

2022-02-16

# Perceptions of long-term impact and change following a midwife-led biomass smoke education programme for mothers in rural Uganda: a qualitative study

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<http://hdl.handle.net/10026.1/18486>

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10.22605/RRH6893

Rural and Remote Health

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1 *Original research article*

2 **Perceptions of long-term impact and change following a midwife-led biomass smoke**  
3 **education programme for mothers in rural Uganda: a qualitative study**

4

5 **Abstract**

6 ***Introduction***

7 Women and children in Uganda and other low- and middle-income countries are exposed to  
8 disproportionately high levels of household air pollution from biomass smoke generated by  
9 smoke-producing cookstoves, especially in rural areas. This population is therefore  
10 particularly vulnerable to the negative health effects caused by household air pollution,  
11 including negative pregnancy outcomes and other health issues throughout life. The Midwife  
12 Project, a collaboration between research and health teams in the UK and Uganda, began in  
13 2016 to implement an education programme on lung health for mothers in Uganda, to reduce  
14 the health risks to women and children. Education materials were produced to guide  
15 midwives in the delivery of health messages across four rural Health Centres and mixed-  
16 methods results of knowledge questionnaires and interviews demonstrated knowledge  
17 acquisition, acceptability and feasibility. This qualitative follow-up study aimed to improve  
18 understanding of the longer-term impact of this education programme from the perspective of  
19 midwives, Village Health Team members and mothers, in consideration of rolling the  
20 programme out more widely in rural Uganda.

21 ***Methods***

22 Purposive sampling was carried out to recruit consenting antenatal or postnatal women,  
23 midwives and Village Health Team members who had been involved in an education session.  
24 Individual interviews were conducted with twelve mothers and four Village Health Team

25 members, and four focus groups were conducted with ten midwives in total. Interviews and  
26 focus groups were conducted across all four Health Centres by two researchers and six  
27 translators as appropriate depending on language spoken (English or Lusoga). These were  
28 semi-structured and directed by topic guides. Reflective and observational notes were also  
29 made. A thematic analysis was carried out by two researchers, along with production of a  
30 narrative for each mother to enrich understanding of each individual story.

### 31 *Findings*

32 Midwives and Village Health Teams had continued with the programme well past the project  
33 end date and all mothers expressed making, or intending to make, changes, suggesting long-  
34 term feasibility and acceptability. Main themes generated were: ability to change and changes  
35 made, ability to change dictated by money, importance of practical education, perceived  
36 health improvements, and passing on knowledge. Additional findings were that some  
37 education topics appeared overlooked, and there was a lack of clarity about the Village  
38 Health Team role for the purposes of this programme. Some mothers had been motivated to  
39 overcome financial barriers, for example, by reconstructing cooking areas cheaply  
40 themselves. However, information given in the programme about building advice and  
41 potential financial gains was inconsistent.

### 42 *Conclusions*

43 Recommendations for future biomass smoke education should include explicit building  
44 advice, emphasis on financial gains, encouragement to share the knowledge acquired, and  
45 clarification of the Village Health Team role. These programme changes will improve focus  
46 and relevancy, optimise impact, and with behaviour change and implementation strategy in  
47 mind, could be used for widespread roll-out in rural Uganda. Future research should include  
48 quantitative data collection to objectively examine surprising perceived health benefits,

49 including reduction in malaria and burns, and further qualitative work on why some  
50 education content appears neglected.

51

52 **Keywords:** Household air pollution; cookstove; implementation; health intervention; sub-  
53 Saharan Africa, lung health, maternal health.

54

## 55 **Introduction**

56 Globally, household air pollution is responsible for 3.8 million deaths per year, over 700,000  
57 of which are in Africa[1,2]. Three billion people, mostly in low- and middle-income countries  
58 (LMICs) like Uganda, use biomass fuel (any organic matter, such as wood and dung), for  
59 cooking, using cookstoves that create household air pollution and lead to adverse health  
60 outcomes. Household air pollution is linked to three of the top five causes of death in  
61 Uganda: neonatal death, respiratory infection and tuberculosis[3,4], as well as negative  
62 pregnancy outcomes (e.g. low birth weight)[5] and other non-communicable diseases like  
63 chronic obstructive pulmonary disease (COPD), heart disease, lung cancer, stroke, and a  
64 twofold increase in risk of childhood pneumonia[1]. The negative health impacts of air  
65 pollution have implications for babies in utero and onwards throughout life[6].

66 Eighty-four percent of the Ugandan population live rurally[7] where on average, women  
67 work a disproportionately higher number of hours per day compared to men (15:8), as  
68 women carry out most of the family responsibilities, including cooking, in addition to  
69 agricultural work[8]. Ninety percent of Ugandans rely on wood for cooking fires, and women  
70 and children can spend up to 9 hours a day in small, smoky, poorly-ventilated kitchens  
71 burning biomass fuels as well as being exposed to other sources of air pollution, such as  
72 burning rubbish. Women and children are therefore particularly vulnerable to the negative  
73 health effects caused by air pollution[9-11].

74 The Midwife Project, a novel implementation study, began in 2016 in response to these  
75 health risks[12]. It was felt that midwives were in an ideal position to reach women and  
76 children, with the aim of targeting health from in utero onwards to reduce lifelong risks, in an  
77 attempt to alter health behaviours from childhood onwards. Researchers from the UK and  
78 Uganda collaborated with midwives from the Jinja region of southern rural Uganda to  
79 produce educational materials in the form of a flipchart, poster and leaflet (see Appendix A)  
80 for midwives and Village Health Teams (VHTs, voluntary members of the community who  
81 assist with health education and care outside of the Health Centre environment) to deliver to  
82 antenatal and postnatal women with the aim of reducing exposure to biomass smoke. These  
83 materials were approved by the Ministry of Health in Uganda.

84 Midwives were recruited from four randomly-selected Health Centre IIIs (rural facilities that  
85 provide outpatient and maternity care) in Jinja: Busede, Lukolo, Mpambwa and Wakitaka,  
86 and VHTs from the four corresponding villages were educated by midwives to reinforce  
87 topics in the community. Delivery was intended to be as often as healthcare workers  
88 (midwives and VHTs) felt able to, and to as many mothers as possible, between April and  
89 June 2018. Topics included: sources of biomass smoke, health risks, cookstove improvement  
90 and placement, improving kitchen ventilation, improving fuels, and avoiding other sources of  
91 smoke (e.g. smoking, burning rubbish).

