J Glob Health Sci. 2021 Jun;3(1):e8
https://doi.org/10.35500/jghs.2021.3.e8
pISSN 2671-6925·eISSN 2671-6933

Journal of Global Health Science JGHS

Original Article

Conducting a household survey in poor urban settlements in Ghana: challenges and strategic adaptations for fieldwork

Elizabeth G. Henry [1], **Caesar Agula** [2], **Patrick O. Asuming** [3], **Navdep Kaur** [1], **Margaret Kruk** [1], **Iqbal Shah** [1], **Ayaga A. Bawah** [2]

[1]Department of Global Health and Population, Harvard T.H. Chan School of Public Health, Boston, MA, USA
[2]Regional Institute for Population Studies, University of Ghana, Accra, Greater Accra Region, Ghana
[3]University of Ghana Business School, University of Ghana, Accra, Greater Accra Region, Ghana

Received: Aug 21, 2020
Accepted: Jun 22, 2021

Correspondence to
Ayaga A. Bawah
Regional Institute for Population Studies, University of Ghana, Accra, Greater Accra Region, Ghana.
E-mail: aabawah@ug.edu.gh

ORCID iDs
Elizabeth G. Henry
https://orcid.org/0000-0003-2547-597X
Caesar Agula
https://orcid.org/0000-0001-9022-7433
Patrick O. Asuming
https://orcid.org/0000-0002-5010-3484
Navdep Kaur
https://orcid.org/0000-0003-4400-1665
Margaret Kruk
https://orcid.org/0000-0002-9549-8432
Iqbal Shah
https://orcid.org/0000-0001-8850-4374
Ayaga A. Bawah
https://orcid.org/0000-0003-4864-4182

Funding
This study was provided by Warren Susan Thompson Foundation. The funding agency

ABSTRACT

Background: As the population in urban centers rise, researchers need to capture reliable and valid data that represent health needs of harder-to-reach populations such as those living in informal settlements. There is limited literature on systematic approaches for conducting fieldwork in urban settings in low-income countries. Using wireless -connected tablets, we collected baseline data from women living in poorer settlements of Accra, Ghana for a program evaluation. We describe emergent issues and adaptations to our fieldwork approaches that expand on previous guidance.
Methods: Our study utilized a three-stage random sampling design to select 2,200 women who were then located and interviewed. We routinely examined quantitative indicators of data collection quality and collectively reviewed challenges in locating respondents. We tested modifications in our fieldwork approach in a subsequent study in a similar urban context.
Results: Key challenges included: sampling dynamic communities; locating respondents who worked away from the home; maintaining interview privacy in densely populated settings; and delays in reporting data inconsistencies. Key adaptive strategies included utilizing household-specific GPS coordinates, using real-time fieldworker tracking statistics, and rapid communication with teams using instant messaging applications. Compared to 82% in the first, nearly all respondents in our second study were interviewed within 2 months of the household listing. We could not relocate only 6.3% of respondents in our second study compared to 14.1% in the first. During analysis there were far fewer data errors after implementing our new fieldwork protocols.
Conclusion: Research teams in urban settings can leverage the widespread use of mobile technology to quickly implement changes to fieldwork procedures, collect data efficiently, and minimize errors. Taken together with proven, more traditional fieldwork approaches, strategies that rely heavily on wireless technology may be increasingly practical and efficient to produce timely, valid data in contexts similar to Accra as networks continue to improve.

Keywords: Urban health; Reproductive health; Ghana; Surveys and questionnaires; Western Africa

participated in discussions related to the study design, data collection approach, but had no role in actual data collection, analysis, or interpretation of data used in this paper.

Conflict of Interest

The authors declare that they have no competing interests.

Authors Contributions

Conceptualization: Henry EG, Kruk ME, Bawah A; Data curation: Henry EG, Agula C, Asuming PO, Bawah A, Kaur N; Formal analysis: Henry EG, Agula C, Kaur N; Funding acquisition: Shah I; Investigation: Henry EG, Agula C, Asuming PO, Bawah A; Supervision: Henry EG, Asuming PO, Shah I, Bawah A; Writing - original draft: Henry EG; Writing - review & editing: Agula C, Asuming PO, Kaur N, Kruk ME, Shah I, Bawah A.

