Environment International 143 (2020) 105991

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Review article

Solid fuel users' perceptions of household solid fuel use in low- and middle-income countries: A scoping review

Amy McCarron[a,*], Isabelle Uny[b], Line Caes[c], Siân E. Lucas[d], Sean Semple[b], Jane Ardrey[e], Heather Price[a]

[a] Biological and Environmental Sciences, Faculty of Natural Science, University of Stirling, Stirling FK9 4LA, UK
[b] Institute for Social Marketing, Faculty of Health Sciences and Sport, University of Stirling, Stirling FK9 4LA, UK
[c] Psychology, Faculty of Natural Sciences, University of Stirling, Stirling FK9 4LA, UK
[d] Social Work, Faculty of Social Sciences, University of Stirling, Stirling FK9 4LA, UK
[e] Liverpool School of Tropical Medicine, Department of Clinical Sciences, Pembroke Place, Liverpool L3 5QA, UK

ARTICLE INFO

Handling Editor: Hanna Boogaard

Keywords:
Household Air Pollution
Perceptions
LMIC
Solid Fuel
Improved Cookstoves
Scoping Review

ABSTRACT

Almost half of the global population is exposed to household air pollution (HAP) from the burning of biomass fuels primarily for cooking, and this has been linked with considerable mortality and morbidity. While alternative cooking technologies exist, sustained adoption of these is piecemeal, indicating that there is insufficient knowledge of understandings of HAP within target communities. To identify potential gaps in the literature, a scoping review was conducted focused on solid fuel users' perceptions of HAP and solid fuel use in low- and middle-income countries. From the initial 14,877 search returns, 56 were included for final analysis. An international multi-disciplinary workshop was convened to develop the research question; six key domains: health; family and community life; home, space, place and roles; cooking and cultural practices, environment; and policy and practice development, were also identified using a Social Ecological Model framework. The review showed a series of disconnects across the domains which highlighted the limited research on perceptions of HAP in the literature. Reviewed studies showed that participants emphasized short-term health impacts of HAP as opposed to longer-term health benefits of interventions and prioritized household security over improved ventilation. There was also a socio-demographic gendered disconnect as although women and children generally have most exposure to HAP, their decision-making power about use of solid fuels is often limited. In the domain of policy and practice, the review identified the importance of community norms and cultural traditions (including taste). Research in this domain, and within the environment domain is however limited and merits further attention. We suggest that interventions need to be locally situated and community-led and a deeper understanding of perceptions of HAP could be obtained using participatory and innovative research methods. Bridging the disconnects and gaps identified in this review is essential if the global disease burden associated with HAP is to be reduced.

1. Introduction

Approximately 3 billion people worldwide rely on solid fuels such as wood, charcoal, animal dung and crop residues to cook, heat and/or light their homes (WHO, 2014). Household air pollution (HAP), that is pollution of the indoor air caused by the incomplete combustion of the solid fuels in the domestic setting, results in an estimated 4 million premature deaths every year from diseases including pneumonia, stroke, ischemic heart disease, chronic obstructive pulmonary disease (COPD) and lung cancer (WHO, 2019). In terms of global health burden, HAP leads to mortality broadly equivalent to a lack of malaria control and is one of the primary environmental health risks (WHO, 2014).

Most of the exposure and consequent disease burden associated with HAP occurs in low- and middle-income country (LMIC) settings (Stanaway et al., 2018), where the use of solid fuel is strongly associated with poverty (e.g. Bonjour et al., 2013). The 'energy ladder', though much critiqued (e.g. Alfaro and Jones, 2018), highlights an idealized progression from solid fuels to cleaner fuels like LPG (liquefied petroleum gas), natural gas and electricity with increasing wealth (Smith, 1987). Ascending the energy ladder, however, is primarily driven by income levels, often with the poorest unable to reach the

* Corresponding author.
E-mail address: amy.mccarron@stir.ac.uk (A. McCarron).

https://doi.org/10.1016/j.envint.2020.105991
Received 3 March 2020; Received in revised form 14 July 2020; Accepted 16 July 2020

'bottom rung' of the ladder with no access to alternatives to reduce their exposure and no opportunity to ascend the ladder. There is also a significant gender dimension to use of solid fuels in LMICs. For example, recent measurements of exposure to HAP from burning solid fuels in households in Uganda and Ethiopia show that women and young girls experience daily concentrations of HAP that are typically seven times higher than men and young boys (Okello et al., 2018). This is reflected in much of the epidemiological evidence reported from HAP studies where women are at greater risk of COPD, lung cancer and eye cataracts (Kurmi et al., 2012).

Many intervention studies have attempted to move people up the energy ladder either by using 'improved' cookstoves (ICS) that still use solid fuels but aim to reduce HAP production during cooking (Alexander et al., 2015) or by moving people to more modern fuels (i.e. electricity or LPG) (Quinn et al., 2019). These approaches place insufficient emphasis on gaining an understanding of the historical, cultural and behavioral complexities that underpin solid fuel use, thereby failing to create sustainable changes that improve people's health. Indeed, despite over 80 million ICS having been distributed since 2010 (GACC, 2017), their sustained use remains a challenge (Das et al., 2018). The urgent need for sustainable solutions facilitating the adoption of cleaner cooking practices has been highlighted by the WHO, who report that without a substantial change in policy, the number of people lacking access to cleaner fuels and technologies will remain static by 2030 (IEA, 2017). Such policy changes and design of sustainable solutions should have individuals at its core and be led by an in-depth understanding of the socio-cultural context of solid fuel usage for cooking, including the influence of non-cooking factors (Gould and Urpelainen, 2018), which can only really be understood when perceptions are considered at the core of solutions.

For instance, introducing new cooking practices needs to respect the cooking-culture relationship, which is particularly relevant in LMICs, with many social and religious occasions being marked by festive meals prepared in traditional ways (Quintero-Angel et al., 2019). Furthermore, beyond the high costs limiting the take-up of clean cooking alternatives, such as ICS, Dickinson et al. (2018) also highlighted the need to recognize the importance of peers in the ICS decision-making process. The role of community leaders in influencing change is an important one. Miller and Mobarak (2013) found that the role of "opinion leaders" were important in the adoption of ICS, however peer-to-peer, or social learning had a negative impact on ICS adoption. Enclosed within this socio-cultural context, but often overlooked, is the importance of understanding individuals' views and opinions towards traditional and alternative cooking practices and associated potential impact on their health.

Whilst academics can deliberate policy, any change has to come from individual users. Consequently, interventions which aim to target individuals or communities must first have an understanding of the perceptions of both exposure to HAP and the associated health risk (Egondi et al., 2013). Many studies have assessed exposures to HAP and evaluated implementation of ICS, yet few have considered behavior change as a fundamental component of the success of such interventions (Barnes et al., 2015; Goodwin et al., 2015). Perceptions on the risk of HAP play a critical role in behavior change, with limited awareness or concerns about the negative health-related impact of HAP representing one of the many barriers to sustainable behavioral change to the uptake of less harmful cooking practices (Jewitt et al., 2020). These findings indicate that without an understanding of users' experiences, views, and motivations for change (or lack of), policy and practice have little chance of success.

In summary, while there is considerable evidence that exposure to HAP resulting from domestic solid fuel use is linked to poor respiratory (Tamire et al., 2020) and cardiovascular health (Yang et al., 2018), significantly less research has examined perceptions in LMIC communities in relation specifically to solid fuel use and collection, and how this influences HAP. The aim of this paper is to explore and summarize knowledge of solid fuel users' perceptions of solid fuel use and collection for cooking, heating and lighting in LMICs. To achieve this, this paper reviews evidence from the scientific literature across a variety of domains and disciplines that looks at perceptions of solid fuel use in terms of:

- Health
- Family and community life
- Home, space, place and roles
- Cooking and cultural practices
- Environment
- Practice and policy development.

2. Methods

To explore solid fuel users' perceptions of solid fuel use for cooking, heating and lighting in LMICs, a scoping review was undertaken. A scoping review provides an overview of a vast topic (Moher et al., 2015) and is a suitable approach for exploring a body of literature and to identify knowledge gaps (Munn et al., 2018). Arksey and O'Malley's (2005) influential work on the 5-step scoping review framework was the basis for the protocol for conducting this scoping review:

2.1. Identifying the scope of the review

Owing to the potentially vast number of research questions that could arise from the chosen topic of solid fuel usage, a workshop (conducted at The University of Stirling on 4th December 2018) was used to develop the research question and key domains (Table 1). The workshop was comprised of academics from and working in the UK, South Africa and Malawi from multiple disciplines including geography, psychology, maternal health, lung health, environmental health, social work and housing to allow us to develop a well-considered research question from a more global perspective. In the final selection of the key domains, the information and opinions gathered in the workshop were considered within the Social Ecological Model (UNICEF, 2016), which suggests that people's perceptions, behaviors and experiences are shaped by the interaction of individuals with their community, environments, interpersonal relationships, and policy and political environments (Fig. 1).

Table 1
Research question and key domains identified from workshop.

Research question	
What are solid fuel users' perceptions of solid fuel collection and solid fuel use in the home?	With respect to: • Health • Family and community life • Home, space, place and roles • Cooking and cultural practices • Environment • Practice and policy development

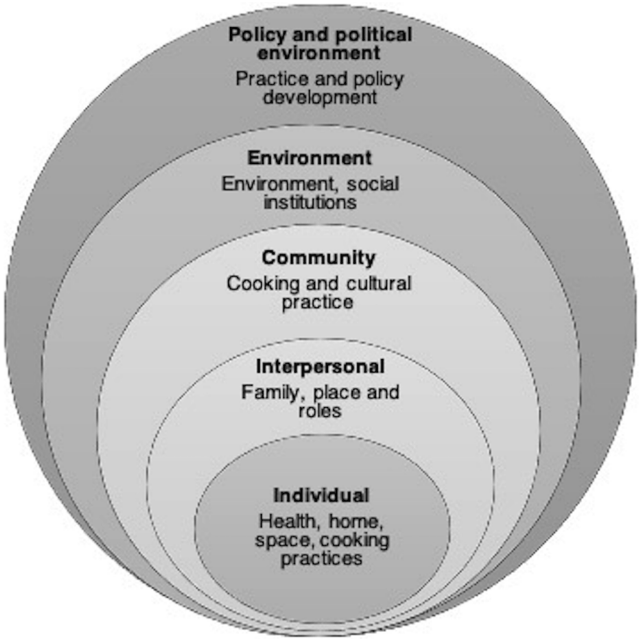

Fig. 1. The key domains of interest developed using the Social Ecological Model theory-based framework to explore the study's research question from individual-level (inner oval) to societal (outer oval) (Sallis et al., 2008).

2.2. Identifying relevant studies: Eligibility criteria, information sources and searching

Five key databases from multiple disciplines were electronically searched (CINAHL, JSTOR, ScienceDirect, PubMed and Web of Science (Core Collection)) using the search terms detailed in Table 2.

Filtering methods included the publication date range from 2000 to 21st March 2019, published in the English-language only, including those papers where the subject country was LMIC-only (for this purpose defined as those receiving Official Development Assistance (ODA)), and excluding grey-literature. The focus on articles published after 2000 was linked to the start of the Millennium Development Goals (MDGs) (United Nations, 2000). Limiting the scope of the analysis by focusing only on articles published in English may mean that some potentially relevant papers have not been included here but was necessary from a time and resources perspective. Whilst the value of grey literature has been recognized (Rothstein and Hopewell, 2009), due to a lack of methodological guidance on the inclusion of grey literature for scoping studies (Adams et al., 2017), this was excluded from the search. Articles were only included if they referred to (although did not have to be the main focus) on solid fuel users' perceptions of fuel use in the domestic setting. Articles which only explored perceptions of non-domestic users (e.g. traders, construction workers) were excluded.

