2018 • VOLUME 15 NUMBER 4

EcoHealth

Clean Cooking Solutions

One Health • Ecology & Health • Public Health

ISSN 1612-9202 (Print)
ISSN 1612-9210 (Electronic)
10393 • 15(4) 000-000 (2018)

Springer

EcoHealth
Volume 15 Number 4 • 2018
000–000

EcoHealth 15, 705–706, 2018
https://doi.org/10.1007/s10393-018-1377-7

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In This Issue

Clean Cooking Solutions

In countries where most people use solid fuels like wood and charcoal for cooking, switching to cleaner fuels like liquefied petroleum gas (LPG) could generate significant health and environmental benefits. **Petach *et al.*** start off the Clean Cooking Solutions Special Feature by setting the context of this important environmental health issue. The articles in this special feature summarize lessons on promoting clean fuels in developing countries, and highlight important considerations for clean cooking programs to achieve universal use of clean fuel. **Abdulai *et al.*** examine supply- and demand-side factors influencing LPG stove adoption in Northern Ghana. **Pope *et al.*** follow up, presenting the LACE census surveys, developed to understand barriers and enablers for, and local interventions to support, adoption and sustained use of LPG, and identified wood and LPG as dominant fuels in rural and peri-urban communities, respectively, with most LPG using households. **Thompson *et al.*** conducted a study of LPG stove use in peri-urban Guatemala using surveys, focus groups, participant observations and key informant interviews, identifying seven themes that relate to adopting LPG stoves.

To limit exposure and environmental degradation, the Government of Ghana promotes LPG use in rural areas via the Rural LPG Programme (RLP). **Ali *et al.*** assessed the experiences of the RLP in 2015 among 200 randomly selected respondents, finding the main barriers of LPG use were financial constraints. **Pillarisetti *et al.*** wrap up this Special Feature describing a novel sensor system that enables a Conditional Cash Transfer (CCT) to encourage clean fuel use among pregnant women in India and evaluate its performance against standard stove use monitors. The system aligns with Indian programs to improve health among the rural poor and contributes a method to encourage clean cooking.

De-Urbanization and Disease Risk

Numerous cities and countries worldwide will experience population declines in the coming decades. Resulting changes to the urban landscape, and the reservoir, vector, and pathogen populations that inhabit them, may alter zoonotic disease risk. Here, **Eskew** and **Olival** call attention to these trends and provide a research agenda for studying disease dynamics in de-urbanizing systems. Effective public health action, especially for disenfranchised urban poor, will increasingly rely on understanding zoonotic disease ecology in the de-urbanization context.

More Like, Arbo(r)virus

The recent epidemics of Zika, Chikungunya, yellow fever and dengue viruses in Brazil have moved the Brazilian Public Health service to prioritize arbovirus surveillance in wildlife and vectors. The objective of this study from **Catenacci *et al.*** was to evaluate the influence of host species, sex and age as sources of variation in arbovirus biodiversity and arbovirus period prevalence in sloths and non-human primates in the Atlantic Forest, Bahia, Brazil.

Monitoring Diseases in Wild Chimpanzees

Infectious diseases threaten the survival of wild great apes and pose zoonotic risks toward humans, but identifying causative pathogens is both time and resource consuming.

Löhrich *et al.* suggest the use of urinary neopterin, a sensitive marker of the cell-mediated immune system activation, as a non-invasive and unspecific screening tool in great ape health monitoring to identify relevant samples, individuals, and time periods for selective pathogen analysis and zoonotic risk assessment.

Hantavirus Reservoirs in Buenos Aires

In a study conducted in an urban reserve in Buenos Aires, Argentina, **Muschetto *et al.*** found the presence of Hanta ANDES Central virus in *Oligoryzomys flavescens*. They registered interannual and seasonal fluctuations in the abundance of this rodent species, with maximum values in winter and spring and minimum values in summer and autumn. This information would allow planning preventive measures with adequate time to ensure their effectiveness.

Bd Pathogen Growth

DiRenzo *et al.* conducted an experiment with *Atelopus glyphus* and *Espadarana prosoblepon* to determine whether *Atelopus* increases infection intensity in other species. Their data indicate that increases in *Batrachochytrium dendrobatidis* (*Bd*) infection intensity are driven primarily by the growth and reinfection of *Bd* on the individual and not from reinfection from outside the host.

