

RESEARCH ARTICLE

Correlates of attendance at community engagement meetings held in advance of bio-behavioral research studies: A longitudinal, sociocentric social network study in rural Uganda

Bernard Kakuhikire¹, Emily N. Satinsky^{2,3*}, Charles Baguma¹, Justin D. Rasmussen⁴, Jessica M. Perkins⁵, Patrick Gumisiriza¹, Mercy Juliet¹, Patience Ayebare¹, Rumbidzai C. Mushavi^{6,7,8}, Bridget F. O. Burns⁹, Claire Q. Evans⁵, Mark J. Siedner^{3,8,10,11}, David R. Bangsberg^{1,12}, Alexander C. Tsai^{1,3,8,10}

1 Mbarara University of Science and Technology, Mbarara, Uganda, **2** Department of Psychology, University of Southern California, Los Angeles, California, United States of America, **3** Center for Global Health, Massachusetts General Hospital, Boston, Massachusetts, United States of America, **4** Department of Psychology, Duke University, Durham, North Carolina, United States of America, **5** Peabody College, Vanderbilt University, Nashville, Tennessee, United States of America, **6** Department of Obstetrics and Gynecology, Massachusetts General Hospital, Boston, Massachusetts, United States of America, **7** Department of Obstetrics and Gynecology, Brigham and Women's Hospital, Boston, Massachusetts, United States of America, **8** Harvard Medical School, Boston, Massachusetts, United States of America, **9** Department of Urban Studies and Planning, Massachusetts Institute of Technology, Boston, Massachusetts, United States of America, **10** Mongan Institute, Massachusetts General Hospital, Boston, Massachusetts, United States of America, **11** Division of Infectious Diseases, Massachusetts General Hospital, Boston, Massachusetts, United States of America, **12** Oregon Health and Science University - Portland State University School of Public Health, Portland, Oregon, United States of America

* These authors contributed equally to this work.

* satinsky@usc.edu



OPEN ACCESS

Citation: Kakuhikire B, Satinsky EN, Baguma C, Rasmussen JD, Perkins JM, Gumisiriza P, et al. (2021) Correlates of attendance at community engagement meetings held in advance of bio-behavioral research studies: A longitudinal, sociocentric social network study in rural Uganda. *PLoS Med* 18(7): e1003705. <https://doi.org/10.1371/journal.pmed.1003705>

Academic Editor: Elvin H. Geng, University of California, San Francisco, UNITED STATES

Received: January 10, 2021

Accepted: June 21, 2021

Published: July 16, 2021

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: <https://doi.org/10.1371/journal.pmed.1003705>

Copyright: © 2021 Kakuhikire et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Background

Community engagement is central to the conduct of health-related research studies as a way to determine priorities, inform study design and implementation, increase recruitment and retention, build relationships, and ensure that research meets the goals of the community. Community sensitization meetings, a form of community engagement, are often held prior to the initiation of research studies to provide information about upcoming study activities and resolve concerns in consultation with potential participants. This study estimated demographic, health, economic, and social network correlates of attendance at community sensitization meetings held in advance of a whole-population, combined behavioral, and biomedical research study in rural Uganda.

Methods and findings

Research assistants collected survey data from 1,630 adults participating in an ongoing sociocentric social network cohort study conducted in a rural region of southwestern

Data Availability Statement: All files are available from the following GitHub repository: <https://github.com/esatinsky/commsens>.

Funding: his project was supported by Friends for a Healthy Uganda and the U.S. National Institutes of Health R01MH113494 and R01MH125667 awarded to ACT (https://projectreporter.nih.gov/project_info_description.cfm?aid=9507908&icde=43069576&ddparam=&ddvalue=&ddsub=&cr=1&csb=default&cs=ASC&pball=-; <https://reporter.nih.gov/search/C8SbEfNIHUGHHTTgqC817w/project-details/10155766>). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests: I have read the journal's policy and the authors of this manuscript have the following competing interests: ACT receives a stipend as a Specialty Consulting Editor for PLoS Medicine and serves on the journal's editorial board.

Abbreviations: ARR, adjusted relative risk; CAB, community advisory board; CI, confidence interval; IQR, interquartile range; LC1, local council level 1; RR, relative risk; SD, standard deviation; VHT, village health team.

Uganda. These community survey data, collected between 2016 and 2018, were linked to attendance logs from community sensitization meetings held in 2018 and 2019 before the subsequent community survey and community health fair. Of all participants, 264 (16%) attended a community sensitization meeting before the community survey, 464 (28%) attended a meeting before the community health fair, 558 (34%) attended a meeting before either study activity (survey or health fair), and 170 (10%) attended a meeting before both study activities (survey and health fair). Using multivariable Poisson regression models, we estimated correlates of attendance at community sensitization meetings. Attendance was more likely among study participants who were women (adjusted relative risk [ARR]_{health fair} = 1.71, 95% confidence interval [CI], 1.32 to 2.21, $p < 0.001$), older age (ARR_{survey} = 1.02 per year, 95% CI, 1.01 to 1.02, $p < 0.001$; ARR_{health fair} = 1.02 per year, 95% CI, 1.01 to 1.02, $p < 0.001$), married (ARR_{survey} = 1.74, 95% CI, 1.29 to 2.35, $p < 0.001$; ARR_{health fair} = 1.41, 95% CI, 1.13 to 1.76, $p = 0.002$), and members of more community groups (ARR_{survey} = 1.26 per group, 95% CI, 1.10 to 1.44, $p = 0.001$; ARR_{health fair} = 1.26 per group, 95% CI, 1.12 to 1.43, $p < 0.001$). Attendance was less likely among study participants who lived farther from meeting locations (ARR_{survey} = 0.54 per kilometer, 95% CI, 0.30 to 0.97, $p = 0.041$; ARR_{health fair} = 0.57 per kilometer, 95% CI, 0.38 to 0.86, $p = 0.007$). Leveraging the cohort's sociocentric design, social network analyses suggested that information conveyed during community sensitization meetings could reach a broader group of potential study participants through attendees' social network and household connections. Study limitations include lack of detailed data on reasons for attendance/nonattendance at community sensitization meetings; achieving a representative sample of community members was not an explicit aim of the study; and generalizability may not extend beyond this study setting.

Conclusions

In this longitudinal, sociocentric social network study conducted in rural Uganda, we observed that older age, female sex, being married, membership in more community groups, and geographical proximity to meeting locations were correlated with attendance at community sensitization meetings held in advance of bio-behavioral research activities. Information conveyed during meetings could have reached a broader portion of the population through attendees' social network and household connections. To ensure broader input and potentially increase participation in health-related research studies, the dissemination of research-related information through community sensitization meetings may need to target members of underrepresented groups.

Author summary

Why was this study done?

- Community engagement is central to the conduct of health-related research studies as a means of developing trust, increasing awareness of and engagement with research procedures, and safeguarding ethical good practice.

- Community sensitization meetings are often held in advance of global health research activities to build community awareness of key scientific and research concepts and to create opportunities for collaboration and feedback.
- Since successful research implementation requires buy-in from a range of stakeholders, fulfillment of community sensitization meeting aims requires widespread attendance and, potentially, subsequent dissemination of information to community members not in attendance.

What did the researchers do and find?

- We conducted a longitudinal, sociocentric social network study with 1,630 adults in a rural region of southwestern Uganda to understand the demographic, health, economic, and social network correlates of attendance at community sensitization meetings held before 2 research study activities.
- Attendance at community sensitization meetings was more likely among study participants who were older age, women, married, members of more community groups, and living in closer geographical proximity to the meeting locations.
- Nonattendees living in the households of meeting attendees were more likely (compared with meeting attendees) to be younger age, men, unmarried, and members of fewer community groups.

What do these findings mean?

- These findings suggest that information dissemination, relationships, and trust achieved through the use of community sensitization meetings held in advance of research studies may disproportionately extend to certain sociodemographic subgroups.
- However, information conveyed during community sensitization meetings may reach a broader sample of the population via informal transmission through attendees' social network and household connections.
- Future community sensitization efforts should aim to better target members of under-represented groups.

Introduction

Community engagement is central to the conduct of health-related research studies. Sometimes described as stakeholder engagement [1], this process is valued by both researchers and community members (including study participants and non-study participants) for its role in cultivating trust and relationships between the research institution and the community, increasing research recruitment and retention, promoting behavior change, and safeguarding ethical good practice [2–7]. Tindana and colleagues describe community engagement as a process that aims to ensure the cultural relevance and acceptability of research procedures, minimize community disruption, avoid harm through exploitation, and consider potential ethical hazards native to the community context [8]. Through this framework, community

engagement allows for a relationship that respects the community and promotes common goals and interests [2,9,10].

Research teams commonly engage with prospective study participants and their communities prior to engaging in study activities in sub-Saharan Africa [4,11–18]. Community engagement can involve diverse formats, including smaller discussions with village leaders and community advisory boards (CABs) [19–23], community mobilization, and larger meetings with community members [9,24]. Studies of these community engagement efforts have highlighted their value as a vehicle for increasing awareness and engagement of prospective study activities [25]. When employed as an intervention, community mobilization has been shown to encourage positive health behaviors, e.g., as was shown in South Africa with respect to higher uptake of HIV testing and condom use [26,27].

Large gatherings of community members, often called “community sensitization” meetings, are typically held prior to implementation of study procedures. These meetings are meant to provide information about upcoming study activities, build awareness of key scientific and research concepts [17,28,29], and create opportunities for collaboration and feedback between researchers and community members [30,31]. For example, an evaluation of a community-wide quality improvement study in rural Tanzania and Uganda elicited recommendations from village volunteers who suggested that community sensitization meetings about maternal and newborn health would support help-seeking behaviors and care practices [32]. Similarly, a qualitative study from Kenya showed that, despite a lack of awareness of mass screening and treatment for malaria after initial sensitization meetings, there was community interest in more targeted sensitization efforts [33]. By developing research literacy among potential participants [34], researchers help to ensure that the consent process is voluntary and valid [2,9,35,36] and to cultivate trust among community members [3,7,16,37,38]. A largely separate literature describes community engagement in the form of disseminating research findings back to study participants and other community members [39–44].

