higher income inequality is associated with a wider gap in prevalence between the wealthiest and poorest households, showing an inequality gradient across all quintiles that is particularly problematic for the lowest quintile (as in Bulgaria, Cyprus, Greece and Portugal). In some countries, such as Belgium, Germany and Slovakia, disadvantage is mostly expressed within the lowest income quintile (quintile 1), which presents a comparatively higher prevalence of heating problems compared to income quintiles 2–5. Conversely, there is much less inequality between

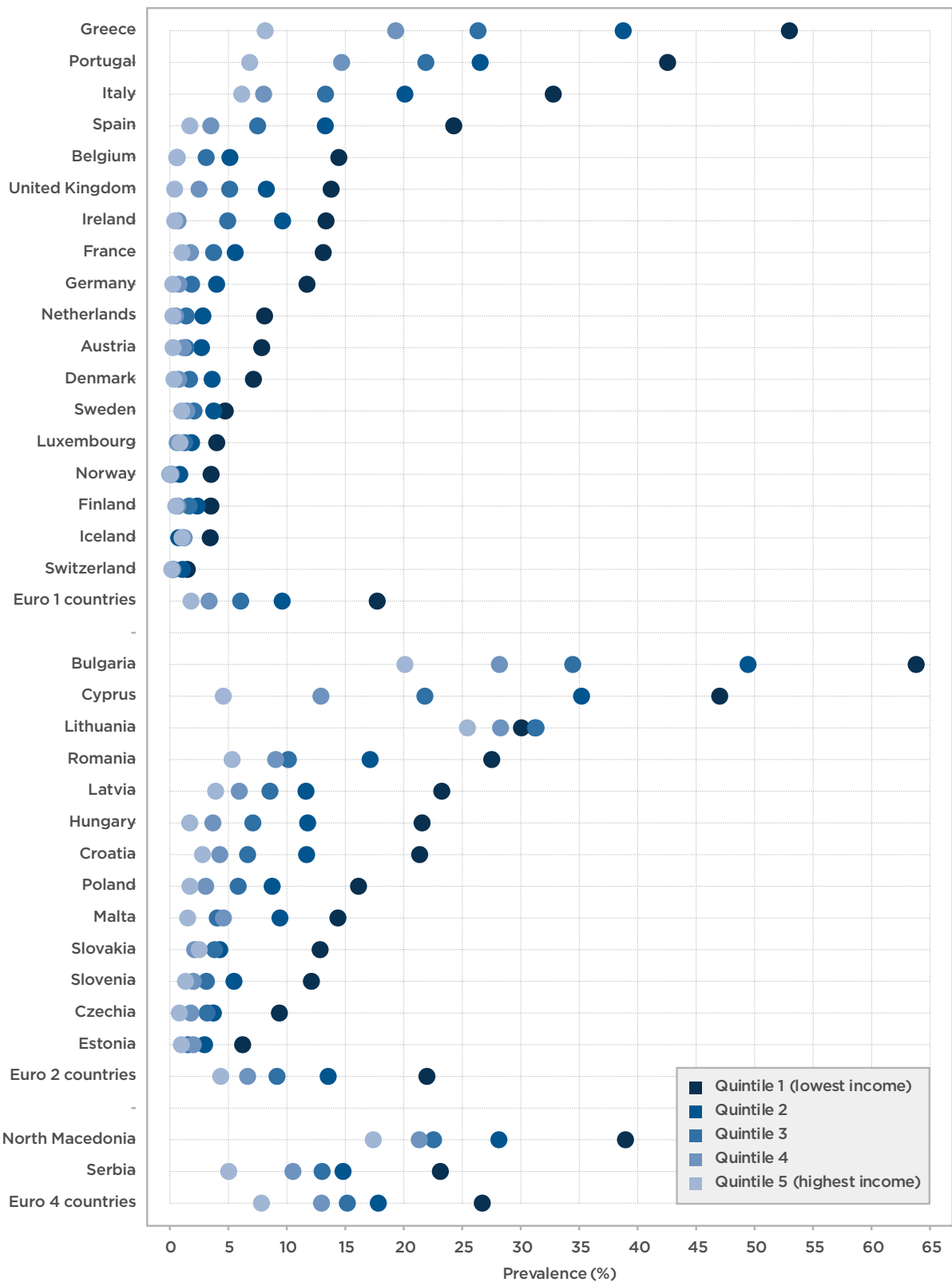
rich and poor households in Finland, Iceland, Luxembourg and Switzerland, which show narrow gradients at low prevalence levels.

### 3.5.3 Conclusions and suggestions

The prevalence of being unable to maintain adequate warmth in the home is generally higher in southern and eastern European countries and among low-income households, particularly those including a single parent or an elderly person. Residents in these categories are thus more at risk of excess winter death and cardiovascular/circulatory and respiratory diseases.

By improving energy deprivation support mechanisms, household income, fuel price regulation and energetic housing conditions (heating systems, energy efficiency and thermal insulation), the ability to maintain health and warmth in the home can be strengthened not only for the general population but especially for those households below the relative poverty level. Maintaining sufficient warmth in households across Europe requires improvement schemes that target the associated magnitude and distribution of inequality.

**Fig. 14.** Prevalence of inability to keep the home warm by income quintile (2016)



Source: Eurostat (2018b), adapted.

**Suggested mitigation actions are:**

- asserting effective financial mechanisms associated with, for example, fuel regulation, minimum wage enhancements and earned income tax credits to increase the accessibility and affordability of energy for the working poor and to alleviate energy poverty;
- providing support mechanisms that target specific household types that disproportionately demonstrate an inability to maintain warmth in the home, such as single-parent and/or elderly-occupied homes;
- enhancing investment in energy-efficient housing.

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## 3.6 Inequalities in inability to keep the home adequately cool in summer

Paula Santana, Ricardo Almendra

### Status

Inability to maintain indoor thermal comfort in summer is influenced by income and urbanization level, with households in cities and with lower incomes reporting most problems with keeping the home cool.

### Trend

Prevalence of inability to keep the home adequately cool in summer decreased for both rich and poor households during the reporting period (2007–2012), but inequalities between rich and poor households increased – especially in Euro 1 countries, where poor households report the issue almost twice as often.

#### 3.6.1 Introduction and health relevance

Exposure to extreme heat has been associated with a significant morbidity and mortality burden, as demonstrated by the health impacts of the heat waves recorded in recent years – for example, the death toll of the 2003 heat wave in Europe is estimated to exceed 45 000 (WHO, 2016). These health impacts are expected to become more severe in the coming years as a result of the increasing trend of summer temperatures and the frequency and intensity of heat waves, according to forecasts from the 2014 report of the Intergovernmental Panel on Climate Change (Gasparrini et al., 2017).

Housing is considered an important factor affecting health and well-being, as people spend the majority of their time at home (Bonney, 2007). Houses can offer protection against harmful elements but can also be responsible for increased exposure to environmental hazards such as heat (Deguen, Fiestas & Zmirou-Navier, 2012). The health impacts of heat waves are higher when buildings do not cool down during the night but keep accumulating heat. Housing characteristics such as poor insulation, inadequate cooling systems and lack of ventilation can exacerbate the effects of climate extremes and be an important vulnerability factor for the population (Braubach & Fairburn, 2010). Evidence on heat waves shows that housing characteristics have a direct impact on heat-related mortality (Vandentorren et al., 2006).

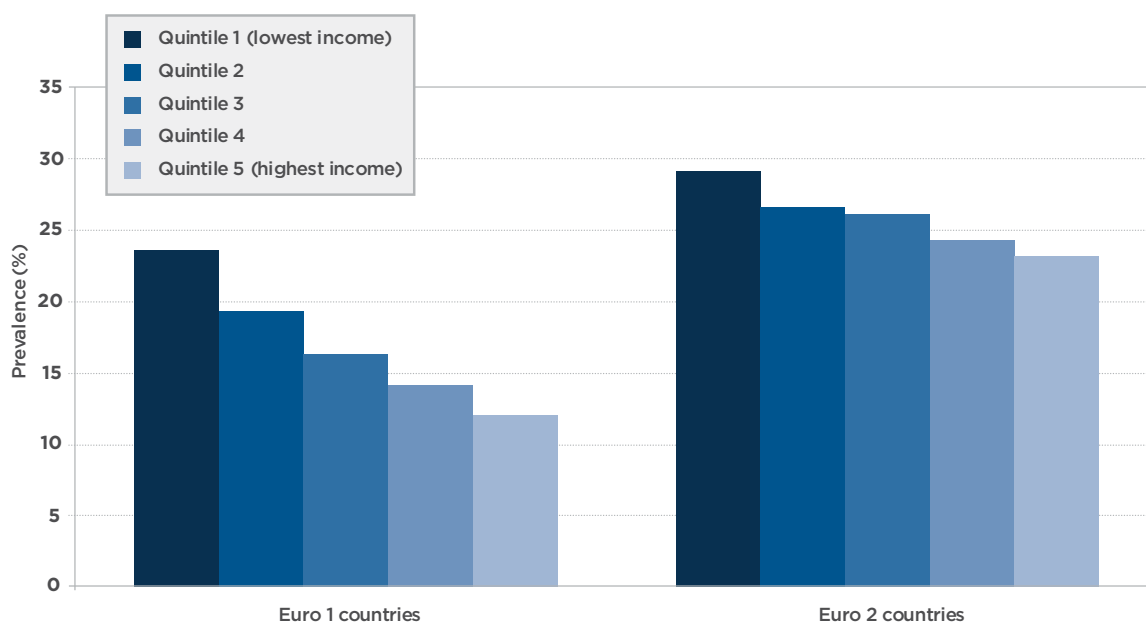
Inequalities in housing quality are often caused by socioeconomic conditions associated with income: more deprived population groups tend to live in less prepared houses; they are therefore often more exposed to heat in the dwelling and experience higher health burdens (Braubach &

Fairburn, 2010). More fragile individuals – both socially and physically – and people living in older buildings with poor insulation systems, in areas with the greatest heat island effects, present a higher prevalence of inability to keep the home adequately cool in summer and are more vulnerable to the consequences of heat (Vandentorren et al., 2006).

#### 3.6.2 Indicator analysis: inability to keep the home adequately cool in summer by income level, urbanization

The Eurostat EU-SILC survey included thermal comfort in summer in a special module in 2012, also covering some western European non-EU countries (Eurostat, 2018). Such data are not available, however, for other countries in the WHO European Region.

The proportion of population unable to keep the house adequately cool in summer is lower among Euro 1 countries (average 17.1%) than Euro 2 countries (average 25.8%). Stratifying the data by income quintile, both subregions demonstrate an almost linear income gradient in the prevalence of people not feeling comfortable in the dwelling due to heat (with households from the lowest income quintile reporting the highest inability to keep the home cool in summer) (Fig. 15). This gradient is steeper among Euro 1 countries (where prevalence in the lowest income quintile (23.6%) is almost twice as high as that in the highest income quintile (12.1%)) than among Euro 2 countries. In Euro 2 countries income inequalities seem to have a weaker impact because the overall prevalence is higher (lowest income quintile: 29.1%; highest income quintile: 23.2%) than in Euro 1 countries, and also affects a significant proportion of affluent households.

**Fig. 15.** Prevalence of inability to keep the home adequately cool in summer by income quintile (2012)

Source: Eurostat (2018).

Fig. 16 presents the income quintile differences for inability to keep the home comfortably cool in summer at the national level. Strong variation in income-related inequalities between European countries can be seen, but it is more strongly expressed in Euro 1 countries. Nevertheless, looking at the spatial pattern of overall prevalence, Mediterranean countries (such as Cyprus, Greece, Malta and Portugal) and some south-eastern European countries (such as Bulgaria and Croatia) tend to have both higher prevalence values and higher inequalities. In Bulgaria 49.5% of all households reported inability to maintain indoor thermal comfort in summer (with a maximum of 70.8% in the lowest income quintile).

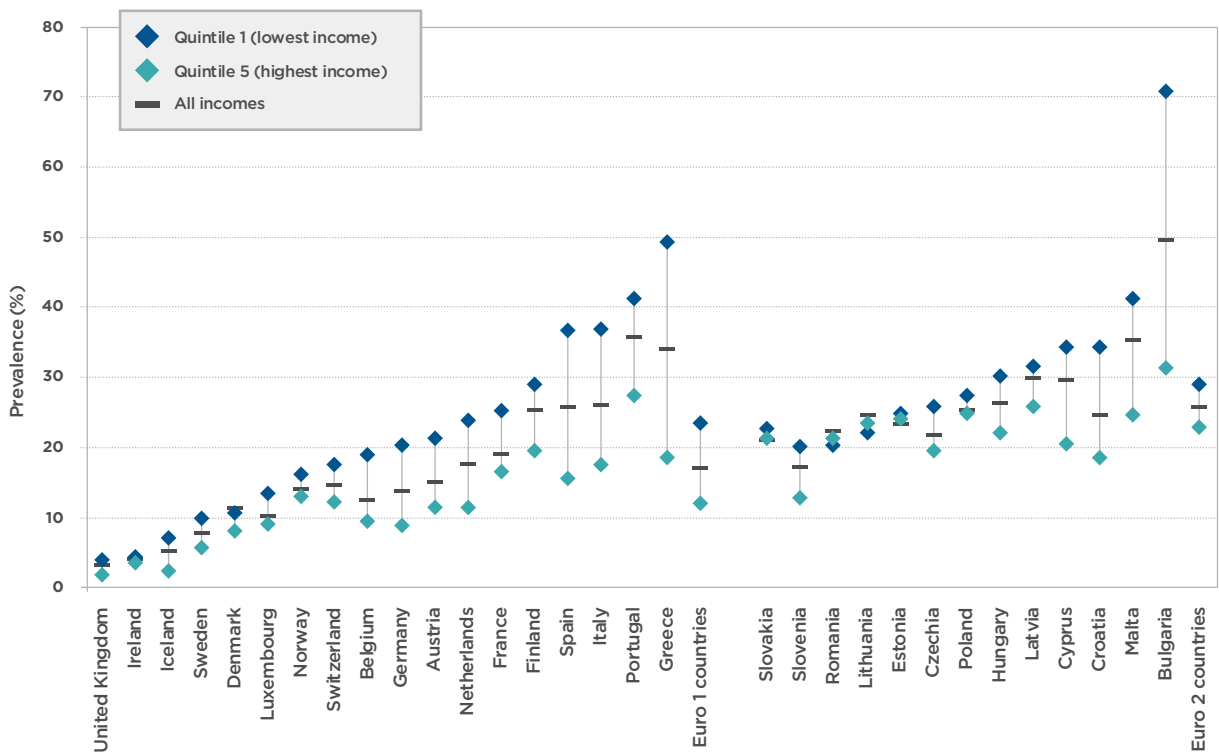
Bulgaria, Greece, Italy and Spain have prevalence differences higher than 20% between income quintiles, while in Estonia, Ireland, Romania and Slovakia income inequalities have almost no impact on the proportion of population unable to keep the home cool in summer (differences lower than 2%). Looking at relative inequalities, however, the poorest households are affected at least twice as strongly as the most affluent in many Euro 1 countries, while in Euro 2 countries the inequalities are less marked (with the exception of Bulgaria, which shows extreme absolute and relative inequalities).

In this context, it should be noted that that in Romania and Lithuania high-income households reported greater difficulties in maintaining indoor thermal comfort in summer than lower-income households, although the differences are marginal.

Fig. 17 highlights the influence of urbanization level on the inability to keep the home cool in summer. In both Euro 1 and Euro 2 countries the prevalence of households struggling to keep comfortably cool in summer is higher in cities (19.4% and 29.6%) than in towns and suburbs (16.3% and 25.4%) and in rural areas (14.6 and 23.2%). Among Euro 1 countries the difference between cities and rural areas is slightly lower (4.8%) than in Euro 2 countries (6.4%). The prevalence of inequalities between cities and rural areas is highest (15% and above) in Austria, Hungary and Malta. In contrast, some countries show very narrow variation by urbanization level; this can be seen in countries with both high (Cyprus and Portugal) and low prevalence levels (Iceland and Sweden).

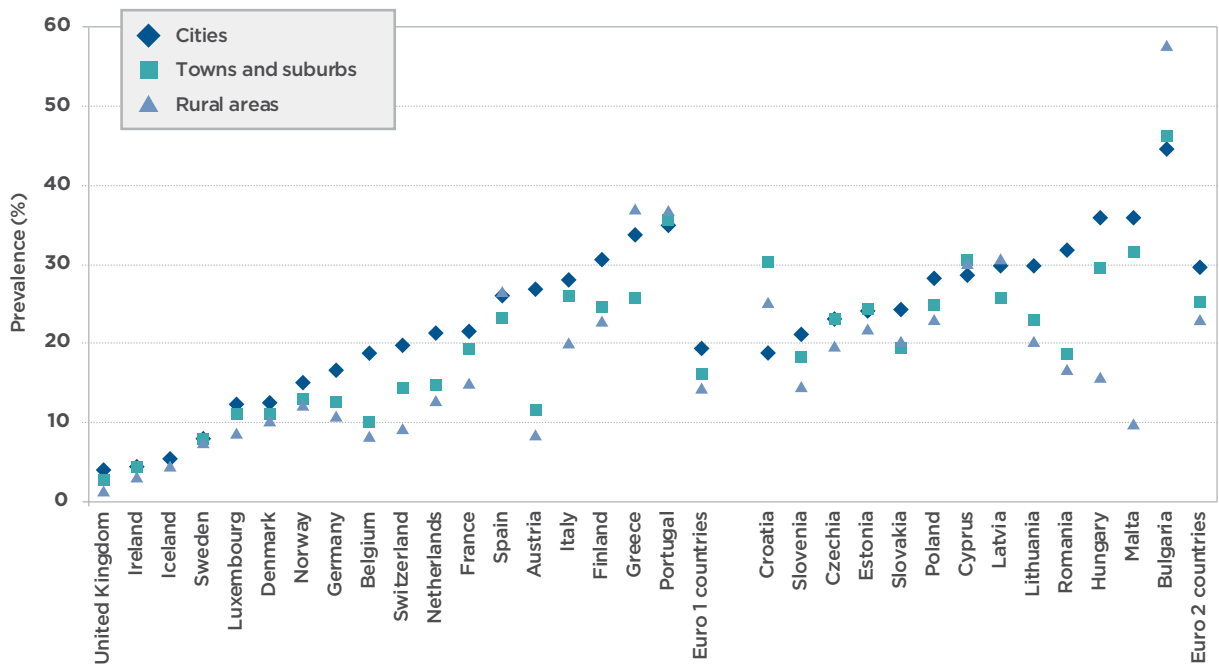
The highest overall prevalence levels were found in rural areas and not in cities, however: among Euro 2 countries Bulgaria reported that 57.8% of rural households were unable to keep the home adequately cool in summer, while among Euro 1 countries the highest level was reported by rural households in Greece (38%).

**Fig. 16.** Prevalence of inability to keep the home adequately cool in summer by country and income quintile (2012)



Source: Eurostat (2018).

**Fig. 17.** Prevalence of inability to keep the home adequately cool in summer by urbanization level (2012)



Source: Eurostat (2018).

### 3.6.3 Conclusions and suggestions

Inability to keep the home adequately cool in summer is an issue in all 31 European countries for which data are available. The indicator analysis identified that households with lower incomes and those living in cities have greater difficulty in maintaining a comfortable thermal environment in the dwelling in summer, with stark inequalities in some countries. The highest effects of income on ability to keep the house cool in summer were found in some Mediterranean countries.

In the majority of countries, households in cities have more difficulties with keeping the home cool in summer than those in rural areas. The urban heat island effect may enhance higher exposure to heat in cities and thus contribute to this higher proportion.

Interventions to increase ability to keep the home adequately cool in summer could contribute to a reduction in the morbidity and mortality burden associated with indoor heat.

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#### Suggested mitigation actions are:

- passive cooling measures for buildings (such as highly reflective materials/colours, application of radiant barriers and proper insulation);
  - use of energy-efficient active cooling systems (including in public buildings such as schools, health services and homes for elderly people);
  - urban planning measures (such as promotion of urban shading, land-use changes, urban design and use of green and blue spaces as a climate buffer);
  - health literacy (such as information about behaviours to mitigate and adapt to heat, with a particular focus on vulnerable population groups).
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## 4. Inequalities in access to basic services

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Healthy housing and living conditions are strongly affected by access to drinking-water, sanitation and energy supply services. Access to and use of these basic services depends on several variables, including building features and installations, local authorities' capacities to provide such services in an adequate and reliable manner, and the costs of these services to the household.

The United Nations explicitly recognizes the human right to water and sanitation and acknowledges that clean drinking-water and sanitation are essential to the realization of all human rights. SDG 6 is to ensure that no one is excluded from access to equitable and safely managed drinking-water and sanitation services, which provide a requirement for healthy lives and well-being.

Although access to energy is not formally defined as a human right, it is of equal concern and has also been included as a separate goal of the sustainable development agenda (SDG 7: affordable and clean energy). A wide range of international and national campaigns and frameworks exist to ensure that all people, irrespective of location and socioeconomic status, have access to sustainable, non-polluting and affordable fuels.

Access to safe drinking-water, adequate sanitation services and clean and affordable energy are not, however, assured in many countries around the world: they remain public health as well as equity challenges in the WHO European Region. This section provides an overview of health-relevant inequalities for three indicators:

- inequalities in access to basic drinking-water services;
- inequalities in access to basic sanitation services; and
- inequalities in energy poverty.

As the data on drinking-water services and sanitation services are provided through the same monitoring instrument and use the same methodology, they are presented in one section. For energy poverty, various data sources are compiled to present inequalities related to energy cost and affordability and to highlight the inequalities in relation to the use of harmful energy sources such as solid fuels.



## 4.1 Inequalities in access to basic drinking-water and sanitation services

Dennis Schmiede, Oliver Schmoll, Chantal Demilecamps

### Status

Inequalities in access to basic and safely managed drinking-water and sanitation services exist throughout the WHO European Region, characterized by geographical, economic and social disparities.

### Trend

Proportions of rural populations relying on limited services, unimproved facilities or surface water sources have decreased, thereby narrowing the urban–rural inequality gap in most countries.

#### 4.1.1 Introduction and health relevance

Access to safe and clean drinking-water and sanitation are basic human rights, acknowledged by United Nations General Assembly resolution 64/292 as “essential for the full enjoyment of life and all human rights” (United Nations, 2010). Access to water, sanitation and hygiene is anchored in the 2030 Agenda for Sustainable Development. SDG 6 calls for universal and equitable access to safe and affordable drinking-water for all, as well as for adequate and equitable sanitation and hygiene for all, highlighting the strong equity lens of the 2030 Agenda (United Nations, 2015).

In the WHO European Region, the Ostrava Declaration sets out the aim of ensuring universal, equitable and sustainable access to safe drinking-water, sanitation and hygiene for all and in all settings (WHO Regional Office for Europe, 2017). In addition, the Protocol on Water and Health is a multilateral legal instrument in the WHO European Region that promotes equitable access to water and sanitation services through a sound accountability framework to translate the human rights to water and sanitation into practice. Among its core principles, the Protocol stipulates that “equitable access to water, adequate in terms both of quantity and of quality should be provided for all members of the population, especially those who suffer a disadvantage or social exclusion” (UNECE & WHO Regional Office for Europe 2007).

Exposure to pathogenic micro-organisms and chemical contaminants through inadequate drinking-water supply and sanitation services may cause adverse health effects. In the WHO European Region waterborne diseases still constitute a significant health burden. While

underreporting means that their true extent is unknown, WHO estimates that approximately 18% of reported outbreaks of infectious diseases are associated with the water exposure pathway: viral gastroenteritis, hepatitis A, *Escherichia coli* diarrhoea and legionellosis are the most common disease outcomes in the Region (WHO Regional Office for Europe, 2016a). Based on data for 2012, Prüss-Ustün et al. (2014) estimate about 14 deaths per day from diarrhoea that can be attributed to inadequate water, sanitation and hygiene in the WHO European Region. The chemicals arsenic, fluoride and lead are of particular relevance in some parts of the Region; excessive levels of these in drinking-water over prolonged periods have also been associated with adverse health outcomes (WHO, 2017). Interventions to improve access to and safety of drinking-water and sanitation services and promote hygiene practices for all are effective interventions to reduce the health burden of water-related disease and foster the development of resilient communities.

Differences in use of water and sanitation services exist both between and within countries. Inequalities in access to water and sanitation services mainly occur in three key dimensions: geographical, economic and social disparities (UNECE & WHO Regional Office for Europe, 2012). Geographical differences refer to varying degrees of access or use, levels of services or price gaps between at least two different settings (such as urban and rural areas). Financial affordability of water and sanitation services lies at the centre of economic disparities and is of growing concern in the Region. Social disparities relate to issues of availability and accessibility of water and sanitation services by vulnerable or marginalized groups facing different barriers such as social exclusion.

#### 4.1.2 Indicator analysis: inequalities by geographical, economic and social disparities

Data on access to drinking-water, sanitation and hygiene are available from the WHO/UNICEF JMP for Water Supply, Sanitation and Hygiene for all countries in the WHO European Region. The JMP database includes information on urban-rural differences and, increasingly, on differences by

wealth status, which are currently available for 11 countries.

In 2017 the JMP suggested a scheme of service ladders for drinking-water and sanitation services, ranging from reliance on surface water and open defecation to safely managed drinking-water and sanitation services (WHO & UNICEF, 2017; Fig. 18).

**Fig. 18.** Drinking-water and sanitation service levels and their definitions

SERVICE LEVEL	DEFINITION	SERVICE LEVEL	DEFINITION
<b>SAFELY MANAGED</b>	Drinking water from an improved water source that is located on premises, available when needed and free from faecal and priority chemical contamination	<b>SAFELY MANAGED</b>	Use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or transported and treated offsite
<b>BASIC</b>	Drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip, including queuing	<b>BASIC</b>	Use of improved facilities that are not shared with other households
<b>LIMITED</b>	Drinking water from an improved source for which collection time exceeds 30 minutes for a round trip, including queuing	<b>LIMITED</b>	Use of improved facilities shared between two or more households
<b>UNIMPROVED</b>	Drinking water from an unprotected dug well or unprotected spring	<b>UNIMPROVED</b>	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines
<b>SURFACE WATER</b>	Drinking water directly from a river, dam, lake, pond, stream, canal or irrigation canal	<b>OPEN DEFECAATION</b>	Disposal of human faeces in fields, forests, bushes, open bodies of water, beaches or other open spaces, or with solid waste
<b>Note:</b> Improved sources include: piped water, boreholes or tubewells, protected dug wells, protected springs, rainwater, and packaged or delivered water.		<b>Note:</b> Improved facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, composting toilets or pit latrines with slabs.	

Source: WHO & UNICEF (2017).

In the WHO European Region most countries display average usage rates of 90–100% for safely managed drinking-water services, but in some the rate is as low as 47%, indicating wide disparities across the Region. The inequality gap for safely managed sanitation services is even wider, with rates between 23% and 100% (WHO & UNICEF, 2017). Despite the generally high usage rates of safely managed drinking-water and sanitation services, the three lowest service levels are of particular concern in terms of impacts on human health.

##### 4.1.2.1 Geographical disparities

Fig. 19 shows the proportion and ratios of urban and rural populations that rely on the three lowest drinking-water service levels shown in Fig. 18.

The proportion of urban populations using limited drinking-water services, unimproved facilities or surface water sources ranges from <0.1% in

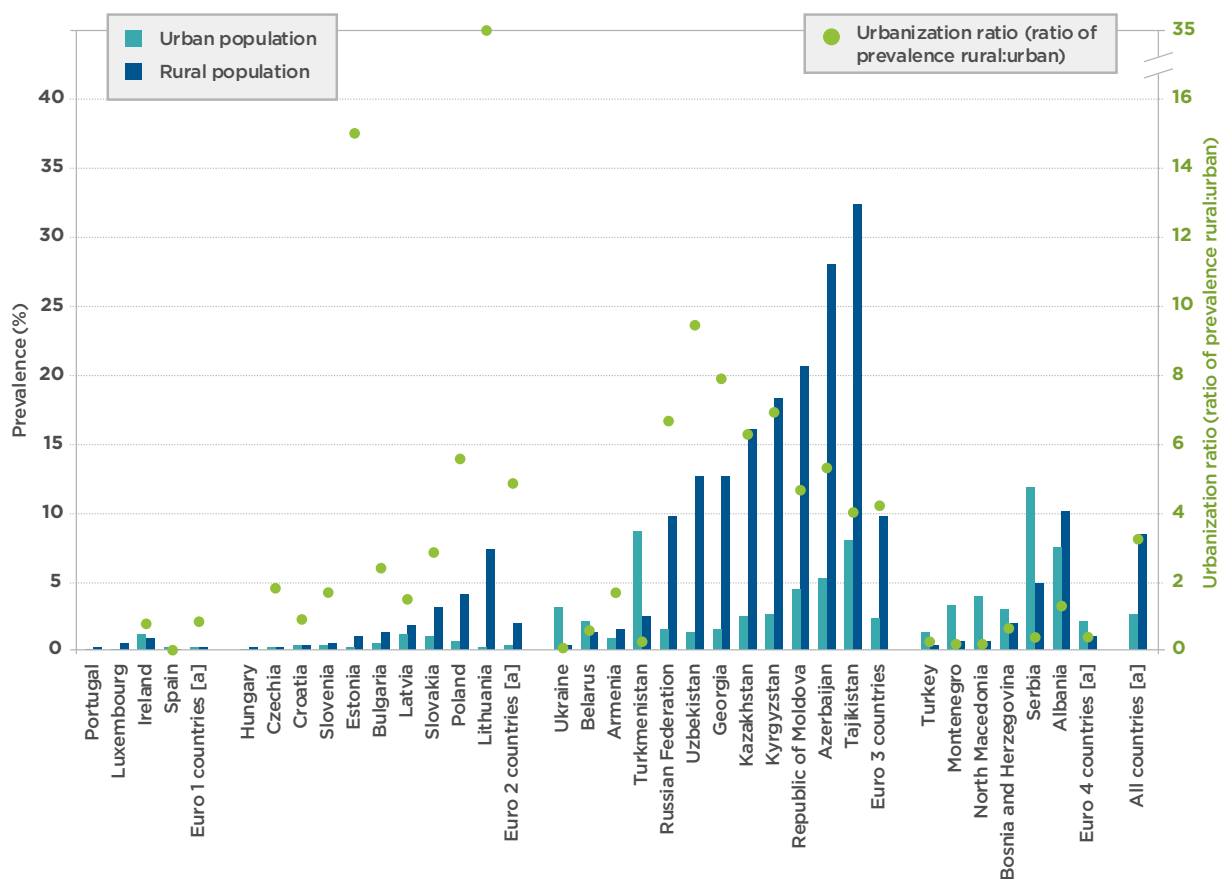
Czechia, Estonia and Spain to 12% in Serbia, while the proportion of rural populations relying on such services ranges from 0.1% in Hungary to 32% in Tajikistan. Overall, Euro 1 countries display the lowest absolute values of such services across urban and rural populations, as well as the lowest relative ratios within countries; Euro 3 countries, on the other hand, feature the highest rates among both urban and rural dwellers. In most countries rural dwellers show higher proportions of use of such services than urban dwellers. This trend is reversed in Euro 4 countries, however, where all countries (except Albania) show higher values in urban than in rural areas.

Estonia and Lithuania (both in the Euro 2 subregion) display by far the highest differences between urban and rural populations within a country, with urbanization ratios for rural to urban dwellers of 35:1 in Lithuania and 15:1 in Estonia. This, however,

may be explained by the very low values for urban dwellers. Eight Euro 3 countries show, on average, six times higher rates for rural than urban populations. Nevertheless, disadvantages may also exist for urban residents, as highlighted by Montenegro, North Macedonia and Ukraine.

These patterns are amplified in the data showing the proportion and ratios of urban and rural populations that rely on the three lowest sanitation service levels (Fig. 20).

**Fig. 19.** Prevalence of urban and rural populations relying on limited services, unimproved facilities or surface water sources for drinking-water (2015)



Notes: countries reporting zero population using limited services, unimproved facilities or surface water sources were excluded from the chart; [a] the values for all subregions are based on data from all countries in the respective subregion, including those with full coverage that are not displayed, with the exception of San Marino (Euro 1), for which no data are available.

Source: WHO & UNICEF (2017).

The proportions of urban populations relying on limited or unimproved sanitation services or practising open defecation range from 0% in very few countries to 13% in Bulgaria; the gap is much wider in rural areas, ranging from 0% in some countries to 32% in Romania. In Euro 2, Euro 3 and Euro 4 countries, the proportion of rural populations using such services is, on average, higher than the proportion of urban populations, while this trend is reversed for Euro 1 countries. Euro 4 countries show, on average, the highest urbanization ratios between urban and rural populations, with up to 11 times higher proportions of rural than urban dwellers using the three lowest sanitation service levels.

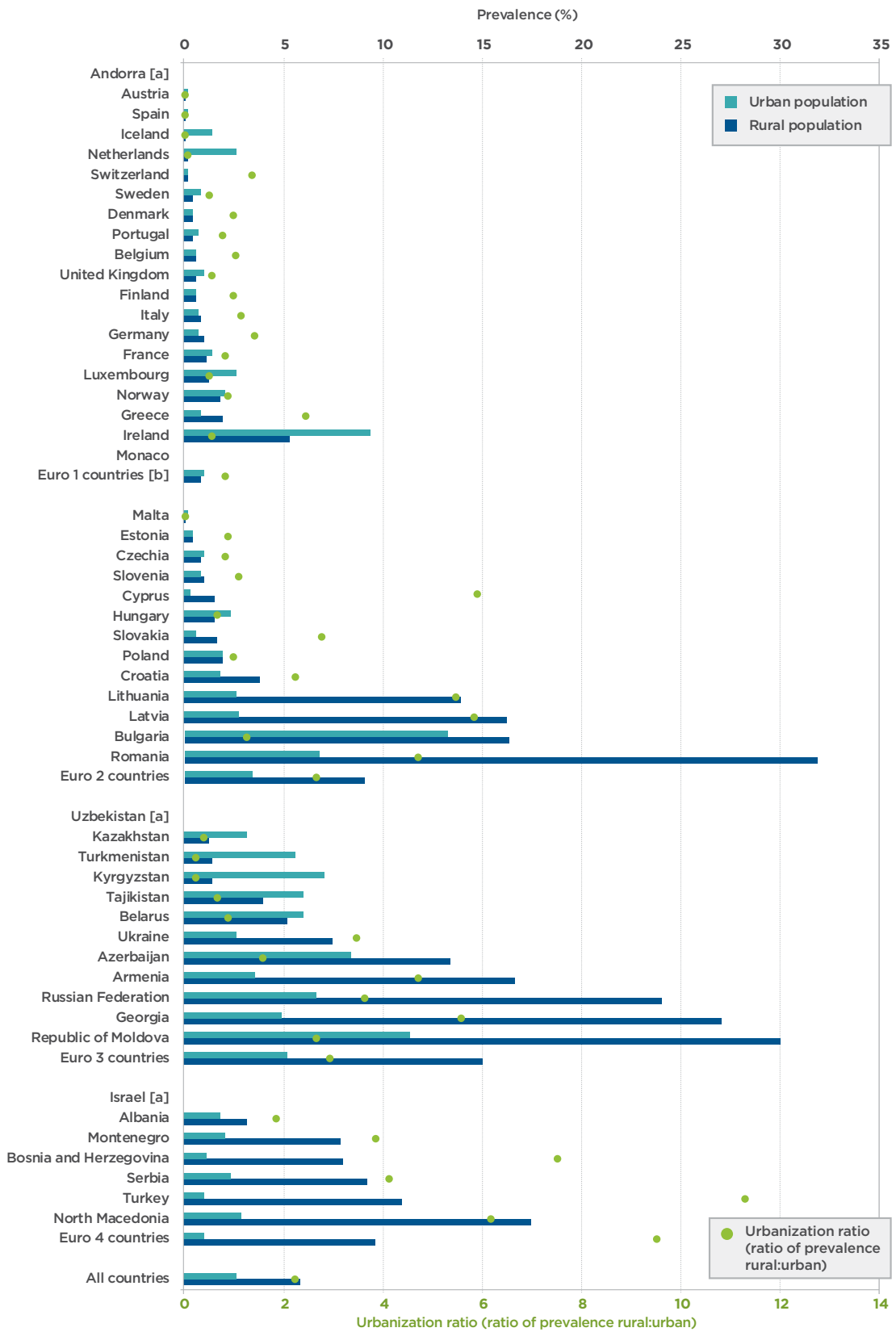
In Fig. 21 and Fig. 22, promising developments can be observed when examining trends of drinking-water or sanitation services since 2000.<sup>3</sup>

In urban areas, positive developments in drinking-water services took place in Euro 3 countries and negative developments in Euro 4 countries; however, the European average remained stable during 2000–2015. The values for rural areas in

<sup>3</sup> Owing to the updated JMP service ladder scheme and the ongoing annual recalculation of service use, the values depicted in these charts cannot be compared directly to the trend figures in the 2012 environmental inequalities in Europe report (WHO Regional Office for Europe, 2012).



**Fig. 20.** Prevalence of urban and rural populations relying on limited or unimproved sanitation services or practising open defecation (2015)



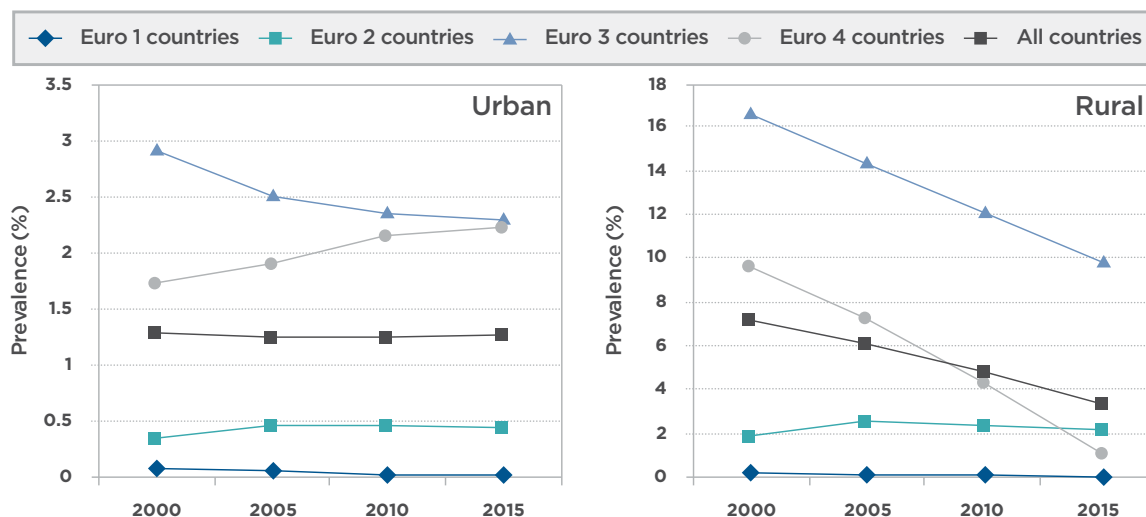
Notes: [a] countries report full coverage with at least basic sanitation services; [b] average of all Euro 1 countries except San Marino (for which no data are available).

Source: WHO & UNICEF (2017).

both Euro 3 and Euro 4 countries have continued to drop since 2000. The trend in Euro 4 countries is especially remarkable: the proportion of the population relying on less than basic drinking-

water services was six times higher in rural than in urban areas in 2000, but in 2015 values in rural areas were lower than those in urban areas.

**Fig. 21.** Trends of prevalence of urban and rural populations relying on limited or unimproved drinking-water services or using surface water sources



Note: different y-axis scales for urban and rural trends.

Source: data from WHO & UNICEF (2017).

A similar picture appears for sanitation services. Euro 1 countries show no change over time, with the lowest values overall, but rates in the other subregions have decreased since 2000 in both urban and rural areas. In Euro 4 countries developments did not happen evenly: whereas the situation improved for urban populations, reaching the same level as Euro 1 countries in 2015, the inequality gap between rural and urban dwellers widened significantly, displaying 10 times higher values in rural than urban areas in 2015. While the inequality gap widened in Euro 4 countries, it narrowed in Euro 3 countries, where the 5:1 inequality ratio for rural to urban populations in 2000 fell to 3:1 in 2015.

#### 4.1.2.2 Economic disparities

Economic disparities are often measured in terms of financial affordability of water and sanitation services. In this report JMP wealth quintiles<sup>4</sup> are used as a proxy indicator to measure water and sanitation outcomes by socioeconomic status.

For the WHO European Region such wealth data are available for 11 countries. Fig. 23 highlights

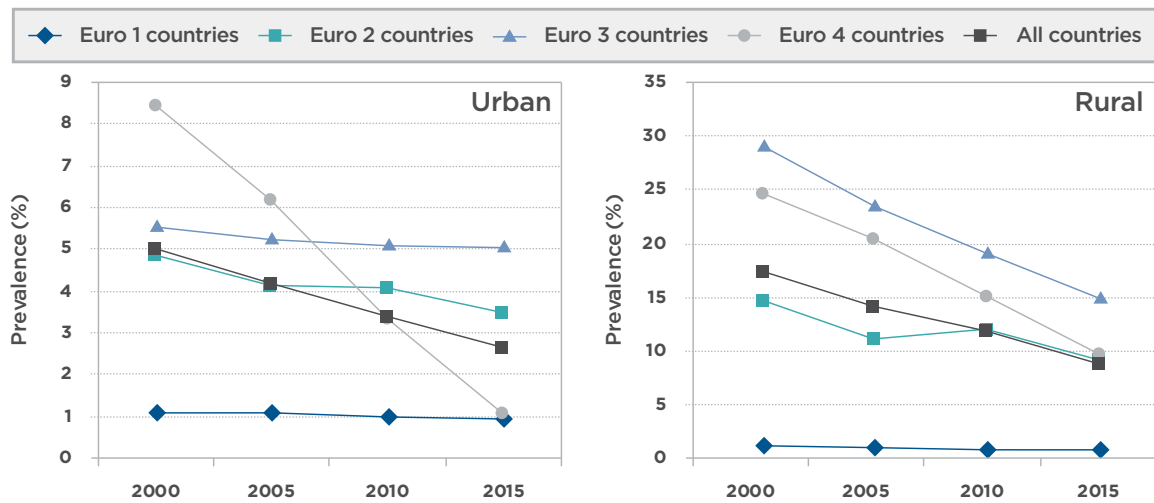
wealth disparities in use of both basic and safely managed drinking-water and sanitation services – the two highest drinking-water service levels shown in Fig. 18 – in these countries.

Seven countries show values of over 97% across all wealth quintiles for the two highest drinking-water service levels; inequality ratios are therefore close to 1:1. Inequality gaps are more significant for the Republic of Moldova, Kyrgyzstan and Azerbaijan, where absolute differences between the poorest and the wealthiest quintiles range between 25% and 29%, with inequality ratios of around 1.4:1, clearly illustrating a significant wealth gradient.

A similar trend can be observed for sanitation, albeit displaying greater differences. Only three countries report values of over 95% across all wealth quintiles. In particular, the populations in the poorest quintiles are often far behind in terms of reliance on basic or safely managed sanitation services. The Republic of Moldova reports the lowest proportions for each wealth quintile, and absolute differences between the poorest and wealthiest quintile are around 38%. Kyrgyzstan and Kazakhstan report high overall reliance and low inequality ratios for the two highest sanitation service levels for all wealth quintiles, although both rank lower for such drinking-water services.

<sup>4</sup> Income quintiles are based on the assumption that an underlying economic status exists, related to the wealth of households in terms of assets owned. The JMP uses quintiles calculated on the basis of a customized wealth index that excludes water and sanitation variables (WHO & UNICEF, 2017).

**Fig. 22.** Trends of prevalence of urban and rural populations relying on limited or unimproved sanitation services or practising open defecation



Note: different y-axis scales for urban and rural trends.

Source: data from WHO & UNICEF (2017).

#### 4.1.2.3 Integrated analysis of geographical and wealth disparities

Integrating the two dimensions of economic and geographical disparities in access to adequate services allows finer analysis of challenges around the two highest drinking-water and sanitation service levels (Fig. 24).

On average, 98% of people in the WHO European Region rely on basic or safely managed drinking-water services, but this regional average masks further differences. Seven countries report almost equal usage rates of over 95% for both wealth quintiles in urban and rural areas, but inequalities are clear in Azerbaijan, Kazakhstan, Kyrgyzstan and the Republic of Moldova – the strongest inequalities suffered by the rural poor in all four countries. For the second-most affected groups, two different inequality profiles arise. The rural wealthiest in Azerbaijan and Kazakhstan show the second-lowest usage rates of the two highest drinking-water service levels, highlighting the relevance of geographical disparities. The usage rates in Kyrgyzstan and the Republic of Moldova are second-lowest for the poorest urban populations, underlining the importance of wealth inequalities.

