Assessing the validity of sexual behavior reporting among young women in Kampala, Uganda: evidence from a randomized interview mode experiment with biological markers

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Introduction

Understanding the transmission dynamics of HIV and other sexually transmitted infections (STIs) at the population level, and evaluating programmatic interventions designed to contain their spread, are critically dependent on accurate sexual behavioral data. Given that sexual activity cannot directly be observed, research must rely on self-reports, which are subject to problems of recall, question misinterpretation, social desirability bias, and normative reporting. Recent studies have found little association between self-reported risky behavior and infection, with several methodological reviews of survey data from developing countries directly questioning the validity and reliability of sexual behavior reporting [1-4]. Indeed, notable oddities in behavioral data – including STI infections among women claiming to be virgins [5, 6], lower than expected HIV incidence among men reporting multiple non-marital partners [7], and discrepancies between information reported during individual interviews and that obtained from medical examination [8] – suggest that under- or over-reporting of sexual activity distorts assessments of HIV risk.

Reporting biases may be reduced or exacerbated depending on the mode of questionnaire delivery. Much of the survey data from developing countries – most notably the Demographic and Health Surveys (DHS) – are collected using traditional face-to-face interviewing (FTFI). While this method has logistical and efficiency advantages over other approaches, reporting via FTFI may be compromised by interviewers' inaccurate re-wording of questions, directive probes, non-verbal cues, and inappropriate feedback. Researchers leading a study in Kenya that found high levels of consistent reporting of sexual behaviors speculated that, despite instructions to the contrary, interviewers sometimes skipped questions to which they assumed they already knew the answers, or reconciled discrepant responses on their own [9]. Another study [10] found that participants in a clinical trial acknowledged deliberately misleading interviewers in FTFI out of politeness to researchers, or because they feared criticism or embarrassment.

Increasing attention has been paid to technology-based interview methods, including audio computer-assisted self-interviewing (ACASI), as potential alternatives to FTFI [11]. A primary advantage of ACASI over other interview techniques is the anonymous nature of data collection, and thus the potential to reduce social desirability bias in the reporting of sensitive or stigmatized behaviors. With ACASI, the participant listens to questions through headphones and answers using a touch screen or an answer keypad. This technique affords a greater standardization of questionnaire administration by providing an identical script to each respondent, and therefore has been considered to largely eliminate interviewer effects. ACASI has been shown to be feasible to implement in a number of low development settings and to elicit higher reports of some sensitive behaviors relative to other interview modes – e.g. in Kenya [9], Malawi [12a], India [13], and Vietnam [14] although results vary by setting and sample. A recent systematic review of questionnaire delivery modes in developing countries found that, overall, ACASI produced higher reporting of sensitive behaviors than did FTFI [3], while a second

review and meta-analysis of quantitative interviewing tools in low- and middle-income countries concluded that results depended on the sensitivity of the outcome and the population under study [11].

In cases where levels or types of reporting statistically differ between interview modes, it is typically assumed that higher reporting of sexual activity and other risk behaviors is inherently more accurate, due to the stigma associated with acknowledging such activities [15]. To formally assess the truthfulness of reporting in different interview modes, it is informative to include an external validation measure against which to compare self-reported behavior. STI biomarkers can provide such an objective standard, although relatively few studies have combined randomized interview mode experimentation with STI outcomes as indicators of risky behavior [3, 11, 16]. Exceptions include an experiment among women in São Paulo, Brazil [15], which evaluated sexual behavior reporting in ACASI and FTFI against STI biomarkers and found both that reporting of STI risk behavior was significantly higher in the computerized interview, and that associations between risk behavior and STI infection were stronger in ACASI relative to FTFI. In South Africa, Mensch and colleagues [17] also observed an ACASI "advantage" over FTFI in a simulated microbicide trial involving testing for recent semen exposure. By contrast, Minnis et al. [18] found in Zimbabwe that self-reported sexual activity and condom use were equally problematic in FTFI and ACASI when validated against an objective biomarker of recent unprotected sex.

Methods

Study design and sample

The study was conducted among women aged 18-24 years in Kampala, Uganda. Study participants were randomized to one of three interview modes:

Group 1: Face-to-face interview using conventional paper and pencil
Group 2: FTFI using computer-assisted personal interviewing (CAPI)[1]
Group 3: Traditional FTFI for non-sensitive questions and ACASI for sensitive ones.

The questionnaire used was a subset of questions from the women's instrument of the 2006 Uganda Demographic and Health Survey (UDHS). The survey covered a number of sensitive topics, including sexual initiation; recent sexual activity, transactional or forced sex; condom use; and HIV/AIDS awareness. As is standard practice in DHS surveys [19], in Group 1 interviewers were permitted, when necessary, to reword questions to improve respondents' understanding.[2] In Group 2 (CAPI), interviewers were trained only to read questions off the computer screen verbatim, regardless of participant's comprehension. The response option "Respondent does not understand question" was added to each question, and treated as missing in analyses. For Group 3 (ACASI), non-sensitive questions were administered via paper-and-pencil FTFI, following the same protocol as Group 1. Participants listened to sensitive questions through headphones connected to a handheld computer and recorded their answers by pressing colored buttons on the screen. In all interview modes, questionnaires were offered in either English or Luganda.