Power differences between research staff and participants can affect research engagement and outcomes [45,46]. By initiating sensitization meetings as guests of the community [47], researchers receive feedback from and consult with potential participants [31], thereby allowing for the co-creation of relationships that can be engaged throughout the implementation of study procedures. Through this dynamic process, sensitization meetings can help identify areas of community misinformation; establish culturally appropriate language for study materials to describe the risks, benefits, and alternatives of participation; and minimize risks to and exploitation of study participants [2,22]. Once identified, concerns about prospective study procedures can then be considered when planning for effective study implementation and/or potentially modified in response to this feedback [17,33,48–52].

Successful community sensitization and subsequent research activities require buy-in from a range of stakeholders in the community, including local political leaders, opinion leaders, and heads of households [31]. While many studies note the importance these leaders play in community sensitization efforts (e.g., to increase buy-in and attendance), and despite evidence suggesting that there is substantial ethical and instrumental value in conducting community sensitization meetings in advance of implementing research study procedures, little is known about the demographic, health, economic, and social network characteristics of community members who attend community sensitization meetings. This is an important gap in the literature because any fulfillment of meeting aims is conditioned on widespread attendance by members of the community and subsequent dissemination of the information contained therein to other community members not in attendance.

Only one study has attempted to answer this question: Dierickx and colleagues conducted a mixed-methods study in The Gambia, sampling 124 households (primary heads of households

and other household leaders) representing a community of 4,456 people to assess their attendance at community sensitization meetings and elicit their perceptions about the benefits of and barriers to participating in the researchers' study. In addition to characterizing meeting attendees, Dierickx and colleagues hypothesized that information discussed during community sensitization meetings may have been passed to nonattendees through informal means, such as word of mouth [53]. Other than this single novel study, no other study has systematically characterized nonattendees who may indirectly receive information discussed at community sensitization meetings from attendees.

To address these gaps in the literature, we aimed to estimate the environmental, demographic, health, economic, and social network correlates of attendance at community sensitization meetings. These meetings were held as part of a whole-population longitudinal sociocentric social network study in a rural region of southwestern Uganda [54]. Understanding the factors that correlate with attendance at community sensitization meetings can aid in the effective targeting of underrepresented populations for further outreach. Researchers can use this information to adapt recruitment efforts, enhance community relationships, and ultimately promote widespread awareness of and engagement with research activities, while ensuring ethical good practice.

Methods

This study is reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline (S1 Checklist). The analysis was conducted using data collected between 2016 and 2019 as part of a longitudinal, sociocentric social network study in rural Uganda [54]. Study activities include surveys of every adult resident at regular intervals, along with community-wide health fairs during which clinical screening, treatment, and referral services are provided and biological specimens are obtained for research purposes. The study is conducted in a parish in Rwampara District, a rural region in southwestern Uganda. The parish is comprised of 8 villages. Most parish residents work as subsistence farmers or engage in small-scale trading/enterprise [55], and food and water insecurity are common in this rural setting [55–58].

Community sensitization meetings

Prior to implementation of study activities, the study team conducted a series of community sensitization meetings in each village of the parish (Fig 1). Before each meeting, the study team worked with selected community stakeholders—including local council level 1 (LC1) chairpersons (i.e., elected leaders at the lowest administrative level of Uganda's decentralized local government system [59]), the parish chief, village health team (VHT) members, community mobilizers, key opinion leaders, religious leaders, and community development officers—to enlist their aid in mobilizing community members to attend meetings. In return for their assistance, these stakeholders were provided with 10,000 Ugandan Shillings (approximately 2.70 USD—the value of 2 kg sugar—given the exchange rate at the time the study was conducted). Community mobilization efforts include distributing placards and banners, broadcasting announcements on the radio, and making written/verbal announcements during community meetings and religious gatherings in local churches and mosques.

In preparation for these meetings, our study team first convened to develop an agenda, brainstorm questions that would likely be raised by community members, and prepare responses. One or 2 community sensitization meetings were held in each village, approximately 1 to 2 months before commencement of subsequent study procedures. Meetings were conducted in Runyankore, the local language, and generally lasted between 1 and 2 hours.

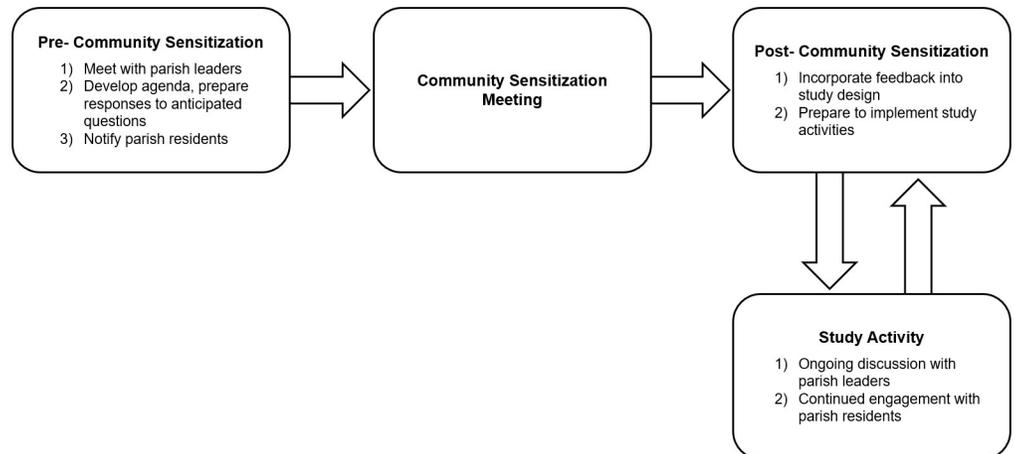


Fig 1. Community sensitization process.

<https://doi.org/10.1371/journal.pmed.1003705.g001>

While there were slight variations from site to site, in general, each meeting followed a similar agenda. Attendees were asked to sign a logbook upon arrival. Once attendees were seated, the meetings began with an opening prayer and, depending on the size of the meeting, introductions. Attendees were provided with soda and cake to enjoy during the meetings. Following introductions, the study team explained the upcoming study procedures and provided general information about its purposes and potential risks, benefits, and alternatives. The information shared at community sensitization meetings was intended to provide a general overview of study procedures, with the expectation that more detailed information would be provided, on a one-on-one basis, during the informed consent process. Following the presentation of the upcoming study activities, attendees were given opportunities to ask questions, share concerns, and provide guidance.

Ethical approval and integration of community feedback

Prior to commencing the study, we obtained feedback from a CAB comprised of 8 community leaders, including 4 women and the district development officer. Their feedback was incorporated into the study design, and the study protocol was reviewed and approved by the Mbarara University of Science and Technology Research Ethics Committee and the Partners Human Research Committee. Consistent with Ugandan national guidelines, clearance for the study was also obtained from the Uganda National Council for Science and Technology. Upon receiving approval, we began conducting community sensitization meetings. Additional community sensitization meetings were held prior to subsequent waves of the community surveys and the community health fairs, thus providing opportunities for community input to be incorporated into subsequent research study activities. For example, during a community sensitization meeting held prior to the first community health fair, meeting attendees requested that our study team provide cervical cancer screening as part of the community health fair activities. In response, we incorporated into the subsequent community health fair a program of cervical cancer prevention education, high-risk human papillomavirus testing, and screening for premalignant lesions using visual inspection with acetic acid (with cryotherapy for screen-positive women meeting treatment criteria). For all study activities, participants provided written informed consent prior to participating; those who could not read and/or write were permitted to indicate consent with a thumbprint mark.

Table 1. Sensitization meetings before each study activity.

Villages	Community Survey	Community Health Fair	Total
Buhingo	1	2	3
Bukuna 1	*	2	2
Bukuna 2	1	2	3
Bushenyi	1	2	3
Nyakabare	1	2	3
Nyamikanja 1	1	2	3
Nyamikanja 2	1	1	2
Rwembogo	1	2	3
Parish Headquarters		1	1
Parish Leadership	1		1
Total	8	16	24

*One meeting was held in this village but was excluded from analysis due to missing attendance log.

