WHO EUROPEAN HIGH-LEVEL CONFERENCE ON NONCOMMUNICABLE DISEASES AND AIR POLLUTION

Time to Deliver: meeting NCD targets to achieve Sustainable Development Goals in Europe
9-10 April 2019, Ashgabat, Turkmenistan
ABSTRACT

Air pollution is the second leading cause of deaths from noncommunicable diseases (NCDs), after tobacco-smoking. In 2018, the third United Nations high-level meeting on NCDs recognized household and outdoor air pollution as a risk factor for NCDs, alongside unhealthy diets, tobacco-smoking, harmful use of alcohol and physical inactivity. More than 550 000 deaths in the WHO European Region in 2016 were attributable to the joint effects of household and ambient air pollution. The main NCDs associated with air pollution include ischaemic heart disease, stroke, chronic obstructive pulmonary disease and lung cancer. Substantial epidemiological evidence links air pollution with diverse health outcomes, with extensive research conducted to advance understanding of the underlying mechanistic pathways. Among the complex mixture of air pollutants, particulate matter is of prime public health concern. Interventions to reduce exposure to air pollution and improve air quality have huge potential in protecting health and contributing to reducing the burden of NCDs. Creating healthier environments for reducing NCDs can result in multiple co-benefits for health, climate change and the environment.

KEYWORDS

AIR POLLUTION
NONCOMMUNICABLE DISEASES
ISCHAEMIC HEART DISEASE
STROKE
CHRONIC OBSTRUCTIVE PULMONARY DISEASE
LUNG CANCER
COMMUNITY-LEVEL INTERVENTIONS

Address requests about publications of the WHO Regional Office for Europe to:

Publications
WHO Regional Office for Europe
UN City, Marmorvej 51
DK-2100 Copenhagen Ø, Denmark

Alternatively, complete an online request form for documentation, health information, or for permission to quote or translate, on the Regional Office website (http://www.euro.who.int/pubrequest).

© World Health Organization 2019

All rights reserved. The Regional Office for Europe of the World Health Organization welcomes requests for permission to reproduce or translate its publications, in part or in full.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers’ products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either express or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use. The views expressed by authors, editors, or expert groups do not necessarily represent the decisions or the stated policy of the World Health Organization.
Acknowledgements ii

The estimated burden of disease due to ambient and household air pollution 1

The contribution of air pollution to NCDs – IHD, stroke, lung cancer and COPD 2

The evidence on NCD outcomes attributable to air pollution 3

Interventions to reduce air pollution and the burden of NCDs 5

References 7
ACKNOWLEDGEMENTS

The background paper was developed by Hanna Yang, Roman Perez Velasco, Pierpaolo Mudu and Dorota Jarosinska [WHO European Centre for Environment and Health].
THE ESTIMATED BURDEN OF DISEASE DUE TO AMBIENT AND HOUSEHOLD AIR POLLUTION

Air pollution is the second leading cause of deaths from noncommunicable diseases (NCDs) after tobacco-smoking (Fig. 1). In 2018, household and outdoor air pollution was recognized as one of the risk factor for NCDs, alongside unhealthy diets, tobacco-smoking, harmful use of alcohol, and physical inactivity [1].

Fig. 1. Fraction of NCDs deaths attributable to selected risk factors

Globally, household and ambient air pollution causes 7 million premature deaths each year, including more than 5 million due to NCD (data for 2016) [3]. More than 550 000 deaths in the WHO European Region were attributable to the joint effects of household and ambient air pollution in 2016, with over 500 000 being due to ambient air pollution and more than 50 000 to household air pollution [4–6].

