

Air pollution and health



Air pollution is one of the great killers of our age. Polluted air was responsible in 2015 for 6.4 million deaths worldwide: 2.8 million from household air pollution and 4.2 million from ambient air pollution.^{1,2} In the same year, tobacco caused 7 million deaths, AIDS 1.2 million, tuberculosis 1.1 million, and malaria 0.7 million.³ In the absence of aggressive control, ambient air pollution is projected by 2060 to cause between 6 million and 9 million deaths per year.⁴

Non-communicable diseases account for 70% of air pollution deaths, and air pollution is a major, insufficiently appreciated cause of non-communicable disease.^{1,2} Air pollution was responsible in 2015 for 19% of all cardiovascular deaths worldwide, 24% of ischaemic heart disease deaths, 21% of stroke deaths, and 23% of lung cancer deaths.³ Additionally, ambient air pollution appears to be an important although not yet quantified risk factor for neurodevelopmental disorders in children⁵ and neurodegenerative diseases in adults.⁶

The nature of air pollution is changing.⁷ Household air pollution has been declining worldwide since 1990 as liquefied petroleum gas and renewable sources of energy come to replace biomass—wood, straw, and dung—as fuels for household cooking and heating. Household air pollution deaths in low-income countries are therefore decreasing.¹ However, offsetting these gains are increases in ambient air pollution driven by the rapid expansion of megacities, globalisation of industrial production, proliferation of pesticides and toxic chemicals, and growing use of motor vehicles. Ambient air pollution deaths have been increasing worldwide since 1990, and increases are most substantial in the most rapidly industrialising countries.^{1,2}

Ambient air pollution is responsible for great economic losses. These losses include medical expenditures—an estimated US\$21 billion globally in 2015⁴—lost economic productivity resulting from pollution-related disease and premature death, and the cost of environmental degradation. These costs are largely invisible because they are spread across large populations over many years and destroy natural resources that too often are taken for granted. But they are so large that they can distort health system spending and sabotage the growth prospects of entire countries.

The good news is that ambient air pollution can be controlled and the diseases it causes prevented. Ambient air pollution is not the unavoidable consequence of modern economic growth.⁸ Wise leadership can decouple development from pollution and help emerging economies to leapfrog over the disasters of the past. The technical, economic, and political feasibility of pollution control is shown by the successes of countries and cities around the world in curbing ambient air pollution. Proven effective strategies include establishment and enforcement of air standards, reduction of emissions from coal-fired power plants and other stationary sources via a requirement for transition to clean fuels and ultimately to renewable energy sources, banning of use of polluting fuels in urban centers, improvement to access to public transportation, mandating of fuel efficiency standards for cars, trucks and buses, and restriction of access to private vehicles.

Urban planning initiatives that reduce sprawl and encourage walking and cycling such as new zoning laws and construction of bicycle paths, creation of pedestrian malls, and institution of bicycle rental programmes represent an additional aesthetically attractive and low-cost strategy for ambient air pollution control.⁹ An added benefit of these approaches is that they increase aerobic exercise and thus reduce risk of obesity, diabetes, and cardiovascular disease.

An unanswered question is whether or not walking or cycling in polluted cities might negate the health benefits of exercise by increasing exposure to airborne pollutants. The meticulous report in *The Lancet Public Health* by Magda Cepeda and colleagues¹⁰ provides a clear answer to this question. This systematic review compares exposure to carbon monoxide, black carbon, nitrogen dioxide, and fine and coarse particles between commuters using active and motorised transport. It also examines differences in life expectancy. On the basis of 42 studies selected from among 4037 potentially eligible reports, the authors found that car commuters had higher exposure to all pollutants than did active commuters in 30 (71%) of 42 comparisons (median ratio 1.22 [IQR 0.90–1.76]). However, active commuters had higher inhalation doses of pollutants than did commuters using motorised

Published Online
November 25, 2016
[http://dx.doi.org/10.1016/S2468-2667\(16\)30023-8](http://dx.doi.org/10.1016/S2468-2667(16)30023-8)

This online publication has been corrected. The corrected version first appeared at thelancet.com/public-health on February 6, 2017

See [Articles](#) page e23

transport because of their increased proximity to traffic, higher air exchange, and longer trip times. Most importantly, commuters using motorised transport were found to lose up to 1 year of life expectancy compared with cyclists. This conclusion provides strong and welcome evidence for the benefits of active transportation. It shows that the gains from aerobic exercise outweigh the risks.

Global elimination of ambient air pollution will require courageous leadership, substantial new resources from the international community, and sweeping societal changes.¹¹ Cities and countries will need to switch to non-polluting energy sources, encourage active commuting, enhance their transportation networks, redesign industrial processes to eliminate waste, and move away from the resource-intensive so-called take-make-use-dispose model of economic growth towards a clean, sustainable, circular economic model. These changes will not be easy. They will need to overcome strong opposition by powerful vested interests. But, fortunately, the technical, institutional, and policy tools needed to control air pollution are already at hand. They have been developed and proven effective in countries at all levels of income. They are available off the shelf and can be deployed today to gain short-term and long-term victories. The forthcoming *Lancet* Commission on pollution and health, to be published in 2017, will provide a blueprint.

Philip J Landrigan

Preventive Medicine and Global Health, Icahn School of Medicine at Mount Sinai, New York, NY 10029–6574, USA
phil.landrigan@mssm.edu

I declare no competing interests.

Copyright © The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY license.

- 1 Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016; **388**: 1659–724.
- 2 Prüss-Üstun A, Wolf J, Corvalán C, Bos R, Neira M. Preventing disease through healthy environments. A global assessment of the burden of disease from environmental risks. Geneva: World Health Organization, 2016.
- 3 Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016; **388**: 1459–544.
- 4 Organisation for Economic Co-operation and Development. The economic consequences of outdoor air pollution. Paris: Organisation for Economic Co-operation and Development Publishing, 2016.
- 5 Grandjean P, Landrigan PJ. Neurobehavioural effects of developmental toxicity. *Lancet Neurol* 2014; **13**: 330–38.
- 6 Kioumourtzoglou MA, Schwartz JD, Weiskopf MG, et al. Long-term PM2.5 exposure and neurological hospital admissions in the northeastern United States. *Environ Health Perspect* 2015; **124**: 23–29.
- 7 Smith KR, Ezzati M. How environmental health risks change with development: the epidemiologic and environmental risk transitions revisited. *Ann Rev Environ Resources* 2005; **30**: 291–333.
- 8 Arrow K, Bolin B, Costanza R, et al. Economic growth, carrying capacity, and the environment. *Science* 1995; **268**: 520–21.
- 9 Frumkin H, Frank L, Jackson R. Urban sprawl and public health: designing, planning and building for healthy communities. Washington: Island Press, 2004.
- 10 Cepeda M, Schoufour J, Freak-Poli R, et al. Levels of ambient air pollution according to mode of transport: a systematic review. *Lancet Public Health* 2016; published online Nov 25. [http://dx.doi.org/10.1016/S2468-2667\(16\)30021-4](http://dx.doi.org/10.1016/S2468-2667(16)30021-4).
- 11 Whitmee S, Haines A, Beyrer C, et al. Safeguarding human health in the Anthropocene epoch: report of the Rockefeller Foundation–Lancet Commission on planetary health. *Lancet* 2015; **386**: 1973–2028.