

In control of ambient and household air pollution — how low should we go?



The *Lancet* Commission on Pollution and Health is a robust call to arms. Stark in its warnings, but brimming with optimism, this report emphasises that pollution is the world's largest environmental cause of poor health today, responsible for 9 million deaths a year and a large burden of non-communicable disease, including respiratory, cardiovascular, and neurological impairment.

Using data from the Global Burden of Disease study,¹ the Commission emphasises that air pollution results in a greater health burden than water, soil, or occupational exposures. Air pollution, combining both ambient and household air pollution (HAP), is responsible for 6.5 million deaths per year (with another 7 million from tobacco smoke) and this number will increase if urgent measures are not taken. The most affected people will be children and older people, especially in low-income and middle-income countries (LMIC), but particularly in cities (55% of the global population), as 98% of urban areas in developing countries do not currently meet accepted air quality standards.

The optimism in the Commission comes from three main messages. First, the solutions to air pollution are predominantly understood. There are good data from most of the world on sources of pollution and the impacts of legislation on reducing pollution's effects. WHO guidelines suggest exposure limits to protect health, including of ambient and HAP levels. Second, the solutions are cost-effective. Economic metrics such as willingness-to-pay and analyses of the long-term cost of pollution, show that pollution control does not, in fact, incur an economic cost but instead offers a sound financial investment. In regions where air pollution control has been implemented, large-scale benefits have accrued. For example, in the USA, a US\$30 benefit is estimated to have resulted from each \$1 invested in controlling air pollution. This benefit has been seen in health, productivity, and life expectancy. Third, the pathway to success is clearly laid out. Responsibility lies with governments, international agencies, and civil society (including health professionals), and there are examples of success starting with each.

The pathway to success is least clear in the LMICs of Africa and Asia, where biomass fuel use results in extraordinarily high levels of HAP in 3 billion homes daily and current technology cannot achieve the

WHO air quality limits. In the 3 years since *The Lancet Respiratory Medicine* Commission on Respiratory Risks from HAP in LMICs² was published, many new data have been generated regarding several of the key health outcomes described in the report. Despite a decreasing use of solid fuel for cooking in many LMICs, the absolute number of people exposed to HAP is expected to be constant over the next decade due to the rise in global population.³ Acute lower respiratory illness (ALRI) in young children and chronic obstructive pulmonary disease (COPD) in adults remain two of the primary drivers of HAP-related burden of disease. The observational epidemiological evidence for the associations between exposure to HAP and early childhood ALRI and COPD has been extensively reviewed and judged by several investigators to be sufficiently strong that intervention trials have been designed and conducted to reduce exposures.⁴⁻⁸

At the time of publication of *The Lancet Respiratory Medicine* Commission on Respiratory Risks from HAP in LMICs, only one randomised controlled trial (RCT) of an improved biomass fuel cookstove, designed to reduce emissions, had been published: the RESPIRE trial⁹ on early childhood ALRI in Guatemala. Subsequently, several RCTs of the efficacy of cleaner-burning biomass stoves in preventing childhood pneumonia have been done.¹⁰⁻¹³ The results of these studies have been presented at conferences, but the results of only two have been published to date.^{10,11} The outcomes of these studies are clear: there is inadequate evidence that the distribution of cleaner-burning biomass stoves alone can directly lower the risk of early childhood pneumonia. Reduction in HAP to a level safe for children remains an important goal for which there is no immediate solution.

In 2017, a pooled analysis¹⁴ of Burden of Obstructive Lung Disease (BOLD) studies from 25 sites around the world, involving over 18 500 adults and using a common questionnaire and high-quality post-bronchodilator spirometry, challenged the prevailing wisdom that HAP exposure is an important risk factor for COPD. In this study, no association between self-reported use of solid fuel for cooking or heating and airflow obstruction was found, although chronic phlegm was more likely to be reported among those exposed for ≥ 20 years. Despite the strength of the outcome data in this study,



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a limitation is the self-reported nature of HAP exposure assessment. Another BOLD analysis¹⁵ showed that national COPD mortality was more strongly associated with lung volume restriction than airway obstruction measured by spirometry, and that poverty was associated with spirometric restriction. The strong associations between poverty, pollution, and impaired lung function in the absence of the simple associations with ALRI and COPD that were previously anticipated¹ support the recommendation by *The Lancet* Commission on Pollution and Health to review the available interventions in LMICs and assess their ability to scale and their potential effects.

The *Lancet* Commission on Pollution and Health identifies improved cookstoves and cleaner fuels as important short-term and middle-term strategies to reduce HAP in the absence of definitive solutions. The Global Alliance for Clean Cookstoves, sponsored by the United Nations Foundation, has the ambitious goal of encouraging the distribution of 100 million clean cook stoves by 2020. An important gap in knowledge, however, is how much emissions need to be reduced to have substantial health effects. Recent studies can be interpreted as suggesting that there is insufficient intervention-based evidence to be certain about the answer to this question, for either early childhood ALRI or adult COPD. A four-country (Guatemala, India, Peru, Rwanda) RCT of a so-called “clean” liquid petroleum gas stove intervention is currently being done, with a primary endpoint of ALRI in children, but spirometry in adults will not be included in this study. Even if the results of this trial show a positive effect of cooking with liquid petroleum gas, large-scale distribution of this fuel is not likely to be feasible in many LMICs and renewable energy solutions would be preferable. Additionally, reducing emissions of cooking sources in isolation is unlikely to have major health effects unless this forms part of a comprehensive, affordable, and sustainable clean air strategy.

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For the Global Alliance for Clean Cookstoves see <http://cleancookstoves.org/>