INTRODUCTION

More than half of the world's population lives in cities, and the rapid urbanization globally has been driven mostly by rural-to-urban migration.[1] Compared to only a quarter of city dwellers worldwide, the majority of the urban population in sub-Saharan Africa live in slums or informal settlements where they are disproportionately affected by poverty and experience vast inequities in access to housing, education, health and other services compared with their wealthier counterparts living in close proximity.[1-3] Like other African countries, Ghana is experiencing rapid urbanization. In 2010 for the first time in the country's history the proportion of the population living in urban areas surpassed those in rural.[4] There is limited capacity to properly provide services for city dwellers, particularly in the cities of Accra, Kumasi and Tema.[5]

The United Nations renewed previous commitments to improve the lives of the global poor with the Sustainable Development Goals, in particular, Goal 11, which aims for cities to be sustainable, safe and resilient.[1] Previous research has documented the unsuccessful application of a health care delivery model that was developed and implemented successfully in rural settings of Ghana to urban areas, and highlighted the need for urban-specific policies to improve health access.[6] In order to design and implement health policies and programs, governments need timely and accurate data that reflect the socio-demographic profiles of all people in urban environments, particularly socioeconomically disadvantaged populations that are historically underrepresented in research.[7] Unique methodological challenges in collecting data require consideration by those undertaking research to improve health care in this setting.[8]

There is some practical guidance on how to conduct fieldwork for health research in urban contexts, including reports from India,[9] South Africa,[10,11] and Uganda.[12] The Demographic and Health Survey (DHS) offers guidance for training enumerators as well as detailed procedures for conducting household surveys, and have recently included sections on social media policy.[13] However, the publicly available DHS manuals assume paper-based surveys, and best practices for navigating the complexities of conducting household-level surveys using electronic applications and mobile technology in urban West Africa are lacking.

The use of digital technology has increased rapidly in Ghana. Connected since 1995, Ghana was the second country in sub-Saharan Africa to have internet connectivity, though through 2005 the penetration rate was very low (1.6%).[14] Recent reports from 2019, however, estimate an internet penetration rate of 48% nationally[15] and the mobile data penetration rate (defined as mobile data subscriptions per population) is reported as of 2019 to be 99.2%.[16]

Reflecting on our recent experience conducting a baseline survey for a prospective, quasi-experimental evaluation of a reproductive health program utilizing mobile technology, our paper uses a framework similar to those used previously[12,17] to describe both the challenges and adaptive strategies for conducting fieldwork in low-income settlements in Accra, Ghana. We share lessons learned in the hopes that others can collected accurate data that represents similar communities they are surveying with maximal efficiency.

We engaged in research to evaluate a reproductive health program implemented in low-income urban settlements of Accra, Ghana. The reproductive health program we were planning to evaluate aims to register all women of reproductive age in a selected

neighbourhood within the city that reports low rates of modern contraceptive use and houses a population that is generally socioeconomically disadvantaged. The program is designed to serve a community of 20,000-30,000 women. Using data from the registration period and a computer-based algorithm and prioritization scheme, the program selectively identifies women with the highest need for family planning and subsequently provides personalized counselling and referral for family planning services.[18]

In Accra, the program was planned for implementation in the coastal parts of Accra in the Osu, La, Teshie and Nungua neighborhoods. Taken together they are home to an estimated 50,000 women of reproductive age, based on the 2010 census, adjusting for population growth.[19,20] The main economic activity is fishing and petty trading and the majority of people identify as practicing the Christian religion.

Our evaluation of the Accra implementation planned a prospective quasi-experimental, pre-post, comparison group study design. We selected the comparison sites: Old Ashongman, La Nkwantanang Madina and Agbogba based on the similarity of women's socio-economic and demographic characteristics, ethnic mix and religious diversity, and having no prior implementation of the program. This paper reports on our experience conducting the baseline study for the evaluation where we aimed to generate data on a representative sample of women of reproductive age who lived in these communities.

A subsequent evaluation study was conducted by our research team a few months later to evaluate the program as implemented in one community in the city of Kumasi, Ghana from 2013–2016, using a retrospective, cross-sectional, quasi-experimental design with comparison group. Though retrospective, the sampling methodology and fieldwork protocols were nearly the same in both studies. Details of the retrospective study, and findings, are documented elsewhere.[21]

As with other papers on this topic,[9-12,17,22] for this paper we retrospectively assessed the implementation of our field procedures and generated a summary of challenges and adaptations. We also reflect on and describe the results of implementing our own recommendations both during our Accra study and for the entirety of our study in Kumasi.

METHODS

Constructing a representative study sample

In order to construct a representative sample of the target population for program we utilized a three-stage random sampling design to select 2,200 women aged 16 to 44 for the planned intervention and comparison areas apiece for a sample total of 4,400. We constructed an original sampling frame for both areas. We obtained maps of Enumeration Areas (EAs) for our study areas from the Ghana Statistical Service from the 2010 census, estimated changes in population over the past 7 years, and divided the EAs into roughly equal-sized study clusters of approximately 60 households. This yielded 678 clusters from 223 EAs. We then conducted a complete household listing of eligible women in all the 400 randomly selected clusters. We developed a listing survey to collect information describing households, including physical descriptions and directions using landmarks, addresses (when available), names of household heads and GPS coordinates, as there is no formal address system that uniquely identifies dwellings. For the context of this study, a household referred to a person,

or 2 or more individuals living together, sharing common assets and/or having a common eating arrangement. Any household member over the age of 16 was eligible to respond to the listing survey and would list all women between the ages of 16–44 who were regular residents of the household. We then randomly selected a target of 20 eligible women from each cluster and, using this sample list, planned to find the selected woman for the survey.