92 The Midwife Project originally aimed to examine: i) feasibility and acceptability; and ii)  
93 whether knowledge, attitudes and behaviours were changed. This was assessed with mixed  
94 methods: quantitatively with a before-and-after knowledge questionnaire for midwives,  
95 VHTs and mothers, and qualitatively, with 21 mothers interviewed. The qualitative  
96 assessment focused on education session content, and barriers and facilitators to attendance  
97 and engagement. Mothers found the intervention to be acceptable, although the main barrier  
98 was lack of money, which prevented them from being able to afford transport to attend the

99 Health Centre and to buy materials for making changes. The education programme was  
100 assessed as feasible, and knowledge was increased across all topics for healthcare workers  
101 and mothers alike[12].

102 The overall objective of The Midwife Project was to design a health-improving education  
103 programme suitable for wider roll-out across Uganda. A 2015 systematic review of improved  
104 cookstove interventions concluded that longer-term follow-up periods are necessary to assess  
105 sustainability[13], but impact and viability past the end date of the original Midwife Project  
106 had not been examined, including if and how educational content had been shared between  
107 communities, outside of the Health Centre setting. Therefore, this follow-up study aimed to  
108 address the following research questions:

- 109 • What is the ongoing impact of this education programme on behaviour change from  
110 the perspective of women and healthcare workers involved in this programme?
- 111 • How has the programme affected health from their perspective?
- 112 • Is programme content being shared amongst the community, how is it being shared,  
113 and what is the impact of this?
- 114 • Are any changes to programme content required in consideration of widespread roll-  
115 out?

116 In the original study, only mothers had been interviewed. For this follow-up study, it was  
117 essential to assess the views of healthcare workers as well to understand the impact on  
118 healthcare delivery in this context.

119

## 120 **Methods**

121 The Standards for Reporting Qualitative Research guidelines[14] were used to guide  
122 reporting (See Appendix B).

## 123 ***Sample***

124 To enable pragmatic recruitment, purposive sampling was carried out by the research team at  
125 the Makerere University Lung Institute in Kampala and the District Health Office in Jinja.  
126 Eligible participants were consenting antenatal or postnatal women, midwives, and VHTs  
127 who had previously attended or delivered an education session on biomass smoke. As the UK  
128 team could not easily return to collect more data, it was agreed beforehand between  
129 researchers that 3 mothers, 2-3 midwives and 1 VHT per Health Centre would be a sufficient  
130 number to balance practical considerations (e.g. time limitation) with the need to assess a  
131 range of experience and perspectives.

### 132 *Data collection*

133 Whilst it was originally intended to carry out interviews only, focus groups were conducted  
134 with midwives to minimise the impact on their time, as they had high patient caseloads at the  
135 time of data collection. Due to these time and access constraints, it was not possible to recruit  
136 off-duty midwives. All other participants were interviewed individually.

137 All interviews and focus groups took place over two days in February 2019 at the Health  
138 Centres in Lukolo, Wakitaka, Busede and Mpambwa in Jinja by two researchers and with the  
139 assistance of six translators as per availability. Translation was not necessary for midwives as  
140 they all spoke English. For translated interviews, questions were asked in English, then  
141 translated into Lusoga, the local dialect. The answer was given in Lusoga and then translated  
142 back to English. Attempts were made during interviews with mothers to encourage rapport  
143 with more familiar body language[15].

144 Interviews and focus groups were semi-structured and directed by topic guides tailored for  
145 each group (see Appendix C). They were recorded with a password-protected audio-recorder,  
146 saved onto a password-protected laptop at the end of each day and then deleted from the  
147 audio-recorder. Reflective and observational notes were made by both researchers at the end  
148 of each day.

149 Twelve mothers who had attended the education programme were interviewed, 3 per Health  
150 Centre. The time between first session attendance and interview ranged between 3 and 16  
151 months. Four focus groups were conducted with 10 midwives in total, 2-4 per Health Centre  
152 (all female), and interviews with 4 VHTs (2 male, 2 female), one per Health Centre.  
153 Interviews and focus groups took similar times to conduct, with a range between 17 and 36  
154 minutes and an average of 27 minutes.

155 A second opportunistic visit to all four Health Centres was made in October 2019, while  
156 researchers were visiting for another research project. Informal discussions were held with  
157 combined groups of 12-14 midwives and VHTs, during which similar topics were covered to  
158 further examine similarities and differences in views, and changes to practice. Notes from  
159 these meetings were incorporated into the analysis.

### 160 *Analysis*

161 A qualitative thematic analysis approach was adopted following Braun & Clarke's suggested  
162 6 stages of thematic analysis: reading and familiarisation, coding across entire dataset,  
163 searching for themes, reviewing themes, defining and naming themes, and writing/finalising  
164 analysis[16]. Constant comparison was utilised throughout analysis by comparing new  
165 concepts with existing ones[17].

166 Verbatim transcription and familiarisation of interviews and focus groups was carried out by  
167 the lead author, and coded thematically using NVivo 12 Pro. There were two coding groups,  
168 one for mothers and another for healthcare workers, to separate out the different perspectives.  
169 Transcripts were initially coded in NVivo, then codes were refined into more coherent themes  
170 and sub-themes. Where questions appeared to deviate from the topic guide in a leading way,  
171 a judgement was made about whether the response seemed unbiased, but responses to these  
172 questions were largely omitted. From each transcript, a narrative 'story' for each mother was  
173 also summarised separately, which provided context and a coherent picture for each woman,

174 to aid understanding of their individual motivations, thus further supplementing concept  
175 development.

176 A second researcher independently generated themes from a sample of transcripts, and this  
177 aided in corroboration of the thematic framework. The visit notes made during both trips in  
178 February and October 2019 were cross-referenced to identify any thematic corroboration or  
179 contrast. Illustrative quotes for this manuscript were chosen and anonymised for reporting by  
180 the lead author.

### 181 *Ethics approval*

182 Primary ethical approval was obtained in 2016 from the Mulago Hospital Research and  
183 Ethics Committee, Kampala as part of the FRESH AIR giant protocol (MREC 971, trial  
184 ID: NTR5759). A renewal of this approval was obtained for this study in February 2019. All  
185 participants provided written informed consent before participation.

186

### 187 **Findings**

188 Whilst the education programme was originally intended to be delivered between April and  
189 June 2018, midwives and VHTs reported in both February and October 2019 that they were  
190 continuing to deliver it frequently. However, only one mother mentioned VHT input during  
191 the February interviews and this was because they had directed her to an education session  
192 but not provided education themselves. Although there was a very wide range of topics  
193 learned, some aspects were not mentioned at all by mothers or healthcare workers: COPD,  
194 using a kitchen hood, more efficient cooking methods (e.g. using a lid to reduce cooking time  
195 and thus reduce the amount of smoke produced), tobacco-smoking, burning leaves as an  
196 insect repellent, not burying plastic in the ground, and adding eves space for ventilation.  
197 Thematic[16] and narrative analysis generated five broad themes as reported below.