Itchy Lakes

Rudko *et al.* applied a qPCR-based cercariometry to assess Swimmer's itch in recreational lakes. While this paper focuses on avian trematodes, causative agent of Swimmer's itch, the approaches described are applicable to numerous other environmentally transmitted parasites, such as related mammalian schistosomes that can cause Schistosomiasis in humans.

Climate and Valley Fever

It is hypothesized that the weather fosters the growth and dispersal of the soil-dwelling Coccidioides fungal species that causes Valley fever (*coccidioidomycosis*) in the western United States. This study uses regression-based analysis to model and assess the seasonal relationships between valley fever incidence and climatic variables in Kern County, California. **Weaver** and **Kolivras** find statistically significant links between disease incidence and climate conditions suggesting that antecedent precipitation is an important predictor of disease.

Rewriting the Textbooks

Völker and Pojjana investigated the determinants of whether physicians at selected hospitals in Thailand assess their patients' exposure to environmental health risk factors and provide environmental health advice. Possible remedies include revisions of the medical school curriculum, clearly presented strategies for addressing ecohealth linkages in the clinical context at the national and hospital level, and enhanced cooperation between government institutions in Thailand.

Yellow Fever Outbreak in Brazil

Figueiredo *et al.* describe the detection and molecular characterization of yellow fever virus (YFV) circulating at the beginning of the unprecedented 2017 outbreak. This data are relevant for public health audience and virologists since YFV can affect not only Brazil, but also other countries, such as those of Africa and South America.

Don't Follow the Herd

Cruz *et al.* performed a serosurvey on a representative number of sheep from central Portugal, belonging to an autochthonous breed with residual movement. Sera collected from sheep farms in 2015 and again in 2016 were tested for *C. burnetii* IgG. A steep increase in *C. burnetii* antibodies was observed demonstrating that Q fever is emerging in central Portugal.

EcoHealth 15, 713–715, 2018
https://doi.org/10.1007/s10393-018-1340-7

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Forum

Social, Ecological, and Health Benefits of Clean Cooking

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The link between pollution and health is well established and evidence increasingly highlights the importance of pollution as a risk factor for premature death. The recently published *Lancet Commission on Pollution and Health* estimates that pollution (including ambient air, household air, ozone, water, chemical, and occupational) is the cause of an estimated 9 million premature deaths globally in 2015, representing 16% of total mortality (Landrigan et al. 2017). Household air pollution (HAP) is a major contributor to pollution-related mortality in low- and middle-income countries (LMICs) and is attributed to 2.6 million premature deaths and 40% of child under-5 deaths due to lower respiratory infections, according to the IHME global burden of disease 2016 estimates (Gakidou et al. 2017).

Since cooking and heating with biomass fuels such as wood, dung, charcoal, and crop residues is the main source of HAP in LMICs, the *Lancet Commission* suggests tackling HAP by expanding access to clean fuels and stoves and monitoring the effects of these efforts on air quality and health (Landrigan et al. 2017). The WHO indoor air quality guidelines also encourage governments and development partners to improve access to clean household energy among poor households (Bruce et al. 2015). Transition to clean cooking will not only facilitate the realization of health improvements, but can also promote ecological benefits (e.g., mitigating deforestation and reducing greenhouse gas and black carbon emissions). Adoption and sustained use of less-polluting energy sources could also increase economic productivity and enhance social well-being (Landrigan et al. 2017).

The complete transition to clean cooking, however, has been elusive in most LMICs. Some countries have focused on promoting improved biomass-burning stoves in the interim, but to date "improved" biomass stoves have not improved household air quality levels to the WHO targets necessary for health benefits (Bruce et al. 2015). Cookstoves defined as Tier 4 or above for indoor emissions according to the International Organization for Standardization International Workshop Agreement (ISO IWA) could lead to significant health improvements (Still et al. 2015), but only with high uptake and sustained use that displaces other polluting stoves and fuels.