The main NCDs associated with air pollution include ischaemic heart disease (IHD), stroke, chronic obstructive pulmonary disease (COPD) and lung cancer. Based on data from 2012, globally, 2.8 and 3.7 million NCD deaths were due to ambient and household air pollution, respectively. Ambient and household air pollution caused, respectively, nearly 480 000 and 120 000 NCD deaths in the WHO European Region from IHD, stroke, COPD and lung cancer [2] (Table 1).
Table 1. Deaths from main NCDs attributable to environmental risks in 2012

<table>
<thead>
<tr>
<th>Disease and their risk factors</th>
<th>Africa</th>
<th>Americas</th>
<th>Eastern Mediterranean</th>
<th>Europe</th>
<th>South-East Asia</th>
<th>Western Pacific</th>
<th>World*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ischaemic heart disease</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household air pollution *</td>
<td>96 000</td>
<td>30 000</td>
<td>51 000</td>
<td>56 000</td>
<td>495 000</td>
<td>366 000</td>
<td>1 095 000</td>
</tr>
<tr>
<td>Ambient air pollution b</td>
<td>51 000</td>
<td>73 000</td>
<td>91 000</td>
<td>263 000</td>
<td>304 000</td>
<td>297 000</td>
<td>1 079 000</td>
</tr>
<tr>
<td>Second-hand tobacco smoke</td>
<td>16 000</td>
<td>27 000</td>
<td>54 000</td>
<td>64 000</td>
<td>113 000</td>
<td>110 000</td>
<td>384 000</td>
</tr>
<tr>
<td>Lead</td>
<td>9000</td>
<td>30 000</td>
<td>44 000</td>
<td>56 000</td>
<td>67 000</td>
<td>32 000</td>
<td>239 000</td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household air pollution</td>
<td>162 000</td>
<td>27 000</td>
<td>49 000</td>
<td>43 000</td>
<td>498 000</td>
<td>679 000</td>
<td>1 458 000</td>
</tr>
<tr>
<td>Ambient air pollution</td>
<td>75 000</td>
<td>37 000</td>
<td>65 000</td>
<td>139 000</td>
<td>273 000</td>
<td>494 000</td>
<td>1 083 000</td>
</tr>
<tr>
<td>Second-hand tobacco smoke</td>
<td>9000</td>
<td>7000</td>
<td>14 000</td>
<td>18 000</td>
<td>48 000</td>
<td>78 000</td>
<td>175 000</td>
</tr>
<tr>
<td>Lead</td>
<td>9000</td>
<td>13 000</td>
<td>21 000</td>
<td>28 000</td>
<td>47 000</td>
<td>38 000</td>
<td>239 000</td>
</tr>
<tr>
<td><strong>Lung cancer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household air pollution</td>
<td>4000</td>
<td>6100</td>
<td>3000</td>
<td>10 000</td>
<td>53 000</td>
<td>195 000</td>
<td>271 000</td>
</tr>
<tr>
<td>Ambient air pollution</td>
<td>4000</td>
<td>20 000</td>
<td>10 000</td>
<td>69 000</td>
<td>47 000</td>
<td>251 000</td>
<td>400 000</td>
</tr>
<tr>
<td>Second-hand tobacco smoke</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>21 000</td>
<td>28 000</td>
</tr>
<tr>
<td>Occupational risks</td>
<td>11 000</td>
<td>62 000</td>
<td>15 000</td>
<td>85 000</td>
<td>42 000</td>
<td>120 000</td>
<td>445 000</td>
</tr>
<tr>
<td>Residential radon</td>
<td>3000</td>
<td>8100</td>
<td>3000</td>
<td>26 000</td>
<td>9000</td>
<td>15 000</td>
<td>64 000</td>
</tr>
<tr>
<td><strong>COPD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household air pollution</td>
<td>30 000</td>
<td>11 000</td>
<td>25 000</td>
<td>8000</td>
<td>493 000</td>
<td>339 000</td>
<td>906 000</td>
</tr>
<tr>
<td>Ambient air pollution</td>
<td>4000</td>
<td>3000</td>
<td>9000</td>
<td>7000</td>
<td>126 000</td>
<td>93 000</td>
<td>242 000</td>
</tr>
<tr>
<td>Second-hand tobacco smoke</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>4000</td>
<td>53 000</td>
<td>44 000</td>
<td>113 000</td>
</tr>
<tr>
<td>Occupational risks</td>
<td>16 000</td>
<td>23 000</td>
<td>14 000</td>
<td>12 000</td>
<td>181 000</td>
<td>108 000</td>
<td>353 000</td>
</tr>
</tbody>
</table>

Notes: * From cooking with polluting fuels; † Outdoor air pollution; ‡ Row totals may not add up due to rounding.
Source: WHO (2).

