## Feature Articles

June 2015

# Clean Cookstoves for Healthier Lives: Progress on a Complex Issue

***By Paula T. Whitacre***

*(Photo courtesy of Global Alliance for Clean Cookstoves)*

Cooking is a daily ritual in households around the world. For three billion people, that ritual can also endanger their health because they burn solid fuels, such as wood, charcoal, crop residue, animal dung, or coal to cook meals in poorly ventilated settings. The World Health Organization (WHO) recently revised its estimated annual mortality associated with household air pollution (HAP) from 1.9 to 4.3 million deaths. This upward revision, based largely on growing recognition of the cardiovascular impacts of particulate matter air pollution, has helped raise the issue of cookstoves and their associated health burden to a high level of priority in international development and global health policy discussions.

NIEHS has funded decades of research related to cookstoves, which has greatly contributed to our understanding of the health effects of household air pollution from cookstoves. Recent research on the health effects of cookstoves highlights the need to incorporate cooking technology interventions and a greater emphasis on behavioral considerations to ensure adoption of new technologies in economic development programs around the world.

The benefits of promoting cleaner fuels and stoves that burn more efficiently have long been understood within the research community, but there remains a need to make this a public health priority for policies and development programs worldwide. NIEHS and NIH are supporting increasing interactions between the research community and global development decision-makers to better inform and design cookstove interventions. These research translation activities are spurring new directions in cookstove intervention programs with an enhanced emphasis on public health.

These new directions include:

- Recognizing that HAP includes not only cooking emissions but also other sources, and that indoor and outdoor air quality are often linked.
- Placing greater emphasis on reducing HAP for public health reasons, as opposed to a long-standing focus on the environmental benefits of cookstove replacements.

- Recognizing that promoting cleaner fuels, not just more efficient biomass cookstoves, will help achieve public health gains.

As global policy begins to shift, informed by decades of research findings, NIH-funded researchers continue to inform new directions in intervention programs through studies to better define the problem as well as research strategies to better understand implementation and adoption of cleaner technologies.

**From “Indoor” to “Household” Air Pollution**

One shift of focus begins with defining the problem itself—from measuring levels of “indoor” air pollution created by cooking and other practices, to a broader look at the exposures caused by “household” air pollution—whether that exposure occurs indoors or outdoors.

Evidence from the Randomized Exposure Study of Pollution Indoors and Respiratory Effects (RESPIRE), a study in Guatemala led by the University of California, Berkeley on the links between indoor air pollution and acute lower respiratory infections in babies and infants, shows that the pollution caused by cooking is not limited to exposures inside the home, but also exposure outside the home in nearby areas. As a result, scientists now understand the need to measure the total effect of household air pollution by measuring indoor and outdoor air adjacent to the cookstove, not just the levels of pollution right next to the cooking device.

“Household air pollution is often a mixture of several things, including smoke from cooking, as well as emissions from heating with solid fuels, lighting with kerosene, tobacco smoke, and ambient air pollution that penetrates the home,” said Joshua Rosenthal, Ph.D., Senior Scientist in the National Institutes of Health (NIH) Fogarty International Center (FIC). “However, in many parts of the world, cooking emissions are the major concern and an exposure that many believe can be reduced to achieve enormous improvements in health around the world.”

Results from the RESPIRE studies, which are funded largely by the NIEHS, have shown that well-designed chimneys removed pollution from the cooking areas inside study participants’ homes. Although indoor pollution levels declined in the study, exposure levels were not greatly reduced and respiratory health did not greatly improve. “The term ‘indoor air pollution’ is misleading,” said Kirk Smith, Ph.D., an NIEHS grantee who is a professor at the University of California, Berkeley, and RESPIRE principal investigator. “The chimneys lowered the indoor pollution levels substantially, but they didn’t get rid of the pollution, they just moved it.”

**Health as a Priority**

Reducing pollution caused by cooking with solid fuels potentially benefits many sectors of development. For example, cleaner cooking may increase energy efficiency, reduce deforestation, reduce climate pollutants, and alleviate the labor burden on women who might spend less time gathering fuel and

cooking. “These are all important goals, but I look at the issue from a health perspective—household air pollution is the biggest single environmental health problem in the world today,” stated Smith.