The determinants of adoption and uptake of improved biomass cookstoves have been investigated and were compiled in a special issue of the *Journal of Health Communication* (Barnes et al. 2015). When these studies were carried out, there were few opportunities to evaluate the uptake and sustained use of truly clean cooking technologies in LMICs, and most studies focused on improved biomass-burning stoves that did not meet the criteria for being clean enough to provide health benefits (ISO IWA Tier 4 for indoor emissions). These studies found that the

Note: The contents are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

Published online: August 6, 2018

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adoption and use of improved biomass stoves by the population were very low, largely due to factors including: cooking traditions, food taste, decision-making in the household, cost, availability of maintenance support, fuel preparation requirements, characteristics of the stove, and many others (Barnes et al. 2015; Rehfuess et al. 2014). One resounding theme across previous assessments is that low adoption and use of the improved technology coupled with continued use of polluting stoves limits the ability of the new cooking system to realize its potential benefits. In other words, the benefits of time savings from faster cooking, money savings from increased fuel efficiency, improved cleanliness from lower smoke emissions, as well as longer-term improved air quality and health outcomes will not be realized if the new technology is not adopted in tandem with abandonment of the old polluting technology.

Recent programs have shifted to focus on clean fuels, promoting cooking with liquefied petroleum gas (LPG), biogas, electricity, ethanol, as well as biomass pellets used in clean-burning stoves. However, demonstrating the effective scale-up of this new paradigm, where the transition is not just to an improved cookstove, but instead to clean fuel, is also likely challenged by slow uptake, albeit for different reasons.

Recent studies indicate that the transition to clean cooking requires ensuring the availability and affordability of clean fuels (Puzzolo et al. 2016). Households may be unwilling to completely transition to a new fuel if there is uncertainty about whether they will be able to consistently access and afford that fuel in the market. Given that clean fuels often come at a much higher cost than biomass fuels, which are often collected freely, ensuring that fuels in the market are affordable based on average incomes and what people currently pay for biomass fuel must also be considered. Thus, transition efforts are increasingly focusing on expanding markets for affordable clean fuels, in addition to household-level interventions to promote and facilitate adoption.

Stove stacking, the concurrent use of both clean cooking technologies and traditional stoves, has been observed extensively. It is important to recognize that the transition to clean cooking will inevitably include some mixing between clean cooking and cooking with stoves or fuels that do not meet the standards of clean. For example, some households may use a biomass stove occasionally for a festival or celebration, to prepare a special traditional dish, or in certain moments while they are waiting for a repair or refill for their clean stove. Though the ultimate goal is to ensure that households have multiple clean technologies that they can use to meet all of their cooking needs, some residual use of traditional stoves and/or unprocessed biomass fuels in the interim should be expected. A small amount of mixed fuel use can still be considered a success from a public health perspective, as modeling estimates suggest that a household can use an open fire for up to 4 h per month and still meet WHO indoor air quality targets (Johnson and Chiang 2015).

Understanding the social and ecological determinants of cooking behaviors is key for developing products and programs that meet peoples' diverse cooking needs, marketing products in a way that will persuade investment, and developing policies that support a strong clean fuels and technologies market. The research presented in this special feature, "Accelerating Uptake and Sustained Use of Clean Cooking Solutions through Social and Ecological Approaches: Innovative Programs and Policies for Increasing Adoption" reviews efforts in sub-Saharan Africa, Asia, and South America to scale up adoption of a range of clean fuels, including LPG and processed biomass pellets. Results presented aim to advance our understanding of the determinants that influence uptake and use of clean cooking fuels and technologies, as well as the effectiveness of potential strategies for achieving universal adoption of clean cooking to promote a range of health, environment, and social benefits.

Acknowledgements

The authors would like to acknowledge the support of Joshua Rosenthal of the National Institutes of Health (NIH) Implementation Science Network (ISN), who collaborated on the framing and conceptualization of the special feature. This work was made possible by the support of the American People through the United States Agency for International Development (USAID) and by the Global Alliance for Clean Cookstoves. The contents of this manuscript are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government. The work was part of Translating Research into Action, TRAction, funded by USAID under cooperative Agreement No. GHS-A-00-09-00015-00. The project team included prime recipient, University Research Co., LLC (URC), Harvard University School of Public Health (HSPH), and sub-recipient research organizations. This work was also supported by the Global Alliance for

Clean Cookstoves, a public–private partnership hosted by the United Nations Foundation.