198 Illustrative quotes appear in the third person for mothers and VHTs, as interviews were  
199 translated in this way.

200

201 ***Ability to change and changes made***

202 Most women reported being able to make changes, the most common of which were to the  
203 cooking area itself (reconstructing the ‘traditional’ cooking place of a cooking pot balanced  
204 on three large stones, to a more stable and efficient construction), changes to kitchen  
205 ventilation (increasing window space and installing chimneys), and staying away from smoke  
206 for both themselves and their children:

207

208 *Now what she has learnt, or ever since she had knowledge about the smoke from the*  
209 *midwives, she now has improved on her cooking place, she has now learnt she should*  
210 *not sit with her children in the kitchen while cooking, as well as she should also not sit*  
211 *in there while cooking ... that she has to get out, get fresh air and only check on what*  
212 *she’s cooking ... She has constructed her cooking facilities with an improved stove.*  
213 *Instead of the ordinary three stones.*

214 [MMo1]

215

216 Some women also reported no longer burning rubbish, and changes to lighting from candles  
217 or kerosene to solar-powered. Some expressed wanting to make further changes if possible,  
218 although there were financial barriers that had prevented them from doing so yet, as reported  
219 below.

220

221 ***Ability to change dictated by money***

222 Most mothers reported crop-growing as their main livelihood, with some acquiring additional  
223 money by other means in order to pay for suggested kitchen improvements. This included  
224 selling snacks or firewood, obtaining crop money from their husband, growing additional  
225 crops to sell, and borrowing from the bank. However, some mothers had specific business  
226 ideas (e.g. selling clothes) but no money to move this forward.

227 Money as a barrier to change was also expressed by most healthcare workers, particularly  
228 with regard to the unaffordability of charcoal and gas as substitutes for firewood, something  
229 also mentioned by mothers. However, some mothers reported that by improving their  
230 cookstove, money was actually saved by buying less firewood and reducing medical costs to  
231 treat negative health impacts caused by smoke exposure:

232

233 *She says that she now rarely goes to seek medical treatment as it used to be because*  
234 *there is great improvement ... not as much as she used to do. She says that it has cut*  
235 *on the costs and it has made her see, even when it comes to maybe buying firewood.*

236 *Because this modern stove requires little firewood compared to the other one whereby*  
237 *one has to keep lots of firewood.*

238 [MMo3]

239

#### 240 ***Importance of practical education***

241 Some mothers reported attending multiple education sessions, up to four times, an  
242 unexpected finding and something that was not an intended outcome. This mostly appeared to  
243 be in an attempt to gain practical information about *how* to make changes, for instance, how  
244 to build a different cookstove, an element that is missing from the education material:

245

246 *But she has heard it twice. They were first given information, then they came and they*  
247 *were told how to improve on their cooking places.*

248 [MMo1]

249

250 The mothers who did report being given practical information had been able to make changes  
251 themselves or even educate others practically, in a resourceful, cost-effective way:

252

253 *She has told her friends, her neighbours. But some of them have requested her to go*  
254 *and construct for them. Because she has the knowledge and has constructed her*  
255 *place. She teaches them how to prepare, for example, the mud where they get bricks*  
256 *from. And then, when they are prepared, she goes and constructs for them. And tells*  
257 *them how to look after it.*

258 [WMo3]

259

260 *She says that she didn't put in anything like money but it is only the knowledge that*  
261 *she got together with her friends because they were taught how to do it. And together*  
262 *with her friends set up a group, they went and used local materials to construct. They*  
263 *did it themselves because she didn't bring in anybody to make it for her, she did it*  
264 *herself. Because she had no money, so she used the local materials and she*  
265 *constructed it there herself. They had groups of five. So they would construct one*  
266 *home and then when it was sorted they go to another home and another home after*  
267 *that.*

268 [Mmo1]

269

270 However, whilst there were consistent reports that some people were setting up groups and  
271 using cheap, local materials to construct, healthcare workers also acknowledged that others  
272 did not have the practical understanding to be able to do this:

273

274 *In addition to telling people what to do, we need to take action. We need to teach*  
275 *them exactly what the stoves look like. Because some of them don't know the*  
276 *techniques.*

277 [VHT3]

278

279 Furthermore, healthcare workers recognised that there was misunderstanding about the  
280 importance of having two windows for ventilation[18] (as per programme content) rather  
281 than one, and this is reflected in the interviews with mothers:

282

283 *But she says that, maybe what she did, she put in there only one window but it is wide*  
284 *... she has no specific reason. She just wanted one big window. Maybe she needs to be*  
285 *educated more about the need for two windows.*

286 [WMo1]

287

### 288 ***Perceived health improvements***

289 Most women interviewed either had no knowledge of the dangers of biomass smoke exposure  
290 prior to attending an education session, or had heard from their community about the health  
291 risks associated with it, but didn't believe it. Some stated that they believed the health risks  
292 after attending an education session with the midwives, and others reported that they  
293 themselves or others had only taken it seriously after experiencing the negative health  
294 consequences they had heard about:

295

296 *There is one she used to tell and she refuses and refuses. But when she [mother]*  
297 *fainted, that very person has said now 'I will stop'.*

298 [LMo3]

299

300 One midwife reported that she had noticed differences in pregnancy outcomes for the same  
301 women, before and after education, and other midwives stated that once they had the  
302 knowledge, they realised the link between smoke and specific health problems in patients:

303

304 *It was interesting, we are getting knowledge of which we are not aware. Because we*  
305 *are getting abortions [miscarriages], when you do investigation, you don't see the*  
306 *cause of that. So now we are getting some abortion [miscarriage], this is biomass*  
307 *smoke. We've got that information. That knowledge.*

308 [MMi1]

309

310 For healthcare workers, perceived health improvements for both mothers and themselves  
311 included reduced coughing, tuberculosis, pneumonia, pregnancy- and baby-related illness,  
312 asthma, rash and breathing difficulties. Mothers reported perceived health improvements in  
313 breathing, respiratory infections, bleeding during pregnancy, fainting, coughing and flu. More  
314 surprising findings included healthcare workers' perceived reduction in burns for children,  
315 and in malaria by both mothers and healthcare workers.