[1] CAPI interviewers used handheld computers to read questions and enter participants' answers, eliminating the need for paper questionnaires and data entry.

[2] The following instructions were included in the interviewers' training manual for paper-and-pencil FTFI: "If the respondent has not understood the question, you should repeat the question slowly and clearly. If there is still a problem, you may reword the question, being careful not to alter the meaning of the original question."

Using the sampling frame from the 2002 census, 40 enumeration areas (EAs) in Kampala were selected using simple random sampling (SRS). Within each sampled EA, thirty households were selected, also using SRS, and all women aged 18-24 who were either permanent residents of selected households or visitors to the household the night preceding the interview, were eligible to participate in the study. Respondents were randomized to one of the three interview modes, and also randomized to an interviewer to control for the potential impact of interviewer characteristics. Written informed consent for the interviews was obtained from all study participants.

Upon completion of the survey and administration of additional informed consent procedures, a blood sample was obtained via finger prick for HIV and Herpes Simplex Virus-type 2 (HSV-2) testing. HIV testing was conducted at the household consistent with the 2005 Uganda National Ministry of Health Guidelines. Specimens for the HIV test were evaluated with Determine™. Positive samples were then retested using Uni-Gold™ Recombigen®. A third rapid test, Clearview® HIV 1/2 STAT-PAK, served as a tie-breaker in the event of discordant results. HSV-2 testing was conducted at the Molecular Research Laboratory (MOLAB) of the Makerere University-University of California San Francisco Research Collaboration in Kampala, using dried blood spots (DBS) collected at the household. DBS were used in preference to whole blood due to the difficulties associated with storing and transporting whole blood to the lab. HSV-2 tests were based on the Kalon ELISA antibody test on DBS. However, of the initial 277 samples tested using the Kalon assay with a 1:4 dilution, only 5 tested positive, a prevalence well below expectations based on prior sero-prevalence surveys. Thus it was concluded that validation of dried blood spots for the Kalon HSV-2 test, which theretofore had not been conducted, needed to be undertaken. The validation, conducted at MOLAB, tested dilutions of 1:2, 1:3 and 1:4 on 220 stored serum-tested positive and negative specimens from the 2004-2005 Uganda HIV/AIDS Sero-Behavioural Survey, and found that the 1:2 ratio of buffer and eluate produced the best results with DBS. However, the sensitivity and specificity were found to be low: 0.85 and 0.74, respectively. The HSV-2 results reported here should therefore be interpreted with caution, although any misclassifications should be randomly distributed among the three interview mode groups.

In addition, participants were asked to perform a self-administered vaginal swab for a Rapid Stain Identification of Human Semen (RSID™) test, a third study biomarker. The RSID™ test indicates whether a woman has engaged in unprotected sex during the previous 48 hours, with a sensitivity to detect the presence of as little as 1 µl of semenogelin, a major component of seminal fluid [20]. RSID specimens were self-swabbed by respondents at the household, placed in a dry tube, and transported to MOLAB for testing.

The study protocol was reviewed and approved by the Population Council Institutional Review Board, the Uganda National Council for Science and Technology, and the Makerere University Higher Degrees Research and Ethics Committee.

Analysis

Combining interview and biomarker data, the analysis will primarily focus on two evaluations of the reporting of sexual behavior:

1. A comparison of the reporting between Groups 1 (FTFI) and 2 (CAPI) to examine the effects of interviewer assistance and question rewording on reporting.

2. A comparison of the reporting between Groups 2 (CAPI) and 3 (ACASI) to assess whether the strict reading of questions in the CAPI mode reproduces the standardization of the ACASI interview, albeit retaining potential other interviewer effects on reporting.

For completeness' sake, we will also compare Groups 1 and 3, which is the interview mode comparison that has been conducted in prior experimental research [e.g. 12, 21].

Statistical analysis was conducted in Stata version 11.2 (College Station, TX). Using pairwise *z* tests, we begin by comparing the proportions of respondents interviewed via FTFI, CAPI and ACASI who report five key sexual behaviors: ever had vaginal sexual intercourse, ever forced to have sex, transactional sex in the past 12 months, more than one lifetime sexual partner, and unprotected sex in the past two days. We examine the association between interview mode and reporting using multiple logistic regression, controlling for selected socio-demographic characteristics.

Using the biological data, we validate the reporting of sexual activity and condom use. For HIV and HSV-2, we quantify the number of respondents in each interview mode who tested positive and yet did not report ever having sex. For the RSID™ test, we examine reporting of unprotected sex in the past two days, as indicated by 1) reporting of sexual activity on the day of interview, the previous day, and two days prior, and 2) condom use on each day of reported sex. Because of rapid clearance of semenogelin from vaginal fluid after exposure, and thus the likelihood that the positive RSID™ tests underestimate true prevalence of recent unprotected sex, we follow Minnis et al. [18] by restricting our analysis of discrepant data only to those respondents who test positive for RSID. We conclude by examining the extent of item non-response in each of the three interview modes, particularly that deriving from participant incomprehension in the CAPI group.