Table 2
Search terms and Boolean operators used in electronic **database searching,**

Relating to *experience/ perceptions*	"AND"	Relating to *air quality*	"NOT"	Relating to *smoking*
Perceptions OR		"Household air pollution" **OR**		"Tobacco" **OR**
Perspective OR		"Indoor air pollution" **OR**		"Smoking"
Belief OR		"Solid fuel"		
"Lived experience" OR				
Experience OR				
Voice OR				
Attitude OR				
Living				

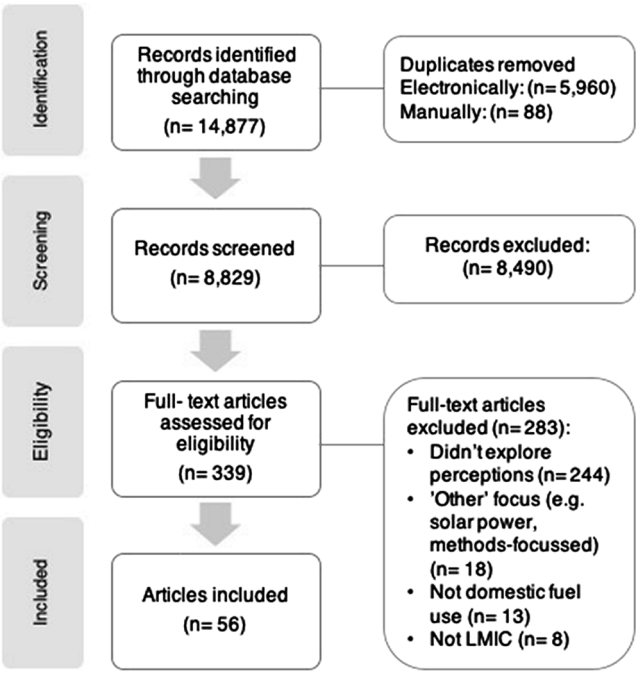

Fig. 2. Flow diagram depicting process of article selection.

2.3. Study selection

The initial search returned 14,877 articles, of which many were duplicates, which highlighted the thoroughness of the search approach. Level 1 screening (title and abstracts) was used to exclude articles that did not address the study's research question. Level 2 screening (full-text) was completed by five reviewers independently (AM, LC, HP, SL, IU) following discussion and agreement of the inclusion/exclusion eligibility criteria (outlined in Section 2.2). Each article was checked for fit with the domains outlined in Table 1. To ensure consistency of the selection across all reviewers, AM double checked all the level 2 screening decisions. For a detailed overview of the article selection see Fig. 2.

2.4. Data extraction

After level 1 and 2 screening, the full-text study characteristics were tabulated and data extracted into a spreadsheet, organized by domain (Table 1) for included studies. Descriptive characteristics of the included studies, as well as micro-data (specifically that which detailed perceptions or experiences in each key domain), were tabulated. The purpose of this exercise was not to review the included articles, but instead to determine which data to extract based upon the agreed criteria. The primary aim was to determine whether studies directly explored solid fuel users' perceptions, followed then by ensuring each study related to at least one of the six domains of the overarching research question. As the focus of this review was not to explore perceptions on all potential issues around solid fuel use and collection, but rather to scope the genuine perceptions identified by those using solid fuels in LMICs, not all domains were equally populated. Data extraction was undertaken by one reviewer (AM) and double-checked independently by a second reviewer (SL) to ensure all relevant data were extracted and organized within the correct domain.

2.5. Data analysis

The data were analyzed by four team members (HP, IU, AM, LC), each analyzing the domain most closely related to their own area of expertise (e.g. health, environment). We used a broad thematic analysis

to develop the main themes from each domain. Subsequently, the four researchers came together to discuss the themes and key findings across all and within each domain.

3. Results

Our initial search yielded a total of 14,877 articles, which was reduced to 8917 after duplicates were removed electronically (Fig. 2). A further 88 duplicates were removed manually having not been detected electronically using Endnote. Level 1 title and abstract screening excluded 8,490 articles based upon factors including the study area being non-LMIC or studies which did not explore participants' experiences and/or perceptions. The remaining 339 articles were full-text screened for eligibility. Of these, 283 articles were excluded because they did not meet the requirements of the study (i.e. they did not focus on perceptions or they did not explore one of the outlined domains (Fig. 1; Fig. 2)). This left 56 articles that met all study criteria and were included in the analysis.

The majority of the 56 included articles were focused on evaluating the impact of interventions such as the introduction of improved cookstoves (ICS)- which, in general, burn less solid fuels thus reduce HAP production when used correctly- or interventions introducing new stoves that use more modern fuels, e.g. electricity or LPG. Although interventions were not deliberately scoped in this review, solid fuel perceptions are not frequently considered without mention of interventions, such as the introduction of ICS (see Appendix). Questionnaires and interviews were the methods most frequently used by researchers to explore perceptions (Table 3), with observations and focus groups also used. Of the six outlined domains (Fig. 1), health and cooking & cultural practice were particularly well documented in the literature, with more than half of all included articles referring to these (Table 3). Perceptions of solid fuel use and collection were studied across 26 different countries in the included articles, of which were most frequently undertaken in India, Bangladesh, Mexico and Kenya (Fig. 3).

The findings of the scoping review are outlined below in relation to the six domains (health; family and community life; home, space, place and roles; cooking and cultural practices; environment; and practice and policy development; Fig. 1).

Table 3
Summary of included article characteristics.

Characteristic		Number of studies (Total = 56)*
Geographic location	Africa	37
	Asia	69
	North America (Mexico and Guatemala)	21
	South America	4
Methods/procedures	Interviews	23
	Focus Group Discussions	11
	Questionnaires	27
	Observations	10
	Willingness to pay surveys^	3
	Reviews	5
	Case Studies	2
Domain	Health	37
	Family & community life	19
	Home, space, place & roles	22
	Cooking & cultural practices	35
	Environment	2
	Practice & policy development	6

*Some articles investigated more than one study area, deployed several qualitative methodologies, and covered various domains hence counts are greater than 56. ^revealing qualitative choice behaviors. In total, 26 different countries spanning 4 continents were studied in included articles and 7 papers explored perceptions in more than one country.

Fig. 3. Word cloud showing the relative frequency of countries studied of included articles. The size of each term is proportionate to its frequency, with India gaining the most research attention of included articles.

3.1. Health

Studies exploring perceptions of long-term health impacts related to solid fuel collection (e.g. lower back pain (Borah, 2015), cancer and COPD (Firdaus and Ahmad, 2011), were rarer than studies that focused on short-term health impacts. The use of solid fuels for cooking was associated with household smoke and was considered to impact comfort as well as being linked to a range of health symptoms (e.g. Akolgo et al., 2018; Devakumar et al., 2018; Troncoso et al., 2007). The symptoms most often reported and linked to HAP exposure included respiratory difficulties, runny eyes, runny nose, throat irritation, coughing, breathing difficulties, wheezing, chest pains, dizziness and nausea (Burwen and Levine, 2012; Chandna and Honney, 2017; Devakumar et al. 2018; Gordon et al., 2007; Jin et al., 2006; Miah et al., 2009; Rouse, 2002; Tamire et al. 2018; Thompson et al. 2007, Thurber et al. 2013). Reviewed studies highlighted that women are particularly at risk of health harms from HAP, given that they are the primary cooks and spend more time in the kitchen and the home (Devakumar et al. 2018). Concern was also frequently expressed for children within the household who were considered particularly at risk from breathing in the smoke or from burns (Hooper et al., 2018; Pailman et al., 2018) because they are often near the mother when she cooks (Alam et al., 2006; Devakumar et al., 2018). Some studies reported that participants did not always see a connection between either their use of the stove, fuel type and/or smoke and their health symptoms (Akintan et al., 2018; Cundale et al., 2017, Hollada et al., 2017, Sesan, 2012), rather some saw the smoke as dirty (Wang and Bailis, 2015). Furthermore, several studies highlighted how participants did not necessarily see ash and smoke as a bad thing; in some cases the smoke was perceived as positive because it protected against insects (Rehfuess et al., 2014), and thus during the rainy season protecting newborns from insect-borne disease (Tamire et al. 2018). Smoke exposure was seen by some as an unavoidable part of daily life (Rhodes et al. 2014).

Many of the studies (n = 37) in this scoping review investigated the health impacts of interventions to reduce exposure to HAP either through switching to cleaner fuels or through the use of ICS. In those studies, interventions participants frequently reported perceived health benefits such as reduced smoke in the home, reduced respiratory problems, fewer burns, fewer headaches, coughs, back pain or runny noses or eye irritation (Alam et al. 2006; Gebreegziabher et al., 2018; Hessen et al., 2001; Khushk et al. 2005; Rehfuess et al., 2014). However, participants were often less clear or less concerned about the long-term

health benefits that the interventions provided (Akintan et al., 2018; Hollada et al., 2017; Stanistreet et al., 2014). Several studies reported that health improvements or benefits were not in fact raised by the participants unless they were prompted by researchers and that participants did not necessarily relate the alleviation of their symptoms to the use of ICS (Cundale et al., 2017, Hollada et al., 2017; Jürisoo et al., 2018; Thurber et al., 2013; Thurber et al., 2014). In other studies, participants had concerns over the safety and fumes produced by cleaner fuels also such as LPG (Gould and Urpelainen, 2018; Hollada et al., 2017; Malakar et al., 2018; Thompson et al., 2018). LPG and other fuels were sometimes highlighted to lack some of the wider health benefits that cooking using solid fuels provided, e.g. insect control due to household smoke (Stanistreet et al., 2014).

3.2. Family and community life

Many of the articles (n = 19) highlighted the important role of the community in shaping thoughts and actions, norms and beliefs, relating to solid fuel use and/or the uptake of ICS. Indeed, neighbors and families had a strong impact on whether an ICS was adopted, and this influence can be both positive and negative. For instance, current practices (e.g. gathering wood) are shaped by community tradition, and therefore give a sense of belonging (Malakar et al., 2018; Sunikka-Blank et al., 2019). Cooking with cleaner fuels (i.e. LPG) when the rest of the community are using solid fuels can be divisive and disassociating from the rest of the community. Conversely, if key members of the community adopt an ICS (e.g. teachers, ministers), they could be a very convincing force in ensuring the entire community adopts the new way of cooking (Jürisoo et al., 2018; Stanistreet et al., 2014). Consequently, new solutions to reduce exposure to HAP through changing cooking habits need to be community-led, including solutions that are approved by the community leaders and meeting the needs and priorities of the local community (Chandna and Honney, 2017; Tamire et al., 2018; Tigabu, 2017).

Several studies highlighted that adopting an ICS was associated with benefits for the whole family, such as acquiring a higher social status (Alam et al., 2006; Diaz et al., 2008; Jürisoo et al., 2018; Thompson et al., 2018) and allowing for more family socializing due to improved conditions (i.e. less smoke) inside the home (Rehfuess et al., 2014; Stanistreet et al., 2014). Such benefits were particularly pronounced for the children, as the smoke created by cooking with solid fuels is perceived to prevent them from concentrating on their education through not being able to play and study indoors (Devakumar et al., 2018; Rehfuess et al., 2014) and through spending time fetching firewood (Asante et al., 2018).

Studies stressed that despite the benefits and even if ICS are perceived as acceptable by a community, there may still be issues of affordability of the ICS for some within the community (Takama et al., 2012). The household's wealth was an important factor influencing the willingness to adopt a new stove, with high costs being identified as a key barrier among poorer households (Stanistreet et al., 2014). This role of cost is considered further in Section 3.6.