Similar patterns can be observed for sanitation, although the range of intracountry inequalities is greater than for drinking-water services and affects more countries. Ukraine and Kazakhstan are the only countries with rates of over 90% for the two

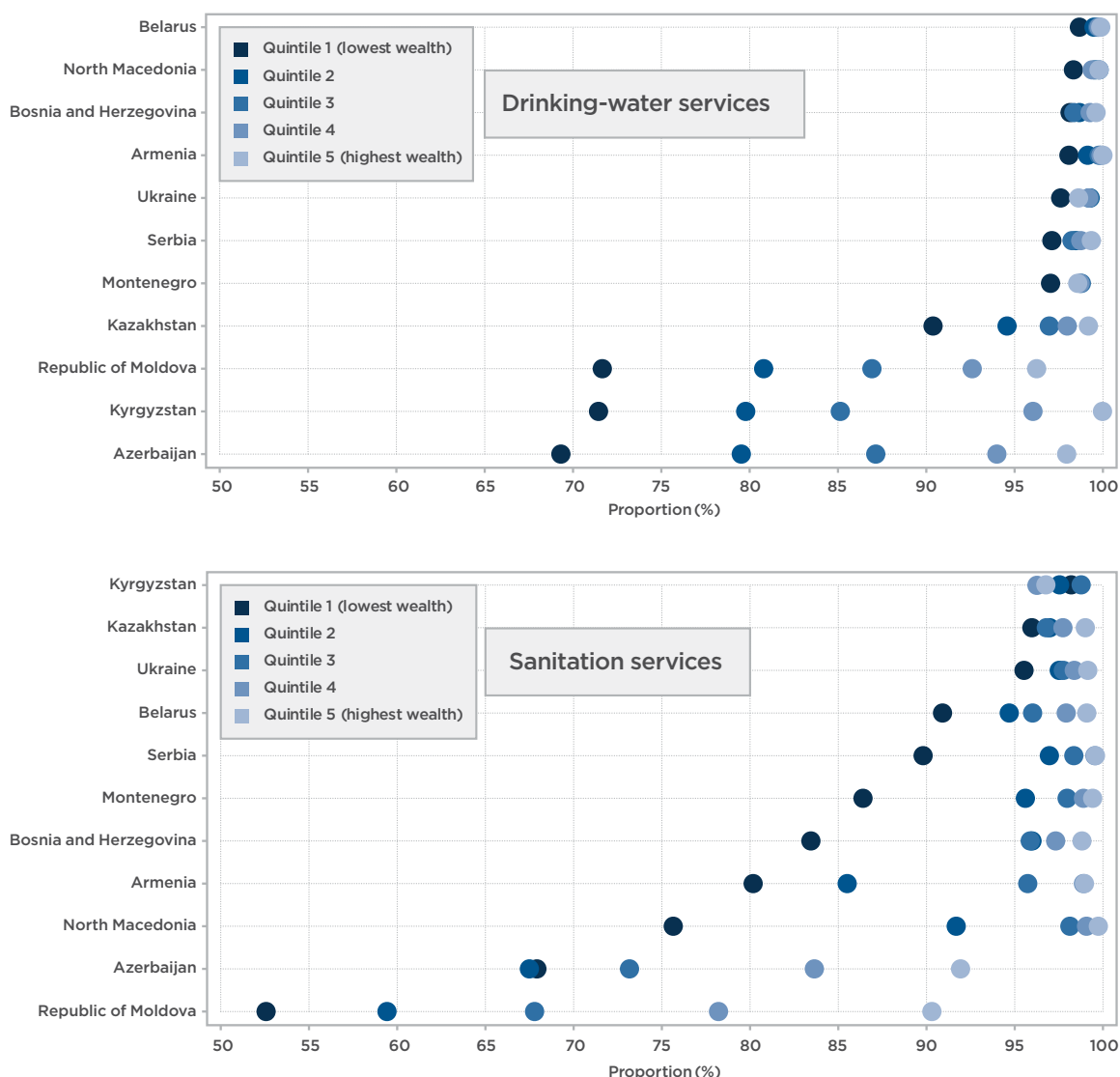
highest sanitation service levels, irrespective of wealth and location.

Wealth inequalities seem to play a greater role than geographical inequalities in the use of basic and safely managed sanitation services: the most affected groups are households in the poorest quintiles in either urban (three countries) or rural (eight countries) areas. The urban and rural wealthiest, on the other hand, show the highest proportions of dwellers using the two highest sanitation service levels, emphasizing the economic disparities in the Region.

#### 4.1.2.4 Social disparities

Alongside geographical and economic disparities, social disparities can also play an important role in drinking-water and sanitation services in the WHO European Region. These can manifest in different dimensions and refer to vulnerable and marginalized groups that are disadvantaged in access to or use of certain levels of drinking-water and sanitation services. Such groups include women and girls (concerning specific sex-related issues); people with special physical needs; users of water, sanitation and hygiene (WASH) facilities in institutions (such as schools, hospitals, workplaces and refugee camps); people without private facilities (such as homeless people and travellers); and people living in insanitary conditions (UNECE & WHO Regional Office for Europe, 2012).

**Fig. 23.** Proportion of the population using basic or safely managed drinking-water or sanitation services by wealth quintile (last year of reporting)



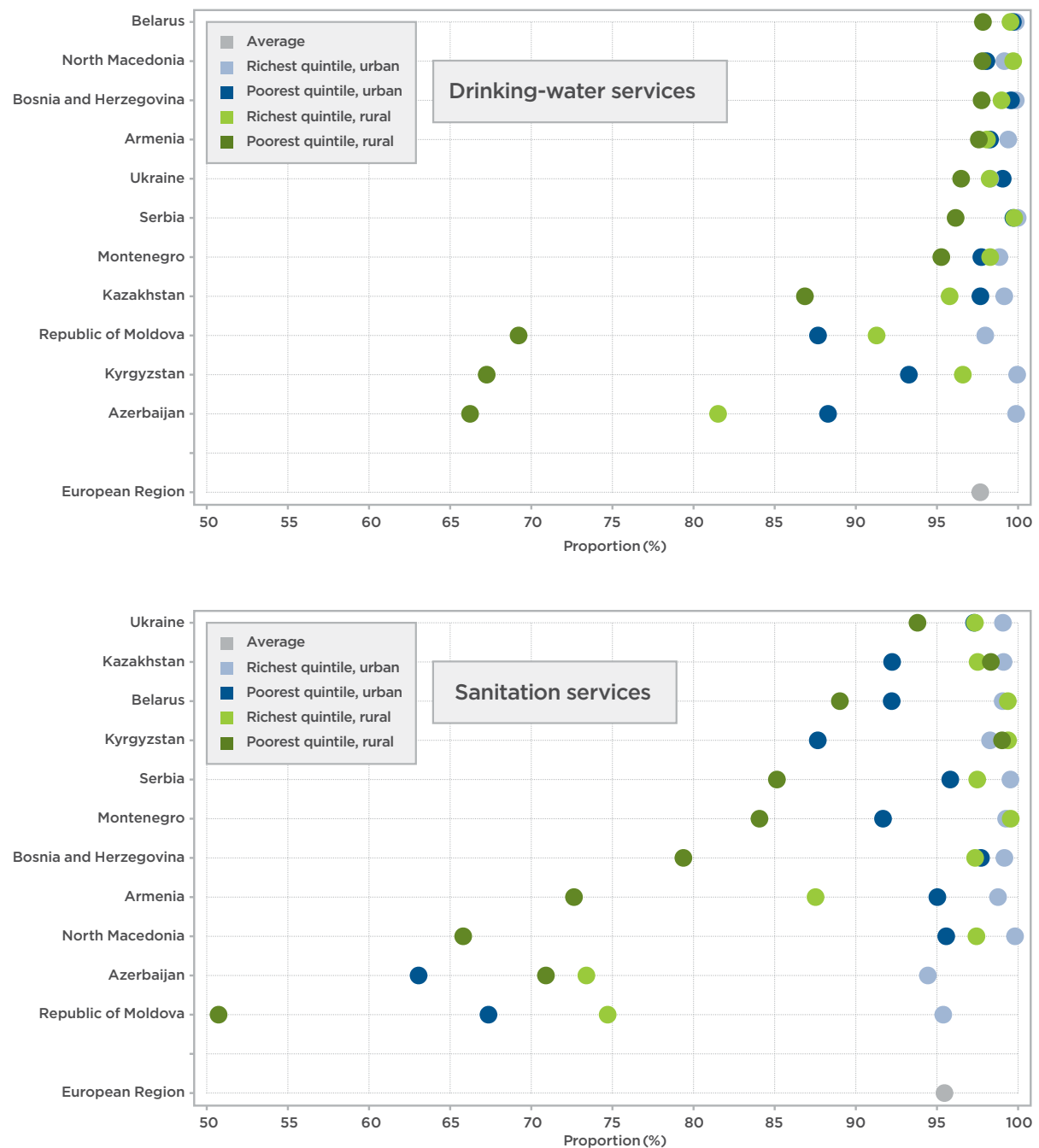
Note: last year of reporting ranges from 2006 to 2014.  
 Source: WHO & UNICEF (2017).

Data availability seems to be a particular issue for social disparities: very few international statistics are available, and they cover only specific aspects of this dimension. Data on WASH facilities in schools and health care institutions, for instance, are increasingly available; coverage figures for basic services in schools are very high for the Region. Noticeable disparities, however, exist between and within countries regarding such services. Country coverage ranges from 51% to 100% for basic drinking-water services, from 34% to 100% for basic sanitation and from 26% to 100% for basic hygiene (WHO & UNICEF, 2018). Equitable access to WASH services in schools has been found a critical issue, including impaired access for pupils with disabilities,

improper and inadequate consideration of girls' needs (such as menstrual hygiene management) and, in some countries, lower levels of services for pupils living in rural areas and/or minority groups (WHO Regional Office for Europe, 2016b).

For other social inequality aspects, however, data remain scarce. No regional or global data collection instrument is readily available for tracking social inequalities. Notwithstanding, the Equitable Access Score-card, developed under the auspices of the Protocol on Water and Health, offers countries a tool to self-assess access to water and sanitation services considering all three inequality dimensions (see Box 2).

**Fig. 24.** Proportion of urban and rural populations using basic or safely managed drinking-water or sanitation services by wealth quintile (last year of reporting)



Note: last year of reporting ranges from 2006 to 2014.

Source: WHO & UNICEF (2017).

### 4.1.3 Conclusions and suggestions

Inequalities in access to basic and safely managed drinking-water and sanitation services manifest in three key disparity dimensions in the WHO European Region: geographical, economic and social. In general, the situation for sanitation services seems to be worse than that for drinking-water. This is characterized by higher overall proportions of populations that rely on limited services or

unimproved facilities or practise open defecation, as well as greater inequality gaps within countries.

The inequality gap between rural and urban populations relying on less than basic drinking-water and sanitation services varies between ratios <0.5:1 and 35:1 for drinking-water and <0.5:1 and 11:1 for sanitation services within countries. With a few exceptions, rural dwellers are the most

disadvantaged, although a decreasing trend in reliance on less than basic drinking-water and sanitation services has been seen since 2000.

Analysis of economic disparities reveals significant gaps between wealthier and poorer population groups. Across all 11 countries with available data, use of both drinking-water and sanitation services follows a wealth gradient, with the poorest quintiles the most disadvantaged. While systematic data on financial affordability of water and sanitation services are not readily available, this is a common and growing concern in the Region.

The integrated analysis of geographical and economic disparities reveals that the most disadvantaged population groups are poor people living in rural areas. Thus, interventions to close persisting inequality gaps in access and use should prioritize those disadvantaged groups and areas.

Social inequalities in access are far less well documented, owing to the scarcity or even lack of

disaggregated data, but detailed baseline analyses carried out under the Protocol on Water and Health highlighted several vulnerable and marginalized groups (including children in schools, Roma populations and homeless people) who do not enjoy the same level of access to water and sanitation as the rest of society.

Overall, data availability remains an issue for particular inequality dimensions, such as wealth (data only available for 11 countries in the Region) and social disparities (very limited data available). To tackle persisting inequalities effectively and identify priority interventions, it is essential to improve the evidence base and data availability. In this context, it is important to establish mechanisms for regular monitoring and assessment of the country situation by putting a lens on disadvantaged population groups, geographical areas and institutional settings. The Equitable Access Score-card enables and facilitates a systematic self-evaluation of the country situation and progress monitoring. Development of a complementary action plan

### **Box 2. National action on equitable access to water and sanitation services through the Equitable Access Score-card**

The Equitable Access Score-card is an analytical tool that aims to support governments and other stakeholders to establish a baseline measure of equity of access to WASH. This creates a starting-point to facilitate discussion on effective interventions to reduce inequities and evaluate progress through a self-assessment process (UNECE & WHO Regional Office for Europe, 2013).

The Score-card guides participative collection of information on various policies that address three critical factors in ensuring equitable access to water and sanitation: reducing geographical disparities; overcoming the barriers faced by vulnerable and marginalized groups; and addressing affordability concerns (UNECE & WHO Regional Office for Europe, 2012). So far, it has been successfully applied in 11 countries in the WHO European Region, where the assessment process and outcomes have raised awareness of numerous gaps to ensure equitable access to WASH services and prompted the adoption of concrete measures to improve the situation.

In North Macedonia, for example, prevailing equity gaps were identified in 2015–2016. The assessment process was carried out in three regions (Skopje, Kumanovo and Veles), which represent about 50% of the country's population, jointly led by the National Institute of Public Health and the nongovernmental organization Journalists for Human Rights (Dokovska et al., 2015).

Overall, the Score-card process revealed a range of social inequalities. Despite comparatively high levels of access to improved sanitation services of 83% in rural areas and 99% in urban areas (WHO & UNICEF, 2017), the self-assessment pointed to problems in access for homeless people, lack of menstrual hygiene management facilities for adolescent girls in schools and an absence of toilets in religious facilities, among others. Furthermore, in the capital Skopje, only 26% of the Roma population had access to drinking-water and only 16% had toilets and a bathroom; others relied on outdoor facilities. Access to water and sanitation services for people with disabilities was also found to be lacking.

The self-assessment raised awareness of the social inequities in ensuring equitable access and helped improve understanding of the challenges faced, looking beyond official statistics. A campaign was set up to improve the situation, through which the assessment results were presented as an incentive to improve detected weaknesses and to promote access to water and sanitation for all, especially in public institutions and schools.

(UNECE & WHO Regional Office for Europe, 2016) to substantiate the targets set will help countries translate the priorities identified into time-bound, concrete interventions.

Required interventions, however, need to go beyond a mere increase in access to certain improved infrastructures. To achieve equitable access to safely managed services in accordance with SDG targets 6.1 and 6.2 and the objectives of the Protocol, it is essential to promote diligent day-to-day operation, management and surveillance of drinking-water and sanitation services to protect health and the environment effectively. In addition to investing in infrastructure, it is necessary to improve the capacity of water and sanitation operators in rural communities to provide safely managed

drinking-water and sanitation services in line with the recommendations of the WHO guidelines on drinking-water quality and on sanitation and health (WHO, 2017; 2018). Moreover, existing water governance frameworks need to apply an “equity lens” by establishing a strategic approach to achieving equitable access and targeting financial resources at this goal (UNECE & WHO Regional Office for Europe, 2012).

Countries in the Region that are Parties to the Protocol can use the opportunity to establish national and/or local targets to define incremental steps towards closing prevailing inequalities and achieving access to drinking-water and sanitation for everyone.

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### Suggested mitigation actions are:

- systematically identifying national equity gaps;
  - improving monitoring and availability of data on the inequality situation, using the Equitable Access Score-card to identify inequality gaps and priority interventions and monitor progress;
  - setting national targets under the Protocol on Water and Health and establishing a supporting equitable access action plan;
  - improving the capacity of water and sanitation operators to embrace and consider equity considerations in planning, management and operation of services;
  - improving the capacity of rural communities to improve their situations and provide safely managed drinking-water and sanitation services.
- 

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## 4.2 Inequalities in energy poverty

Jon Fairburn

### Status

Energy poverty data show some of the widest inequities and inequalities in the environmental literature, as well as some of the most widespread. Across the WHO European Region tens of millions of people are directly affected by energy poverty, which has a direct link to negative health impacts.

### Trend

The overall problem of energy poverty has been slightly reduced for both poor and non-poor income groups, but inequality remains strong in Europe.

#### 4.2.1 Introduction and health relevance

Energy poverty encompasses the issues of availability and affordability of different energy supplies. It therefore has some overlap with the indicators of ability to keep the home warm and ability to keep the home cool, which look at the potential consequences of energy poverty.

Availability of cleaner energy sources varies between and within countries; even if they are available, a lack of money often means that people end up using dirtier fuels, affecting their health and the health of others. It is estimated that almost 50 million households in the EU experience energy poverty (European Commission, 2018).

Use of solid fuels in households can worsen indoor air quality and lead to increased morbidity. For example, Sapkota et al. (2013) found an increase

in aerodigestive tract cancers in eastern Europe among those who used wood and coal fuels to heat their homes. A review of the health impacts of fuel poverty found significant effects on the physical health (especially weight gain) and susceptibility to illness of infants, as well as mental health effects in adults and adolescents (Liddell & Morris, 2010). Indoor air pollution has been linked to respiratory and cardiovascular mortality (WHO Regional Office for Europe, 2015).

The burden of disease due to indoor air pollution from household activities such as heating or cooking was estimated to be 117 200 deaths in the WHO European Region in 2012 (WHO, 2014). The use of solid fuels for heating also contributes to outdoor air pollution; the proportion its contribution represents has increased over time (Table 5).

**Table 5.** Residential heating contribution to outdoor air pollution and burden of disease in European regions, 1990 and 2010

Region	Proportion of PM <sub>2.5</sub> from residential heating (%)		Volume of PM <sub>2.5</sub> from residential heating (ug/m <sup>3</sup> )		Premature deaths per year		Disability-adjusted life-years	
	1990	2010	1990	2010	1990	2010	1990	2010
Central Europe	11.1	21.1	3.5	3.4	18 000	20 000	370 000	340 000
Eastern Europe	9.6	13.1	2	1.4	24 000	21 000	480 000	410 000
Western Europe	5.4	11.8	1.3	1.7	17 000	20 000	280 000	290 000

Note: PM<sub>2.5</sub> = particulate matter with an aerodynamic diameter of less than 2.5 micrometres.

Source: adapted from WHO Regional Office for Europe (2015).

#### 4.2.2 Indicator analysis: inequalities by location, rural/urban areas and income

Energy poverty data are available from Eurostat and derived from EU-SILC as well as EU Household Budget Surveys, which include Norway, Turkey and two Balkan countries (Eurostat, 2018a;

2018b). In addition, data have been compiled for other countries from the most recent national Multiple Income Cluster Surveys (UNICEF, 2019). Data on energy poverty and related inequalities are scarce, however, in the eastern part of the WHO European Region.

Table 6 shows differences in solid fuel use between rural and urban areas, ethnicities and income groups in five locations in eastern Europe and central Asia. The ranges between all types of classification are extremely wide. For example, in Kazakhstan only 1.5% of the population uses solid fuel to cook, compared to nearly half the population (44.8%) in Montenegro and almost three quarters of the population (71%) in Kosovo<sup>5</sup>. In all five locations rural populations have a starkly higher likelihood of using solid fuels.

Ethnicity is also a factor in all countries in terms of equity between different groups. Nevertheless, it is wealth (undoubtedly linked to ethnicity and location) that shows the most extreme levels of inequity in solid fuel use for cooking. The differences between the highest and lowest quintiles are among the highest inequalities identified by this report. This is particularly important, as the evidence is so strong on the health impacts of poor air quality on morbidity and mortality.

**Table 6.** Proportion of households using solid fuels for cooking in locations in eastern Europe and central Asia (data from 2013 to 2015)

Country/area	National average (%)	Urban (%)	Rural (%)	Most disadvantaged ethnicity (%)	Lowest wealth quintile (%)	Highest wealth quintile (%)
Kazakhstan (2015)	1.5	0.1	3	Kazakh ethnicity: 2.1	5.6	0
Kosovo [a] (2013–2014)	71	48.3	84.6	Albanian ethnicity: 71.8	95.1	23.6
Kyrgyzstan (2014)	29.3	7.2	39.5	Uzbek ethnicity: 47.2	55.4	0.3
Montenegro (2013)	44.8	33.5	63.8	Islamic religion [b]: 71.4	79.8	16.8
Serbia (2014)	34.2	17.5	58.5	Bosnian ethnicity: 82.3	75	3.2

Notes: [a] in accordance with United Nations Security Council resolution 1244 (1999), [b] in the Montenegro Multiple Income Cluster Survey, ethnicity was replaced by religion.

Source: derived from five Multiple Income Cluster Surveys in the Balkans and central Asia (UNICEF, 2019).

Across the EU as a whole, people below the relative poverty level are three times as likely to have difficulty paying their energy bills as households above it. Between 2010 and 2016, very little variation has occurred in the annual figures (Fig. 25).

Looking at Greece in particular, which was the only country put into special measures by the EU during austerity, the data identify three results.

- Households of all incomes were twice as likely to have difficulty paying their bills as equivalent households in the EU in 2010.
- A dramatic increase in households below the poverty level having difficulty paying their bills can be seen: increasing from 29.5% in 2008 to 65.3% in 2016. This was three times as high for the equivalent populations in the rest of the EU.
- A dramatic increase in households above the poverty level having difficulty paying their bills can be seen: increasing from 12.4% in 2008 to 36% in 2016. This was over three times as high as for the equivalent population in the rest of the EU.

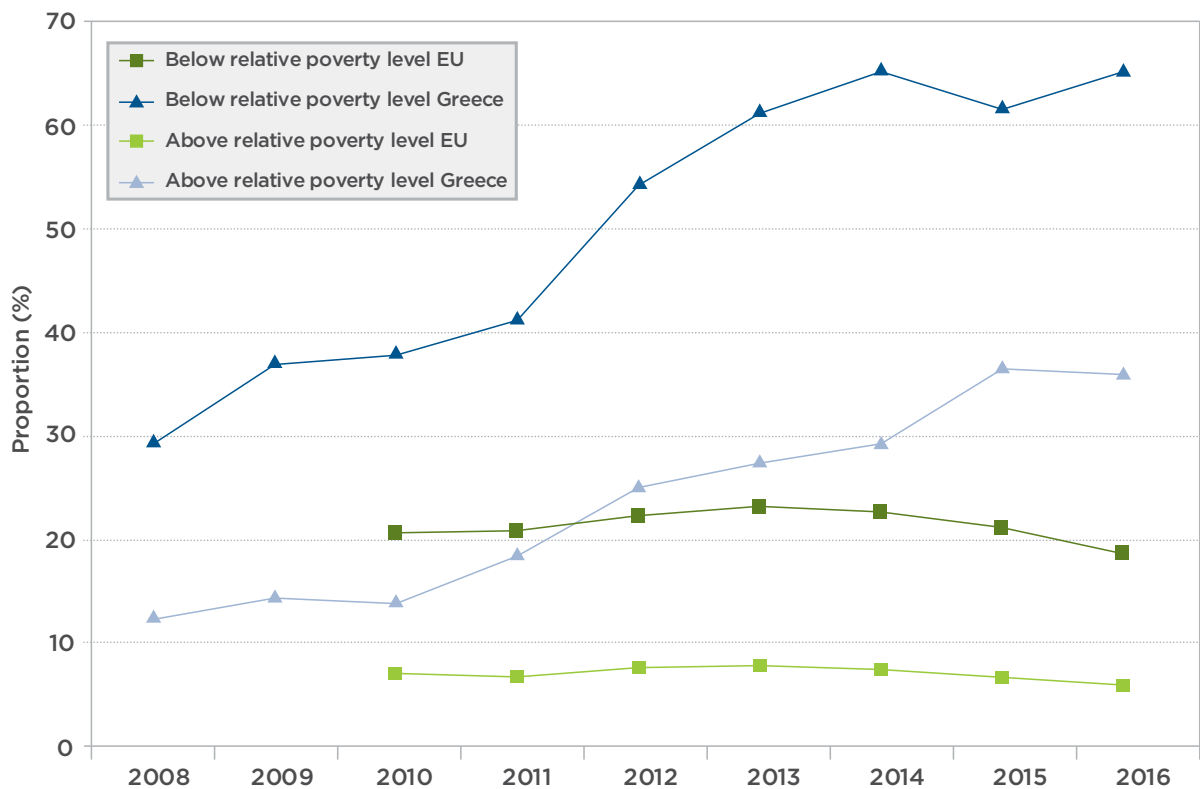
Fig. 26 shows a wide variety of energy spending, both within countries by income group and between countries. The lowest income groups spend a greater proportion of their income on energy, with both higher expenditure and higher levels of inequality in the Euro 2 subregion. It is also worth noting that energy poverty by itself is not linked to climate; Finland and Sweden record some of the lowest expenditures for energy of any country, as well as very low intracountry inequalities due to a range of housing and social policies.

#### 4.2.3 Conclusions and suggestions

Living in cold and damp homes contributes to a variety of mental stressors, as well as physical discomfort. Being in debt can give rise to mental health concerns; it may lead to people cutting back on food to save for energy bills. It can also lead to spatial shrink in the home, if people only heat one or two rooms. Energy poverty presents some of the largest environmental inequalities across a range of cohort types including rural/urban areas, ethnicity and – most especially – income groups.

<sup>5</sup> In accordance with United Nations Security Council resolution 1244 (1999).

**Fig. 25.** Proportion of households with difficulty paying energy bills in the EU and Greece by poverty level, 2008–2016



Source: data from Eurostat (2018a).

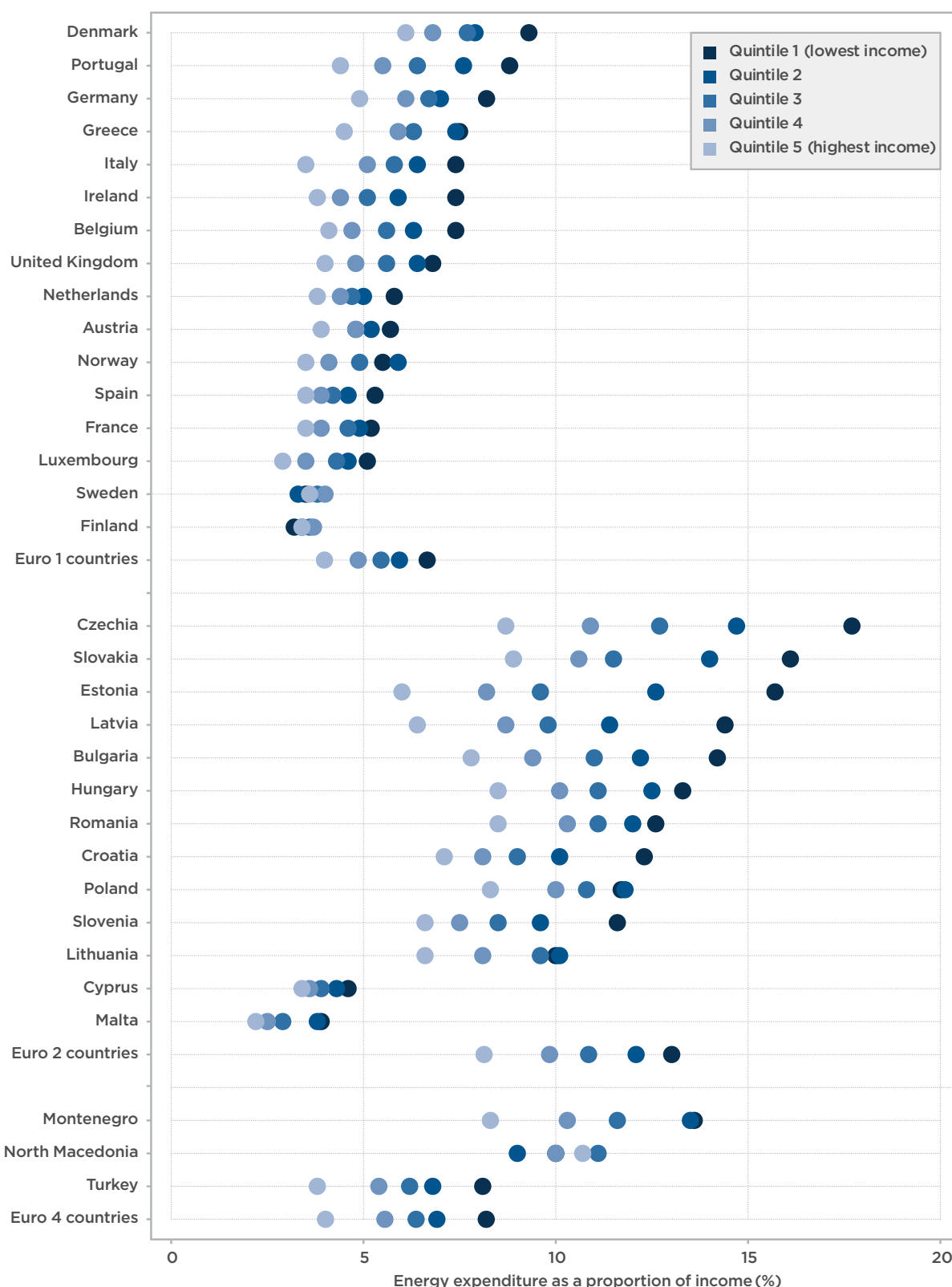
Defining energy poverty varies across countries, both conceptually and in the ability to measure and monitor the phenomenon (Thomson, Bouzarovski & Snell, 2017). Within the EU less than one third of countries recognize the concept of energy poverty: “energy poverty is a linked yet distinctive issue from vulnerable consumers, and requires different metrics to define it and measures to tackle it” (INSIGHT\_E, 2015).

A recent review (INSIGHT\_E, 2015) provides a comprehensive oversight of policy measures in place in different economies in Europe. More recently, the EU has established an online EU Energy Poverty Observatory (European Commission, 2018), which has a range of data and policy options categorized by socioeconomic group, housing situation, energy carrier and location, among others.

#### Suggested mitigation actions are:

- establishing appropriate metrics to measure and monitor energy poverty;
- using energy audits as a starting-point to find out how big the problem is;
- focusing initially on the most vulnerable households - for example, disallowing disconnection completely during wintertime for certain physically more vulnerable households, such as disabled people and pensioners;
- providing strong social security provision that can ensure energy costs are met - for example, use of social tariffs or energy bill protection measures;
- focusing on energy efficiency in the social housing sector or in the housing sector in general.

**Fig. 26.** Energy expenditure as a percentage of household income, by income quintile (2015 or latest available year)



Note: Italy: 2005 data; Denmark, France, North Macedonia, Montenegro, Norway, Portugal, United Kingdom: 2010 data; all other countries: 2015 data.  
 Source: Eurostat (2018b), adapted.

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## 5. Urban environment and transport inequalities

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The quality of the urban environment and the related functions carried out in urban settings – such as mobility, recreation and social exchange within the community – affect health, well-being and quality of life for all citizens residing in and using the neighbourhood. The relevance of local environments and urban settings for sustainable development is also reflected in SDG 11, which calls for inclusive, safe, resilient and sustainable cities and human settlements.

The urban setting shapes the social and physical environment in which families and individuals spend a significant amount of their time. Residents with a high level of dependence on local conditions and amenities (such as children, elderly people and those with functional limitations and disabilities) are especially affected.

Urban conditions can be very diverse across different districts and neighbourhoods of the same city. Districts may be affected by industrial activities and related environmental emissions; high levels of traffic and the associated air pollution and noise; and a lack of quality features that enhance healthy living, such as recreation areas, urban green spaces and nature sites. Socially disadvantaged areas, mostly inhabited by households with lower financial capacities, are often affected by double environmental disadvantage: a lack of environmental resources and higher levels of environmental deprivation.

Urban conditions and local environmental quality are not only key mechanisms for local authorities to shape healthy cities and protect their citizens from environmental and health risks; they also provide opportunities to mitigate inequalities and focus on the most deprived areas where the environmental burden is highest. This section highlights various inequalities related to urban environments and transport through six indicators:

- inequalities in exposure to air pollution;
- inequalities in self-reported noise annoyance;
- inequalities in fatal road traffic injuries;
- inequalities in lack of access to recreational or green areas;
- inequalities in chemical exposure; and
- inequalities in exposure to and health risks from contaminated sites.

Unfortunately, many of these indicators lack information from countries in the eastern part of the WHO European Region, where equity-sensitive data on urban environmental conditions could not be identified from international databases. For chemical risks and contaminated sites, this also applies to countries in the western part of the Region. As a result, data from an EU project on human biomonitoring and from an Italian project on assessment of contaminated site exposure are used to provide insights into the magnitude of inequalities for these risks, which are often undocumented.



## 5.1 Inequalities in exposure to air pollution

Alberto González Ortiz, Aleksandra Kaźmierczak, Matthias Braubach

### Status

Air pollution is a major European environmental challenge that often affects seriously socially disadvantaged areas more than others and can be associated with increased exposure levels among socially disadvantaged populations.

### Trend

Although air pollution levels have decreased over recent years, inequalities in exposure persist.

#### 5.1.1 Introduction and health relevance

Despite continuous improvements in air quality, air pollution poses a serious risk to human health in Europe, especially in urban areas, where most of the population lives and is exposed to air pollutants from transport, industry and domestic energy consumption – particularly residential heating (WHO Regional Office for Europe, 2015).<sup>6</sup> Air pollution triggers major health effects, including respiratory and cardiovascular diseases and cancer. It is the largest environmental health risk in the WHO European Region, with nearly 500 000 deaths per year related to outdoor air pollution (WHO, 2016).

Differences in exposure to air pollution are present at very different scales: among countries and among regions and cities within countries. For example, Branis & Linhartova (2012) found that smaller cities in Czechia tend to have higher concentrations of combustion-related air pollutants (sulfur dioxide and particulate matter (PM) less than or equal to 10 µg in diameter (PM<sub>10</sub>)), whereas larger cities are exposed to higher levels of nitrogen dioxide. In England, United Kingdom, PM concentrations were found to be higher generally in socially deprived areas, but the pollution–deprivation relationship varied by urban/rural status (Milojevic et al., 2017).

A large body of evidence suggests that exposure to air pollution is often associated with socioeconomic status: people with lower status tend to live in environmental conditions that are more exposed to air pollution, although national and regional differences are observed. For instance, people on lower incomes are more likely to live near main roads, where rents may be cheaper. An analysis of air pollution exposure in nine European metropolitan areas found higher pollution levels

in areas with greater proportions of people born outside the EU and higher unemployment rates (Samoli et al., 2019). The most important drivers for inequalities in air pollution exposure are:

- land use and urbanization (people with lower socioeconomic status tend to live in areas with higher levels of traffic and industrial activity, leading to higher levels of air pollution);
- housing conditions (low-income groups tend to live closer to work in city centres or industrial areas due to better access and/or lower costs);
- work conditions (low-income groups are more likely to work outdoors or in places affected by air pollution).

Employment status, education level and income can affect people's underlying health conditions, influencing their sensitivity and, therefore, vulnerability to the health effects of air pollution. These effects tend to be stronger among populations with lower socioeconomic status as a result of long-term health conditions, poor housing, inadequate diet and stress (EC, 2016; Kim et al., 2018; Barnes et al., 2018).

Abundant evidence is emerging from Europe on the associations between socioeconomic status and air pollution, but these associations are highly location- and scale-specific, and conclusions from local studies may not be applicable to all situations across the WHO European Region.

#### 5.1.2 Indicator analysis: inequalities in exposure to air pollution by region, income and education

Within the EU, the EEA compiles and maintains air pollution databases for its member and cooperating countries (EEA, 2019). No European or international database exists to enable assessment of air pollution exposure levels by social or demographic determinants, however. In the most eastern part of the WHO European

<sup>6</sup> See chapter 4.2 on energy poverty for information on the air pollution impacts of residential energy sources.

Region, information on air pollution levels is limited and inequality dimensions cannot be assessed.

This analysis of inequalities in exposure to air pollution relies on EEA and WHO air pollution databases and draws from a recent EEA assessment, which overlaid spatially selected socioeconomic indicators with exposure to air pollutants, expressed as population-weighted concentrations (EEA, 2018a). This was done for three types of spatial unit: NUTS 2 regions, NUTS 3 regions and Urban Audit cities.<sup>7</sup> The analysis was undertaken for three time points, to explore changes in exposure over time. To minimize the impact of meteorological variability, data were combined to obtain averages across several years (2007–2008, 2010–2011 and 2013–2014 for NUTS 2 and NUTS 3 regions; only 2010–2012 for Urban Audit cities). The results provide an overview of the associations between aspects of social disadvantage and exposure to selected air pollutants in Europe. Because of the European scale only general patterns can be identified: differences in pollution exposure and social indicators among small neighbourhoods in different parts of cities cannot be assessed, so the

study findings cannot be extrapolated to individual regions or cities. Further, the results do not imply any causality between social and environmental conditions.

Although the initial EEA study covered four main pollutants (PM less than or equal to 2.5 µm in diameter (PM<sub>2.5</sub>), PM<sub>10</sub>, nitrogen dioxide and ozone), this analysis presents results for PM<sub>2.5</sub> only, owing to its substantial impacts on human health.

### 5.1.2.1 Geographical variation in PM<sub>2.5</sub> exposure at NUTS 3 region level

The data on exposure to PM<sub>2.5</sub> (expressed as population-weighted annual mean PM<sub>2.5</sub> levels) in NUTS 3 regions show that exposure has decreased over time for all quintiles (Table 7), although it increased between 2007–2008 and 2010–2011. Despite this general reduction, both relative and absolute differences in exposure between the most polluted and least polluted quintiles remained stable. For instance, in 2013–2014 exposure to PM<sub>2.5</sub> in the most polluted quintile of NUTS 3 regions (21 µg/m<sup>3</sup>) was on average 2.4 times higher than that in the least polluted quintile (9 µg/m<sup>3</sup>).

**Table 7.** PM<sub>2.5</sub> exposure at NUTS 3 region level and relationships between the most and least polluted quintiles

Year	Mean population-weighted concentration (µg/m <sup>3</sup> )					Ratio of quintile 5:quintile 1	Absolute difference (quintile 5–quintile 1)
	Quintile 1 (least polluted)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (most polluted)		
<b>2007–2008</b>	10.3	13.0	14.1	16.5	23.1	2.25	12.8
<b>2010–2011</b>	10.6	14.2	15.4	17.7	24.5	2.30	13.8
<b>2013–2014</b>	8.8	12.3	13.3	14.9	20.8	2.37	12.0

Source: ETC/ACM (2018).

Although all quintiles experienced an overall reduction in mean PM<sub>2.5</sub> exposure values, however, this does not mean that every NUTS 3 region in Europe benefited from reduced air pollution levels: regional analyses found some increases (Fig. 27). The strongest exposure increase was detected in regions of Poland, but increasing PM<sub>2.5</sub> levels were also reported in a range of other countries – especially Czechia, Ireland and parts of Germany and the United Kingdom.

### 5.1.2.2 Relationship of PM<sub>2.5</sub> exposure with socioeconomic disadvantage variables

Differences in PM<sub>2.5</sub> exposure are not only found between regions; they are also associated with socioeconomic status and levels of disadvantage within each region. Table 8 indicates that PM<sub>2.5</sub> exposure tends to be higher in more disadvantaged areas; this is valid at all spatial scales and for most of the indicators of disadvantage considered. For example, at NUTS 3 level more disadvantaged regions according to gross domestic product (GDP) per capita tend to have higher PM<sub>2.5</sub> exposure (exposure ratio of 1.3:1, indicating 30% higher exposure levels in the most disadvantaged regions).

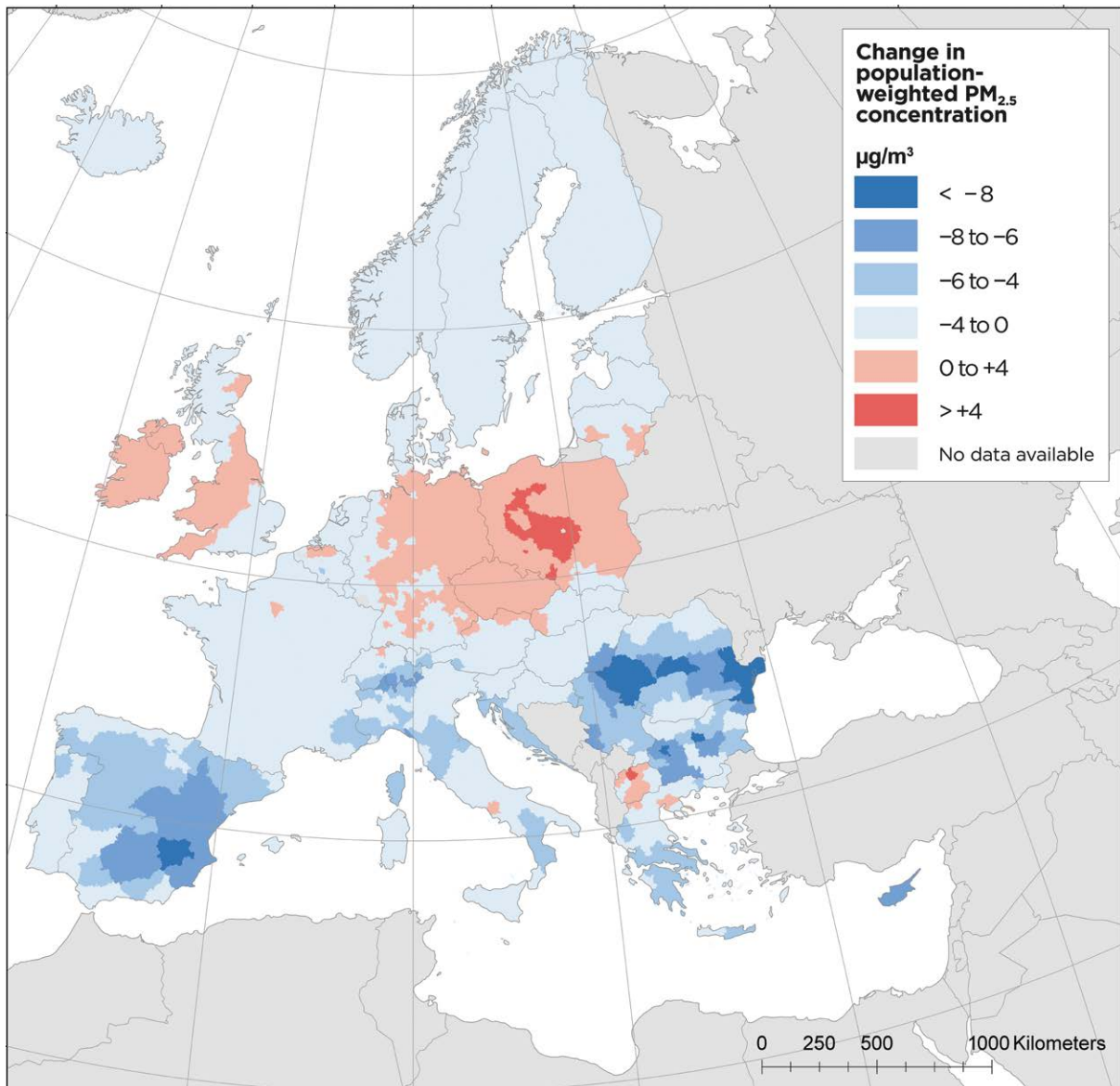
<sup>7</sup> The NUTS classification (nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU for statistical studies. Urban Audit refers to EU-wide city statistics.



Most associations have remained relatively consistent over the period, except that between long-term unemployment and  $PM_{2.5}$  exposure at the NUTS 2 level, which has weakened over time.

This resulted in reduced unemployment-related inequality in  $PM_{2.5}$  exposure in both relative and absolute terms across NUTS 2 regions.

**Fig. 27.** Absolute change in  $PM_{2.5}$  exposure in NUTS 3 regions, 2007–2008 to 2013–2014



Source: ETC/ACM (2018).

These data indicate that regions affected by high levels of social disadvantage are more likely to have elevated exposure to air pollution. In the following sections, two associations between indicators of social disadvantage and exposure to air pollution are explored in more detail to show the gradient of  $PM_{2.5}$  exposure across quintiles of social disadvantage.

### 5.1.2.3 $PM_{2.5}$ exposure and GDP per capita at NUTS 3 region level

Fig. 28 shows that, within the whole period studied, people in the most disadvantaged quintiles of NUTS 3 regions by GDP per capita were exposed to higher  $PM_{2.5}$  concentrations than those in wealthier quintiles. However, the association was not linear, as the four less disadvantaged quintiles all had very similar average  $PM_{2.5}$  exposure.

All GDP per capita quintiles show the same pattern of change over time, however:  $PM_{2.5}$  exposure

decreased between the first (2007–2008) and last (2013–2014) time points, and all had a peak in 2010–2011. This consistent reduction in pollution explains why the relative and absolute

difference in exposure between the most and least disadvantaged quintiles remained similar over time (Table 8), although the most disadvantaged quintile shows larger decreases between time points.

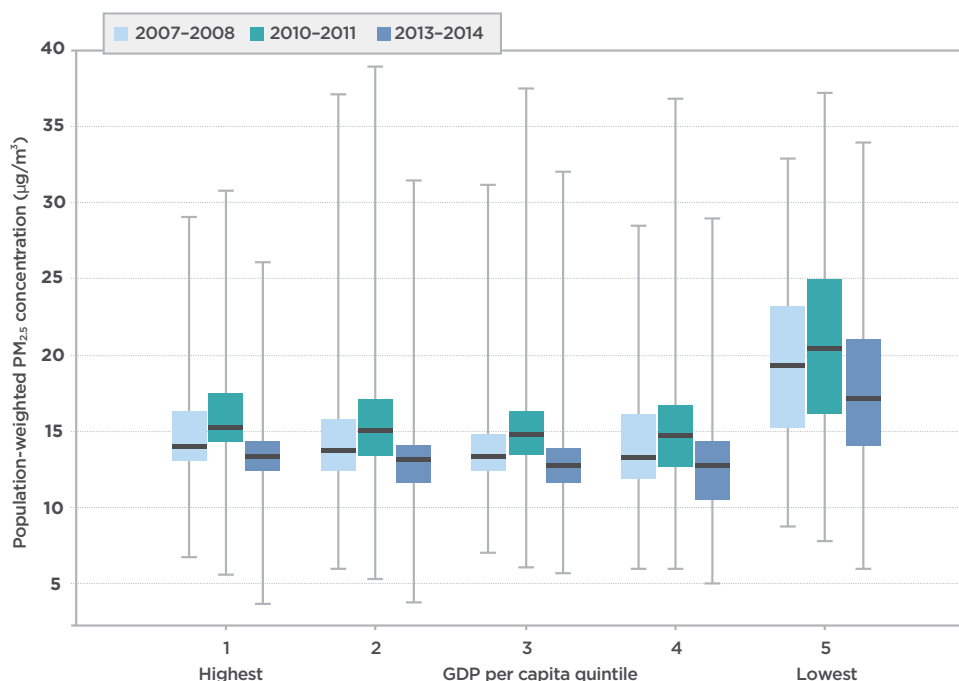
**Table 8.** PM<sub>2.5</sub> exposure by social disadvantage indicators at NUTS 3 region, NUTS 2 region and city levels

Spatial scale	Social indicator	Exposure ratio of most disadvantaged:least disadvantaged quintile			Exposure difference between most disadvantaged and least disadvantaged quintile (µg/m <sup>3</sup> )		
		2007–2008	2010–2011	2013–2014	2007–2008	2010–2011	2013–2014
<b>NUTS 3 region</b>	Per capita GDP	1.31:1	1.30:1	1.33:1	4.6	4.7	4.3
	Percentage of people without higher education	1.45:1	1.36:1	1.46:1	5.8	5.0	5.2
<b>NUTS 2 region</b>	Household income	1.29:1	1.39:1	1.37:1	4.5	6.1	5.0
	Long-term unemployment rate	1.39:1	1.24:1	1.29:1	5.1	3.3	3.3
		2010–2012			2010–2012		
<b>Urban Audit city</b>	Percentage of people without higher education	1.20:1			2.9		
	Unemployment rate	1.01:1			0.1		

Notes: an exposure ratio value >1:1 indicates that the most disadvantaged regions have higher exposure levels than the least disadvantaged ones; a value <1:1 indicates the opposite.