Results

Figure 1 shows the number of completed interviews in each questionnaire delivery mode. Overall, 81.9% of eligible women were successfully interviewed. The completion rate in the CAPI group (85.1%) was significantly higher than that in ACASI (78.5%, p=0.012). There was no difference between the CAPI and FTFI (82.3%) arms, nor between FTFI and ACASI. Thirty-two women refused to participate in the study, with a slightly lower proportion (1.2%) of eligible women in the CAPI group declining relative to the other two interview modes (3.1% in FTFI, p=0.053; and 2.9% in ACASI, p=0.086) An additional 7.1% and 3.6% of the electronic data collected via CAPI and ACASI, respectively, were unrecovered due to technology or backup protocol failure.

Table 1 shows the socio-demographic characteristics of each interview group. Mean age in each was 21 years[3], with approximately half of respondents being currently married. Education levels were very similar across arms: just over 50% had reached at least secondary school, and a further 17% attended tertiary education or university. Over half of respondents in each group had ever given birth, although the mean number of children

[3] For the 72 women in the CAPI group who provided an inconsistent month and year of birth and current age, we use the reported month and year of birth to assign an age. 11 women did not know their year of birth and are therefore excluded from the mean calculation.

ever born was significantly higher in the CAPI group relative to the other two (1.9 in CAPI vs. 1.6 in FTFI and ACASI). Just over 40% of women in each interview mode were currently using contraception; slightly more used a non-hormonal method in CAPI than in FTFI or ACASI. All covariates listed in Table 1 were included in multivariate models, except where indicated.

Table 2 compares the reported prevalence of the sexual behavior measures across interview modes and indicates that for four of the five outcomes reporting was higher in ACASI than in either of the other two modes, although differences were not universally significant. 91.8% of respondents reported ever having sex in ACASI vs. 86.2% in CAPI (p=0.020) and 88.0% in FTFI (p=0.091).[4] Prevalence of forced sex was also higher in ACASI (39.7% vs. 33.9% in CAPI and 31.0% in FTFI) and was significantly different from FTFI (p=0.015). Note that respondents were given the opportunity to report an episode of forced sex even if they had not provided an age at sexual debut; 17 women (1 in FTFI, 8 in CAPI, 8 in ACASI) did so. However, the questionnaire skip pattern restricted subsequent questions related to sexual activity only to those who had reported an age at first sex. Among these women, a higher percentage acknowledged more than one lifetime sexual partner in ACASI than did respondents in FTFI or CAPI, but the differences were not significant. Approximately one-fifth (19.1%) of sexually active women reported engaging in transactional sex in ACASI, relative to 11.9% in FTFI (p=0.013). Prevalence was also slightly higher in CAPI (16.9%) compared with FTFI (p=0.089).

Although similar proportions of women in each of the three interview modes reported having had sex in the previous two days, reporting of condom use was significantly higher in ACASI compared with FTFI and CAPI (p<0.001 in each case). Given the social desirability associated with condom use in a country with high HIV prevalence, the opposite pattern of responses was expected. Combining the five sexual behavior indicators, women in ACASI reported more behaviors on average (2.3) than did women in CAPI (2.1, p=0.017) or FTFI (2.1, p=0.006).

The logistic regression results shown in Table 3, which use CAPI as the reference category and control for socio-demographic characteristics (Table 1), largely parallel the findings of Table 2. Because only one married woman (in the ACASI arm) reported never having sex, we restrict analysis of the ever had sex indicator to never-married women and find that, relative to CAPI, respondents in ACASI were more likely to report having premarital sex (AOR: 1.81, p=0.073). Including all participants, ACASI respondents were more likely to report forced sex, multiple lifetime partners, and transactional sex relative to those in CAPI, although only the result for multiple lifetime partners achieves significance at p<0.1.

ACASI performed strongly relative to the FTFI group as well, with higher reporting of forced sex (AOR: 1.5, p=0.019), transactional sex (AOR: 2.0, p=0.007), and multiple lifetime partners (AOR: 1.4, p=0.080); data not shown. Reporting of recent sexual activity was similar across all three interview modes, but women in ACASI were significantly less likely to report that it was unprotected relative to both FTFI and CAPI (p<0.001). We did not observe any significant differences in reporting between the CAPI and FTFI groups in the adjusted regression models.

In addition to interview mode, several socio-demographic characteristics proved to be consistently associated with sexual behavior. Unsurprisingly, members of older age groups were more likely to have engaged in

[4] We determine that a woman has had sex if she provided an age at first intercourse. Also included are the 11 women in the CAPI group who responded “Don’t know” to the age at first sex question but reported sexual activity elsewhere in the survey.

premarital sex and to have had multiple lifetime partners than were women in the youngest age group. Previously married women were more likely to report forced sex, multiple lifetime partners, transactional sex, and recent sex than were never-married women, and engaging in paid work in the past 12 months was also significantly associated with four of the five indicators. Conversely, neither educational attainment nor literacy showed a consistent relationship with sexual behavior.