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EcoHealth 15, 875, 2018
https://doi.org/10.1007/s10393-018-1376-8

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What's New

UN Biodiversity Summit 2018

The 14th meeting of the CBD Conference of the Parties to the Convention on Biological Diversity (CBD), the 9th Meeting of the Parties to the Cartagena Protocol on Biosafety and the 3rd Meeting of the Parties to the Nagoya Protocol on Access and Benefit-sharing (CBD COP 14, Cartagena Protocol COP/MOP 9, and Nagoya Protocol COP/MOP 3) are expected to address a series of issues related to implementation of the Convention and its Protocols.

November 14–29, 2018, Sharm el-Sheikh, Egypt
https://www.cbd.int/conferences/2018

G-STIC 2018

Global Sustainable Technology and Innovation Conferences (G-STIC) is a series of conferences that aim to accelerate the development, dissemination and deployment of technological innovations that enable the achievement of the Sustainable Development Goals (SDGs). G-STIC is focused on building knowledge bases and global expert networks to support the technological transitions that are needed for the implementation of the Paris Agreement and the 2030 Agenda for sustainable development.

November 28–30, 2018, Brussels, Belgium
https://2018.gstic.org

Albert Einstein School of Medicine One Health Conference

One Health recognizes that the health of people is connected to the health of animals and the environment. It is an approach to designing and executing programs and research in which a number of sectors communicate and work together to achieve better public health outcomes.

December 3–4, 2018, Bronx, New York
https://www.einstein.yu.edu/centers/global-health/events/one-health-approach.aspx

American Geophysical Union Fall Meeting 2018

The AGU 2018 Fall Meeting will mark another dynamic year of discovery in Earth and space science, serve as the advent of AGU's Centennial year, and provide a special opportunity to share science with world leaders in Washington, D.C. As the largest Earth and space science gathering in the world, the Fall Meeting places you in the center of a global community of scientists drawn from myriad fields of study whose work protects the health and welfare of people worldwide, spurs innovation, and informs decisions that are critical to the sustainability of the Earth.

December 10–14, 2018, Washington D.C., USA
https://fallmeeting.agu.org/2018/

CUGH Conference

CUGH's annual conference is a must-attend event on the global health calendar. Over 1800 scientists, students and implementers from academia, NGOs, Government and the private sector will present, learn and collaborate to address some of the pressing challenges the world faces.

March 8–10, 2019, Chicago, USA
https://www.cugh2019.org

Published online: October 11, 2018

EcoHealth 15, 876–877, 2018
https://doi.org/10.1007/s10393-018-1381-y

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Cover Essay

Fueling Clean Household Environments

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The World Health Organization (WHO) defines household air pollution (HAP) as air pollution generated by household fuel combustion, leading to indoor air pollution and contributing to ambient air pollution (WHO 2014). From the first study some 30 years ago, which reported rural Indian women's personal exposure measurements to particulate matter from using biomass cookstoves to the hundreds of studies that now present HAP exposure measurements, these have collectively and unequivocally shown air pollution levels in homes that burn solid fuels to be unacceptably high, exposing women, men and children to pollutant concentrations well in excess of WHO air quality guidelines. The health burden attributable to HAP is massive, with WHO estimating 2.6–3.8 million premature deaths resulting from child pneumonia, ischemic heart disease, stroke, chronic obstructive lung disease and lung cancer, mostly among the rural poor of low- and middle-income countries (LMICs). The list of diseases impacted by HAP continues to expand, including early data for diabetes and cognitive effects, and now includes nearly every health end point shown to be previously associated with active and passive tobacco smoking.

While images of poor rural women engulfed in a plume of smoke from their cookstoves as they prepare the everyday family meal abound in scientific and development literature, the artwork presented in the cover is unique in several ways. It serves as a poignant reminder for the global scientific community to rally around a health issue that continues to be an everyday reality for 3 billion people in low- and middle-income countries. It addresses the complexity of the 'seemingly simple' task of making a meal for a family. While their urban counterparts have multiple clean and convenient technologies to choose from, rural women are challenged by more than just air pollution as they juggle the numerous cooking-related tasks on inefficient cookstoves. The sheer physical hardship of preparing the meal is unmistakable, yet the meal is what makes her house a home!