Source: ETC/ACM (2018).

**Fig. 28.** PM<sub>2.5</sub> exposure by GDP per capita across NUTS 3 regions over time



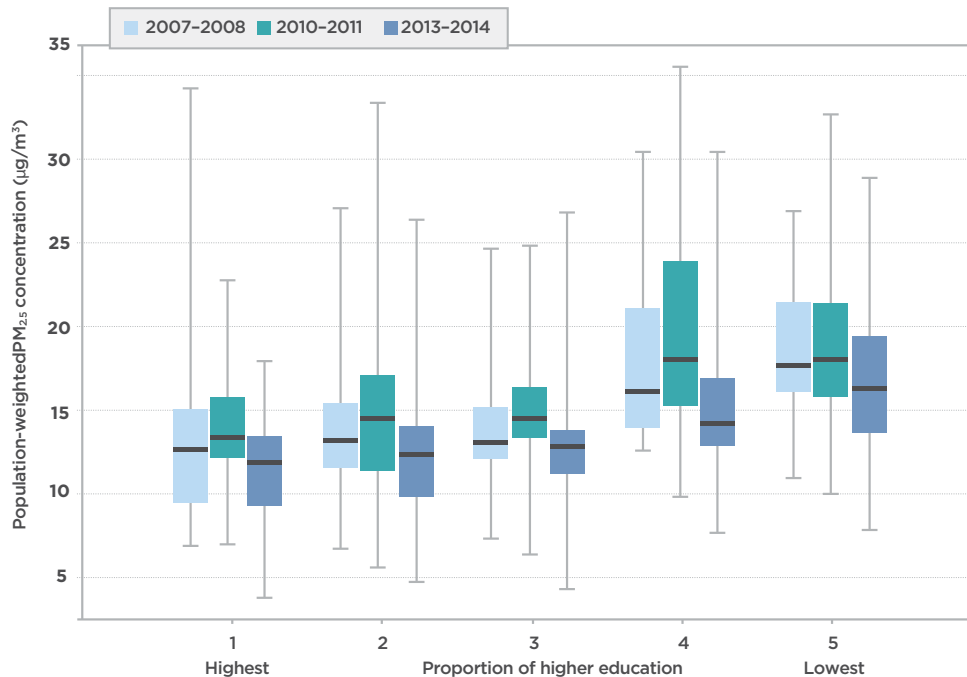
Source: based on ETC/AM (2018).

#### 5.1.2.4 PM<sub>2.5</sub> exposure and higher education at NUTS 2 region level

NUTS 2 regions with a higher percentage of people without higher education tended to have higher exposure to PM<sub>2.5</sub> across the period studied. Exposure increased from 2007–2008 to 2010–

2011, then decreased by 2013–2014 for all quintiles (Fig. 29). In contrast to the GDP per capita data, however, air pollution levels reflect a more linear social gradient, rising as the proportion of people without higher education increases.

**Fig. 29.** PM<sub>2.5</sub> exposure by higher education across NUTS 2 regions over time



Source: based on ETC/AM (2018).

#### 5.1.2.5 Differences in PM concentrations within countries

Moving from a European overview to exploring air pollution differences within countries, Fig. 30 shows the average number of days that PM<sub>10</sub> levels exceeded the EU limit value (daily PM<sub>10</sub> concentration = 50 µg/m<sup>3</sup>) in 2016 for selected countries, using data from background monitoring stations.<sup>8</sup> The data suggest that this concentration threshold is exceeded much more often at urban than rural monitoring stations, but variations between countries in relation to the difference of exceedance days are wide. There is also diversity between countries when considering data for industrial and traffic monitoring stations in urban settings (which are limited because of the low number of stations): France, Italy and Poland report their highest number of exceedance days in relation to traffic, while Czechia, Germany and Spain report it at industrial stations. In Czechia, France and Germany urban industrial or traffic monitoring stations record roughly 2.5 times more exceedance days than urban background monitoring stations, showing the impact of local air pollution sources (noting that socially disadvantaged households are often more likely to live closer to industrial sites or traffic hot spots).

Unfortunately, these data can only show spatial variations in PM<sub>10</sub> concentrations and further research is needed to explore whether variations in exposure are also associated with socioeconomic disadvantages such as poverty, education or social deprivation.

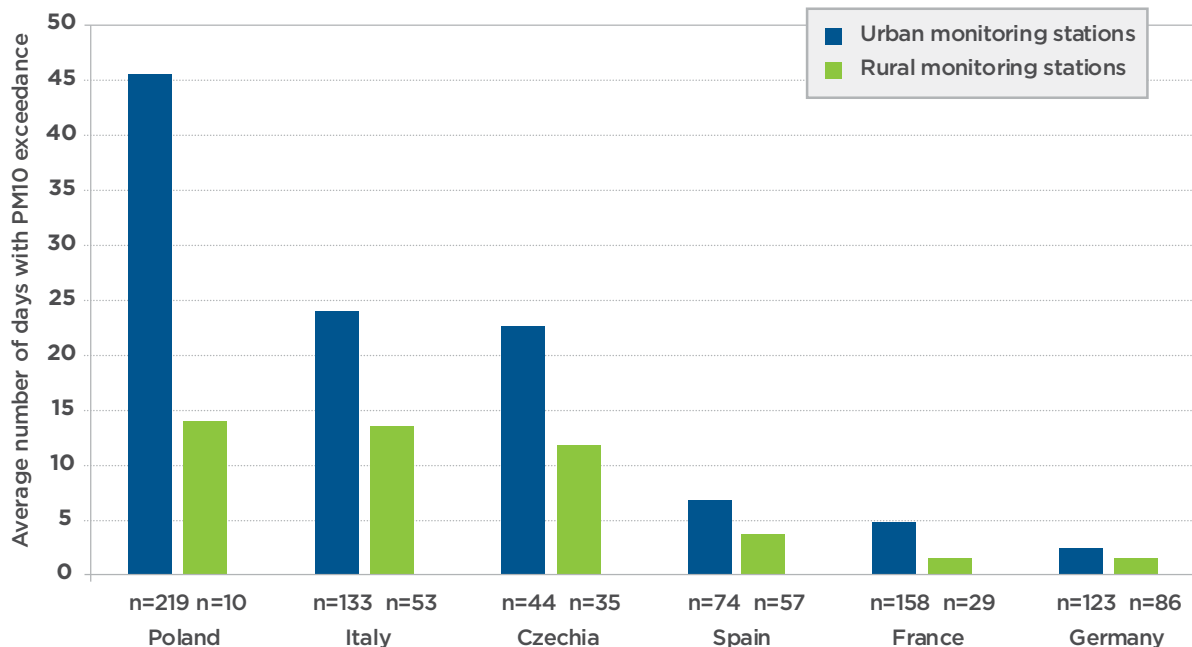
Fig. 31 draws data from all urban monitoring station types (background, traffic and industrial) and shows the differences of average PM<sub>2.5</sub> concentrations at the local level, highlighting the pollution differences among cities within various European countries. Average PM<sub>2.5</sub> levels in cities tend to be higher in eastern European and Balkan countries, where the highest values can reach beyond 40 µg/m<sup>3</sup> and the absolute difference is also high (for example, concentration differences between cities in Bosnia and Herzegovina and Croatia are above 30 µg/m<sup>3</sup>). The data indicate

<sup>8</sup> Background stations are used to monitor air pollution levels that are not affected by specific sources such as industry or traffic (for which industrial and traffic monitoring stations are established). Depending on their surroundings, the stations can be categorized as urban or rural.

that strong intracountry differences exist in almost all countries, however, including those with comparatively low concentration levels such as Portugal and Sweden. The highest inequalities

among cities can be found in Czechia (where the most polluted city compared to the least polluted city gives a pollution ratio of more than 8:1), followed by Italy and Sweden, with ratios of 6:1.

**Fig. 30.** Average number of days with PM<sub>10</sub> exceedance in urban and rural background monitoring stations, selected countries, 2016



Note: “n” represents the number of monitoring stations  
 Source: EEA (2018b).

### 5.1.3 Conclusions and suggestions

Air pollution is the largest environmental health risk in Europe, and although everyone is exposed to ambient air, groups in socially or economically deprived situations are more likely to be exposed to higher levels of air pollution.

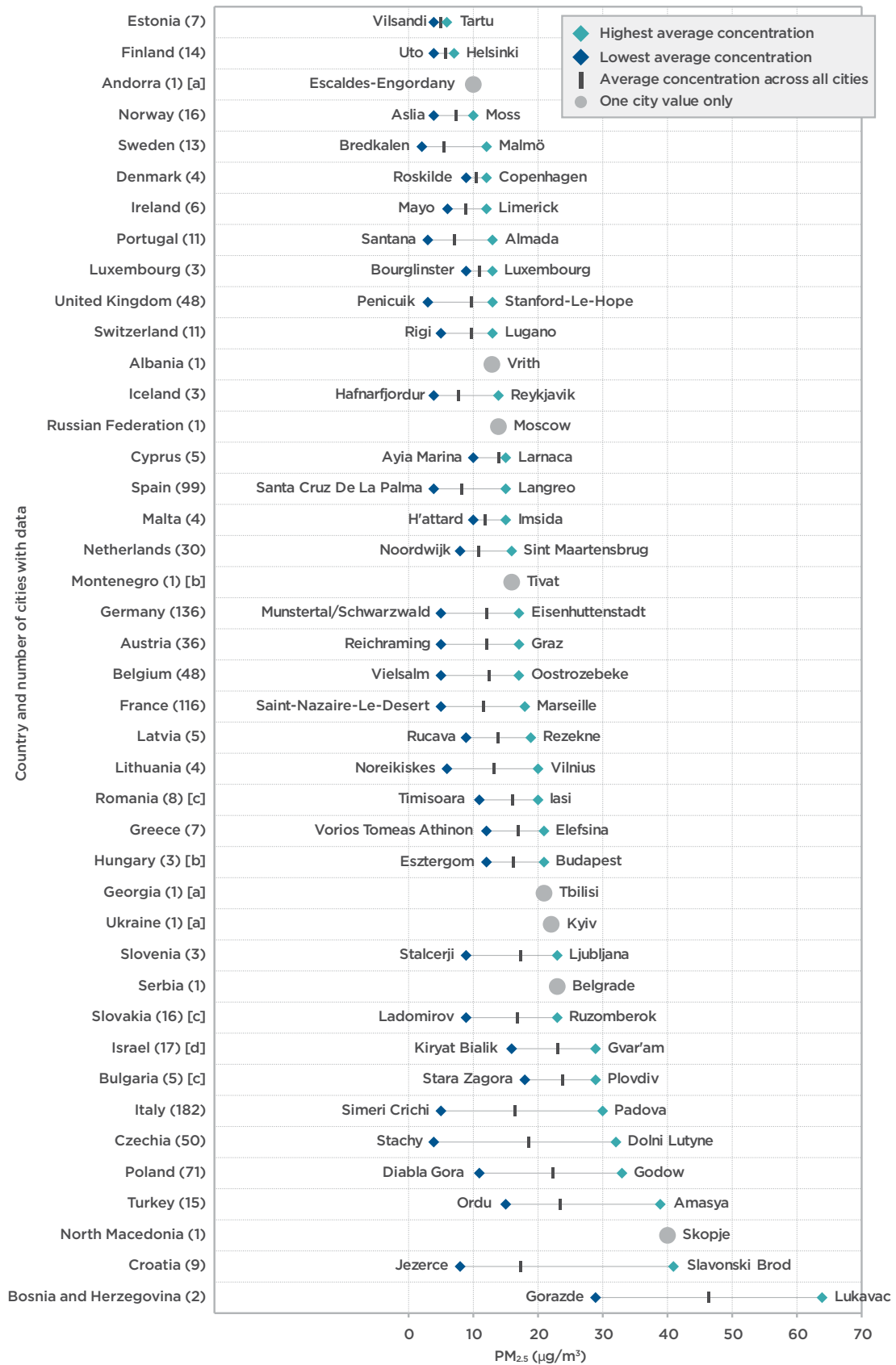
In general, European air quality has improved over time, which implies a general reduction in exposure across all categories of socioeconomic disadvantage. Nevertheless, inequality in exposure by socioeconomic disadvantage has not been reduced and the most disadvantaged regions in terms of GDP per capita, higher education or long-term unemployment tend to have higher exposure to PM<sub>2.5</sub>.

Different air pollutants and spatial scales may show different inequality patterns and affect different

population groups. Data on air pollution exposure differences at the individual level and especially for socioeconomic dimensions and small-scale spatial variations are lacking. Further, outside EU and EEA member and cooperating countries, data on air pollution are often unavailable, and reliable monitoring and data access functions are required.

Tackling the social distribution of environmental risks through environmental policies and enhancing coherence between policies in terms of human health and air pollution may help to address the current inequalities. Finally, monitoring needs to be enhanced to include more air pollution data where they are missing and equity dimensions to identify the most exposed groups and develop appropriate mitigation actions.

**Fig. 31.** Average concentration of PM<sub>2.5</sub> in cities (2016 or last indicated reporting year)



Notes: average concentration calculated as the average over all monitoring stations in the city; [a] last reporting year: 2017; [b] last reporting year: 2014; [c] last reporting years: 2015 and 2016 combined; [d] last reporting year: 2015.

Source: WHO (2019).

### Suggested mitigation actions are:

- extending air pollution monitoring networks in countries where they are poor and continuing to reduce air pollution in general;
- observing EU limits and target values and following the WHO air quality guidelines;
- road traffic management, such as a shift in transport mode to walking and cycling, improving public transport or the introduction of low-emission zones in city centres – this would help to reduce exposure to air pollution where socially vulnerable groups tend to live;
- improved spatial and land-use planning (for instance, creating multipolar cities or greening public spaces) to reduce emissions of air pollutants and exposure of most deprived groups, reducing socioeconomic and exposure contrasts;
- banning certain domestic heating fuels, like coal, combined with subsidizing switching to cleaner heating options for low-income households – this could improve air quality in low-income zones;
- defining measures in short-term action plans to reduce concentrations in places where deprived people live or spend their time.

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## 5.2 Inequalities in self-reported noise annoyance

Stefanie Dreger, Gabriele Bolte

### Status

Inequalities in complaints about noise from neighbours or from the street are evident among different income levels: poorer people show higher prevalence, especially in Euro 1 countries. The same pattern of inequalities in self-reported noise annoyance is observable for urban and for rural regions in Euro 2 countries.

### Trend

Although the prevalence of self-reported noise annoyance due to noise from neighbours or from the street has decreased slightly over recent years in Euro 1 and Euro 2 countries, absolute inequalities have increased – especially in Euro 1 countries.

#### 5.2.1 Introduction and health relevance

Environmental noise (defined as noise emitted from all sources except industrial workplaces) is an important public health problem. The most frequently cited sources of noise are traffic noise, noise from neighbours and aircraft noise. At least 100 million people in the EU are affected by road traffic noise, and in western Europe at least 1.6 million years of healthy life are lost because of road traffic noise (WHO Regional Office for Europe, 2018). Effects of noise can be physiological as well as psychological. There is also convincing evidence of the non-auditory effects of noise on adult health (WHO Regional Office for Europe, 2018) highlighting the substantial public health impact of this environmental pollution.

Epidemiological studies present inconsistent results on the distribution of noise exposure between different social groups (Kohlhuber, Schenk & Weiland, 2012). Some studies show evidence of an inverse social gradient in residential noise exposure, demonstrating that people in a lower socioeconomic position are exposed to higher noise levels (see, for example, Grelat et al., 2016), while others show the opposite pattern (such as Havard et al., 2011). Inconsistent evidence on social inequalities in noise exposure may be due to differences in methodological approaches, such as social indicators used, different scales of exposure assessment, objective measurement of noise exposure (e.g. based on outdoor noise exposure prediction models and expressed with average noise indicators  $L_{DEN}$  and  $L_{NIGHT}$ ) or assessment of subjective exposure (e.g. perception of noise, self-reported annoyance due to noise). In some cities affluent people may indeed be more exposed, as they prioritize a central living location to avoid commuting

(Havard et al., 2011). The recent systematic review by Dreger et al. (2019) also found mixed results, but studies using indicators of material deprivation or deprivation indices showed higher environmental noise exposure levels in groups with lower socioeconomic positions.

It is important to highlight the fact that studies also indicate that more advantaged individuals are less likely to suffer from noise-related health impacts, even if they live in noisier areas (Science for Environment Policy, 2016). Health inequalities may therefore arise not only as a result of exposure differentials but also from differences in vulnerability (Bolte, Pauli & Hornberg, 2011). Chronic diseases or less healthy lifestyles may contribute to increased vulnerability to noise-related health effects. On the other hand, more affluent residents may be able to afford better-constructed housing. It is most likely that a combination of higher exposure, increased vulnerability and fewer resources result in more pronounced noise-related health impacts among socially disadvantaged people.

#### 5.2.2 Indicator analysis: inequalities by income, rural/urban areas, relative poverty and household type

Data on self-reported noise annoyance are available from the Eurostat EU-SILC survey, which includes some western European and Balkan non-EU countries (Eurostat, 2018). For countries not covered by EU-SILC, no equity-sensitive information on noise exposure was identified.

The overall prevalence of complaints about noise from neighbours or from the street varies by country between 7% (North Macedonia) and 26% (Malta), with an average of 18% across all countries.



Fig. 32 presents the prevalence of complaints about noise from neighbours or from the street by income quintile. Prevalence of complaints is, on average, higher in Euro 1 than in Euro 2 and in Euro 4 countries.

**Fig. 32.** Prevalence of complaints about noise from neighbours or from the street by income quintile (2016)



Source: Eurostat (2018), adapted.

In most Euro 1 countries there is an inverse social gradient between income of the household and self-reported noise annoyance, with people in the highest income quintile showing the lowest prevalence (as low as 6.9% for Iceland) and people in the lowest income quintile showing the highest prevalence (above 30% in the cases of Germany and the Netherlands). Exceptions are found for three Euro 1 countries. In Greece the relationship is the opposite: people in the highest income quintile have the highest prevalence and people in the lowest quintile the lowest. Ireland and Italy show a nonlinear distribution of prevalence, with the highest prevalence in the lower income quintiles, the lowest prevalence in the higher/middle income groups and the prevalence of the highest income quintile in the middle.

In Euro 2 countries, the pattern is heterogeneous, with no consistent inverse social gradient across countries. Some countries follow a similar trend to Euro 1 countries, with lower prevalence for the highest income quintile and higher prevalence for the lowest. Others have nonlinear distributions of prevalence or no major income differences in self-reported noise annoyance at all. The largest inequalities by income quintile are found in Romania, where prevalence of complaints about noise from neighbours or from the street among people from the most affluent households is 24.7% compared to a prevalence of 13.5% among people of the poorest households. Overall, a slightly positive social gradient might be observable in Euro 2 countries, if at all, indicating that prevalence is higher in the higher income quintiles. Ranges of prevalence for the lowest and highest income quintiles are smaller in Euro 2 than Euro 1 countries.

For Euro 4 countries, data are available only for North Macedonia and Serbia. In both countries, the prevalence of complaints about noise from neighbours or from the street is lower in the two lower income quintiles than in the three middle and higher income quintiles.

For greater detail, Fig. 33 is divided into two charts, outlining the prevalence of complaints about noise from neighbours or from the street by poverty level, contrasting people living in cities and in rural areas. People living in suburbs or towns are not presented. Overall, the prevalence of complaints about noise from neighbours or from the street is higher in urban than in rural areas, and this difference is more strongly expressed – in both Euro 1 and 2 countries – than the difference between above and below the poverty level. For both urban and rural areas, Euro 1 countries show the highest prevalence, followed by Euro 2 and Euro 4 countries. Irrespective of urbanization level and subregion, significant differences by poverty status can be observed in both urban and rural areas.

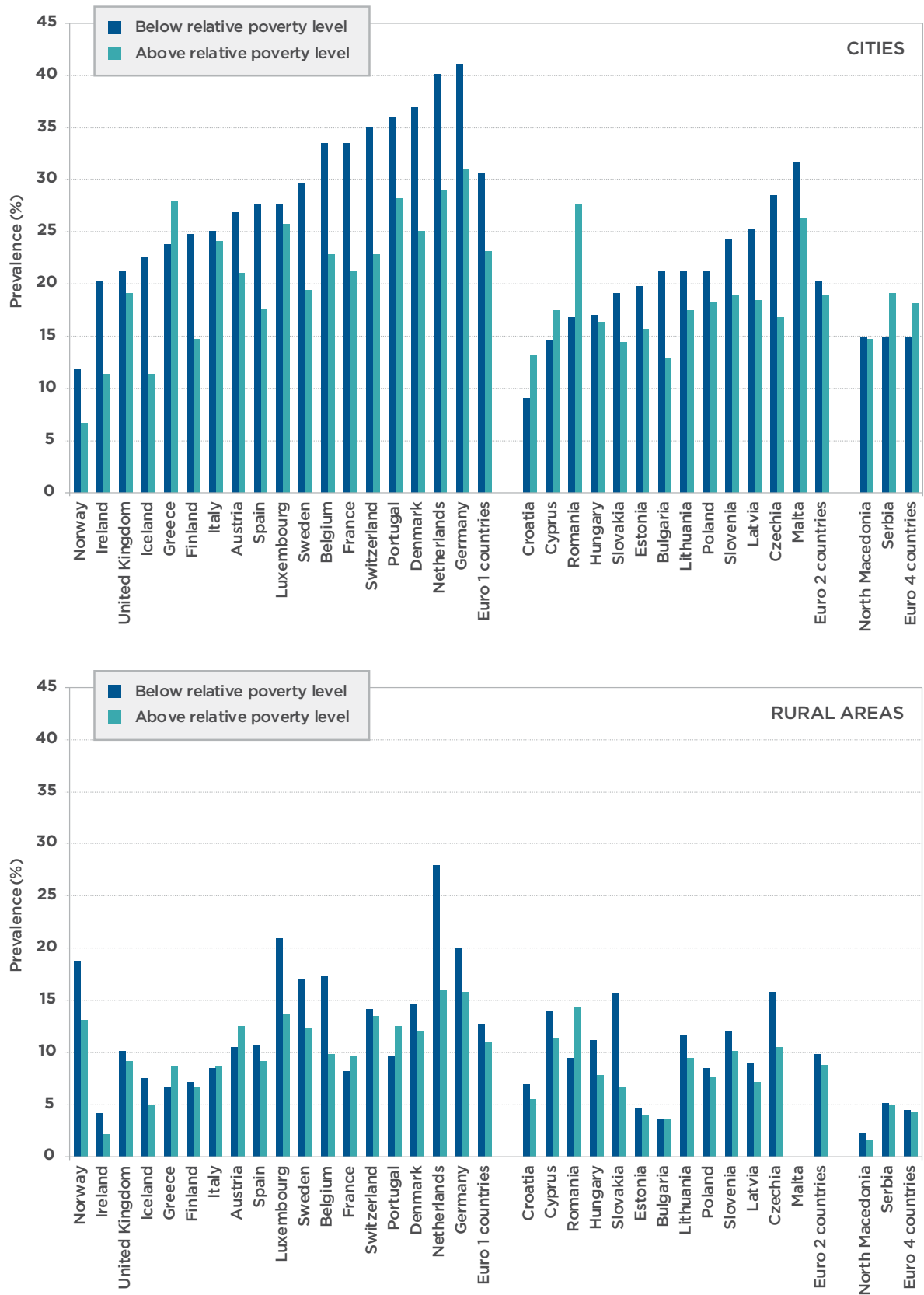
In urban areas, people living in households below the poverty level tend to have a higher prevalence of complaints – Croatia, Cyprus, Greece, Romania and Serbia being exceptions. The highest prevalence is observed for people living in households below the poverty level in urban areas of Germany (41.2%) and the Netherlands (40.2%). In rural areas a similar trend can be observed, with people living in households below the poverty level showing a higher prevalence; Austria, Bulgaria, France, Greece, Italy, Portugal and Romania are exceptions. In rural areas, people living in households below the poverty level in the Netherlands have (by far) the highest prevalence (28.0%).

Fig. 34 presents data on the time trend of prevalence of complaints about noise from neighbours or from the street by poverty level. These show decreasing values for both socioeconomic groups: those living above and below the poverty level in Euro 1 and Euro 2 countries. Despite general reductions in complaints about noise for all groups, the reduction is slightly more pronounced for people living above the relative poverty level in Euro 1 countries than for those living below it. The absolute inequality has increased over time, reaching a difference in prevalence of 5.4% in 2016. Relative inequalities (ratio of exposure prevalence: prevalence among people living in relative poverty divided by prevalence among people living above relative poverty level) have slightly increased over recent years from 1.17:1 in 2007 to 1.31:1 in 2016 in Euro 1 countries.

In contrast to Euro 1 countries, in Euro 2 countries households above the relative poverty threshold have a higher prevalence of complaints about noise from neighbours or from the street. In general, the reduction in prevalence of complaints is slightly larger in Euro 2 than Euro 1 countries. Prevalence in the two income groups has decreased by more or less the same amount over time. In 2016 the absolute inequality was 0.8%. Relative inequalities have slightly increased over recent years from 0.99:1 in 2007 to 0.94:1 in 2016 in Euro 2 countries.

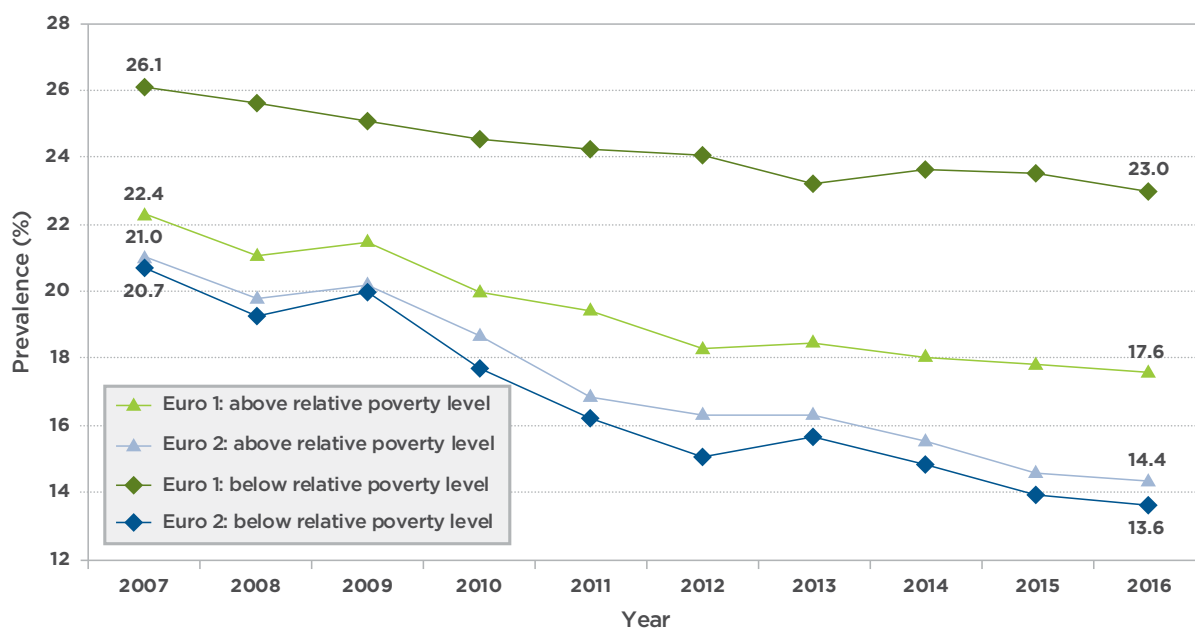
Comparing prevalence of self-reported noise annoyance between different household types, most countries show the highest prevalence for single-parent households with dependent children. In Euro 1 countries, single-parent households with dependent children have a prevalence of 25%, followed by all households with dependent children (19%) and households with one adult older than 65 years (15%). In Euro 2 countries, prevalence for single-parent households with dependent children is 16%; all households with dependent children and households with one adult older than 65 years have a similar prevalence of 14% (data not shown).

**Fig. 33.** Prevalence of complaints about noise from neighbours or from the street in cities and rural areas by poverty level (2016)



Source: Eurostat (2018).

**Fig. 34.** Time trend of prevalence of complaints about noise from neighbours or from the street by poverty level



Note: Euro 1 figures for 2016 exclude Iceland due to lack of data; Euro 2 figures for 2007–2009 exclude Croatia due to lack of data.

Source: Eurostat (2018).

### 5.2.3 Conclusions and suggestions

Prevalence of self-reported noise annoyance varies considerably between countries. Irrespective of social differences, in many countries a relevant proportion of the population is affected by noise from neighbours or from the street. Overall, people living in cities have a higher prevalence of self-reported noise annoyance than people living in rural areas. In urban and rural regions of Euro 1 and Euro 2 countries poorer people were more often annoyed due to noise exposure than people living above the relative poverty level. People living below the relative poverty level in cities in Euro 1 countries face the highest noise burden. If towns and suburban regions are included in the analyses, the overall prevalence is slightly higher among people living above the relative poverty level in Euro 2 countries.

Separate analyses of annoyance by noise from neighbours and annoyance by noise from the street are not possible with the available data. Studies have shown that health impacts such as annoyance, sleep disturbance and cardiovascular disease are mostly related to traffic noise, so data on subjective noise exposure in terms of self-reported complaints about noise exposure should be gathered separately for different sources of noise. In addition to subjective noise exposure, data on objective source-specific noise exposure would increase the validity of noise exposure monitoring. Moreover, vulnerable groups such as children and chronically ill and elderly people (WHO Regional Office for Europe, 2018) should always be considered in monitoring social inequalities in noise exposure and in the development of mitigation actions specifically to address those with increased vulnerability and poorer coping capacities due to their socioeconomic position.

### Suggested mitigation actions are:

- better reporting of objective traffic-related noise exposure and subjective noise annoyance by gender and further socioeconomic dimensions as prerequisite for efficient targeting of most affected population groups or neighbourhoods;
- further enforcement of the EU Environmental Noise Directive to tackle the important public health issue of traffic-related noise – particularly addressing socially vulnerable groups in monitoring and mitigation measures;
- ensuring that action plans to address noise issues at a regional level take potential social inequalities in noise exposure and different vulnerabilities into account;
- targeted measures to reduce the vulnerability of socioeconomically deprived populations to the health impacts of noise exposure, to ensure they are not subjected to greater risks because of a lack of resources, lack of coping capacity and higher exposure;
- promoting and adopting more sustainable forms of transport to reduce both noise and air pollution from motorized traffic.

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## 5.3 Inequalities in fatal road traffic injuries (RTIs)

Sani Dimitroulopoulou, Christina Mitsakou

### Status

RTIs and related deaths are a major public health risk, unevenly distributed among and within countries in the WHO European Region. Income, age and sex affect RTI-related mortality rates: the highest rates observed occur in higher middle-income countries, among males rather than females and in the age groups 15–24 years and 65 years and over.

### Trend

RTI-related mortality rates show a decreasing trend, but significant inequalities by age and sex persist.

#### 5.3.1 Introduction and health relevance

RTIs are one of the leading causes of death, disability and property loss worldwide. In 2015 they caused an estimated 1.5 million deaths globally (Wang et al., 2016). RTIs also have a substantial impact on affected families, health care services and national economies (Ainy et al., 2014).

In the WHO European Region RTIs represent a major public health risk, as they are responsible for thousands of fatalities (Mitis & Sethi, 2013; Shen et al., 2013). This burden is unevenly distributed: the average mortality rates in low- and middle-income countries are more than twice as high as those in high-income countries. The number of deaths from land transport accidents per 100 000 inhabitants decreased in most EU countries between 1999–2001 and 2011–2013, but increased in eastern European countries, as reported by the EU's Shaping European policies to promote health equity (EURO-HEALTHY) project (Santana et al., 2017). Substantial downward trends over time were also observed – between as well as within countries – in the systematic review by Sengoelge et al. (2019). The cross-country studies showed association of RTIs with education among women and with area deprivation among men, while within-country studies indicated inequalities in RTIs for those from less well-off living areas. This indicates that more systematic efforts are needed if the global target of a 50% reduction in deaths associated with RTIs is to be achieved by 2020 (Jackisch et al., 2015). Interventions related to the road traffic environment for control and prevention of injuries will reduce RTIs, and may also reduce social inequalities (Sengoelge et al., 2019).

Child mortality rates from RTIs also declined in the Region between 2000 and 2015; however, the mortality gap has widened between low- and

middle-income countries and high-income ones (Sethi et al., 2017). Unfortunately, no European data are available on RTIs by personal income or socioeconomic status. Individual studies show that the parental behaviour (not using car seats) is related to less well-educated parents or those from deprived areas (Sengoelge et al., 2019).

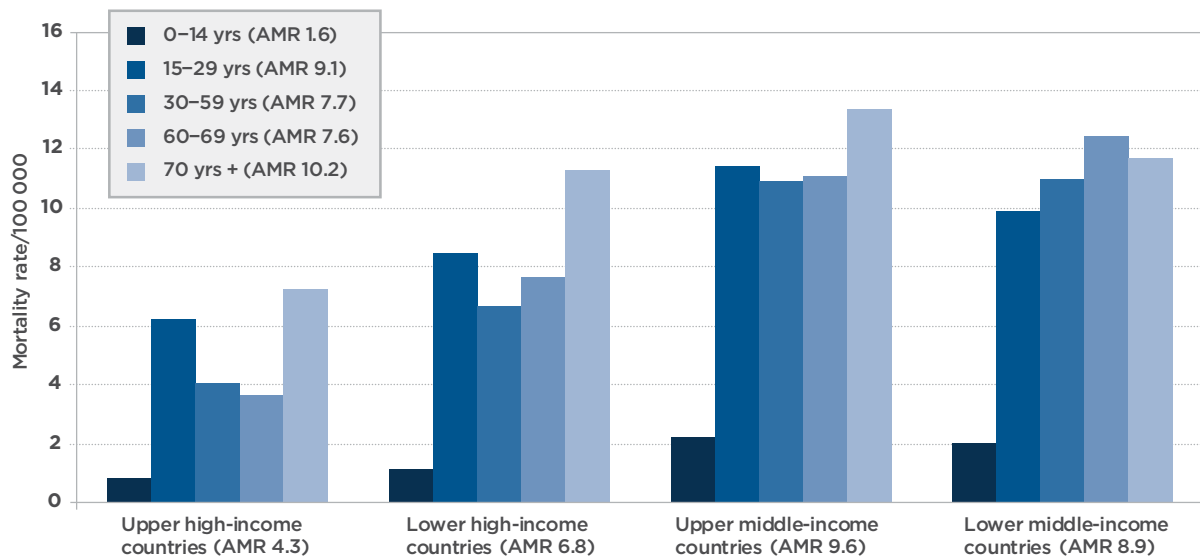
#### 5.3.2 Indicator analysis: inequalities by country income, age and sex

Data on RTIs are available by sex and age in the WHO mortality database for the vast majority of countries in the WHO European Region (WHO, 2018a). For seven countries lacking RTI data, information on transport-related injuries is compiled from the WHO database instead. To show further intracountry and intracity inequalities, data from the EURO-HEALTHY project covering EU countries are used.

Based on recent mortality data, Fig. 35 shows the inequalities in RTI mortality rates between upper and lower high-income countries and upper and lower middle-income countries in the WHO European Region. The average rates range from 4.3/100 000 in upper high-income countries to 9.6/100 000 in upper middle-income countries. The group aged 70 years and over has the highest average mortality rate (10.2/100 000), followed by those aged 15–29 years (9.1/100 000); the rate among the latter group is especially high in high-income countries.

Among all age groups, the highest mortality rates are found in the upper and lower middle-income countries. The relative inequality between the 70 years and over and 15–29 years age groups is consistent (15–30% higher mortality rates in the oldest age group) across the various income categories.

**Fig. 35.** RTI mortality rate/100 000 population by national income level and age in the WHO European Region (last year of reporting)



Note: AMR = average mortality rate, calculated as the population-weighted average for country income categories.  
Source: data from WHO (2018a).

Age-standardized national RTI mortality rates are shown in Fig. 36. The same calculation is shown in Fig. 37, based on all transport-related mortality rates for four countries where RTI-specific data were not available.

Aggregated data for all countries in Fig. 36 show that the lowest average mortality rate is among children (0-14 years), at 1.4/100 000. The rates for all other age groups are much higher, peaking among those aged 65 years and over (9.9/100 000). The highest rates occur in the highest age group in 29 of the 45 countries represented (peaking at 23.8/100 000 in Kyrgyzstan) and in the 15-24 years age group in 13 of the 45 (peaking at 16.0/100 000 in Latvia). This is nevertheless encouraging, as it shows a significant reduction in the average RTI mortality rates of this latter age group (which had the highest rate in the 2012 WHO environmental health inequalities assessment report at 11.9/100 000) to 8.2/100 000.

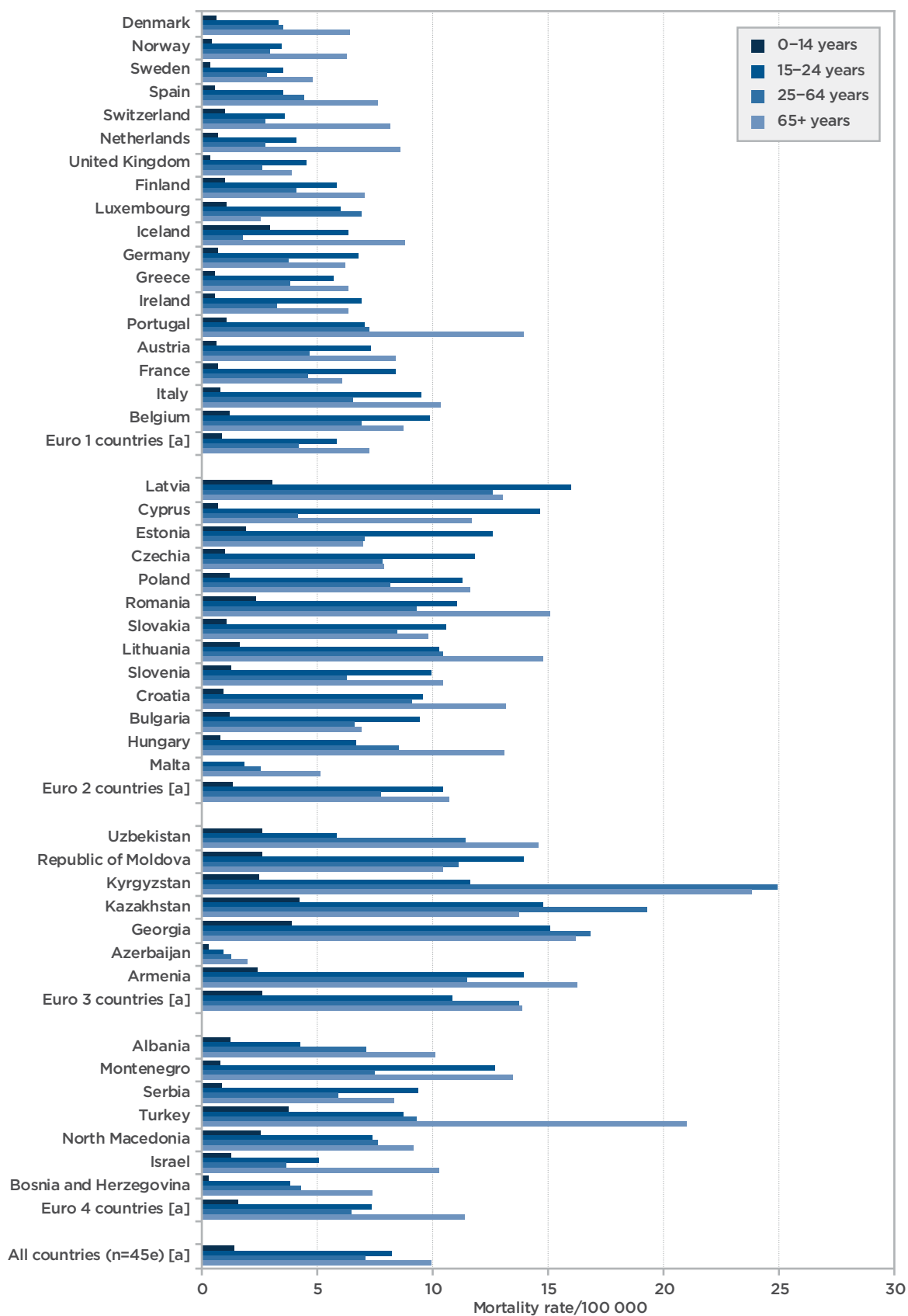
As illustrated in Fig. 37 for mortality from all transport injuries, the highest rate is reported for the 15-24 years age group (overall average of 14.3/100 000, peaking at 26.1/100 000 in the Russian Federation). This is followed by the 25-64 years (13.6/100 000) and the 65 years and over age group (11/100 000), while children aged 0-14 years have the by far lowest mortality rate (2.2/100 000). These rates are lower than the corresponding mortality rates reported in the 2012 WHO environmental health inequalities assessment report (18.6, 15.6, 14.8 and 2.9, respectively), showing that overall mortality rates decrease, while inequalities by age persist.

The differences by sex in road traffic-related mortality are demonstrated by the sex ratios of fatal RTIs for different age groups (Fig. 38), which show that males are at higher risk. The inequalities between males and females are greatest in the younger adult groups (20-24, 25-29, 30-44 years), with men aged 25-29 years five times more likely to die from RTIs than women. After the age of 29, the inequality decreases moderately to a sex ratio of between 2.4:1 and 1.5:1 in the older age groups (65 years and over). The dots represent the outlier values within each age group, showing that in some countries the sex ratio can go beyond 10. It must be noted, however, that in some countries sex-related inequalities are reversed for certain age groups, indicating that there can sometimes be higher mortality rates among females.

The recently completed EURO-HEALTHY project found a range of intracountry differences for RTI mortality rates (Table 9). Regional disparities are very high (factor greater than 5) in Austria, Belgium, Finland, Germany and the United Kingdom, but low in Bulgaria, Croatia, Hungary, Poland, Romania and Slovenia.

Fig. 39 presents the rate of RTI victims (injured and killed) per 100 000 inhabitants in European metropolitan areas, monitored at the municipal level in 2001 and 2011. The number of victims shows a decreasing trend overall, but the results indicate persistence of significant variations of RTI-related mortality rates across the different districts of the metropolitan areas.

**Fig. 36.** Age-standardized mortality rate/100 000 population from RTIs by age group (last year of reporting)

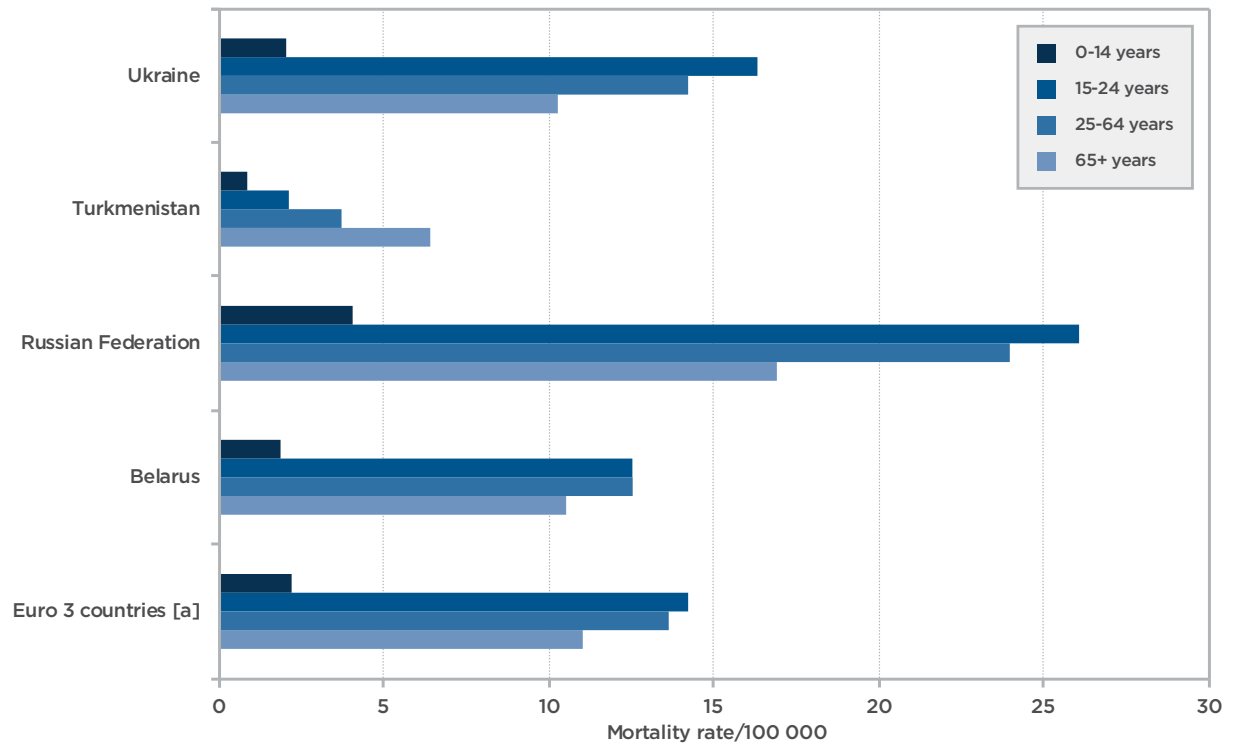


Note: [a] average of national rates.