Validation with biomarkers

Among the women for whom survey and biomarker data were available, 7.2% tested positive for HIV (9.0% in the FTFI group, 7.3% in CAPI, and 5.3% in ACASI; marginally significant difference between FTFI and ACASI, p=0.071), and 46.9% for HSV-2 (44.5% FTFI, 51.4% CAPI, and 45.0% ACASI; marginally significant difference between CAPI and FTFI, p=0.078). Table 4 shows that no self-reported virgins in any of the three interview modes tested positive for HIV. However, the same is not the case for HSV-2: among those who reported never having had sex, 20.0% tested positive for HSV-2 antibodies in the FTFI group, 21.6% in CAPI, and 44.4% in ACASI. The higher percentage of discrepant reporting in ACASI relative to FTFI and CAPI is significant at p<0.1 in both cases, but the denominator is small and confidence intervals wide.

Table 4 also breaks down RSID™ test results according to reporting of recent sex and condom use. Among women who tested RSID™ positive, 39 (49.4%) did not report having unprotected sex in the previous two days in FTFI, and 49 (53.3%) did not do so in CAPI. Fifty-one women, or 67.1% of those who tested positive, did not report unprotected sex in the past two days in ACASI, a proportion that is significantly higher than in both the FTFI (p=0.025) and CAPI (p=0.069) groups. Interestingly, while the vast majority of discrepant reports in the FTFI and CAPI groups stemmed from women not reporting any sex in the past two days, one-third of women in ACASI who tested positive for RSID reported using condoms during all recent sex acts.

Other measures of data quality

We now briefly examine the extent to which the socio-demographic characteristics and sexual behavior indicators displayed in Tables 1 and 2 were affected by item non-response. In the FTFI and ACASI interviews, respondents were given the option to decline to answer a particular question, or to answer “Don’t know”. In the CAPI interview, there was the additional possibility that participants did not understand the question, which interviewers indicated via a designated response option. For questions regarding socio-demographic characteristics, no participants in any interview mode did not know the answer or declined to respond,[5] but question incomprehension was noted in the CAPI interview. While questions regarding schooling and childbirth, for example, were minimally affected, 19 women – or 5.8% of participants who were asked – did not understand at least one of the series of questions related to labor force participation (data not shown). Among the sexual behavior questions, reporting of transactional sex was most affected by question incomprehension: 9 women – or 3.2% of the subset of sexually active women who were asked – did not understand. In addition, CAPI participants were significantly more likely than FTFI respondents to answer “Don’t know” to questions related to age at first sex (3.3% vs. 0%, p<0.001) or to the number of lifetime sexual partners (4.3% vs. 1.3%, p=0.024).

[5] With the exception of marital status, all socio-demographic questions were asked to Group 3 participants via FTFI, following the protocol of Group 1.

Discussion

We investigated whether the reported prevalence of five measures of sexual behavior differed by interview mode, and then assessed the validity of self-reported data against three biological outcomes. The first featured comparison, between variants of the face-to-face interview (FTFI – paper and pencil and FTFI – CAPI), did not reveal any significant differences in either the reported prevalence of sexual behavior or in the magnitude of discrepant data when validated against biomarker results. This suggests that interviewer delivery had neither a strongly positive nor a strongly negative impact on the reporting of our outcomes of interest. We saw above, however, that item non-response to questions related both to socio-demographic characteristics and to sexual behavior was higher in CAPI relative to FTFI, stemming partly from question incomprehension. Although the magnitude of non-response in Group 2 was for the most part very low, it seems likely that Group 1 interviewers played some role in clarifying queries and resolving inconsistencies.

The second featured comparison explored whether ACASI elicited higher reporting of sensitive behavior than did FTFI administered using a standardized script from which interviewers were instructed not to deviate. Results show that reporting of some key measures – most notably sexual initiation – were significantly higher in ACASI than in CAPI, but compared with biological data, reporting in ACASI was more inconsistent. There are, however, a number of possible explanations for the discrepant data which do not necessarily imply deliberate misreporting. Firstly, the survey instrument did not include questions on condom slippage or breakage, which may have caused some respondents who reported having protected sex nevertheless to be exposed to semenogelin. This is particularly significant for the ACASI group, since reporting of condom use during recent sex was considerably higher there. Alternatively, although the wording and administration of the sequence of condom use questions was the same in ACASI as in the other two modes, and reporting of condom use was not associated with low education or literacy levels which might signal question incomprehension, it could be that some participants misunderstood what was being asked. A calendar question such as this, which involved respondents first answering a series of questions about sexual activity on specific days, and then a sequence of questions asking about condom use on particular days, may not be suited to self-administered interview modes.[6]

It is also possible that for women who had unprotected intercourse more than 48 hours before the RSID™ test, traces of semenogelin remained detectable by the test [17]. However, adjusting the threshold for recent sex to 72 hours does not change the nature of our findings. Finally, as noted above, the Kalon ELISA test used with dried blood spots was found to have a low specificity. It stands to reason that false positive results produced by the test would have been distributed equally across randomization arms, but if they featured disproportionately in the ACASI group this could explain the higher presence of discrepant data among these respondents.

