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Assessing strategies to improve participation in mobile phone surveys for non- communicable diseases: Randomized studies from Bangladesh, Colombia, and Uganda

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Abstract

Background

Mobile phone surveys (MPS) provide a cost-effective and logistically simpler alternative to household surveys for monitoring non-communicable diseases (NCDs) and their risk factors in low- and middle-income countries (LMICs). However, improving response and completion rates remains a challenge. This study aimed to assess strategies to optimize MPS for NCD risk factor surveillance.

Methods

In Bangladesh, Colombia, and Uganda, participants were randomly assigned to one of three study arms: 1) Interactive Voice Response (IVR) survey only, 2) IVR with pre-survey SMS notification, or 3) Calling-in, with a toll-free number. Contact, response, refusal, and cooperation rates were calculated and compared across arms using log-binomial regression models.

Results

A total of 301,024 (complete interviews: 630), 160,437 (complete interviews: 760), and 49,107 (complete interviews: 1,157) MPS calls were made in Bangladesh, Colombia, and Uganda, respectively. Across the three countries, the SMS pre-notification arm had significantly higher contact rates (risk ratios [RR] ranging from 1.60 to 1.86) and response rates (RR: 1.54–1.84) compared to the IVR-only arm. While the call-in arm had a low yield in Bangladesh and Colombia, it performed well in Uganda with the highest cooperation rate (RR 1.41, 95% CI: 1.32–1.52). No single strategy was favored by any demographic group. The call-in arm was costliest in Bangladesh ($112.06 per completed survey) and Colombia ($143.21), but most cost-effective in Uganda ($3.97).

Conclusions

SMS pre-notifications and call-in strategies can improve MPS participation rates, but their effectiveness and cost-efficiency vary across contexts. Tailoring strategies to local preferences and contexts are crucial for optimizing MPS for NCD surveillance in LMICs.

Introduction

Non-communicable diseases (NCDs) are responsible for deaths of more than 40 million people each year, and most of these deaths occur in low- and middle-income countries (LMIC) [1, 2]. Several risk factors contribute to the development of NCDs, including physical inactivity, poor diet, excessive alcohol and tobacco smoking, and the burden of the most metabolic and behavioral risk factors has worsened in recent years [1, 3, 4]. Monitoring NCD and risk factor trends is important for informing interventional priorities, and several modalities exist to collect this information [5]. Although the World Health Organization (WHO) recommends a household survey with a STEPwise approach for NCD risk factor surveillance, the process can be logistically complicated, time-consuming, and expensive [5, 6].

The widespread penetration of mobile technologies in LMICs (one mobile-cellular subscription on average per inhabitant, 2018) demonstrates the potential for mobile phone surveys (MPS) to be used to monitor a population's health in such resource-limited settings [6, 7]. The Bloomberg Philanthropy's Data for Health (D4H) initiative aims to explore innovative methods for public health data collection, namely mobile phone surveys (MPS), which have several modes of survey delivery and include short message service (SMS), interactive voice response (IVR), or computer assisted telephone interview (CATI) surveys. SMS surveys involve sharing questions and receiving answers via text-based SMS platforms. In IVR surveys, the participant receives a pre-recorded questionnaire and can answer questions using their device's keypad, whereas the questions are asked by a live interviewer in the Computer Assisted Telephone Interview modality [7].

While SMS-based surveys have demonstrated good response and completion rates, they pose the concern of not representing populations with poor digital literacy [8, 9]. This problem is overcome with modalities such as IVR and CATI. Though several of these survey processes have demonstrated promise, there remains a challenge to improve survey completeness, representativeness, and response rates [5, 10]. Several studies have explored providing airtime incentives to overcome this problem and have found mixed results [11–13]. While they are generally looked upon favorably by survey participants, there are several data quality and ethical concerns that have been raised [6, 14]. Multiple studies have established that the time of day, frequency, and timing of mHealth interventions often influence their level of acceptance and efficiency [7, 8, 12, 15]. An alternative to combat low response and completion rates could be sharing pre-notifications or allowing participants to schedule a time to take the survey. Several studies have reported that with pre-notification SMS alerts improving response rates in studies conducted in developed countries [8, 16, 17]; however, their effect on response rates to MPS in LMIC's hasn't been explored extensively, especially comparing that with the survey methods that are already in place. Through this study, we aim to fill in some of the above-mentioned gaps and assess strategies to optimize MPS for NCD risk factor surveillance. Our study assessed several strategies to improve the contact, response, and cooperation rates using randomized controlled study designs implemented in Bangladesh, Colombia, and Uganda. We compared the representativeness and participation of 'pre-survey SMS notification to call-in' with IVR (control group) and 'pre-survey SMS notification' in these countries. Findings of this study will be helpful to design and implement MPS in LMICs.