THE CONTRIBUTION OF AIR POLLUTION TO NCDS – IHD, STROKE, LUNG CANCER AND COPD

Worldwide, 24% of cases of stroke, 25% of IHD, 28% of lung cancer and 43% of COPD were attributable to ambient and household air pollution in 2016, and evidence on additional NCDs is emerging (7). In the WHO European Region, 15% of IHD, 14% of stroke, 19% of lung cancer and 6% of COPD were attributable to ambient and household air pollution in 2012 (Table 2).

Table 2. Fraction of main NCD deaths attributable to environmental risks by region in 2012

<table>
<thead>
<tr>
<th>Disease and their risk factors</th>
<th>Africa</th>
<th>Americas</th>
<th>Eastern Mediterranean</th>
<th>Europe</th>
<th>South-East Asia</th>
<th>Western Pacific</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ischaemic heart disease</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household air pollution *</td>
<td>31%</td>
<td>4%</td>
<td>10%</td>
<td>3%</td>
<td>31%</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>Ambient air pollution b</td>
<td>16%</td>
<td>9%</td>
<td>18%</td>
<td>12%</td>
<td>19%</td>
<td>16%</td>
<td>15%</td>
</tr>
<tr>
<td>Second-hand tobacco smoke</td>
<td>4%</td>
<td>2%</td>
<td>7%</td>
<td>5%</td>
<td>6%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Lead</td>
<td>2%</td>
<td>3%</td>
<td>6%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household air pollution</td>
<td>37%</td>
<td>6%</td>
<td>15%</td>
<td>3%</td>
<td>35%</td>
<td>25%</td>
<td>22%</td>
</tr>
<tr>
<td>Ambient air pollution</td>
<td>17%</td>
<td>8%</td>
<td>20%</td>
<td>11%</td>
<td>19%</td>
<td>18%</td>
<td>16%</td>
</tr>
<tr>
<td>Second-hand tobacco smoke</td>
<td>2%</td>
<td>1%</td>
<td>4%</td>
<td>2%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Lead</td>
<td>2%</td>
<td>3%</td>
<td>6%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Lung cancer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household air pollution</td>
<td>25%</td>
<td>2%</td>
<td>11%</td>
<td>2%</td>
<td>37%</td>
<td>27%</td>
<td>17%</td>
</tr>
<tr>
<td>Ambient air pollution</td>
<td>23%</td>
<td>8%</td>
<td>10%</td>
<td>11%</td>
<td>33%</td>
<td>34%</td>
<td>35%</td>
</tr>
<tr>
<td>Second-hand tobacco smoke</td>
<td>1%</td>
<td>&lt;1%</td>
<td>2%</td>
<td>&lt;1%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Occupational risks</td>
<td>28%</td>
<td>21%</td>
<td>30%</td>
<td>21%</td>
<td>25%</td>
<td>31%</td>
<td>26%</td>
</tr>
<tr>
<td>Residential radon</td>
<td>8%</td>
<td>3%</td>
<td>6%</td>
<td>6%</td>
<td>5%</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td><strong>COPD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household air pollution</td>
<td>35%</td>
<td>4%</td>
<td>25%</td>
<td>3%</td>
<td>39%</td>
<td>31%</td>
<td>29%</td>
</tr>
<tr>
<td>Ambient air pollution</td>
<td>5%</td>
<td>1%</td>
<td>9%</td>
<td>3%</td>
<td>10%</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Second-hand tobacco smoke</td>
<td>3%</td>
<td>1%</td>
<td>5%</td>
<td>1%</td>
<td>4%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Occupational risks</td>
<td>16%</td>
<td>7%</td>
<td>12%</td>
<td>3%</td>
<td>14%</td>
<td>10%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Notes: * From cooking with polluting fuels; † Outdoor air pollution.
Source: WHO (2).
THE EVIDENCE ON NCD OUTCOMES ATTRIBUTABLE TO AIR POLLUTION

