Commentary
Kerosene-based lighting: an overlooked source of exposure to household air pollution?

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Access to affordable, reliable, modern and sustainable energy is one of the seventeen Sustainable Development Goals (SDG) set by the United Nations for 2030. However, estimates indicate that progress towards that goal is not on track: 650 million people worldwide are estimated to remain without access to electricity in 2030 (IEA, IRENA, UNSD, WB, WHO, 2019). Nine out of ten of these people will live in Sub-Saharan Africa (SSA), mostly in rural communities, which face barriers in terms of affordability and supply.

Without access to affordable and reliable clean energy to meet daily cooking, lighting, and heating needs, individuals rely on inefficient fuels and technologies that give rise to household air pollution (HAP). Although HAP can arise from several indoor sources, cooking fuels have received most of the attention with respect to global initiatives (e.g. the Global Alliance for Clean Cookstoves supported by the United Nations, https://www.cleancookingalliance.org/) and research-based interventions focused on the health benefits of improved or cleaner cookstoves. Examples of major cookstove interventions conducted in SSA include the Cooking and Pneumonia Study in rural Malawi (Mortimer et al., 2017) and the Rwanda site within the multi-country HAPIN trial of liquefied petroleum gas (Clasen et al., 2020). However, kerosene-based lighting remains a prevalent source of HAP in SSA; estimates indicate that it is used by more than half of households without a connection to the electrical grid (Bensch et al., 2017), particularly in East African countries.

Kerosene lamp emissions contain many health-damaging pollutants (Lam et al., 2012). Use of kerosene lamps has been linked with increased risk of infectious diseases, including tuberculosis (Pokhrel et al., 2010) and acute respiratory infection in children (Barron and Torero, 2017) as well as other safety hazards (e.g. burns, poisonings). Beyond concerns for human health, kerosene lamps are also of concern for their climate impacts. Kerosene lamps have been estimated to emit an average of 25 g of climate warming black carbon per kg of fuel burned (Pfotenhauer et al., 2019).

While HAP exposure from biomass-fuelled cookstoves is an obvious health concern, several aspects of kerosene-based lighting warrant more attention than it has so far received. Portable kerosene lamps tend to be kept very near to users for prolonged periods, resulting in high levels of inhaled pollutants (i.e. more mass inhaled per mass emitted). An experimental study in Kenya estimated that night kiosk vendors can inhale 1560 µg of fine particles per day emitted by kerosene lamps alone (Apple et al., 2010). Relatively few studies have attempted to quantify the contribution of kerosene-based lighting to particle exposure in populations in SSA. We previously reported that kerosene-based lighting was the strongest determinant of 24-h average and peak personal exposure to black carbon among women living in a semi-rural area of Mozambique (Curto et al., 2019). Women who used kerosene as the primary source of lighting had 81% and 93% higher average and peak personal black carbon exposure, respectively, than those using electricity.

Fuel-based lighting is also a potentially attractive target for HAP interventions. First, it has a high exposure reduction potential. Lam and colleagues provided three pico-solar lamps to non-electrified households mainly using kerosene lamps, and three-four weeks later, the 48-h personal exposure to fine particles in adults and school children living in the household was reduced by 52-73% (Lam et al., 2018). Second, in contrast with cookstove interventions, lighting interventions may be more feasible to implement and to have fewer socio-cultural barriers to adoption and sustained use. For example, solar-powered technology such as pico-solar lamps are easily distributed and have had high social acceptability in rural communities mainly because they are convenient, provide brighter light than kerosene, and are linked to cost savings, as they reduce or eliminate expenditure on kerosene. Although the main purpose of pico-solar products is the provision of light, some models of pico-solar lamps include a USB port for mobile phone charging, which incentivizes uptake among off-grid households who can avoid mobile phone charging fees.

The transition from fuel-based lighting to clean technologies is already under way in much of SSA, largely driven by economic development. Although the extent of penetration of clean lighting technology remains uncertain mostly due to population growth and barriers to market consolidation (Lighting Global, WB, GOGLA, ESMAP, 2020). Nonetheless, there is important scope for policies and programs for accelerating this transition, which would likely lead to important health and environmental benefits. For example, shifting subsidies from kerosene fuel to pico and household solar products should be prioritized.

There is a clear need for better quantification of the exposure reduction potential and potential health benefits that could be expected from this transition. High quality research studies on this topic would be of great value to develop evidence to inform effective strategies to accelerate adoption of clean lighting technology and remove barriers. Such evidence can support progress to meeting the SDG goals and to create more healthy, sustainable, and climate-resilient communities.

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