ADDITIONAL RESOURCES

STATE OF
GLOBAL AIR /2019

GBD METHODS

These references provide background details on the latest GBD methods used to estimate $PM_{2.5}$, ozone, and household air pollution exposures and to estimate the premature deaths and disability-adjusted life-years (DALYs) reported in the State of Global Air this year:

Cohen AJ, Brauer M, Burnett R, Anderson HR, Frostad J, Estep K, et al. 2017. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: An analysis of data from the Global Burden of Diseases Study 2015. Lancet 389:1907–1918; *https://doi.org/10.1016/S0140-6736(17)30505-6*.

Gaudel A, Cooper OR, Ancellet G, Barret B, Boynard A, Burrows JP, et al. 2018. Tropospheric Ozone Assessment Report: Present-day distribution and trends of tropospheric ozone relevant to climate and global atmospheric chemistry model evaluation. Elem Sci Anth 6(1):39; https://doi.org/10.1525/elementa.291.

GBD 2017 Risk Factors Collaborators. 2018. Global, regional, and national comparative risk assessment of 84 behavioral, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. Lancet Global Health Metrics 392:1923-1994; *https://doi.org/10.1016/S0140-6736(18)32225-6*.

Shaddick G, Thomas M, Jobling A, Brauer M, Donkelaar A, Burnett R, et al. 2017. Data integration model for air quality: A hierarchical approach to the global estimation of exposures to ambient air pollution. J R Stat Soc Ser C Appl Stat 67:231–253; *https://doi.org/10.1111/rssc.12227*.

Shaddick G, Thomas ML, Amini H, Broday DM, Cohen A, Frostad J, et al. 2018. Data integration for the assessment of population exposure to ambient air pollution for global burden of disease assessment. Environ Sci Technol 52:9069–9078; https://arxiv.org/abs/1609.00141.

Explore and download additional information and data on mortality and disease burden for air pollution, as well as other risk factors, at the IHME/GBD Compare site.

$PM_{2.5}$ AND OZONE HEALTH EFFECTS

For scientific evidence on the health effects associated with exposures to $PM_{2.5}$, ozone, and related air pollution, see the following publications:

IARC (International Agency for Research on Cancer). 2013. Air Pollution and Cancer. IARC Scientific Publication No. 161. Lyon, France:World Health Organization. Available: *www.iarc.fr/en/publications/books/sp161/AirPollutionandCancer161.pdf* [accessed 5 March 2019].

Rao X, Patel P, Puett R, Rajagopalan S. 2015. Air pollution as a risk factor for type 2 diabetes. Toxicol Sci 143:231–241; *http://doi.org/10.1093/toxsci/kfu250*.

Turner MC, Jerrett M, Pope CA 3rd, Krewski D, Gapstur SM, Diver WR, et al. 2016. Long-term ozone exposure and mortality in a large prospective study. Am J Respir Crit Care Med. 193:1134–1142; *https://doi.org/10.1164/rccm.201508-1633OC*.

U.S. EPA (United States Environmental Protection Agency). 2013. Final Report: Integrated Science Assessment (ISA) of Ozone and Related Photochemical Oxidants (Final Report, Feb 2013). EPA/600/R-10/076F, 2013. Washington, DC:U.S. Environmental Protection Agency. Available: *https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492* [accessed 5 March 2019].

U. S. EPA (United States Environmental Protection Agency). 2009. Final Report: Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2009). EPA/600/R-08/139F, 2009. Washington, DC:U.S. Environmental Protection Agency. Available: *http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=216546* [accessed 5 March 2019].

WHO (World Health Organization). 2015. Air Quality Guidelines: Global Update 2005. WHO Reg Off Eur. Available: *www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/* [accessed 5 March 2019].

HOUSEHOLD AIR POLLUTION

Chafe ZA, Brauer M, Klimont Z, Dingenen RV, Mehta S, Rao S, et al. 2014. Household cooking with solid fuels contributes to ambient $PM_{2.5}$ air pollution and the burden of disease. Environ Health Perspect 122:1314–1320; https://doi.org/10.1289/ehp.1206340.

Clark ML, Peel JL, Balakrishnan K, Breysse PN, Chillrud SN, Naeher LP, et al. 2013. Health and household air pollution from solid fuel use: The need for improved exposure assessment. Environ Health Perspect 121:1120–1128; *https://doi.org/10.1289/ehp.1206429*.