316

### 317 ***Passing on knowledge***

318 Eleven of the 12 mothers reported educating others about biomass smoke (with the 12<sup>th</sup>  
319 intending to now that she had taken the content seriously), and whilst it was reported that

320 most people had reacted positively to this and had made changes, some had again  
321 experienced a financial barrier. Some mothers seemed unsure about passing the knowledge  
322 on more widely:

323

324 *She has passed on the information to her immediate relatives. And she says that if she*  
325 *gets anything new and if she learns more, she is going to start telling the community.*  
326 *She says that she could, but maybe when we come back just as you've now come, you*  
327 *could give them more information before she is able to go out into the community.*

328 [BMo2]

329

330 Several healthcare workers stated that they had encouraged mothers to share knowledge from  
331 this project with their community and that they had seen evidence of this happening. Both  
332 midwives and VHTs stated that obtaining money for transport was the biggest barrier to them  
333 sharing the education more widely, with the local community areas being geographically very  
334 large. However, this may differ between Health Centres, with one VHT conversely stating  
335 they felt in a good position to communicate with 'masses' of people. Healthcare workers  
336 expressed a desire to spread the message to other healthcare workers, communities, schools  
337 and churches.

338

## 339 **Discussion**

### 340 *Main findings*

341 **Themes:** The altered behaviours of healthcare workers and mothers suggest that this  
342 programme was successful in delivering its key messages of: (i) the health risks associated  
343 with household air pollution and; (ii) how to improve the home environment or avoid smoke  
344 to reduce air pollution exposure. Healthcare workers had continued to deliver this education

345 long past the project end date, which was not a set expectation, suggesting acceptability and  
346 feasibility for sustained implementation. All mothers described their ability and desire to  
347 make changes to avoid biomass smoke in order to prioritise their health and the health of their  
348 families, even if lack of money had prevented them from changing everything they would  
349 have liked to. This included construction changes to cooking areas and housing ventilation,  
350 no longer burning rubbish, and change to solar power for lighting.

351 There were some inspiring resourceful stories from mothers about the ways in which they  
352 had overcome financial barriers, by making additional funds and/or together as a community,  
353 using cheap, local materials to construct new cooking areas themselves. Significantly, this  
354 shows that changes can be made in this context without the need to spend much money, and  
355 some experiences reflect actual financial benefits from using less firewood and spending less  
356 on medical bills. Many women also reported staying away from smoke, a completely free  
357 option. However, not all mothers had been given practical information, and it would seem  
358 that those making changes had only been able to do so by having explicit building advice,  
359 including how to do it cheaply or for free, suggesting inconsistency in healthcare worker  
360 knowledge.

361 There was some suggestion of health improvements, and it is interesting to note that some  
362 mothers reported only taking biomass smoke education seriously after experiencing or  
363 witnessing health effects. However, quantitative research would be needed to explore the  
364 validity of these subjective views. The repeated mention of malaria reduction was surprising  
365 as it was not an expected health improvement in relation to reduction in biomass smoke  
366 exposure. There are several possible explanations for this:

- 367 1. There could have been a misconception regarding what constitutes malaria and  
368 perhaps the opportunity to clarify this was missed.

- 369 2. The use of mosquito coils, which produce smoke, is one of the education topics.  
370 Several mothers stated that they had changed from using a coil to mosquito net and it  
371 could be that this provides better protection.
- 372 3. Malaria incidence is reducing in this population regardless[19].
- 373 4. It is possible that a reduction in biomass smoke exposure improves health generally  
374 and, in turn, malaria resistance.
- 375 5. Malaria is one of the leading causes of death in Uganda[20] and is therefore well-  
376 recognised; it could be that mothers mentioned it due to social desirability bias -  
377 reporting what they assumed they should (discussed further below).

378 There were also unexpected reports from midwives of fewer burns in children, which was  
379 attributed by them to improved cooking areas. Traditionally, the three-stone cookstove is  
380 located in a small, dark kitchen and can be very unstable and dangerous. With changes in  
381 construction and location, it is possible that children were being burned less.

382 Analysis of how education was shared demonstrated that not all mothers felt empowered to  
383 pass information on to others; midwives and VHTs could encourage communities to share  
384 education with as many people as possible and thus reduce unnecessary Health Centre  
385 attendance. There is, however, a risk of messages becoming distorted, and it is therefore  
386 important that the education being given is clear and consistent, and that VHTs reinforce the  
387 correct messages in the community. Despite healthcare workers being keen to share  
388 information more widely in places like schools and churches, there was already possible  
389 miscommunication evident, such as the misunderstanding of the need for two windows rather  
390 than one[18]. There further seemed to be misunderstanding of the VHT role in sharing  
391 education for this project, with midwives stating that they would like to go into the villages to  
392 educate people and one woman reporting that a midwife had visited her at home to  
393 ‘supervise’ changes. Whilst this demonstrates enthusiasm and could be useful, this should be

394 the remit of the VHTs. It is interesting that mothers did not really mention VHTs as having an  
395 educational role; this may not have been made clear, or could highlight a gap in VHT  
396 training.

397 **Implications:** Whilst money was perceived by some as a barrier to change, we suggest that  
398 the simple option of staying away from smoke, along with potential financial benefits, could  
399 be emphasised more to alter this perception. The inclusion of practical information in all  
400 education sessions could reduce the need for multiple session attendance, which was not an  
401 original intention of the programme, thus reducing the time and cost burden for both mothers  
402 and midwives. Together, this would ensure all participants are given the same message and  
403 equal opportunity to make changes and would be invaluable for future implementation of this  
404 programme and possibly other similar public health interventions in low-resource settings.

405 A further adaptation to programme content could be a review of education topics. There was  
406 a consistent focus on some education topics, while others were not mentioned at all; further  
407 qualitative interviews with healthcare staff and mothers could help to establish why this has  
408 happened. It could be that there are too many topics to focus on, understanding is limited in  
409 certain areas, the least useful topics as perceived by midwives are left out, or that mothers are  
410 not receptive to some ideas. Adaptation could therefore be warranted to make the education  
411 as focused and useful as possible. To optimise reach and impact, it is further important that  
412 women are empowered to share what they have learned and that the educational role of VHTs  
413 is clear to all.

