Air pollution and climate change

Air pollution and climate change are both threats to population health worldwide. In the UK, we have seen how climate change is already affecting all the systems on which our health depends. The consequences range from inconvenient, such as fresh produce shortages in supermarkets, to profoundly impactful, such as excess deaths related to the unprecedented heatwaves in 2022. Even if the most ambitious reductions in greenhouse-gas emissions are achieved, which is unlikely if current trends continue, the consequences of climate change will be experienced by future generations due to the greenhouse-gas emissions that have already accumulated in the atmosphere.[1] Despite substantial progress during the past few decades towards improving air quality, including in the UK,[2] air pollution remains the largest modifiable environmental risk to public health globally.[3] In the UK, human-made air pollution is associated with the onset and exacerbation of several chronic disorders, such as cardiovascular and respiratory diseases, and leads to between 28 000 and 36 000 deaths every year.[4]

There are substantial inequalities in the effects of air pollution and climate change worldwide.[3] People in the UK who are experiencing deprivation or other forms of socioeconomic disadvantage, including minoritised-ethnic groups, are more likely to live close to sources of air pollution, such as major roads or industrial sources.[5,6] Furthermore, they have less access to green and blue spaces, which reduce exposure to air pollution and heat stress.[7] In cities, where most of the UK population now lives, urban heat-islands have a disproportionate impact on the most deprived communities. These inequalities are the basis of the deprivation gradient in morbidity and mortality related to air pollution and heat, which exacerbates the effects of other risk factors, such as inadequate access to healthy food or poor housing and working conditions.[8]

Air pollution and climate change are deeply interconnected because the chemical species that lead to a degradation in air quality are frequently co-emitted with greenhouse gases.[9] As well as the substantial risks to the population that are associated with air pollution and climate change separately, each can exacerbate the effects of the other. Drier and hotter conditions can lead to high air pollution in general, particularly high ozone, by increasing the rates of photochemical production. Future, more intense heatwaves that are caused by climate change will lead to more wildfires, which will increase emissions of harmful greenhouse gases and particulate matter (PM).

This commonality between air pollution and greenhouse-gas emissions means that interventions to address one will generally cause changes in the other.[7] Several examples show how greenhouse gases and air-pollution emissions can be addressed simultaneously. Reducing the combustion of fossil fuels (whether for energy, transport, space heating, or cooking) reduces CO_2, NOx, and PM emissions. Reducing NOx also helps to restrict the formation of secondary pollutants, such as ozone and nitrate aerosols. When this reduction is achieved by switching to active travel (ie, methods of travel that involve some human activity), there are added physical and mental health co-benefits from increased physical activity and a reduced risk of obesity.[10] Sustainable agricultural practices, particularly in livestock farming, reduce emissions of ammonia, which is an air pollutant and greenhouse gas (as are N_2O and methane). Predominantly plant-based diets not only reduce livestock emissions of greenhouse gases and air pollutants, but improve health; for example, by increasing the intake of fibre and essential nutrients and reducing the consumption of saturated fat.[10] These are examples of situations in which climate and air-quality interventions can provide benefits in air pollution and climate change.

However, not all interventions have reinforcing or universal co-benefits for air quality and climate.[7] Vehicle electrification has major benefits for CO_2 reduction and elimination of NOx from the tailpipe, but PM emissions from tyre and brake friction still occur. Interventions to reduce energy consumption in buildings can, if not carefully implemented, have unintended consequences for overheating and increasing exposure to indoor air pollution. Low-carbon energy sources (eg, combustion of biofuels, hydrogen, ammonia, and 'sustainable' aviation fuels) reduce net greenhouse-gas emissions compared with fossil fuels, but they continue to contribute to air pollution, especially PM and NOx.[7] Depending on the land-use change, cultivation of fast-growing crops for biofuels might also increase the emission of biogenic volatile organic compounds, with downwind ozone

and secondary organic-aerosol formation. Therefore, the production and use of low-carbon fuels should be carefully managed to ensure that any air-quality effects have mitigation measures in place.

Air pollution and climate change are both threats to global population health and require a response that involves intersectoral policy and action. Multidisciplinary teams that include architects, engineers, climatologists, and physical and social scientists will need to work collaboratively to devise innovative solutions that enable a clean outdoor and indoor air transition to green energy, buildings, transport, and food and that provide adaptation to the unavoidable warming that is already built into the planetary system. Public health professionals have a crucial role to play in coordinating this response and ensuring that health inequalities are one of the main focuses of all policies and interventions.

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