When evaluated against biological data, our results suggest that self-reported sexual behavior data are problematic, irrespective of questionnaire delivery mode. However, because reporting of sexual activity was high in all groups, the number of respondents reporting discrepantly is actually fairly small.[7] It would be

[6] Although we focus here on sexual activity and condom use in the past two days, participants were asked about both for each of the five days prior to the interview, which could have made the exercise more challenging.

[7] Note that it is possible, had participants been told before completing the interview that their responses would be compared against biological specimens, that they may have improved their accuracy, but a recent study did not find a significant difference in the reporting of unprotected sex between participants randomized to know and not to know about subsequent biomarker validation [22].

informative to test the association between self-reported sexual behavior and STI infection in each interview mode group. In a subsequent analysis, we plan to develop a more refined empirical approach which controls for the endogenous nature of sexual behavior vis-à-vis STI.

We have seen that biomarkers can play a key role in sexual behavior research, by providing alternate measures of STI risk and validating self-reported behavioral data [20]. For outcomes that cannot be adequately measured by biomarker tests, such as the frequency of intercourse and the circumstances under which it occurs, self-reports can provide potentially valuable insights. Researchers should therefore continue to develop and evaluate innovative ways to collect self-reported data which encourage accurate reporting [e.g. 23], and to supplement such methods with biomarker tests.

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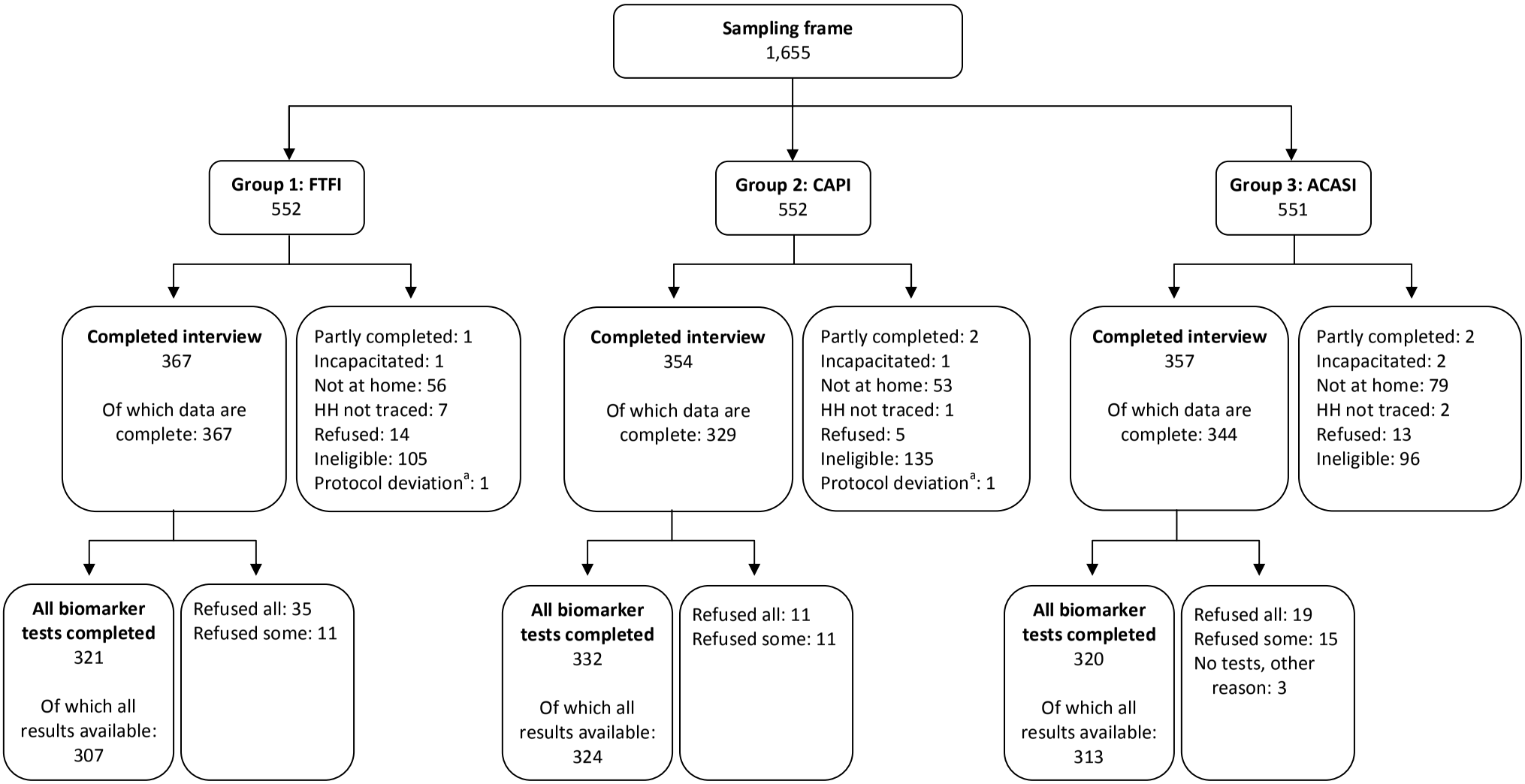
Figure 1: Study participation



[a] One participant was randomized to the FTFI group, but was interviewed via CAPI, and vice versa.

