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Editorial article

## Air pollution and health, 20 years later

### Contaminación del aire y salud, 20 años después

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Today, the effects of air pollution on health are undeniable. Moreover, current evidence indicates that air pollution has become a multi-systemic risk, not only limited to the cardiovascular and respiratory systems, and its effects are recognised even at low doses. Beyond the impact on medicine, over the last few years, there have been 5 crucial global developments regarding the effect of air pollution on health:

- 1 In 2014, the World Health Organisation (WHO) reported that air pollution causes several million deaths per year and is the leading cause among environmental determinants of human mortality and morbidity.<sup>1</sup>
- 2 In 2015, the World Bank confirms similar figures and estimates the health cost of air pollution at trillions of dollars.<sup>2</sup>
- 3 In 2019, the United Nations commissioned a group of scientists to draw up a plan to prioritise the most efficient actions among the sustainable development goals. This was set out in the report "The future is now"<sup>3</sup> in which, among the 5 priority actions on a global scale, urban redevelopment stood out, especially due to the effects of mobility and motorised transport on urban pollution and health.
- 4 By 2020, the lockdown measures linked to the COVID-19 pandemic demonstrated, worldwide, a drastic reduction in urban air levels of pollutants such as NO<sub>2</sub> (nitrogen dioxide) due to the marked decline in road traffic. The decrease in particulate matter below 10 and 2.5 microns (PM<sub>10</sub> and PM<sub>2.5</sub>, respectively), however, is not uniform. This is attributed to the impact of other peri-urban sources such as excess agricultural waste or biomass burning.<sup>4</sup> The multifactorial origin of particulate matter in cities supports the recent finding that, worldwide, the largest source of air pollution with effects on mortality is agriculture and intensive livestock farming.<sup>5</sup> However, at a more local level, road traffic emissions are the main source in urban areas, where a significant part of the population lives.
- 5 In 2021, WHO developed new guideline values for various air pollutants to ensure air quality that protects health.<sup>6</sup> For NO<sub>2</sub> and PM<sub>2.5</sub>, the values are 4 and 5 times lower than the EU quality

criteria, respectively, and between 3 and 4 times lower than the daily values in most southern European cities.

The evidence on the health effects of air pollution is overwhelming. In the last five years, about 12 articles per day have been published on health and air pollution in journals indexed in PubMed. Of these, those showing an improvement in mortality or morbidity following air pollution reduction stand out for their impact on causality. For example, a reduction by 10 µg/m<sup>3</sup> of PM<sub>2.5</sub> in the 100 most polluted US cities produces a life expectancy improvement of 7 months.<sup>7</sup> Or the improvement in air quality in Los Angeles between 1994 and 2011 has led to a decrease in bronchial obstruction from 7 to 9% to 3.6% in schoolchildren.<sup>8</sup> Also noteworthy is the research that has calculated the impact based on the "Global Burden of Diseases" panel located in Seattle. From the 5 diseases for which evidence of effects is well established (lower respiratory infections, chronic obstructive pulmonary disease [COPD], lung cancer, myocardial infarction and stroke), they have determined that the impact is greater on the cardiovascular system than on the respiratory system, that this impact is increasing year by year and that the number of deaths is more than 8 million per year, with about half due to urban pollution and the other half due to indoor pollution.<sup>9</sup> More recent analyses estimate an impact of more than 10 million deaths per year from emissions due to the burning of fossil fuels.<sup>10</sup> It is important to note that beyond the 5 diseases mentioned, there is strong evidence that there are many diseases related to air pollution, from disorders in pregnant women<sup>11</sup> and foetal growth<sup>12</sup> to effects on lung<sup>13</sup> or cognitive<sup>14</sup> development, and even effects on Alzheimer's disease,<sup>15</sup> other degenerative diseases such as Parkinson's disease,<sup>16</sup> or mental health.<sup>17</sup> Finally, there has been a breakthrough in understanding the molecular and pathophysiological mechanisms underlying the effects of pollution. The involvement of multiple distinct pathways, including intercellular signalling, the microbiome, epigenetics, oxidative stress, mitochondrial or nervous system dysfunction, among others, to explain a multisystemic effect at low doses, most likely impacting all organs of the human body, is noteworthy.<sup>18</sup>

A new approach in this area has been to study the effect of air pollution in its context, as part of urban design. Motor vehicle use is known to produce health effects not only through the presence of air toxics, but also through the health effects of noise, the lack of physical activity through passive transport, the use of

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common urban space for vehicles instead of other social activities or green spaces, and the increase in temperature due to heat island effects. Thus, in studies carried out in the city of Barcelona, it is concluded that redesigning the city in compliance with the health quality criteria recommended by the WHO for all these determinants would reduce mortality by 20% and save a high number of hospital admissions.<sup>19</sup> This leads to the consensus that community-based prevention should involve urban mobility and behavioural interventions including low emission zones, non-emission zones (especially around schools and hospitals), and the promotion of physically active modes of transport, in order to prevent health effects.<sup>20</sup>

Other aspects beyond the redesign of cities and their mobility would also have a positive impact on air quality. On the one hand, the use of more efficient fireplaces and heaters (certified, closed and use of high-quality pellets) for burning biomass for recreational/aesthetic use or for heating. At a rural level and in the field of agriculture and, above all, livestock farming (responsible for 75% of ammonia emissions in the EU), there are also a number of good practices to reduce the impact on air quality, such as not burning stubble, burying manure instead of spreading it on the surface, having covered manure storage tanks and the like, and keeping the animal housing area clean and dry.<sup>21</sup>

Finally, current challenges focus on research and implementation of prevention actions on urban transport and on other sources. Medical research still needs to further deepen the understanding of the effects and mechanisms in the prenatal phase and their impact throughout life, as well as in ageing. Understanding the effect on the brain, nervous, endocrine, immune or metabolic systems, kidney, eyes, skin and other organs beyond the cardiorespiratory system must also be completed. Finally, it is still important to highlight the lack of guidelines for therapeutic and preventive actions in clinical practice, which concerns multiple medical specialties.

### Conflict of interests

The authors declare that there is no conflict of interest.

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