<https://doi.org/10.1371/journal.pmed.1003705.t001>

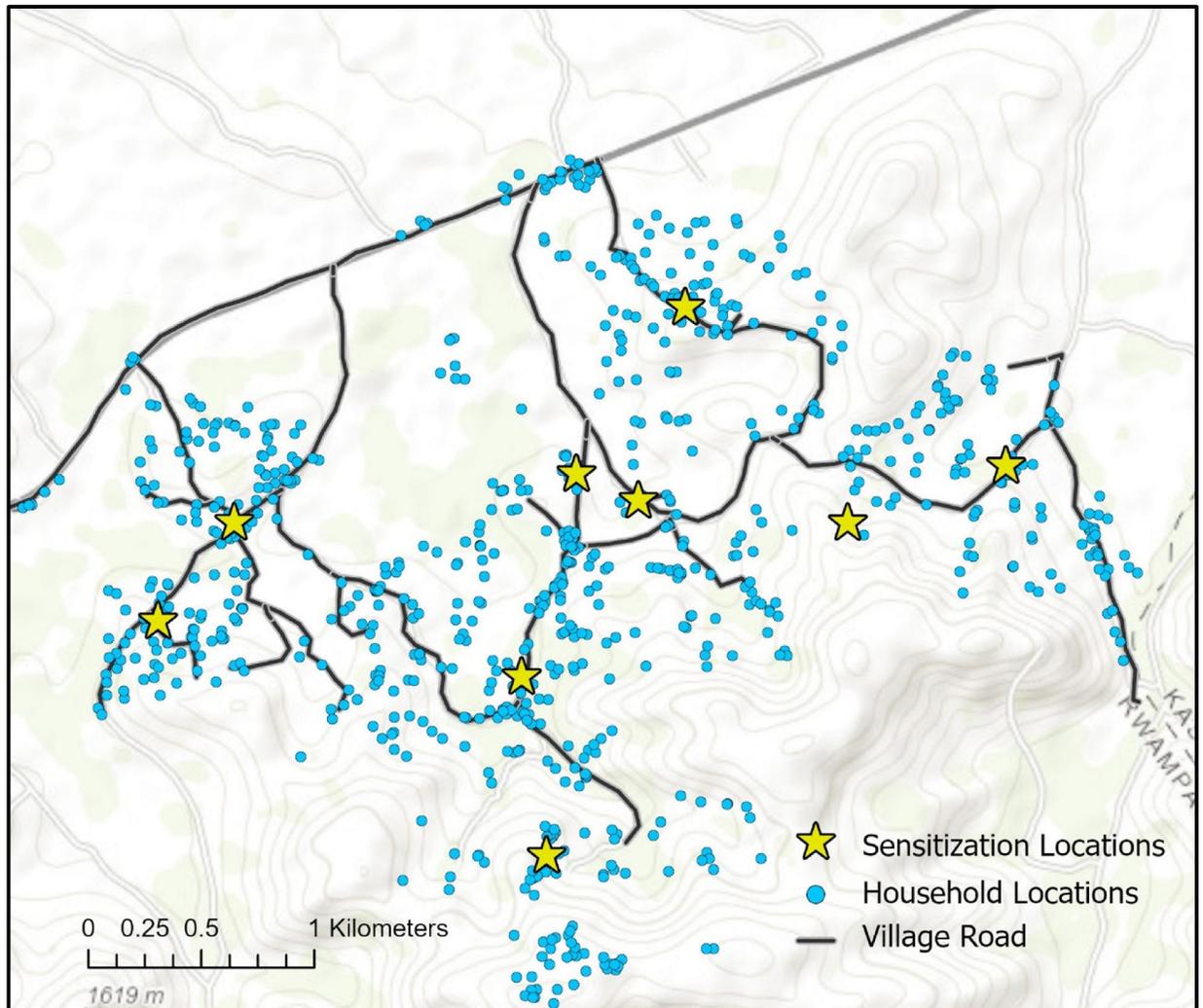
Primary outcome variable

The primary outcome for the present study was attendance at community sensitization meetings. This information was recorded from attendance logs collected from 8 community sensitization meetings held before the community survey and from 16 community sensitization meetings held before the community health fair (Table 1, Fig 2). From these data, we created 2 dichotomous outcome variables specifying attendance or nonattendance at the community sensitization meetings: (1) attendance at any community survey sensitization meeting; and (2) attendance at any community health fair sensitization meeting. We were unable to find the attendance log for one of the community sensitization meetings (held in Bukuna 1 prior to the community survey).

Explanatory variables

All attendee names were matched with participants' unique study identification numbers to facilitate linkage of the 2018 to 2019 attendance variables to study participant data collected during the previously administered (2016 to 2018) community survey. Variables used in this study represented environmental, demographic, health, economic, and social network domains. Using household Global Positioning System coordinates, we calculated the shortest straight-line distance (in kilometers) from each study participant's home to the meeting location in their respective village (continuous). Demographic variables included sex (binary), age (continuous), marital status (binary), and educational attainment (binary). Health variables included self-reported HIV serostatus (binary), obesity (binary; based on waist circumference, measured halfway between the lower costal margin and the iliac crest, with thresholds of ≥ 102 cm for men and ≥ 88 cm for women who were not currently pregnant [60]), and depression symptom severity (continuous; modified Hopkins Symptom Checklist for Depression [58,61,62]). Economic variables included food insecurity (categorical; 9-item Household Food Insecurity Access Scale [55,63]), water insecurity (categorical; 8-item Household Water Insecurity Access Scale [57,58]), and household asset wealth (categorical; [64,65]).

Survey data were used to capture different components of study participants' social integration, or their participation in various aspects of community life [66,67]. We administered network name generators [68] to elicit social ties: Each participant was asked to name specific residents in the parish ("alters") with whom they interacted on a regular basis. We used 5



World Topographic Map Sources: Esri, OpenStreetMap contributors, HERE, Garmin, USGS. Contains information from OpenStreetMap and OpenStreetMap Foundation, which is made available under the Open Database License.

Fig 2. Map of the study parish, community sensitization meeting locations, and participants' households. Base layer map available at: www.arcgis.com/apps/mapviewer/index.html?layers=30e5fe3149c34df1ba922ebbf808f.

<https://doi.org/10.1371/journal.pmed.1003705.g002>

different domain-specific name generators (social, health, financial, emotional, and food exchange) to ensure that participants identified alters across multiple domains of personal life [69–71]. These data were used to calculate individual network characteristics, including in-degree, out-degree, closeness centrality, and betweenness centrality [72]. We used a locally derived 10-item scale to measure membership and participation in different community groups (continuous). Finally, the 3-item University of California at Los Angeles Loneliness Scale [73] was used to assess study participants' subjective experiences of connectedness (continuous).

Data analysis

The analysis was not preregistered, but we followed a prespecified analysis plan and tracked deviations that resulted from peer review (S1 Text). Single-variable and multivariable Poisson

regression models with robust estimates of variance were fitted to estimate correlates of attendance at community sensitization meetings held before the community survey and the community health fair (2018 to 2019). Explanatory variables were based on data collected during the previously administered community survey (2016 to 2018). We adjusted for clustering at the village level. We fitted separate regression models for the 2 dichotomous attendance variables since we hypothesized that participants from different sociodemographic subgroups might be interested in attending meetings before the study activities for different reasons. For example, the community health fair provided a clear service (i.e., disease screening/testing and referral for treatment), so individuals with health concerns or individuals whose family members had health problems might be more likely to attend. As described previously, we were unable to find the attendance log for the community sensitization meeting held in Bukuna 1 prior to the community survey. Therefore, models estimating correlates of attendance at a meeting before the community survey excluded residents from that village. Following Zou, the exponentiated regression coefficients were interpreted as relative risk ratios [74].

The sociocentric social network design of the cohort permitted us to identify study participants who did not attend a community sensitization meeting themselves but who may have been indirectly exposed to a meeting (and the information disseminated therein) through their social affiliation with someone who did attend a meeting. We identified the number of study participants who did not attend a community sensitization meeting themselves and who were a geodesic distance of 1 from meeting attendees [75]. Formally, the geodesic distance between 2 vertices in a network graph is the number of edges corresponding to the shortest path connecting the 2 vertices; informally, a geodesic distance of 1 is one handshake away. These participants did not attend a community sensitization meeting themselves but were nominated as an alter (in the previously administered community survey), across any of the 5 domains, by someone who had attended a meeting. Similarly, we used household roster data to identify the number of study participants who did not attend a community sensitization meeting themselves and who lived in the same household with at least 1 meeting attendee. Thus, we were able to identify the number of study participants who were directly exposed to a meeting (i.e., attendees) and the number of study participants who may have been indirectly exposed to a meeting (i.e., nonattendees who were either one handshake away from an attendee or who resided in the same household with an attendee). The total sum of directly exposed and indirectly exposed study participants provided us with an estimate of the potential reach of the information conveyed during the community sensitization meetings.

Analyses were conducted using Stata version 16 (College Station, Texas).

Results

Characteristics of the sample

Of 1,795 individuals eligible for the community survey, 1,630 individuals participated (response rate, 91%; [Table 2](#)). Of these participants, 264 (16%) attended a community sensitization meeting before the community survey, 464 (28%) attended a meeting before the community health fair, 558 (34%) attended a meeting before either study activity (survey or health fair), and 170 (10%) attended a meeting before both study activities (survey and health fair). Of note, 56 additional individuals attended a community sensitization meeting but did not participate in the prior community survey (either because they refused, were not found, or were not yet enrolled in the study). These meeting attendees were therefore excluded from the analyses. Yet overall, 281 (16%) parish residents attended a meeting before the community survey, 510 (28%) parish residents attended a meeting before the community health fair, 614 (34%) parish residents attended a meeting before either study activity, and 177 (10%) parish

Table 2. Characteristics of study participants stratified by attendance or nonattendance at any community sensitization meeting.

	Attendance at Any Community Sensitization Meeting					
	Attended Meeting (n = 558, 34.2%)		Did Not Attend Meeting (n = 1,072, 65.8%)		Total (N = 1,630)	
	n	%	n	%	n	%
Age Category						
18–25 years	56	10.0%	309	28.8%	365	22.4%
26–35 years	129	23.1%	276	25.8%	405	24.9%
36–45 years	116	20.8%	185	17.3%	301	18.5%
46–55 years	132	23.7%	132	12.3%	264	16.2%
56+ years	117	21.0%	154	14.4%	271	16.6%
Missing	8	1.43%	16	1.49%	24	1.47%
Sex						
Female	379	67.9%	532	49.6%	911	55.9%
Male	179	32.1%	540	50.4%	719	44.1%
Married						
Yes	392	70.3%	602	56.2%	994	61.0%
No	166	29.8%	470	43.8%	636	39.0%
Education						
Completed Primary School	281	50.4%	697	65.0%	978	60.0%
Did Not Complete Primary School	277	49.6%	375	35.0%	652	40.0%
HIV Status						
HIV Positive	68	12.1%	99	9.24%	167	10.3%
HIV Negative	490	87.8%	973	90.8%	1,463	89.8%
Obese						
Yes	205	36.7%	334	31.2%	539	33.1%
No	326	58.4%	702	65.5%	1,028	63.1%
Missing	27	4.84%	36	3.36%	63	3.87%
Depression						
Median (IQR)	1.40 (1.20–1.73)		1.33 (1.20–1.67)		1.40 (1.20–1.67)	
Household Food Insecurity						
Food secure	159	28.5%	366	34.1%	525	32.2%
Mild food insecurity	59	10.6%	148	13.8%	207	12.7%
Moderate food insecurity	238	42.7%	382	35.6%	620	38.0%
Severe food insecurity	101	18.1%	165	15.4%	266	16.3%
Missing	1	0.18%	11	1.03%	12	0.74%
Household Water Insecurity						
Water secure	258	46.2%	536	50.0%	794	48.7%
Mild water insecurity	72	12.9%	118	11.0%	190	11.7%
Moderate food insecurity	129	23.1%	222	20.7%	351	21.5%
Severe food insecurity	98	17.6%	184	17.2%	282	17.3%
Missing	1	0.18%	12	1.12%	13	0.80%
Membership in Community Groups (No. of Groups)						
Median (range)	1 (0–9)		0 (0–6)		1 (0–9)	
Participation in Community Groups (No. of Groups)						
Median (range)	1 (0–8)		0 (0–6)		0 (0–8)	
Loneliness						
Median (IQR)	3 (3–5)		3 (3–5)		3 (3–5)	
Distance to Meetings in Village (km)						
Median (IQR)	0.36 (0.23–0.50)		0.40 (0.27–0.63)		0.39 (0.25–0.59)	

(Continued)

Table 2. (Continued)

	Attendance at Any Community Sensitization Meeting					
	Attended Meeting (<i>n</i> = 558, 34.2%)		Did Not Attend Meeting (<i>n</i> = 1,072, 65.8%)		Total (<i>N</i> = 1,630)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
In-Degree						
Median (IQR)	6 (3–9)		3 (1–6)		4 (2–7)	
Out-Degree						
Median (IQR)	6 (4–8)		5 (3–7)		5 (4–7)	
Closeness Centrality						
Median (IQR)	0.24 (0.22–0.25)		0.23 (0.21–0.24)		0.23 (0.22–0.25)	
Betweenness Centrality						
Median (IQR)	5,472 (2,099–12,585)		2,808 (444–7,605)		3,708 (862–9,318)	

Figures do not add to 100% due to rounding.