Air pollution is a complex mixture of gaseous and particulate pollutants. Among those, particulate matter, ground-level ozone \((O_3)\), nitrogen dioxide \((NO_2)\) and sulphur dioxide \((SO_2)\), the so-called classical air pollutants, are most extensively studied for their health impacts. Particulate matter, mainly its fine fraction \((PM2.5)^1\) is a prime public health concern. A large number of studies from Europe and elsewhere lend strong support to the wide array of mortality and morbidity outcomes associated with PM2.5.

Epidemiological evidence of long-term effects is supported by large cohort studies, while short-term effects are underpinned by cumulative evidence from many multi- and single-city studies. These show consistent results from a wide range of settings, including a variety of PM mixtures, environments, personal characteristics and health systems. Newer studies provide evidence for a pathophysiological response to current ambient concentrations of PM2.5 and plausible biological mechanisms that link short- and long-term exposure to PM2.5 with mortality and morbidity, as observed in epidemiological, clinical and toxicological studies.

In addition to cardiovascular and respiratory outcomes, evidence is emerging on other effects of air pollution, such as diabetes, neurological development issues in children and neurological problems in adults (neurodevelopmental and neurodegenerative effects), among others \((7,8)\).

Exposure to PM2.5 has also been linked to impaired lung function in children. Evidence is increasing for an association of ambient air pollution, including fine particles, with birth outcomes; for example, a systematic review reported significant associations between exposure to PM2.5 and low birth weight, preterm birth and small-for-gestational-age births \((8)\). Exposure to air pollution in early childhood and the risk of developmental and health consequences in later life point to the need for actions to avoid early life exposures and put the prevention of the health impacts of air pollution in the context of the life-course approach.

In addition to epidemiological evidence linking PM pollution to a diversity of health outcomes, there is also extensive research that aims to determine the underlying mechanistic pathways. Mechanistic evidence indicates that PM2.5 is associated with oxidative stress, systemic inflammation and alteration of the cardiac electrical processes. Animal studies, complemented by experimental studies in humans \((8,9)\), provide robust evidence of vasoconstriction and systemic proinflammatory responses. The scientific conclusions about the evidence for a causal link between PM2.5 and adverse health outcomes from the WHO air quality guidelines in 2005 have been confirmed and strengthened in a WHO review of evidence on health aspects of air pollution, published in 2013 \((8)\).

Fig. 2 and 3 reproduce WHO infographics highlighting the threats of air pollution on children’s health and the risks associated with outdoor and household air pollution.

---

\(^{1}\) PM2.5 – particulate matter with an aerodynamic diameter smaller than 2.5 μm.
Fig. 2. WHO infographic – impact of air pollution on children’s health © WHO.

Fig. 3. WHO infographic – deaths linked to outdoor and household air pollution © WHO.
INTERVENTIONS TO REDUCE AIR POLLUTION AND THE BURDEN OF NCDs

Given the body of evidence on the health effects of air pollution and the magnitude of the public health impact of this environmental risk factor, interventions to reduce exposure to air pollution and improve air quality have huge potential to protect health. They require multidisciplinary and multisectoral approaches, and multilevel governance.

Interventions to reduce exposure to air pollution and, through this, to contribute to reducing the NCD burden range from regulatory measures, through community-level interventions, to interventions directed to individuals. A wide range of interventions is available to improve ambient and household air quality and prevent disease from air pollution. Some examples shown in Table 3 target actions in different sectors and settings (10).