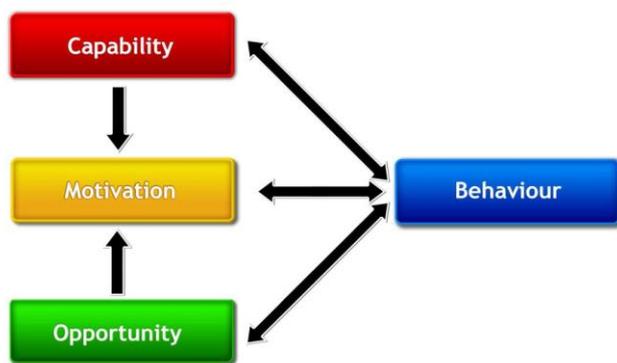
414 The Midwife Project is a novel education programme; as stated by the researchers involved,  
415 it is the first of its kind to utilise midwives in delivering health education on biomass  
416 smoke[12]. There is a knowledge and literature gap for examining implementation of this  
417 type of public health education programme in Uganda, and indeed across Africa and in other  
418 LMICs. This follow-up study therefore informs understanding of how co-produced health

419 education can be implemented and replicated in similar settings and for other health topics. A  
420 recent scoping review of health screening interventions in sub-Saharan Africa concluded that  
421 more effective interventions included those utilising community health educators and those  
422 targeting financial barriers[21]. The Midwife Project has included VHTs to educate the  
423 community, and this follow-up study has demonstrated how financial barriers can be  
424 overcome in this context.

425 Other studies aiming to reduce biomass smoke seem to focus only on the outcomes of  
426 providing improved cookstoves. However, two recent studies suggest that more needs to be  
427 done than simply introducing ‘cleaner’ cookstoves, by taking behaviour change into  
428 consideration and improving implementation strategy, aspects that have been neglected in  
429 previous interventions, and which can help to improve sustained change[22,23]. A 2018  
430 systematic review and meta-analysis demonstrated varying effectiveness for health  
431 improvement following cookstove improvement, but did not examine the behaviour change  
432 and implementation implications behind this; inconsistent effectiveness of alternative  
433 cookstoves could be due to neglect of these important factors[24]. The Midwife Project  
434 therefore benefits both from taking behaviour change into account, by allowing women the  
435 autonomy of making adaptable and resourceful changes for themselves rather than just  
436 providing a different cookstove, and by employing an iterative implementation strategy  
437 involving midwives, VHTs and local communities at every stage.

438 Michie et al.’s COM-B framework for understanding behaviour (see Figure 1)[25] suggests  
439 that behaviour is influenced by capability, motivation and opportunity. It could be argued that  
440 the mothers making the most impactful changes were motivated by the education session(s)  
441 they attended, had capability by having the knowledge and skills to make changes, and  
442 opportunity by making additional money and/or having access to local materials.

443



444

445

446 The Midwife Project did provide evidence of increased knowledge in the original study, as  
 447 did another awareness-raising education project for healthcare workers in rural Uganda in  
 448 2014[26]. However, a recent review of education programmes for midwives in LMICs  
 449 showed lack of evidence that knowledge acquisition alone correlated with behaviour change  
 450 or improved outcomes for women and children[27]. By taking behaviour change and  
 451 implementation strategy into account, this follow-up study has demonstrated a different  
 452 outcome in that behaviours have changed for those with capability, motivation and  
 453 opportunity, and therefore there is additional potential for improved health outcomes.  
 454 Utilising midwives to deliver other health-related messages in this way could be an impactful  
 455 method for other public health interventions in Uganda and beyond.

456

457 ***Strengths and limitations of this study***

458 Participants were interviewed from four Health Centres spanning a large area of Jinja. The  
 459 sample therefore represented a diversity of experiences in this region, a strength of this  
 460 follow-up study that potentially optimises transferability for widespread roll-out.  
 461 It is possible that there was some sampling bias in that mothers may have been chosen  
 462 because of their enthusiasm to take part, and therefore they were more likely to express  
 463 positivity. It was not feasible for the UK team to organise recruitment and so this is a

464 potential limitation that we were aware of from the start; attempts were therefore made to  
465 minimise sampling bias through liaison with the Ugandan research and healthcare teams  
466 responsible for recruitment. There is also the possibility of social desirability bias in that  
467 mothers and healthcare workers alike may have stated what they felt we wanted to hear in  
468 order to gain approval, especially due to our differences in socioeconomic backgrounds; there  
469 was some evidence of recitation of education topics rather than answering the questions. One  
470 translator was the District Health Officer for women's services in the region, whose presence  
471 may have increased this bias further by being a figure of authority. However, the topics  
472 recited were the same for both mothers and healthcare workers, at least demonstrating a  
473 consistency in the topics being taught and received. Attempts were made during interviews to  
474 balance encouragement with not praising responses too much in order to minimise this bias.

475

#### 476 *Recommendations for future research and practice*

477 Based on the findings of this research, the following recommendations are made for  
478 amendments to the programme:

- 479 1. Inclusion of affordable, practical building information in education sessions,  
480 including an emphasis of the importance of having two windows.
- 481 2. More emphasis during education on overcoming financial barriers: for example, (i)  
482 staying away from smoke is free; (ii) it is cheaper overall to improve the kitchen than  
483 pay for ongoing firewood and medical costs.
- 484 3. Emphasis on the benefits of (consistent) dissemination of learning to others.
- 485 4. The role of VHTs to be made clearer to midwives, mothers, and VHTs themselves.

486 Additionally, further research is recommended in the followings areas:

- 487 1. Further qualitative work to review why some topics are being neglected and whether  
488 some items need clarification, or removal altogether.

489 2. Whilst the health benefits of improved cooking conditions have been evidenced  
490 elsewhere[28], the experience of health benefits in this study is subjective and cannot  
491 be relied upon alone; this would need to be triangulated with objective pre- and post-  
492 education quantitative data collection related to health impacts and outcomes,  
493 including malaria and burns. The District Health Office in Jinja has been contacted to  
494 assist in obtaining this data, although this is currently on hold due to COVID-19.

495

## 496 **Conclusions**

497 In an area for which there is very limited literature, this follow-up study has improved  
498 knowledge and understanding of the longer-term impact of a midwife-led health education  
499 intervention and has shown that behaviour change and implementation strategy are important  
500 factors in enabling change in this context. Based on our findings, adaptation to educational  
501 messages for this programme would optimise impact for women in rural Uganda and could  
502 be used for widespread roll-out. The Midwife Project strategy could have impact both for  
503 reducing biomass smoke exposure and therefore improving health, but also be used for other  
504 health-related interventions in low-resource settings. Further research is needed to enable  
505 refinement of education topics and to examine health benefits.

506

## 507 **Acknowledgements**

508 Funding for this study was supported by the Global Challenges Research Fund.  
509 Authors would like to thank the research team at the Makerere Lung Institute and the District  
510 Health Office in Jinja for their invaluable help with recruitment and the organisation of visits  
511 to Uganda in February and October 2019, and the mothers, midwives and VHTs in Busede,  
512 Lukolo, Mpambwa and Wakitaka for their time and continued help in understanding  
513 implementation of The Midwife Project.