IQR, interquartile range.

<https://doi.org/10.1371/journal.pmed.1003705.t002>

residents attended at least 1 meeting before both study activities. Attendance at the meetings held before the community survey averaged 36 attendees (range, 10 to 61), while the meetings held before the community health fair averaged 43 attendees (range, 24 to 70).

Compared to the full sample of participants (mean age = 39.4 years; standard deviation [SD] = 16.7), participants who attended community sensitization meetings were older (community survey: mean age = 45.1, SD = 15.6; community health fair: mean age = 44.7, SD = 15.5). Additionally, a higher percentage of meeting attendees were women (overall sample, 56%; community survey meeting attendees, 65%; community health fair meeting attendees, 70%) and married (overall sample, 61%; community survey meeting attendees, 75%; community health fair meeting attendees, 70%).

Correlates of attendance at community sensitization meetings

In the single-variable Poisson regression models, adjusted for clustering at the village level, the following variables had statistically significant associations with attendance at a community sensitization meeting: older age, female sex, being married, not having completed primary school, higher depression symptom severity, membership and participation in more community groups, and residing in closer geographic proximity to the meeting location (Table 3). Attendance at community sensitization meetings was more likely among study participants who were older age (adjusted relative risk [ARR]_{survey} = 1.02 per year, 95% confidence interval [CI], 1.01 to 1.02, $p < 0.001$; ARR_{health fair} = 1.02 per year, 95% CI, 1.01 to 1.02, $p < 0.001$), married (ARR_{survey} = 1.74, 95% CI, 1.29 to 2.35, $p < 0.001$; ARR_{health fair} = 1.41, 95% CI, 1.13 to 1.76, $p = 0.002$), and members of more community groups (ARR_{survey} = 1.26 per group, 95% CI, 1.10 to 1.44, $p = 0.001$; ARR_{health fair} = 1.26 per group, 95% CI, 1.12 to 1.43, $p < 0.001$). Attendance at community sensitization meetings was less likely among study participants who lived farther away from meeting locations (ARR_{survey} = 0.54 per kilometer, 95% CI, 0.30 to 0.97, $p = 0.041$; ARR_{health fair} = 0.57 per kilometer, 95% CI, 0.38 to 0.86, $p = 0.007$).

There were slight differences in some of the estimated associations in terms of convention thresholds of statistical significance. For example, women were more likely to have attended a community sensitization meeting before the health fair (ARR = 1.71, 95% CI, 1.32 to 2.21, $p < 0.001$) but not more likely to have attended a community sensitization meeting held before

Table 3. Unadjusted and multivariable Poisson regression models estimating correlates of attendance at community sensitization meetings.

	Attendance at Community Sensitization Meeting Held in Advance of Community Survey				Attendance at Community Sensitization Meeting Held in Advance of Community Health Fair			
	RR (95% CI)	p-value	ARR (95% CI)	p-value	RR (95% CI)	p-value	ARR (95% CI)	p-value
Age	1.02 (1.01–1.02)	<0.001	1.02 (1.01–1.02)	<0.001	1.02 (1.01–1.02)	<0.001	1.02 (1.01–1.02)	<0.001
Female	1.45 (1.10–1.91)	0.009	1.38 (0.99–1.92)	0.055	1.85 (1.41–2.41)	<0.001	1.71 (1.32–2.21)	<0.001
Married	1.79 (1.31–2.46)	<0.001	1.74 (1.29–2.35)	<0.001	1.48 (1.20–1.83)	<0.001	1.41 (1.13–1.76)	0.002
Completed Primary School	0.68 (0.53–0.88)	0.003	0.94 (0.78–1.14)	0.551	0.71 (0.58–0.86)	<0.001	1.05 (0.86–1.28)	0.627
HIV Positive	1.13 (0.66–1.94)	0.662	1.11 (0.59–2.11)	0.746	1.25 (0.93–1.69)	0.144	1.14 (0.89–1.47)	0.302
Obese	1.20 (0.92–1.56)	0.175	0.94 (0.73–1.21)	0.615	1.35 (1.11–1.65)	0.003	0.99 (0.87–1.14)	0.911
Depression Symptom Severity	1.37 (1.14–1.65)	0.001	1.29 (0.98–1.69)	0.072	1.25 (1.10–1.43)	0.001	1.08 (0.90–1.30)	0.424
Household Food Insecurity: Food Secure (reference)								
Mild Food Insecurity	1.16 (0.79–1.70)	0.451	0.88 (0.52–1.50)	0.633	0.98 (0.70–1.35)	0.881	0.87 (0.63–1.20)	0.408
Moderate Food Insecurity	1.28 (0.73–2.25)	0.381	0.98 (0.51–1.88)	0.952	1.30 (0.99–1.70)	0.060	1.06 (0.80–1.40)	0.693
Severe Food Insecurity	1.22 (0.76–1.95)	0.402	0.93 (0.55–1.56)	0.771	1.28 (1.02–1.59)	0.030	1.07 (0.84–1.35)	0.587
Household Water Insecurity: Water Secure (reference)								
Mild Water Insecurity	1.30 (0.99–1.70)	0.056	1.09 (0.92–1.29)	0.327	1.06 (0.89–1.26)	0.485	0.93 (0.81–1.08)	0.343
Moderate Water Insecurity	1.07 (0.70–1.64)	0.754	0.94 (0.63–1.39)	0.745	1.11 (0.95–1.30)	0.199	0.99 (0.87–1.14)	0.909
Severe Water Insecurity	0.91 (0.63–1.31)	0.594	0.81 (0.63–1.05)	0.115	1.01 (0.81–1.26)	0.923	0.90 (0.75–1.08)	0.244
Household Asset Wealth Quintile Category 1st (Poorest, reference)								
2nd	1.17 (0.79–1.71)	0.434	1.08 (0.69–1.71)	0.731	1.01 (0.86–1.19)	0.906	0.95 (0.81–1.11)	0.541
3rd	1.09 (0.91–1.30)	0.357	1.01 (0.80–1.26)	0.962	1.04 (0.96–1.12)	0.320	0.97 (0.83–1.14)	0.747
4th	1.00 (0.85–1.16)	0.957	0.86 (0.63–1.18)	0.348	0.92 (0.76–1.11)	0.393	0.81 (0.67–0.98)	0.033
5th (Least poor)	0.62 (0.37–1.05)	0.079	0.61 (0.34–1.10)	0.100	0.58 (0.41–0.81)	0.001	0.57 (0.41–0.80)	0.001
Membership in Community Groups (No.)	1.34 (1.26–1.43)	<0.001	1.26 (1.10–1.44)	0.001	1.33 (1.23–1.43)	<0.001	1.26 (1.12–1.43)	<0.001
Participation in Community Groups (No.)	1.34 (1.21–1.47)	<0.001	1.03 (0.82–1.30)	0.809	1.31 (1.22–1.40)	<0.001	0.99 (0.93–1.06)	0.840
Loneliness	1.01 (0.93–1.10)	0.796	0.99 (0.91–1.07)	0.798	1.01 (0.98–1.05)	0.377	0.99 (0.96–1.02)	0.657
Distance to Meetings in Village (km)	0.51 (0.28–0.93)	0.028	0.54 (0.30–0.97)	0.041	0.56 (0.39–0.80)	0.002	0.57 (0.38–0.86)	0.007
Constant			0.04 (0.02–0.09)	<0.001			0.08 (0.05–0.15)	<0.001
Observations			1,297				1,524	

ARR, adjusted relative risk; CI, confidence interval; RR, relative risk.

The adjusted models include each of the variables listed in the table row headers: age, sex, marital status, education, HIV status, obesity, depression symptom severity, household food insecurity, household water insecurity, household asset wealth, membership in community groups, participation in community groups, loneliness, and straight-line distance to the meeting corresponding to participant's village of residence.

<https://doi.org/10.1371/journal.pmed.1003705.t003>

the community survey (ARR = 1.38, 95% CI, 0.99 to 1.92, $p = 0.055$). Furthermore, compared with individuals from the poorest household asset wealth quintile category, the least poor individuals were less likely to have attended a community sensitization meeting before the health fair (ARR = 0.57, 95% CI, 0.41 to 0.80, $p = 0.001$); the least poor individuals were similarly less likely to have attended a community sensitization meeting before the community survey, but the estimated association was not statistically significant (ARR = 0.61, 95% CI, 0.34 to 1.10, $p = 0.10$).