Methods

Study design and participants

In this randomized controlled micro-trial, participants were recruited through random digit dialing (RDD) [18]. RDD uses the known prefixes (typically three digits) for each mobile network operator (MNO) in each country to identify a digit sequence as the base and randomly generates the remaining digits to create a mobile phone number. In RDD, a large proportion of generated mobile phone numbers are inactive or not registered. A built-in randomization schema randomly assigned each dialed participant to one of the following three study arms (Supplemental Fig. 1):

1) Control: Only an IVR survey.

2) SMS: Participants were sent an SMS pre-notification, which included details of the sponsoring agency, requirements to receive an airtime incentive, and that an automated health survey would be shared with them in

5 minutes.

3) Call-in: The participants received a pre-notification message, which included the sponsoring agency, the incentive amount, and a toll-free phone number where participants could call to take the free IVR survey. If the participant did not call-in to the IVR survey, the reminder message was shared via SMS 24 hours later.

Bangladesh, Colombia, and Uganda are three LMICs in South Asia, South America, and East Africa, respectively [19]. Mobile phone subscriptions in all three countries have increased in recent decades. For instance, the mobile phone subscription rates in Bangladesh, Colombia, and Uganda were 1, 6, and 1 per 100 people in 2000; and these rates increased to 105, 156, and 70 per 100 people in 2022, respectively [20].

Process

Numbers were dialed by computer software connected to phone lines until a human respondent answered the call. Similarly, computer software shared SMS messages until a human respondent replied to them. Upon connecting to an active line, participants were asked to select the language they would prefer to take the survey. After a brief introduction, they were asked to enter their age. Participants were excluded from taking the survey if they entered an age less than 18. Aside from age, answering the phone, and consenting to the survey, there were no other inclusion or exclusion criteria.

Once screened, respondents were asked whether they agreed to participate in the study. Respondents who chose to continue with the survey after hearing the brief introduction and procedures were asked to press a number on their keypad to indicate their willingness to continue (e.g. “Press 1 if you would like to participate in this survey. Press 3 if you do not want to participate in the survey”). Participants were asked to reconfirm their selection (e.g., “You have indicated that you do wish to complete the survey, press 1 to continue the survey or press 3 to end this survey”) to ensure that consent (or refusal) was not mistakenly provided. In Bangladesh and Uganda, the consent question was offered after establishing age-eligibility. Due to legal requirements, in Colombia, there was a two-step consent process at the start of the survey. Respondents who did not consent to participate were thanked for their time, and the survey ended. After this, respondents received the survey questions and answered a series of NCD modules whose order of presentation was randomized between participants.

In all arms, the participants with incomplete surveys were called back twice. The first call-back attempt was made immediately, and the second attempt was made one hour later. In one arm of the study, where pre-notification SMS was shared, the message read– *“Hello. You will receive an automated health survey from [Country Partner] in 5 min. You will get [incentive amount] airtime if you complete the 20 min survey.”* The name of the country partner and incentive amount (in brackets) were adapted for each country. In another arm, the pre-notification SMS provided the same details and a toll-free number that the participants could dial if they were interested in taking the survey. The system would then call them back with the IVR survey immediately.