Table 1: Socio-demographic characteristics of women interviewed via FTFI, CAPI, and ACASI

	Group 1 FTFI (N=367)	a	Group 2 CAPI (N=329)	b	Group 3 ACASI (N=355)	c
Language of questionnaire (%)						
English	22.9		21.9		30.6	
Luganda	77.1		78.1	**	69.4	*
Age (mean)	21.2		21.1[d]		21.2	
Highest level of schooling attended (%)						
No school	1.9		3.1		1.7	
Primary	28.6		29.4		26.5	
Secondary	52.3		50.5		54.1	
Tertiary/university	17.2		17.1		17.8	
Literate (%) [e]	91.2		88.4		89.0	
Marital status (%)						
Never married	41.1		42.3	†	35.8	
Currently married	52.3		50.9		54.7	
Previously married	6.5		6.7		9.6	
Ever given birth (%)	55.3		55.0		56.3	
Number of children ever born (mean)	1.6	**	1.9	**	1.6	
Religion (%)						
Catholic	33.2		31.4		35.8	
Protestant	28.3	*	20.9		22.5	†
Muslim	18.8		23.7		26.2	*
Pentecostal	14.2		18.8	†	13.5	
Other	5.4		5.2	*	2.0	*
Number of assets owned (mean) [f]	5.0		5.1		5.0	
Paid work in past 12 months (%) [g]	41.9	*	51.6	*	41.6	
Current contraceptive use (%)						
None	65.7		60.4		63.4	
Hormonal method [h]	21.3		19.9		22.7	
Non-hormonal method [i]	13.0	*	19.6	*	13.9	

** p<0.01; * p<0.05; † p<0.1

[a] Difference in means/proportions between FTFI and CAPI

[b] Difference in means/proportions between CAPI and ACASI

[c] Difference in means/proportions between ACASI and FTFI

[d] Excludes 11 women in the CAPI group who did not know their year of birth so their exact age could not be determined.

[e] Could read partial or full sentence taken from 2006 UDHS

[f] Range 0-8. Participants were asked if their household had: electricity, radio, television, mobile phone, refrigerator, table, sofa set, or DVD or CD player.

[g] Includes women who reported being paid in cash, or both in cash and in kind, for work performed during the past 12 months. Excludes 19 women in the CAPI group who did not understand questions related to labor force participation.

[h] Includes pill, injectable, implant

[i] Includes IUD, condom, lactational amenorrhea, rhythm, withdrawal, other method not mentioned

NOTES: Ns may be smaller than reported due to missing values

Table 2: Reporting of sexual behavior outcomes in each interview mode (%)

	Group 1 FTFI (N=367)	a	Group 2 CAPI (N=329)	b	Group 3 ACASI (N=344)	c
Ever had sex [d]	88.0		86.2	*	91.8	†
Forced sex [e]	31.0		33.9		39.7	*
	FTFI		**CAPI**		**ACASI**	
If ever sex [f]:	**(N=323)**		**(N=282)**		**(N=315)**	
>1 lifetime sexual partner [g]	67.1		67.9		71.9	
Transactional sex past 12 months	11.9	†	16.8		19.1	*
Sex in past two days [h]	25.9		27.0		29.2	
Condom use in past two days (if sex in past two days) [i]	6.0		9.2	***	30.4	***
Unprotected sex in past two days	24.4		24.6		20.3	
Mean number of sexual behaviors reported [j]	2.1		2.1	*	2.3	**

*** p<0.001; ** p<0.01; * p<0.05; † p<0.1

[a] Difference in means/proportions between FTFI and CAPI

[b] Difference in means/proportions between CAPI and ACASI

[c] Difference in means/proportions between ACASI and FTFI

[d] We determine that a woman has had sex if she provided an age at first intercourse. Also included are the 11 women in the CAPI group who responded "Don't know" to the age at first sex question but reported sexual activity elsewhere in the survey.

[e] Respondents were considered to have experienced forced sex if they reported any of the following: sexual debut was forced, forced sex with current/previous husband/partner, forced sex with a non-husband/partner in the past 12 months, forced sex with any person at any other time.

[f] Sexually active women were determined by the age at first sex question, according to the questionnaire skip instructions. Ns for subsequent sexual behavior questions may be lower than reported due to missing values.

[g] Participants were asked how many different people they had had sexual intercourse with in their lifetime. Those who report more than one lifetime sexual partner are included here. We exclude those who answered "Don't know", unless elsewhere in the survey they reported having more than one partner in the past year or having been married more than once.