Table 3. Actions in different sectors and settings to combat pollution

<table>
<thead>
<tr>
<th>Pollution</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient air pollution</td>
<td>• Develop healthy and efficient transport options, such as combining rapid transit with walking/cycling</td>
</tr>
<tr>
<td></td>
<td>• Provide transport network space for pedestrian and cycling infrastructure</td>
</tr>
<tr>
<td></td>
<td>• Improve land-use systems, leading to reduced travel times</td>
</tr>
<tr>
<td></td>
<td>• Implement engineering and speed-reduction measures</td>
</tr>
<tr>
<td></td>
<td>• Regulate and implement industrial emission controls</td>
</tr>
<tr>
<td></td>
<td>• Select energy options, while considering health impacts and their financial implications</td>
</tr>
<tr>
<td>Household air pollution</td>
<td>• Provide access to clean fuels and technologies for all cooking, lighting and heating, as defined by WHO guidelines for indoor air quality on household fuel combustion</td>
</tr>
<tr>
<td></td>
<td>• Avoid use of unprocessed coal and kerosene, as well as the inefficient use of solid fuels, in households</td>
</tr>
<tr>
<td></td>
<td>• Acknowledge that the switch to clean household energy will take time; prioritize transition fuels and technologies that offer substantial health benefits</td>
</tr>
<tr>
<td></td>
<td>• Build a larger market ecosystem for clean and modern household energy solutions through innovations in financing and business models for household consumers, stove designers and distributors</td>
</tr>
<tr>
<td></td>
<td>• Develop health-based national performance and safety standards for household energy fuels and technologies</td>
</tr>
</tbody>
</table>

Community-level interventions and air quality management measures can target specific sources that contribute significantly to air pollution. Examples include change in fuels used in industry, transport and individual households, and urban planning, including green spaces and planning of roads and tracts for non-motorized transportation (such as cycling).

Interventions directed at individuals involve the implementation of established primary, secondary and tertiary interventions (such as controlling hypertension, lowering lipids, reducing obesity, promoting physical activity and smoking cessation) for diseases affected by air pollution exposure. For example, some forms of physical activity, like walking and cycling, instead of using motorized transportation, can positively affect health, as well as contributing to reducing air pollution. Fig. 4 provides some ideas for solutions in infographic form.

Creating healthier environments for reducing NCDs can result in multiple co-benefits. For example, reducing air pollution from coal-fired power plants may not only diminish health risks due to particulate matter, but also prevent mercury from entering the food chain. Many policies to combat air pollution also
mitigate climate change through actions in, for instance, the energy and transportation sectors. Less polluting vehicles, and public transportation combined with walking and cycling, can also facilitate physical activity. Lower red meat consumption can reduce NCDs directly and contribute to mitigating climate change through the reduced emissions of greenhouse gases from livestock (2,7).

Fig. 4. Solutions to air pollution

The health sector needs to be engaged in leadership and coordination of health-related matters. It plays a crucial role in raising awareness of the health impacts of air pollution and in advocacy activities. It now needs to participate in the development of sectorial policies, in particular those linked to generating environmental risks to health, such as energy or transport. To assume this role, the health sector may need to acquire additional competencies and be supported by new governance mechanisms (7).


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.

Member States

Albania
Andorra
Armenia
Austria
Azerbaijan
Belarus
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Georgia
Germany
Greece
Hungary
Iceland
Ireland
Israel
Italy
Kazakhstan
Kyrgyzstan
Latvia
Lithuania
Luxembourg
Malta
Monaco
Montenegro
Netherlands
North Macedonia
Norway
Poland
Portugal
Republic of Moldova
Romania
Russian Federation
San Marino
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
Tajikistan
Turkey
Turkmenistan
Ukraine
United Kingdom
Uzbekistan

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
Web site: www.euro.who.int