Source: data from WHO (2018a).

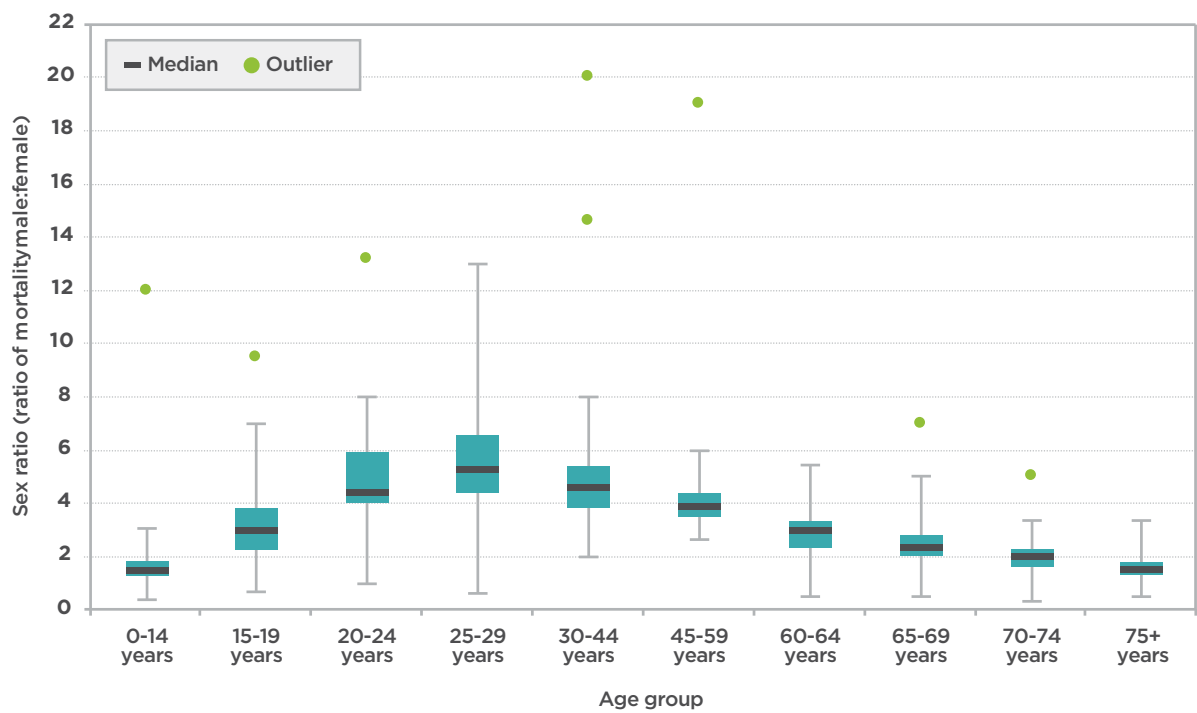


**Fig. 37.** Age-standardized mortality rate/100 000 population from all transport injuries by age group (last year of reporting)



Note: [a] average of national rates  
 Source: data from WHO (2018a).

**Fig. 38.** Sex ratios by age group for RTI mortality (last three reporting years)



Note: country coverage as for Fig. 36.  
 Source: data from WHO (2018a).

**Table 9.** Intracountry differences in RTI death rates/100 000 population for selected countries, 2014

Country	Minimum mortality rate (region)	Average national mortality rate	Maximum mortality rate (region)	Ratio of minimum: maximum rates
Austria	1.2 (Wien)	5.0	7.3 (Niederösterreich)	6.2
Belgium	2.4 (Région de Bruxelles-Capitale)	7.3	13.0 (Prov. Namur)	5.3
Bulgaria	6.4 (Yugozapaden)	8.9	11.3 (Severozapaden)	1.8
Croatia	6.3 (Kontinentalna Hrvatska)	7.5	8.8 (Jadranska Hrvatska)	1.4
Czechia	2.0 (Praha)	6.3	9.1 (Střední Čechy)	4.6
Denmark	1.6 (Hovedstaden)	3.4	4.7 (Nordjylland)	2.9
Finland	1.5 (Helsinki-Uusimaa)	5.3	9.8 (Åland)	6.3
France	2.6 (Île de France)	5.7	7.5 (Franche-Comté)	2.9
Germany	1.5 (Berlin)	4.5	7.8 (Niederbayern)	5.2
Greece	4.6 (Attiki)	7.7	11.0 (Dytiki Ellada)	2.4
Hungary	4.9 (Közép-Magyarország)	6.4	8.1 (Dél-Alföld)	1.7
Italy	3.6 (Liguria)	6.0	9.8 (Valle d'Aosta)	2.7
Poland	5.2 (Śląskie)	8.1	9.7 (Łódzkie)	1.9
Portugal	3.2 (Região Autónoma dos Açores)	6.5	12.3 (Alentejo)	3.8
Romania	5.5 (București - Ilfov)	8.4	9.4 (Sud-Vest Oltenia)	1.7
Slovenia	5.0 (Východné Slovensko)	5.2	5.4 (Západné Slovensko)	1.1
Spain	1.7 (País Vasco)	4.0	6.1 (Castilla y León)	3.7
Sweden	1.6 (Stockholm)	3.2	5.1 (Mellersta Norrland)	3.2
United Kingdom	1.2 (Greater Manchester)	3.2	6.8 (Highlands and Islands)	5.5

Source: data from EURO-HEALTHY (2018).

### 5.3.3 Conclusions and suggestions

The inequalities in RTI-related mortality rates are associated with income, age and sex, with age the greatest contributor to inequalities by a factor of seven. For almost all age groups, the highest RTI-related mortality is observed in higher middle-income countries, while the countries with highest income show the lowest mortality rates.

There is great variation in transport-related mortality between age groups within countries. In more than half of the Euro 1–4 countries for which RTI mortality rates are available, the highest rates occurred for the group aged 65 years and over, while for countries with only all transport-related mortality data, the highest rates are reported

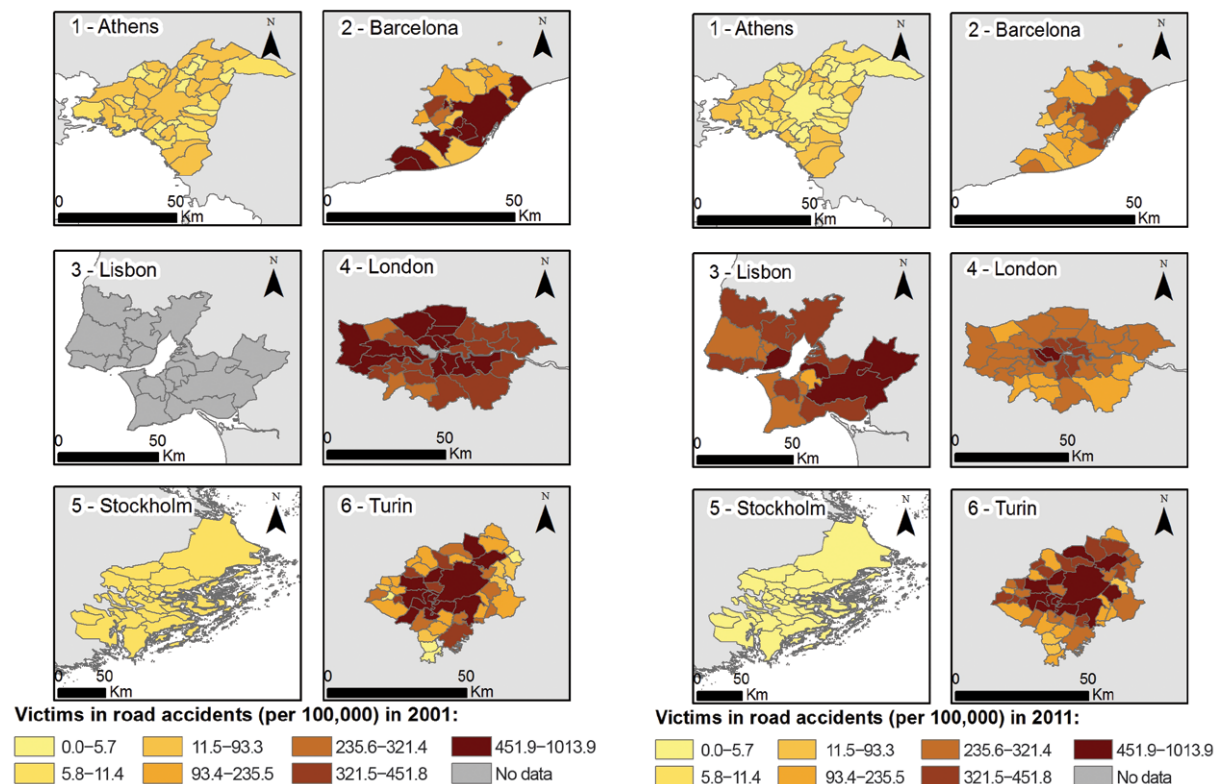
for those aged 15–24 years. Relative inequalities between males and females are particularly prevalent in the younger adult groups (20–24, 25–29). Finally, wide variability of RTI mortality rates is evident within country regions and metropolitan areas, indicating that there are hot spots for transport accidents.

Systematic equity-sensitive monitoring and reporting of RTIs is needed from all countries to harmonize the data in order to allow a more accurate assessment of inequalities. This is especially relevant for the socioeconomic status of injury victims, as no reliable information on this is available.

#### Suggested mitigation actions are:

- building and managing transport systems that are safe, clean and affordable for all road users – including improvement of road conditions;
- making walking and cycling safer by separating motorized vehicles from pedestrians and cyclists;
- development of programmes to increase awareness and educate drivers – including promotion of personal health and safety measures;
- a combination of measures and targeted actions to enact and enforce legislation and strict monitoring to reduce the key behavioural risk factors (speed, drink-driving and failing to use motorcycle helmets, seat-belts and child restraints (WHO, 2018b));
- advancing monitoring and reporting on RTIs, ensuring consistency among countries.

**Fig. 39.** Number of RTI victims (injured and killed) per 100 000 inhabitants in 2001 (2002 for London) and 2011



*Note:* the indicator values for the City of London municipality are not considered in the London statistical analysis: the number of people moving in this municipality is disproportionately greater than the number of inhabitants.

*Source:* Mitsakou et al. (2019).

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## 5.4 Inequalities in lack of access to recreational or green areas

Hanneke Kruize

### Status

In almost all countries, people with lower socioeconomic status report having greater difficulty accessing recreational or green areas than people with higher socioeconomic status.

### Trend

Although it is not possible to compare data directly with previous surveys owing to use of different indicators, socioeconomic inequalities in access to recreational or green areas seem to persist over time.

#### 5.4.1 Introduction and health relevance

The potential health benefits of visiting recreational or green areas have been studied extensively in recent decades. Much research has been done on the health benefits associated with green space, showing positive associations with physical and mental health (Lee & Maheswaran, 2011; Nieuwenhuijsen et al., 2014; Hartig et al., 2014; WHO Regional Office for Europe, 2016). Suggested mechanisms of the positive association between nature and health documented in these studies and reviews are:

- recovery from mental fatigue and attentional capacities (restoration);
- facilitation of physical activity;
- facilitation of social contact;
- stimulation of development in children;
- stimulation of personal development and a sense of purpose;
- mitigation against potentially harmful environmental exposures such as air and noise pollution, excessive ultraviolet from sunlight and heat stress;
- improved functioning of the immune system.

Use of urban green space for walking or cycling to school and work can reduce greenhouse gas emissions. It can also make active travel attractive and thereby encourage and support new, environmentally friendly behaviours (Staatsen et al., 2017). Recreational or green areas may have adverse effects, however, such as elevated exposure to pesticides and herbicides and increased risks of vector-borne diseases (such as Lyme disease) and allergies (WHO Regional Office for Europe, 2016; Staatsen et al., 2017).

There is evidence that people who spend more time in the vicinity of their homes (children, young

people, older people and people who run the household) and people with lower socioeconomic status may benefit more from recreational or green areas in their living environments (Staatsen et al., 2017). A 2016 WHO literature review concluded that this association is not straightforward, as studies show contradictory results, but stated that it is essential for all populations to have adequate access to green space, with particular priority placed on provision for disadvantaged communities (WHO Regional Office for Europe, 2016). Mixed results were also found in the systematic review by Schüle et al. (2019), indicating that ecological studies showed a consistent trend that areas with higher deprivation had less green or blue space than more affluent areas, while cross-sectional studies showed diverse findings, depending on the type of social indicator and the environmental measure applied.

The proportion of natural spaces – such as green and blue areas – in the total city surface area differs between European cities: Sweden has the largest share of green and blue areas within cities and Hungary the smallest (EEA, 2012). Various studies have shown that socially disadvantaged neighbourhoods are often affected by lower amounts and reduced quality and functionality of recreational or green areas (Allen & Balfour, 2014; Hoffmann, Barros & Ribeiro, 2017).

#### 5.4.2 Indicator analysis: inequalities by income, difficulty paying bills, education level and sex

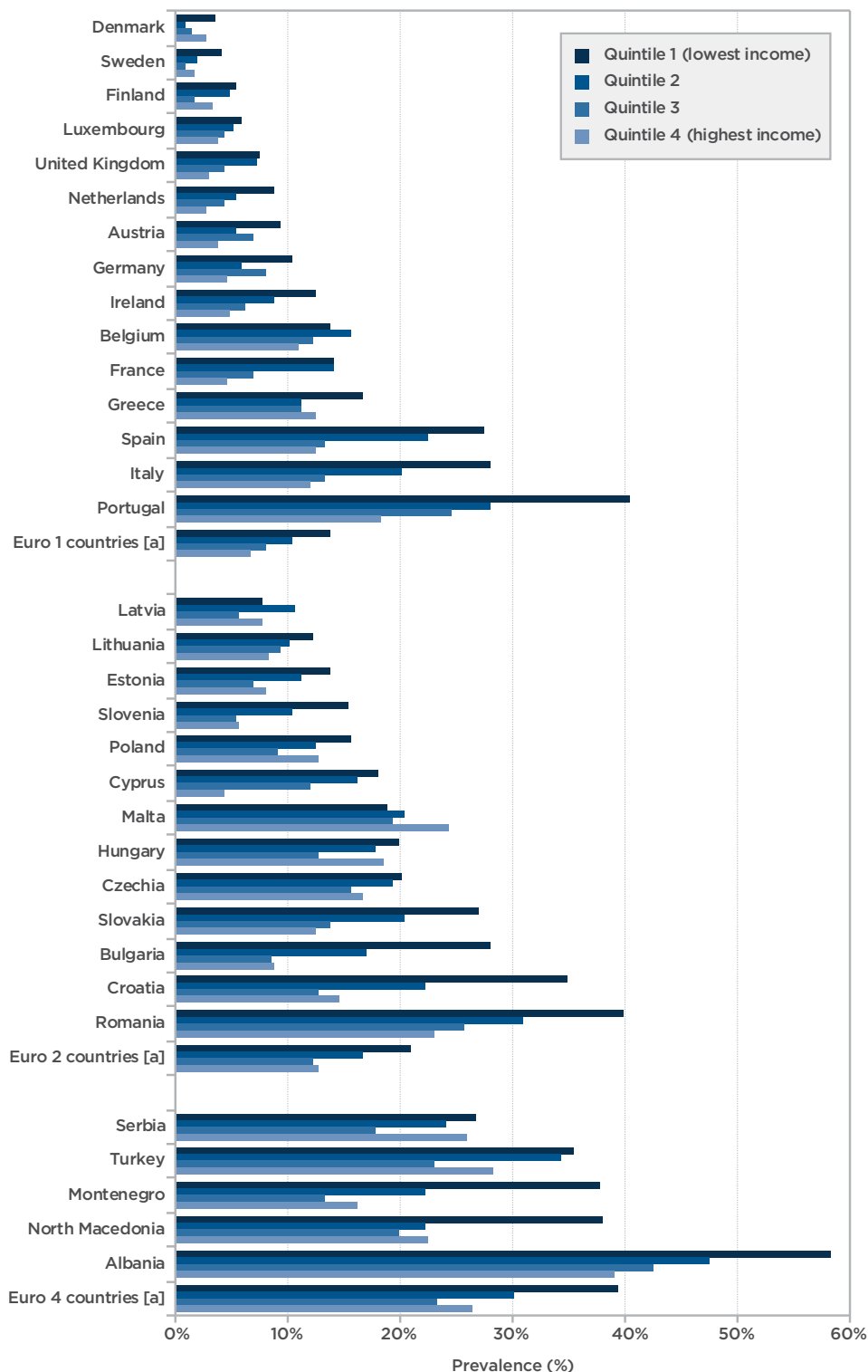
Data on self-reported access to recreational or green areas are available from the recent Eurofound European Quality of Life Survey, which includes Turkey and some Balkan countries (Eurofound, 2018). No data indicating inequalities in relation to availability of or access to such areas

were identified for other countries in the WHO European Region.

Differences in self-reported difficulty accessing recreational or green areas are observed within

all countries across Europe (Fig. 40). While in the Scandinavian countries all income quartiles report less than 6% difficulty, this rises to 40% for the lowest income quartile in Portugal and Romania, and to almost 60% in Albania.

**Fig. 40.** Prevalence of difficulty accessing recreational or green areas by income quartile (2016)



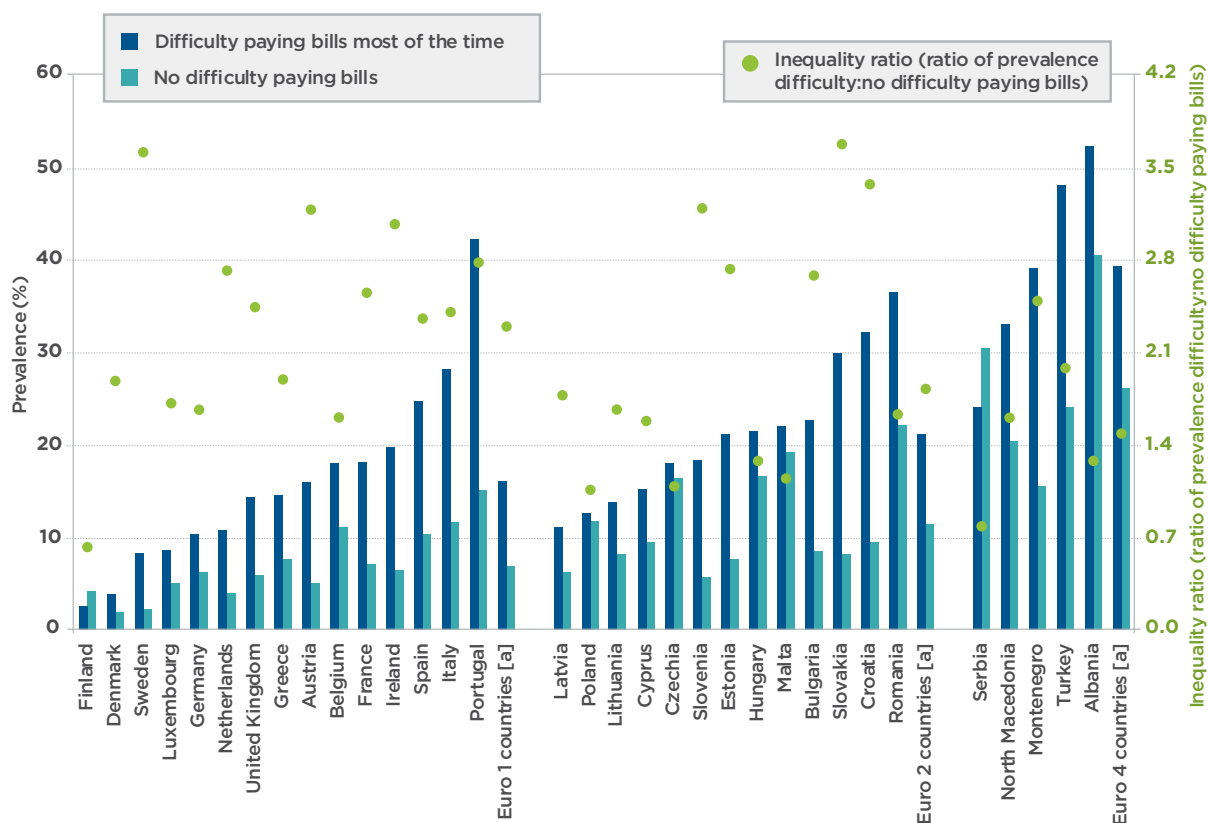
Note: [a] average of national rates.

Source: data from Eurofound (2018).

In almost all countries the prevalence shows a clear socioeconomic gradient, with the lowest income quartile clearly reporting more difficulty accessing these areas than the higher quartiles. Exceptions are Malta, where the highest income quartile reports most difficulty with access, and Hungary and Serbia, where the lowest and highest quartiles each report most difficulty. The biggest relative inequality between the highest and lowest income quartiles is found for Cyprus (where the lowest-income population reports 4.1 times more difficulty than the highest-income population), followed by Bulgaria (inequality ratio of 3.2:1), France (inequality ratio 3.1:1) and the Netherlands (inequality ratio of 3.0:1).

These patterns are similar for people who have difficulty paying bills and those who do not (Fig. 41): the former report more difficulty accessing recreational or green areas than the latter, including in Malta. In Finland and Serbia, however, the trend is reversed: here, people with no difficulty paying bills report more difficulty accessing recreational or green areas (inequality ratios of 0.6:1 and 0.8:1, respectively). The highest relative inequalities between disadvantaged and advantaged population groups are found in Slovakia (inequality ratio of 3.7:1) followed by Sweden and Croatia (inequality ratios of 3.6:1 and 3.4:1, respectively).

**Fig. 41.** Prevalence of difficulty accessing recreational or green areas by difficulty paying bills (2016)



Note: [a] average of national rates.

Source: data from Eurofound (2018).

Differences are also present for education level, with people with lower levels of education reporting more difficulty accessing recreational or green areas than those with higher levels. This inequality pattern applies for both males and females; the inequality ratios between high and low education range from 1.5:1 to 1.9:1 for males and

from 1.8:1 to 1.9:1 for females. The highest absolute difference by education is found among females in Euro 4 countries, where 43% of females with low education levels report difficulty accessing recreational or green areas versus 22.9% of females with higher education levels (Table 10).

**Table 10.** Prevalence of difficulty accessing recreational or green areas by education level and sex (2016)

Subregion	Female				Male			
	Education level			Education ratio (primary: tertiary)	Education level			Education ratio (primary: tertiary)
	Primary	Secondary	Tertiary		Primary	Secondary	Tertiary	
<b>Euro 1 countries</b>	13.2%	9.2%	7.4%	1.8:1	11.4%	8.1%	6.6%	1.7:1
<b>Euro 2 countries</b>	22.1%	14.9%	11.6%	1.9:1	18.7%	14.3%	9.6%	1.9:1
<b>Euro 4 countries</b>	43.0%	28.0%	22.9%	1.9:1	38.2%	28.4%	26.0%	1.5:1

Note: subregion values calculated as an average of national prevalence rates.

Source: data from Eurofound (2018).

### 5.4.3 Conclusions and suggestions

Considerable differences are found within European countries in reporting difficulty accessing recreational or green areas. People with lower socioeconomic status have greater difficulty in almost every country; in some countries this can affect them three times more. The data do not allow identification of the specific difficulties faced, however, which could arise from several factors. One potential explanation could be a lack of recreational or green areas in the direct surroundings of the home; other could be that the green space is not accessible, that it is not perceived to be safe or that people do not have time to go there. Adequate provision of recreational or green areas that are nearby,

accessible and safe, as well as meeting the needs of all potential users, is therefore important.

Specific actions targeting socially disadvantaged people in particular to improve their access to and use of these areas are recommended, since this may improve population health and well-being through several pathways. Ensuring adequate provision of recreational or green areas requires a wide range of stakeholders to work together, including nature conservation authorities and nongovernmental organizations, city and regional authorities, health professionals, social agencies, citizens, policy-makers and funders, at all spatial scale levels.

#### Suggested mitigation actions are:

- providing recreational or green areas and areas that are attractive, safe, easily accessible and within (perceived) walking distance;
- educating professionals and citizens on the health and other benefits of recreational or green areas;
- informing people about (activities in) the recreational or green areas in their neighbourhoods;
- organizing activities and social events in recreational and green spaces;
- consulting or involving potential users in the design of recreational or green areas and their maintenance.

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## 5.5 Inequalities in chemical exposure

Jurgen Buekers, Bert Morrens, Ilse Loots, Catherine Ganzleben, Greet Schoeters

### Status

Human exposure to chemicals is unequally distributed across socioeconomic strata. Higher exposure is associated with higher socioeconomic status for some chemicals and with lower status for others. Lifestyle and behaviours appear to be mediating factors.

### Trend

European data on inequalities in chemical exposure are only sporadically available. Making a time-trend analysis is therefore not justified.

#### 5.5.1 Introduction and health relevance

Chemical pollution is a growing global problem, with significant impacts on human health. Pollutants are emitted from industrial processes, traffic and housing, among others, and are released from manufactured and chemical products, including pesticides, biocides and pharmaceuticals. Related health impacts are unevenly distributed across society, with a disproportionate burden falling on poor and vulnerable populations, affecting their rights to health, water, food, life, housing and development (UNEP, 2017). Knowledge about the magnitude of inequality in chemical exposure within countries in the WHO European Region is very limited, however.

It has been estimated that risks related to selected chemicals and chemical mixtures in the home, community or workplace caused 1.3 million deaths from noncommunicable diseases globally in 2016 – mainly cardiovascular diseases, chronic obstructive pulmonary disease and cancers (Prüss-Ustün et al., 2019). Lead poisoning alone was estimated to cause more than 500 000 deaths worldwide in 2016 (WHO, 2018). A significant part of the burden of disease is attributed to chemical exposure, with people of lower socioeconomic status more likely to be affected (Prüss-Ustün et al., 2017).

Initial economic estimates reveal that chemical exposure entails a cost to society that may exceed 10% of global domestic product (Grandjean & Bellanger, 2017). These calculations are based on limited information on human exposure and related health outcomes for only a few chemicals; thus, the real burden is expected to be larger. Associations taken into account in such estimates (Hänninen et al., 2014; Trasande et al., 2015; Grandjean & Bellanger, 2017) include:

- exposure to lead, organophosphates, brominated flame retardants and methylmercury with IQ loss;
- exposure to phthalates with obesity, diabetes and infertility;
- exposure to air pollution with premature mortality;
- exposure to second-hand smoke with respiratory diseases and cancer.

Factors underlying the disproportionate burden on people of lower socioeconomic status include increased exposure, increased susceptibility to chemicals, reduced capacity to avoid impacts and access health care and combined exposure to other (non-chemical) stressors. Human biomonitoring is a recognized tool for assessing integrated exposure to chemicals and variations in chemical exposure across temporal, geographical, demographic, lifestyle and socioeconomic dimensions, but such data are currently scarce at the European level. Separate human biomonitoring programmes in Germany and Belgium analysed the social distribution of their national data. Both found that children and adolescents with lower socioeconomic status or migrant status had higher body concentrations of heavy metals (lead, cadmium, nickel). In contrast, children and adolescents with higher socioeconomic status or a native background had higher concentrations of persistent organic pollutants (Becker et al., 2008; Morrens et al., 2012).

#### 5.5.2 Indicator analysis: inequalities in exposure to cadmium, cotinine and mercury by education level

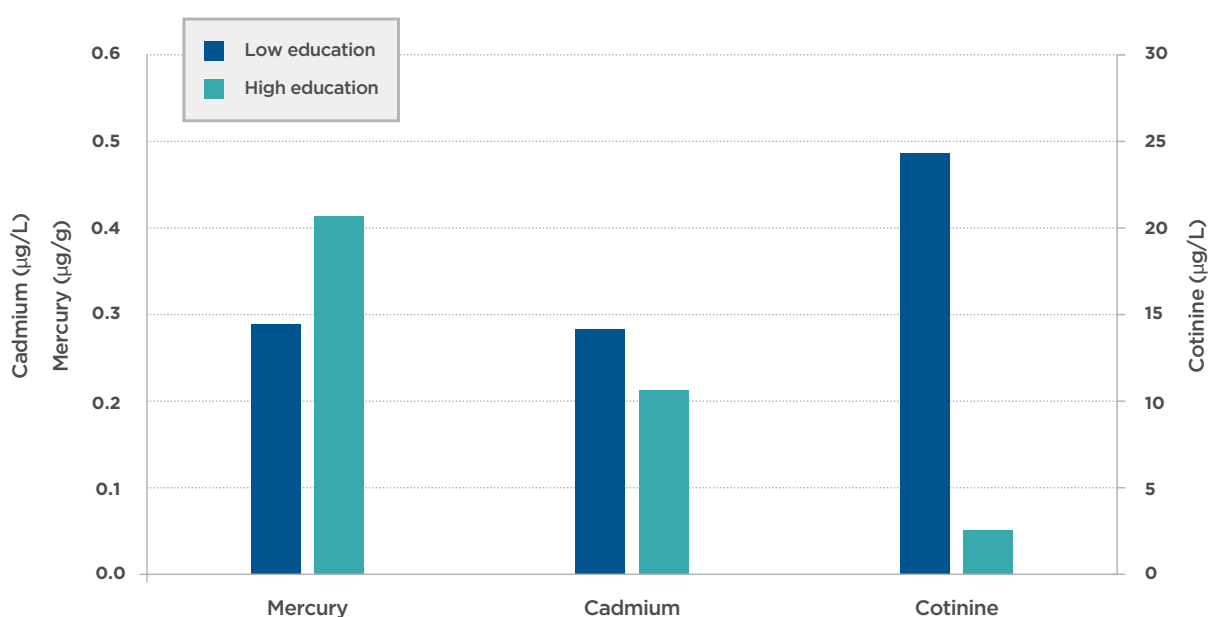
There are no international databases on inequalities in chemical exposure, and in the eastern part of the WHO European Region data on chemical exposure are generally lacking. This indicator

analysis provides data on chemical exposure differences by education, based on data from the EU's DEMOCOPHES human biomonitoring project covering 17 countries (FPS Health, 2019).<sup>9</sup> While data on cadmium, cotinine and mercury are presented here, inequalities in exposure by socioeconomic status were also found for other chemicals. The DEMOCOPHES project surveyed 1844 children and 1844 mothers from 17 European countries, but was not representative for the whole of Europe. Stratification for socioeconomic status at the country level results in small groups, meaning that results must be interpreted with

caution. Nevertheless, consistent trends were observed across the participating countries.

The difference in chemical body burden in mothers (generally  $n=120/\text{country}$ ), stratified by the highest education level in the family, was studied, building further on the analysis of DEMOCOPHES data by Den Hond et al. (2015). Fig. 42 presents the average concentrations by education level for all countries studied. Overall, urinary cadmium and especially cotinine concentrations were higher in the group with lower educational attainment, while mercury concentrations in hair were higher in the group with higher education levels.

**Fig. 42.** Average concentration of cadmium, cotinine and mercury in mothers by education level, 2011–2012



*Note:* includes one measurement per person only.

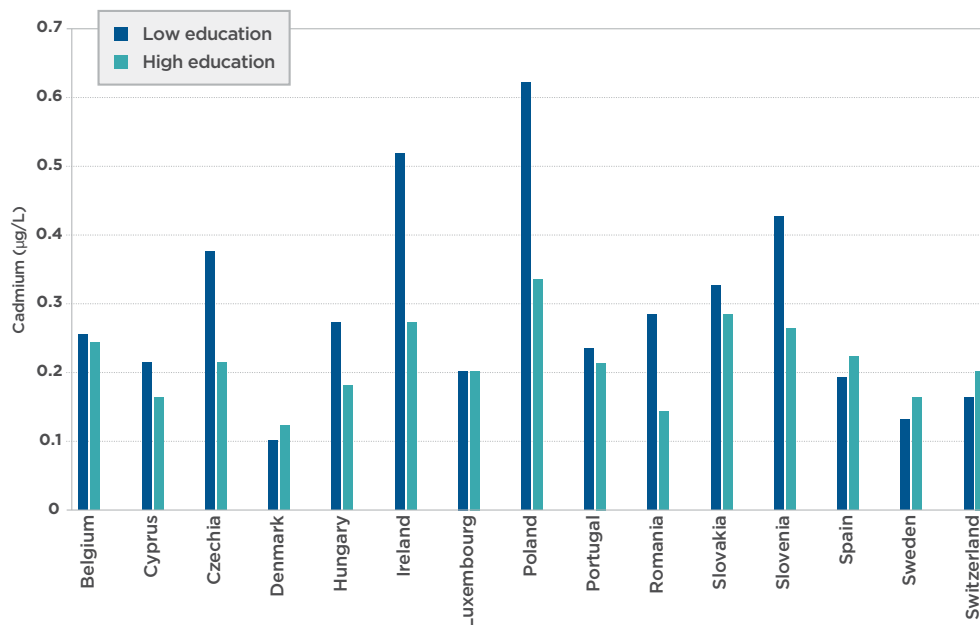
*Source:* data from DEMOCOPHES country-specific statistical analysis reports.

Looking at individual countries, concentrations of cadmium showed no clear differences across education categories for more than half the countries studied (ratio of low:high education between 0.8:1 and 1.2:1). For seven countries, mothers in the low education group clearly showed higher cadmium concentrations than those in the high education group (Fig. 43). The greatest inequalities were found in countries where the

sample population exhibited the highest cadmium concentrations (such as Ireland and Poland). Contributory factors may include differences in smoking behaviour, diet (for example, cadmium is present in offal and a low iron intake facilitates cadmium intake), occupational exposure, proximity to industrial hot spots and the age of the dwelling (with higher cadmium exposure in older houses).

<sup>9</sup> Data are taken from DEMOCOPHES country-specific statistical analysis reports provided by the Belgian Federal Public Service Health, Food Chain Safety and Environment (Coordinating beneficiary of the DEMOCOPHES PROJECT LIFE09/ENV/BE000410, co-funded by the LIFE programme, and by the participating countries). The reports are unpublished but are available on request from the Belgian Federal Public Service Health, Food Chain Safety and Environment.

**Fig. 43.** Average concentration of cadmium in mother’s urine by education level, 2011–2012

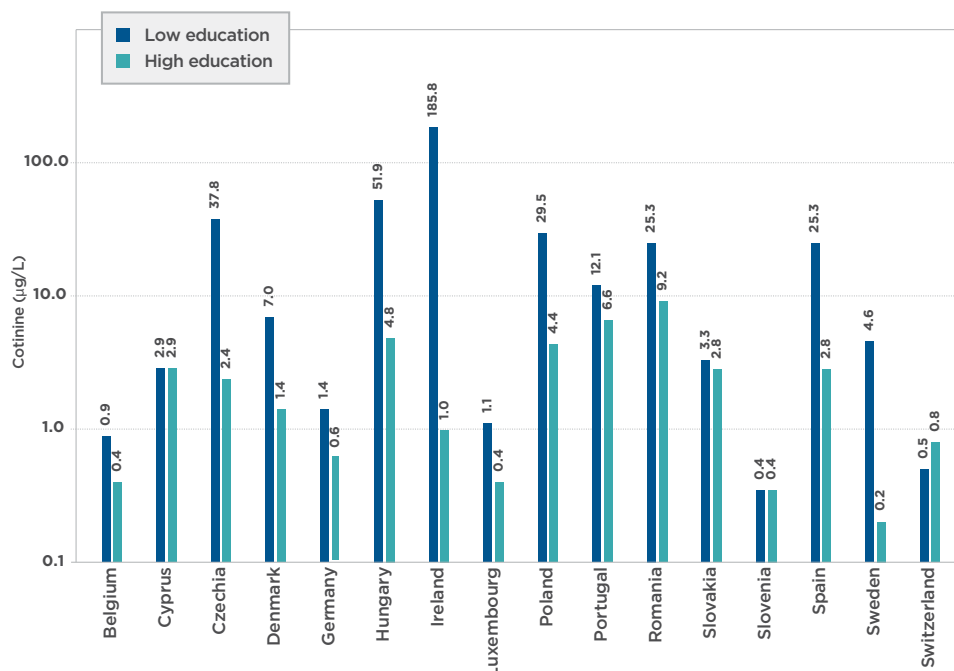


Note: low and high education can represent different education categories across countries.  
 Source: data from DEMOCOPHES country-specific statistical analysis reports.

Smoking, in particular, is an important source of cadmium exposure. In the DEMOCOPHES survey a metabolite of nicotine (cotinine) was consistently higher in mothers of the low education group (Fig. 44). The difference by education was large,

reaching more than 20-fold in Ireland and Sweden. In absolute terms, the highest concentrations for all education groups were found in countries that had weak antismoking legislation at the time of sampling (Smolders et al., 2015).

**Fig. 44.** Average concentration of cotinine in mother’s urine by education level, 2011–2012

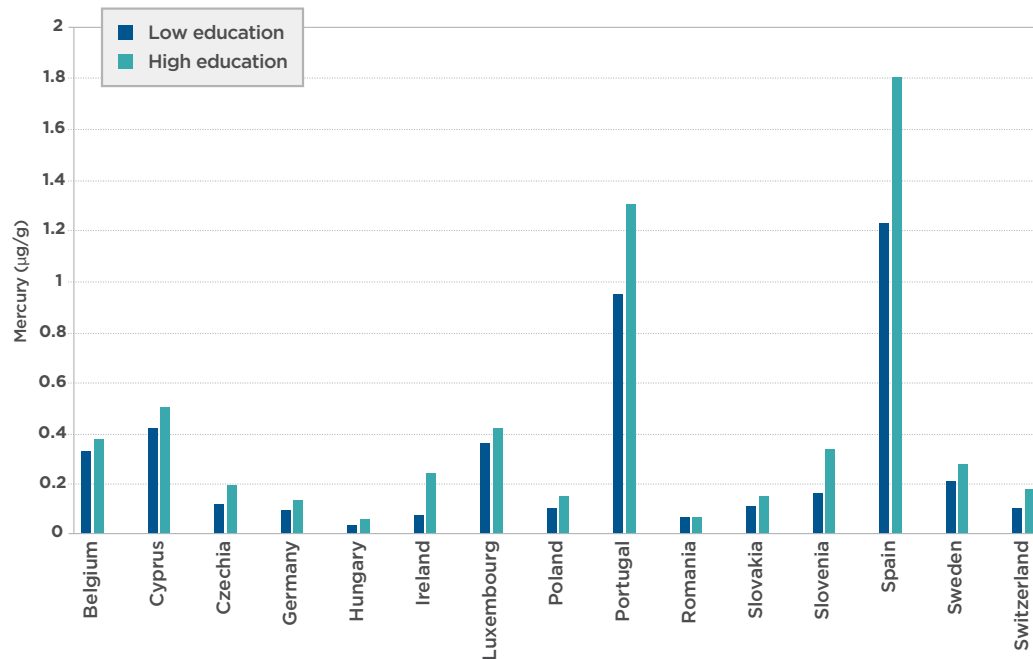


Notes: low and high education can represent different education categories across countries; for Switzerland no participants in the low education group exceeded the limit of quantification; the cotinine concentration was set at half the limit of quantification value; for clarity, values are presented on a logarithmic scale.  
 Source: data from DEMOCOPHES country-specific statistical analysis reports.

A different pattern of inequality emerges for mercury: mothers in the high education group exhibit higher concentrations in hair than those in the low education group, with a ratio of low:high education below 1. This is consistent for all countries in the DEMOCOPHES project (Fig. 45). Consumption of fish and shellfish has been associated with increased levels of mercury, and

fish consumption is generally higher among groups with higher education and/or income. Mercury concentrations were highest in countries adjacent to the sea – Portugal and Spain in particular – where fish consumption is part of the daily diet. The largest social disparities in mercury concentration, however, were seen in countries where the overall exposure was lower (Ireland, Slovenia).

**Fig. 45.** Average mercury concentration in mother's hair by education level, 2011–2012



*Note:* low and high education can represent different education categories across countries.

*Source:* data from DEMOCOPHES country-specific statistical analysis reports.

Differences of biomarker concentrations in mothers by education level corresponded with findings in children for cotinine and mercury. For cadmium, the results were less clear for children.

### 5.5.3 Conclusions and suggestions

Overall, information on the distribution of chemical exposure and related inequalities within countries in the WHO European Region is insufficient, especially in the eastern part of the Region where there are no – or very limited – data on chemical exposure in general.

Based on the DEMOCOPHES project findings, concentrations of chemicals in mothers are distributed unequally across socioeconomic groups within many EU countries, but the patterns of inequality go in both directions. Exposure to cadmium and cotinine was higher in groups with lower socioeconomic status (indicated by low education level), while for mercury, exposure

increased with educational attainment. Lifestyle practices such as food consumption may partly explain these inequalities, although the real causal factors are not yet fully understood.

Large-scale human biomonitoring studies that include social and lifestyle variables – such as the ongoing EU project HBM4EU (Environment Agency, 2019) – are needed to unravel the nexus between socioeconomic factors, environment and health. This would enhance understanding of the drivers of unequal exposure to chemicals and provide a knowledge base to inform policies and measures to target these inequities. One example for such coordinated action is the work on the Minamata Convention on Mercury, which includes both political and technical measures and aims to develop national capacities for prevention, diagnosis, treatment and monitoring of health risks related to exposure to mercury (WHO Regional Office for Europe, 2018).

### Suggested mitigation actions are:

- establishment of adequate monitoring systems for chemical exposure, including human biomonitoring surveillance;
- human biomonitoring with exposure biomarkers to serve as an early warning for emerging (social) exposure differences and, in combination with effect biomarkers, to target the early onset of diseases;
- further efforts to reduce emissions of pollutants from industrial installations, agriculture, transport and waste to contribute to a nontoxic and healthy living environment;
- implementation of safe-by-design principles and green chemistry to reduce the toxicity and persistency of chemicals in products;
- ensuring that chemical risk assessments focus not only on average exposure levels but also on inequalities in exposure;
- preventing exposure at different levels (local, national, global), tailored to specific communities with relatively high exposure levels;
- advising citizens on how to reduce their chemical exposure through healthy lifestyles;
- creating knowledge about the causal factors underlying the inequality in chemical exposure needed for awareness-raising and policy development.

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## 5.6 Inequalities in exposure to and health risks from contaminated sites in Italy

Roberto Pasetto

### Status

Across Europe, communities living in or close to contaminated sites tend to be characterized by socioeconomic deprivation. Country assessments of environmental health inequities in relation to contaminated sites are rarely available, however.

### Trend

The total quantity of pollutants released from industrial plants has declined in recent years, but most contaminated sites still need to be remediated and, when active industries are sources of local contamination, their emissions need to be reduced.

#### 5.6.1 Introduction and health relevance

The European Environment Information and Observation Network (Eionet) defines a contaminated site as a well defined area where the presence of soil contamination has been confirmed, which therefore presents a potential risk to humans, water, ecosystems or other receptors. The last Eionet survey, carried out in 2011-12, estimated around 342 000 contaminated sites and more than 2.5 million potential contaminated sites for 37 European countries and Kosovo<sup>10</sup> (Panagos et al., 2013). Waste disposal and treatment were estimated to contribute to more than 37% of contaminated sites; industrial and commercial activities to around 33% (Panagos et al., 2013).

The European Industrially Contaminated Sites and Health Network (ICSHNet) adopted an operational definition of industrially contaminated sites that focuses on the actual or potential risk for human health: “areas hosting or having hosted industrial human activities which have produced or might produce, directly or indirectly (waste disposals), chemical contamination of soil, surface or groundwater, air, food-chain, resulting or being able to result in human health impacts” (Iavarone & Pasetto, 2018). The main target populations are communities residing close to contaminated areas, which are “hot spots” of local pollution and can affect all environmental media (not only soil), including air, water and the food-chain.

Data from the European Pollutant Release and Transfer Register (E-PRTR), hosted and run by the EEA, document a decline in emissions to air from industries of all major contaminants between 2007

and 2016 (EEA, 2018). In 2016 industrial activities were responsible for half of all anthropogenic emissions to air of carbon dioxide, non-methane volatile organic compounds and heavy metals; they also contributed to emissions of nitrogen oxides, sulfur oxides and PM<sub>10</sub>, albeit to a lesser degree. Data on industrial releases to water also show a reduction in major pollutants from 2007 to 2016 (EEA, 2018). Three industrial sectors account for the vast majority of pollutant releases to water: chemical production (50%), wastewater treatment plants (21%) and extractive industries (17%).

Inequalities of environmental exposure to pollutants from contaminated sites have been documented for the WHO European Region by a systematic review, showing an overburden of exposure for areas with socioeconomic deprivation or vulnerability in most of the studies reviewed (Pasetto, Mattioli & Marsili, 2019). Country assessments including environmental health inequalities for municipalities close to contaminated sites are largely lacking, however. Wherever assessments have been carried out, in both high-income and low-income countries, high levels of hazardous exposure and/or excesses of health risks and impacts associated with the contamination have been observed (Martuzzi, Pasetto & Martin-Olmedo, 2014; Iavarone & Pasetto, 2018). Most local assessments of health risks have applied an ecological/area design, with mortality and morbidity occurrence and cancer incidence as outcomes.

At present, no estimates are available on the overall health impact of contaminated sites in Europe. An initial promising effort was made by ICSHNet to estimate the burden of disease associated with exposure from waste landfills. The study identified the location of landfills using georeferenced

<sup>10</sup> In accordance with United Nations Security Council resolution 1244 (1999).



data available in E-PRTR. This exercise enabled researchers to estimate a total of 61 325 disability-adjusted life-years attributable to diseases for which there is suggestive evidence of association with exposure from landfills (Shaddick et al., 2018).