Expanded reach of community sensitization meetings beyond attendees

In addition to the 264 study participants who attended a sensitization meeting before the community survey, an additional 533 (33%) participants had a geodesic distance of 1 from at least one of the attendees (Table 4). The remaining 833 (51%) study participants were more than 1 geodesic from an attendee. Compared with the nonattendees who were not part of attendees' social networks, nonattendees who were part of attendees' social networks were more likely to be older age (44.7 years versus 35.3 years, difference, 9.4 years, 95% CI, 7.7 to 11.2, $p < 0.001$). Additionally, nonattendees in attendees' social networks were more likely to be women (57.8% versus 51.9%, $\chi^2 = 4.60$, $p = 0.032$), married (70.9% versus 50.2%, $\chi^2 = 57.5$, $p < 0.001$), and members of more community groups (1.13 groups versus 0.63 groups, difference, 0.50 groups, 95% CI, 0.39 to 0.60, $p < 0.001$) (S1 Table).

Similarly, in addition to the 464 study participants who attended a meeting before the community health fair, 593 (36%) participants had a geodesic distance of 1 from at least one of the attendees. The remaining 573 (35%) participants were more than 1 geodesic from an attendee. Compared with nonattendees who were not part of attendees' social networks, nonattendees

Table 4. Reach of community sensitization meetings through attendees' social networks and households.

	Attendance at Any Community Sensitization Meeting Before			
	Community Survey		Community Health Fair	
	n	%	n	%
Social Network Reach				
Attendees	264	16.2%	464	28.5%
Nonattendees in Attendees' Social Network	533	32.7%	593	36.4%
Total Possible Social Network Reach	797	48.9%	1,057	64.8%
Nonattendees not in Attendees' Social Network	833	51.1%	573	35.2%
Household Reach				
Attendees	264	16.2%	464	28.5%
Nonattendees in Attendees' Households	281	17.2%	433	26.6%
Total Possible Household Reach	545	33.4%	897	55.0%
Nonattendees not in Attendees' Households	1,085	66.6%	733	45.0%
Combined Social Network and Household Reach				
Attendees	264	16.2%	464	28.5%
Nonattendees in Attendees' Social Networks only	368	22.6%	339	20.8%
Nonattendees in Attendees' Households only	116	7.12%	179	11.0%
Nonattendees in Attendees' Social Networks and Households	165	10.1%	254	15.6%
Total Possible Social Network and Household Reach	913	56.0%	1,236	75.8%
Nonattendees not in Attendees' Social Networks or Households	717	44.0%	394	24.2%

Data include $N = 1,630$ individuals who participated in 2016–2018 community survey.

Figures do not add to 100% due to rounding.

<https://doi.org/10.1371/journal.pmed.1003705.t004>

who were part of attendees' social networks were more likely to be older age (mean age = 44.0 years versus 31.9 years, difference, 12.1 years, 95% CI, 10.2 to 13.9, $p < 0.001$), married (72.5% versus 41.9%, $\chi^2 = 111.8$, $p < 0.001$), and members of more community groups (1.02 groups versus 0.45 groups, difference, 0.57 groups, 95% CI, 0.47 to 0.67, $p < 0.001$) (S2 Table).

Comparing in-degree, out-degree, closeness centrality, and betweenness centrality, nonattendees (both for the community survey and the community health fair meetings) in attendees' social networks were more socially integrated compared with nonattendees not in attendees' social networks. Some alters were nominated by more than 1 attendee. For example, of the 533 participants with a geodesic distance of 1 from at least 1 attendee of a meeting before the community survey, 131 (25%) participants were named by 2 attendees, and 65 (12%) participants were named by 3 attendees.

Separately, in addition to the 264 study participants who attended a sensitization meeting before the community survey, 281 (17%) nonattendees lived in the same household as at least 1 attendee. Thus, information discussed during these meetings potentially reached 545 (33%) study participants. Compared with meeting attendees, these nonattendees living in attendees' households were more likely to be younger age (36.1 years versus 45.1 years, difference, 8.98 years, 95% CI, 6.21 to 11.8, $p < 0.001$), men (56.9% versus 35.2%; $\chi^2 = 25.8$, $p < 0.001$), unmarried (46.6% versus 25.0%; $\chi^2 = 27.6$, $p < 0.001$), and members of fewer community groups (0.74 groups versus 1.32 groups, difference, 0.58 groups, 95% CI, 0.39 to 0.76, $p < 0.001$).

In addition to the 464 study participants who attended a meeting before the community health fair, 433 (27%) study participants who did not attend a meeting lived in attendees' households, for a total household-level reach of 897 (55%) study participants. Compared with meeting attendees, these nonattendees living in attendees' households were also more likely to be younger age (35.2 years versus 44.7 years, difference, 9.46 years, 95% CI, 7.37 to 11.6, $p < 0.001$), men (61.2% versus 30.0%; $\chi^2 = 88.3$, $p < 0.001$), unmarried (46.4% versus 30.2%; $\chi^2 = 25.1$, $p < 0.001$), and members of fewer community groups (0.71 groups versus 1.32 groups, difference, 0.61 groups, 95% CI, 0.46 to 0.75, $p < 0.001$). Comparing in-degree, out-degree, closeness centrality, and betweenness centrality (both for the community survey and the community health fair meetings), nonattendees in attendees' households were less socially integrated than attendees.

Combined, 913 (56%) study participants either attended a sensitization meeting before the community survey or were in the social network or household of an attendee. Additionally, 1,236 (76%) study participants either attended a sensitization meeting before the community health fair or were in the social network or household of an attendee.

Discussion

In this sociocentric social network cohort study from rural Uganda, we found that attendance at community sensitization meetings was correlated with a range of sociologically and economically meaningful characteristics. People who were older age and more socially integrated, women, and people who lived in close geographic proximity to the meeting location were more likely to attend community sensitization meetings. These findings suggest that the relationships and trust that are built through community sensitization activities may disproportionately extend to certain subgroups within the community. Investigators conducting health-related research studies in similar settings in rural, sub-Saharan Africa may need to engage in more targeted outreach if aiming to ensure representation by community members belonging to certain subgroups.

Study participants who attended community sensitization meetings were more likely to be older women. In Ankole culture, older-age individuals typically hold more power and make

decisions within the family structure, which is consistent with the wisdom and respect accorded to older-age persons across some cultures [76]. As such, they may be more likely to attend meetings in order to gather information about upcoming study activities and relay information to others within their households, or they may be more likely to have discretionary time and availability to attend meetings held during a typical school- or workday. The greater representation of women in attendance at meetings held before the community health fair can potentially be explained by gender-unequal norms in Uganda that increase their likelihood of engaging in unpaid caregiving and domestic work [77], which may extend to attending meetings that provide information on research activities relevant to the health of their family members. Men's attendance could also have been limited by idealized forms of masculinity that undermine engagement in health behaviors [78–80] or caregiving and domestic activities traditionally accorded to women [58,77], or by scheduling difficulties given their predominant work outside the village setting (e.g., as “bodaboda” [motorcycle taxis common to East Africa] drivers, casual laborers, and traders).

A number of other important variables were also correlated with attendance. Depending on the specification, proxies for economic status (e.g., household asset wealth quintile category) and social integration (e.g., being married, membership and participation in community groups) were also correlated with attendance. These estimates suggest that people who have greater economic status are less likely to attend community sensitization meetings, while people who are more socially integrated are more likely to attend. Community members who are less well-off economically may be more interested in attending meetings to learn about opportunities for free services, to receive study incentives, and to develop relationships with study staff members who may provide instrumental support in times of need. People who were more socially integrated may have been more likely to attend community sensitization meetings, either because they had more opportunities to hear about meeting times and locations or because they were simply more inclined to view participation favorably in the same way as participation in other community groups.

The extent to which these differentials manifested in differential spread of key information (e.g., about proposed study activities and their impacts on the community) is unknowable given our study design and data availability. In high-income countries, there are well-known disparities in either participation or opportunities to participate in clinical trials of therapeutics and other potentially beneficial health interventions such that racialized minorities, women, and older-age persons are underrepresented [81–84]. Human subjects research in resource-limited settings has often been characterized by exploitation [85,86]. However, given the importance of community sensitization meetings in ensuring awareness of and engagement in research activities, developing relationships and trust between participants and research institutions, and ensuring ethical good practice [6,7], it remains important to meet these goals in a way that ensures that all subgroups within a community have a voice in the conduct of human subjects research. We recognize the power relations between researchers and community members and the need to thoughtfully navigate these dynamics to prevent coercion within community engagement itself [87].

Of note, the sociocentric social network design of our cohort enabled us to determine that information conveyed during community sensitization meetings may have indirectly reached a broader portion of the population through social network or household connections. While attendees of the community sensitization meetings were more likely to be older, more socially integrated women, their social network ties were also more likely to be older and more socially integrated—but nonattendees who were indirectly exposed by virtue of living in the same household as an attendee were more likely to be younger, unmarried, and less socially integrated men. These findings suggest that information conveyed during meetings could be

indirectly transmitted to community members from less well-represented sociodemographic subgroups.

The primary programmatic implication of our findings is that, while community sensitization efforts appear to reach a wide range of community members, more work is needed to understand how to better target younger, less socially integrated men [31]. It is possible that by holding such meetings at different times (e.g., on weekends or in the evenings) or in locations where younger men typically congregate (e.g., “bodaboda” stations), research teams may increase attendance at community sensitization meetings among men who work away from villages in rural settings. Such changes would need to be made in collaboration with local research staff to ensure appropriate remuneration in return for working outside of traditional working hours or to ensure they are able to manage their own caregiving and other responsibilities. A second implication of our findings is that, in the conduct of community sensitization meetings, researchers may wish to consider explicitly encouraging attendees to discuss the information conveyed, including details of upcoming study activities, with household members and other social ties. Future research might also assess the extent to which social networks facilitate the dissemination of key information conveyed during community sensitization meetings [88,89].

These findings may have relevance for the implementation of research and public health programs more broadly, particularly those that rely on community leader-led mobilization to support recruitment and resource distribution. Involving community leaders in mobilization efforts is key to community engagement, as it can diffuse power imbalances between researchers and community members, increase participation, and demonstrate respect for community structures [87]. However, programs need to identify the leaders and other “gatekeepers” within a given community, as well as those individuals that leaders and gatekeepers can reach through their networks. Considering access barriers for certain subgroups within the community, researchers and program administrators may wish to consider collaborating with community leaders and codeveloping targeted community mobilization plans to address blind spots. Initial meetings with community leaders can then lead to outreach with other community members. By integrating voices from multiple levels within a community structure, both during design and implementation, collaborative groups can increase buy-in, cultural humility, and community equity.