[h] Includes women who reported having sex on one or more of: the day of the interview, the day before the interview, and two days before the interview.

[i] For each day that women reported having sex, they were asked if they used a condom for every sex act on that day. We include only women who reporting using a condom on every day that they reported having sex.

[j] Range 0-5. Includes ever had sex, forced sex, multiple lifetime partners, transactional sex, unprotected sex in past two days.

Table 3: Unadjusted and adjusted logistic regression estimates of reported sexual behavior

	Ever had sex						Forced sex					
	Unadjusted (N=411)			Adjusted (N=395)			Unadjusted (N=1032)			Adjusted (N=977)		
Interview mode	**OR**		**95% CI**	**AOR**		**95% CI**	**OR**	**95% CI**		**AOR**		**95% CI**
CAPI	1.00			1.00			1.00			1.00		
FTFI	1.18		0.71-1.94	1.17		0.64-2.13	0.87	0.63-1.20		0.90		0.63-1.28
ACASI	1.70	†	0.98-2.97	1.81	†	0.95-3.47	1.28	0.93-1.76		1.35		0.94-1.92
Language of questionnaire												
English				1.00						1.00		
Luganda				1.08		0.62-1.89				0.96		0.66-1.38
Age												
18-19				1.00						1.00		
20-22				2.25	**	1.27-3.96				0.93		0.64-1.35
23-24				3.62	**	1.54-8.51				0.95		0.62-1.45
Undetermined [a]				-- [b]						1.36		0.35-5.34
Highest level of schooling attended												
Primary or less				1.00						1.00		
Secondary				0.99		0.43-2.28				0.76		0.53-1.09
Tertiary/university				0.73		0.28-1.87				0.69		0.41-1.15
Literacy												
Cannot read				1.00						1.00		
Can read partial or full sentence				1.02		0.21-4.83				1.24		0.74-2.07
Religion												
Catholic				1.00						1.00		
Protestant				1.32		0.65-2.70				0.90		0.62-1.31
Muslim				1.11		0.52-2.37				0.96		0.66-1.40
Pentecostal				0.45	*	0.23-0.89				1.08		0.70-1.66
Other				0.77		0.23-2.55				1.12		0.54-2.29
Number of assets owned				0.84	**	0.74-0.96				0.88	***	0.82-0.94
Paid work in past 12 months												
No				1.00						1.00		
Yes				2.83	***	1.60-4.99				1.42	*	1.06-1.91
Marital status												
Never married										1.00		
Currently married										1.04		0.70-1.54
Previously married										3.46	***	1.84-6.49
Ever given birth												
No										1.00		
Yes										1.10		0.73-1.67
Current contraceptive use												
None										1.00		
Non-hormonal method										0.87		0.58-1.30
Hormonal method										1.01		0.70-1.46
LR chi2				69.4	***					84.0	***	
Pseudo R2				0.151						0.068		

*** p<0.001; ** p<0.01; * p<0.05; † p<0.1

Table 3 continued:

	Multiple lifetime partners					Transactional sex in past 12 months				
	Unadjusted (N=897)		Adjusted (N=854)			Unadjusted (N=905)		Adjusted (N=863)		
Interview mode	**OR**	**95% CI**	**AOR**		**95% CI**	**OR**	**95% CI**	**AOR**		**95% CI**
CAPI	1.00		1.00			1.00		1.00		
FTFI	0.96	0.68-1.36	1.02		0.70-1.50	0.67	†	0.77		0.46-1.31
ACASI	1.21	0.85-1.73	1.43	†	0.95-2.13	1.17		1.51		0.92-2.46
Language of questionnaire										
English			1.00					1.00		
Luganda			1.61	*	1.08-2.38			2.65	**	1.45-4.83
Age										
18-19			1.00					1.00		
20-22			1.41	†	0.94-2.10			0.86		0.50-1.49
23-24			1.94	**	1.22-3.08			1.11		0.61-2.00
Undetermined [a]			1.36		0.24-7.69			0.69		0.07-6.11
Highest level of schooling attended										
Primary or less			1.00					1.00		
Secondary			1.20		0.81-1.80			1.45		0.89-2.38
Tertiary/university			1.42		0.81-2.50			1.29		0.62-2.68
Literacy										
Cannot read			1.00					1.00		
Can read partial or full sentence			0.57	†	0.31-1.05			1.69		0.75-3.79
Religion										
Catholic			1.00					1.00		
Protestant			0.98		0.65-1.47			0.95		0.56-1.59
Muslim			0.90		0.60-1.36			0.93		0.56-1.55
Pentecostal			0.86		0.53-1.40			0.44	*	0.21-0.93
Other			1.14		0.50-2.61			1.60		0.65-3.94
Number of assets owned			0.94	†	0.87-1.01			0.96		0.87-1.05
Paid work in past 12 months										
No			1.00					1.00		
Yes			1.57	**	1.14-2.18			2.57	***	1.69-3.92
Marital status										
Never married			1.00					1.00		
Currently married			0.99		0.65-1.50			0.93		0.54-1.59
Previously married			2.57	*	1.14-5.81			1.98	†	0.92-4.23
Ever given birth										
No			1.00					1.00		
Yes			1.42		0.92-2.18			0.74		0.43-1.28
Current contraceptive use										
None			1.00					1.00		
Non-hormonal method			1.12		0.72-1.70			1.11		0.63-1.94
Hormonal method			1.53	*	1.01-2.31			1.23		0.75-2.00
LR chi2			77.5	***				77.0	***	
Pseudo R2			0.073					0.103		