In Bangladesh, the costs per text message and per minute of airtime were, respectively, $0.02 and $0.07. In Colombia, the respective costs were $0.07 and $0.09; in Uganda, they were $0.02 per text message and $0.13 per minute of airtime. Incentives were sent to all participants who completed the NCD survey. Participants received the airtime incentive in local currency: Bangladesh (50 Taka; $1.79 USD), Colombia (5000 Colombian Pesos; $1.60 USD), and Uganda (5000 Ugandan Shillings; $1.91 USD).

Outcomes

We examined the contact, response, and cooperation rates by study arm (Supplemental Table 1), in each country, and as defined by the American Association for Public Opinion Research (AAPOR) [21].

We considered an interview complete if the participants answered at least four of the five modules. Those who responded to one out of three modules were considered partial interviews. When age-eligible participants did not indicate consent or terminate the survey before consenting, they were marked as refusals. Age-eligible participants who did not finish any NCD module despite providing consents were marked as break-offs. Participants who did not respond to the age question after survey initiation were marked as unknown.

The contact rate is calculated by dividing the total number of potential eligible participants by the total number of complete and partial interviews, refusals, and other events. The total number of full and partial interviews divided by the total number of potential eligible participants yielded the response rate. The number of full interviews divided by the total of partial and full interviews, refusals, and other factors was the cooperation rate.

Statistical Analysis

The sample size for each arm was calculated assuming a baseline survey completion rate of 30%. To detect a difference of at least 10% between study arms at an alpha of 0.05 and power of 80%, we would need at least 376 participants to complete the survey in each arm. With the baseline survey completion rate assumption of 30%, this meant 1254 participants would have to consent to take the survey per study arm. With three study arms in this trial, this meant 3762 participants to be enrolled in each country.

The distribution of sociodemographic variables among complete interviews was compared by study arm within each country using chi-squared tests. Contact, response, and cooperation rates were compared by study arm in each country. *A priori, a*n alpha of 0.05 was used for hypothesis testing. The control arm was selected as the reference category to which other arms of the study are compared. We conducted a log-binomial regression to assess the risk ratio and corresponding 95% Confidence Interval (95% CI) for each comparison.

For the costing analysis, using an ingredients approach, all costs associated with inputs into making the IVR system functional were recorded. The USD provided values were the costs borne by the research arm and included the costs of the incentive, plus a small fee to send the incentive. These costs were used to assess the cost per completed NCD survey. R was used to analyze data.

Results

Table 1: Disposition codes by country and study arm

Country	Call type	Control	SMS	Call-in
Bangladesh	**Total Calls**	**153234**	**142408**	**5382**
	Complete Interview	387 (0.25)	240 (0.17)	3 (0.06)
	Partial Interview	183 (0.12)	105 (0.07)	0 (0%)
	Refusal/ Breakoffs	193 (0.13)	122 (0.09)	0 (0%)
	Unknown, picked up phone	15070 (9.83)	12181 (8.55)	4 (0.07)
	Unknown, didn't pick up phone	92302 (60.2)	22910 (16.1)	NA
	Unknown, no call-in	NA	NA	1943 (36.1)
	Ineligible- underage	660 (0.43)	594 (0.42)	0 (0%)
	Ineligible- unallocated	44439 (29.0)	271 (0.19)	NA
	Ineligible- SMS did not go through	NA	102071 (71.7)	3432 (63.8)
	Ineligible-IVR did not go through	0(0)	3914 (2.8)	0(0)
Colombia	**Total Calls**	**94574**	**51829**	**14034**
	Complete Interview	377 (0.4)	376 (0.72)	7 (0.05)
	Partial Interview	53 (0.06)	44 (0.08)	0 (0)
	Refusal/ Breakoffs	30 (0.03)	26 (0.05)	0 (0)
	Unknown, picked up phone	28278 (29.9)	18158 (35.0)	15 (0.11)
	Unknown, didn't pick up phone	20363 (21.5)	7920 (15.3)	NA
	Unknown, no call-in	NA	NA	11026 (78.6)
	Ineligible- underage	47 (0.05)	31 (0.06)	0 (0%)
	Ineligible- unallocated	45426 (48.0)	14386 (27.8)	0 (0)
	Ineligible- SMS did not go through	NA	10888 (21.0)	2986 (21.3)
	Ineligible-IVR did not go through	0 (0)	0 (0)	0 (0)
Uganda	**Total Calls**	**14047**	**9295**	**25765**
	Complete Interview	385 (2.74)	387 (4.16)	385 (1.45)
	Partial Interview	113 (0.80)	108 (1.16)	28 (0.11)
	Refusal/ Breakoffs	124 (0.89)	146 (1.57)	27 (0.11)
	Unknown, picked up phone	2049 (14.6)	1634 (17.6)	425 (1.6)
	Unknown, didn't pick up phone	3556 (25.3)	1748 (18.8)	NA
	Unknown, no call-in	NA	NA	21382 (80.3)
	Ineligible- underage	222 (1.58)	175 (1.88)	33 (0.12)