3.3. Home, space, place and roles

The findings from this review revealed that cooking with solid fuels produces smoke and soot (e.g. Baquié and Urpelainen, 2017), which sticks to walls, appliances and cookware (Yonemitsu et al. 2014), making the home look less attractive and requiring more frequent cleaning (Asante et al., 2018; Wang and Bailis, 2015). Some studies highlighted that this more frequent cleaning can cause painful roughness to the women's hands (Alam et al., 2006). Avoiding using solid fuels was associated with more appealing, cleaner and warmer homes (Chen et al. 2016; Diaz et al., 2008; Granderson et al., 2009; Khushk et al., 2005; Malakar, 2018; Stanistreet et al., 2014; Thompson et al., 2018; Tigabu, 2017; Wang and Bailis, 2015), with cold homes or feeling cold being linked back to ill-health (Gordon et al., 2007). A more appealing-looking home could, in fact, improve the household's social status (Wang and Bailis, 2015).

Across the included articles it was clear that gender roles had a key part to play in the fuel decision-making process. In most cases, women are the primary cooks, clean and oversee childcare, whilst men are often seen as the decision-makers (e.g. about fuel usage). In this review, men were generally not accepted as cooks within the home (Malakar et al., 2018; Stanistreet et al., 2014). In the context of uptake of ICS or cleaner fuels, gender roles remained important. The studies stressed that cooking methods need to be time-saving (Cundale et al., 2017; Stanistreet et al., 2014) and suitable for cooking large family meals more efficiently (Hollada et al., 2017). Although the time-saving component would mostly influence the woman's time (i.e. reducing time to collect cooking material, reduced cooking time and reduced time spent on cleaning and illness management (Cundale et al., 2017; Devakumar et al., 2018), several articles also reported the importance of the husband's satisfaction with the meal preparation time (Rhodes et al., 2014; Thompson et al., 2018). However, it is important to consider that while improved satisfaction with cooking times could convince husbands to change practice, they did not always believe the smoke produced during cooking was harmful to health (Thompson et al., 2018). These findings indicated that different aspects of ICS need to be addressed depending on the target audience.

The findings from this review also revealed other competing priorities with regards to home safety rather than HAP exposure (Devakumar et al., 2018). For instance, it was acknowledged that modifications made to the home to protect from other issues (e.g. keeping windows closed to avoid crime or plastic bags in the ceiling to avoid malaria) can worsen HAP, but avoiding the risk of crime or malaria were seen are bigger priorities to individuals than HAP prevention. Lack of ventilation was, in addition to increasing exposure to HAP, linked to bad smells (Devakumar et al., 2018; Qian et al., 2016). Although a questionnaire study did reveal that most participants are aware of the benefits of better ventilation, using a chimney and separating the kitchen from the home (Ali et al., 2011), the issue of proper ventilation is complex and influenced a variety of factors. These factors range from safety concerns (due to insecurity of the community and fears of malaria), the poor nature of houses (e.g. no windows or chimneys available), and avoiding the cold, through to mixed knowledge about the benefits of ventilation (Muindi et al., 2014; van Gemert et al., 2013; Weaver et al., 2017). This stressed the importance of the socio-spatial environment to any intervention to reduce HAP from cooking or heating the home with solid fuels.

3.4. Cooking and cultural practices

Our scoping review showed that cultural traditions, norms and habits underpin household cooking practices (e.g. Malakar et al., 2018; Rhodes et al., 2014; Tigabu, 2017; Troncoso et al., 2007). Frequently, the use of solid fuels for cooking has been passed down through the generations and is therefore considered as something to be valued and abided by (e.g. Bielecki and Wingenbach, 2014; Malakar et al., 2018; Rehfuess et al., 2014). Religious beliefs (Wang and Bailis, 2015) and myths (Akintan et al., 2018; Tamire et al., 2018) were found in some cultures to affect the design of the kitchen and the choice of fuel or the stove used. There was often a resistance to change the type of fuel or stove used for cooking because people were satisfied with the traditional methods they used (Akolgo et al., 2018; Stanistreet et al., 2014; Troncoso et al., 2011; Wijayatunga and Attalage, 2003), or because some members of the household were thought not to approve of the change (Troncoso et al., 2007). In Guatemala, Bielecki and Wingenbach (2014) found generational differences also in the uptake of cleaner cooking fuels, with younger generations more willing to move away from solid fuel use. Indeed, younger generations expressed less fear of the ICS exploding and causing fires (Hollada et al., 2017) and seemed

more easily convinced to adopt new practices (Wang and Bailis, 2015).

Another important factor underpinning cooking practices was the taste of the food when cooked using different fuels (e.g. Asante et al., 2018; Rhodes et al., 2014), with solid fuels generally considered to give a preferential taste to foods (Malakar et al., 2018; Taylor et al., 2011; van Gemert et al., 2013). For example, roti, the traditional Indian flatbread, was found to be unpalatable when cooked using LPG instead of using traditional cooking methods (i.e. using solid fuels) (Wang and Bailis, 2015). In addition to taste, the cooking fuel used was in some cases also linked to the nutritional content of food (Hollada et al., 2017). Those cultural aspects are key to understanding the complex issue of fuel use for cooking and heating, particularly in LMICs.

Finally, the review revealed that the choice of cooking fuel is underpinned by the availability of fuel types (or conversely the lack of choice) within proximity to the household (Gupta & Köhlin, 2006; Stanistreet et al., 2014; Akolgo et al., 2018; Pailman et al., 2018). Where multiple fuels were available for people, the cost of fuel then commonly influenced cooking fuel choice, with cleaner fuels more expensive than solid fuels (Taylor et al., 2011; van Gemert et al., 2013). The use of cleaner fuels, e.g. LPG, were often linked to convenience (Gould and Urpelainen, 2018), since they were generally perceived to cook food quicker than traditional biomass-based fires (Asante et al., 2018; Wang and Bailis, 2015), and were often used when short of time or when people were tired (Hollada et al., 2017). While some perceived solid fuel collection as a time-consuming task and therefore favored cooking methods which reduced or eliminated time spent on this task (Gebreegziabher et al., 2018; Granderson et al., 2009; Hooper et al., 2018), others perceived time spent collecting fuel as an opportunity for social interactions (Hollada et al., 2017). The versatility and flexibility of open solid fuel fires were valued by some (Akintan et al., 2018), given that fires could be moved to different locations as required and were made on the floor, thereby reducing the amount of lifting required for heavy cooking pots (Troncoso et al., 2007). However, some found that keeping a fire going required constant tending, meaning people could not get on with other tasks at the same time as cooking (Granderson et al., 2009). In comparison to traditional solid fuel-based fires, there were often concerns regarding durability, maintenance and repair with regards to improved biomass cook stoves and stoves that used cleaner fuels (Cundale et al., 2017; Stanistreet et al., 2014). Furthermore, the fuel used for cooking was often also required to meet multiple household energy needs, for example, seasonal space heating (e.g. Benka-Coker et al., 2018; Bielecki and Wingenbach, 2014; Hollada et al., 2017; Rehfuess et al., 2014), heating water for bathing (Malakar et al., 2018) and lighting the home (Diaz et al., 2008). However, the multiple services provided by the cooking fuel were not always desired, for example the use of solid fuels for cooking indoors during periods of warmer weather was highlighted as an issue because of overheating (Akolgo et al., 2018; Wang and Bailis, 2015). Consequently, it was relatively common for households to rely on multiple fuels or stoves for cooking (e.g. Benka-Coker et al., 2018; Cundale et al., 2017; Pailman et al., 2018), with decisions about which to use dependent upon several factors. The type of food being cooked was frequently a determining factor for which fuel or stove to use (Hollada et al., 2017; Rhodes et al., 2014; Stanistreet et al., 2014). Cooking capacity was also an important factor which determined the stove/fuel type used for cooking particular meals in terms of the number of people that were being fed (Bielecki and Wingenbach, 2014; Rhodes et al., 2014), the size of cooking pot that a particular stove could heat (Diaz et al., 2008; Hooper et al., 2018; Taylor et al., 2011), the variety of household cooking pots that could be used with that method (Bhogle, 2003) and the number of cooking pots that could be used simultaneously (Khushk et al., 2005; Rehfuess et al., 2014; Rouse, 2002). The weather and season also played a role in determining the fuel source or stove type relied upon, with wet conditions reducing reliance on solid fuels for cooking due to difficulties in keeping fuel dry before use (Troncoso et al., 2007) and difficulties lighting (and maintaining) solid fuel-based fires during adverse weather conditions (Hollada et al., 2017; Pailman et al., 2018; Rhodes et al., 2014; Tamire et al., 2018).

3.5. Environment

Only two papers were identified under the domain of environment (in this case referring to the wider, outdoor environment) in the review process (Akolgo et al. 2018; Muindi et al. 2014), and so it is difficult to be clear whether people are unconcerned about the environmental aspects of solid fuel collection and use, or simply it is not a current research focus. Deforestation, for example, is a substantial environmental impact of solid fuel harvesting, however its lack of occurrence as such in the scoped literature indicates that it is not something that participants perceive as an environmental issue. While smoke inside the home was frequently identified as a problem associated with solid fuel use (Akolgo et al., 2018; Devakumar et al., 2018; Troncoso et al., 2007), the link between HAP and outdoor air pollution was rarely considered by participants in the reviewed literature. Where outdoor air pollution was considered, this was generally regarded as a normal part of life and participants were resigned to it (Muindi et al., 2014). This may be linked to a lack of knowledge of the wider environmental impacts caused by traditional cooking methods (Akolgo et al., 2018) and the interactions between indoor and outdoor air.

3.6. Practice and policy development

A key theme to emerge from the review surrounding practice and policy development was microeconomic constraints as a barrier in the prevention of changes in behavior away from solid fuels (Gordon et al., 2007). The high cost of cleaner fuels or technologies (in this case ICS), was well documented (Devakumar et al. 2018; Gordon et al., 2007; Hollada et al., 2017; Jeuland et al., 2015; Stanistreet et al., 2014). Devakumar et al. (2018) report of participants citing insufficient money to deal with the problem of HAP, which has been linked to the high-cost of cleaner fuels, such as LPG (Hollada et al., 2017), as well as high-costs in the production of ICS (Gordon et al., 2007). However, participants did not always view high cost as a preventative factor and found ways around it. For example, one article found brokering agreements between village members, local government and NGOs allowed people to take out loans or pay in instalments, which supported increased uptake of ICS (Stanistreet et al., 2014).

However, incentives to aid the adoption of cleaner fuels and technologies to combat air pollution were not always well received. Hollada et al. (2017) report of participants not using vouchers to lower the cost of LPG issued by the government because it was felt this was not enough, owing to the large investment to purchase the LPG tank. Similarly, although some ICS have been subsidized, these are still seen as largely inaccessible to the poorest families (Gordon et al., 2007). Incentives are not always capital in nature, for example the Maharashtra State Government offer “Clean Village” awards (Stanistreet et al., 2014). However, as participants note, adoption of cleaner cookstoves as a result of such incentives are “not because of the smoke”, but rather to win the award (Stanistreet et al., 2014).

Government involvement was also not always well-regarded (Asante et al., 2018; Muindi et al., 2014). Participants reported experiences of bias in the selection of beneficiary districts for rural LPG programs, with those affiliated with certain political parties more likely to receive a cookstove (Asante et al., 2018). Participants have also reported a lack of voice to petition leaders to address issues surrounding air pollution (Muindi et al., 2014). Moreover, those who have complained in the past have experienced being threatened with eviction and forced to keep quiet (Muindi et al., 2014).