Finding and recruiting study participants

The baseline study was conducted in 2 phases. During phase 1, in the intervention area, we conducted the listing between November and December 2017 and interviewed between January and May 2018. For phase 2, in the comparison areas, we listed women in May 2018 and conducted interviews in June and July of 2018. Enumerators worked in 5 teams of between 3 and 7 members with a field supervisor. Teams were given a list of assigned study clusters and charged with visiting households to interview each of the women selected using information gathered at the listing. As per the protocol, enumerators visited the household up to 3 times, varying the time of day and day of the week and recorded the outcome of the visit. When enumerators made contact with the woman, they verified her eligibility using a recruitment script. If eligible, they asked for informed written consent and, if granted, proceeded with the survey.

In the event that a "gatekeeper" such as a husband/partner, parent, or in-law first requested information on why they were inviting a woman in their household to participate, our protocol included a "Gatekeepers Script" which provided general information about the study and was used to request their agreement to speak with the woman.

Ensuring privacy and confidentiality

Enumerators completed a ten-day training workshop during which they reviewed protocols and procedures for interacting with human subjects, and on data confidentiality and privacy. The study protocol required complete privacy for the interview's duration. The survey was conducted wherever the participant was most comfortable, which included outdoor spaces, or inside their home or work, which often was an informal shop or market stall.

During training, the enumerators also rehearsed techniques for building rapport with respondents. This was especially critical as our survey asked sensitive questions about women's reproductive health. Specific training days were reserved for the team to pilot field test both the app and all the interviewing techniques.

Supervision, enumerator tracking and fieldwork monitoring

Field teams were supported by a project coordinator, who oversaw all operations; a data manager, who managed data quality checks; and an IT manager who dealt with the tablets, app, mobile network and logistics. Field supervisors directly supported teams in locating houses and gaining entry and also monitored the teams, providing daily reports to the coordinator.

We utilized an electronic data collection system, the CommCare application (app) platform, developed by Dimagi.[23] Enumerators administered both the listing survey and main household-level survey using CommCare on Android tablets. The apps were programmed to minimize data entry errors at the point of the interview. Using CommCare, we also captured real-time data on enumerator statistics, including days and times enumerators were most active in their data collection efforts.

We developed a list of quality checks that would alert us to when revisits would be required to correct missing, incomplete, or inconsistent data. This involved analysing exported data using statistical software to check for cross-survey inconsistencies. A report of inconsistencies, by enumerator and by survey question, was shared with supervisors, and those that could be remedied with additional data collection in the field were addressed immediately. In addition, we developed a set of monitoring indicators to assess the effectiveness of fieldwork. These included: time elapsed from month of household listing to month of interview, ineligibility determined at the time of the interview (using criteria that should have been screened at the listing stage such as age and regular household resident), refusal rates, and proportion of women who were unable to be located and interviewed following the listing activity. These indicators, as well as the data accuracy reports, were monitored through the study.

Starting in May of 2018 we had the opportunity to implement the newly revised set of protocols and strategies for the Kumasi evaluation of the program, which utilized the same sampling strategy, including the household listing activity and subsequent household survey as described above. Some of the study supervisors and enumerators from the Accra study participated in this implementation, but more than half of the data collectors were newly hired and trained in these approaches. We report on the monitoring indicators for this study as well.

Ethical approvals

The studies were conducted in partnership between the Harvard T. H. Chan School of Public Health in Boston, USA, and the Regional Institute for Population Studies at the University of Ghana in Accra. Ethical approval was obtained from the Institutional Review Board at Harvard (IRB 17-1107 for the Accra study and IRB 17-1569 for the Kumasi study) and the Ethics Committee for the Humanities at the University of Ghana (ECH 020/17-18), as well as the Ghana Health Service Ethical Review Committee (GHS-ERC:005/08/17) (for both). Written, informed consent was obtained from all study participants.

RESULTS

Key challenges and adaptive strategies

The following are the adaptations made for each of the major fieldwork challenges we faced based on our collective experience as well as the results from the monitoring indicators (**Table 1**).

Challenge & adaptations #1: constructing a representative study sample with a dynamic population and changing landscapes

The population we listed and interviewed is dynamic. A number of women were transitory and move to areas where there is demand for their products or to engage in other daily economic activities for a living. In the Accra study sample nearly 7% of women had not remained in the home where we had listed them by the time we had returned for the survey (within weeks to maximum of 4 months).