Ineligible- unallocated	7598 (54.1)	3888 (41.8)	NA
Ineligible- SMS did not go through	NA	1209 (13.0)	3485 (13.1)
Ineligible-IVR did not go through	0 (0)	0 (0)	0 (0)

The total number of calls made in Bangladesh Colombia and Uganda was 301,034, 160,437, 49,979, respectively (see Figure 1 and Table 1). Although the distribution of disposition codes differed substantially by survey arm and country, most call attempts resulted in noncontact outcomes in all countries. In Bangladesh, only 0.2% of all call attempts resulted in a completed interview (n = 631), with the call-in arm producing only 3 completions. The predominant outcome in both control and SMS arms was unknown–no answer, accounting for 60.2% and 16.1% of calls, respectively. A large proportion of SMS calls failed due to messages not going through (71.7%). In Colombia, completion was similarly low (0.4%), ranging from 0.05% in the call-in arm to 0.72% in the SMS arm, and nearly half of the control arm calls were classified as unallocated. Uganda had the highest number of completed interviews across countries, approximately 385 completed surveys per arm, and had higher proportions of calls that resulted in an answered phone than the other two studied countries.

Table 2: Demographic characteristics for complete surveys by study arm in each country

Country	Demographics		Total	Control	SMS	Call-in	P-val
Bangladesh[1]	**N**		**630**	**387**	**240**	**3**	**--**
	Age group	18-29	411(65.2%)	243(62.8%)	166(69.2%)	2(66.6%)	.076
		30-49	194(30.8%)	126(32.6%)	67(27.9)	1(33.3%)	
		50-69	21(3.3%)	15(3.88%)	6(2.5%)	0(0%)	
		70+	4(0.63%)	3 (0.78%)	1(0.42)	0(0%)	
	Sex	Male	502(79.7%)	317(81.9%)	183(76.3%)	2 (66.6%)	.69
		Female	121(19.2)	66(17.1%)	54(22.5%)	1(33.3 %)	
		Other	1(0.16%)	0 (0%)	1(0.42%)	0 (0%)	
		Refused	6(0.95 %)	4(1.0%)	2(0.83%)	0 (0%)	
	Education	None	41(6.51%)	26(6.72%)	15(6.25)	0(0%)	.24
		Primary	79(12.5%)	47(12.1%)	31(12.9%)	1(33.3%)	
		Secondary	197(31.3)	124 (32.0%)	72(30.0%)	1(33.3%)	
		Tertiary	137(21.8%)	72(18.6%)	64(26.7%)	1(33.3%)	
		Graduate	172(27.3%)	116(30.0%)	56(23.3%)	0(0%)	
		Refused	4(0.63%)	2 (0.52%)	2(0.83%)	0(0%)	
	Location	Urban	325(51.6%)	197(50.9%)	125(52.1%)	3 (100%)	.59
		Rural	302(47.9%)	188(48.6%)	114(47.5%)	0(0%)	
		Refused	3(0.48%)	2(0.52%)	1(0.42%)	0(0%)	
Colombia[1]	**N**		**760**	**377**	**376**	**7**	**--**
	Age group	18-29	315(41.5%)	137(36.3%)	173(46.0%)	5(71.4%)	**.003**
		30-49	331(43.6%)	168(44.6%)	162(43.9%)	1(14.3%)	
		50-69	98(12.9%)	60(15.9%)	37(9.8%)	1(14.3%)	
		70+	16(2.1%)	12(3.2%)	4(1.1%)	0(0%)	
	Sex	Male	345(45.4%)	172(45.6%)	166 (44.1%)	7(100%)	.39
		Female	405(53.3%)	198(52.5%)	207(55.1%)	0(0%)	
		Other	10(1.3%)	7(1.9%)	3(0.8%)	0(0%)	
	Education	None	48(6.32%)	27(7.2%)	21(5.59%)	0(0%)	.112
		Elementary	110(14.5%)	60(15.9%)	50(13.3%)	0(0%)	