### 5.6.2 Indicator analysis: inequalities by deprivation at the community level in Italy

As no international dataset exists to facilitate assessment of environmental health inequalities related to contaminated sites, this section describes an indicator based on data from Italy as an example of a national assessment. Hazardous exposure and health risks associated with contaminated sites mainly affect local communities. Assessments of the national distribution of related environmental health inequalities can be highly informative and provide a basis for targeting and priority-setting.

In Italy communities identified as living close to major contaminated sites are monitored by the SENTIERI epidemiological surveillance system, using data at the municipality level (Pasetto & Iavarone, forthcoming). Most of these contaminated areas are registered as national priority contaminated sites; many are contaminated by industrial complexes that are still active. SENTIERI's main aim is to describe the health profile of communities living close to each national priority contaminated site to provide evidence for local public health interventions. It also facilitates overall national assessments of environmental health issues related to these sites.

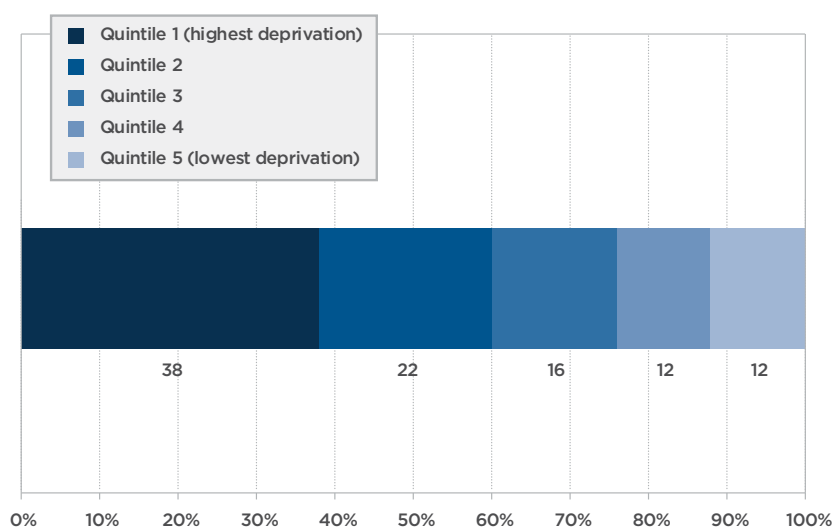
The first findings provided by SENTIERI documented overall excess mortality in the 44

monitored areas (298 municipalities), showing around 10 000 more deaths than expected among the 404 000 observed (men and women combined; all-cause mortality) over a period of 8 years (1995–2002). About 3600 deaths were associated with pollution present in the contaminated sites. A subsequent overall analysis of cancer incidence data over 10 years, limited to the 23 sites served by cancer registries, showed an excess of 9% among men and 7% among women (Pasetto & Iavarone, forthcoming).

The most recent figures provided by SENTIERI cover data on mortality, hospitalization, cancer incidence (for the overall population and for children) and congenital anomalies for 319 municipalities in 49 monitored areas. Data on mortality document an excess all-cause mortality of 2.5% (around 5300 deaths) among men and 3% (around 6700 deaths) among women over a period of 8 years (2006–2013) (Zona et al., 2019).

SENTIERI also investigated social inequalities in the 44 monitored areas, using an index of multiple deprivation at the municipality level, computed using data from the 2001 national census (Pasetto & Iavarone, forthcoming). The index is derived from a combination of census variables associated with the socioeconomic dimensions of education, employment and material deprivation. The results showed a clear pattern that municipalities with the highest social deprivation are almost twice as likely to be located in a contaminated site area (Fig. 46). Of municipalities close to national priority contaminated sites, 60% fall into the two most deprived quintiles, whereas only 24% belong to the two most affluent quintiles.

**Fig. 46.** Municipalities in Italy close to national priority contaminated sites by level of deprivation

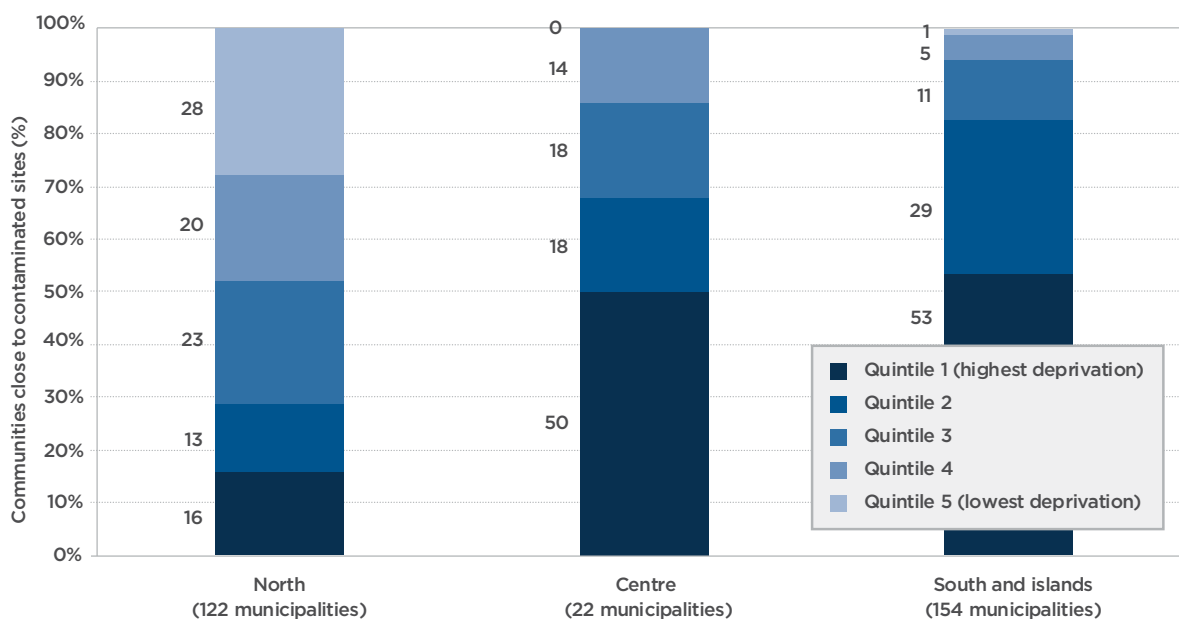


Source: SENTIERI data, taken from Pasetto & Iavarone (forthcoming).

Fig. 47 shows the results of a spatial analysis of deprivation levels of communities close to contaminated sites by region (north; central; south and islands). It highlights a marked north-south gradient, with worst conditions in the south and islands, where 82% of municipalities close to national priority contaminated sites fall into the two most deprived quintiles (1 and 2). In central Italy 50% of

municipalities close to such sites belong to the most deprived quintile, but the middle quintiles (2-4) are more balanced. In the north the pattern is reversed, but the disparities are weaker. It is suggested that a possible explanation for this pattern involves the marginalization of local communities during the industrialization process in southern regions of the country (Pasetto & Iavarone, forthcoming).

**Fig. 47.** Municipalities in Italy close to national priority contaminated sites by level of deprivation and region



Source: SENTIERI data, taken from Pasetto & Iavarone (forthcoming).

SENTIERI also analysed the population health risk by deprivation level. Mortality risk for all causes and all cancers was calculated for the municipalities near contaminated sites in the two highest deprivation quintiles and the two lowest deprivation quintiles. Initial results showed a higher risk for both all causes and all cancers in the group including the most deprived communities, especially among men (Pasetto & Iavarone, forthcoming).

### 5.6.3 Conclusions and suggestions

National assessments on environmental and health inequalities for communities close to contaminated areas can be helpful in addressing such a commitment.

In contaminated areas interventions should be primarily directed to site remediation activities and, where active industries are the sources of contamination, to adoption of the best available environmental technologies. Interventions should also include strengthening local health services, promoting secondary prevention interventions and

ensuring that disadvantaged and the most affected groups have access to these services.

National assessments should be integrated with the reinforcement of local environmental and epidemiological monitoring programmes oriented to assess inequalities in exposure and health within local communities. Such programmes can be helpful in verifying the effectiveness of equity-oriented public health interventions.

The last international WHO Ministerial Conference on Environment and Health, held in Ostrava, Czechia, in June 2017, provided a set of suggested actions on seven major environmental themes including - for the first time - contaminated sites. Annex 1 to the Ostrava Declaration, which sets out a compendium of possible actions to advance its implementation, promotes a commitment to “preventing and eliminating the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites” (WHO Regional Office for Europe, 2017).

### Suggested mitigation actions are:

- implementation of the actions on contaminated sites listed in Annex 1 to the Ostrava Declaration;
- defining priorities for remediation activities at the country level, having identified areas and contaminated sites with the highest levels of inequity;
- promoting use of the best available technologies to reduce contamination in the presence of active industrial plants;
- promoting environmental and epidemiological local monitoring programmes to identify inequalities in exposure and disease patterns;
- reinforcing secondary prevention interventions that promote access of disadvantaged groups to health services;
- promoting initiatives to improve awareness of the health effects of contamination among communities and disadvantaged subgroups.

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## 6. Work-related inequalities

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Safe working conditions are a foundational concern of public health and affect a large part of the population. Occupational risks can be found for all employment types and in all work settings, leading to a diversity of impacts on health and well-being. This dimension of employment and work conditions is also touched upon by SDG 8, which targets safe and secure working environments for all, including migrant workers and those in precarious employment.

As employment is a basic necessity to generate income, workers are reliant on safe working conditions but may not be in a position to influence them. This can lead to work-related risks and exposures that directly affect health and well-being through work injuries, stress symptoms, chronic diseases or functional limitations.

The work setting represents an environment in which specific risks are encountered; thus, specific regulations are required to prevent impacts on health. This is especially relevant for vulnerable

workers who may have less capacity to cope with occupational exposures.

Such regulations may not be present, however, and may not always be implemented effectively – causing avoidable risks to all workers and especially those with less ability to protect their rights (such as migrant workers, self-employed people and employees in unsecure and unstable contractual arrangements).

This section highlights work-related inequalities through two indicators:

- inequalities in work-related fatal injuries; and
- inequalities in health risks in working environments.

While data on work injuries are available for many countries in the WHO European Region, much less information is available on working environments, and data were only identified for EU countries.

## 6.1 Inequalities in work-related fatal injuries

Evanthia Giagloglou, Richard Graveling

### Status

Work-related fatal injuries are predominantly a problem among males. The group most affected is those aged 55 years and over.

### Trend

In some European countries the mortality rate from work injuries has decreased for both sexes, but the greater reduction among female workers maintains the trends, since 2011, of predominance of fatal injuries among males.

#### 6.1.1 Introduction and health relevance

Fatal injuries at work are among the most preventable concerns because safety is a basic human need and is specifically protected at work by several regulations. Inequalities in working environment conditions, such as social and economic factors, vary across countries and are important indicators of workers' overall health (WHO, 2007).

In the 28 countries of the EU 3876 fatal accidents at work occurred during 2015, which was 102 more than the previous year. The construction, manufacturing, agricultural and transport sectors are among the most dangerous in terms of fatal and non-fatal injuries in EU countries (Eurostat, 2018). Common causes are falls from height, transport accidents, people entering dangerous areas – such as behind a reversing vehicle – and loss of control of animals on farms (HSA, 2018).

Since work-related fatal injuries by definition affect those of a productive age, the psychosocial costs cannot be assessed accurately but, based on data for 2015, the economic costs have been estimated as €1207 billion worldwide and €260 billion for EU countries (EU-OSHA, 2017).

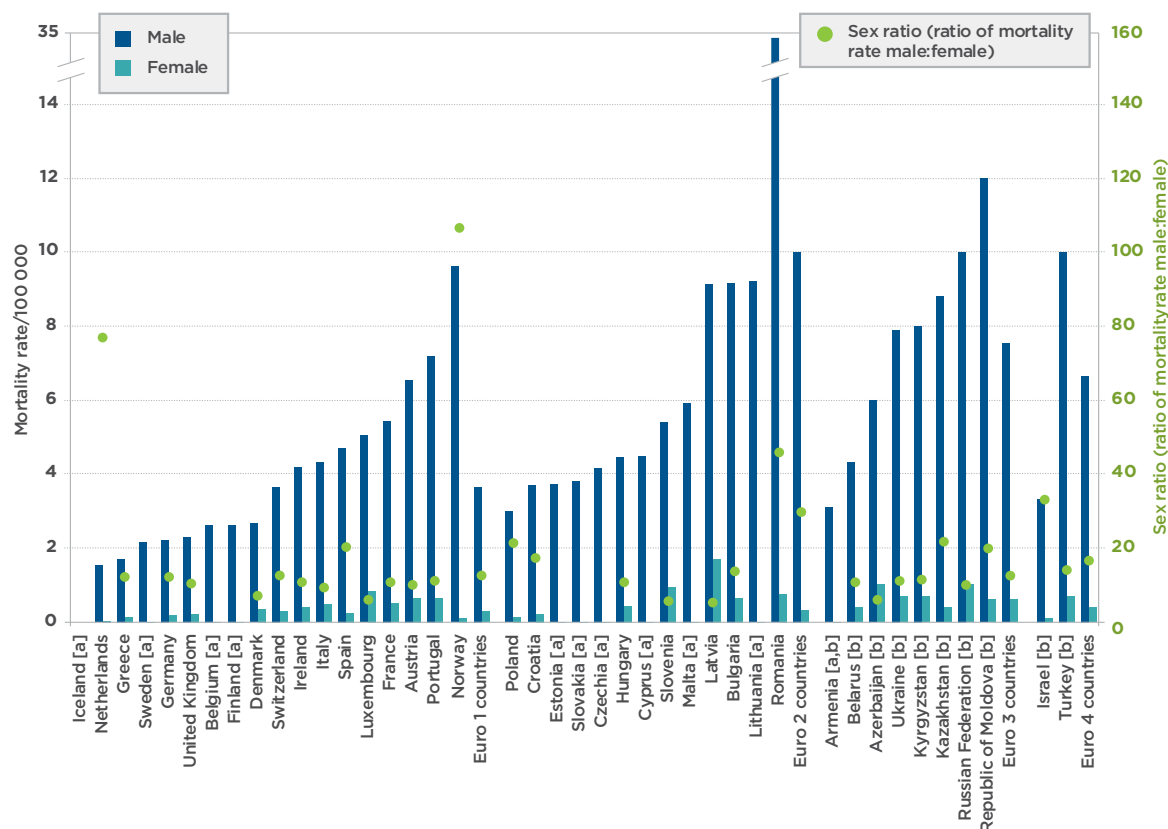
The mortality rate from injuries at work indicate several areas of inequality. Men are at particularly high risk compared to women, probably because of their predominant employment in higher-risk professions (such as in the construction and agricultural sectors). Villanueva & Garcia (2011) also report other risk factors for male workers, such as longer work shift hours and temporary working tasks for which workers may not possess the required expertise (where factors such as a lack of familiarity can lead to an increased risk).

Age is another factor of inequality, with older members of the workforce at greater risk of fatal injuries (Peng and Chan, 2019). A further equity dimension relates to “vulnerable workers”: those with less formal work arrangements (often lacking decent working conditions (ILO, 2018a)). This category may include younger and older workers, people with disabilities and migrant workers, who often experience difficult work conditions.

#### 6.1.2 Indicator analysis: inequalities by sex, age and migrant status

This analysis uses data from Eurostat (Euro 1 and Euro 2 countries) and ILO (Euro 3 and Euro 4 countries) on fatal work injuries by sex and age, and ILO data on fatal work injuries among migrants. Although ILO data are available for many countries in the WHO European Region, more information is available for EU countries.

In general, work-related fatal injuries seem to be a predominantly male issue. The highest difference between male and female fatal injuries at work occurs in Norway, with a sex ratio of 107:1 (more than 100 fatalities among males for each female fatality), followed by the Netherlands (77:1) and Romania (46:1). Fig. 48 shows that the mortality rate per 100 000 from injuries at work is higher among the male population in each Euro subregion, with the highest inequality observed in the Euro 2 subregion (sex ratio of 30:1). These high inequalities can be caused by a low number of fatalities among females (as in Norway and the Netherlands) and/or a very high number of fatalities among males (as in Romania), possibly suggesting that different factors are at play. The lowest sex ratios – in Latvia (5.4:1), Slovenia (5.8:1) and Azerbaijan (6:1) – still indicate that males are around six times more likely than females to die from a work-related injury in these countries.

**Fig. 48.** Work-related injury mortality rate/100 000 population in employment by sex (last year of reporting)


Notes: All data are from 2014, except Iceland and Armenia (2013); Israel, Kazakhstan, Kyrgyzstan, Republic of Moldova and Ukraine (2015); and Azerbaijan, Belarus, Russian Federation and Turkey (2016).

[a] Armenia, Belgium, Czechia, Cyprus, Estonia, Finland, Lithuania, Malta, Slovakia and Sweden all report zero fatal injuries for females (thus no sex ratio can be calculated), and Iceland reports zero fatal injuries at work for both males and females; [b] data from ILO.

Sources: Eurostat (2018); ILO (2018b).

The sex ratio of non-fatal injuries at work is unequally distributed between economic sectors. The data show similar inequality patterns by sex

in the Euro 1 and Euro 2 subregions, however (Table 11). The highest sex ratios (5.2:1 and 5.0:1, respectively) occur in the construction sector.

**Table 11.** Non-fatal accidents at work by economic sector and sex (average for 2013–2015)

Economic sector	Incidence/100 000 in employment					
	Euro 1			Euro 2		
	Male	Female	Sex ratio	Male	Female	Sex ratio
Construction	3738	715	5.2	1059	213	5.0
Electricity, gas, steam and air-conditioning supply; water supply; sewerage, waste management and remediation activities	2348	912	2.6	1369	418	3.3
Manufacturing	2377	1164	2.0	1372	641	2.1
Wholesale and retail trade; repair of motor vehicles and motorcycles	1770	961	1.8	603	408	1.5
Financial and insurance activities; real estate activities	773	445	1.7	329	208	1.6
Transportation and storage; information and communication	1602	1096	1.5	615	404	1.5
Agriculture, forestry and fishing	2462	1594	1.5	766	610	1.3
Accommodation and food service activities	1734	1497	1.2	670	553	1.2

Source: Eurostat (2018).

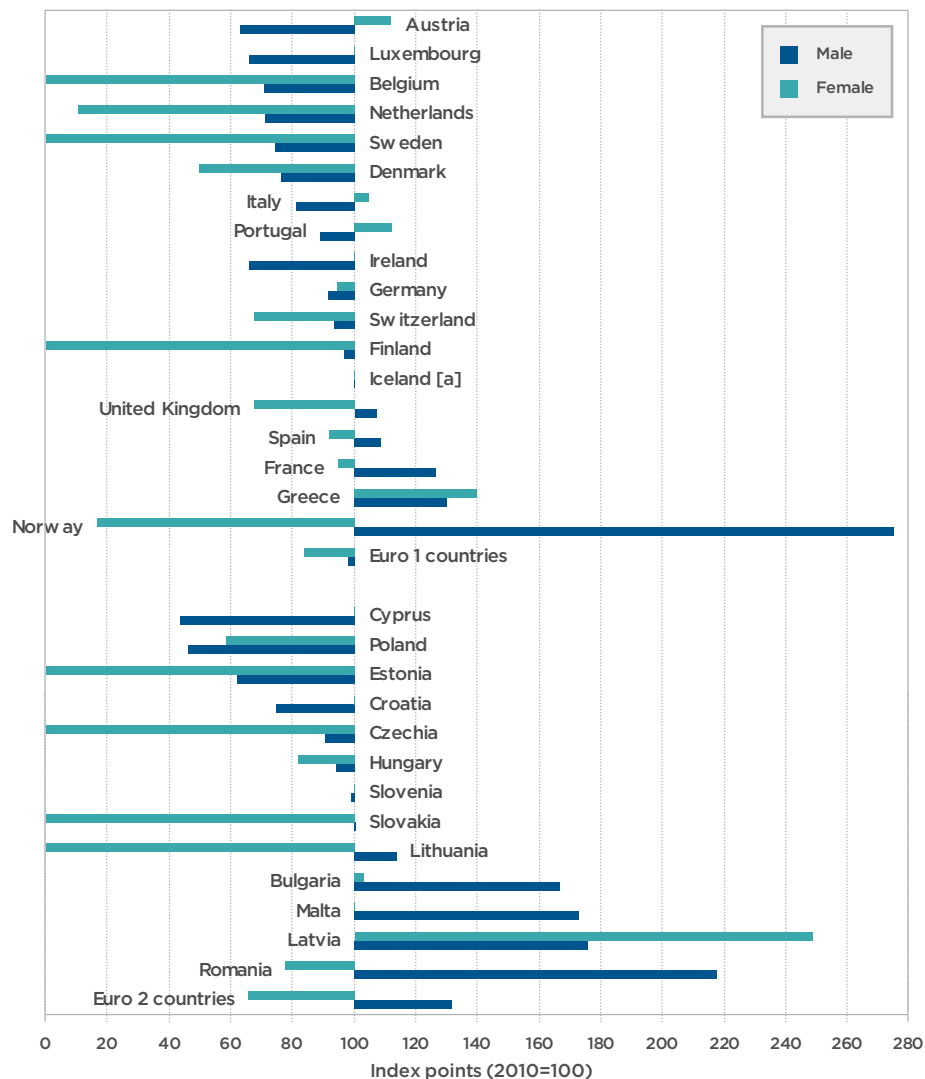
Fig. 49 shows the development of work-related mortality rates from 2010 to 2014. The bars show the changes in incidence rates for males and females, based on an index value of 100 for the baseline year of 2010.

In many countries in the WHO European Region the work-related mortality rate decreased for both sexes, but with a stronger reduction among females. In Euro 1 countries the mortality index for males was 98 in 2014, indicating a reduction of 2% since 2010. In the same year the mortality index for females was 84, indicating a reduction of 16%. Nevertheless, in some countries (Austria, Italy and Portugal) the work-related mortality rate increased for females. An increase in fatal work injuries among males occurred in France, Spain and the United Kingdom; further, Norway

saw a considerable increase of 275 index points, indicating that the level of fatal work injuries in males relative to females almost tripled. In Greece the index increased for both males and females.

The Euro 2 subregion shows an even more pronounced reduction for females, with an index of 66 across the period, indicating a reduction of fatal injuries among women of about 34% since 2010. Males, however, experienced an overall increase in work-related mortality, with an index of 132. The largest sex-related inequality is observed in Romania, where male fatalities increased by 118%, while female fatalities decreased by 22%. Latvia, however, reported a strong increase in female fatalities at work (almost 150%), which is unique among Euro 2 countries.

**Fig. 49.** Work-related injury mortality rate/100 000 population in employment by sex in index points (2014)



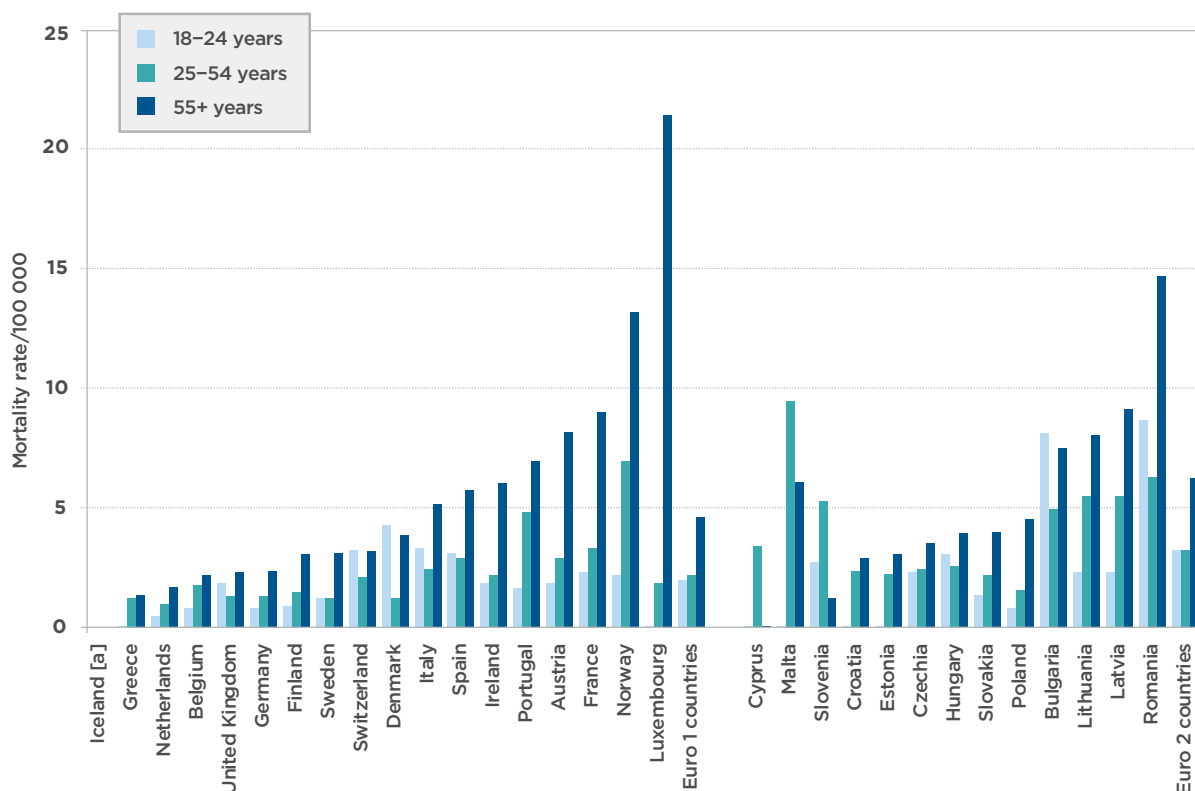
Note: [a] baseline year 2011, with associated index value from 2013.

Source: Eurostat (2018).

Inequalities in work-related fatalities are also apparent between different age groups (Fig. 50). Those most affected in the majority of Euro 1 and Euro 2 countries seem to be workers aged over 55 years. Luxembourg shows the highest difference of work-related deaths between the age groups, with a mortality rate of 21.44/100 000 for workers aged over 55 years. Romania has the highest mortality rate (14.6) for older workers among Euro

2 countries. Luxembourg reports zero fatal injuries at work for the youngest working age group (18–24 years), while Romania has the second highest rate for young workers in addition to the high rate among older workers. The highest mortality rate (9.43) for the youngest age group occurs in Malta, which reports zero fatal injuries at work for the oldest age group. Iceland reports zero fatal injuries for all age groups.

**Fig. 50.** Work-related injury mortality rate/100 000 population in employment by age group (2014)



Note: [a] Iceland data from 2013 (reporting zero cases).  
Source: Eurostat (2018).

Much less information is available on migrant workers and other vulnerable employment conditions, as national records rarely capture these dimensions and data are only available for some countries. Nevertheless, Fig. 51 shows that for selected countries where the data are available, migrant workers (from within and outside the EU) often have higher mortality rates. Marked increases for migrant workers are not apparent in all countries with relevant data, however: in Germany and Ireland no increase has been recorded of work-related mortality rates among migrant workers compared to non-migrant workers.

### 6.1.3 Conclusions and suggestions

The incidence of fatal injuries at work shows a clear predominance among the male population. In recent years the overall incidence rate for males and females has decreased slightly for the Euro 1 subregion but increased for male workers in Euro 2 countries. The literature provides evidence that some workers are particularly vulnerable and therefore at risk of workplace accidents and injuries. Such vulnerability can arise for a number of reasons. For example, it is often suggested that temporary or migrant workers may be given riskier tasks to carry out or might miss out on essential training; or that workers of one sex may be more (or less) likely to work in a particular sector, with its attendant risks. Although the data are limited, the overall picture among migrant workers seems



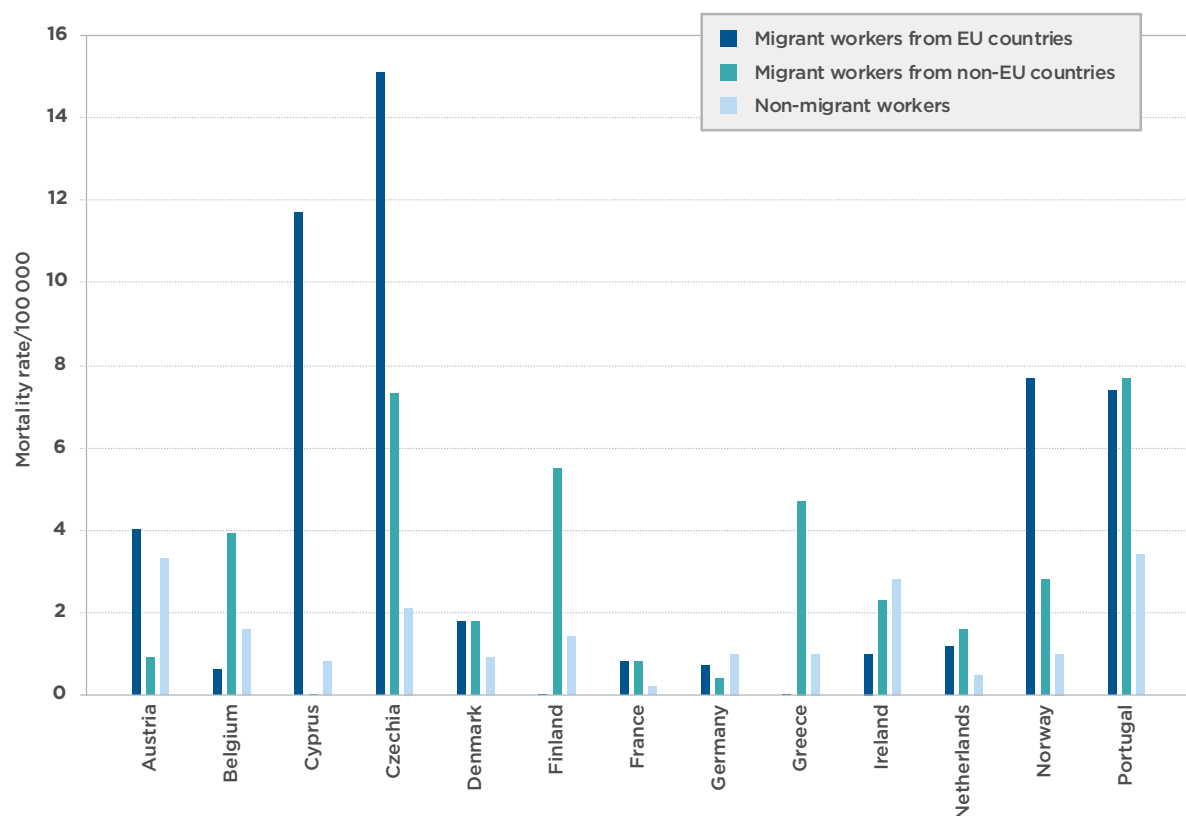
to support the notion that such workers are more at risk – at least of fatal injuries.

The risk of fatal injuries can be reduced by adopting appropriate policies, with a focus on those groups particularly affected. Hence, mortality statistics collected through appropriate national registries, providing demographic and social details, could dictate specific policies that may vary according to worker vulnerability. For instance, most fatal injuries affect the group aged 55 years and over and are associated with the occupation and type of work carried out (Peng and Chan, 2019); this indicates a need for specific occupational health and safety age-related policies to be adopted as a matter of some urgency. The pattern of an increased risk for older workers is of particular concern because demographic trends clearly indicate an ageing workforce worldwide, suggesting that a greater proportion of the working population will be at increased risk of fatal injury in future years.

Consideration should be given to measures such as periodic retraining, especially in cases of introducing new tasks and new equipment. Studies have suggested that – contrary to the common adage “You can’t teach an old dog new tricks” – older people can earn new skills, but their training requirements are different from those of their younger counterparts, reinforcing the need for particular attention to this age group (Crawford et al., 2016).

Older workers can be regarded as a specific example of a vulnerable group, and the limited available data suggest that other vulnerable groups (in this case migrant workers) might also warrant specific policies and actions. Such measures need, however, to be driven by improved understanding of what, in workplace terms, creates these vulnerabilities.

**Fig. 51.** Work-related injury mortality rate/100 000 by migrant status for selected countries (2015)



Note: countries may have different recording systems, with varying coverage of workers.

Source: ILO (2018b).

**Suggested mitigation actions are:**

- implementation of national programmes on occupational safety and health as suggested by the ILO Promotional Framework for Occupational Safety and Health Convention (ILO, 2006);
- further implementation and enforcement of the EU Occupational Safety and Health Strategic Framework 2014–2020 (EC, 2014) and similar relevant policies applying outside the EU;
- undertaking risk assessment of job tasks and implementing necessary preventive measures, including training;
- adopting more detailed data collection systems at the national level including specific groups;
- focusing on countries with increased rates of fatal injuries since 2010 – investigating the reasons to provide a better understanding of the causes and promote prevention;
- exploring what it is that makes certain groups more vulnerable to injury and, based on this knowledge, developing and promoting appropriate preventive measures.

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## 6.2 Inequalities in health risks in working environments

**Evanthia Giagloglou, Richard Graveling**

### Status

The self-reported prevalence of intrinsic and extrinsic risk factors in work environments differs between sexes; males are reportedly more exposed to risk from extrinsic factors and females from intrinsic factors.

### Trend

These trends do not differ between Euro 1 and Euro 2 countries. Previous European working condition surveys indicate stable levels of inequality between sexes from intrinsic and extrinsic work environment factors.

#### 6.2.1 Introduction and health relevance

The working environment is characterized by a range of factors that can broadly be divided into intrinsic and extrinsic. Intrinsic factors are those inherent in the work itself. These can be related to difficult work postures or repeated work movements, lifting weights or activities involving intense visual concentration, among others. Extrinsic factors are those related to the surrounding work environment, such as exposure to chemicals, dusts, fumes, smoke or gases, or to noise and vibration. Both intrinsic and extrinsic factors influence the way people work and may affect their health. For example, exposure to vibration or heavy loads at work is associated with musculoskeletal disorders (Punnett & Wegman, 2004; Charles et al., 2018), while exposure to chemical substances can be related to skin diseases and cancer (Baan et al., 2009). Another extrinsic factor to which some workers are still exposed is tobacco smoke, although many countries have established regulations that prohibit smoking in the workplace (Filippidis et al., 2016).

Harmful work conditions are widespread: recent studies suggest that one in three workers report being exposed to vibration (Donati et al., 2008), 17% to chemicals for a quarter of their time or more (EU-OSHA, 2005) and 35% to the risk of carrying and lifting heavy loads (EU-OSHA, 2007). Intrinsic and extrinsic conditions are not homogeneous among the working population. Geography and demography play an important role in influencing underlining inequalities, with factors such as educational level, sex, age, poverty level and type of employment influencing the prevalence of either intrinsic or extrinsic conditions (WHO Regional Office for Europe, 2012). Regulations on exposure

to tobacco smoke – and their enforcement – also vary greatly between countries.

Musculoskeletal, fatigue, skin and vision problems seem to have a different prevalence among different professions; thus, managers and professionals report a higher prevalence of vision problems, while operators and workers in elementary occupations seem to be more affected by musculoskeletal problems (Siegrist, Montano & Hoven, 2014) and these are further affected by variations in national employment in relevant sectors. Headache and eyestrain affect more females, while skin problems affect mainly the male population. Some interesting differences can also be found within the same category of problems; for example, musculoskeletal problems affecting the back, hips, legs or feet seem to be more prevalent among male workers; those affecting the neck, shoulders and arms affect mainly females (Eurostat, 2010). Again, these may be a reflection of differing patterns of employment in different sectors. In addition, Stier and Yaish (2012) note that women tend to work in less physically challenging work settings but are instead affected by, for example, more challenging emotional conditions and less autonomy in the job.

#### 6.2.2 Indicator analysis: inequalities by exposure to intrinsic and extrinsic factors, sex and education level

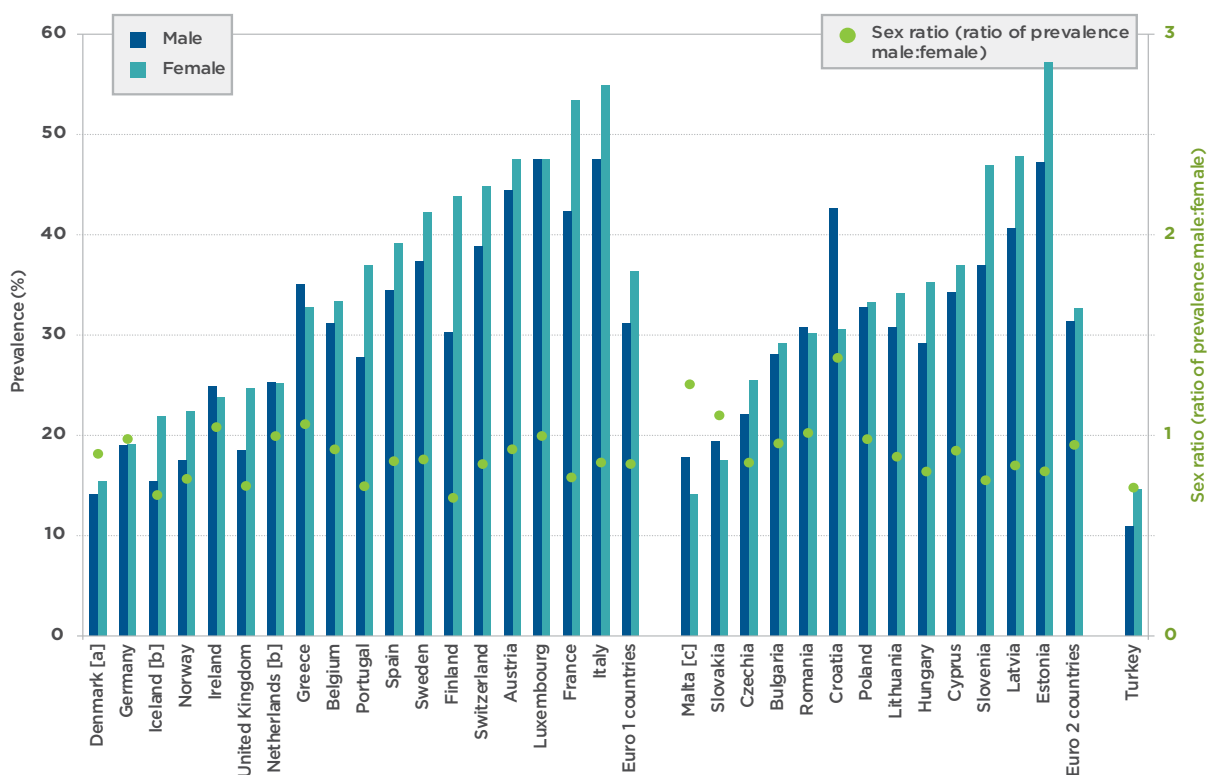
The data are based on self-reported exposure, derived from the results of the Labour Force Survey from 2013 (as reported in Eurostat (2018)) and the Special Eurobarometer 429 on the attitudes of Europeans towards tobacco (European Commission, 2015). No data could be identified for countries not covered by EU-coordinated surveys.

Fig. 52 presents the prevalence of self-reported exposure among workers aged 15–64 years to intrinsic factors (combining exposure to difficult work postures or work movements, handling of heavy loads and activities involving visual concentration) for 2013. Euro 1 and Euro 2 countries follow a very similar trend, with a slightly higher prevalence among female than male workers in almost all countries (sex ratio of 0.86:1 for Euro 1 and 0.96:1 for Euro 2 countries).

Estonia, France and Italy report the highest values for females, with more than 50% reporting some

exposure to intrinsic factors (it is notable that the same three countries also report some of the highest rates for males). The highest relative inequality to the disadvantage of female workers is found in Finland, Iceland and Turkey, with a sex ratio of 0.7:1, indicating that males report intrinsic risk factors 30% less often. Croatia and Malta are the only countries where males report a markedly higher level of exposure to intrinsic factors than females, with sex ratios of 1.4:1 and 1.3:1, while slightly higher rates in males are found for Greece, Ireland and Slovakia.

**Fig. 52.** Reported workplace exposure to intrinsic factors, by sex (2013)

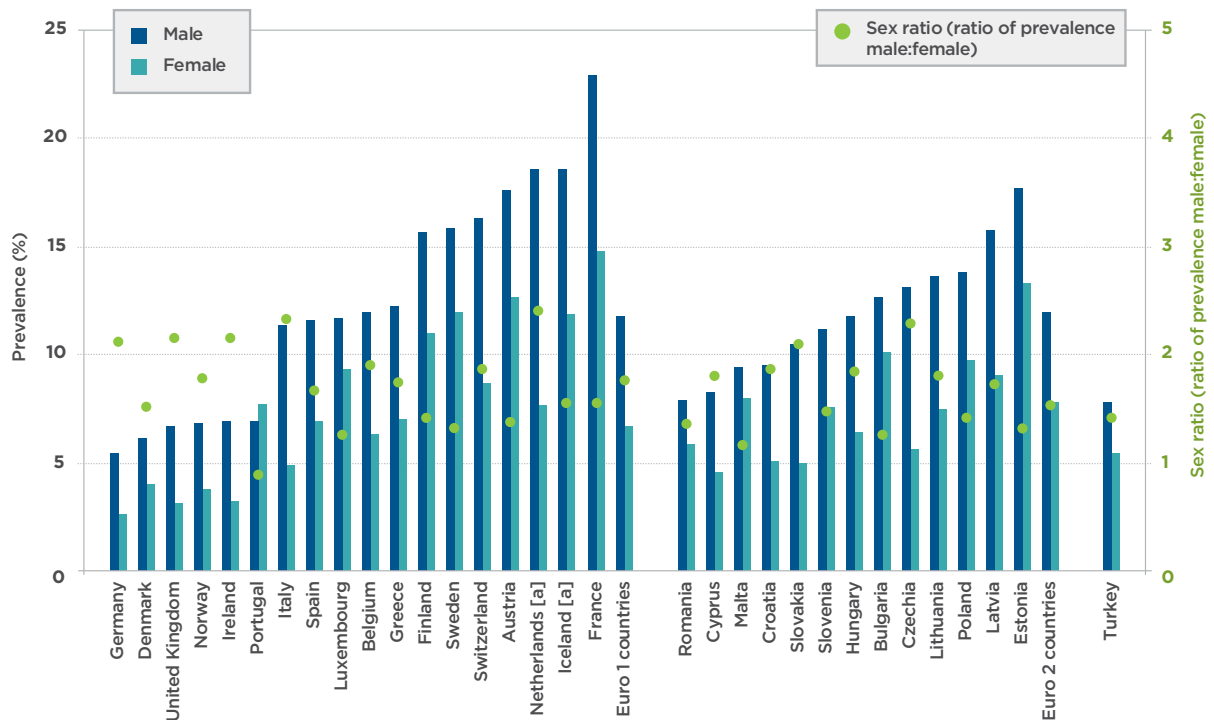


Notes: [a] Denmark reported no data for activities involving strong visual concentration; [b] Iceland and the Netherlands reported no data for handling of heavy loads and activities involving strong visual concentration (these data are from 2007); [c] data for females reporting exposure to noise or vibration from 2007.

Source: Eurostat (2018).

Fig. 53 presents self-reported work exposure to extrinsic factors (combining exposure to chemicals, dusts, fumes, smoke or gases, noise and vibration) for female and male workers. A very different pattern from that for intrinsic factors emerges, with a higher self-reported prevalence of exposure for males in almost all countries. Only Portugal has a higher prevalence for female workers, with a sex ratio of 0.9:1 between males and females. France presents the highest and Germany the lowest prevalence of workplace exposure to extrinsic factors for both males and females, but inequalities

between male and female workers are stronger in Germany (sex ratio of 2.1:1) than in France (1.6:1). Six countries overall report more than the double prevalence for male workers compared to their female counterparts, with the Netherlands reporting the highest inequality (2.4:1). Overall, the inequality is somewhat stronger in Euro 1 countries (1.8:1, suggesting that males have an 80% higher prevalence than females) than in Euro 2 countries, where a sex ratio of 1.5:1 applies. These trends are similar to those found in older surveys (Eurofound, 2010).

**Fig. 53.** Reported workplace exposure to extrinsic factors, by sex (2013)

Note: [a] data are from 2007.

Source: Eurostat (2018).

Specific data are available on occupational exposure to tobacco smoke (unfortunately without distinguishing between open and enclosed workplaces), indicating that the issue still affects a significant proportion of the European workforce. Fig. 54 shows inequalities in tobacco smoke exposure in the workplace by sex, indicating that across both subregions male workers report exposure more frequently (sex ratio of 1.5:1). Greece has the highest exposure levels among Euro 1 countries and Cyprus among Euro 2 countries for both sexes. Although Finland has relatively low overall levels of tobacco smoke exposure for both sexes, it has the highest inequality with a sex ratio of 3.4:1 between males and females. All Euro 2 countries have a higher prevalence of reported tobacco exposure among males, while females report a higher prevalence in Euro 1 countries Denmark and Spain.