Many women and families in these neighborhoods live in makeshift structures. Some households and entire neighbourhoods in Accra had changed dramatically from the 2010 census, requiring re-drawing of cluster map divisions, additional sampling for replacement, and adjustments based on fluctuations in population size. Although the population of the

Table 1. Preparatory activities, key challenges, adaptive strategies and recommendations for field work in urban settings

Activity	Preparatory work	Key challenges	Adaptive strategies	Additional recommendations
Constructing a representative study sample	• Obtained 2010 census Enumeration Area (EA) maps from Ghana Statistical Service • Estimated population increase since 2010 census • Developed recruitment scripts • Listing App required capturing detailed household descriptors and GPS	• Cluster/EA-level population changes were dynamic with growth in some and a decrease in others • Maps were outdated and did not include new housing developments or commercial areas, changes in major landmarks. • Listing respondents were reluctant to give full names or eager to give names of women out of the age range if potentially tied to future resources	• Field staff spent significant time establishing the boundaries of clusters before listing • Post-hoc exclusion criteria based on areas not representing the population of study and re-sampling additional clusters • Additional field supervision and on-the-job training for how to engage listing respondents to obtain accurate information	• Set a budget for field work to update and refine census maps if completed more than 2 years prior • Ensure during sampling that all study clusters are listed in random order in case post-hoc sampling changes are required • Train listers in study objectives so they can clearly recruit and advise potential respondents to avoid refusal rate at the listing stage
Finding and recruiting study participants	• Designed field teams to support close field supervision & monitoring and efficient data collection • Created a "Gatekeeper Script" for enumerators to navigate any issues with husbands or others who may limit access to women	• Physical characteristics of households change or do not distinguish individual households sufficiently • The longer the time between listing and surveying, the greater the likelihood women migrating/moving • The listing respondent may call a woman by one name, when she goes by another more formally or has another common name • Women who work outside the home (~80%) were not found at home during traditional data collection hours • Three visits to a household/dwelling was not enough to find the woman	• Created teams with at least one member of the household listing team who was familiar with the households • Used GPS and both formal and common names of household head and woman • Made efforts to visit households on very different days/times of day • Added categories to the reasons why women were not available to feed into case status report (See next row) • Created a log of number of household contacts that was shared with supervisors to gauge additional fieldwork budgeting and planning needs to find women • Set a schedule with the woman, once found, for convenient time to complete the interview	• List a complete cluster, conduct the random selection of women and immediately conduct surveys before moving to a new cluster • Start with detailed enumerator reports to monitor dynamics of the field for quick decision making especially with limited field resources
Ensuring privacy and confidentiality	• Rigorous training on human subjects research, privacy and confidentiality • Training and practice on rapport building	• Densely constructed housing structures and interviewing women in their busy homes or work spaces made establishing and maintaining privacy harder • Many women did not wish to sign their names electronically	• Supervisors observed enumerators in the field and gave feedback immediately on appropriate spaces for conducting the survey • We allowed for the woman to sign their names on a consent form and have a photo taken of this for documentation	• When piloting the field work, visit each enumerator at least once to reflect on meeting privacy guidelines • Allow for non-electronic signatures or seek waiver of written consent
Supervision, enumerator tracking, and data quality monitoring	• Supervision and management team structure developed • Programmed the App to minimize data entry errors • Automated times and days of form submission • Developed list of quality checks for data consistency	• Still some issues with App program logic and inconsistent responses across the survey • Delayed reporting of quality checks leading to not being able to find a woman again to obtain information • Inconsistency in enumerator behaviour: high rates of refusals or migration, above average submission of surveys	• Continued to improve and update the app throughout field work • Added in repeat GPS to the last form to ensure that people weren't filling in surveys at home/night • Launched a three-step quality check system: - Installed a "Supervisor Check" module to allow for field review of key data - Utilized daily reports of higher-level quality checks and reports • Created Whatsapp® text messaging groups for easy communication	• Create comprehensive, but flexible, quality check system advance and test with the piloting of the tools • Build-in automated checks to ensure enumerator fidelity to the administration of the survey when possible

entire area had increased, this was not homogenous across EAs. In some areas, new housing developments had replaced previously densely populated areas and the population living there did not match the eligibility criteria of our sample. At the same time, some EAs that had al ow concentration of housing in 2010 had seen a spike in new informal dwellings.

While administering the listing survey, some respondents thought that listing a woman in their household might lead to provision of services or benefits, which is expected in an environment where the majority of residents are more economically disadvantaged. In Accra overall, we found women in our sample who should have not been included because they were not in the age range (3%), or did not actually reside in the household (0.3%) or did not exist at all (2.7%). After training enumerators to more clearly and sensitively communicate the purpose of study at the listing phase, the time-of-interview ineligibility rate dropped from 9.2% to 5.6% from the first to second phases of the Accra study, and was 6.4% in Kumasi. Of those in Kumasi who were ineligible at the survey, only 1.2% were determined not to have existed at the time of listing, compared to 3.8% in our first Accra data collection phase.

Challenge & adaptations #2: finding respondents in urban communities takes time, patience and perseverance

To find sampled women, especially in crowded areas where structures might look similar or be hidden from the main roads and paths in the neighborhood, GPS and detailed directions using up-to-date landmarks were essential. Using both the formal and the "common" names of the household head and the woman were also important. In addition, ensuring that each field team had at least one person who had participated in the listing activity aided in reducing the time it took in the field to locate a household.