This scoping review highlighted that challenges linked to the introduction of new technologies to reduce exposure to HAP are manifold. Awareness-raising campaigns including stove demonstrations in the home and at markets, at community meetings, and through door-to-

door promotion have been attempted by health promoters (Stanistreet et al., 2014), and yet despite this, lack of education and information is still being blamed as a factor in preventing dealing with the problem of HAP by study participants (Devakumar et al. 2018; Gordon et al., 2007).

4. Discussion

A household's decision on which fuel (or combination of fuels) to use to meet their needs is complex and multi-dimensional, incorporating several 'near' and 'visible' factors (e.g. affordability, availability and convenience) and more 'hidden' factors (e.g. cultural traditions and gender roles). This is further complicated by the variety of different services which fuel(s) in the home are required to provide, i.e. cooking, heating and lighting (Sovacool, 2011). The aim of this scoping review was to explore and summarize knowledge of solid fuel users' perceptions of solid fuel use and collection for cooking, heating and lighting in LMICs. Beyond illustrating how perceptions within each of the six key domains (health; family and community life; home, space, place and roles; cooking and cultural practices; environment and practice and policy development; Fig. 1) play an important role in decision-making regarding fuel, two domain-overarching topics were also observed: the role of senses and disconnects. With respect to the role of senses it was clear how these, whether this be sight, smell or taste, were important in shaping perceptions of solid fuel use. Due to the mostly invisible nature of air pollution, people's sensory faculty is vital for giving air pollution a physical and viable parameter, and it is often this physical experience with air pollution that shapes public understanding and risk perception (Bickerstaff, 2004). The theme of "disconnects" was observed in a variety of ways such as a disconnect between solid fuel usage and perceived health impact, temporal disconnect, gender-related disconnect and disconnect between the different relevant stakeholders. Each of these will be explored in more detail below.

Though in most studies participants linked solid fuel use with adverse health impacts manifested most commonly as respiratory irritation (e.g. Chandna and Honney, 2017; Tamire et al. 2018; Thompson et al. 2007), for some there was a disconnect between solid fuel use and health impacts, with either no link made between the two (Akintan et al., 2018; Cundale et al. 2017; Hollada et al., 2017) or smoke perceived to have positive health impacts, e.g. protection against insects (Rehfuess et al., 2014). Even where a link was made, exposure to HAP was sometimes considered an unavoidable part of daily life (Muindi et al., 2014; Rhodes et al., 2014), and participants rarely considered the connection between HAP and ambient air pollution. There was also frequently a gap between knowledge of health impacts of solid fuel use and household solid fuel practices. For example, understanding of health impacts of HAP contrasted with the lack of action to reduce HAP through strategies including ventilation of the home. This reflects the complexity of the issue and the wider factors that control household behaviors, i.e. in this instance prioritizing household safety and security (Muindi et al., 2014; van Gemert et al., 2013; Weaver et al., 2017), and the sense of not only belonging in the community, but the esteem that having access to more modern, cleaner cooking alternatives brought (Jürisoo et al., 2018; Kenrick et al. 2010). Importantly, these findings highlight that consideration to apply theoretical frameworks on (health) behavior change could be of relevance to further understand how to develop sustainable interventions to reduce HAP (Morrison and Bennett, 2012). These theoretical frameworks, such as the Theory of Planned Behavior (Ajzen, 1985) and the Health Belief Model (Champion and Skinner, 2008), postulate that knowledge is not the only factor determining behavior change and highlight how changing behavior is influenced by a range of factors. Indeed, our findings align with these postulations and highlight how beyond knowledge on HAP, attitudes towards the new behavior (e.g. favorable evaluation of a solid fuel alternative), subjective norm (i.e. pressure from the community to a cleaner fuel), behavioral control (i.e. the perception of sufficient resources, opportunities and skills to use alternatives to solid fuels) as well as perceived susceptibility and severity (e.g. individual perception of how susceptible they are to and the severity of the health impacts of HAP). While attempts to apply these behavioral change frameworks to the context of cooking are limited, the recently developed CI-CHANGE framework (Kar and Zerriffi, 2018), a cookstove specific behavior change framework which integrates the Theory of Planned Behavior and the Transtheoretical Model, is a promising development and warrants further investigation.

A temporal disconnect in relation to household solid fuel use manifested itself in a number of ways. Fuel collection and/or purchase happens regularly within a household, with decisions being made about which fuels to use depending on the energy services required, the season, the food being cooked, the number of people in the household, among other factors (e.g. Asante et al., 2018; Stanistreet et al., 2014; van Gemert et al., 2013). These short-term decisions contrast with the longer-term changes that affect energy use in the home, including shifts in cultural traditions, beliefs and practices and policy changes (e.g. Malakar et al., 2018; Rhodes et al., 2014; Tigabu, 2017). However, the taste and smell of food cooked in a traditional and culturally appropriate way arguably has no temporal variation, with traditional living valued and preferred by many (Akolgo et al. 2018; Hollada et al. 2017; Rhodes et al., 2014; Taylor et al. 2011; van Gemert et al. 2013). A secondary temporal disconnect was found in terms of health, with many of the health impacts relating to the daily use of solid fuels (e.g. chronic back pain from fuel collection, COPD and lung cancer) not manifesting until later in life (Grigsby et al., 2016; Morgan et al., 2019). Yet, people more frequently referred to the near-term health impacts of solid fuel use (e.g. coughing and wheezing) (Devakumar et al., 2018; Gordon et al., 2007; Miah et al., 2009) than long-term health impacts.

Within the household, socio-demographic factors were important in shaping perceptions of solid fuel use (Kar and Zerriffi, 2018). There was a frequent disconnect between those that were most affected by using solid fuels in the household (i.e. women and children; e.g. Devakumar et al. 2018; Okello et al., 2018; Schlag & Zuzarte, 2008) and those that were making decisions about which fuels to use in the home and budgets (i.e. males; e.g. Rehfuess et al., 2014; Thompson et al., 2018). Age was also an important factor when considering perceptions of solid fuel use, with frequent generational differences in knowledge, attitudes and beliefs (e.g. Bielecki and Wingenbach, 2014). For example, younger people were more likely to be accepting of trying new practices and did not attach the same value to traditions as older generations (Wang and Bailis, 2015). Although children were frequently considered to be most at risk from HAP and burns (Hooper et al., 2018; Pailman et al., 2018), limited attention is given to their role in, and their perception of, cooking practices. Consequently, in designing interventions to reduce HAP it might be of importance to have a clear and specific target audience, with respect to gender and generation or to include flexibility in the approach to account for gender and generational differences in perceptions and responsibilities within the household.

The final level of disconnects was between the different stakeholder groups outlined in our adapted social ecological model (Fig. 1). In particular, community norms and cultural traditions were strong influences on household uptake of new energy sources (e.g. Akintan et al., 2018; Wang and Bailis, 2015). Key community members, e.g. community leaders, teachers and ministers, were also repeatedly highlighted as guardians of cultural norms and important influencers (Jürisoo et al., 2018; Stanistreet et al., 2014). Consequently, energy solutions need to fit the local community context and ideally be community-led (Chandna and Honney, 2017; Tamire et al., 2018; Tigabu, 2017). There were also disconnects between the outer ring of the adapted social-ecological model (Practice and policy development; Fig. 1), and households and communities, with policies and interventions designed to reduce reliance on solid fuel use (e.g. subsidies) often not fit for purpose, for example subsidizing the cost of the fuel, but not subsidizing the one-off cost of a new stove (Hollada et al., 2017). Such

high-level consideration of availability and access to alternative fuel sources or cooking technologies may be too distant from the individuals who rely on solid fuels, again, highlighting the need for policies and interventions to be community-led, with a strong understanding of the community's priorities, perceptions and preferences. A full understanding of community priorities will help policymakers and researchers adapt the key messages they are providing to increase uptake of new technologies and/or fuels and ultimately improve health. Lastly, the findings highlighted that there is limited research that focuses on people's perceptions of the societal domains within our social ecological model (Fig. 1), both in terms of the environment (e.g. deforestation and the relationship between HAP and ambient air pollution) and policy and practice (e.g. roles of stakeholders, legislation). These are areas where further research is warranted.

5. Conclusions and recommendations

We have conducted a scoping review to explore solid fuel users' perceptions of solid fuel use in LMICs. This has highlighted that most previous work exploring peoples' perceptions of solid fuel use for cooking, heating and lighting in LMICs has been undertaken in relation to ICS interventions and not on solid fuel use for open fire or basic cookstoves. Further research that is grounded in and starts at the community-level, which identifies the priorities and perceptions of solid fuel users, and which aims to better understand the lived experience and knowledge of solid fuel use in a variety of contexts, the complexities of gendered household decision-making, and food-related cultures and traditions is therefore necessary.

In undertaking these ICS intervention studies, common methodologies to explore perceptions have included questionnaires, interviews and focus groups. While these have clear value in exploring perceptions of solid fuel use, these methods do not necessarily reflect participant's lived experiences which can be vital to uncover the more 'hidden' factors such as culture and tradition. Our scoping review has highlighted the importance of the senses in shaping people's perceptions of solid fuel use, whether that be smell, taste or vision. There is therefore potential here to innovate in terms of the methods being used to explore people's perceptions of solid fuel use and to bring the participant and their solid fuel experiences closer together. We know from ongoing work by some of the authors in projects in Malawi and Kenya that a range of participatory methodologies (mapping, body mapping, walking interviews, video diaries, photovoice) and more creative forms of community engagement – created and practiced routinely in regions such as Latin America and Africa—such as theatre for development, storytelling and drawing, may not only fill this methodological gap, but also capture more accurately people's lived experiences of solid fuel use in the home.

The findings show that every day in LMICs solid fuel users are making household decisions that affect their HAP-related health, e.g. choosing to ventilate their homes or not. This combined with the fact that participants consistently focused on the short-term (e.g. coughing) rather than long-term (e.g. lung cancer) adverse health consequences of exposure to HAP highlights that more awareness-raising interventions that provide participants with the evidence base needed to make better-informed decisions that affect the health and wellbeing of the household are required. While this alone may not change household use of solid fuels, because of other more pressing issues such as cost and availability, it will provide people with the full evidence base to feed into decision-making and enable people to advocate for change more widely.

This review offers, for the first time, an amalgamation of LMIC solid fuel users' perceptions, focused specifically on solid fuel use and collection. The review has demonstrated the richness and potential of exploring perceptions, and yet perception of solid fuel use has not well explored. This review highlights the importance of understanding and considering perceptions of solid fuels from a social ecological perspective (i.e., in terms of health, family and community life, home, space, place and roles, cooking and cultural practices, environment and practice and policy development) in order to reduce exposure to HAP, be this through (infra)structural or behavioral interventions. Of particular importance, future interventions need to take into account complex gendered and community dynamics to make 'connections' that are currently lacking in order to overcome the various disconnects identified throughout this review. It is anticipated that such a participatory approach from a social ecological perspective will ensure that any intervention or alternative fuel source is available and affordable to the poorest communities, as well as seen as acceptable in the local and cultural context.

Funding

This work was supported by internal funding from the University of Stirling Crucible program which went towards the development of the scoping review.

CRediT authorship contribution statement

Amy McCarron: Formal analysis, Investigation, Data curation, Writing - original draft, Visualization, Project administration. **Isabelle Uny:** Conceptualization, Methodology, Formal analysis, Writing - original draft, Supervision, Funding acquisition. **Line Caes:** Conceptualization, Methodology, Formal analysis, Writing - original draft, Funding acquisition. **Siân E. Lucas:** Conceptualization, Methodology, Formal analysis, Writing - original draft, Funding acquisition. **Sean Semple:** Writing - original draft, Writing - review & editing. **Jane Ardrey:** Conceptualization, Writing - original draft, Writing - review & editing. **Heather Price:** Conceptualization, Methodology, Formal analysis, Writing - original draft, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We would like to thank all workshop attendees: Dr Sinead Currie (Health Psychology, University of Stirling), Dr Ian Law, Ms. Kirelle McManus, Dr Lejone Ntema (Development Studies, University of South Africa), Dr Pamela Rackow (Psychology, University of Stirling), Ms. Martine Stead (Institute of Social Marketing, University of Stirling), Simon Sikwese (Exec. Director, Pakachere IHDC, Malawi) and Prof. Aziz Sheikh (College of Medicine and Veterinary Medicine, University of Edinburgh), for their attendance at the workshop and in their input to develop the research question.