Strengths and limitations

Strengths of this analysis include the whole-population design with full information about both attendees and nonattendees and the availability of data on objectively assessed (rather than self-reported) attendance. Yet interpretation of our findings is subject to certain limitations. First, while this analysis allowed us to examine demographic, health, economic, and social network characteristics associated with attendance at community sensitization meetings, we did not collect data on motivations for attendance. Qualitative studies may yield greater insight into the specific aspects of the meetings that motivate attendance. For example, individuals may attend because of genuine interest and investment in the research, perceived duty to the community, opportunities to socialize with friends, or the refreshments provided. Alternatively, as found by Dierickx and colleagues, some community members may not have attended any meetings due to either lack of awareness or time constraints. Future research in this area could be codesigned with community members. For example, focus groups could be used to elicit community members’ perceptions about why some individuals may or may not attend community sensitization meetings. This feedback could then be integrated into community surveys or the development of key informant interview guides.

Second, while our research teams sought to disseminate broadly all notices about upcoming community sensitization meetings, it was not an explicit aim to achieve a representative sample of community members in attendance. It is therefore possible that different aspects of the dissemination process, both structural and behavioral, led to skew in the distribution of community members attending. For example, VHT members and research assistants were disproportionately women, and older women are also more likely to attend church in this setting. Thus, because recruitment efforts were largely led by women or conducted in spaces commonly occupied by women, these efforts may have led to disproportionate attendance by women.

Third, our findings may not generalize beyond the study setting. However, the data are based on a whole-population study, and the study setting is broadly representative of rural regions in Eastern Africa. Although further study will be needed to replicate our findings, we expect that our findings will be relevant to other investigators conducting health-related research throughout sub-Saharan Africa. Finally, since we linked survey data collected between 2016 and 2018 to attendance data collected between 2018 and 2019, some of the demographic, health, economic, and social network correlates of attendance may have been out of date. For example, social ties that were present in 2016 to 2018 may have no longer been present by 2018 to 2019 (or, conversely, social ties that were not present in 2016 to 2018 could have formed by 2018 to 2019), which could have affected our estimates of the potential reach of information conveyed during community sensitization meetings.

Conclusions

In this longitudinal population-based study, we found that women and people who were older age and more socially integrated were more likely to attend community sensitization meetings conducted in advance of research study activities in this rural region of southwestern Uganda. Individuals with lower socioeconomic status were also more likely to attend meetings. While significant proportions of the study population either attended a meeting or were indirectly exposed to a meeting through a social affiliation with a meeting attendee, our findings nonetheless raise some concerns that attendance at the meetings may be stratified along sociologically meaningful lines.

Supporting information

S1 Checklist. STROBE Checklist.

(DOCX)

S1 Text. Methods.

(DOCX)

S1 Table. Characteristics of study participants, stratified by attendance at sensitization meetings before the community survey, and attendees' social network and household reach.

(DOCX)

S2 Table. Characteristics of study participants, stratified by attendance at sensitization meetings before the community health fair, and attendees' social network and household reach.

(DOCX)

Acknowledgments

We thank the HopeNet cohort study participants, without whom this research would not be possible. We also thank members of the HopeNet study team for research assistance; in addition to the named study authors, HopeNet and other collaborative team members who contributed to data collection and/or study administration during all or any part of the study were as follows: Phionah Ahereza, Owen Alleluya, Dickson Beinomugisha, Clare Kamagara, Justus Kananura, Allen Kiconco, Viola Kyokunda, Patrick Lukwago Muleke, Rhina Mushagara, Elijah Musunguzi, Sarah Nabachwa, Elizabeth Namara, Immaculate Ninsiima, Moran Owembabazi, Mellon Tayebwa, and Dagmar Vořechovská. We thank Hawk Arachy and Meredith Meadows for their assistance with generating Fig 2, and Roger Hofmann of West Portal Software Corporation (San Francisco, Calif.) for developing and customizing the Computer Assisted Survey Information Collection Builder software program used to collect the survey and social network data.

The content is solely the responsibility of the authors and does not necessarily represent the views of Friends for a Healthy Uganda or the US National Institutes of Health. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Author Contributions

Conceptualization: Bernard Kakuhikire, Alexander C. Tsai.

Data curation: Bernard Kakuhikire, Emily N. Satinsky.

Formal analysis: Emily N. Satinsky.

Funding acquisition: Bernard Kakuhikire, Alexander C. Tsai.

Investigation: Bernard Kakuhikire, Emily N. Satinsky, Charles Baguma, Justin D. Rasmussen, Jessica M. Perkins, Patrick Gumisiriza, Mercy Juliet, Patience Ayebare, Rumbidzai C. Mushavi, Bridget F. O. Burns, Claire Q. Evans, Mark J. Siedner, David R. Bangsberg, Alexander C. Tsai.

Project administration: Bernard Kakuhikire, Emily N. Satinsky, Charles Baguma, Justin D. Rasmussen, Alexander C. Tsai.

Supervision: Alexander C. Tsai.

Writing – original draft: Bernard Kakuhikire, Emily N. Satinsky.

Writing – review & editing: Charles Baguma, Justin D. Rasmussen, Jessica M. Perkins, Patrick Gumisiriza, Mercy Juliet, Patience Ayebare, Rumbidzai C. Mushavi, Bridget F. O. Burns, Claire Q. Evans, Mark J. Siedner, David R. Bangsberg, Alexander C. Tsai.

References

1. Day S, Blumberg M, Vu T, Zhao Y, Rennie S, Tucker JD. Stakeholder engagement to inform HIV clinical trials: A systematic review of the evidence. *J Int AIDS Soc.* 2018; 7(Suppl 7):e25174.
2. Adhikari B, Pell C, Cheah PY. Community engagement and ethical global health research. *Glob Bioeth.* 2019; 31(1):1–12. <https://doi.org/10.1080/11287462.2019.1703504> PMID: 32002019
3. Molyneux CS, Peshu N, Marsh K. Trust and informed consent: Insights from community members on the Kenyan coast. *Soc Sci Med.* 2005; 61(7):1463–73. <https://doi.org/10.1016/j.socscimed.2004.11.073> PMID: 16005781
4. Hamer DH, Herlihy JM, Musokotwane K, Banda B, Mpamba C, Mwangelwa B, et al. Engagement of the community, traditional leaders, and public health system in the design and implementation of a large

- community-based, cluster-randomized trial of umbilical cord care in Zambia. *Am J Trop Med Hyg.* 2015; 92(3):666–72. <https://doi.org/10.4269/ajtmh.14-0218> PMID: 25646254
5. Farnsworth SK, Bose K, Fajobi O, Souza PP, Peniston A, Davidson LL, et al. Community engagement to enhance child survival and early development in low- and middle-income countries: An evidence review. *J Health Commun.* 2014; 19(Suppl 1):67–88. <https://doi.org/10.1080/10810730.2014.941519> PMID: 25207448
 6. Kamanda A, Embleton L, Ayuku D, Atwoli L, Gisore P, Ayaya S, et al. Harnessing the power of the grassroots to conduct public health research in sub-Saharan Africa: A case study from western Kenya in the adaptation of community-based participatory research (CBPR) approaches. *BMC Public Health.* 2013; 13(91):1–10. <https://doi.org/10.1186/1471-2458-13-91> PMID: 23368931
 7. Simwinga M, Bond V, Makola N, Hoddinott G, Belemu S, White R, et al. Implementing community engagement for combination prevention: Lessons learnt from the first year of the HPTN 071 (PopART) community-randomized study. *Curr HIV/AIDS Rep.* 2016; 13:194–201. <https://doi.org/10.1007/s11904-016-0322-z> PMID: 27405816
 8. Tindana PO, Singh JA, Tracy CS, Upshur REG, Daar AS, Singer PA, et al. Grand challenges in global health: Community engagement in research in developing countries. *PLoS Med.* 2007; 4(9):e273. <https://doi.org/10.1371/journal.pmed.0040273> PMID: 17850178
 9. Adhikari B, Pell C, Phommasone K, Soundala X, Kommarasy P, Pongvongsa T, et al. Elements of effective community engagement: Lessons from a targeted malaria elimination study in Lao PDR (Laos). *Glob Health Action.* 2017; 10(1).
 10. Emanuel EJ, Currie XE, Herman A, Project P. Undue inducement in clinical research in developing countries: Is it a worry? *Lancet.* 2005; 366(336–340).
 11. Shepler S. The rites of the child: Global discourses of youth and reintegrating child soldiers in Sierra Leone. *J Hum Rights.* 2006; 4(2):197–211.
 12. Nakibinge S, Maher D, Katende J, Kamali A, Grosskurth H, Seeley J. Community engagement in health research: Two decades of experience from a research project on HIV in rural Uganda. *Tropical Med Int Health.* 2009; 14(2):190–5. <https://doi.org/10.1111/j.1365-3156.2008.02207.x> PMID: 19207175
 13. Okello G, Jones C, Bonareri M, Ndegwa SN, Mcharo C, Kengo J, et al. Challenges for consent and community engagement in the conduct of cluster randomized trial among school children in low income settings: Experiences from Kenya. *Trials.* 2013; 14(142).
 14. Denno DM, Hoopes AJ, Chandra-Mouli V. Effective strategies to provide adolescent sexual and reproductive health services and to increase demand and community support. *J Adolesc Health.* 2015; 56(1): S22–41.
 15. Ediau M, Wanyenze RK, Machingaidze S, Otim G, Olwedo A, Iriso R, et al. Trends in antenatal care attendance and health facility delivery following community and health facility systems strengthening interventions in Northern Uganda. *BMC Pregnancy Childbirth.* 2013; 13(189). <https://doi.org/10.1186/1471-2393-13-189> PMID: 24134717
 16. Miller KS, Cham HJ, Taylor EM, Berrier FL, Duffy M, Vig J, et al. Formative work and community engagement approaches for implementing an HIV intervention in Botswana schools. *Am J Public Health.* 2016; 106(8):1439–41. <https://doi.org/10.2105/AJPH.2016.303225> PMID: 27196663
 17. Asante KP, Agyemang CT, Zandoh C, Saah J, Febir LG, Donlebo CK, et al. Community engagement in biomedical research in an African setting: The Kintampo Health Research Centre experience. *BMC Health Serv Res.* 2013; 13(383):1–8.
 18. Torpey K, Kabaso M, Kasonde P, Dirks R, Bweupe M, Thompson C, et al. Increasing the uptake of prevention of mother-to-child transmission of HIV services in a resource-limited setting. *BMC Health Serv Res.* 2010; 10(29).
 19. Cox LE, Rouff JR, Svendsen KH, Markowitz M, Abrams DI. Community advisory boards: Their role in AIDS clinical trials. *Health Soc Work.* 1998; 23(4):290–7. <https://doi.org/10.1093/hsw/23.4.290> PMID: 9834882
 20. Buchanan D, Sifunda S, Naidoo N, Reddy P, James S. Assuring adequate protections in international health research. A principled justification and practical recommendations for the role of community oversight. *Public Health Ethics.* 2008; 1(3):246–57.
 21. Mlambo CK, Vernooij E, Geut R, Vrolings E, Shongwe B, Jiwan S, et al. Experiences from a community advisory board in the implementation of early access to ART for all in Eswatini: A qualitative study. *BMC Med Ethics.* 2019; 20(1):50. <https://doi.org/10.1186/s12910-019-0384-8> PMID: 31311526
 22. Shubis K, Juma O, Sharifu R, Burgess B, Abdulla S. Challenges of establishing a Community Advisory Board (CAB) in a low-income, low-resource setting: Experiences from Bagamoyo, Tanzania. *Health Res Policy Syst.* 2009; 7(16).