Limiting the time between the listing activity and actual survey was also helpful in finding a woman for an interview. For our phase 1 intervention area the was an average of 1.6 months (standard deviation [SD] 1.0) between the listing and conduct of household surveys, ranging from 0 to 4 months, with 82% of final contacts (completed, refused or moved/migrated) made within 3 months. For the phase 2 in the comparison area where we employed some of our updated protocols, 87% of final contacts were made within 2 months from the listing, with an average of 1.2 months (SD 0.4). In our Kumasi study, the time elapsed between listing and interview was a similar 1.4 months (SD 0.5) but 99.6% of final contacts were made within 2 months.

Nearly 80% of eligible women in our sample worked outside the home. For this reason, we encouraged enumerators not to count just passing by a household as a visit but rather to count 3 distinct, meaningful attempts to locate a woman at different times on different days. As our ethical approved protocol did not allow for the collection of any identifying information prior to obtaining consent, we were not able to capture women's mobile numbers. Thus, we advised enumerators to identify a woman's regular schedule when possible to plan their visits to the household, and, when they made in-person contact, make appointments with her to find a convenient time for completing the survey. The supervising team encouraged enumerators to adapt their schedule to the extent they were comfortable in order to accommodate very early morning and late evening interviews. During the first full week of data collection, enumerators completed interviews at most days and times of the week (**Fig. 1A**) because they had a long list of women to interview and could postpone interviews and still reach a daily target. As fieldwork progressed, the lists had a higher proportion of harder-to-find women, and enumerators had to complete interviews in more scheduled blocks, especially Saturdays and Sunday afternoons (**Fig. 1B**). Despite these modifications, of the sampled women who were eligible for consent, we would not locate 12% after several attempts. However, in Kumasi, with our modified fieldwork protocols, only 6.3% were not able to be found at the time of the survey.

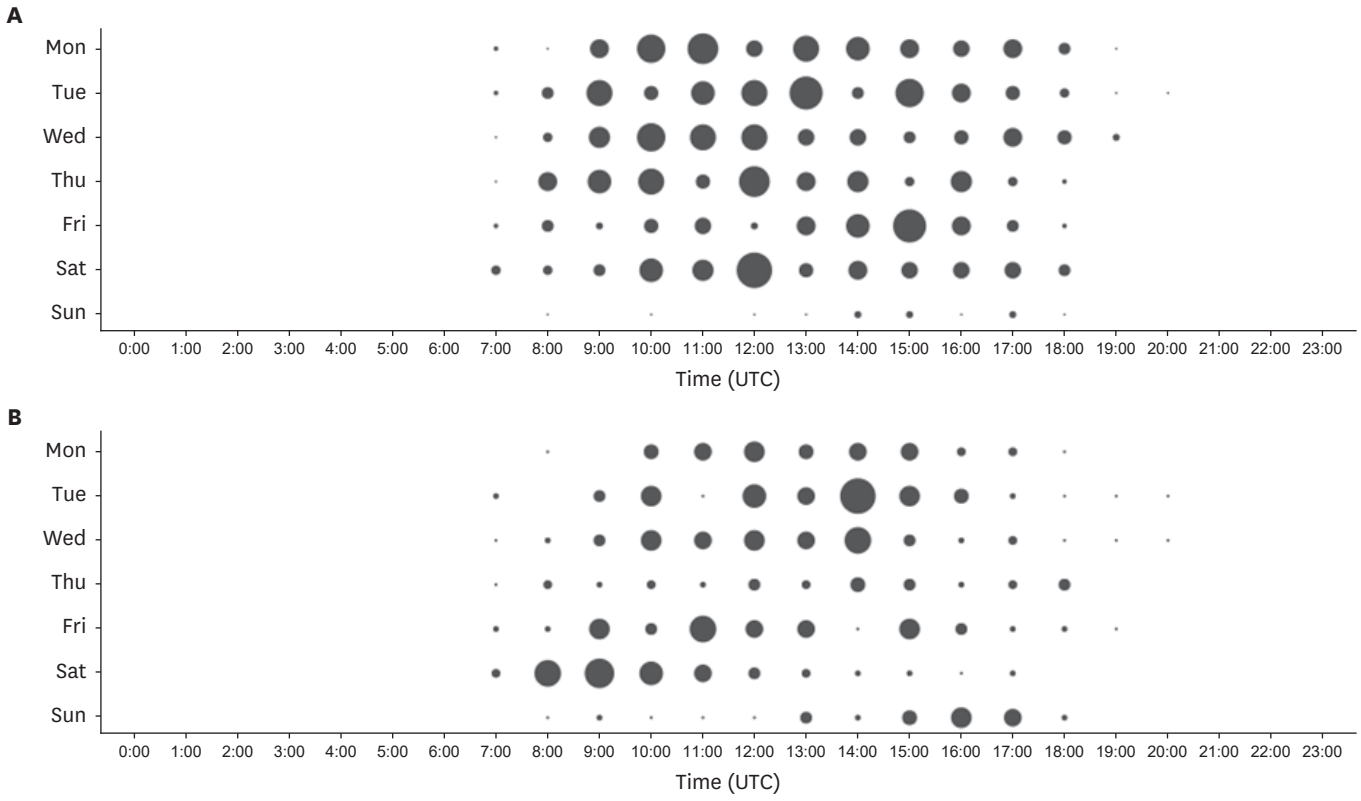

Fig. 1. (A) Days and times surveys were completed during the first full week of data collection, WIE Retrospective Study, 21–27 January 2018. (B) Days and times surveys were completed during Week 7 of data collection, WIE Retrospective Study, 25 February–3 March 2018.