We would like to thank the NIHR Global Health Research Unit on Lung Health and TB in Africa at LSTM - "IMPALA" for helping to make this work possible. In relation to IMPALA (grant number 16/136/35) specifically: IMPALA was commissioned by the National Institute for Health Research (NIHR) Global Health Research (GHR) using UK aid from the UK Government. The views expressed in this publication are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care.

Appendix A

First Author, Year	Title	Journal	Region of study	Type of data	Method of collection (relevant)	Focus of study (SF vs. ICS)	Objective of paper	Perceptions of domestic fuel users main focus of study?
Akintan et al., 2018	Culture, tradition and taboo: Understanding the social shaping of fuel choices and cooking practices in Nigeria	Energy Research and Social Science	Ado Ekiti, Nigeria	Qualitative	Household surveys, participant observations and semi-structured interviews	SF & ICS (fuel wood collection, fuel choices and cooking practice).	Explore cultural perspectives of fuel wood harvesting and HAP for domestic activities.	Yes
Akolgo et al., 2018	The potential of dual purpose improved cookstove for low income earners in Ghana- improved cooking methods and biochar production	Renewable and Sustainable Energy Reviews	Ghana	Qualitative	Survey (qualitative questions)	ICS	Determine the features cookstove users would like to see incorporated into cookstoves and biochar programs.	Yes
Alam et al., 2006	Effect of improved earthen stoves: improving health for rural communities in Bangladesh	Energy for Sustainable Development	Bangladesh	Mixed-methods	Questionnaire (qualitative and quantitative questions), FGD	ICS	Evaluate the health effects of biomass combustion in improved cookstoves with consideration to socio-economic factors.	Yes
Ali et al., 2011	LOCAL PERCEPTION OF INDOOR AIR POLLUTION WITH USE OF BIOFUEL IN RURAL COMMUNITIES OF UCHALLI WETLANDS COMPLEX, SALT RANGE PAKISTAN	Journal of Animal and Plant Sciences	Khushab district, Pakistan	Qualitative	Questionnaires	SF	Understand local perceptions on HAP generated from biofuel use.	Yes
Asante et al., 2018	Ghana's rural liquefied petroleum gas program scale up“ A case study	Energy for Sustainable Development	Ghana	Mixed-methods	Review	Rural LPG	Document Ghana’s scale up to LPG.	No
Baquié & Urpelainen, 2017	Access to modern fuels and satisfaction with cooking arrangements: Survey evidence from rural India	Energy for Sustainable Development	Rural India	Mixed-methods	Survey	Various fuel types	Determine predictors of satisfaction of fuel access and cooking arrangements.	Yes
Benka-Coker et al., 2018	A case study of the ethanol CleanCook stove intervention and potential scale-up in Ethiopia	Energy for Sustainable Development	Addis Ababa, Ethiopia	Mixed-methods	Surveys	ICS	Explore the impact of clean cookstove on urban and refugees populations and examine the policy impact of the refugee program and the potential for commercialization of ethanol in the urban setting, while evaluating the factors that could impact the success of ethanol as domestic fuel.	No
Bhogle, 2003	Rural women as agents of improved woodstove dissemination: a case-study in Huluvangala, Karnatake, India	Energy for Sustainable Development	Huluvangala village, Karnataka, India	Qualitative	Case study	ICS	Describe the coming together of NGOs and a self-help group to provide income generating opportunities for rural women as stove entrepreneurs.	No (equal focus on NGOs)
Bielecki & Wingenbach, 2014	Rethinking improved cookstove diffusion programs: A case study of social perceptions and cooking choices in rural Guatemala.	Energy Policy	Guatemala	Qualitative	Case-study; interviews and participant observations	ICS	Describe how culture and social perceptions affect the adoption and use of ICSs.	Yes
Borah, 2015	Physiological workload of hill farm women of Meghalaya, India involved in firewood collection.	Procedia Manufacturing	Meghalaya, India	Mixed-methods	Question	SF	Determine the perceived physiological exertion, physiological responses and musculoskeletal problem while collecting firewood.	No
Burwen & Levine, 2012	A rapid assessment randomized-controlled trial of improved cookstoves in rural Ghana	Energy for Sustainable Development	Sissala West district, Upper West Ghana	Mixed-methods	Surveys and usage observations	ICS	Randomized-controlled trial to quantify changes in fuel use, exposure to smoke, and self-reported health attributable to deployment of an improved wood cookstove.	No
Chandna & Honney, 2017	INSPiRE: an integrated approach to tackling household air pollution and improving health in rural Cambodia	Public Health	Samlout district in northwest rural Cambodia	Mixed-methods	Household surveys	Varied: ICS, HAP, fuelwood…	Communicate key findings and challenges faced by the INSPiRE project.	No

Chen et al., 2016	Household biomass energy choice and its policy implications on improving rural livelihoods in Sichuan, China	Energy Policy	Sichuan, China	Quantitative	Willingness to pay methods	Various fuel types	Examine rural household energy choice behaviors using revealed and stated preference methods.	No (preference more than perception)
Cundale et al., 2017	A health intervention or a kitchen appliance? Household costs and benefits of a cleaner burning biomass-fuelled cookstove in Malawi	Social Science and Medicine	Chilumba, Malawi	Qualitative	Semi-structured interviews	ICS	Provide an insight into the household costs and perceived benefits from use of biomass-fueled cookstove.	Yes
Devakumar et al., 2018	Women's Ideas about the Health Effects of Household Air Pollution, Developed through Focus Group Discussions and Artwork in Southern Nepal	International Journal of Environmental Research and Public Health	Janakpur, Dhanusha district, Southern Nepal	Qualitative	FGDs and artwork	HAP	Explore the lived experiences and perceptions of women of the health effects of household air pollution.	Yes
Diaz et al., 2008	Self-rated health among Mayan women participating in a randomised intervention trial reducing indoor air pollution in Guatemala	BMC International Health and Human Rights	Rural highland Guatemala	Mixed-methods	Interview-led questionnaire (quantitative questions)	ICS	Compare self-rated health and change in health among women participating in a randomized control trial comparing an open-fire and chimney stove, to describe impacts on women's daily lives and their perceptions of how kitchen smoke affects their and their children's health.	Yes
Firdaus & Ahmad, 2011	Indoor air pollution and self-reported diseases – a case study of NCT of Delhi	Indoor Air	Delhi	Qualitative	Questionnaires	HAP and SF	Assess the indoor air quality of households through an integrated survey and interview approach	Yes
Gebreegziabher et-al., 2018	Fuel savings, cooking time and user satisfaction with improved biomass cookstoves: Evidence from controlled cooking tests in Ethiopia	Resource and Energy Economics	Ethiopia	Mixed-methods	Survey	ICS	Analyze evidence from controlled cooking tests on fuel savings and use surveys to provide information on what motivates users to want to use an ICS	No
Gordon et al., 2007	Perceptions of the health effects of stoves in Mongolia	Journal of Health Organization and Management	Ulaanbaatar, Mongolia	Qualitative	FGDs and individual interviews	ICS	Evaluate the views of stove users on how stoves affect their health.	Yes
Gould and Urpelainen, 2018	LPG as a clean cooking fuel: Adoption, use, and impact in rural India	Energy Policy	Rural India	Qualitative	Survey	LPG	Report results from a survey of LPG use to understand the integration of a clean cooking fuel into rural household's energy mixes.	Yes
Granderson et al., 2009	Fuel use and design analysis of improved woodburning cookstoves in the Guatemalan Highlands	Biomass and Bioenergy	Guatemalan Highlands	Mixed-methods	Direct participant observation and informal interviews	ICS	Provide an in-depth analysis of the kitchen performance test method.	No
Gupta & Köhlin, 2006	Preferences for domestic fuel: Analysis with socio-economic factors and rankings in Kolkata, India	Ecological Economics	Kolkata, India	Mixed-methods (?)	Survey	Various fuel types	Analyze demand between multiple fuels, with a ranking exercise that highlights how various factors affect the preferences over fuels.	No (preference more than perception)
Hessen et al., 2001	Motivational factors related to improving indoor air quality in rural Nepal	Mountain Research and Development	Jumla region, Nepal	Qualitative	Questionnaire	ICS	Evaluate motivational factors and kitchen characteristics that may influence the implementation of improved cookstoves programs.	Yes
Hollada et al., 2017	Perceptions of Improved Biomass and Liquefied Petroleum Gas Stoves in Puno, Peru: Implications for Promoting Sustained and Exclusive Adoption of Clean Cooking Technologies	International Journal of Environmental Research and Public Health	Puno, Peru	Qualitative	Semi-structured interviews and participant observations	ICS	Explore cooking norms and preferences which influence the adoption of ICSs, identify potential strategies to overcome clean cooking adoption barriers and encourage more widespread exclusive use of clean cooking technologies.	Yes

Hooper et al., 2018	Traditional cooking practices and preferences for stove features among women in rural Senegal: Informing improved cookstove design and interventions	PLOS One	Senegal	Qualitative	Survey	ICS	Describe stove and fuel use, to identify preferences on stove features and function, and to elicit the community perceptions of ICSs with a focus on LPG.	Yes
Jeuland et al., 2015	Preferences for improved cook stoves: Evidence from rural villages in north India	Energy Economics	North India	Quantitative	WTP surveys	ICS	Report on preferences for biomass-burning ICS attributes such as reductions in emissions, inconvenience, and fuel requirements.	No (preference more than perception)
Jin et al., 2006	Exposure to indoor air pollution from household energy use in rural China: The interactions of technology, behavior, and knowledge in health risk management	Social Science and Medicine	China and Mongolia	Mixed-methods	Questionnaire	SF	Examine the linkages among technology, knowledge and behavior, and access and infrastructure in exposure to HAP from household fuel use.	No
Jürisoo et al., 2018	Beyond buying: The application of service design methodology to understand adoption of clean cookstoves in Kenya and Zambia	Energy Research and Social Science	Kenya and Zambia	Qualitative	Interviews	ICS	Generate recommendations on specific approaches that support the household transition to cleaner cookstoves.	Yes
Khushk et al., 2005	Health and social impacts of improved stoves on rural women: a pilot intervention in Sindh, Pakistan	Indoor Air	Sindh, Pakistan	Qualitative	Questionnaire and FGDs	ICS	Assess the acceptability, social and health impacts of improved stoves among women.	Yes
Malakar et al., 2018	Resistance in rejecting solid fuels: Beyond availability and adoption in the structural dominations of cooking practices in rural India	Energy Research and Social Science	Rural India	Qualitative	Interviews and FGDs	SF	Explore the role that social structure plays in the perpetuation of the use of solid fuels for cooking.	Yes
Malakar, 2018	Studying household decision-making context and cooking fuel transition in rural India	Energy for Sustainable Development	Rural India	Mixed-methods	Interview (qualitative and quantitative questions) and participant observations	Various fuel types	Investigate the context within which a household makes the decision not to adopt LPG as quickly comparative to TV technology.	Yes
Miah et al., 2009	Wood fuel use in the traditional cooking stoves in the rural floodplain areas of Bangladesh: A socio-environmental perspective	Biomass and Bioenergy	Bangladesh	Mixed-methods	Semi-structured questionnaire	CS's and various types of fuel	Determine the structural characteristics of the traditional cooking stoves, amount of wood fuel consumed, and figure out the socio- economic and environmental consequences of wood fuel usage in the traditional cooking stove.	No
Muindi et al., 2014	"We are used to this": a qualitative assessment of the perceptions of and attitudes towards air pollution amongst slum residents in Nairobi	BMC Public Health	Nairobi	Qualitative	FGDs	Air pollution general	Assess the perceptions and attitudes of slum residents about air pollution.	Yes
Pailman et al., 2018	Experiences with improved cookstoves in Southern Africa	Journal of Energy in Southern Africa	South Africa, Mozambique, Malawi and Zambia	Qualitative	Questionnaire	ICS	Explores user experiences with improved cookstoves drawing from findings from household surveys.	Yes
Qian et al., 2016	Associations between Parents' Perceived Air Quality in Homes and Health among Children in Nanjing, China	PloS One	Nanjing, China	Qualitative	Questionnaire	Air pollution general	Investigate associations between parents' perceived air quality in domestic environments and children's allergic diseases using a questionnaire.	Yes
Rehfuess et al., 2014	Enablers and Barriers to Large-Scale Uptake of Improved Solid Fuel Stoves: A Systematic Review	Environmental Health Perspectives	Various	Qualitative	Systematic review	ICS	Review the factors that enable or limit large-scale uptake of ICSs in low- and middle-income countries.	No
Rhodes et al., 2014	Behavioral Attitudes and Preferences in Cooking Practices with Traditional Open-Fire Stoves in Peru, Nepal, and Kenya: Implications for Improved Cookstove Interventions	International Journal of Environmental Research and Public Health	Peru, Nepal and Kenya	Qualitative	Interviews and direct observations	ICS	Describe traditional cooking practices and stove use and outline the implications of these practices for ICS adoption and stove design.	Yes
Rouse, 2002	Community participation in household energy programmes: a case-study from India	Energy for Sustainable Development	India	Qualitative	Discussion and observations	ICS	Describe findings and lessons learned from an ongoing improved biomass cook- stove program.	No