514 This is independent research supported by the National Institute of Health Research Applied  
515 Research Collaboration South West Peninsula. The views expressed in this publication are  
516 those of the authors and not necessarily those of the National Institute for Health Research or  
517 the Department of Health and Social Care.

518

### 519 **Author contributions**

520 LLC, JF, LEC and RJ designed the study. LLC and RJ conducted the interviews and focus  
521 groups. LLC analysed the data and JF provided additional analytical input. LLC interpreted  
522 the findings and drafted the manuscript. JF, LEC, RJ and RN provided critical revision of the  
523 manuscript.

524

### 525 **Data availability statement**

#### 526 *Data*

527 Anonymised interview transcripts are available on request.

#### 528 *Coding*

529 The complete NVivo 12 Pro coding structure and narrative summaries are available on  
530 request.

531

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## 629 **Figure Legends**

630 Figure 1. The COM-B (Capability Opportunity Motivation-Behaviour) system – a framework  
631 for understanding behaviour

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644 **Appendices**

645 *Appendix A. Education materials*

646 *Flipchart*

**THE IMPORTANCE OF HOUSEHOLD AIR POLLUTION EXPOSURE REDUCTION**  
FLIP CHART FOR HEALTH WORKERS (MIDWIVES)

647

**CONTENTS**

- What is biomass smoke? ..... 4
- Sources of biomass smoke ..... 6
- Who is most affected by biomass smoke ..... 8
- Effect of household air pollution/biomass smoke ..... 10
- How to prevent/reduce exposure to smoke ..... 12
- Common types of cooking methods, fuel and alternatives that reduce smoke ..... 14
- Other sources of household smoke and how to reduce exposure to them ..... 16
- Benefits of reducing exposure to biomass smoke/household air pollution ..... 18

**TIPS**

- Best used in a clinic setting for one to one or small (5-12 people) community outreach.
- Make sure that the client can see the images while you explain.
- Point to the illustrations as you talk- while you read the text behind.

**ADVICE ON DELIVERING THE MESSAGE**

- Make the client feel welcome and relaxed to talk to you openly.
- Face your clients while talking.
- Ask questions and encourage discussion- especially about their desires and experience.
- Keep checking that the clients understand you (e.g. ask if they can repeat what you previously told them).
- Ask the clients if they have any questions to ask you.

**HOW TO USE THIS FLIP CHART**

1. Your client may ask you questions. Use the frequently asked questions section to guide your answers.
2. Remember to always refer them to nearby facilities in case you have conducted the health education in the community.

**INTRODUCTION.**

Research has shown a relationship between pregnancy-related complications (pre-eclampsia, pre-mature labour, antepartum haemorrhage), poor newborn (low birth weight, and neonatal deaths), and exposure to biomass smoke. In addition, the high levels of particulate matter, carbon monoxide and other pollutants in the environment, have been associated with increased occurrence of acute respiratory tract infections, pneumonia, asthma attacks and poor lung function in young children. Thus there is evidence that people of all ages are at risk from biomass smoke exposure. The greatest damage to a child's lungs occurs during pregnancy and infancy.

In order to ensure proper lung growth and reduce infant mortality from respiratory tract problems, interventions to reduce exposure to biomass smoke during

pregnancy and early childhood are needed. Furthermore, reduction of exposure to biomass smoke among pregnant mothers leads to other benefits such as reduced exposure in children because, in many communities, the children are always in close contact with their mothers as they (mothers) do their household chores including cooking.

In a study in Uganda we have shown that many people are widely exposed to biomass smoke throughout their lifetime, and this has been associated with many respiratory diseases and impaired lung function, especially in younger women.

Midwives have unrivaled access to pregnant women and already have dedicated education sessions which are very well attended. However, they currently do not offer any education sessions on biomass smoke mainly due to lack/low awareness about the effects of biomass exposure and its impact on pregnancy outcomes and child health.

This flip chart therefore is to be used by midwives to conduct health education sessions during ANC and PNC clinics with clients.

**WHAT IS HOUSEHOLD AIR POLLUTION?**

Household Air Pollution refers to chemical, biological and physical contamination of the air inside the houses, including kitchens indoor air. It can lead to adverse health effects in people of all age groups. Household Air Pollution (HAP) from biomass smoke is a major public health especially in low-income countries, where more than 90% of households use biomass for cooking, lighting and heating.

Household air pollution is a major public health problem

**KEY MESSAGES**

**Note: Always remember to give these take away messages to the audience after every session.**

- Always attend ANC appointments for monitoring of your pregnancy.
- Avoid staying in the kitchen for long hours while cooking.
- Keep babies and young children away from the smoke/kitchen.
- The effects of the smoke may not be immediately visible but are very detrimental/harmful to the baby's/mother's health.

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**WHAT IS BIOMASS SMOKE?**



**WHAT IS BIOMASS SMOKE?**

Biomass is any organic matter- wood, crops, seaweed, animal waste that can be used as a source of energy.



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**SOURCES OF BIOMASS SMOKE.**



**SOURCES OF BIOMASS SMOKE.**

- The major sources of biomass smoke are:
- Firewood,
  - Charcoal,
  - Crop residues and
  - Dung from animals.

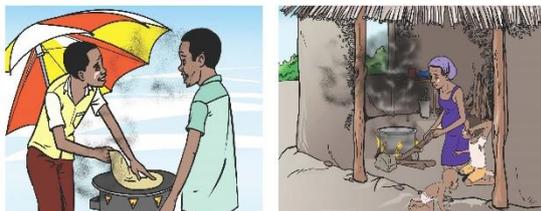
**OTHER SOURCES OF HOUSEHOLD AIR POLLUTION.**

- Apart from the above sources of household air pollution through exposure to biomass smoke, there are other sources like:
- Tobacco smoke,
  - Using kerosene lamp (tadocaa),
  - Using wax candles.



650

**WHO IS MOST AFFECTED BY BIOMASS SMOKE.**



**WHO IS MOST AFFECTED BY BIOMASS SMOKE.**

Women and young girls. This is because of the traditions and cultures that require them to cook and spend a long time doing so hence prolonged exposure to biomass smoke.

In addition, young children are affected by biomass smoke because of their close contact with their mothers and young girls through the day.



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**EFFECT OF HOUSEHOLD AIR POLLUTION/BIOMASS SMOKE.**



**EFFECT OF HOUSEHOLD AIR POLLUTION/BIOMASS SMOKE.**

- In pregnancy**
- Growth of baby is slowed, hence giving birth to small babies.
  - Increased risk of premature births.
  - Increased risk of stillbirth.
  - Increased risk of antipartum hemorrhage.
  - Increased risk of pre-eclampsia.
- In children**
- Increased risk of:
- Acute respiratory tract infections.
  - Pneumonia.
  - Asthma.
  - TB.
- In adults**
- Increased risk of:
- Asthma.
  - COPD- Chronic Obstructive Pulmonary (lung) Disease.
  - Heart disease.
  - Cancer (especially Lung and the larynx).