Challenge & adaptations #3: establishing & maintaining privacy in densely populated communities

Safeguarding privacy and confidentiality are critical when interviewing populations that are harder-to-reach and/or vulnerable. Physically ensuring this in informal settlements posed challenges, due to closeness of dwellings within communities. If a woman chose to conduct the interview outside of her home, the interview might still be heard through a window or door of a neighbouring dwelling. Supervisors observed enumerators at the launch of fieldwork and gave feedback immediately on appropriate spaces for conducting the survey.

In addition, some women expressed privacy concerns regarding giving electronic consent. Per protocol, the consent was planned to be documented by obtaining the electronic signatures using the participant's fingertip on the tablet. However, some participants were suspicious of providing signatures electronically as they did not necessarily trust the technology. In this case, we modified the protocol so that the respondents could sign a paper form, and enumerators used the tablet to take a photo of the completed informed consent form. Given the concerns expressed by study participants we suggest that future studies seek a waiver of consent for women's health surveys conducted on tablets, setting up procedures for obtaining and documenting verbal consent.

Challenge & adaptations #4: timely, actionable tracking and reporting systems for data quality

Despite extensive programming and piloting of the app, enumerators were still able to input inconsistent responses across the survey. We continued to refine the app and periodically

sent out app updates to the team, requiring us to ensure that everyone was working from the most updated version.

Initial delays in quality check reports prevented field teams from being able to quickly relocate a woman to correct errors, as study teams moved to new cluster areas. We therefore implemented a more comprehensive, three-stage data quality procedure that was implemented fully in our second phase. During step one supervisors conducted a field-based review of each case reported complete by an enumerator. We designed an additional "supervisor check" form in the app where supervisors could review a list of 10 quality checks for each case that did not require any data manipulation, and either certify them as consistent and complete, or flag them for clarification. If necessary, this prompted an immediate revisit to the woman to correct any critical information. This stage also included verification of refusals or ineligibility.

or step 2 the data manager exported the data and ran it through a statistical program to check for cross-survey inconsistencies (as mentioned above based on our initial plan). The outcome of this analysis was initially reported to supervisors on a daily basis and then every few days as the frequency of data errors decreased. For the Kumasi implementation these reports were produced and shared daily, with the volume of errors dropping more quickly as the study progressed then they had for the Accra study.

Our third step included a generating a daily report of enumerator behaviour and cluster completion. This involved enumerator-level indicators such as response rate, daily completion rate, and reasons for not finding women, as well as team performance indicators. The reports allowed us to flag high rates of refusals or migrations, or far above average/ unreasonable daily form submission rates.

Finally, our project coordinator facilitated cross-team communication by creating a group chat using the WhatsApp ® platform for instant messaging. WhatsApp® allows users to send and receive phone calls, and encrypted texts, photos, documents, and to share actual location using GPS. Supervisor teams also had group chats to facilitate easy communication on a daily basis. This allowed for real-time responses to fieldwork or app challenges, sharing of immediate location in case of the need for supervisors to step in and assist an enumerator with a respondent or gatekeeper, and immediate communication of app fixes, protocol changes or data error reports.

At the data analysis phase, our team agreed that those data collected in the first phase included more data inconsistencies and errors that we were unable to clarify, leading to more missing or incomplete values than for the second phase of the Accra data and for the Kumasi dataset.

DISCUSSION

The methodological challenges of conducting fieldwork for health research in low-income urban areas have been identified previously, including the development of sampling frames, high rates of mobility among residents and lack of formal addressing systems.[8] Our own work has expanded on these findings. Despite designing a detailed protocol informed by the local research teams' extensive experience, continuous adaptive measures were necessary to reflect the dynamic environment of urban Accra when collecting household survey data.