Sesan, 2012	Navigating the limitations of energy poverty: Lessons from the promotion of improved cooking technologies in Kenya	Energy Policy	Kenya	Qualitative	Semi-structured interviews and observations	ICS	Examine the outcomes of Practical Action's technology-led smoke alleviation intervention in relation to the wider socio-economic context of the community.	Yes
Stanistreet et al., 2014	Factors Influencing Household Uptake of Improved Solid Fuel Stoves in Low- and Middle-Income Countries: A Qualitative Systematic Review	International Journal of Environmental Research and Public Health	LMIC	Qualitative	Systematic review	ICS	Identify factors that influence household uptake of ICSs in LMIC.	Yes
Sunikka-Blank et al., 2019	Gender domestic energy and design of inclusive low-income habitats: A case of slum rehabilitation housing in Mumbai, India	Energy Research and Social Science	Mumbai, India	Qualitative	Semi-structured interviews and FGD (with local communities-relevant)	Housing	Understand elementary slum rehabilitation housing typologies in Mumbai, understand how female occupants' cooking, thermal comfort, entertainment, childrearing and working practices have changed since the relocation and how relocation affects domestic energy use and the factors that influence these practices.	Yes
Takama et al., 2012	Evaluating the relative strength of product-specific factors in fuel switching and stove choice decisions in Ethiopia. A discrete choice model of household preferences for clean cooking alternatives	Energy Economics	Ethiopia	Quantitative	WTP surveys	CS's and various types of fuel	Improve the methodological foundations in the area of cook stove choice.	No (preference more than perception)
Tamire et al., 2018	Socio-Cultural Reasons and Community Perceptions Regarding Indoor Cooking Using Biomass Fuel and Traditional Stoves in Rural Ethiopia: A Qualitative Study	International Journal of Environmental Research and Public Health	Rural Ethiopia	Qualitative	FGDs	CS's and various types of fuel	Explore the perceptions of the community towards indoor cooking and the socio-cultural barriers to change.	Yes
Taylor et al., 2011	Burning for Sustainability: Biomass Energy, International Migration, and the Move to Cleaner Fuels and Cookstoves in Guatemala	Annals of the Association of American Geographers	Guatemala	Qualitative	Observations and interviews	CS's and various types of fuel	Examine Guatemalan migrant's potential as agents for change in the transition to cleaner fuels or the more efficient use of existing renewable energy sources.	No
Thompson et al., 2007	Nxwisen, ntzarrin or ntzo'lin? Mapping children's respiratory symptoms among indigenous populations in Guatemala	Social Science and Medicine	Guatemala	Qualitative	Individual interviews, FGDs	Health effects of AP	Describe the process used to investigate and validate respiratory terminology relating specifically to asthma signs and symptoms, for construction of a respiratory questionnaire.	No (description of symptoms)
Thompson et al., 2018	Adoption of Liquefied Petroleum Gas Stoves in Guatemala: A Mixed-Methods Study	Ecohealth	Guatemala	Mixed-methods	Semi-structured survey, in-depth interviews and FGDs	ICS	Evaluate the drivers and determinants of LPG stove use among households that used both gas and wood-stoves.	Yes
Thurber et al., 2013	To Promote Adoption of Household Health Technologies, Think Beyond Health	American Journal of Public Health	Various	Qualitative	Review	Health effects of AP	Assess the relative importance of different health and non-health factors on the uptake of household health technologies.	Yes
Thurber et al., 2014	'Oorja' in India: Assessing a large-scale commercial distribution of advanced biomass stoves to households	Energy for Sustainable Development	Maharashtra and Karnataka, India	Mixed-methods	Surveys and interviews	ICS	Assess the benefits and challenges of a commercial approach to distribution of "Oorja" stove in India.	No
Tigabu, 2017	Factors associated with sustained use of improved solid fuel cookstoves: A case study from Kenya	Energy for Sustainable Development	Kenya	Qualitative	Survey	ICS	Examine the factors that influence the usage rate of ICS, drawing on a survey of cookstove users conducted in Kenya.	No
Troncoso et al., 2007	Social perceptions about a technological innovation for fuelwood cooking: Case study in rural Mexico	Energy Policy	Rural Mexico	Qualitative	Participant observation and semi-structured interviews	ICS	Understand perceptions about a technological innovation for fuelwood cooking.	Yes

Troncoso et al., 2-011	Understanding an improved cookstove program in rural Mexico: An analysis from the implementers' perspective	Energy Policy	Rural Mexico	Qualitative	Interviews	ICS	Document and analyze the views and opinions of different members of an ICS implementation team, namely the researchers, the NGO's team, the physician and the consultants, as well as users themselves.	No
van Gemert et al., 2013	Impact of chronic respiratory symptoms in a rural area of sub-Saharan Africa: an in-depth qualitative study in the Masindi district of Uganda.	Primary Care Respiratory Journal	Masindi district, Uganda	Qualitative	FGDs	Health and SF	Explore beliefs and attitudes concerning health (particularly respiratory illnesses), use of biomass fuels, tobacco smoking, and the use of health services.	Yes
Wang & Bailis, 2015	The revolution from the kitchen: Social processes of the removal of traditional cookstoves in Himachal Pradesh, India	Energy for Sustainable Development	Himachal Pradesh, India	Qualitative	Surveys, semi-structured interviews	ICS	Highlight the socio-political processes of the removal of the traditional chulha cookstove.	Yes
Weaver et al., 2017	Pilot intervention study of household ventilation and fine particulate matter concentrations in a low-income urban area, Dhaka, Bangladesh	American Journal of Tropical Medicine and Hygiene	Dhaka, Bangladesh	Mixed-methods	In-depth interviews	Household intervention	Describe the relationships between existing ventilation structure and behaviors and PM2.5 concentrations, determine the effect of household behavioral and structural interventions to increase ventilation on indoor PM2.5 concentrations, and describe the feasibility and acceptability of behavioral and structural ventilation interventions in a low-income urban area.	No
Wijayatunga & Attalage, 2003	Analysis of rural household energy supplies in Sri Lanka: energy efficiency, fuel switching and barriers to expansion	Energy Conservation and Management	Sri Lanka	Mixed-methods	Questionnaire	Energy supplies	Highlight policy issues associated with rural energy supplies and possible solutions to them in the context of Sri Lanka's overall picture of the energy sector.	No
Yonemitsu et al., 2014	Household fuel consumption based on multiple fuel use strategies: A case study in Kibera Slums	APCBEE Procedia	Kibera, Kenya	Qualitative	Survey	Various fuel types	Understand the relative importance of fuel substitution and fuel complementation, among charcoal, fuel briquettes and kerosene, and the factors associated with these choices	No

References

Adams, R.J., Smart, P., Huff, A.S., 2017. Shades of Grey: Guidelines for Working with the Grey Literature in Systematic Reviews for Management and Organizational Studies. Int. J. Manage. Rev. 19 (4), 432–454.

Akintan, O., Jewitt, S., Clifford, M., 2018. Culture, tradition, and taboo: Understanding the social shaping of fuel choices and cooking practices in Nigeria. Energy Res. Social Sci. 40, 14–22.

Akolgo, G.A., Essandoh, E.O., Gyamfi, S., Atta-Darkwa, T., Kumi, E.N., Maia, C.M.B.d.F., 2018. The potential of a dual purpose improved cookstove for low income earners in Ghana – Improved cooking methods and biochar production. Renew. Sustain. Energy Rev. 82, 369–379.

Alam, S.M.N., Chowdhury, S.J., Begum, A., Rahman, M., 2006. Effect of improved earthen stoves: improving health for rural communities in Bangladesh. Energy Sustain. Devel. 10 (3), 46–53.

Alexander, D., Larson, T., Bolton, S., Vedal, S., 2015. Systolic blood pressure changes in indigenous Bolivian women associated with an improved cookstove intervention. Air Qual. Atmos. Health 8 (1), 47–53.

Alfaro, J.F., Jones, B., 2018. Social and environmental impacts of charcoal production in Liberia: Evidence from the field. Energy Sustain. Devel. 47, 124–132.

Ali, Z., Shelly, S.Y., Bibi, F., Nasir, Z.A., Colbeck, I., 2011. Local perception of indoor air pollution with use of biofuel in rural communities of Uchalli Wetlands Complex, Salt Range Pakistan. J. Animal Plant Sci. 21, 429–434.

Ajzen, I., 1985. From intentions to actions: a theory of planned behaviour. In: Kuhl, J., Beckman, J. (Eds.), Action Control: From Cognition to Behaviour. Springer, Heidelberg, pp. 11–39.

Arksey, H., O'Malley, L., 2005. Scoping studies: towards a methodological framework. Int. J. Soc. Res. Methodol. 8 (1), 19–32.

Asante, K.P., Afari-Asiedu, S., Abdulai, M.A., Dalaba, M.A., Carrión, D., Dickinson, K.L., Abeka, A.N., Sarpong, K., Jack, D.W., 2018. Ghana's rural liquefied petroleum gas program scale up: A case study. Energy Sustain. Devel. 46, 94–102.

Baquié, S., Urpelainen, J., 2017. Access to modern fuels and satisfaction with cooking arrangements: Survey evidence from rural India. Energy Sustain. Devel. 38, 34–47.

Barnes, B., Rosenbaum, J., Mehta, S., Williams, K.N., Jagoe, K., Graham, J., 2015. Behavior change communication: A key ingredient for advancing clean cooking. J. Health Commun. 20, 3–5.