Fig. 55 shows the differences in reported exposure to tobacco smoke at work, stratified by level of education (measured by age during final year of education). For both subregions exposure is reported most frequently by workers with low education levels, while the longest education time is usually associated with the lowest exposure, although in some countries the highest reported exposure is found for workers with

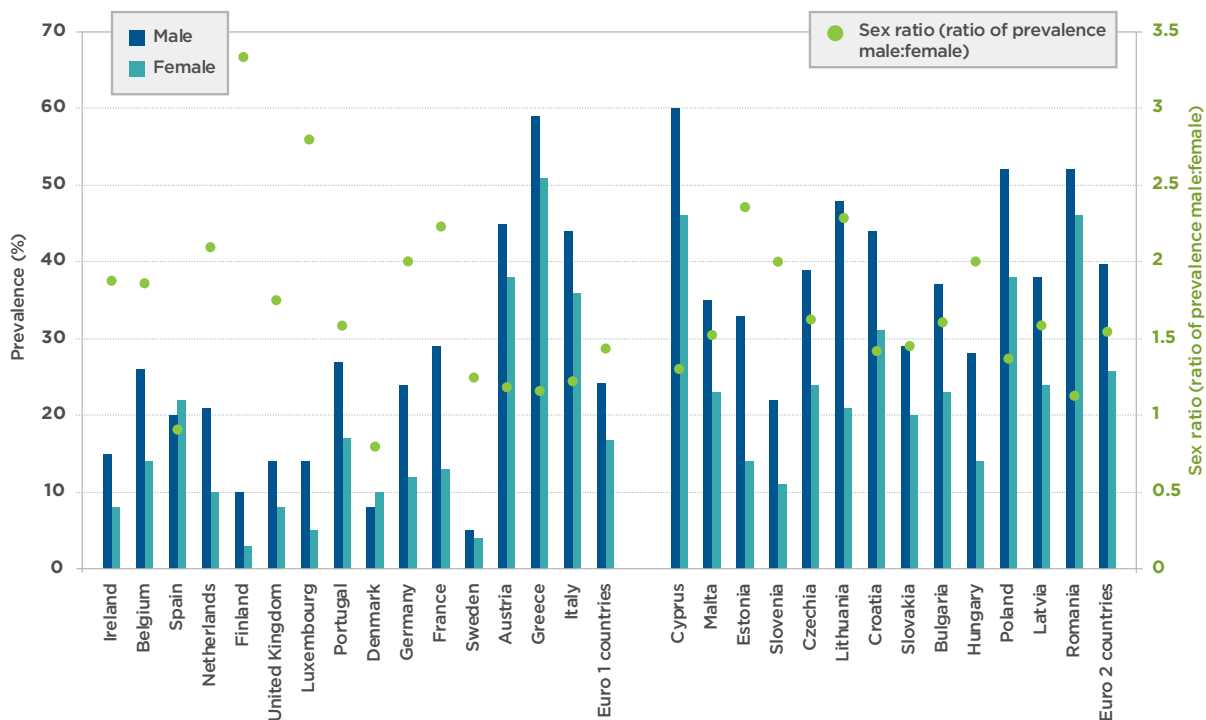
longer education periods. The Netherlands and France have the highest inequalities in exposure to tobacco among those who only remained in education until the age of 15 years. On average, Euro 1 countries have lower prevalence of reported exposure than Euro 2 countries.

### 6.2.3 Conclusions and suggestions

Almost all countries examined show higher exposure to extrinsic risk factors (including tobacco smoke) at work for males and higher exposure to intrinsic risk factors for females. These trends indicate that workplace exposure factors affect both sexes, but with an uneven prevalence of work challenges (presumably reflecting different types of work). As exposure to these factors may have very different outcomes, the differences are likely to be reflected in different patterns of work-related health problems. It is relevant to note that these trends are similar in both Euro 1 and Euro 2 subregions.

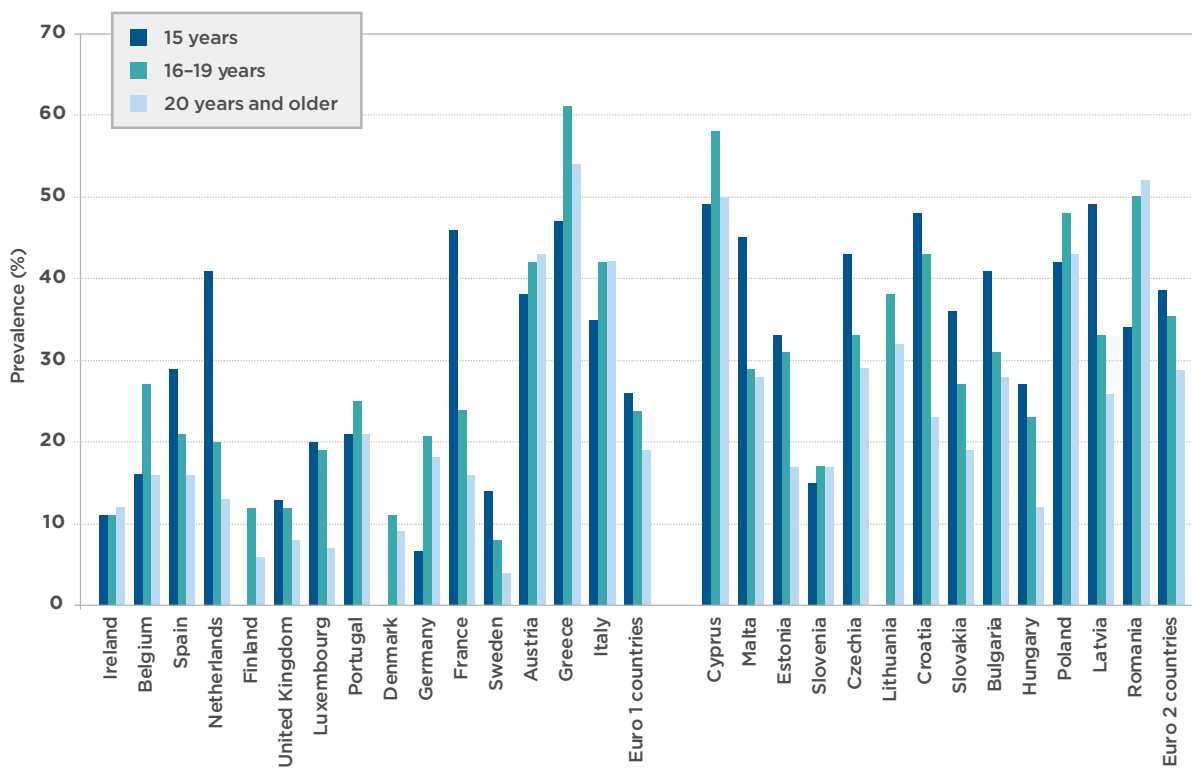
Although laws in many countries prohibit smoking in the workplace, it seems that their enforcement is not fully effective. For occupational tobacco exposure in particular, social measures should be adopted as well as legislative ones, since prevalence seems to be affected by sex, age and national factors.

**Fig. 54.** Workers reporting exposure to tobacco smoke at the workplace by sex (2014)



Source: European Commission (2015).

**Fig. 55.** Workers reporting exposure to tobacco smoke at the workplace by age during final year of education (2014)



Source: European Commission (2015).

Adoption of suitable preventive or protective measures needs to reflect these different patterns of exposure, to reduce the work risks effectively through targeted policies. This is especially

relevant for vulnerable workers (such as young people, migrants and pregnant women), who may be more exposed to occupational risks for legal, social or other reasons.

### Suggested mitigation actions are:

- effective implementation of European directives regulating working conditions and work processes within the EU (also reflected in some non-EU European countries), which establish minimum standards and specifically encourage improvements regarding health and safety (such as Occupational Health and Safety Framework Directive 89/391 EEC and related directives);
- adoption of preventive and protection measures in line with ILO and United Nations conventions;
- identification of workplace hazards and adoption of necessary preventive measures;
- undertaking ergonomic risk assessment of tasks involving intrinsic risk factors, including manual tasks (especially those involving repetitive, difficult and/or prolonged demanding postures);
- exploring comparative analysis of data on health issues with extrinsic and intrinsic workplace factors at the national level;
- fully implementing and enforcing tobacco smoke ban regulations;
- adopting social measures to eliminate health risks, such as educational programmes, raising social awareness among vulnerable groups.

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## 7. Injury-related inequalities

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Injuries such as falls, poisoning and burns often occur in the private home, but they are not setting-specific as they can also occur during sport and recreation or other activities. For many injuries the relative contribution of the environment is unclear: it can be the single cause (as with poisoning caused by lack of adequate cooling or storage of food items) or a contributor (as with a fall on a staircase), but it can also have no causal impact (as with intentional poisoning or sports injuries). The risk of injury therefore often depends on a combination of personal factors (such as age, sex, physical capacity and level of risk awareness) and environmental context factors (such as conditions and safety features of built environments, consumer products and technical and electrical equipment).

No environment is free from risks but the most vulnerable populations groups, who have lower coping capacity, are often exposed to settings with higher levels of injury risk (such as inadequate housing); this is for example the case for children and elderly people and those with functional limitations. These population groups may suffer from a higher likelihood of injury, and may also be especially vulnerable to the consequences of such injuries and affected by more severe health outcomes.

Social disadvantage is often associated with poorly maintained physical environments and reduced coping capacities, indicating that injuries may not only be affected by demographic aspects but also be distributed unequally across socioeconomic strata. As injury monitoring systems have traditionally focused on the demographic characteristics (age and sex) of injury victims, however, this section centres on injury-related inequalities by sex and age in the WHO European Region for two indicators:

- inequalities in fatal poisoning
- inequalities in fatal falls.

These cover most of the countries in the WHO European Region, but the data provide very little insight into socioeconomic inequalities in injuries and related deaths.

Transport-related injuries and injuries related to work settings are addressed in the sections on urban environment and transport inequalities (Chapter 5) and on work-related inequalities (Chapter 6).



## 7.1 Inequalities in fatal poisoning

Lucie Laflamme

### Status

Male sex, increasing age and residing in a middle-income country are strongly associated with increased poisoning mortality. Alcohol, medical drugs and narcotics are the most common causes. The percentage of alcohol-related poisoning mortality differs extensively across subregions and countries.

### Trend

Compared to the 2012 report on environmental health inequalities, some countries have seen a reduction in sex-related inequalities in poisoning mortality, although men remain at higher risk than women.

#### 7.1.1 Introduction and health relevance

Poisoning occurs when a substance that is swallowed, inhaled, injected or absorbed interferes with normal body functions. In the WHO European Region, as in other parts of the world, recent decades have witnessed a decline in the number of poisoning deaths (Haggma et al., 2016). In the European Region alone the annual number of poisoning deaths fell from 21 909 in 2000 to 9124 in 2015. This represents a reduction of 58.4%, compared to a reduction of 25.4% for all unintentional injuries aggregated (Aldridge, Sethi & Yon, 2017).

Sex differences to the detriment of men exist for poisoning mortality in the Region, as for other injury mechanisms. In recent years, however, the differences have become relatively smaller, reaching a male:female mortality rate ratio of 1.9:1 in 2015 compared to 2.5:1 for all injuries aggregated, including intentional injuries (Aldridge, Sethi & Yon, 2017). Sex differences are observable throughout the life-course, albeit to different degrees and for causes that vary with age (INVS, 2008).

Strong associations exist between age and both the risk and the causes of accidental poisoning. Among the very young, unintentional poisoning occurs for a range of behavioural and environmental factors, such as curiosity, a desire to imitate adults and unsafe storage. Older adults tend to sustain unintentional poisoning because they are more exposed to and have more access to medical drugs, to which they also respond differently for physiological, pathological and environmental reasons (Scientific Committee on Consumer Safety, 2011). In the European Region as a whole, poisoning is the third leading cause of injury death among people aged 65 years and over. Among children aged under 15 years, although the risk

has declined, poisoning remains the mechanism of injury with the greatest disparities among middle-income and high-income countries. The death-rate ratio for this age group in middle-income versus high-income countries was 16.0:1 in 2000 and 12.3:1 in 2015, compared to 4.8:1 and 6.2:1, respectively, for all injuries aggregated, including intentional injuries (Aldridge, Sethi & Yon, 2017).

The death-rate ratios for poisoning for all ages aggregated in middle-income versus high-income countries were 8.0:1 in 2010 and 3.8:1 in 2015 (Aldridge, Sethi & Yon, 2017), showing an overall reduction in inequality between affluent and less affluent countries. This downward trend in poisoning mortality seems not to benefit national populations to the same extent (not least among children), however, and inequalities remain a major challenge. In this context, a review of evidence showed that the recent downward trend in unintentional injuries as a whole – also present for RTIs, falls and burns – is accompanied by stagnating or even increasing levels of inequality (Sengoelge et al., 2019). Whether this applies to poisoning as well remains to be investigated.

#### 7.1.2 Indicator analysis: inequalities by national income level, age, cause and sex

Data on poisoning mortality are taken from the WHO mortality database, which covers most countries in the WHO European Region (WHO, 2018). These data only allow assessment of inequalities related to sex and age.

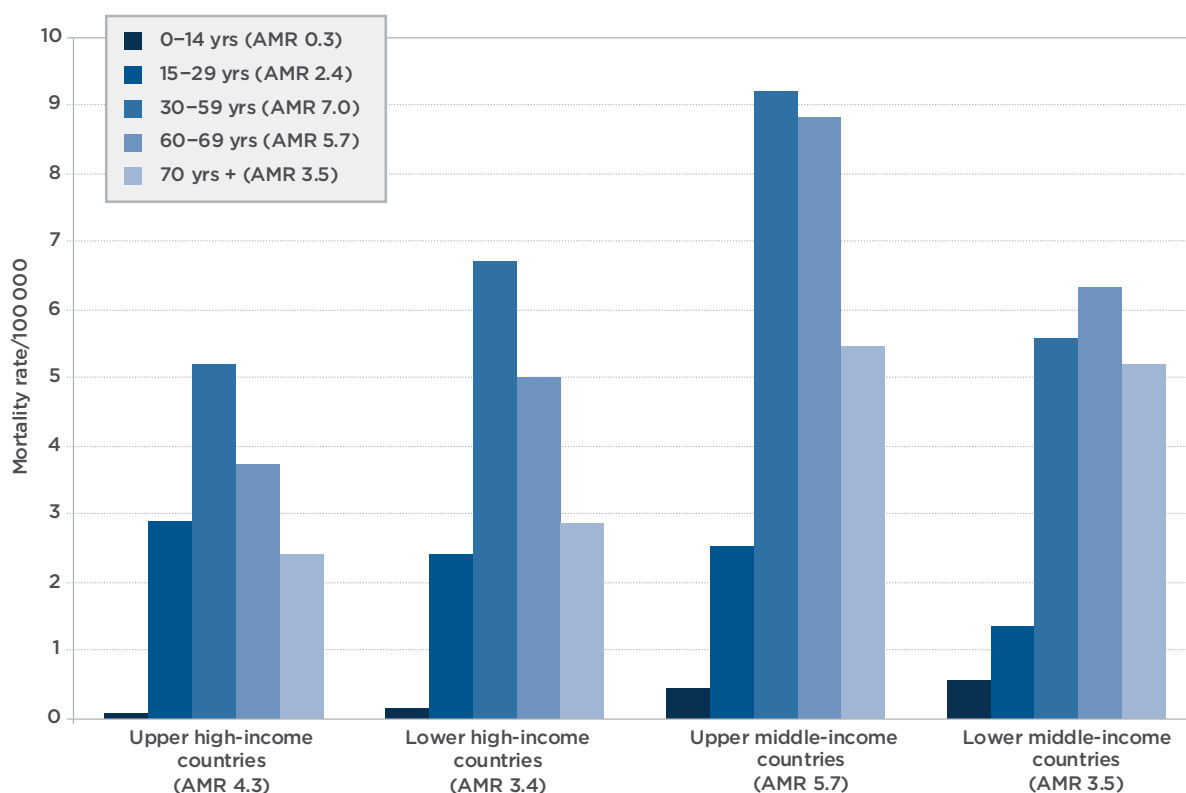
The overall average rate of poisoning mortality (excluding intentional poisoning cases) is 4.0 per 100 000 population. Fig. 56 shows the distribution by national income level, stratified by age category. A steep gradient can be seen in the average

mortality rate from the 0–14 years to the 30–59 years age groups (0.3 to 7.0/100 000), followed by reductions in the two oldest age categories, but with rates that are still higher or close to the overall average rate.

Poisoning rates demonstrate a general increase with declining national income level, followed by a reduction from upper middle-income countries to lower middle-income countries, which again show a lower than average poisoning mortality (3.5/100 000). This pattern is observed in the 30–59 years and 60–69 years age groups (those most at risk) but not in the others. The mortality rates in lower middle-income countries surpass that of high-income ones in adults aged both 60–69 and 70+ years.

Fig. 57 presents the proportions of seven causes of poisoning mortality by age group. The proportions of other gases and vapours (26.6%), alcohol (26.2%) and medical drugs excluding narcotics/psychodysleptics (20.2%) and, to some extent, narcotics and psychodysleptics (17.3%) are relatively high for all ages aggregated but vary extensively by age. Other gases and vapours, for instance, predominate among the youngest (73.6%) and oldest (45.6%) age groups, as does alcohol in the age groups 40–49 years (46.6%), 50–59 years (59.6%) and 60–69 years (57.7%). The highest mortality rate per 100 000 population is found for the age group 50–59 years: alcohol causes almost 60% of these deaths.

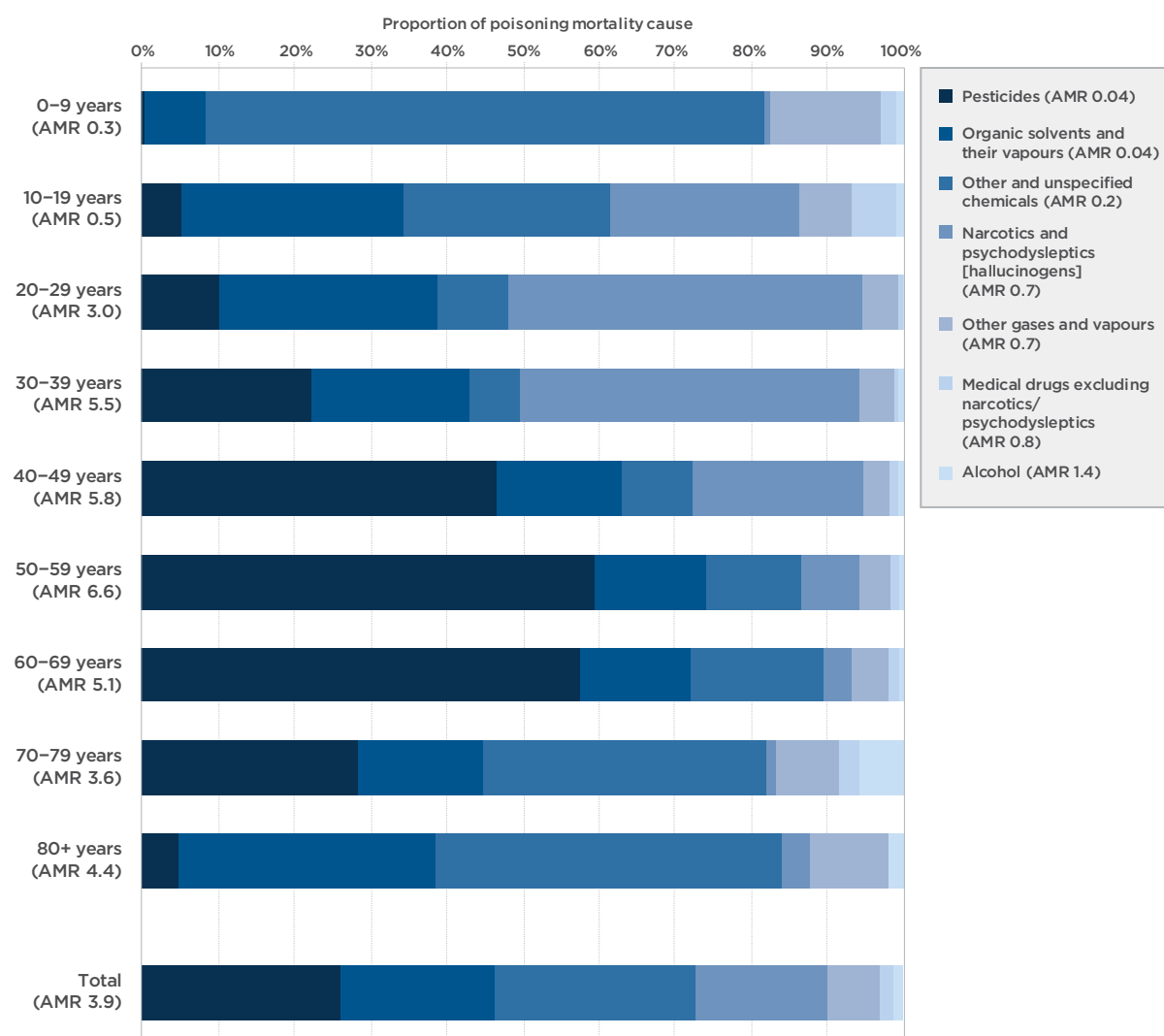
**Fig. 56.** Poisoning mortality rate/100 000 population by national income level and age (last year of reporting)



Note: AMR = average mortality rate, calculated as the population-weighted average for country income categories. Source: data from WHO (2018).

Data from the WHO mortality database reveal a stark difference in average mortality rates from poisoning for males and females (6.5 versus 2.0/100 000, respectively), giving an overall sex ratio of 3.3:1. The three charts in Fig. 58 outline poisoning mortality by sex and country, grouped by subregion. It is of note that males have a higher poisoning mortality rate than

females in all countries except Iceland, and that in each subregion some countries reach strikingly high rates of fatal poisoning in general. Some countries also stand out for their extreme sex ratios, including Greece (5.3:1), Poland (5.7:1) and Azerbaijan (6.9:1). The highest sex ratios are found for the Euro 2 (4.0 times more poisoning cases in males than females) and Euro 3 subregions (3.8:1).

**Fig. 57.** Proportions of fatal poisoning mortality, by cause and age group (last year of reporting)


Note: AMR = average mortality rate.

Source: data from WHO (2018).

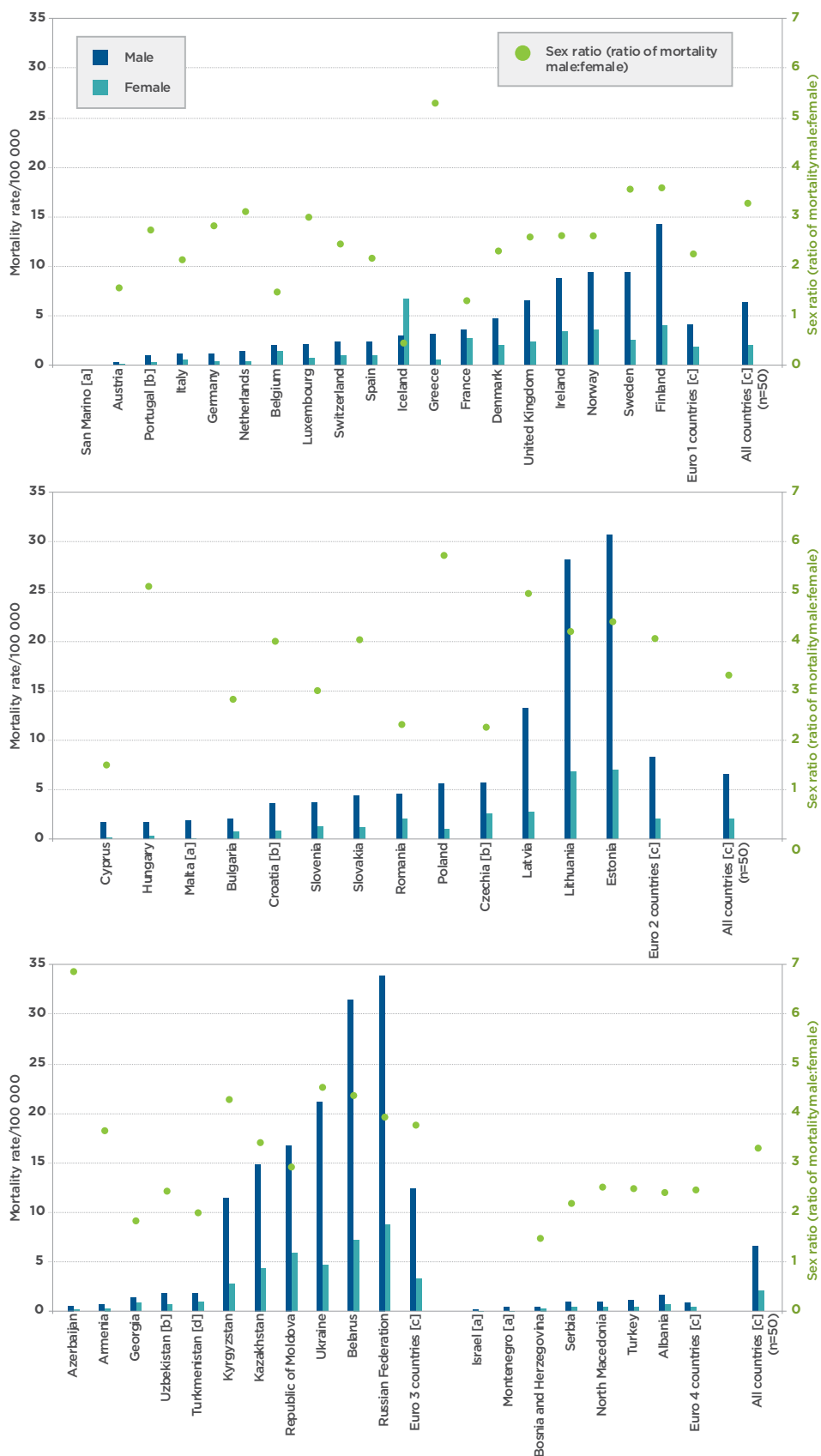
Table 12 shows the proportion of alcohol poisoning among all poisonings for countries reporting that information. On average, alcohol is the main cause of 28% of all poisonings, with extremely wide variation across countries. Rates range from as low as 2% in Italy, 5% in Denmark and Spain, 6% in the Netherlands and 7% in North Macedonia to proportions above 70% in Latvia (71%), Kyrgyzstan (73%), Poland (76%) and Slovakia (77%). With two exceptions (Denmark and Iceland), males are much more affected by alcohol-related poisoning, but the overall sex ratio for alcohol-related poisoning mortality (3.7:1) is only slightly higher than for poisoning mortality in general (3.3:1). At the country level, sex-related differences in alcohol-related poisoning mortality are more extreme than for all poisoning, with some countries exceeding a sex ratio of 10:1.

### 7.1.3 Conclusions and suggestions

Poisoning mortality is strongly associated with sex; the risk for men is higher than that for women not only globally but also by subregion and in all but one country (see Fig. 58). The risk of poisoning also rises until the age group 30-59 years, where it peaks. Medical drugs excluding narcotics/psychodysleptics are the predominant causes of poisoning in the second and third decades of life; alcohol in the fifth and sixth.

The rate of poisoning mortality increases with decreasing country income level, from higher high-income countries to higher middle-income countries, followed by a sharp reduction in lower middle-income countries. The age-specific pattern is, however, not consistent.

**Fig. 58.** Poisoning mortality rate/100 000 population by sex (last year of reporting)



Notes: [a] San Marino reports zero cases for males and females; Malta, Israel and Montenegro report zero cases for females; [b] population data taken from United Nations Population Statistics; [c] average of national rates; [d] population data taken from populationpyramid.net.

Source: data from WHO (2018).

**Table 12.** Alcohol-related poisoning mortality rate/100 000 population by sex and country (last year of reporting)

Country	Alcohol-related poisoning			Mortality rate sex ratio (male:female; X:1)	Proportion of all poisonings related to alcohol (%)
	Total	Male	Female		
Austria	0.1	0.1	0.02	4.2	21
Belgium	0.3	0.5	0.1	3.2	17
Denmark	0.2	0.1	0.2	0.7	5
Finland	5.0	8.0	2.1	3.8	56
France	0.6	1.0	0.2	4.0	19
Germany	0.2	0.2	0.1	3.2	19
Iceland [a]	0.9	0.0	1.8		19
Ireland	1.2	2.0	0.4	5.2	19
Italy	0.0	0.04	0.003	11.7	2
Luxembourg	0.4	0.4	0.4	1.0	25
Netherlands	0.1	0.1	0.02	4.1	6
Norway	0.6	0.9	0.4	2.6	10
Portugal	0.1	0.2	0.1	2.2	21
Spain	0.1	0.2	0.05	3.7	5
Sweden	1.1	1.5	0.7	2.3	18
Switzerland	0.2	0.3	0.1	2.8	11
United Kingdom	0.8	1.0	0.5	2.0	17
Euro 1 countries [b]	0.7	1.0	0.4	2.3	17
Bulgaria	0.5	0.7	0.2	3.9	33
Croatia [a]	0.5	1.0	0.0		22
Czechia	1.9	3.1	0.7	4.2	48
Estonia	9.4	14.6	4.7	3.1	52
Hungary	0.2	0.4	0.04	10.4	21
Latvia	5.4	9.5	1.9	5.1	71
Lithuania	8.7	14.3	4.0	3.6	52
Malta [a]	0.2	0.5	0.0		25
Poland	2.4	4.5	0.5	8.7	76
Romania	1.3	2.1	0.5	4.1	41
Slovakia	2.1	3.6	0.7	4.9	77
Slovenia	0.7	1.4	0.1	14.2	29
Euro 2 countries [b]	2.8	4.6	1.1	4.2	46
Armenia [a]	0.03	0.1	0.0		10
Azerbaijan [a]	0.1	0.2	0.0		35
Georgia	0.2	0.4	0.1	7.7	22
Kazakhstan	4.8	8.1	1.8	4.4	51
Kyrgyzstan	5.1	8.8	1.5	6.0	73
Republic of Moldova	3.8	5.6	2.1	2.7	35
Uzbekistan	0.2	0.3	0.0	7.0	13
Euro 3 countries [b]	2.0	3.3	0.8	4.3	34
Bosnia and Herzegovina [a]	0.03	0.1	0.0		8
Serbia	0.1	0.1	0.1	2.6	15
North Macedonia [a]	0.05	0.1	0.0		7
Turkey	0.1	0.2	0.01	35.2	14
Euro 4 countries [b]	0.1	0.1	0.01	8.0	11
All countries [b]	1.5	2.4	0.65	3.7	28

Notes: Israel excluded because only a single case for poisoning overall was reported; [a] Croatia, Malta, Armenia, Azerbaijan, Bosnia and Herzegovina and North Macedonia reported zero female cases and Iceland reported zero male cases; [b] average of national rates.

Source: data from WHO (2018).

It is of concern that the observed downward trend in poisoning mortality does not seem to benefit all population groups and countries to the same extent, as stark inequalities remain. The reasons are likely to be found in differential exposure to poisonous substances and differential

susceptibility (Laflamme et al., 2009). Although there may be a need for targeted actions, these need to be combined with more “inclusive” actions aiming at the reduction of exposure to poisonous substances and better acute care of victims.

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#### Suggested mitigation actions are:

- regulating the mode of packaging and storing of poisonous/toxic substances;
  - regulating access to and sales of toxic/poisonous substances;
  - implementing and enforcing restrictive alcohol policies;
  - introducing and strengthening poison centres and control services;
  - implementing medication reviews in primary care for groups of patients at greater risk (such as older people).
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## 7.2 Inequalities in fatal falls

Merel Leithaus, Matthias Braubach

### Status

Inequalities in fatal falls are mainly driven by demographic factors, and are most frequent above the age of 70 years. They tend to occur more often in males, but as age increases the difference by sex decreases.

### Trend

The sex ratio in fall-related mortality (male:female) has decreased significantly over recent years in all except the Euro 4 subregion.

#### 7.2.1 Introduction and health relevance

Falls are the second leading cause of unintentional injury deaths worldwide and lead to an estimated 646 000 deaths annually (WHO, 2018a). The link between fatal falls and age is clear, with elderly adults experiencing fatal injuries most often. Older people also tend to suffer from more severe consequences of non-fatal falls: fractures, in particular, are frequent and cause major health care costs.

Individuals aged over 80 years have sixfold higher mortality than individuals aged 65–79 years; this is explained by a higher likelihood of falling and a greater level of frailty. In the EU area elderly citizens suffer around 40 000 deaths from falls each year (European Network for Safety among Elderly, 2012). About 30% of people over the age of 65 years living in the community fall each year in the WHO European Region (Sethi et al., 2006). Fear of falls is a well known consequence that can result from falls and often leads to a reduction in mobility and increased isolation. Falls thus affect the quality of life of the elderly population in more ways than one (European Network for Safety among Elderly, 2012).

Over 1500 fatal falls annually also happen among people aged 0–19 years in the European Region (Sethi et al., 2008), making them the fourth leading cause of injury deaths in this age group. Generally, boys have a higher risk of falls than girls. Risk factors affecting the frequency of falls in children include environmental hazards, type of housing and socioeconomic factors such as unemployment or low maternal education (Peden et al., 2008).

Little information is available about the relationship between socioeconomic status and falls. A study reviewing socioeconomic differences in injuries showed that for younger age groups fall-related injuries are more frequent in deprived communities. No clear socioeconomic pattern for falls among

elderly people could be identified, however, indicating that inequalities are different in varying settings (Laflamme, Burrows & Hasselberg, 2009).

#### 7.2.2 Indicator analysis: inequalities by national income level, age and sex

Data on fatal falls are available by sex and age from the WHO mortality database, which covers most countries in the WHO European Region (WHO, 2018b).

Fig. 59 shows the mortality rate of falls per 100 000 population, stratified by national income level and age. The overall mortality rate is 7.4/100 000, but the rates vary widely among age groups. A significant age-related increase in fall mortality from 0.3/100 000 in children to 7.9/100 000 in people aged 60–69 years can be identified. Small variations by national income level can be observed in these age groups, indicating higher mortality for the lower high-income and the upper middle-income countries. By far the highest fall mortality rate is then observed in the group aged 70 years and over, with an average mortality rate of 54.2/100 000. For this age group, a sharp rise in fall mortality rates occurs in all country income groups, but the increase is expressed most strongly in countries with the highest income levels (with a mortality rate of 74.5/100 000), suggesting that falls among elderly people are a particular challenge in more affluent societies.

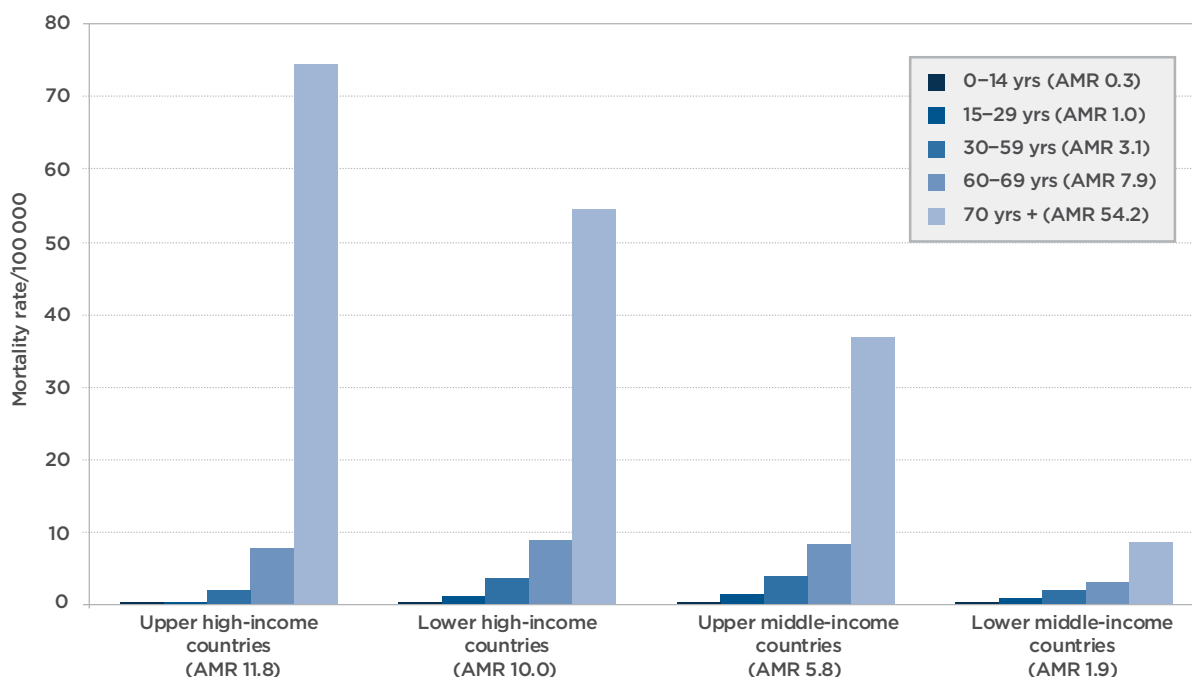
Fig. 60 is divided into three graphs, outlining fall mortality data by sex and subregion. In the Euro 2, 3 and 4 subregions, males have a higher fall mortality rate in all countries except Slovenia and Croatia, where females have the highest mortality rates observed in all countries (26 and 33/100 000, respectively). The highest inequalities by sex can be found in the Euro 3 subregion (with a sex ratio between males and females of 3.1:1); the highest national differences can also be observed



in this subregion, in Azerbaijan (sex ratio 6.9:1) and Uzbekistan (sex ratio 5.2:1). Euro 1 countries present no clear inequality pattern as higher rates

for females are found in seven out of 18 countries, and the differences by sex are less strong in general (the highest sex ratio is 2.2:1 in Greece).

**Fig. 59.** Fall mortality rate/100 000 population by national income level and age (last year of reporting)



Note: AMR = average mortality rate, calculated as the population-weighted average for country income categories.  
Source: data from WHO (2018b).

Fig. 61 presents fall mortality rates stratified by detailed age groups, showing how the fatality rate evolves with age. While fall mortality rates are comparably low in the young age groups (0–19 years), a steady increase can be seen from the 15–19 years age group onward. The largest male/female difference is noticeable in the 20–24 years to 55–59 years age groups; the mortality rate can be 5–6 times higher for males. Above the age of 60 years the gender gap between males and females narrows again. The population aged 85 years and over reaches fall mortality rates of 200/100 000 for males and 150/100 000 for females.

### 7.2.3 Conclusions and suggestions

The data show a clear link between fatal falls and age, with older adults having the highest risk. The analysis also identified that fatal falls among elderly people are notably higher in high-income countries than middle-income countries. Differences by sex can be observed in every age range but the middle age groups in particular have higher fall mortality rates in males than females.

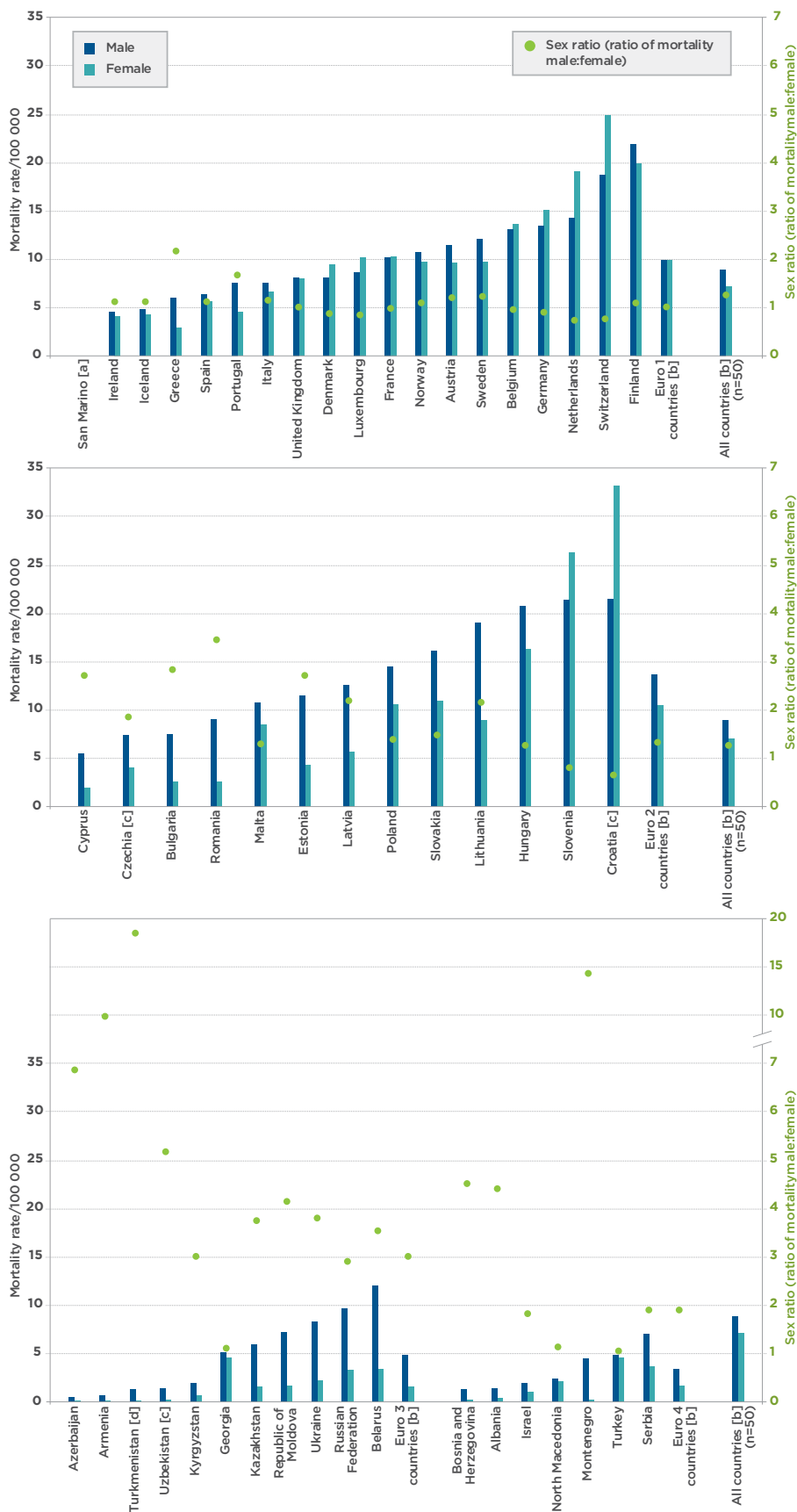
The most affected population groups are elderly people and males. Moreover, the literature

suggests that older people who experience a fall are generally confronted with more severe health consequences.

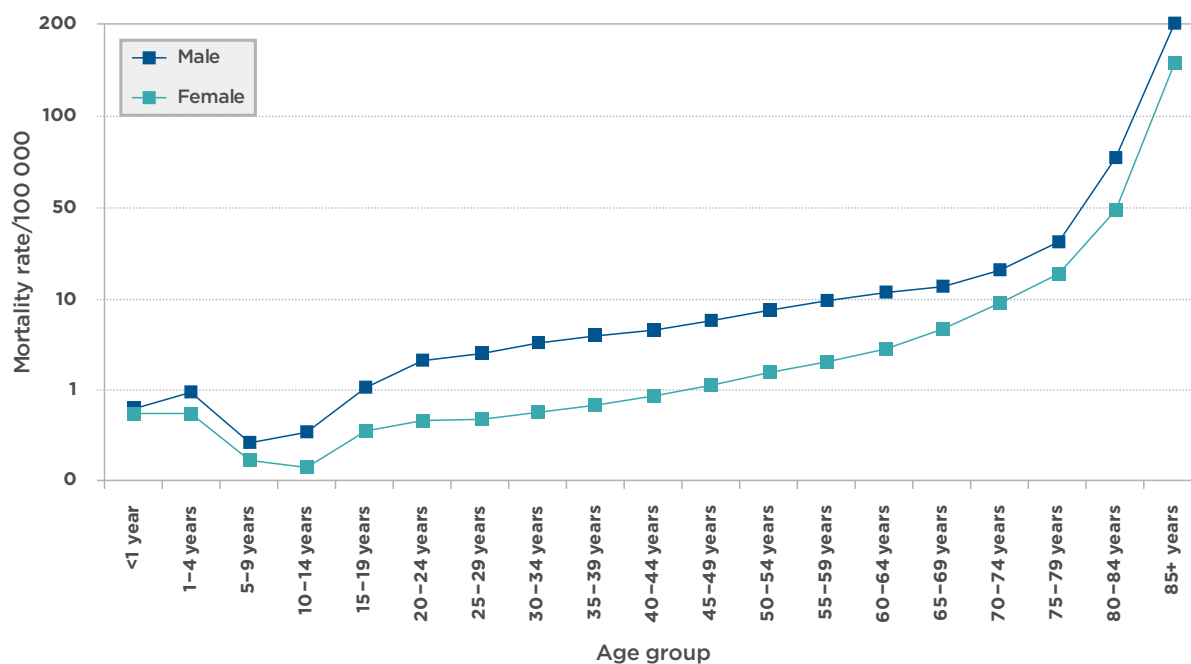
Owing to demographic trends, fatal falls are a major public health problem that needs to be tackled. The living environment plays a great role in facilitating or hindering falls; the home environment in particular should be free from hazards to reduce the risk of falls (European Network for Safety among Elderly, 2012). Home modification and barrier-free design strategies could be introduced to minimize environmental hazards, reduce the occurrence of falls and promote healthy ageing. Examples of home modifications include installation of grab rails, bathroom modifications and adjustments to fix loose carpets and slippery surfaces. In addition, programmes that strengthen physical activity and reduce fragility are beneficial (European Network for Safety among Elderly, 2012).

To reduce the risk of fatal falls in the younger age groups, prevention strategies that aim to support a safe environment are valuable (Peden et al., 2008). Both the indoor and outdoor environments need to be considered for children.

Fig. 60. Fall mortality rate/100 000 population by sex (last year of reporting)



Notes: [a] San Marino reports zero cases for males and females; [b] average of national rates; [c] population data taken from United Nations Population Statistics; [d] population data taken from populationpyramid.net.  
 Source: data from WHO (2018b).

**Fig. 61.** Fall mortality rate/100 000 population by age (last year of reporting)

Note: data aggregated from 50 countries.

Source: data from WHO (2018b).

### Suggested mitigation actions are:

- introducing barrier-free design into building codes to increase safety and independence and reduce risk of falls;
- creating age-friendly public environment designs that encourage healthy ageing;
- establishing national programmes and funding schemes to implement/coordinate home assessments and home modifications;
- providing physical activity and balance training to support active and healthy ageing;
- informing parents about effective home measures (such as window guards, roof railings and stair gates) to reduce the risk of falls in children.

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# 8. Changes in environmental health inequalities over time

**Firmino Machado, Matthias Braubach**

This chapter provides an analysis of the changes in environmental health inequalities for countries in the WHO European Region, comparing information from this report (mainly based on data collected in 2016) and the 2012 report (mainly based on data collected in 2008/2009, see WHO Regional Office for Europe, 2012). The comparison looks at the changes in inequality gaps and shows whether the difference in environmental exposure across population subgroups – between rich and poor or rural and urban populations, for example – has increased or decreased over time.

Three change patterns were identified in the variations observed for the environmental health inequality indicators:

- success stories – a reduction in inequalities in most countries;
- mixed evidence – no clear pattern of increasing or decreasing inequalities across countries;
- challenges – an increase in inequalities in most countries.