		High School	261(34.3%)	133(35.3%)	125(33.2%)	3(42.9%)	
		Technical	208(27.4%)	87(23.1%)	119(31.7%)	2(28.6%)	
		Graduate	133(17.5%)	70(18.6%)	61(16.22%)	2(28.6%)	
	Location	Rural	211(27.8%)	109 (28.9%)	101(26.9%)	1(14.3%)	.53
		Urban	549(72.2%)	268(71.1%)	275(73.1%)	6(85.7%)	
Uganda	**N**		**1157**	**385**	**387**	**385**	**--**
	Age group	18-29	742(64.1%)	240(62.3%)	235(60.7%)	267(69.4%)	.26
		30-49	359(31.0%)	124(32.2%)	131(33.9%)	104(27.0%)	
		50-69	46(3.98%)	18(4.68%)	17(4.39%)	11(2.86%)	
		70+	10(0.86%)	3(0.78%)	4(1.03%)	3(0.78%)	
	Sex	Male	816(70.5%)	268(69.6%)	265(68.5%)	283(73.5%)	.39
		Female	333(28.8%)	113(29.4%)	118(30.5%)	102(26.5%)	
		Other	8(0.7%)	4(1.03%)	4(1.03%)	0(0%)	
	Education	None	184(15.9%)	66(17.14%)	68(17.6%)	50(13.0%)	.28
		Primary	324(28.0%)	117(30.4%)	97(25.1%)	110(28.6%)	
		O Level	363(31.4%)	116(30.1%)	116(30.0%)	131(34.0%)	
		A Level	95(8.21%)	31(8.1%)	29(7.5%)	35(9.09%)	
		University	173(15.0%)	51(13.3)	68(17.6%)	54(14.0%)	
		Post Graduation	18(1.56%)	4(1.04%)	9(2.3%)	5(1.3%)	
	Location	Urban	522(45.11%)	175(45.5%)	183(47.3%)	164(42.6%)	.42
		Rural	635(54.9%)	210(54.5%)	204(52.7%)	221(57.4%)	

Notes: 1. chi-square test only for control and SMS arms; excludes refusals

In Table 2, we reported the sociodemographic characteristics of the respondents according to study arm in each country. In Bangladesh, a majority of the respondents were 18-29-year-olds (65.2%), males (79.7%), and urban residents (51.6%); this pattern was observed across survey arms. Respondents from Uganda had a similar pattern, and respondents were largely 18–29-year-olds (64.1%) or males (70.5%). When we compared the study arms, no significant differences were observed for age, sex, education, or location (all $p > .05$). Among respondents from Colombia, the age distribution differed significantly across arms ($p = .003$), and younger respondents (i.e., 18-29-year-olds, 41.5%) or males (45.4%) were substantially lower than other two countries.