While evidence on the impacts of solid fuel use has been available for nearly two decades, the scientific understanding of how to ameliorate the situation has undergone a sea change in the last decade. In 2015, Dr. Kirk R. Smith provided an eloquent description of new paradigms for accelerating the transition to cleaner cooking (Smith 2015). Much scientific evidence has accumulated to lend additional credence to the proposed paradigms, which emphasize the cleanest possible fuels. Clean fuels (e.g., liquified petroleum gas or LPG) are the only technologies that will enable households to meet WHO air quality guidelines. Virtually, every survey that has assessed user perceptions for fuel choices, across more than a dozen countries, reports a strong preference for LPG over biomass fuel. Although multiple reasons are cited as barriers for sustained adoption of clean fuels, economic barriers that preclude use of clean fuels remain the overwhelming reason behind inadequate levels of use among poor communities.

The artwork provides a beautiful imagery of igniting the flame on a clean stove that perhaps symbolizes the

Published online: October 11, 2018

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innate desire of every poor household to dispel the darkness of poverty. Access to LPG can open the door for the poor to fulfill their aspirational goals for their own household. While access to clean fuels is not sufficient to reduce HAP exposures, it is a necessary first step on the journey to a complete transition to clean household energy, along a trajectory of reduced exposures (as shown by the graph on the cover). Indeed, the impact of clean fuels on time savings (resulting from elimination or reduction in time for fuel collection as well as faster cooking), cleaner kitchens, improved air quality and health symptoms are perceived almost instantaneously wherever LPG has been introduced at the community or programmatic levels (across countries of South Asia, Africa or South America). This is in sharp contrast to the 'poor' or at best 'mixed' feedback obtained from numerous 'improved biomass cookstove' studies from the same countries that have reported limited use and insignificant health relevant reductions in HAP exposures. Indeed, the astounding success of the massive roll out of the LPG program in India (termed the Pradhan Mantri Ujjwala Yojana) that seeks to provide free 'connections' (a term that denotes improved access to an LPG distribution network) to 80 million households by 2019 bears testimony for overwhelming community preference for clean fuels.

The newest scientific evidence gathered from personal exposure and rural ambient monitoring studies and assessment of contributions from residential solid fuel use to ambient concentrations, however, point to the need to do more than just increase access. Without a critical mass of households that transition completely, no one stands to gain on health. Indeed, the WHO definition of household air pollution and the accompanying air quality guidelines provide an overarching framework for designing and implementing HAP interventions. The guidelines do not differentiate between indoor vs outdoor or rural vs urban environments for attainment of recommended standards of air quality. It has now become clear that it will be virtually impossible to meet the ambient air quality guidelines in communities or countries with significant solid fuel use without the complete transition to clean fuels. The scientific foresight used in formulating the guidelines is now backed by an emerging and expanding pool of evidence.

There is now a remarkable confluence of favorable circumstances to push the case for clean fuels in LMICs. Quantitative evidence on HAP exposure reductions, associated with LPG use and user preferences for LPG as a clean fuel choice, is now available from numerous LMICs. The pool of evidence on health effects draws heavily on the literature from LMICs despite the relative paucity of long-term mortality studies. Programmatic infrastructure to supply and sustain LPG use is in place in many LMICs, most notably in populous countries such as India. Emissions from residential cooking are identified as a major contributor to the burden of disease attributable to both ambient and household air pollution. Ongoing and newly launched randomized control trials (that include exposure–response analyses) are expected to provide considerable additional evidence for health outcomes for vulnerable groups (including pregnant women and infants). Several insights for implementation of LPG programs are also expected to be gleaned from these studies. Meanwhile, much can be gained now, by pushing the clean cooking agenda within the health, energy and environment sectors. More importantly, much health would be lost for the rural poor if imminent actions are not facilitated at national, regional and global levels.

Fueling clean household environments is within our reach. The art on the cover and collection of articles in the issue can be yet another vehicle to bring concerted actions for the health of our women, men and children at risk from HAP exposures.

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