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**HOW TO PREVENT/REDUCE EXPOSURE TO BIOMASS SMOKE.**



**HOW TO PREVENT/REDUCE EXPOSURE TO BIOMASS SMOKE.**

- Reduce the amount of time spent by the fire especially mothers and small children.
- Keep children out of the kitchen especially when the fire is producing smoke.
- Do not put babies in smoky places.
- Avoid burning rubbish and leaves, recycle or dispose of plastic. Leaves and other organic matter should be buried or taken to the garden (this actually improves soil fertility).

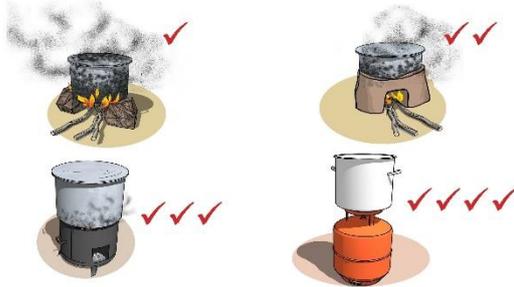
**HOW TO REDUCE EXPOSURE IN A KITCHEN.**

- Kitchen ventilation requires good air flow.
- 2 windows which are adjacent one another.
- Five spaces.
- A hood to collect smoke from fire.
- A stove with a chimney.
- Alternatively build a new cooking hut with good ventilation.



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**COMMON TYPES OF COOKING METHODS, FUEL AND ALTERNATIVES THAT REDUCE SMOKE.**



**COMMON TYPES OF COOKING METHODS, FUEL AND ALTERNATIVES THAT REDUCE SMOKE.**

**Fuel.**

- Dry wood is better than wet wood.
- Charcoal is better than dry wood.
- Gas is better than charcoal.

**Cookers and cooking.**

- Cooking with lids on pans reduces the time to boil.
- Retained heat cooking – the boiling pot is put into a box and packed around with suitable materials to keep it hot for a long time may be used to keep things hot.
- There are many types of new/lean cook stoves which:
  - Burn wood/charcoal more cleanly- more heat less smoke.
  - Use much less wood.
  - Reduce risk of burns.



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**OTHER SOURCES OF HOUSEHOLD SMOKE AND HOW TO REDUCE EXPOSURE TO THEM.**



**OTHER SOURCES OF HOUSEHOLD SMOKE AND HOW TO REDUCE EXPOSURE TO THEM.**

**Other sources of household smoke include:**

- Kerosene lamp (Tidooba).
- Mosquito coil.
- Tobacco smoke.
- Wax candles.
- Lait-in.

**How to reduce exposure to the above:**

- Avoid burning kerosene lamps, but if they are used do not let them burn all night.
- Avoid burning mosquito coils.
- Ask smokers to smoke outside.
- Avoid burning leaves and herbs to keep insects away.



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**BENEFITS OF REDUCING EXPOSURE TO BIOMASS SMOKE/HOUSEHOLD AIR POLLUTION.**



**BENEFITS OF REDUCING EXPOSURE TO BIOMASS SMOKE/HOUSEHOLD AIR POLLUTION.**

**Keeping your unborn and small children away from smoke has lifelong benefits:**

- Healthy pregnancy.
- Healthy baby.
- Healthy child.
- Healthy adult.



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669 *Poster*

## You Can Reduce Exposure To Biomass Smoke During Pregnancy, After Delivery And Among Young Children By;



1. Spending less time by the fire while cooking.
2. Using dry firewood to cook to reduce smoke.



3. Avoiding burning rubbish and leaves; instead, recycle plastics and dispose of leaves and organic rubbish by burying into the soil.
4. Having two windows adjacent to each other and eave spaces.



5. Using locally built cooking stoves that produce less smoke.



**HOW TO PREVENT EXPOSURE TO BIOMASS SMOKE**

- Reduce the amount of time spent by the fire especially mothers and young children.
- Keep children out of the kitchen especially when the fire is producing smoke
- Do not put young babies in smoky places
- Avoid burning rubbish and leaves, recycle or dispose of plastic, leaves and other organic matter should be dug into the soil.



**HOW TO PREVENT EXPOSURE TO HOUSEHOLD AIR POLLUTION**

- Kitchen ventilation requires good air flow
- 2 windows
- Eaves spaces
- A hood to collect smoke from fire
- A stove with a chimney
- Alternatively build a new cooking hut with good ventilation
- Avoid burning kerosene lamps, but if they are used do not let them burn all night



**COMMON TYPES OF COOKING METHODS, FUEL AND ALTERNATIVES THAT REDUCE SMOKE.**

**Fuel.**

- Dry wood is better than wet wood.
- Charcoal is better than dry wood
- Gas is better than charcoal

**Coasters and cooking.**

- Cooking with lids on pans reduces the time to boil
- Retained heat cooking – the boiling pot is put into a box and packed around with suitable materials to keep it hot for a long time.
- There are many types of new cook stoves which:
  - Burn more cleanly (more heat less smoke)
  - Use much less wood
  - Reduce burns

**BENEFITS OF REDUCING EXPOSURE TO BIOMASS SMOKE/HOUSEHOLD AIR POLLUTION.** Keeping your unborn and young children away from smoke has lifelong benefits. These are:

- Healthy pregnancy
- Healthy baby
- Healthy child
- Healthy adult



**KEY POINTS TO NOTE.**

- Always attend ANC appointments for monitoring of your pregnancy.
- Avoid staying in the kitchen for long hours while cooking
- Keep babies and young children away from the smoke/kitchen
- The effects of the smoke may not be immediately visible but are very dangerous/harmful to the baby's/mother's health.

**BIOMASS SMOKE:**  
What every pregnant woman and mother needs to know.



**FRESH AIR**

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**INTRODUCTION**

An estimated 3 billion people (about half the world's population) burn biomass fuel (wood, crop residues, animal dung and coal) for cooking and heating purposes exposing a large population, especially women and children, to high levels of indoor air pollution.

Recent findings indicate that exposure to biomass smoke is a major contributor to illness and death among the population. Children, women and the elderly are most affected. The risk of developing respiratory tract infections (pneumonia) is greatly increasing in children living in homes using biomass. Women who spend many hours cooking food in poorly ventilated homes develop Chronic Obstructive Lung Disease (COPD), asthma, including tuberculosis and lung cancer.