“In the last two years or so, there has been an increasing push from the health community to look at emissions as they relate to health,” said Rosenthal. As described below, a focus on health has implications for technology and implementation strategies.

**From Improved to Clean Cookstoves**

This focus on health has led to a search for inexpensive, effective ways to make clean fuels more accessible to the approximately 40 percent of the global population still burning solid fuels.

“We at the NIH are currently focusing primarily on clean fuels—liquefied petroleum gas [LPG, such as propane], electricity, ethanol, and biogas—that emit very little, if any, particulate matter, which is the primary health insult,” said Rosenthal.

Smith referred to this emphasis on clean-fuel cookstoves as “making the clean available, rather than just focusing on making the available clean.” In other words, he stresses expanding the availability of clean fuels and stoves that use them, rather than just working to make improvements on solid-fuel burning stoves. “I am still working on projects using advanced biomass stoves, and I am not saying it’s impossible to lower exposures significantly,” Smith said. “But we already know what’s clean—the fuels that 60 percent of the world’s population already uses. Why not work on making the clean available as well?”

In 2014, WHO issued guidelines on household fuel combustion, which countries can use to develop their own policies. In addition to setting targets for $PM_{2.5}$ and CO emissions, the guidelines recognized that “the transition to exclusive use of very low emission devices and fuels will occur over time, with a progressive shift towards a higher proportion of energy usage provided by the newer, cleaner options.”

The recognition in the WHO guidelines of a transition over time, rather than immediately, is based on many factors. These factors include the cost and reliable availability of cleaner fuels and stoves, community norms, and individual behaviors. In some situations, such as very remote areas of where flammability of liquid fuel is a concern, improved solid-fuel burning stoves may remain the most viable option.

Smith noted that moving to clean fuels requires large-scale changes. In India, for example, he said the Ministry of Petroleum and Natural Gas plans to expand LPG access by 500 million people within 10 years. “Working with ministries of petroleum and gas involves a very different set of actors and perspectives,” he said. “But this is the kind of scale that I think is needed to see real improvements.”

**Changing Behaviors**

“Can we get people to displace the three-stone fire?” Rosenthal asks rhetorically. In addition to studying HAP and exposure levels, he said, “There is a critical research agenda around the adoption and sustained correct use of the cleanest possible cooking technology. If we can’t identify ways to do this, then research on clean cooking is likely to have little impact.”

In addition to research on exposure science and health outcomes, NIH is developing a research agenda related to implementation. For example, with money from the NIH Common Fund, FIC recently launched the Clean Cookstove Implementation Science Network to bring together researchers interested in implementation and uptake, according to Rosenthal, who is leading these efforts as chair of the network.

The Global Environmental and Occupational Health (GEOHealth) program is another trans-NIH initiative that supports a set of networked hubs for research and capacity building in low- and moderate-income countries. HAP is one of the areas covered.

Individual NIH institutes also have invested and continue to invest in research related to cookstoves. NIEHS alone has invested $9 million in cookstove research over the past eight years, including two ongoing randomized controlled trials, and also undertakes cookstove-related activities as a WHO Collaborating Centre. The overall NIH investment is likely to grow in the coming years, according to Rosenthal.

“Another realization that has come in recent years,” said Smith, “is that the most effective interventions are likely to occur at the community level, not household by household.” According to Smith, this is because the pollution spreads from house to house; thus, even if a few households use clean cookstove or fuels, they will have exposures from their neighbors who do not. “Community interventions can apply some of the behavior-change methods used in tobacco control and sanitation that rely on social pressure,” he adds.

He also noted that the argument is made that people prefer the taste of food created by solid-fuel cooking, a perception that can act as a barrier to implementing cleaner cooking technologies. However, Smith points to the need to overcome this appetite. “People may like the taste of tobacco or salt,” he said. “As a health scientist I would ask, however, are those preferences worth losing millions of lives every year? Tastes can change or be provided for in some other way.”