These patterns are presented below, illustrated by example figures showing the absolute changes in inequality gaps between two reporting years. Box 3 outlines the method applied to calculate the change in inequalities.

## **Box 3.** Calculation of inequality changes over time

The arrow base represents the inequality gap determined in the first year of reporting and the arrowhead the inequality gap quantified in the second.

Green arrows represent a decrease and blue arrows an increase in inequalities. If the data are available for only one year it is not possible to compute the difference over time, so the inequalities are represented by a grey circle.

While the green and blue arrows indicate whether inequalities have decreased or increased between the reporting years, they do not provide further insight into the dynamics of inequalities and why the change has occurred. To provide this information, vertical arrow symbols (↑ and ↓) are inserted next to the blue and green arrows for each country to represent the increase or decrease over time for the population groups compared (such as lowest versus highest income quintile, rural versus urban or female versus male). The first arrow shows whether the exposure prevalence (or mortality rate) has gone up or down for the first group (for example, the lowest income quintile); the second arrow whether it has gone up or down for the second group (for example, the highest income quintile), thereby facilitating greater understanding of the dynamics of the inequalities and the causes of their changes between the groups over time. This is especially important when the data suggest a decrease of inequality between two population groups, but the reduction is caused not by lower prevalence or mortality in the disadvantaged group but by higher prevalence or mortality in the advantaged group. Statistically speaking, this leads to a decrease of inequality between the groups, but it is certainly not something to be celebrated. Therefore, a full assessment of the inequality trends should look not only at the overall decrease or increase in inequality gaps (represented by the green and blue arrows) but also at the change dynamics for the groups compared.

In some cases the inequalities may be reversed, which means that for a specific indicator, in one reporting year, the difference between the population groups is negative (for example, in one reporting year the highest income quintile might be more affected or exposed than the lowest). Such reversed inequality is reflected by † when it applies to the first reporting year and by ‡ when it applies to the second reporting year; inclusion of both symbols († and ‡) represents reversed inequalities in both reporting years. If just one year has reversed inequality, the magnitude of change in inequality cannot easily be quantified by the length of the blue or green arrow alone.

Based on a similar approach, individual country profiles have been developed to show the changes in environmental and injury inequalities for all countries in the Region over time. The profiles will be accessible as an online supplement via the report website and

present – for each country – the environmental risks and injury types for which inequalities have increased and those for which they have declined (WHO Regional Office for Europe, 2019).

## 8.1 Success stories

For some indicators a significant reduction in the magnitude of inequalities can be observed over recent years for a majority of countries (i.e. the number of countries seeing a reduction in inequalities is at least twice the number of countries seeing an increase). Success stories indicate that it is possible both to improve the environmental conditions of the most exposed and most affected population groups and to reduce the inequalities overall. Two examples of such success stories across the WHO European Region are shown below, presenting the reduction in inequalities in transport-related mortality between males and females (Fig. 62) and in access to less than basic drinking-water services between people living in rural and urban areas (Fig. 63).

A reduction – often a strong one – in RTI-related mortality differences between males and females over time was reported by 42 countries. In most of these a reduction in mortality was observed for both sexes (indicated by the vertical arrows ↓↓), but the reductions among males, who represent the major risk group for RTIs, were stronger. The largest reduction in inequalities was observed in Andorra, Estonia and Lithuania (noting that in Andorra the inequality reduction is caused by both a mortality decrease in males and an increase in females). In seven countries (Albania, Armenia, Bosnia and Herzegovina, Georgia, Luxembourg, San Marino and Turkey), however, the inequality increased. The examples of Armenia, Bosnia and Herzegovina, Georgia and Turkey show that a mortality rate increase for both sexes (↑↑) can still be associated with a rising level of inequalities in mortality. Only Andorra, Kyrgyzstan, Malta and San Marino show diverging mortality trends for males and females, with a reduction among males and an increase among females (↓↑) in the last reporting year for the first three countries (hence showing inequality reductions) and an increase in males versus a decrease in females for the second reporting year in San Marino, where the highest increase in inequality over time is found.

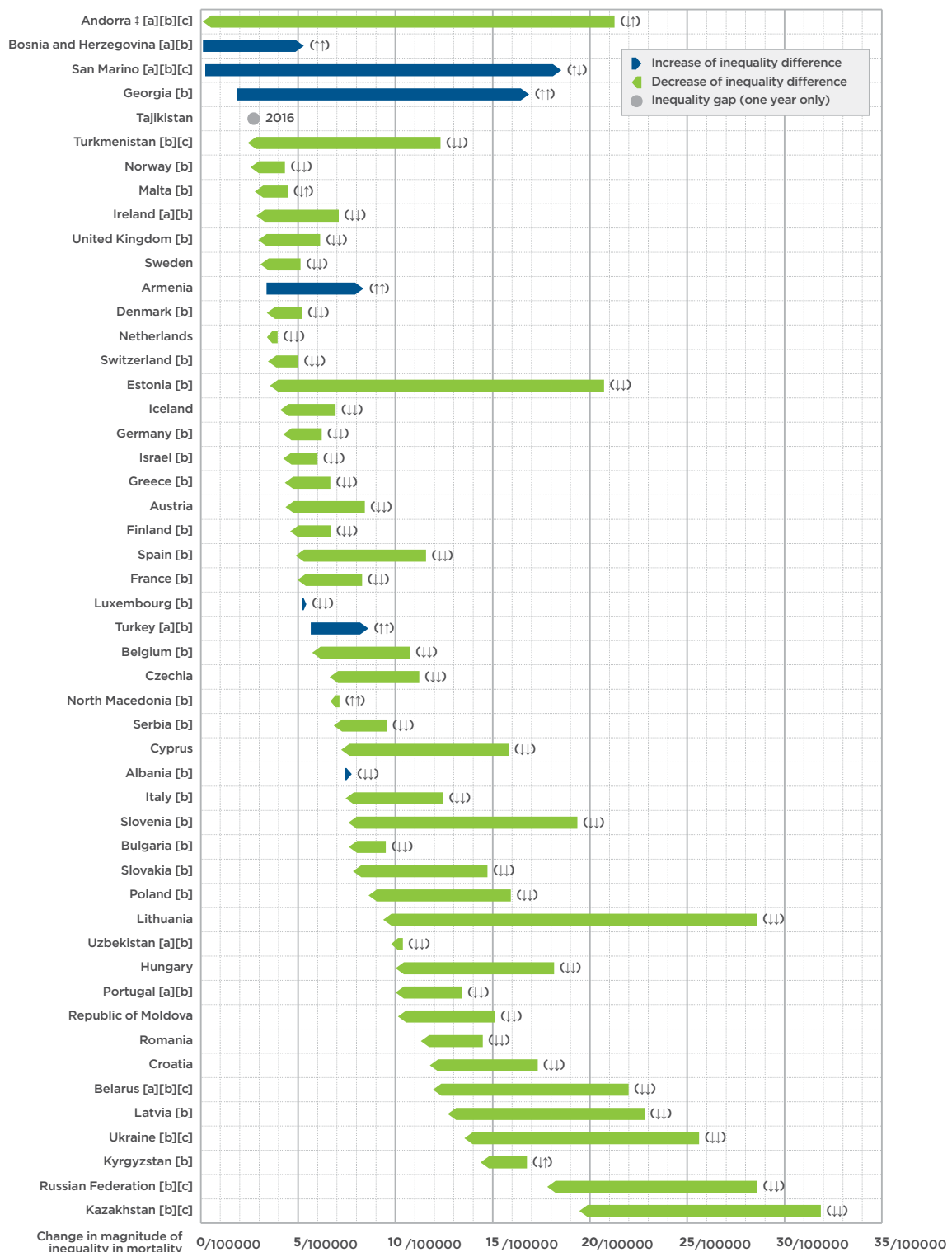
For the drinking-water inequality indicator (Fig. 63), 22 countries showed a reduction and 8 an increase in inequalities between people living in rural and urban areas in 2005–2015. The largest decreases were observed in Tajikistan, Albania, Lithuania, Azerbaijan and Armenia, but in few countries the inequality increased, with the largest rise in Serbia. For many EU countries full coverage is reported and thus no inequality can be illustrated; in EU countries without full coverage inequalities tend to be small, but they can still – as in Bulgaria, Spain and Portugal – be increasing.

In this indicator profile † indicates reversed inequalities in the first reporting year (2005), with people living in urban areas more affected than those in rural areas, which was observed in Belarus, Ireland, North Macedonia and Serbia. A ‡ indicates reversed inequalities in the second reporting year (2015), which was observed, for example, in Croatia and Spain. In Belarus, Ireland, North Macedonia and Serbia both symbols (†‡) are displayed, indicating a reverse of inequalities in both reporting years.

Similar success stories, reflecting a reduction in inequalities across the majority of countries in the WHO European Region, are also observed for these indicators:

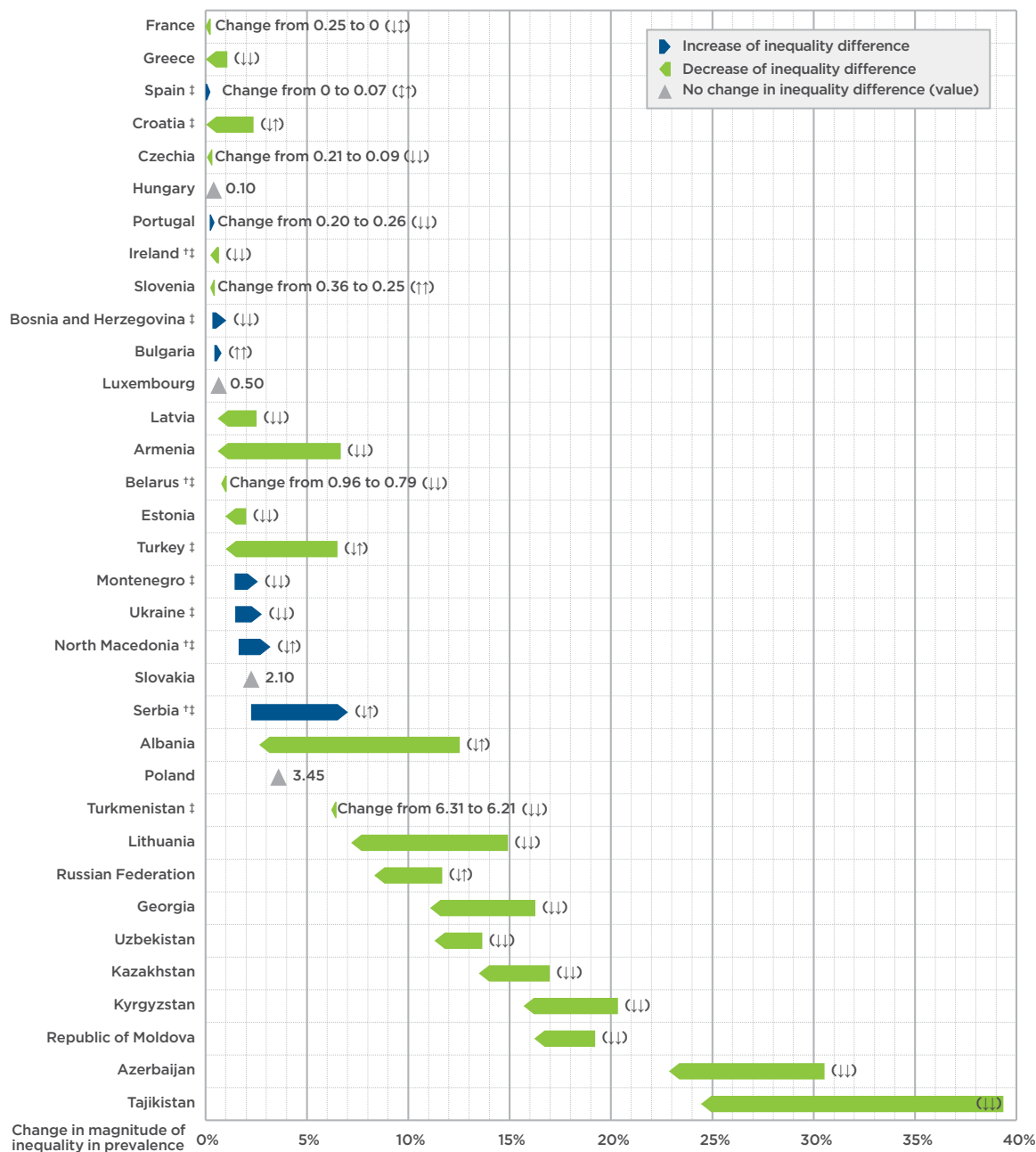
- lack of bath and shower, stratified by income quintile (a decrease in inequalities is seen in 21 and an increase in 9 countries);
- lack of flush toilet, stratified by above versus below the relative poverty level (decrease in 19, increase in 6 countries);
- poisoning mortality, stratified by sex (decrease in 35, increase in 8 countries);
- mortality from falls, stratified by sex (decrease in 34, increase in 10 countries);
- difficulty accessing recreational or green areas, stratified by low versus high education level (decrease in 22, increase in 11 countries).

**Fig. 62.** Changes in magnitude of inequality in RTI-related mortality, male versus female, 2006 to 2016 (or closest reporting year to each)



Notes: [a] the first reporting year was 2005 for Uzbekistan, 2007 for Belarus, Ireland and Portugal, 2009 for Turkey, 2011 for Andorra, Bosnia and Herzegovina and San Marino; [b] the second reporting year was 2010 for Albania, 2012 for Kazakhstan, 2013 for Greece and North Macedonia, 2014 for Belarus, Bosnia and Herzegovina, Bulgaria, France, Ireland, Portugal, Slovakia and Uzbekistan, 2015 for Andorra, Belgium, Denmark, Estonia, Finland, Georgia, Germany, Israel, Italy, Kyrgyzstan, Latvia, Luxembourg, Malta, Norway, Poland, Russian Federation, San Marino, Serbia, Slovenia, Spain, Switzerland, Turkey, Turkmenistan, Ukraine and United Kingdom; [c] for Albania, Belarus, Greece, the Russian Federation, San Marino, Turkmenistan and Ukraine, transport mortality data are used instead of road traffic mortality data; ‡ represents reversed inequality in the last reporting year; vertical arrows (↑ or ↓) represent the increase or decrease of RTI-related mortality for the second time point (last year available): the first vertical arrow refers to the change in RTI-related mortality for males and the second to the change for females.

**Fig. 63.** Changes in magnitude of inequality in access to less than basic drinking-water services, rural versus urban areas, 2005 to 2015



Notes: countries with full coverage of water supply in both reporting years are not depicted; [a] the first reporting year was 2010; [b] the second reporting year was 2010; † represents reversed inequality in 2005; ‡ represents reversed inequality in 2015; vertical arrows (↑ or ↓) represent the increase or decrease in reported access to less than basic drinking-water for the second time point (2015); the first refers to the change in prevalence for rural and the second to the change in prevalence for urban areas.

## 8.2 Mixed evidence

For most of the environmental health inequality indicators in this report, countries show diverse and contrasting performances (i.e. the number of countries with a decrease in inequalities is

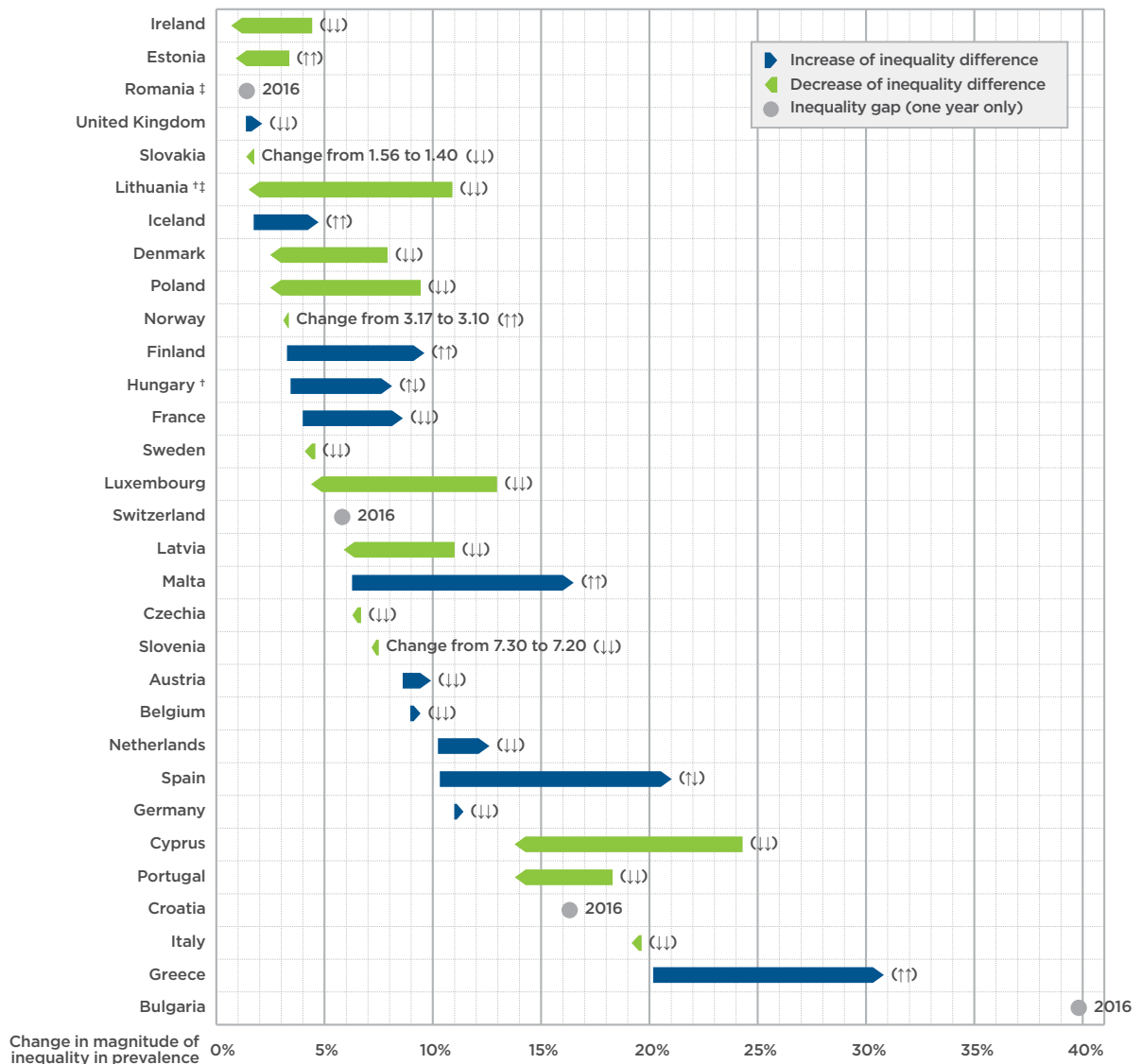
approximately the same as those with an increase), so no clear change patterns over time are observed. Fig. 64 and Fig. 65 present two examples of this mixed evidence pattern, depicting the indicators



ability to keep the home cool in summer (stratified by income quintile) and overcrowding (stratified by single-parent households versus households with dependent children).

Fig. 64 shows that income-related inequalities in ability to keep the home cool in summer have decreased in 15 countries but increased in 12 countries, with no specific patterns found (such as similar trends in southern or eastern European countries).

**Fig. 64.** Changes in magnitude of inequality in ability to keep the home cool in summer, lowest versus highest quintile, 2007 to 2012

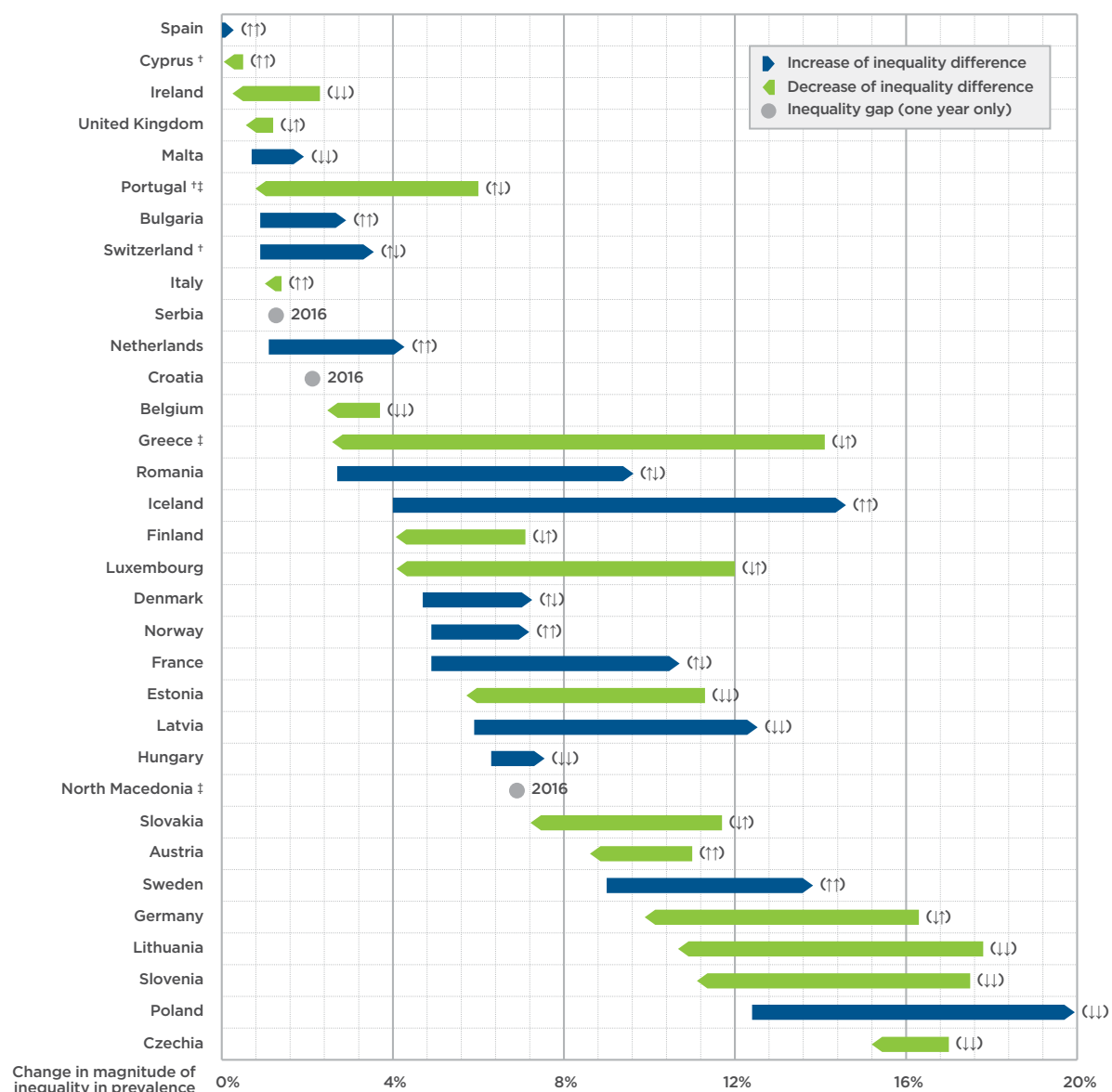


Notes: † represents reversed inequality in 2007; †† represents reversed inequality in 2012; vertical arrows (↑ or ↓) represent the increase or decrease in reported ability to keep the home cool for the second time point (2012); the first refers to the change in prevalence for the lowest income quintile and the second to the change in prevalence for the highest.

For inequalities in overcrowding, 14 countries report an increase in inequalities, but 16 show a reduction (including countries in northern, eastern, southern and western Europe). The largest increases were

observed in France, Iceland, Latvia, Poland and Romania; the largest decreases in Germany, Greece, Lithuania, Luxembourg and Slovenia (Fig. 65).

**Fig. 65.** Change in magnitude of inequality in overcrowding by single-parent households versus households with dependent children, 2009 to 2016



Notes: † represents reversed inequality in 2009; ‡ represents reversed inequality in 2016; vertical arrows (↑ or ↓) represent the increase or decrease in reported overcrowding for the second time point (2016); the first refers to the change in overcrowding prevalence for single-parent households and the second to the change in prevalence for households with dependent children.

Other environmental health inequality indicators that show the mixed evidence pattern are:

- less than basic sanitation, stratified by rural versus urban populations (decrease in 20, increase in 19 countries);
- lack of bath and shower, stratified by single-parent households versus households with dependent children (decrease in 13, increase in 16 countries);
- lack of flush toilet, stratified by single-parent households versus all households (decrease in 15, increase in 14 countries);
- dampness in the home, stratified by single-parent households versus all households

(decrease in 13, increase in 17 countries);

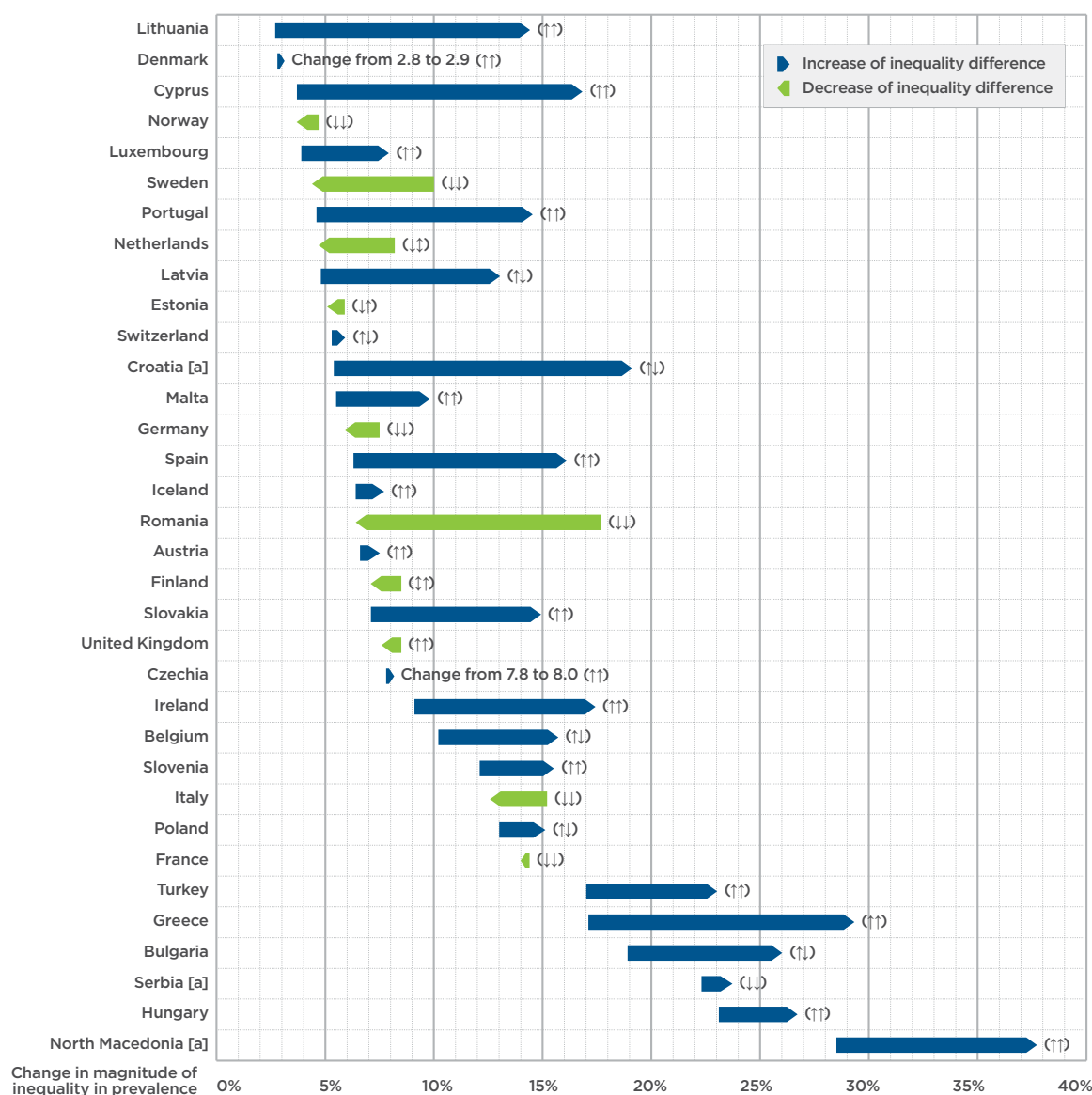
- overcrowding in the home, stratified by single-parent households versus households with dependent children (decrease in 16, increase in 14 countries);
- inability to keep the house warm, stratified by single-parent household versus all households (decrease in 14, increase in 16 countries);
- alcohol poisoning mortality, stratified by sex (decrease in 16, increase in 12 countries) and by age group (decrease in 11, increase in 16 countries);
- mortality from falls, stratified by age group (decrease in 20, increase in 26 countries).

### 8.3 Challenges

Four environmental health inequality indicators show an increase in inequalities for the vast majority of countries in the WHO European Region (i.e. the number of countries with an increase in inequalities is at least twice the number of countries with a decrease), indicating key challenges of environmental health inequality that seem to be a concern across the Region. Two such examples are energy poverty, stratified by below versus above the relative poverty level (Fig. 66) and complaints about noise, stratified by below versus above the relative poverty level (Fig. 67).

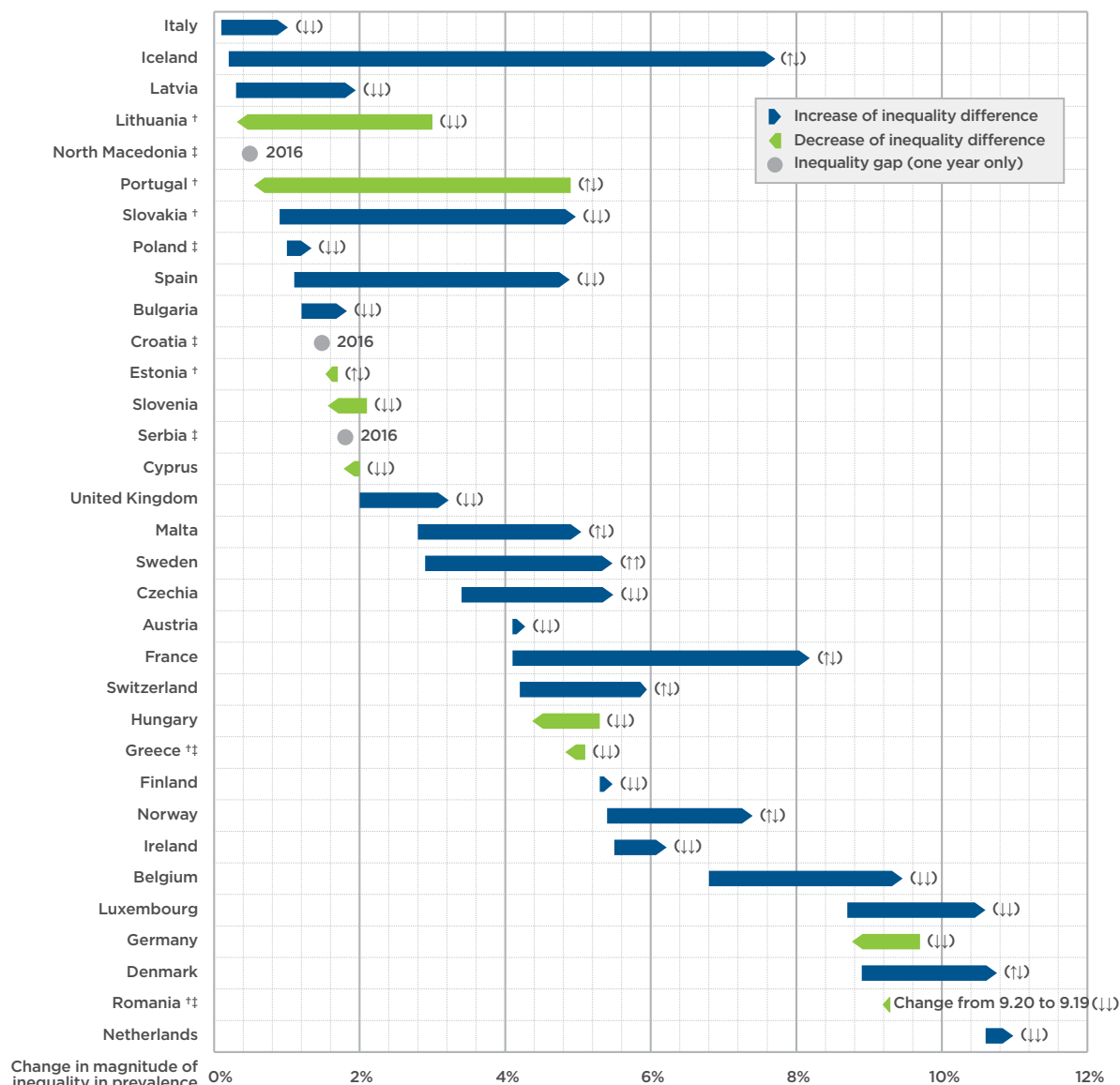
Poverty-driven inequalities in energy payments have increased in 24 and decreased in only 10 countries, with the increases often more strongly expressed than the decreases (Fig. 66). The largest increases in inequality were observed in Croatia, followed by Cyprus, Greece, Lithuania and Portugal with an inequality gap increase of more than 10%. A similarly strong reduction of inequality is only found for Romania, with a decrease of the inequality gap by more than 10%.

**Fig. 66.** Changes in magnitude of inequality in difficulty paying energy bills, below versus above relative poverty level, 2008 to 2016



Notes: [a] the first reporting year for Croatia and North Macedonia was 2010, for Serbia was 2013; vertical arrows (↑ or ↓) represent the increase or decrease in reported difficulty paying energy bills for the second time point (2016); the first refers to the change in prevalence for those below the relative poverty level and the second to the change in prevalence for those above.

**Fig. 67.** Changes in magnitude of inequality in self-reported noise annoyance, below versus above relative poverty level, 2009 to 2016



Notes: † represents reversed inequality in 2009; ‡ represents reversed inequality in 2016; vertical arrows (↑ or ↓) represent the increase or decrease in self-reported noise annoyance for the second time point (2016); the first refers to the change in prevalence for those below the relative poverty level and the second to the change in prevalence for those above.

For self-reported noise annoyance the inequality between people below and above the relative poverty level increased in 21 countries and decreased in 9 (Fig. 67). The largest increases were observed in Iceland, France, Slovakia, Spain and Belgium, where the inequality gap increase ranged from 3% to 8%. Most of the decreases had a smaller magnitude, except in Portugal and Lithuania, which had reductions of 4% and 3%, respectively.

The other two environmental health inequality indicators defined as challenges across the Region are:

- dampness in the home, stratified by income quintile (decrease in 10, increase in 20 countries);
- inability to keep the house warm, stratified by below versus above the relative poverty level (decrease in 7, increase in 23 countries).

For these four environmental health risks, countries across the Region have not been able to mitigate inequalities and provide effective policies and interventions to protect the most disadvantaged population groups.

## 8.4 Conclusion

The change patterns show that the performance of countries across the WHO European Region is very diverse and may vary greatly depending on the inequality considered. This suggests that the causes of inequalities, as well as the related solutions, can be different from country to country, requiring national analysis leading to country-specific policies and target-setting – especially for those indicators that show an increasing inequality gap within the country (WHO Regional Office for Europe, 2019).

As well as the mixed results for many indicators, however, the change patterns present some success stories and some challenges that relate to the majority of countries within the Region. Countries can use these success stories to understand and learn how to define political priorities and policies tackling environmental health inequalities effectively. On the other hand, environmental noise, energy poverty and the related issues of home heating and indoor dampness represent priorities for environmental justice across the Region, requiring urgent action.

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# 9. Key messages and conclusions

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**Matthias Braubach, Gabriele Bolte, Sani Dimitroulopoulou, Jon Fairburn, Catherine Ganzleben, Firmino Machado, Marco Martuzzi**

## KEY MESSAGES

- 1.** Environmental conditions have improved markedly in most countries in the WHO European Region, and the incidence of fatal injuries has decreased. These improvements are marred by marked inequalities, however, as many population subgroups cannot benefit from them.

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- 2.** Inequalities in environmental exposure occur between countries and, even more worryingly, within countries and local communities, where they contribute to avoidable health inequalities.

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- 3.** Despite environmental improvements, inequalities in environmental exposure and injury mortality often persist or have even increased, in some cases.

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- 4.** In addition to the uneven distribution of environmental pressures, variable vulnerability of different population subgroups can amplify the resulting health inequalities.

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- 5.** Disadvantaged population subgroups can have five times higher exposure levels or injury rates than advantaged subgroups. The resulting health inequalities are therefore preventable, to a great extent, through environmental interventions.

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- 6.** Individual countries show different patterns of environmental health inequalities; therefore, country-specific strategies are necessary to mitigate these inequalities.

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- 7.** For energy poverty, thermal comfort, damp homes and noise perception, increasing inequalities are found in most countries in the Region, representing a common challenge.

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- 8.** The lack of data on inequalities in environmental risk exposure is a key concern, especially in the eastern part of the Region.

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- 9.** Governance of environmental health equity requires all-of-society involvement and all-of-government action, combined with careful consideration of targeted interventions.

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- 10.** Equity-sensitive monitoring and surveillance systems are needed at various scales to document environmental inequalities and the most affected population subgroups adequately.

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## 9.1 Conclusions

### **1. Environmental conditions have improved markedly in most countries in the WHO European Region, and the incidence of fatal injuries has decreased. These improvements are marred by marked inequalities, however, as many population subgroups cannot benefit from them.**

In the last decade, countries in the WHO European Region have witnessed a reduction of many environmental health risks, indicating that environmental governance and regulations are effective mechanisms to protect the population. The Region still has some unfinished business, however, and various environmental challenges should be dealt with by individual countries – as reflected in the background document and the Declaration of the recent Sixth Ministerial Conference on Environment and Health in Ostrava, Czechia (WHO Regional Office for Europe, 2017a; 2017b).

One challenge – relevant for many countries – is that progress in environmental conditions is not equally shared by all. Environmental health and injury inequalities occur in spite of declining environmental pollution levels, indicating that the most affected population subgroups do not benefit from the improvements achieved and are left behind. Addressing inequalities in environmental risk therefore remains a priority for all national and local governments.

### **2. Inequalities in environmental exposure occur between countries and, even more worryingly, within countries and local communities, where they contribute to avoidable health inequalities.**

Inequalities in risk exposure and injury mortality (as well as inequalities in environmental goods or access to environmental resources) can be found in all countries in the WHO European Region, irrespective of the overall level of exposure prevalence or mortality. While a certain degree of variability is intrinsic, the magnitude of inequality varies greatly. Preventable disparities are apparent in each country and the provision of equitable living conditions is thus a challenge in all countries. Since environmental factors account for at least 15% of the overall burden of disease in the WHO European Region (WHO Regional Office for Europe, 2018), environmental equity action is clearly a key mechanism to mitigate health inequalities through reductions of the exposure differential.

Inequalities are most relevant and apparent when they occur within countries and at the local scale, when people living in close proximity experience very different environmental conditions. This is due to powerful determinants (such as, for example, material deprivation, discrimination relating to certain demographic characteristics or geographical location) that have a direct impact on a person's opportunities and choices in life, and thus affect environmental exposure risk.

### **3. Despite environmental improvements, inequalities in environmental exposure and injury mortality often persist or have even increased, in some cases.**

Although many countries report declining averages of risk exposure or injury mortality, environmental inequalities often remain stable or even increase in magnitude. This is reflected in several environmental health indicators in this report, as well as a number of systematic reviews (see Annex 3). The report therefore provides strong evidence that environmental progress is not equally shared, and that especially disadvantaged population subgroups and deprived areas are most affected by environmental problems.

For several indicators, high levels of relative inequalities can be found in countries with comparatively low absolute exposure levels. This is reflected in Figs. 7, 12 and 41, showing that overall low prevalence levels are no indication of low levels of inequality. In countries with high overall exposure levels, significant environmental inequalities exist with even higher burdens among socially disadvantaged subgroups.

### **4. In addition to the uneven distribution of environmental pressures, variable vulnerability of different population subgroups can amplify the resulting health inequalities.**

The environmental inequality indicators presented in this report can only describe the exposure differential between population subgroups; they cannot document the vulnerability differential. This relates to the varying levels of vulnerability to environmental impacts that a person, population subgroup or community may have. Higher vulnerability can cause stronger health effects, resulting in larger impacts for specific people. Using only exposure data may neglect these interactions and underestimate the impact of environmental inequalities on health and well-being.

Vulnerable groups that may react more strongly to environmental risks or may be more susceptible to developing health effects include children, elderly people, pregnant women and people with pre-existing health limitations. Similarly, socially disadvantaged population subgroups may be more vulnerable due to, for example, psychosocial stress or fewer resources to cope with an environmental burden.

**5. Disadvantaged population subgroups can have five times higher exposure levels or injury rates than advantaged subgroups. The resulting health inequalities are therefore preventable, to a great extent, through environmental interventions.**

Environmental inequalities are most often associated with (and at least partly explained by) different forms of social or demographic disadvantage. Almost all indicators presented in this report show that socioeconomic disadvantage (notably poverty and low income) is associated with higher exposure to various environmental pressures. Inequalities of risk and exposure can be very high between population subgroups within the same country; relative inequalities can frequently exceed a ratio of 5:1 between disadvantaged and advantaged subgroups. In extreme cases, inequality ratios can even reach 20:1 in some countries. This can be observed, for example, for energy poverty and drinking-water and sanitation services by wealth quintile (see Table 6 and Fig. 23) and for fatal work injuries by sex (see Fig. 48).

Although these inequalities in risk exposure are largely driven by sociodemographic determinants, it is obvious that the universal provision of healthy environments and basic services for all citizens, irrespective of social status or other forms of disadvantage, can help to mitigate health inequalities through the reduction of environmental health risks – especially for those who are most exposed and/or vulnerable.

**6. Individual countries show different patterns of environmental health inequalities; therefore, country-specific strategies are necessary to mitigate these inequalities.**

Countries show different inequality levels across the whole indicator set: national patterns of inequalities are very diverse, indicating that countries may have somewhat different priorities for review and follow-up. A good understanding of national inequalities in environmental risks and injury mortality is essential, however, and will contribute to more effective policies, based on a clear identification

of the priorities for action and the most affected people to be protected.

Each country also has a unique profile of “inequality performance” over recent years.<sup>11</sup> These profiles identify the environmental conditions for which countries have been successful (or not) in reducing inequalities over recent years. The evidence may help countries to assess which policies may have been effective from an equity perspective, and for which environmental inequalities new strategies may need to be considered.

**7. For energy poverty, thermal comfort, damp homes and noise perception, increasing inequalities are found in most countries in the Region, representing a common challenge.**

Despite the diversity of national priorities, four environmental inequality indicators show an increase in most countries for which data are available: energy poverty, thermal comfort, damp homes and noise perception (see Chapter 8). Three of these factors relate to material housing conditions that are directly linked to financial resources, and in all three cases the disadvantaged subgroups are those below the relative poverty threshold or in the lowest income quintile. The same applies to noise perception, which largely affects poorer population subgroups but also sees affluent subgroups reporting higher noise levels in some countries.

The increase in these inequalities shows that socioeconomic status is at the centre of the most urgent factors to be tackled across the Region and suggests that housing policies and access to affordable good-quality living space are key measures to reduce environmental inequalities.

**8. The lack of data on inequalities in environmental risk exposure is a key concern, especially in the eastern part of the Region.**

This report compiles data from international databases, and the inequality indicators were selected according to the data availability for a wide range of countries in the WHO European Region. National data and statistics were not systematically identified, so relevant data may be available in some countries through domestic reporting and surveillance systems. Nevertheless, it must be acknowledged that environmental monitoring and related databases often tend to be “equity blind”

<sup>11</sup> For further detail, see the country profile supplement to this report, available at <http://www.euro.who.int/en/EHinequalities2019>



- collecting environmental information but rarely compiling information on the population subgroups most affected.

Within this report, the lack of data is most critical in the eastern part of the Region, where no harmonized international surveys and monitoring are established (in comparison to EU-coordinated monitoring frameworks), and the main source of comparable information tends to come from surveys coordinated by the United Nations. If no national data can fill this gap, inequality assessments cannot be carried out and no identification of disadvantaged subgroups (and no insight into the determinants causing the inequalities) is possible. The lack of data on the distribution of environmental risks is therefore a major challenge to be tackled in these countries.

#### **9. Governance of environmental health equity requires all-of-society involvement and all-of-government action, combined with careful consideration of targeted interventions.**

In the last decade, environmental regulations and governance actions on healthy environments have proved to be effective in many countries; these need to be fully implemented to prevent harmful conditions. These general approaches may, however, be less effective in reducing environmental inequalities. Targeted interventions are a key strategy when universal approaches to environmental protection do not provide equal benefits to disadvantaged population subgroups.

Effective interventions against inequality require multisectoral and all-of-government action, connecting social services and employment and education sectors with decision-makers in environmental protection, urban planning and health promotion. In neighbourhoods with high levels of social deprivation and environmental pollution, local interventions should target both the socioeconomic and demographic determinants of inequalities and the environmental conditions. In many cases, such interventions will have multiple benefits for disadvantaged people and create co-benefits for health and well-being, as well as social cohesion.

To tackle existing inequalities, national and local politics also need to become more aware of the importance of “procedural justice”. This refers to a fair and equal political approach to responding to environmental problems and emission sources (such as industrial areas, transport infrastructure, contaminated sites or landfills). These are too often located in areas that have an excessive amount of

environmental disadvantage already but less power to influence decision-making. Accessible forms of engagement and participation, as well as equal rights in the decision-making process, are needed to ensure that disadvantaged population subgroups are not left behind, and social, environmental and health actors require preparedness to engage in negotiations over environmental health to protect the most exposed and the most vulnerable people.