Studies done in Uganda have shown that the population is widely exposed to biomass smoke, from conception to adulthood with an associated high burden of respiratory symptoms and impaired lung function, especially in younger women.

The purpose of this information leaflet is to provide you with information on how to prevent/reduce exposure to biomass smoke.

**WHAT IS HOUSEHOLD AIR POLLUTION?**

Household Air Pollution refers to chemical, biological and physical contamination of indoor air. It may result in adverse health effects.

**WHAT IS BIOMASS SMOKE?**

Biomass is any organic matter- wood, crops, seaweed, animal waste that can be used as a source of energy.

**SOURCES OF BIOMASS SMOKE**

In low-income countries over 90% of the households use biomass for cooking, heating and lighting. The major sources of biomass smoke are;



Firewood, Charcoal, Crop residues, Dung from animals

**OTHER SOURCES OF HOUSEHOLD AIR POLLUTION**

Apart from the mentioned sources of household air pollution, there are other sources of biomass smoke like;



Tobacco, Kerosene lamp (tadooba), Wax candles, Lantern, Mosquito coil

**WHO IS MOST AFFECTED BY BIOMASS SMOKE?**

Women and girls are most affected because of the traditions and cultures in many settings that require them to cook. The long period spent cooking exposes them to biomass smoke. In addition, young children are affected by biomass smoke because of their close contact with their mothers and young girls throughout the day.

**WHAT ARE THE EFFECTS OF HOUSEHOLD AIR POLLUTION/BIOMASS SMOKE?**

**In pregnancy**

Increased risk of:

- Slowed growth of baby leading to small babies at birth.
- Giving birth to a baby not yet due (premature).
- Giving birth to baby who is already dead (still birth).
- Bleeding.
- High blood pressure.

**In children**

Increased risk of:

- Acute respiratory tract infections
- Pneumonia
- Asthma
- TE

**In adults**

Increased risk of:

- Asthma
- Chronic Obstructive Pulmonary Diseases (COPD)
- Heart disease
- Cancer (especially Lung and the throat)



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685 **Appendix B. Standards for Reporting Qualitative Research (SRQR)**<sup>25</sup>

No.	Topic	Item
<b>Title and abstract</b>		
S1	Title	Concise description of the nature and topic of the study identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended
S2	Abstract	Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions
<b>Introduction</b>		
S3	Problem formulation	Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement
S4	Purpose or research question	Purpose of the study and specific objectives or questions
<b>Methods</b>		
S5	Qualitative approach and research paradigm	Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/interpretivist) is also recommended; rationale <sup>b</sup>
S6	Researcher characteristics and reflexivity	Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability
S7	Context	Setting/site and salient contextual factors; rationale <sup>b</sup>
S8	Sampling strategy	How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale <sup>b</sup>
S9	Ethical issues pertaining to human subjects	Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues
S10	Data collection methods	Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale <sup>b</sup>
S11	Data collection instruments and technologies	Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study
S12	Units of study	Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)
S13	Data processing	Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/deidentification of excerpts
S14	Data analysis	Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale <sup>b</sup>
S15	Techniques to enhance trustworthiness	Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale <sup>b</sup>
<b>Results/findings</b>		
S16	Synthesis and interpretation	Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory
S17	Links to empirical data	Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings
<b>Discussion</b>		
S18	Integration with prior work, implications, transferability, and contribution(s) to the field	Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field
S19	Limitations	Trustworthiness and limitations of findings
<b>Other</b>		
S20	Conflicts of interest	Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed
S21	Funding	Sources of funding and other support; role of funders in data collection, interpretation, and reporting

<sup>a</sup>The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

<sup>b</sup>The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

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## TOPIC GUIDE FOR MOTHERS

692

693 1. What made you decide to attend the education session on biomass smoke?

694

695 2. What did you learn from the education sessions that you didn't know before?

696

697 3. What changes did you make based on what you learned?

698

699 4. What helped you to maintain these changes?

700

701 5. Were there any changes that you wanted to make that you were not able to?

702 What were they?

703 Why?

704

705 6. Did you make any changes initially that were not maintained?

706 What were they?

707 Why?

708

709 7. What health improvements do you hope to achieve, or have already achieved?

710

711 8. Do you have any future plans for reducing exposure to biomass smoke?

712 What are they?

713 How will you achieve this?

714

715 9. Were you able to share what you learned with other people?

716 How did they react to what you told them?

717 OR

718 Why not?

719

720 10. Is there anything else that we haven't covered, about your experience of the education  
721 session and what you've done since, that you'd like to share with me?

722

723 **TOPIC GUIDE FOR MIDWIVES**

724

725 1. What made you decide to take part in delivering the education sessions on biomass  
726 smoke?

727

728 2. How have you incorporated the education sessions into your usual, regular midwifery  
729 practice?

730

731 3. What has helped or hindered you to continue delivering sessions?

732

733 4. What positive feedback have you received from mothers or other community  
734 members about the sessions?

735

- 736 5. What negative feedback have you received from mothers or other community  
737 members about the sessions?  
738
- 739 6. Have you noticed any health improvements in women and/or community members?  
740 If so, what have they been?  
741 Have there been any unexpected benefits?  
742
- 743 7. What changes would you say that women are able to implement based on the  
744 education you deliver?  
745
- 746 8. To what extent are you delivering the sessions in the original format?  
747 What adaptations have you made?  
748 Why?  
749
- 750 9. What are your future plans for educating people in this subject?  
751
- 752 10. Is there anything else that we haven't covered about the sessions that you'd like to  
753 share with me?  
754

### 755 **TOPIC GUIDE FOR VHTs**

- 756
- 757 1. What made you decide to take part in providing education on biomass smoke to the  
758 community?  
759

- 760 2. How have you incorporated the education into your usual practice as a VHT?  
761
- 762 3. What has helped or hindered you to continue delivering education?  
763
- 764 4. What positive feedback have you received from mothers or other community  
765 members about the education?  
766
- 767 5. What negative feedback have you received from mothers or other community  
768 members about the education?  
769
- 770 6. Have you noticed any health improvements in women and/or community members?  
771 If so, what have they been?  
772 Have there been any unexpected benefits?  
773
- 774 7. What changes would you say that women are able to implement based on the  
775 education you deliver?  
776
- 777 8. To what extent are you delivering the education as you were in the beginning?  
778 What adaptations have you made?  
779 Why?  
780
- 781 9. What are your future plans for educating people in this subject?  
782
- 783 10. Is there anything else that we haven't covered about education on biomass smoke that  
784 you'd like to share with me?