GBD 2016 Risk Factors Collaborators. 2017. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. Lancet 390:1345–1422; *https://doi.org/10.1016/S0140-6736(17)32366-8*.

GBD 2015 Risk Factors Collaborators. 2016. Global Burden of Disease Study 2015 (GBD 2015) Socio-Demographic Index (SDI) 1980–2015. Available: *http://ghdx.healthdata.org/record/global-burden-disease-study-2015-gbd-2015-socio-demographic-index-sdi-1980%E2%80%932015* [accessed 5 March 2019].

Lelieveld J, Evans JS, Fnais M, Giannadaki D, Pozzer A. 2015. The contribution of outdoor air pollution sources to premature mortality on a global scale. Nature 525:367–371; http://doi.org/10.1038/nature15371.

HEI Household Air Pollution Working Group. 2018. *Summary for Policy Makers. Household Air Pollution and Noncommunicable Disease*. Boston, MA:Health Effects Institute.

HEI Household Air Pollution Working Group .2018. *Household Air Pollution and Noncommunicable Diseases. Communication 18*. Health Effects Institute, Boston, MA.

Weagle CL, Snider G, Li C, van Donkelaar A, Philip S, Bissonnette P, et al. 2018. Global sources of fine particulate matter: Interpretation of $PM_{2.5}$ chemical composition observed by SPARTAN using a global chemical transport model. Environ Sci Technol 52:11670–11681; https://doi.org/10.1021/acs.est.8b01658.

WHO (World Health Organization). 2019. Household Air Pollution (website). Available: www.who.int/airpollution/household/en/ [accessed 19 March 2019].

WHO (World Health Organization). 2016. Burning Opportunity: Clean Household Energy for Health, Sustainable Development, and Wellbeing of Women and Children. Geneva, Switzerland:World Health Organization. Available: *http://apps.who.int/iris/bitstream/10665/204717/1/9789241565233_eng.pdf* [accessed 5 March 2019].

WHO (World Health Organization). 2014. WHO Guidelines for Indoor Air Quality: Household Fuel Combustion. Executive Summary. Geneva, Switzerland:World Health Organization. Available: *http://apps.who.int/iris/bitstream/10665/144309/1/WHO_FWC_IHE_14.01_eng.pdf?ua=1* [accessed 5 March 2019].

GBD MAPS

GBD MAPS Working Group. 2016. *Burden of Disease Attributable to Coal-Burning and Other Major Sources of Air Pollution in China*. Special Report 20. Boston, MA:Health Effects Institute.

GBD MAPS Working Group. 2016. Executive Summary. *Burden of Disease Attributable to Coal-Burning and Other Major Sources of Air Pollution in China*. Special Report 20. Boston, MA:Health Effects Institute.

Special Report 20 in Chinese: 燃煤和其他主要大气污染源所致的中国疾病负担

GBD MAPS Working Group. 2018. *Burden of Disease Attributable to Major Air Pollution Sources in India*. Special Report 21. Boston, MA:Health Effects Institute.

GBD MAPS Working Group. 2018. *Summary for Policy Makers. Burden of Disease Attributable to Major Air Pollution Sources in India*. Special Report 21. Boston, MA:Health Effects Institute.

ECONOMIC IMPACTS OF AIR POLLUTION AND DISEASE

Bommer C, Heesemann E, Sagalova, V, Manne-Goehler J, Atun R, Bärnighausen T, et al. 2017. The global economic burden of diabetes in adults aged 20–79: A cost-of-illness study. Lancet Diabetes Endocrinol 2017. 5:423-430; *https://doi.org/10.1016/S2213-8587(17)30097-9*.

Organization of Economic Cooperation and Development. 2014. The Cost of Air Pollution: Health Impacts of Road Transport. Paris:OECD Publishing. Available: *https://dx.doi.org/10.1787/9789264210448-en*.

World Bank. 2016. The Cost of Air Pollution: Strengthening the Economic Case for Action. Washington, DC:World Bank Group. Available: *http://documents.worldbank.org/curated/en/781521473177013155/The-cost-of-air-pollution-strengthening-the-economic-case-for-action* [accessed 5 March 2019].

LIFE EXPECTANCY

Apte JS, Brauer M, Cohen AJ, Ezzati M, Pope CA. 2018. Ambient $PM_{2.5}$ reduces global and regional life expectancy. Environ Sci Technol Lett 5:546–551; https://doi.org/10.1021/acs.estlett.8b00360.