Table 3: Study rates by country and study arm

Country	Rates		Control	SMS	Call-in
Bangladesh	**Contact Rate**	**%**	0.71%	1.31%	0.15%
		Risk ratio (95%CI)	Ref.	1.86 (1.66, 2.09)	0.22 (0.07-0.68)
		P value	--	<0.001	0.008
	Response Rate	**%**	0.53%	0.97%	0.15%
		Risk ratio (95%CI)	Ref.	1.84 (1.61, 2.19)	0.29 (0.09-0.91)
		P value	--	<0.001	0.033
	Cooperation Rate	**%**	50.7%	51.4%	100.00%
		Risk ratio (95%CI)	Ref.	1.01 (0.91, 1.13)	NA
		P value	--	0.905	NA
	Cost/completed survey		$7.72	$32.65	$112.06
	Call/completed survey		281	168	1794
Colombia	**Contact Rate**	**%**	0.94%	1.68%	0.06%
		Risk ratio (95%CI)	Ref	1.79 (1.58, 2.04)	0.07 (0.03, 0.14)
		P value		<0.001	<0.001
	Response Rate	**%**	0.88%	1.58%	0.06%
		Risk ratio (95%CI)	Ref	1.81 (1.58, 2.07)	0.07 (0.03, 0.15)
		P value		<0.001	<0.001
	Cooperation Rate	**%**	81.96%	84.3%	100%
		Risk ratio (95%CI)	Ref.	1.03 (0.97, 1.09)	NA
		P value		0.345	NA
	Cost/completed survey		$9.54	$16.98	$143.21
	Call/completed survey		130	71	1578
Uganda	**Contact Rate**	**%**	9.99%	15.9%	1.98%
		Risk ratio (95%CI)	Ref	1.60 (1.44, 1.77)	0.20 (0.18, 0.22)
		P value		<0.001	<0.001
	Response Rate	**%**	8.0%	12.3%	1.86%
		Risk ratio (95%CI)	Ref	1.54 (1.37, 1.73)	0.23 (0.20, 0.26)
		P value		<0.001	<0.001
	Cooperation Rate	**%**	61.9%	60.4%	87.5%
		Risk ratio (95%CI)	Ref.	0.98 (0.89, 1.07)	1.41 (1.32, 1.52)

P value	--	.58	<0.001
Cost/completed survey	$4.52	$4.80	$3.97
Call/completed survey	17	11	58

Table 3 shows the survey participation rates by study arms in all three countries. Overall, the SMS arm had higher contact and response rates than the control arm. The call-in arm had the lowest rates in Bangladesh and Colombia. For instance, in Bangladesh, compared to the control arm, the SMS arm demonstrated significantly higher contact (RR = 1.86; 95% CI: 1.66–2.09; p < .001) and response rates (RR = 1.84; 95% CI: 1.61–2.19; p < .001); however, cooperation rates were similar (51.4% vs. 50.7%) and the call-in arm showed very low contact (0.15%) or response (0.15%) rates. In this country, the cost per completed survey was lowest in the control arm ($7.72) and highest in the call-in arm ($112.06).Findings of Colombia were consistent with Bangladesh; the SMS arm had significantly higher contact (RR = 1.79; 95% CI: 1.58- 2.04, p < .001) and response rates (RR = 1.81; 95% CI: 1.58-2.07, p < .001) than the control arm. Cooperation was higher than 80% in both arms. The call-in arm had a response rate of only 0.06%, and the cost per completion ranged from $9.54 (control) to $143.21 (call-in). Uganda demonstrated the strongest performance across modes. Compared to the control arm, the SMS arm had higher contact (RR = 1.60; 95% CI: 1.44-1.77, p < .001) and response rates (RR = 1.54; 955 CI: 1.37-1.73, p < .001). Cooperation rates were comparable between control (61.9%) and SMS (60.4%) arms but substantially higher in the call-in arm (87.5%). Costs per completed survey were lower in all modes ($3.97–$4.80) than in the other two countries.

Discussion

We conducted these NCD surveys in Bangladesh, Colombia, and Uganda using RDD with participants randomized to one of three arms: IVR only; IVR with SMS pre-notification; and IVR with a toll-free number for calling-in shared via SMS. Our goal was to test which strategies could improve survey response and cooperation rates while being most cost-effective. Although the calling-in strategy was successful in Uganda, the low yield in Bangladesh and Colombia led us to prematurely stop this assessment in these regions. This resulted in a very few complete surveys and a high cost per completed survey for these study arms. Further research and an understanding of the local context in Uganda could help better understand the reason behind the success of the call-in strategy in this setting only.