Many of the adaptations are updates to more traditional fieldwork approaches that recognize the constraints particular to the urban setting. When utilizing existing records such as census data and administrative maps to establish a sampling frame we needed to schedule sufficient time to revisit each EA to identify changes since the records were created. Creating schedules such that households in each cluster could be listed and surveyed with minimal lag time minimized attrition. Researchers conducting fieldwork for a women's health survey in Bangladesh faced similar obstacles in accessing women in urban households due to scheduling, and needed to revisit homes several times before successfully recruiting a woman.[22]

Other adaptations maximized on the use of digital technology to improve efficiency. Using tablets equipped with an app that synced data to a cloud-based server instantly enabled our research team to monitor both worker activity and survey outcomes on a daily basis to course-correct and modify field protocols when necessary. Electronic data capture also enabled built-in data quality checks to minimize time between data review and revisits for clarification. Other studies have also shown the use of electronic data capture tools in health research in low-income settings to be effective at reducing data collection error and improving data quality.[24-26]

However, the risk and benefits of utilizing mobile technology for data collection efforts should be weighed in this context. While we have limited evidence to suggest that our methods improved our efficiency in data collection over the many phases of fieldwork, and our team experienced a reduction in data errors at the analysis phase, there are still many considerations about using this technology. In a rural southern African setting, start up and operating costs were important factors to consider and depended heavily on the length of time of the study. Digital fluency of otherwise highly skilled data collectors was another possible limitation to using digital platforms, and the type of internet connectivity needed for an application and how much can be done offline needed to be considered.[27] It is also important to ensure that systems are in place to provide the highest levels of data security.

Key aspects of our work that were originally part of our fieldwork strategies and did not require adaptation also deserve recognition. For example, some of the critical components of doing work with harder-to-reach populations include: partnering with local community leaders and ensuring that research strategies are appropriate for the community, using multi-lingual data collectors, phrasing the survey questions appropriately, and building trust and rapport with respondents.[7,28] In our studies it was local community leaders who advised us on our approaches and helped us gain entry and acceptance with community members so we could construct a more representative sample of all women residing there, not just those most easily or obviously accessible. We also recruited data collectors so that we had full representation of the languages that participants might feel most comfortable speaking, and who had a thorough understanding of the environments in which we were working to minimize the risks associated with power dynamics. At the same time, there are other well-established methods for generating data to reflect the lived experiences of harder-to-reach and vulnerable populations that should be considered in lieu of or in conjunction with the multi-stage sampling strategy that we used, especially qualitative methods, that should be further considered for this work.[28]

With a growing interest in conducting research that sheds light on the health disparities among the urban dwellers in Africa,[29,30] it is important that surveys reflect the actual conditions and needs of the population in an efficient way. Our experience underscores the

need for guidance to improve the production of accurate, representative data of underserved populations in urban settings in order to develop appropriate policy and program recommendations. Research teams in urban African settings can leverage the widespread use of mobile technology to quickly implement protocol changes, collect data efficiently, and minimize errors. Taken together with proven, more traditional fieldwork approaches, strategies that rely heavily on wireless technology may be increasingly practical and efficient in contexts similar to Accra where there are high rates of mobile phone ownership and networks continue to improve. Findings from our study may aid in improving efficient deployments of field teams in future household surveys in similar settings.

ACKNOWLEDGEMENTS

The authors wish to sincerely thank the study participants for the Willows Impact Evaluation in Accra, as well as the dedicated team of study supervisors and enumerators. We also to wish to thank the Ghana Health Service, the Ghana Statistical Service, the Municipal and District Assemblies, and the Assemblymen and community leaders in our study areas who supported this work.

REFERENCES

1. United Nations. *The Sustainable Development Goals Report*. New York, NY: United Nations Department of Economic and Social Affairs; 2017.
2. Hove M, Ngwerume ET, Muchemwa C. The urban crisis in Sub-Saharan Africa: a threat to human security and sustainable development. *Stability* 2013;2(1):7.
CROSSREF
3. Cobbinah PB, Erdiaw-Kwasie MO, Amoateng P. Africa's urbanisation: implications for sustainable development. *Cities* 2015;47:62-72.
CROSSREF
4. World Bank Group. *Rising through Cities in Ghana: Ghana Urbanization Review Overview Report*. Washington, D.C.: World Bank; 2015.
5. Achana FS, Bawah AA, Jackson EF, Welaga P, Awine T, Asuo-Mante E, et al. Spatial and socio-demographic determinants of contraceptive use in the Upper East region of Ghana. *Reprod Health* 2015;12(1):29.
PUBMED | CROSSREF
6. Adongo PB, Phillips JF, Aikins M, Arhin DA, Schmitt M, Nwameme AU, et al. Does the design and implementation of proven innovations for delivering basic primary health care services in rural communities fit the urban setting: the case of Ghana's community-based health planning and services (CHPS). *Health Res Policy Syst* 2014;12(1):16.
PUBMED | CROSSREF
7. Bonevski B, Randell M, Paul C, Chapman K, Twyman L, Bryant J, et al. Reaching the hard-to-reach: a systematic review of strategies for improving health and medical research with socially disadvantaged groups. *BMC Med Res Methodol* 2014;14(1):42.
PUBMED | CROSSREF
8. Harpham T. Urban health in developing countries: what do we know and where do we go? *Health Place* 2009;15(1):107-16.
PUBMED | CROSSREF
9. Mahapatra T, Mahapatra S, Pal D, Saha J, Lopez A, Ali M, et al. Trials and tribulations of conducting interventional studies in urban slums of a developing country: experiences from Kolkata, India. *Hum Vaccin Immunother* 2016;12(1):182-6.
PUBMED | CROSSREF
10. Casale MA, Flicker S, Nixon SA. Fieldwork challenges: lessons learned from a north-south public health research partnership. *Health Promot Pract* 2011;12(5):734-43.
PUBMED | CROSSREF