23. Reddy P, Buchanan D, Sifunda S, James S, Naidoo N. The role of community advisory boards in health research: Divergent views in the South African experience. *J Soc Aspects HIV/AIDS*. 2010; 7(3):2–8. <https://doi.org/10.1080/17290376.2010.9724963> PMID: 21409299
24. King KF, Kolopack P, Merritt MW, Lavery JV. Community engagement and the human infrastructure of global health research. *BMC Med Ethics*. 2014; 15(84). <https://doi.org/10.1186/1472-6939-15-84> PMID: 25495054
25. de R. Creating "Communicative Spaces": A case of NGO community organizing for HIV/AIDS prevention. *Health Commun*. 2009; 24(8):692–702. <https://doi.org/10.1080/10410230903264006> PMID: 20183378
26. Lippman SA, Neilands TB, MacPhail C, Peacock D, Maman S, Rebombo D, et al. Community mobilization for HIV testing uptake: Results from a community randomized trial of a theory-based intervention in rural South Africa. *J Acquir Immune Defic Syndr*. 2017; 74:S44–51. <https://doi.org/10.1097/QAI.0000000000001207> PMID: 27930611
27. Lippman SA, Leddy AM, Neilands TB, Ahern J, MacPhail C, Wagner RG, et al. Village community mobilization is associated with reduced HIV incidence in young South African women participating in the HPTN 068 study cohort. *J Int AIDS Soc*. 2018; 21:e25182. <https://doi.org/10.1002/jia2.25182> PMID: 30334377
28. Lavery JV. Putting international research ethics guidelines to work for the benefit of developing countries. *Yale J Health Policy Law Ethics*. 2004; 4:319–36. PMID: 15536914
29. Newman PA, Rubincam C, Slack C, Essack Z, Chakrapani V, Chuang DM, et al. Towards a science of community stakeholder engagement in biomedical HIV prevention trials: An embedded four-country case study. *PLoS ONE*. 2015; 10(8):e0135937. <https://doi.org/10.1371/journal.pone.0135937> PMID: 26295159
30. Campbell C. Community mobilisation in the 21st century: Updating out theory of social change? *J Health Psychol*. 2014; 19(1):46–59. <https://doi.org/10.1177/1359105313500262> PMID: 24000384
31. Baltzell K, Harvard K, Hanley M, Gosling R, Chen I. What is community engagement and how can it drive malaria elimination? Case studies and stakeholder interviews. *Malar J*. 2019; 18(245). <https://doi.org/10.1186/s12936-019-2878-8> PMID: 31315631
32. Tancred T, Mandu R, Hanson C, Okuga M, Manzi F, Peterson S, et al. How people-centered health systems can reach the grassroots: Experiences implementing community-level quality improvement in rural Tanzania and Uganda. *Health Policy Plan*. 2014; 33(1):e1–e13.
33. Shuford K, Were F, Awino N, Samuels A, Ouma P, Kariuki S, et al. Community perceptions of mass screening and treatment for malaria in Siaya County, western Kenya. *Malar J*. 2016; 15(71). <https://doi.org/10.1186/s12936-016-1123-y> PMID: 26852227
34. Lippman SA, Maman S, MacPhail C, Twine R, Peacock D, Kahn K, et al. Conceptualizing community mobilization for HIV prevention: Implications for HIV prevention programming in the African context. *PLoS ONE*. 2013; 8(10):e78208. <https://doi.org/10.1371/journal.pone.0078208> PMID: 24147121
35. Bull S, Lindegger GC. Ensuring consent to research is voluntary: How far do we need to go? *Am J Bioeth*. 2011; 11:27–9. <https://doi.org/10.1080/15265161.2011.585272> PMID: 21806434
36. Boga M, Davies A, Kamuya D, Kinyanjul SM, Kivaya E, Kombe F, et al. Strengthening the informed consent process in international health research through community engagement: The KEMRI-Wellcome Trust research programme experience. *PLoS Med*. 2011; 8(9):e1001089. <https://doi.org/10.1371/journal.pmed.1001089> PMID: 21931539
37. Geissler PW, Kelly A, Imokhuede B, Pool R. He is now like a brother, I can even give him some blood"—relational ethics and material exchanges in a malaria vaccine 'trial community' in The Gambia. *Soc Sci Med*. 2008; 67:696–707. <https://doi.org/10.1016/j.socscimed.2008.02.004> PMID: 18455854
38. Molyneux S, Bull S. Consent and community engagement in diverse research contexts: Reviewing and developing research and practice: Participants in the community engagement and consent workshop, Kilifi, Kenya, March 2011. *J Empir Res Hum Res Ethics*. 2013; 8(4):1–18. <https://doi.org/10.1525/jer.2013.8.4.1> PMID: 24169417
39. Baylor A, Muzoora C, Bwana M, Kembabazi A, Haberer JE, Matthews LT, et al. Dissemination of research findings to research participants living with HIV in rural Uganda: Challenges and rewards. *PLoS Med*. 2013; 10(3):e1001397. <https://doi.org/10.1371/journal.pmed.1001397> PMID: 23472055
40. Long CR, Stewart MK, McElfish PA. Health research participants are not receiving research results: A collaborative solution is needed. *Trials*. 2017; 18(449).
41. Long CR, Purvis RS, Flood-Grady E, Kimminau KS, Rhyne RL, Burge MR, et al. Health researchers' experiences, perceptions and barriers related to sharing study results with participants. *Health Res Policy Syst*. 2019; 17(25).

42. McElfish PA, Long CR, James LP, Scott AJ, Flood-Grady E, Kimminau KS, et al. Characterizing health researcher barriers to sharing results with study participants. *J Clin Transl Sci*. 2019; 3(6):295–301. <https://doi.org/10.1017/cts.2019.409> PMID: 31827902
43. McElfish PA, Purvis RS, Scott AJ, Haggard-Duff LK, Riklon S, Long CR. The results are encouraging: perceptions to make positive changes to be healthier: Qualitative evaluation of Marshallese participants' perceptions when receiving study results in a randomized control trial. *Contemp Clin Trials Commun*. 2020; 17:100543. <https://doi.org/10.1016/j.conctc.2020.100543> PMID: 32140610
44. Moortz JJ, Taylor L, Wainberg ML, Khoshnood K. Ethical considerations for disseminating research findings on gender-based violence, armed conflict, and mental health: A case study from rural Uganda. *Health Hum Rights*. 2019; 21(1):81–92. PMID: 31239616
45. Adhikari B, Vincent R, Wong G, Duddy C, Richardson E, Lavery JV, et al. A realist review of community engagement with health research. *Wellcome Open Res*. 2019; 4:87. <https://doi.org/10.12688/wellcomeopenres.15298.2> PMID: 31289754
46. Angwenyi V, Kamuya D, Mwachiro D, Kalama B, Marsh V, Njuguna P, et al. Complex realities: Community engagement for paediatric randomized controlled malaria vaccine trial in Kilifi, Kenya. *Trials*. 2014; 15(65). <https://doi.org/10.1186/1745-6215-15-65> PMID: 24565019
47. Cheah PY, Lwin KM, Phaiphun L, Maelankiri L, Parker M, Day NP, et al. Community engagement on the Thai-Burmese border: Rationale, experience and lessons learnt. *Int Health*. 2010; 2(2):123–9. <https://doi.org/10.1016/j.inhe.2010.02.001> PMID: 22984375
48. Omedo MO, Matey EJ, Awiti A, Ogutu M, Alaii J, Karanja DMS. Community health workers' experiences and perspectives on mass drug administration for schistosomiasis control in Western Kenya: the SCORE project. *Am J Trop Med Hyg*. 2012; 87:1065–72. <https://doi.org/10.4269/ajtmh.2012.12-0435> PMID: 23091190
49. Caldwell B. Mark Nichter: Global Health: Why cultural perceptions, social representations, and biopolitics matter. *J Popul Res*. 2009; 26:203–5.
50. Geissler PW. Kachinja are coming!': Encounters around medical research work in a Kenya village. *Africa*. 2005; 75:173–202.
51. Silumbe K, Chiyende E, Finn TP, Desmond M, Puta C, Hamainza B. A qualitative study of perceptions of a mass test and treat campaign in Southern Zambia and potential barriers to effectiveness. *Malar J*. 2015; 14(171). <https://doi.org/10.1186/s12936-015-0686-3> PMID: 25896068
52. Compaore A, Dierickx S, Jaiteh F, Nahum A, Bohissou TFE, Tinto H, et al. Fear and rumours regarding placental biopsies in a malaria-in-pregnancy trial in Benin. *Malar J*. 2018; 17(425).
53. Dierickx S, O'Neill S, Gryseels C, Anyango EI, Bannister-Tyrell M, Okebe J, et al. Community sensitization and decision-making for trial participation: A mixed-methods study from The Gambia. *Dev World Bioeth*. 2018; 18(4):406–19. <https://doi.org/10.1111/dewb.12160> PMID: 28816023
54. Takada S, Nyakato V, Nishi A, O'Malley AJ, Kakuhiere B, Perkins JM, et al. The social network context of HIV stigma: Population-based, sociocentric network study in rural Uganda. *Soc Sci Med*. 2019; 233:229–36. <https://doi.org/10.1016/j.socscimed.2019.05.012> PMID: 31229909
55. Tsai AC, Bangsberg DR, Emenyonu N, Senkungu JK, Martin JN, Weiser SD. The social context of food insecurity among persons living with HIV/AIDS in rural Uganda. *Soc Sci Med*. 2011; 73(12):1717–24. <https://doi.org/10.1016/j.socscimed.2011.09.026> PMID: 22019367
56. Perkins J, Nyakato V, Kakuhiere B, Tsai A, Subramanian S, Bangsberg D, et al. Food insecurity, social networks and symptoms of depression among men and women in rural Uganda: A cross-sectional, population-based study. *Public Health Nutr*. 2018; 21(5):838–48. <https://doi.org/10.1017/S1368980017002154> PMID: 28988551
57. Tsai AC, Kakuhiere B, Mushavi R, Vorechovska D, Perkins JM, McDonough AQ, et al. Population-based study of intra-household gender differences in water insecurity: Reliability and validity of a survey instrument for use in rural Uganda. *J Water Health*. 2016; 14(2):280–92. <https://doi.org/10.2166/wh.2015.165> PMID: 27105413
58. Mushavi RC, Burns BFO, Kakuhiere B, Owembabazi M, Vorechovska D, McDonough AQ, et al. "When you have no water, it means you have no peace": A mixed-methods, whole-population study of water insecurity and depression in rural Uganda. *Soc Sci Med*. 2020; 245(112561). <https://doi.org/10.1016/j.socscimed.2019.112561> PMID: 31790879
59. Francis P, James R. Balancing rural poverty reduction and citizen participation: The contradictions of Uganda's decentralization program. *World Dev*. 2003; 31(2):325–37.
60. Klein S, Allison DB, Heymsfield SB, Kelley DE, Leibel RL, Nonas C, et al. Waist circumference and cardiometabolic risk: A consensus statement from Shaping America's Health: Association for weight management and obesity prevention; NAASO, The Obesity Society; the American Society for Nutrition; and the American Diabetes Association. *Diabetes Care*. 2007; 30(6):1647–52. <https://doi.org/10.2337/dc07-9921> PMID: 17360974