We also found a very high number of ineligible numbers dialed by the system in Bangladesh across the study arms, when compared to Colombia and Uganda. This may be due to the saturation of numbers with the selected MNO prefixes, resulting in calls to numbers that do not exist and hence are ineligible.

An assessment of demographic features across the study arms in each country demonstrated no significant differences, except for a marginally higher number of younger individuals who completed the survey in the SMS arm in Colombia. Similar findings have been reported in previous studies, with the hypothesis that older adults (> 45 years) in Columbia are economically active and hence may not have the time to answer the survey [22, 23]. We can infer that no specific MPS strategy was preferred by a particular demographic group or was able to successfully cater to hard-to-reach populations such as older women, individuals with low education levels or populations living in rural areas [23].

When we look at the contact rates across the three countries, we see lower values in Bangladesh than in Colombia and Uganda. This was similar in other previous studies [12, 24, 25]. This means that fewer individuals In Bangladesh picked up their phones when called to take the survey, and this may be attributed to a high incidence of spam calls in the region, which has resulted in mistrust and poor willingness to answer calls from unknown numbers [26, 27]. While we see an improvement in the contact rate with a pre-notification SMS in Bangladesh, the cost per completed survey is still high and potentially not feasible for large-scale implementation.

A comparison of survey rates across the study arms in the three countries showed us significant differences between the study arms and the control arm. The significantly higher response rates correlated with findings from similar studies that found an increase in responses when survey participants are notified about the survey in advance [16, 17]. This may be due to several reason, including increased trust in the source of the survey, participants know what to expect when they receive the call, and they can set aside time for the task. Our results also showed us very high cooperation rates in the call-in arm due to low refusals and partially completed surveys. As participants dial the toll-free number to showcase their willingness towards survey participation, it serves as preliminary consent, and the few respondents lost during the survey are often due to age ineligibility.

Apart from the survey rates, it is also crucial to assess the cost-effectiveness of these strategies. The cost incurred in each study arm was due to the cost of every call placed, SMS sent, and airtime incentive provided [11–13]. We see a relatively higher cost per completed survey in Colombia as compared to Uganda and Bangladesh. This could be attributed to a much longer informed consent question, which was mandated by law [28]. This not only drives up the airtime cost but may be associated with a high drop-out rate, which drives up the cost per completed survey.

Apart from the survey modality, several other factors that are specific to the country context may have influenced these results. These include differences in mobile phone penetration rates, levels of digital literacy, and cultural appropriateness [29–33]. A qualitative assessment of user perceptions of MPS in Uganda also found that other factors, such as short survey lengths, a reliable and recognizable survey source, and evening survey calls, among several other factors, were conducive to participant willingness and could improve survey response rates [15].

Our results demonstrate that a specific mHealth survey strategy may be appropriate for a particular setting. For example, the call-in strategy is successful in Uganda and was the most cost-effective as well. In Bangladesh, while the SMS arm had the highest response rate, it was not financially feasible on a large scale; therefore, the IVR survey alone may be the most suitable strategy for Bangladesh. In Colombia, the SMS pre-notification arm had almost twice the response rate when compared to IVR alone. However, a cost-benefit assessment would help determine which of these would be apt for the local country context.

One of the limitations of the study was that the call-in arms in Colombia and Bangladesh had to be prematurely stopped due to a low yield of responses. Hence, our understanding of the survey rates comparison is limited to one context–Uganda. The order of questions and the questions themselves were standardized in the survey. However, due to legal and regulatory reasons in some contexts, such as Colombia, the consent questions were altered and re-ordered. This may have altered the survey participation rates and limited the inference we can make.

This study also has several strengths. The randomized study design and multi-country assessment broadened the scope of inferences we can make. It allows us to explore the effect of different mobile survey strategies and local country contexts. The use of standardized AAPOR definitions for disposition codes and survey rate calculations makes the study results comparable and easy to understand across contexts. Future studies can aim to further explore the effect of socio-cultural norms, gender dynamics, and in-country policy contexts on MPS rates.