Benka-Coker, M.L., Tadele, W., Milano, A., Getaneh, D., Stokes, H., 2018. A case study of the ethanol CleanCook stove intervention and potential scale-up in Ethiopia. Energy Sustain. Devel. 46, 53–64.

Bhogle, S., 2003. Rural women as agents of improved woodstove dissemination: a case-study in Huluvangala village, Karnataka, India. Energy Sustain. Devel. 7 (3), 70–75.

Bickerstaff, K., 2004. Risk perception research: Socio-cultural perspectives on the public experience of air pollution. Environ. Int. 30 (6), 827–840.

Bielecki, C., Wingenbach, G., 2014. Rethinking improved cookstove diffusion programs: A case study of social perceptions and cooking choices in rural Guatemala. Energy Policy 66, 350–358.

Bonjour, S., Adair-Rohani, H., Wolf, J., Bruce, N.G., Mehta, S., Prüss-Ustün, A., Lahiff, M., Rehfuess, E.A., Mishra, V., Smith, K.R., 2013. Solid fuel use for household cooking: Country and regional estimates for 1980–2010. Environ. Health Perspect. 121 (7), 784–790.

Borah, S., 2015. Physiological Workload of Hill Farm Women of Meghalaya, India Involved in Firewood Collection. Procedia Manuf. 3, 4984–4990.

Burwen, J., Levine, D.I., 2012. A rapid assessment randomized-controlled trial of improved cookstoves in rural Ghana. Energy Sustain. Devel. 16 (3), 328–338.

Champion, V.L., Skinner, C.S., 2008. The health belief model. Health behavior and health education: Theory, research, and practice, 4, 45-65. Available at: https://s3.amazonaws.com/academia.edu.documents/49289960/Health_Behavior__Health_Education_book_4th_Ed.pdf?response-content-disposition=inline%3B%20filename%3DHealth_Behavior_and_Health_Education_boo.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20200123%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20200123T140415Z&X-Amz-Expires=3600&X-Amz-SignedHeaders=host&X-Amz-Signature=7c00853a0ab67af69773986078e31aeea299b576ed208d3d0b6a004df348390c#page=83 (accessed: 10/01/2020).

Chandna, A., Honney, R., 2017. INSPiRE: an integrated approach to tackling household

air pollution and improving health in rural Cambodia. Public Health 145, 70–74.
Chen, Q., Yang, H., Liu, T., Zhang, L., 2016. Household biomass energy choice and its policy implications on improving rural livelihoods in Sichuan, China. Energy Policy 93, 291–302.
Cundale, K., Thomas, R., Malava, J.K., Havens, D., Mortimer, K., Conteh, L., 2017. A health intervention or a kitchen appliance? Household costs and benefits of a cleaner burning biomass-fuelled cookstove in Malawi. Soc. Sci. Med. 183, 1–10.
Das, I., Pedit, J., Handa, S., Jagger, P., 2018. Household air pollution (HAP), micro-environment and child health: Strategies for mitigating HAP exposure in urban Rwanda. Environ. Res. Lett. 13 (4). https://doi.org/10.1088/1748-9326/aab047.
Devakumar, D., Qureshi, Z., Mannell, J., Baruwal, M., Sharma, N., Rehfuess, E., Saville, N.M., Manandhar, D.S., Osrin, D., 2018. Women's Ideas about the Health Effects of Household Air Pollution, Developed through Focus Group Discussions and Artwork in Southern Nepal. Int. J. Environ. Res. Public Health 15 (2).
Diaz, E., Bruce, N., Pope, D., Diaz, A., Smith, K.R., Smith-Sivertsen, T., 2008. Self-rated health among Mayan women participating in a randomised intervention trial reducing indoor air pollution in Guatemala. BMC Int. Health Hum. Rights 8, 7.
Dickinson, K.L., Dalaba, M., Brown, Z.S., Alirigia, R., Coffey, E.R., Mesenbring, E., Achazanaga, M., Agao, D., Ali, M., Kanyomse, E., Awaregya, J., Adagenera, C.A., Aburiya, J.B.A., Gubilla, B., Oduro, A.R., Hannigan, M.P., 2018. Prices, peers, and perceptions (P3): Study protocol for improved biomass cookstove project in northern Ghana. BMC Public Health 18 (1).
Egondi, T., Kyobutungi, C., Ng, N., Muindi, K., Oti, S., Vijver, S., Rocklöv, J., 2013. Community perceptions of air pollution and related health risks in Nairobi slums. Int. J. Environ. Res. Public Health 10 (10), 4851–4868.
Firdaus, G., Ahmad, A., 2011. Indoor air pollution and self-reported diseases - a case study of NCT of Delhi. Indoor Air 21 (5), 410–416.
GACC (Global Alliance for Clean Cookstoves), 2017. Progress Report. Driving Demand; Delivering Impact. Available at: http://cleancookstoves.org/binary-data/RESOURCE/file/000/000/536-1.pdf (accessed: 21/12/2018).
Gebreegziabher, Z., Beyene, A.D., Bluffstone, R., Martinsson, P., Mekonnen, A., Toman, M.A., 2018. Fuel savings, cooking time and user satisfaction with improved biomass cookstoves: Evidence from controlled cooking tests in Ethiopia. Resource Energy Econ. 52, 173–185.
Goodwin, N.J., O'Farrell, S.E., Jagoe, K., Rouse, J., Roma, E., Biran, A., Finkelstein, E.A., 2015. Use of behavior change techniques in clean cooking interventions: A review of the evidence and scorecard of effectiveness. J. Health Commun. 20, 43–54.
Gordon, J.K., Emmel, N.D., Manaseki, S., Chambers, J., 2007. Perceptions of the health effects of stoves in Mongolia. J Health Organ Manage. 21 (6), 580–587.
Gould, C.F., Urpelainen, J., 2018. LPG as a clean cooking fuel: Adoption, use, and impact in rural India. Energy Policy 122, 395–408.
Granderson, J., Sandhu, J.S., Vasquez, D., Ramirez, E., Smith, K.R., 2009. Fuel use and design analysis of improved woodburning cookstoves in the Guatemalan Highlands. Biomass Bioenergy 33 (2), 306–315.
Grigsby, M., Siddharthan, T., Chowdhury, M.A.H., Siddiquee, A., Rubinstein, A., Sobrino, E., Miranda, J.J., Bernabe-Ortiz, A., Alam, D., Checkley, W., 2016. Socioeconomic status and COPD among low-and middle-income countries. Int. J. COPD 11 (1), 2497–2507.
Gupta, G., Köhlin, G., 2006. Preferences for domestic fuel: Analysis with socio-economic factors and rankings in Kolkata. India. *Ecological Economics* 57 (1), 107–121.
Hessen, J.O., Schei, M.A., Pandey, M.R., 2001. Motivational factors related to improving indoor air quality in rural. Mt. Res. Dev. 21 (2), 148–153.
Hollada, J., Williams, K.N., Miele, C.H., Danz, D., Harvey, S.A., Checkley, W., 2017. Perceptions of Improved Biomass and Liquefied Petroleum Gas Stoves in Puno, Peru: Implications for Promoting Sustained and Exclusive Adoption of Clean Cooking Technologies. Int. J. Environ. Res. Public Health 14 (2).
Hooper, L.G., Dieye, Y., Ndiaye, A., Diallo, A., Sack, C.S., Fan, V.S., Neuzil, K.M., Ortiz, J.R., 2018. Traditional cooking practices and preferences for stove features among women in rural Senegal: Informing improved cookstove design and interventions. PLoS ONE 13 (11).
IEA (International Energy Agency), 2017. Energy Access Outlook: World Energy Outlook Special Report. Available at: https://www.iea.org/reports/energy-access-outlook-2017 (accessed: 21/12/2018).
Jeuland, M.A., Bhojvaid, V., Kar, A., Lewis, J.J., Patange, O., Pattanayak, S.K., Ramanathan, N., Rehman, I.H., Tan Soo, J.S., Ramanathan, V., 2015. Preferences for improved cook stoves: Evidence from rural villages in north India. Energy Econ. 52, 287–298.
Jewitt, S., Atagher, P., Clifford, M., 2020. "We cannot stop cooking": Stove stacking, seasonality and the risky practices of household cookstove transitions in Nigeria. *Energy Research and Social.* Science 61.
Jin, Y., Ma, X., Chen, X., Cheng, Y., Baris, E., Ezzati, M., 2006. Exposure to indoor air pollution from household energy use in rural China: the interactions of technology, behavior, and knowledge in health risk management. Soc Sci Med 62 (12), 3161–3176.
Jürisoo, M., Lambe, F., Osborne, M., 2018. Beyond buying: The application of service design methodology to understand adoption of clean cookstoves in Kenya and Zambia. Energy Res. Social Sci. 39, 164–176.
Kar, A., Zerriffi, H., 2018. From cookstove acquisition to cooking transition: Framing the behavioural aspects of cookstove interventions. Energy Res. Social Sci. 42, 23–33.
Kenrick, D.T., Griskevicius, V., Neuberg, S.L., Schaller, M., 2010. Renovating the pyramid of needs: Contemporary extensions built upon ancient foundations. Perspect. Psychol. Sci. 5 (3), 292–314.
Khushk, W.A., Fatmi, Z., White, F., Kadir, M.M., 2005. Health and social impacts of improved stoves on rural women: a pilot intervention in Sindh, Pakistan. *Indoor Air* 15 (5), 311–316.
Kurmi, O.P., Lam, K.B.H., Ayres, J.G., 2012. Indoor air pollution and the lung in low- and medium-income countries. Eur. Respir. J. 40 (1), 239–254.
Malakar, Y., 2018. Studying household decision-making context and cooking fuel transition in rural India. Energy Sustain. Devel. 43, 68–74.
Malakar, Y., Greig, C., van de Fliert, E., 2018. Resistance in rejecting solid fuels: Beyond availability and adoption in the structural dominations of cooking practices in rural India. Energy Res. Social Sci. 46, 225–235.
Miah, M.D., Al Rashid, H., Shin, M.Y., 2009. Wood fuel use in the traditional cooking stoves in the rural floodplain areas of Bangladesh: A socio-environmental perspective. Biomass Bioenergy 33 (1), 70–78.
Miller, G., Mobarak, A.M., 2013 Gender Differences In Preferences, Intra-Household Externalities, And Low Demand For Improved Cookstoves. NBER Working Paper Series. Available at: https://www.nber.org/papers/w18964.pdf (accessed: 07/01/2019).
Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L.A., PRISMA-P Group, 2015. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Systemat. Rev. 4 (1). https://doi.org/10.1186/2046-4053-4-1.
Morgan, B.W., Grigsby, M.R., Siddharthan, T., Chowdhury, M., Rubinstein, A., Gutierrez, L., Irazola, V., Miranda, J.J., Bernabe-Ortiz, A., Alam, D., Wise, R.A., Checkley, W., 2019. Epidemiology and risk factors of asthma-chronic obstructive pulmonary disease overlap in low- and middle-income countries. J. Aller. Clin. Immunol. 143 (4), 1598–1606.
Morrison, V., Bennett, P., 2012. An Introduction to Health Psychology, third ed. Pearson/Prentice Hall.
Muindi, K., Egondi, T., Kimani-Murage, E., Rocklov, J., Ng, N., 2014. "We are used to this": a qualitative assessment of the perceptions of and attitudes towards air pollution amongst slum residents in Nairobi. BMC Public Health 14, 226.
Munn, Z., Peters, M.D.J., Stern, C., Tufanaru, C., McArthur, A., Aromataris, E., 2018. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Med. Res. Method. 18 (1), 143.
Okello, G., Devereux, G., Semple, S., 2018. Women and girls in resource poor countries experience much greater exposure to household air pollutants than men: Results from Uganda and Ethiopia. Environ. Int. 119, 429–437.
Pailman, W., de Groot, J., Clifford, M., Jewitt, S., Ray, C., 2018. Experiences with improved cookstoves in Southern Africa. J. Energy Southern Africa 29 (4), 13–26.
Qian, H., Zheng, X., Zhang, M., Weschler, L., Sundell, J., 2016. Associations between Parents' Perceived Air Quality in Homes and Health among Children in Nanjing, China. PLoS One 11 (5), e0155742.
Quinn, A.K., Williams, K., Thompson, L.M., Rosa, G., Díaz-Artiga, A., Thangavel, G., Balakrishnan, K., Miranda, J.J., Rosenthal, J.P., Clasen, T.F., Harvey, S.A., 2019. Compensating control participants when the intervention is of significant value: Experience in Guatemala, India, Peru and Rwanda. *BMJ Global Health* 4 (4).
Quintero-Angel, M., Mendoza, D.M., Quintero-Angel, D., 2019. The cultural transmission of food habits, identity, and social cohesion: A case study in the rural zone of Cali-Colombia. Appetite 1, 75–83.
Rehfuess, E.A., Puzzolo, E., Stanistreet, D., Pope, D., Bruce, N.G., 2014. Enablers and Barriers to Large-Scale Uptake of Improved Solid Fuel Stoves: A Systematic Review. Environ. Health Perspect. 122 (2), 120–130.
Rhodes, E.L., Dreibelbis, R., Klasen, E., Naithani, N., Baliddawa, J., Menya, D., Khatry, S., Levy, S., Tielsch, J.M., Miranda, J.J., Kennedy, C., Checkley, W., 2014. Behavioral Attitudes and Preferences in Cooking Practices with Traditional Open-Fire Stoves in Peru, Nepal, and Kenya: Implications for Improved Cookstove Interventions. Int. J. Environ. Res. Public Health 11 (10), 10310–10326.
Rothstein, H.R., Hopewell, S., 2009. Grey literature. In: Cooper, H., Hedges, L.V., Valentine, J.C. (Eds.), The handbook of research synthesis and meta-analysis, second ed. Russell Sage Foundation, New York, NY, pp. 103–125.
Rouse, J., 2002. Community participation in household energy programmes: a case-study from India. Energy Sustain. Devel. 6 (2), 28–36.
Sallis, J.F., Owen, N., Fisher, E.B., 2008. Ecological models of health behaviour. Health Behav. Health Educ. Theory, Res. Pract. 4, 465–482.
Sesan, T., 2012. Navigating the limitations of energy poverty: Lessons from the promotion of improved cooking technologies in Kenya. Energy Policy 47, 202–210.
Schlag, N., Zuzarte, F., 2008. Market Barriers to Clean Cooking Fuels in Sub-Saharan Africa: A Review of Literature. Working Paper, Stockholm Environment Institute (SEI), Stockholm, Sweden. Available at: https://pdfs.semanticscholar.org/6965/b960ed89e9d4b2514f7658c78b2aadbc73f2.pdf (accessed: 04/11/2019).
Smith, K.R., 1987. The Biofuel Transition. Pac Asian J Energy 1 (1), 13–32.
Sovacool, B.K., 2011. Conceptualizing urban household energy use: Climbing the "Energy Services Ladder". Energy Policy 39 (3), 1659–1668.
Stanaway, J.D., Afshin, A., Gakidou, E., Lim, S.S., Abate, D., Abate, K.H., Abbafati, C., Abbasi, N., Abbastabar, H., Abd-Allah, F., Abdela, J., Abdelalim, A., Abdollahpour, I., Abdulkader, R.S., Abebe, M., Abebe, Z., Abera, S.F., Abil, O.Z., Abraha, H.N., Abrham, A.R., Abu-Raddad, L.J., Abu-Rmeileh, N.M.E., Accrombessi, M.M.K., Acharya, D., Acharya, P., Adamu, A.A., Adane, A.A., Adebayo, O.M., Adedoyin, R.A., Adekanmbi, V., Ademi, Z., Adetokunboh, O.O., Adib, M.G., Admasie, A., Adsuar, J.C., Afanvi, K.A., Afarideh, M., Agarwal, G., Aggarwal, A., Aghayan, S.A., Agrawal, A., Agrawal, S., Ahmadi, A., Ahmadi, M., Ahmadieh, H., Ahmed, M.B., Aichour, A.N., Aichour, I., Aichour, M.T.E., Akbari, M.E., Akinyemiju, T., Akseer, N., Al-Aly, Z., Al-Eyadhy, A., Al-Mekhlafi, H.M., Alahdab, F., Alam, K., Alam, S., Alam, T., Alashi, A., Alavian, S.M., Alene, K.A., Ali, K., Ali, S.M., Alijanzadeh, M., Alizadeh-Navaei, R., Aljunid, S.M., Alkerwi, A., Alla, F., Alsharif, U., Altirkawi, K., Alvis-Guzman, N., Amare, A.T., Ammar, W., Anber, N.H., Anderson, J.A., Andrei, C.L., Androudi, S., Animut, M.D., Anjomshoa, M., Ansha, M.G., Antó, J.M., Antonio, C.A.T., Anwari, P., Appiah, L.T., Appiah, S.C.Y., Arabloo, J., Aremu, O., Ärnlöv, J., Artaman, A., Aryal, K.K., Asayesh, H., Ataro, Z., Ausloos, M., Avokpaho, E.F.G.A., Awasthi, A., Quintanilla, B.P.A., Ayer, R., Ayuk, T.B., Azzopardi, P.S., et al., 2018. Global,