61. Ashaba S, Kakuhikire B, Vorechovska D, Perkins JM, Cooper-Vince CE, Maling S, et al. Reliability, validity, and factor structure of the Hopkins Symptom Checklist-25: Population-based study of persons living with HIV in rural Uganda. *AIDS Behav.* 2018; 22(5):1467–74. <https://doi.org/10.1007/s10461-017-1843-1> PMID: 28667469
62. Bolton P, Ndogoni L. Cross-cultural assessment of trauma-related mental illness (Phase II). World Vision Uganda and The Johns Hopkins University. 2001.
63. Swindale A, Bilinsky P. Development of a universally applicable household food insecurity measurement tool: Process, current status, and outstanding issues. *J Nutr.* 2006; 136(5):1449S–52S. <https://doi.org/10.1093/jn/136.5.1449S> PMID: 16614442
64. Smith ML, Kakuhikire B, Baguma C, Rasmussen JD, Bangsberg DR, Tsai AC. Do household asset wealth measurements depend on who is surveyed? Asset reporting concordance within multi-adult households in rural Uganda. *J Glob Health.* 2020; 10(1):010412. <https://doi.org/10.7189/jogh.10.010412> PMID: 32373331
65. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data or tears: An application to educational enrollments in states of India. *Demography.* 2001; 38(1):115–32. <https://doi.org/10.1353/dem.2001.0003> PMID: 11227840
66. Tsai AC, Lucas M, Sania A, Kim D, Kawachi I. Social integration and suicide mortality among men: 24-year cohort study of U.S. health professionals. *Ann Intern Med.* 2014; 161(2):85–95. <https://doi.org/10.7326/M13-1291> PMID: 25023247
67. Moen P, Dempster-McClain D, Williams RM. Social integration and longevity: An event history analysis of women's roles and resilience. *Am Sociol Rev.* 1989; 54(4):635–47.
68. Burt RS. Network items and the general social survey. *Soc Netw.* 1984; 6(4):293–339.
69. Bailey S, Marsden PV. Interpretation and interview context: Examining the General Social Survey name generator using cognitive methods. *Soc Netw.* 1999; 21(3):287–309.
70. Takada S, Nyakato V, Nishi A, O'Malley AJ, Kakuhikire B, Perkins JM, et al. The social network context of HIV stigma: Population-based, sociocentric network study in rural Uganda. *Soc Sci Med.* 2019; 233:229–36. <https://doi.org/10.1016/j.socscimed.2019.05.012> PMID: 31229909
71. Perkins JM, Subramanian SV, Christakis NA. Social networks and health: A systematic review of socio-centric network studies in low- and middle-income countries. *Soc Sci Med.* 2015; 125:60–78. <https://doi.org/10.1016/j.socscimed.2014.08.019> PMID: 25442969
72. Wasserman S, Faust K. Social network analysis: Methods and applications. Cambridge University Press; 1994.
73. Hughes ME, Waite LJ, Hawkey LC, Cacioppo JT. A short scale for measuring loneliness in large surveys: Results from two population-based studies. *Res Aging.* 2004; 26(6):655–72. <https://doi.org/10.1177/0164027504268574> PMID: 18504506
74. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol.* 2004; 159(7):702–6. <https://doi.org/10.1093/aje/kwh090> PMID: 15033648
75. Papachristos AV, Wildeman C, Roberto E. Tragic, but not random: The social contagion of nonfatal gunshot injuries. *Soc Sci Med.* 2015; 125:139–50. <https://doi.org/10.1016/j.socscimed.2014.01.056> PMID: 24560101
76. Lockenhoff CE, De F, Terracciano A, McCrae RR, De M, Costa PT, et al. Perceptions of aging across 26 cultures and their culture-level associates. *Psychol Aging.* 2009; 24(4):941–54. <https://doi.org/10.1037/a0016901> PMID: 20025408
77. Gabola M, Katunze M, Ssewanyana M, Ahikire J, Musimenta P, Boonabaana B, et al. Gender Roles and The Care Economy in Ugandan Households: The Case of Kaabong, Kabale and Kampala Districts. Oxford, UK: Oxfam International; 2018.
78. Courtenay WH. Constructions of masculinity and their influence on men's well-being: A theory of gender and health. *Soc Sci Med.* 2000; 50(10):1385–401. [https://doi.org/10.1016/s0277-9536\(99\)00390-1](https://doi.org/10.1016/s0277-9536(99)00390-1) PMID: 10741575
79. Siu GE, Seeley J, Wight D. Dividuality, masculine respectability and reputation: How masculinity affects men's uptake of HIV treatment in rural eastern Uganda. *Soc Sci Med.* 2013; 89:45–52. <https://doi.org/10.1016/j.socscimed.2013.04.025> PMID: 23726215
80. Wyrod R. Masculinity and the persistence of AIDS stigma. *Cult Health Sex.* 2011; 13(4):443–56. <https://doi.org/10.1080/13691058.2010.542565> PMID: 21246426
81. Timmermans S, McKay T. Clinical trials as treatment option: Bioethics and health care disparities in substance dependency. *Soc Sci Med.* 2009; 69(12):1784–90. <https://doi.org/10.1016/j.socscimed.2009.09.019> PMID: 19819059

82. Colon-Otero G, Smallridge RC, Solberg LA, Keith TD, Woodward TA, Willis FB, et al. Disparities in participation in cancer clinical trials in the United States: A symptom of a healthcare system in crisis. *Cancer*. 2007; 112(3).
83. Murthy VH, Krumholz HM, Gross CP. Participation in cancer clinical trials: Race-, sex-, and age-based disparities. *JAMA*. 2004; 291(122):2720–6.
84. Lee PY, Alexander KP, Hammill BG, Pasquali SK, Peterson ED. Representation of elderly persons and women in published randomized trials of acute coronary syndromes. *Clin Cardiol*. 2001; 286(6):708–13. <https://doi.org/10.1001/jama.286.6.708> PMID: 11495621
85. Lurie P, Wolfe SM. Unethical trials of interventions to reduce perinatal transmission of the human immunodeficiency virus in developing countries. *N Engl J Med*. 1997; 337:853–6. <https://doi.org/10.1056/NEJM199709183371212> PMID: 9295246
86. Petryna A. *When Experiments Travel: Clinical Trials and the Global Search for Subjects*. Princeton University Press; 2009.
87. Nyirenda D, Sariola S, Kingori P, Squire B, Bandawe C, Parker M, et al. Structural coercion in the context of community engagement in global health research conducted in a low resource setting in Africa. *BMC Med Ethics*. 2020; 21(90).
88. Kim DA, Hwong AR, Stafford D, Hughes A, O'Malley AJ, Fowler JH, et al. Social network targeting to maximise population behaviour change: A cluster randomised controlled trial. *Lancet*. 2015; 386(9989):145–53. [https://doi.org/10.1016/S0140-6736\(15\)60095-2](https://doi.org/10.1016/S0140-6736(15)60095-2) PMID: 25952354
89. Bond RM, Fariss CJ, Jones JJ, Kramer ADI, Marlow C, Settle JE, et al. A 61-million-person experiment in social influence and political mobilization. *Nature*. 2012; 489:295–8. <https://doi.org/10.1038/nature11421> PMID: 22972300