Conclusion

Our study findings suggest that SMS pre-notifications and call-in strategies can be successful in increasing survey response and contact rates. However, the degree of effectiveness can vary depending on several factors specific to the local context and preferences of the participants. In some settings, call-in strategies can be very successful with high cooperation rates and cost-effectiveness. Any single strategy is not particularly favorable to a demographic group, and more research can be done to develop survey methods that can reach vulnerable populations that are often missed. MPS have shown promise in assessing health- related topics, such as NCDs and can facilitate timely, data-driven decision-making for improved health outcomes in LMICs.

Declarations

Ethical approval and consent to participate:

Ethical approval was received from the institutional review boards of the institutions involved in the study, namely the Johns Hopkins University Bloomberg School of Public Health, Baltimore, Maryland, U.S; and Pontificia Universidad Javeriana, Bogotá, Colombia. All participants provided informed consent by pressing a number on their keypad. We only included adult individuals. All methods were carried out in accordance with relevant guidelines and regulations.

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Author Contribution

DG did the conception and supervision of this study. GMAK and KS conducted literature review, analyzed data, and prepared the first draft. AVC, FRV, ER, CS, IAK, and ER contributed to the study design and administered the project. All other authors reviewed the manuscript and edited it. Final approval of the first draft was approved by all authors.

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Declarations Competing interests: The authors declare no competing interests.

Data Availability

Data will be available upon acceptance from the OpenICPSR repository database (https://www.openicpsr.org/openicpsr/.')

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Figures

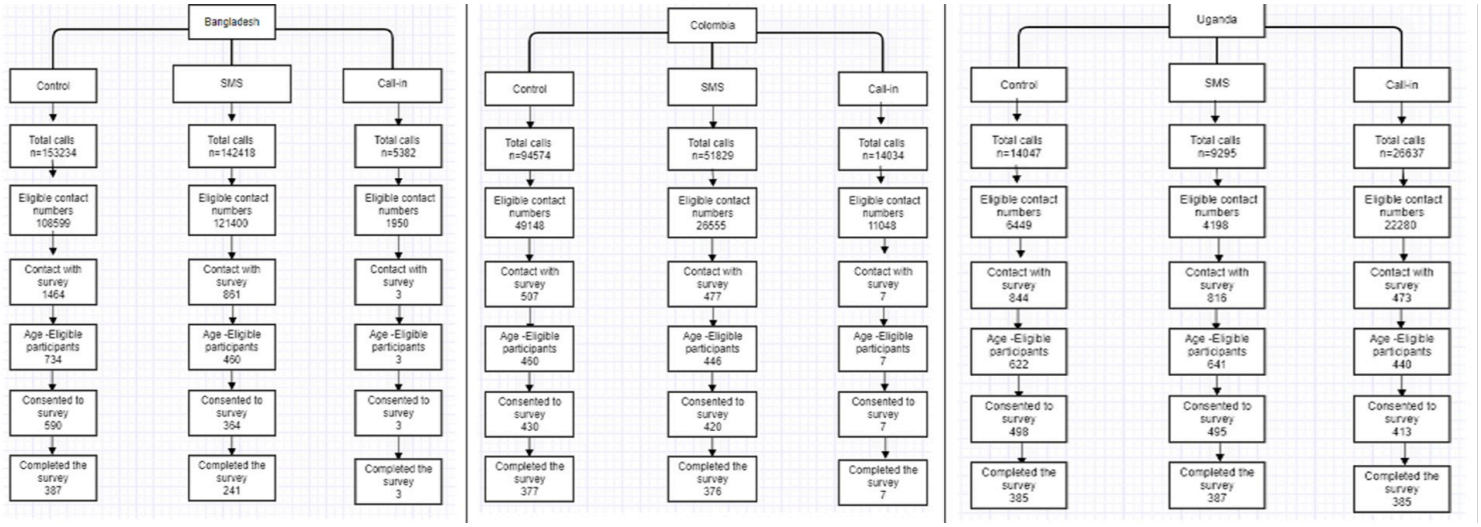


Figure 1

Flowchart depicting the number of calls made and loss of respondents at various stages in Bangladesh, Columbia, and Uganda