regional, and national comparative risk assessment of 84 behavioural, 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 392 (10159), 1923–1994.
Stanistreet, S., Puzzolo, E., Bruce, N.G., Pope, D., Rehfuess, E.A., 2014. Factors influencing household uptake of improved solid fuel stoves in low- and middle-income countries: a qualitative systematic review. Int. J. Environ. Res. Public Health 11 (8), 8228–8250.
Sunikka-Blank, M., Bardhan, R., Haque, A.N., 2019. Gender, domestic energy and design of inclusive low-income habitats: A case of slum rehabilitation housing in Mumbai, India. Energy Res. Social Sci. 49, 53–67.
Takama, T., Tsephel, S., Johnson, F.X., 2012. Evaluating the relative strength of product-specific factors in fuel switching and stove choice decisions in Ethiopia. A discrete choice model of household preferences for clean cooking alternatives. Energy Econ. 34 (6), 1763–1773.
Tamire, M., Addissie, A., Skovbjerg, S., Andersson, R., Larstad, M., 2018. Socio-Cultural Reasons and Community Perceptions Regarding Indoor Cooking Using Biomass Fuel and Traditional Stoves in Rural Ethiopia: A Qualitative Study. Int. J. Environ. Res Public Health 15 (9).
Tamire, M., Addissie, A., Kumie, A., Husmark, E., Skovbjerg, S., Andersson, R., Lärstad, M., 2020. Respiratory symptoms and lung function among Ethiopian women in relation to household fuel use. Int. J. Environ. Res. Public Health 17 (1).
Taylor, M.J., Moran-Taylor, M.J., Castellanos, E.J., Elias, S., 2011. Burning for Sustainability: Biomass Energy, International Migration, and the Move to Cleaner Fuels and Cookstoves in Guatemala. Ann. Assoc. Am. Geogr. 101 (4), 918–928.
Thompson, L., Diaz, J., Jenny, A., Diaz, A., Bruce, N., Balmes, J., 2007. Nxwisen, ntzarrin or ntzo'lin? Mapping children's respiratory symptoms among indigenous populations in Guatemala. Soc. Sci. Med. 65 (7), 1337–1350.
Thompson, L.M., Hengstermann, M., Weinstein, J.R., Diaz-Artiga, A., 2018. Adoption of Liquefied Petroleum Gas Stoves in Guatemala: A Mixed-Methods Study. EcoHealth 15 (4), 745–756.
Thurber, M.C., Warner, C., Platt, L., Slaski, A., Gupta, R., Miller, G., 2013. To Promote Adoption of Household Health Technologies, Think Beyond Health. Am. J. Public Health 103 (10), 1736–1740.
Thurber, M.C., Phadke, H., Nagavarapu, S., Shrimali, G., Zerriffi, H., 2014. 'Oorja' in India: Assessing a large-scale commercial distribution of advanced biomass stoves to households. Energy Sustain. Devel. 19, 138–150.
Tigabu, A., 2017. Factors associated with sustained use of improved solid fuel cookstoves: A case study from Kenya. Energy Sustain. Devel. 41, 81–87.
Troncoso, K., Castillo, A., Masera, O., Merino, L., 2007. Social perceptions about a technological innovation for fuelwood cooking: Case study in rural Mexico. Energy Policy 35 (5), 2799–2810.
Troncoso, K., Castillo, A., Merino, L., Lazos, E., Masera, O.R., 2011. Understanding an improved cookstove program in rural Mexico: An analysis from the implementers' perspective. Energy Policy 39 (12), 7600–7608.
UNICEF, 2016. A social and behaviour change agenda for inclusion and equity in education. Available at: https://www.unicef.org/esa/media/1756/file/UNICEF-ESA-2016-Program-Brief-Education-Inclusion.pdf (accessed: 14/08/2019).
United Nations, 2000. Millennium Development Goals. Available at: https://www.un.org/millenniumgoals/bkgd.shtml (accessed: 22/12/2018).
van Gemert, F., Chavannes, N., Nabadda, N., Luzige, S., Kirenga, B., Eggermont, C., de Jong, C., van der Molen, T., 2013. Impact of chronic respiratory symptoms in a rural area of sub-Saharan Africa: an in-depth qualitative study in the Masindi district of Uganda. Primary Care Respirat. J. 22 (3), 300–305.
Wang, Y., Bailis, R., 2015. The revolution from the kitchen: Social processes of the removal of traditional cookstoves in Himachal Pradesh, India. Energy Sustain. Devel. 27, 127–136.
Weaver, A.M., Parveen, S., Goswami, D., Crabtree-Ide, C., Rudra, C., Yu, J., Mu, L., Fry, A.M., Sharmin, I., Luby, S.P., Ram, P.K., 2017. Pilot Intervention Study of Household Ventilation and Fine Particulate Matter Concentrations in a Low-Income Urban Area, Dhaka, Bangladesh. Am. J. Trop. Med. Hyg. 97 (2), 615–623.
Wijayatunga, P.D.C., Attalage, R.A., 2003. Analysis of rural household energy supplies in Sri Lanka: energy efficiency, fuel switching and barriers to expansion. Energy Convers. Manage. 44 (7), 1123–1130.
WHO (World Health Organisation), 2014. Indoor Air Quality Guidelines: Household Fuel Combustion. Available at: https://apps.who.int/iris/bitstream/handle/10665/141496/9789241548885_eng.pdf?sequence=1 (accessed: 07/04/2019).
WHO (World Health Organisation), 2019. Healthy Environments For Healthier Populations: Why Do They Matter, And What Can We Do? Available at: https://apps.who.int/iris/bitstream/handle/10665/325877/WHO-CED-PHE-DO-19.01-eng.pdf?ua=1 (Accessed: 01/04/2019).
Yang, Y., Tang, R., Qiu, H., Lai, P.C., Wong, P., Thach, T.Q., Allen, R., Brauer, M., Tian, L., Barratt, B., 2018. Long term exposure to air pollution and mortality in an elderly cohort in Hong Kong. Environ. Int. 117, 99–106.
Yonemitsu, A., Njenga, M., Iiyama, M., Matsushita, S., 2014. Household Fuel Consumption Based on Multiple Fuel Use Strategies: A Case Study in Kibera Slums. APCBEE Proc. 10, 331–340.