11. Mathee A, Harpham T, Naicker N, Barnes B, Plagerson S, Feit M, et al. Overcoming fieldwork challenges in urban health research in developing countries: a research note. *Int J Soc Res Methodol* 2010;13(2):171-8.
CROSSREF

12. Abimanyi-Ochom J. Practicalities of health survey fieldwork research in a resource limited setting: challenges and lessons learnt from Uganda. *Afr Health Sci* 2017;17(1):278-84.
PUBMED | CROSSREF

13. ICF. *Demographic and Health Survey Supervisor's and Editor's Manual.* Rockville, MD: ICF; 2017.

14. Quarshie H, Ami-Narh J. The growth and usage of internet in Ghana. *J Emerg Trends* 2012;3(9):1302-8.

15. GlobalWebIndex. *Middle East & Africa: Regional Report.* London: GlobalWebIndex; *2019*.

16. National Communications Authority (Ghana). Quarterly statistical bulletin on communications in Ghana. http://www.nca.org.gh. Updated 2019. Accessed November 7, 2020.

17. Casale M, Lane T, Sello L, Kuo C, Cluver L. Conducting health survey research in a deep rural South African community: challenges and adaptive strategies. *Health Res Policy Syst* 2013;11(1):14.
PUBMED | CROSSREF

18. Murphy EM. The willows reproductive health project: reaching poor women in Turkey. http://www.prb.org. Updated 2008. Accessed August 21, 2017.

19. Ghana Statistical Service. *2010 Population & Housing Census. Summary Report of Final Results*. Accra: Ghana Statistical Service; 2012.

20. Ghana Statistical Service (GSS). 2015–2020 projected populations by regions, districts and sex. http://www.statsghana.gov.gh/nationalaccount_macros.php?Stats=MTA1NTY1NjgxLjUwNg==/webstats/s679n2sn87. Updated 2019. Accessed May 1, 2019.

21. Henry EG, Hackett KM, Bawah A, Asuming PO, Agula C, Canning D, et al. The impact of a personalized, community-based counselling and referral programme on modern contraceptive use in urban Ghana: a retrospective evaluation. *Health Policy Plan* 2021;35(10):1290-9.
PUBMED | CROSSREF

22. Islam RM, Bell RJ, Hossain MB, Davis SR. Bangladesh midlife women's health study (BMWHS): methods, challenges and experiences. *Maturitas* 2015;80(1):89-94.
PUBMED | CROSSREF

23. Dimagi Inc. *CommCare (version 2.40.1) [Mobile application software]*. Cambridge, MA: Dimagi Inc.; 2018.

24. Zeleke AA, Worku AG, Demissie A, Otto-Sobotka F, Wilken M, Lipprandt M, et al. Evaluation of electronic and paper-pen data capturing tools for data quality in a public health survey in a health and demographic surveillance site, Ethiopia: randomized controlled crossover health care information technology evaluation. *JMIR Mhealth Uhealth* 2019;7(2):e10995.
PUBMED | CROSSREF

25. Paudel D, Ahmed M, Pradhan A, Lal Dangol R. Successful use of tablet personal computers and wireless technologies for the 2011 Nepal Demographic and Health Survey. *Glob Health Sci Pract* 2013;1(2):277-84.
PUBMED | CROSSREF

26. Style S, Beard BJ, Harris-Fry H, Sengupta A, Jha S, Shrestha BP, et al. Experiences in running a complex electronic data capture system using mobile phones in a large-scale population trial in southern Nepal. *Glob Health Action* 2017;10(1):1330858.
PUBMED | CROSSREF

27. King C, Hall J, Banda M, Beard J, Bird J, Kazembe P, et al. Electronic data capture in a rural African setting: evaluating experiences with different systems in Malawi. *Glob Health Action* 2014;7(1):25878.
PUBMED | CROSSREF

28. Ellard-Gray A, Jeffrey NK, Choubak M, Crann SE. Finding the hidden participant. *Int J Qual Methods* 2015;14(5):160940691562142.
CROSSREF

29. Oni T, Smit W, Matzopoulos R, Hunter Adams J, Pentecost M, Rother HA, et al. Urban health research in Africa: themes and priority research questions. *J Urban Health* 2016;93(4):722-30.
PUBMED | CROSSREF

30. Vearey J, Luginaah I, Magitta NF, Shilla DJ, Oni T. Urban health in Africa: a critical global public health priority. *BMC Public Health* 2019;19(1):340.
PUBMED | CROSSREF