#### **10. Equity-sensitive monitoring and surveillance systems are needed at various scales to document environmental inequalities and the most affected population subgroups adequately.**

To improve future assessments of environmental inequalities, enable the quantification of related health impacts and develop effective intervention, national and local monitoring systems are needed. These should include a range of data to enable the collection and analysis of:

- the socioeconomic and demographic characteristics of the exposed population;
- the level or concentrations of environmental risks; and
- the occurrence of relevant health outcomes by subgroup.

While most of the personal characteristics are usually collected through surveys, it is difficult to make a reliable assessment of environmental risk exposure (as well as access to environmental goods and resources) through surveys that rely on self-reporting. A connection to housing conditions databases and cadastres, urban and environmental monitoring data, and objective measurements of concentrations would therefore be strongly desirable. All countries would benefit from a review of the effectiveness of their existing monitoring systems, to ensure that relevant data can be deployed in a holistic and integrated manner to address environmental inequalities and their health impacts.

Data sharing and the connection of existing databases at the national and local levels could, together with a careful extension of survey items and questions to incorporate equity issues, significantly improve the knowledge base on inequalities and help with assessments of the equity impact of policies or interventions. Further opportunities to be explored are the SDG indicators, which are applied for national and international progress evaluations of the 2030 Agenda for Sustainable Development and include various stratifications by sex, age or urbanization level, among others. Such

data will enable stakeholders at the national and local levels to understand the magnitude and causes of environmental inequalities, and to identify the

most disadvantaged population subgroups, which should therefore be at the centre of political action.

## 9.2 The way forward

Population subgroups with lower socioeconomic capacities, less influence and other social, demographic or local disadvantages suffer most from inequalities in environmental risk exposure and injury outcomes. Many of these inequalities are systemic, as they result from societal structures and processes, and unfair, as they distribute environmental goods and bads unequally and create an environmental underclass with an increased likelihood of risk exposure and negative health impacts.

These inequalities can be tackled, reduced and prevented by public authorities at the national and local levels through:

- equity-sensitive environmental policies and decision-making;
- intersectoral collaboration between social, environmental and health actors and stakeholders;
- integration of equity concerns in urban and infrastructural planning and related impact assessments;
- full-scale implementation of environmental regulations and standards, with a specific focus on pollution hotspots and contamination sources;
- targeted interventions addressing environmentally disadvantaged subgroups or neighbourhoods;
- better integration of equity dimensions in environmental monitoring and surveillance; and
- recognizing the needs of disadvantaged communities and giving them a voice in decision-making processes.

The commitment to shape healthy environments for all is strongly associated with a range of other political frameworks, such as the Agenda for Sustainable Development (aiming at leaving no one behind and focusing on reducing inequalities), the WHO Health 2020 European health policy framework (featuring key objectives of reducing inequalities and establishing health-supportive environments) and the recent Ministerial Declaration on Environment and Health (calling for the prevention and reduction of inequalities as a cross-cutting objective for any environmental action).

In line with the theme of the Sixth Ministerial Conference on Environment and Health (“Better Health. Better Environments. Sustainable Choices.”), these policy frameworks and political commitments request and facilitate action to identify population subgroups that are left behind. For these disadvantaged parts of the population, the commitment to “better environments” and thus “better health”, providing equal environmental conditions that will enable sustainable choices for all, is yet to be realized. It is hoped that the data presented in this report, informing national governments about the inequalities and discrepancies in environmental conditions within their countries, may be a foundation for national follow-up and a strong argument for integrating environmental inequalities into national portfolios of action on environment and health.

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# Annex 1. Methods and data sources

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**Dennis Schmiede, Matthias Braubach**

To highlight prevailing inequalities in environmental health in countries in the WHO European Region and to update the data of the 2012 inequalities assessment report (WHO Regional Office for Europe, 2012), a variety of indicators from different sources were analysed. Since different sources often do not allow the same data stratification, each indicator was investigated with a slightly different, tailored focus. This annex gives an overview of all indicators and their data sources, structured according to the report's five main domains of housing inequalities, inequalities in access to basic services, urban environment and transport inequalities, work-related inequalities and injury-related inequalities.

Some general methodological notes apply to all indicators, such as the restrictions due to survey methods and sample size, the weighting of averages for country groupings and the general lack of data in countries not covered by EU-related surveys and data collection.

- Reliance on different data sources for the assessment of environmental health inequalities introduces some constraints, such as potential inconsistencies between data sources using different data collection methods and issues around population and sample sizes that might reduce the reliability of the assessment. Both the Eurostat and the Eurofound surveys (Eurostat, 2018a; 2018b; Eurofound, 2018) are designed to provide nationally representative values for the total population of the country. When an indicator is stratified into smaller population groups, the sample size inevitably shrinks, making the findings less reliable. Moreover, to arrive at nationally representative values for the total population, sample sizes already vary because of national populations: smaller countries have lower sample sizes, which further reduces reliability. Nevertheless, the surveys still provide useful and consistent data that can be used to analyse environmental health inequalities in the WHO European Region.
- The population-weighted average figures for subregions were calculated as follows. The population of each country was divided by the whole population of its subregion; this population weight was multiplied by the prevalence or mortality rate in the source country; finally, all population-weighted values were combined to create the average figure for the subregion (Euro 1, Euro 2, Euro 3 or Euro 4). This approach has some implications. First, the higher the population of a country, the greater its impact on the subregional average, meaning that prevalence rates in countries with high populations contribute more to the averages. Conversely, the influence of high or low prevalence levels in small countries on the subregional average is limited. For the weighting, the primary source was national population data from Eurostat, but in some chapters population data were derived from other sources, such as the WHO mortality databases or United Nations population statistics, because a particular stratification (for example, by age) was necessary. For some indicators, however, the subregional averages are calculated as average of national rates only, mostly due to the complexity of the age categories applied within the indicator. In summary, subregional averages are population weighted unless indicated otherwise.
- For the majority of environmental health inequality indicators, data can only be compiled for EU countries and – depending on the survey – a limited number of countries participating in or contributing to data collections and databases coordinated by the EU or its agencies. The exceptions are some United Nations-coordinated databases – such as the WHO/UNICEF JMP for Water, Sanitation and Hygiene (WHO & UNICEF, 2017), the WHO mortality database covering injuries (WHO, 2018) and ILO statistics on work injuries (ILO, 2018) – which have global coverage and therefore also provide data for all – or almost all – countries in the WHO European Region. For some non-EU countries, inequality data can also be obtained from Multiple Income Cluster Surveys coordinated by UNICEF (2019), but these are not carried out annually and have different thematic coverage. The lack of data coverage for non-EU countries is a severe limitation as it only allows detailed assessment of environmental health inequalities within the western part of the WHO European Region, with exceptions for only a few inequality indicators.

The sections below describe the data used for the five inequalities domains and illustrate how the indicators are conceptualized statistically. The methodological notes also indicate shortcomings and limitations of the data.

## Methodological notes on housing inequalities

The indicators dealing with housing inequalities are based on data from the Eurostat EU-SILC survey (Eurostat, 2018a). The data sources for the housing indicators are listed in Table A1.1, with the variable codes where applicable.

**Table A1.1.** Housing inequality indicators and their source

Indicator	Description	Source and variable code
<b>Lack of a flush toilet</b>	Population not having indoor flushing toilet for the sole use of their household	Eurostat EU-SILC: ilc_mdho03
<b>Lack of a bath or shower</b>	Population having neither a bath nor a shower in their dwelling	Eurostat EU-SILC: ilc_mdho02
<b>Overcrowding</b>	Population living in an overcrowded dwelling	Eurostat EU-SILC: ilc_lvho05a,b,d
<b>Dampness in the home</b>	Population living in a dwelling with a leaking roof, damp walls, floors or foundation, or with rot in window frames or floor	Eurostat EU-SILC: ilc_mdho01
<b>Inability to keep the home adequately warm</b>	Population reporting inability to keep home adequately warm	Eurostat EU-SILC: ilc_mdse01
<b>Inability to keep the home adequately cool in summer</b>	Population living in a dwelling not comfortably cool during summer time	Eurostat EU-SILC: ilc_hcmp03

### Lack of a flush toilet, bath or shower, overcrowding, dampness, inability to keep the home warm and keep the home cool

The figures and data presented in the housing-related chapter are mostly based on 2016 data from the Eurostat EU-SILC survey (Eurostat, 2018a), which are available by country and provide data on the proportion of the population exposed to or affected by certain living conditions. The only exception is the indicator on keeping the home cool in summer, which is not implemented as part of the annual EU-SILC survey but was collected via an ad hoc module on housing conditions carried out in 2012. The target population consists of all people living in private households in each country; people living in collective households and in institutions are generally excluded. The data offer various stratification opportunities, such as income, poverty, age, sex, household type and urbanization level. For various indicators EU-SILC only offers income stratification above and below the relative poverty threshold (which is set at 60% of the national median equivalized income), so the relevant income data were requested from Eurostat for distribution into income quintiles.

The housing data were sorted according to the stratification of interest – household type or poverty level – for the indicator under investigation. The inequality assessment usually compared two different dimensions within countries (such as single-parent households versus all households, or population below versus above the relative poverty level) but in some cases three dimensions are presented (such as three different household types). Where applicable, the ratio between two dimensions was added to represent relative inequality dimensions. The country values were categorized into the subregions Euro 1, Euro 2 and Euro 4, and subregional averages were calculated as population-weighted values, using 2016 population data from Eurostat. No data were available for the Euro 3 subregion.

## Methodological notes on inequalities in access to basic services

The indicators dealing with inequalities in access to basic services cover water supply and sanitation services, as well as energy poverty in relation to energy use in the home and the associated costs. The indicator on drinking-water and sanitation is based on data from the WHO and UNICEF JMP (WHO & UNICEF, 2017). Data from the Eurostat EU-SILC survey, the EU Household Budget Surveys and UNICEF

Multiple Income Cluster Surveys are used for the energy poverty indicator to provide insight into energy expenses in EU countries and energy-related inequalities in some Balkan and central Asian countries (Eurostat, 2018a; 2018b; UNICEF, 2019). The data used for the basic service indicators are listed in Table A1.2, with the variable codes or names where applicable.

**Table A1.2.** Basic service inequality indicators and their source

Indicator	Description	Source and variable code
Lack of access to basic drinking-water services	Population not served by safely managed or basic drinking-water services	WHO/UNICEF JMP
Lack of access to basic sanitation services	Population not served by safely managed or basic sanitation services	WHO/UNICEF JMP
Energy poverty	<ul style="list-style-type: none"> <li>Population with arrears on utility bills for energy services</li> <li>Energy expenditure as a percentage of household income</li> <li>Households using solid fuel for cooking</li> </ul>	<ul style="list-style-type: none"> <li>Eurostat EU-SILC: ilc_mdes07</li> <li>Eurostat Consumption expenditure of private households database: hbs_str_t223, code CPO45</li> <li>UNICEF Multiple Income Cluster Surveys</li> </ul>

### Lack of access to basic drinking-water and sanitation services

As the data for access to drinking-water and sanitation services are taken from the same monitoring programme and based on similar methodologies, the two indicators were combined into one section.

Rates of coverage for drinking-water and sanitation services are available from the WHO/UNICEF JMP website for all 53 countries in the WHO European Region. Prevalence rates are given as percentages per country, which can be analysed by year, residence type (urban/rural), wealth quintile (11 countries only) and the service level for both drinking-water and sanitation services. It should be noted that there is no standard reporting scheme for the wealth quintile data, which come from different reporting years between 2006 and 2014. The JMP service levels for drinking-water include surface water, unimproved, limited, basic, safely managed and the aggregated category “at least basic”. The sanitation service levels are open defecation, unimproved, limited, basic, safely managed and “at least basic”. For the indicator descriptions of drinking-water and sanitation services, the opposite category “less than basic” was created, indicating the share of population not covered by basic or safely managed drinking-water and sanitation services.

In accordance with SDG 6 targets and indicators, JMP adopted a revised approach to water and sanitation monitoring in 2016. The JMP database was retrospectively updated for earlier years to correspond to the new classification scheme. Data presented in the 2012 inequalities assessment report (WHO Regional Office for Europe, 2012) distinguished between access to improved (adequate) and unimproved (inadequate) drinking-water sources and sanitation facilities. The comparison of inequality data between 2005 and 2015 presented in this report draws completely from the updated JMP data as the 2012 report data cannot be directly compared.

For the population-weighted subregional averages, the population data come from Eurostat for Euro 1 and Euro 2 countries, and from the World Bank for Euro 3 and 4 countries.

### Energy poverty

Energy poverty draws from a variety of data sources in presenting Eurostat data from Household Budget Surveys to show the percentage of household income used for energy expenses, EU-SILC data on difficulties paying energy bills (defined as arrears on utility bills for energy services), and data on solid fuel use for cooking, derived from recent UNICEF Multiple Income Cluster Surveys for selected countries (Eurostat, 2018a; 2018b; UNICEF, 2019). All data are available by country; computations are similar to those described above and subregional averages are population weighted, based on Eurostat population data for 2016.

The data on energy expenses are part of a larger data collection on household budgets, using the Classification of Individual Consumption by Purpose categories and selecting the consumption purpose

“Electricity, gas and other fuels”, provided as per mille (thousandth) of total household expenditure and transferred into percentage values. As with the EU-SILC data, the Household Budget Surveys target private households only; institutional households and people living in collective households or in institutions are generally excluded.

In the energy poverty section, the specific case of Greece is presented to show the national increase of energy poverty in relation to the economic crisis in 2009–2010 in comparison to energy poverty trends for all EU countries; this was directly taken from the Eurostat database.

## Methodological notes on urban environment and transport inequalities

Highlighting inequalities related to urban environment and transport conditions in the WHO European Region, data from following sources were used (Table A1.3): air pollution data and figures from the EEA Air Quality e-Reporting database and the WHO Global Urban Ambient Air Pollution Database (EEA, 2018a; WHO, 2019); data on perceived noise exposure from the Eurostat EU-SILC survey (Eurostat 2018a); and data on lack of access to recreational and green spaces from the fourth wave of the 2016 European Quality of Life Survey (EQLS) coordinated by Eurofound (2018). Data on road traffic and transport injuries and fatalities were taken from the WHO mortality database, using WHO International Classification of Diseases, revision 9 and revision 10 (ICD-9, ICD-10) codes (WHO, 2018) and the EURO-HEALTHY project (EURO-HEALTHY, 2018). For chemical exposure and exposure to contaminated sites, no European databases were identified that provide information on differences in exposure. Therefore, data from the European DEMOCOPHES survey on human biomonitoring were used to present examples on differences in chemical exposure, and the Italian SENTIERI project contributed national data on a contaminated sites assessment as a country example on inequalities related to contaminated sites.

**Table A1.3.** Urban environment and transport inequality indicators and their source

Indicator	Description	Source and variable code
<b>Air pollution</b>	<ul style="list-style-type: none"> <li>Number of days above 50 µg/m<sup>3</sup> for PM<sub>10</sub></li> <li>Annual mean concentration of PM<sub>2.5</sub> (µg/m<sup>3</sup>) in cities and localities</li> </ul>	<ul style="list-style-type: none"> <li>EEA Air Quality e-Reporting database</li> <li>WHO Global Urban Ambient Air Pollution Database (update 2018)</li> </ul>
<b>Self-reported noise annoyance</b>	Noise from neighbours or from the street	Eurostat EU-SILC: ilc_mddw01
<b>Fatal road traffic/transport injuries</b>	<ul style="list-style-type: none"> <li>Death cases related to RTIs</li> <li>Death cases related to transport injuries</li> <li>Death rates by country regions</li> </ul>	<ul style="list-style-type: none"> <li>WHO mortality database ICD-10: V01-V79, V82-V89; ICD-9: 810–816, 826, 829</li> <li>WHO mortality database ICD-10 mortality tabulation list 1: A:1096</li> <li>Data taken from EU EURO-HEALTHY project</li> </ul>
<b>Lack of access to recreational or green areas</b>	Difficulty accessing recreational or green areas	Eurofound EQLS2016: Y16_Q56d
<b>Chemical exposure</b>	Cadmium, cotinine and mercury	Data taken from EU Human Biomonitoring project DEMOCOPHES
<b>Contaminated sites (national example)</b>	Municipalities close to contaminated sites	Data taken from SENTIERI project (Italy)

### Air pollution

Most data and figures on inequalities in air pollution exposure are extracted from EEA work on unequal exposure to and unequal impacts of air pollution, noise and extreme temperatures in Europe, published in a recent report (EEA, 2018b). For this report, socioeconomic status has been approximated by indicators of income, unemployment level and educational attainment, limited by both relevance to

social disadvantage and availability of data at different regional units, using the European NUTS regions as well as city-level data from the Urban Audit<sup>12</sup> (Table A1.4).

**Table A1.4.** Indicators of social disadvantage used in the assessment of exposure to air pollution

NUTS 2 region	NUTS 3 region	Urban Audit city
Household income (per capita after social transfers, purchasing power standard; euros)	Per capita GDP, purchasing power standard (euros) <sup>a</sup>	-
Long-term unemployment rate (12 months or more; percentage of population economically active)	-	Unemployment rate (percentage of population economically active)
Percentage of people (aged 25–64 years) without higher education <sup>b</sup>	-	Percentage of people (aged 25–64 years) without higher education

*Notes:* <sup>a</sup> average GDP per capita does not provide an indication of the distribution of wealth between different population groups within a region; nor does it measure the average income ultimately available to private households in a region; <sup>b</sup> “higher education” refers to International Standard Classification of Education levels 5–8.

*Source:* data from Eurostat.

The associations between individual indicators of social disadvantage and exposure to air pollution were analysed with the use of correlation and by comparing average exposure levels between the NUTS regions and cities, categorized according to levels of disadvantage. Annual mean concentrations of PM<sub>2.5</sub> were combined with population data to calculate the population-weighted average concentration (considered a proxy for personal exposure) at NUTS 2 region, NUTS 3 region and city levels. Further guidance on the methodology applied is available (ETC/ACM, 2018).

In addition to the EEA work on social disadvantage in air pollution at the regional and city levels, the air pollution indicator section investigates inequalities in exposure within countries. Data on the number of days with PM<sub>10</sub> concentrations above 50 µg/m<sup>3</sup> were taken from the EEA Air Quality e-Reporting database (EEA, 2018a) to compare urban and rural conditions for several European countries. Data from the 2018 update of the WHO Global Urban Ambient Air Pollution Database (WHO, 2019) were applied to identify the intracountry concentration differences in PM<sub>2.5</sub> by extracting the lowest and highest average concentration levels measured at the local scale within each country (limiting the data to PM<sub>2.5</sub> measurements taken by the monitoring station and excluding PM<sub>2.5</sub> data produced by conversion of PM<sub>10</sub>).

### Self-reported noise annoyance

For the noise exposure indicator, EU-SILC data dealing with the perception of noise from neighbours or from the street were used. These are self-reported and therefore have some limitations, but no international dataset is available that enables the assessment of objective or measured noise differences by socioeconomic or demographic dimensions. As with other EU-SILC variables, the noise data available on the Eurostat website only allow for stratification by relative poverty, so the relevant income data were requested from Eurostat for distribution into income quintiles.

As for other indicators generated from the EU-SILC dataset, population-weighted averages are provided for subregions based on population data from Eurostat.

### Fatal RTIs

The indicator on road traffic and transport fatalities is based on data from the WHO mortality database, covering 50 countries (WHO, 2018). The most recent data on RTIs were downloaded for 43 countries, for years ranging between 2000 and 2015. For seven countries, RTI data were substituted with data on all transport injuries as road transport-specific information was not available. These are presented in a separate figure. Data for Andorra, Monaco and Tajikistan were not available.

For fatal RTIs, data were reported as absolute mortality cases split into both sexes and 24 age groups per country. Of those age groups, five age categories were created for analysis: 0–14, 15–29, 30–59, 60–69 and 70+ years.

<sup>12</sup> The NUTS classification (nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU for statistical studies. Urban Audit refers to EU-wide city statistics.

To calculate mortality rates by age group and sex, the WHO mortality database and the United Nations data portal provided population data broken down into the age groups matching the reported mortality cases in each country in the same year. For Turkmenistan, however, no recent population data were available from either source; they were therefore taken from an online source (PopulationPyramid.net, 2019). To calculate mortality rates for specific age groups, the absolute mortality cases were aggregated by these groups and then divided by the population per 100 000 inhabitants of each age group. The values for each age group were calculated as the simple, non-weighted average of all country mortality rates in the respective age group and country grouping.

As injury data were only reported by sex and age, not by socioeconomic status, no assessment of social dimensions is possible. In line with the 2012 inequalities assessment report (WHO Regional Office for Europe, 2012), however, some figures in the injury-related sections stratify the countries by national income level into high- and middle-income countries, based on gross national income per capita (2016), as recommended by the World Bank. Updated income thresholds published by the World Bank were used to create these groupings (World Bank, 2017), categorizing 30 countries as high-income and 20 as middle-income countries. To further divide these categories, the median of each group was applied as a separator to establish upper and lower high-income and upper and lower middle-income countries. The aggregated mortality values for each group are the averages of the mortality ratios in the age groups of all countries in the income group.

Additional data on RTIs were provided by the EURO-HEALTHY project, showing the intracountry differences of mortality rates between national regions within EU countries (EURO-HEALTHY, 2018).

### Lack of access to recreational or green areas

Data on the lack of access to recreational or green areas were taken from the public use files for the fourth wave of the EQLS in 2016. For analysis, the two answer options “very difficult” and “rather difficult” to access recreational and green areas were grouped together; answer options “don’t know” (which was considered a valid value for analysis), “very easy” and “rather easy” were also grouped.

The EQLS data are based on self-reporting and may be affected by different modes of perception and awareness. Owing to changes in methodology (using a modified set of pre-coded answer options), the data from the 2016 EQLS presented in this report are not fully comparable with the data from the second EQLS survey (2007) used in the 2012 inequalities assessment report (WHO Regional Office for Europe, 2012), which grouped three answer options (“a few reasons”, “many reasons” and “very many reasons” to complain about lack of access to recreational and green areas) versus one option (“no reason” to complain).

Average figures for Euro 1, Euro 2 and Euro 4 subregions were calculated as the simple average of national rates.

### Chemical exposure and contaminated sites

For inequalities in exposure to chemicals and to contaminated sites, no international databases enabling the assessment of exposure inequalities were identified. For these two indicator sections, project data are used instead, presenting selected results to reflect the relevance of unequal exposure to these environmental risks.

For chemical risk exposure, data from the European DEMOCOPHES project (2010–2012) are presented, covering human biomonitoring data for 17 EU countries. The data are taken from the country-specific project reports and focus on the concentration of selected chemicals in mothers, but also refer to results in children. As the project measures the concentrations of chemicals in the body, the results do not directly indicate the exposure pathway, which could be food, water, air, household products or other items and consumables.

For exposure to contaminated sites, data from the SENTIERI project in Italy, initiated in 2007, are presented to provide a national example. The data and figures shown are taken and modified from the project reports and publications.



## Methodological notes on work-related inequalities

Data on work-related fatal and non-fatal injuries were taken from a Eurostat survey and ILO databases (Eurostat, 2018c; ILO, 2018), with the latter covering a wider range of countries and also adding information on migrant workers for some countries. The assessment of inequalities in exposure to health risks in working environments used data from the Eurostat database on accidents and work-related health problems and risk factors (using data from the 2013 Labour Force Survey) and the Special Eurobarometer 429 on attitudes of Europeans towards tobacco (Eurostat, 2018d; European Commission, 2015; Table A1.5).

**Table A1.5.** Work-related inequality indicators and their source

Indicator	Description	Source and variable code
<b>Work-related injuries and mortality</b>	<ul style="list-style-type: none"> <li>Accidents at work</li> <li>Fatal occupational injuries per 100 000 workers</li> </ul>	<ul style="list-style-type: none"> <li>Eurostat European Statistics on Accidents at Work: hsw_mi01</li> <li>ILOSTAT Safety and health at work section</li> </ul>
<b>Risks in working environments</b>	<ul style="list-style-type: none"> <li>People reporting exposure to risk factors that can adversely affect physical health</li> <li>Exposure to tobacco smoke indoors at the workplace</li> </ul>	<ul style="list-style-type: none"> <li>Eurostat database on accidents at work and other work-related health problems: hsw_exp4</li> <li>Special Eurobarometer 429: QC16.1</li> </ul>

### Work-related fatal injuries

For EU countries, the indicator on work-related injuries and mortality is based on the European statistics on accidents at work (Eurostat, 2018c). These data were downloaded as standardized incidence rate per country in 2014, with age and sex stratification. For non-EU countries, data about fatal occupational injuries per 100 000 employed people by sex were supplied by ILO, but no data by age were available. ILO data also cover fatal work injuries by migrant status, but these are not provided by all countries and may be affected by varying definitions of migrant status; they are therefore provided for selected countries only to serve as illustrative examples.

The average values for Euro 3 and Euro 4 subregions (relying exclusively on ILO data) are calculated as the simple average of the country values, whereas the average figures for the countries covered by Eurostat – exclusively Euro 1 and Euro 2 subregions – are population weighted, using population data from Eurostat.

### Health risks in working environments

The indicator of exposure to risk factors in the work setting is retrieved from the EU Labour Force Survey ad hoc module data from 2013, accessed through the Eurostat database on accidents at work and other work-related health problems (Eurostat, 2018d). Different risk factors are available for analysis. These were compiled into intrinsic (difficult work postures or repeated work movements, lifting weights and activities involving intense visual concentration) and extrinsic risk factors (exposure to chemicals, dusts, fumes, smoke or gases and exposure to noise and vibration). It should also be noted that the prevalence data of risk exposure are valid for the working population aged 15–64 years only.

Data on indoor tobacco exposure at the workplace are taken from the Special Eurobarometer 429 from 2015, with data compiled in late 2014 (European Commission, 2015). The indicator is based on the total percentage of workers reporting exposure to tobacco smoke; for the categorization by education the Eurobarometer approach (age of worker in final year of education) was used, representing educational differences between end of education at age 15, age 16–19 and age 20 and above. In this context, it should be noted that the Eurobarometer has small national sample sizes and the age categorization may therefore provide unrepresentative data.

The values for Euro 1 and Euro 2 subregions were calculated as population-weighted averages for intrinsic and extrinsic risks, and as averages of national rates for indoor tobacco exposure.

## Methodological notes on injury-related inequalities

Injury-related inequalities cover fatal poisoning and falls, and the related data were extracted from the WHO mortality database (WHO, 2018). Table A1.6 sets out the respective data sources.

**Table A1.6.** Injury inequality indicators and their source

Indicator	Description	Source and variable code
<b>Fatal poisoning</b>	Death cases due to (unintentional) poisoning	WHO mortality database ICD-10: X40-X49 WHO mortality database ICD-10 mortality tabulation list 1: A:1100 WHO mortality database ICD-9: 850-869
<b>Fatal falls</b>	Death cases due to falls	WHO mortality database ICD-10: W00-W19 WHO mortality database ICD-10 mortality tabulation list 1: A:1097 WHO mortality database ICD-9: 880-886, 888

### Fatal poisoning and falls

These injury-related indicators are based on data from the WHO mortality database and cover 50 countries (WHO, 2018). As with fatal RTIs, injury data were reported as absolute mortality cases split into both sexes and 24 age groups per country. Of those age groups, five age categories were created for analysis: 0-14, 15-29, 30-59, 60-69 and 70+ years.

As injury data were only reported by sex and age, not by socioeconomic status, no assessment of social dimensions is possible. In line with the 2012 inequalities assessment report (WHO Regional Office for Europe, 2012), however, some figures in the injury-related sections stratify the countries by national income level into high- and middle-income countries, based on gross national income per capita (2016), as recommended by the World Bank. Updated income thresholds published by the World Bank were used to create these groupings (World Bank, 2017), categorizing 30 countries as high- and 20 as middle-income countries. To further divide these categories, the median of each group was applied as a separator to establish upper and lower high-income and upper and lower middle-income countries.

To calculate mortality rates by age groups and sex, the WHO mortality database and the United Nations data portal provided population data broken down into the age groups matching the reported mortality cases in the country in the same year. For Turkmenistan, however, no recent population data were available from either source; they were therefore taken from an online source (PopulationPyramid.net, 2019). To calculate mortality rates for specific age groups, the absolute mortality cases were aggregated by these age groups and divided by the population per 100 000 inhabitants of each age group. The values for each age group were calculated as the simple, non-weighted average of all country mortality rates in the respective age and income group. The values provided for the Euro 1-4 subregions are also simple averages of the national rates.

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# Annex 2. Summaries of systematic reviews

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## Social inequalities in environmental noise exposure: a review of evidence in the WHO European Region

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**Stefanie Dreger, Steffen Andreas Schüle, Lisa Karla Hilz and Gabriele Bolte**

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### Background

Environmental noise is a major public health problem and is among the top environmental risks to health. In the EU 100 million people are exposed to traffic noise levels that are considered health threatening by scientists and health experts, and 1.6 million healthy life-years are lost due to road traffic noise in western Europe every year. The burden of environmental noise seems to be unequally distributed, with some studies pointing to higher exposure in more affluent population groups and some reporting higher exposure in socially deprived groups.

### Objective

The aim of this review was to systematically assess published evidence on social inequalities in environmental noise exposure in the WHO European Region, taking different sociodemographic and socioeconomic dimensions, as well as subjective and objective measures of environmental noise exposure into account.

### Method

The systematic review was carried out following the PRISMA statement and was registered with the PROSPERO international prospective register of systematic reviews database (Registration number: CRD42018099466). Based on the PROGRESS-Plus framework, various socioeconomic and sociodemographic indicators were considered. The databases MEDLINE (via PubMed), SCOPUS and Web of Science were searched for relevant studies. Original studies written in English and published between 2010 and 2017 in peer-reviewed journals were included. Altogether, 194 studies were identified; after duplicate removal 139 were included in the title and abstract screening process.

### Key findings

#### Description of studies

After title and abstract screening, eight studies were included in the qualitative synthesis. Of those analysed, four were conducted in France, three in Germany and one in the United Kingdom. Four studies analysed individual data and four analysed aggregated data. Of the four studies with individual data, three assessed noise exposure in adults, one in children. The focus of most studies was road traffic noise. One study from France analysed three different types of environmental noise: noise annoyance due to road traffic noise, general transportation noise and ambient noise. In one study different sources of traffic noise were combined into one noise indicator. Most studies assessed objective noise exposure; some assessed subjective noise annoyance.

#### Associations between indicators of socioeconomic position and environmental noise

The associations between indicators of socioeconomic position and exposure to environmental noise were mixed between and within studies. Studies analysing a small number of socioeconomic indicators pointed towards higher exposure to environmental noise in groups of lower socioeconomic status. Studies analysing a wider range of different socioeconomic indicators mostly showed mixed results

for the different indicators. Generally, studies analysing indices of deprivation and those analysing socioeconomic indicators reflecting material aspects of deprivation, such as income or ownership of dwelling, pointed to higher environmental noise exposure in groups of low socioeconomic position. These material factors are associated with where people can afford to live.

The socioeconomic indicator education, which not only represents material aspects but might also be linked to behavioural aspects, was not consistently associated with the extent of noise exposure. Lower environmental noise exposure was found in older people. For the other indicators of socioeconomic position analysed the number of studies per indicator was too low to draw general conclusions. All studies investigated the association between individual or contextual indicators of socioeconomic position and environmental noise exposure; however, the main research question of all studies was not explicitly to assess environmental inequalities. Four of the articles commented briefly on potential underlying mechanisms of inequalities in environmental noise exposure.

### Limitations

Due to the heterogeneity of study methods, quality assessment, estimation of the magnitude of inequalities and a comprehensive overview of the mechanisms leading to inequities in environmental noise exposure (procedural justice), were not possible.

### Discussion of health impacts across studies

Two of the eight studies in the review analysed the association between environmental noise and health outcomes directly (in subanalyses). All but one mentioned potential health impacts in the introduction as part of the rationale for the study or commented on health impacts in the discussion. They either highlighted that inequalities in environmental noise exposure might be linked to inequalities in health outcomes or mentioned more general health effects of environmental noise. Explicitly named factors were auditory effects of noise, childhood obesity, physical activity, myocardial infarction, sleep disturbances, hypertension, coronary heart disease, a negative impact on cognition, blood pressure reactions, depression, migraines, respiratory and arthritic symptoms, lack of concentration, hearing damage and mental health symptoms.

### Implications for future research

More research on inequalities in environmental noise exposure is needed to gain valid results on which social indicators are linked to environmental noise exposure and to identify the most affected groups. Social inequalities in environmental noise exposure on a small spatial scale should be monitored. This may be implemented in structural health monitoring activities.

## Social inequalities in environmental resources of green and blue spaces: a review of evidence in the WHO European Region

**Steffen Andreas Schüle, Lisa Karla Hilz, Stefanie Dreger and Gabriele Bolte**

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### Background

Evidence suggests that green and blue spaces play a health-promoting role, so unequal distribution of these environmental resources across social groups contributes to unequal distribution of health. Therefore, investigating associations between social indicators and measures of green and blue space is an important field of research in the context of environmental health inequalities.

## Objectives

The overall aim of this review was to gain a systematic overview of social inequalities in environmental resources in the WHO European Region. Environmental resources were defined as availability of or access to green and blue spaces, both subjectively and objectively. The following research questions were addressed in detail.

- How were green and blue space measured?
- Which indicators for describing socioeconomic position were used?
- Which statistical approaches were applied to analyse social inequalities in environmental resources?
- Did relationships between socioeconomic measures and environmental resources differ by types of socioeconomic position indicator or resource measure?
- To what extent were health impacts discussed in the context of environmental inequalities?

## Methods

The three electronic databases MEDLINE (via PubMed), SCOPUS and Web of Science were searched for studies on green and blue space combined with sociodemographic and socioeconomic terms according to the PROGRESS-Plus framework and terms indicating inequality, inequity or environmental justice. Only peer-reviewed articles in English published between 1 January 2010 and 31 December 2017 were considered. The review followed the PRISMA statement and was registered in the PROSPERO review database (Registration number: CRD42018099460).

## Key findings

### Description of studies

The three databases revealed 861 records after removal of duplicates. Following title and abstract screening and full text analysis, 14 studies were considered for qualitative synthesis.

The majority were conducted in Germany (8 of the 14 studies); 12 analysed environmental inequalities in green spaces and 2 focused on blue spaces. Ecological studies that analysed aggregated data, mostly on a small scale, mainly applied indices of socioeconomic deprivation and calculated availability measures of resources in the area considered. Cross-sectional studies of the individual level analysed adult populations and focused more on single socioeconomic position measures, such as education or income, applying both distance and availability measures of resources. Most studies applied bivariate statistics, such as correlation coefficients or Chi<sup>2</sup> tests, to analyse relations between socioeconomic position and environmental resources.

### Associations between indicators of socioeconomic position and environmental resources

In ecological studies there was a consistent trend that areas with higher deprivation had less green or blue space available than more affluent areas. In cross-sectional studies which predominantly analysed single socioeconomic indicators results were more mixed and dependant on the type of indicator and environmental measure. Consistent relationships were found for education indicators, meaning that individuals with low education levels had fewer available resources or longer distances to resources. Age studies detected more green space availability or shorter distances to green spaces for older than for young people. Mixed associations were found for other indicators such as income, migration background or nationality. Opposing associations were detected when different resource measures were analysed (availability and distance measures) in relation to one socioeconomic position indicator within studies or for different indicators analysed in relation to the same environmental measure.

### Limitations

Social and environmental measures and the analytical methods applied were very heterogeneous across studies. Therefore, no comparable assessment of the magnitude of inequalities and no systematic quality assessment of the studies included was possible.

### Discussion of health impacts across studies

Three of the 14 studies analysed not only environmental inequalities of resources but also relationships between environmental factors and health (infant and neonatal mortality, viso-motoric development in children) or health determinants (outdoor walking). As a rationale for analysing environmental inequalities, most of the studies identified relied on existing evidence of the health-promoting role of environmental resources and elucidated that an unequal distribution of environmental resources across

social groups would foster environmental health inequalities. Potential health-promoting interventions to overcome existing environmental inequalities were rarely discussed in the studies.

### Implications for future research

More comparable and longitudinal studies within and across European countries are needed. Comparable methods would further support the development of integrative monitoring of environmental inequalities.

## Environmental justice in industrially contaminated sites. A review of scientific evidence in the WHO European Region

**Roberto Pasetto, Benedetta Mattioli and Daniela Marsili**

(Published as an open access paper by the *International Journal of Environmental Research and Public Health* 16(6):998, doi:10.3390/ijerph16060998, in the topical collection “Achieving environmental health equity: great expectations”)

### Background

At the Sixth WHO Ministerial Conference on Environment and Health, held in Ostrava, Czechia, in 2017, the theme of contaminated sites was recognized as a public health priority in Europe for the first time. In the WHO European Region, wherever assessments have been carried out in the two last decades, high level of hazardous exposure and/or an excess of health risks and impacts associated with “hot spot” contaminated areas have been documented. The Ostrava Declaration also highlighted the need to prevent and eliminate inequalities associated with waste and contaminated sites, but no assessment of scientific evidence on socioeconomic and sociodemographic inequalities in contaminated sites in the Region was available.

### Objectives

The aim of this review was to gain an overview of the scientific evidence on socioeconomic and sociodemographic inequalities (distributive justice) and on the mechanisms of their generation and maintenance (procedural justice) in industrially contaminated sites (ICS) in the Region. The definition of ICS adopted by the Industrially Contaminated Sites and Health Network (ICSHNet) was used: “Areas hosting or having hosted industrial human activities which have produced or might produce, directly or indirectly (waste disposals), chemical contamination of soil, surface or ground-water, air, food-chain, resulting or being able to result in human health impacts”.

### Methods

The review strategy focused on inequalities in exposure to ICS and/or related health risks (distributive justice) as well as the mechanisms causing and maintaining such inequalities (procedural justice).

Two categories of search terms were used to explore the dimension of ICS: general terms referring to ICS and specific terms related to the sources of contamination. Three topics were chosen to select the terms related to specific sources: main heavy industries producing chemical contamination (metallurgic, chemical, petrochemical, oil refining, steel, gas, power plants – excluding nuclear plants); mines and quarries; and waste, incinerators and landfills. The search strategy was applied to MEDLINE (via PubMed), SCOPUS and Web of Science. Only manuscripts written in English were included in the review.

### Key findings

#### Description of studies and main results

After removal of duplicates 453 records were revealed from the three databases. Following title and abstract screening 60 studies were considered pertinent to the review. Studies carried out outside the WHO European Region were excluded; full text analysis of the remaining studies led to 14 being considered for qualitative synthesis: 10 on distributive justice and 4 on procedural justice.

Analysis of distributive and procedural justice in ICS available in the peer-reviewed scientific literature in the WHO European Region is in its early stages, except in the United Kingdom. Wherever assessments on environmental inequalities have been carried out, an overburden of socioeconomic deprivation or vulnerability, with very few exceptions, has been observed. Eligible studies were carried out in northern and western Europe, with the exception of one study in Czechia. The sources of industrial contamination considered were mines (areas with present or former mining activities), industrial plants producing chemical contamination, coal power plants, incinerators and landfills.

The four studies focused on procedural justice concerned heavy industries. A common resulting key issue is the asymmetric power relationships among stakeholders in the decision-making process, in which ethnic minority groups and/or disadvantaged population subgroups living in the vicinity of the contaminated areas suffer from a lack of influence in decisions concerning land use.

### **Critical analysis of results**

The selected studies on inequalities were based on geographical analysis, reporting details on the association between the presence of industrial sources of contamination and the disproportion of socioeconomic vulnerabilities in the most affected areas.

Local assessments can provide evidence and information with more details useful for local interventions, while national assessments can give general information useful to identify priorities for the management of inequalities and inequities at the national level. In countries in the WHO European Region this complementarity seems to have been explored in the United Kingdom and very recently in Germany.

Limiting the review to manuscripts written in English excluded some studies with eligible abstracts (from Italy and Spain) from the analysis.

Methods used in the selected studies for the qualitative and quantitative assessment of inequalities were very heterogeneous, reflecting the differences in study design and data availability. They ranged from bivariate analysis to assess the correlation between the presence/absence of industrial sites and socioeconomic level to multivariate analysis using different regression models for the assessment of associations between exposure and multiple socioeconomic/sociodemographic determinants. The socioeconomic/sociodemographic attributes of populations affected by industrial pollution in the studies were assessed using single variables (usually from national censuses or data from a local bureau of statistics) or by combining variables in indices of multiple deprivation.

The socioeconomic variables commonly used to assess the socioeconomic status of the residents in ICS were unable to account for the social dimensions, such as the quality of relationships among the stakeholders involved and the existence of local communication networks and of participative processes in decision-making.

### **Implications for future research**

The evaluation highlighted at least three main directions for future studies. The first is to develop study strategies that include different phases and study methods, with the contribution of experts on social, environmental and health sciences, to improve the causative assessment of environmental health inequalities. The second is to improve applications and study designs in order to include the dimension of health in the analysis. The third is to consider both local and national assessments.

Other aspects to be explored include assessment of socioeconomic characteristics, combining information retrieved and attributable to individuals with data representing the context, and analysis of inequalities related to ethnicity.



# Are there changes in inequalities in injuries? A review of evidence in the WHO European Region

**Mathilde Sengoelge, Merel Leithaus, Matthias Braubach and Lucie Laflamme**

(Published as an open access paper by the *International Journal of Environmental Research and Public Health* 16(4):653, doi:10.3390/ijerph16040653, in the topical collection “Achieving environmental health equity: great expectations”)

The objective of this review was to assess the state of knowledge concerning changes over time in social inequality in injuries in the WHO European Region. A total of 1274 records were identified and 62 underwent full text review. Of the 27 studies retained, 7 were cross-country and 20 country-specific; 12 reported changes over time and 15 presented recent data.

## Key findings

### *Changes over time*

Studies on changes over time, both cross-country and within-country, reveal substantial downward trends in injuries – all causes and cause-specific – in recent decades. At the same time, however, inequalities between countries and, as found by a majority of studies, even those within countries persist (although the number of countries contributing data is low).

For children, cross-country studies show downward trends in risk levels over time in the Region, at the expense of widening inequalities between children from high-income and low-income countries. Cause-specific studies, all from the United Kingdom, point in the same direction, showing rates of pedestrian injuries, burns and poisonings going down (except among adolescents). Socioeconomic relative inequalities (for burns in small children, pedestrian injuries in all children, poisonings among adolescents) and even ethnic differences in child pedestrian injuries persist.

The authors did not find any cross-country study on changes over time in the general or the adult population. Within-country studies are from few countries, mainly from the north of Europe, and also point to reductions in risks levels and widening relative differences. Studies on all injuries aggregated are from Spain, where no difference was found over time in injury mortality between the poorest and the richest provinces; and from Norway and Finland, where individual-based comparisons revealed narrowing relative differences among older adults when considering mortality by education level (Norway) and among adults when considering occupation-based long-term injury-related sickness absence (for which absolute differences did not change; Finland). For RTIs, a study from Israel shows reductions in mortality and morbidity for all categories of road user but persisting differences between ethnic groups.

## Studies based on more recent data

Studies that present more recent data introduce a number of new angles of investigation; for example, cross-country differences, the impact of the physical environment on the magnitude of social inequalities and ethnicity differences. As shown in previous reviews, the number of countries that contribute data is limited and the results tend to vary depending on the population group considered (children, adults, whole population), how social differences are measured and even the injury outcome (cause, severity, etc.). Thus, the new data complement and align with those reviewed previously.

For children, more recent studies show that country-level characteristics like income disparities or economic levels are associated with injury mortality (all injuries and RTIs) to the detriment of those from countries with higher income disparities and lower income levels. It also appears that “housing strain” could explain some of the association between country-level income inequality and economic development and child injury mortality. For cause-specific injuries, reports of social inequalities appear even in more recent years, in particular for RTIs requiring emergency department attendance and for pedestrian injuries (in England, United Kingdom) and for burns and poisonings (England and Spain).

In other population groups, no clear pattern emerges from cross-country studies. For all-injury mortality (all ages) associations with intraregional deprivation levels are common, but not consistent, and are more

frequent among men than women. The same applies to some extent when considering education level in the adult population. Those countries where associations are found (and the number of countries this relates to) vary by sex and by injury cause – RTI, fall mortality. For within-country studies, which are also from very few countries, there is a tendency again for all-injury studies (Sweden, Spain, Scotland) to yield mixed results and for cause-specific ones to show more consistent social inequalities. This is the case for RTIs (Belgium) and for burns and poisonings (England, United Kingdom and Spain).

## Conclusion

Studies on changes over time reveal substantial downward trends in injuries in recent decades, but inequalities between countries and, as found by a majority of studies, within countries persist. Studies that present more recent data introduce a number of new angles of investigation (such as cross-country differences, the impact of the physical environment on the magnitude of social inequalities and ethnicity differences). As shown in previous reviews, the number of countries that contribute data is limited and the results tend to vary depending on the population group considered, how social differences are measured and even the injury outcome. Relative social inequalities in injuries are a persisting public health issue in the European Region.



## 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 they are not shared equally across the population. Higher levels of environmental risk are often found in disadvantaged population subgroups. This assessment report considers the distribution of environmental risks and injuries within countries and shows that unequal environmental conditions, risk exposures and related health outcomes affect citizens daily in all settings where people live, work and spend their time.

The report documents the magnitude of environmental health inequalities within countries through 19 inequality indicators on urban, housing and working conditions, basic services and injuries. Inequalities in risks and outcomes occur in all countries in the WHO European Region, and the latest evidence confirms that socially disadvantaged population subgroups are those most affected by environmental hazards, causing avoidable health effects and contributing to health inequalities.

The results call for more environmental and intersectoral action to identify and protect those who already carry a disproportionate environmental burden. Addressing inequalities in environmental risk will help to mitigate health inequalities and contribute to fairer and more socially cohesive societies.



### World Health Organization Regional Office for Europe

UN City, Marmorvej 51, DK-2100 Copenhagen Ø, Denmark  
Tel.: +45 45 33 70 00  
Fax: +45 45 33 70 01  
Email: [eurocontact@who.int](mailto:eurocontact@who.int)  
Website: [www.euro.who.int](http://www.euro.who.int)