***p<0.001; ** p<0.01; * p<0.05; † p<0.1

Table 3 continued:

	Sex in past two days					Unprotected sex, if sex in past two days				
	Unadjusted (N=916)		Adjusted (N=870)			Unadjusted (N=251)		Adjusted (N=237)		
Interview mode	**OR**	**95% CI**	**AOR**		**95% CI**	**OR**	**95% CI**	**AOR**		**95% CI**
CAPI	1.00		1.00			1.00		1.00		
FTFI	0.94	0.66-1.36	1.08		0.70-1.84	1.58		0.96		0.21-4.32
ACASI	1.11	0.78-1.59	1.30		0.85-2.19	0.23	**	0.09	***	0.03-0.31
Language of questionnaire										
English			1.00					1.00		
Luganda			2.00	**	1.20-3.33			1.83		0.47-7.05
Age										
18-19			1.00					1.00		
20-22			0.78		0.48-1.25			4.53	*	1.34-15.3
23-24			0.68		0.41-1.13			4.88	*	1.29-18.4
Undetermined [a]			0.55		0.11-2.84			0.11		0.01-2.18
Highest level of schooling attended										
Primary or less			1.00					1.00		
Secondary			0.82		0.54-1.25			0.29	*	0.10-0.82
Tertiary/university			1.43		0.73-2.80			0.20	†	0.03-1.29
Literacy										
Cannot read			1.00					1.00		
Can read partial or full sentence			1.41		0.78-2.55			0.80		0.16-4.06
Religion										
Catholic			1.00					1.00		
Protestant			1.13		0.72-1.79			1.48		0.43-5.07
Muslim			1.12		0.72-1.75			2.07		0.65-6.68
Pentecostal			1.29		0.73-2.27			0.57		0.16-2.03
Other			1.37		0.56-3.36			0.60		0.09-4.13
Number of assets owned			0.93	†	0.86-1.01			0.89		0.71-1.12
Paid work in past 12 months										
No			1.00					1.00		
Yes			0.83		0.58-1.20			0.76		0.29-1.99
Marital status										
Never married			1.00					1.00		
Currently married			15.1	***	7.96-28.6			0.79		0.12-5.16
Previously married			3.52	**	1.38-8.98			0.23		0.02-2.72
Ever given birth										
No			1.00					1.00		
Yes			0.62	†	0.38-1.01			0.35		0.09-1.34
Current contraceptive use										
None			1.00					1.00		
Non-hormonal method			1.78	*	1.06-3.00			0.27	†	0.07-1.02
Hormonal method			2.43	***	1.62-3.64			0.90		0.31-2.62
LR chi2			201.6	***				54.3	**	
Pseudo R2			0.198					0.260		

***p<0.001; ** p<0.01; * p<0.05; † p<0.1

Table 3 continued:

[a] Consists of the 11 women in the CAPI group who did not know their year of birth so their exact age could not be determined.
[b] Predicts failure perfectly and 1 observation not used.

NOTES: Dummy variables for interviewer ID were also included in each multivariable regression (not shown). For notes about how outcome and explanatory variables were constructed, please consult Tables 1 and 2.

Table 4: Biomarker validation (using HIV, HSV-2, and RSID testing) of reports of sexual activity and condom use, by interview mode

	FTFI		CAPI		ACASI	
	HIV +	**HIV –**	**HIV +**	**HIV –**	**HIV +**	**HIV –**
Never had sex (N)[a]	0	40	0	37	0	18
% who test positive among those who report never having had sex	0.0%		0.0%		0.0%	
	HSV-2 +	**HSV-2 –**	**HSV-2 +**	**HSV-2 –**	**HSV-2 +**	**HSV-2 –**
Never had sex (N)[a]	8	32	8	29	8	10
% who test positive among those who report never having had sex (95% CI)	8/40 = 20.0% (7.6% - 32.4%)		8/37 = 21.6% (8.4% - 34.9%)		8/18 = 44.4%[b] (21.5% - 67.4%)	
	RSID +	**RSID –**	**RSID +**	**RSID –**	**RSID +**	**RSID –**
Never had sex (N)[a]	2	33	5	31	0	17
No sex in past 2 days (N)	36	167	42	147	38	157
Protected sex only in past 2 days (N)	1	3	2	5	13	14
Unprotected sex in past 2 days (N)	40	29	43	23	25	31
% who report no unprotected sex in past 2 days among those who test positive (95% CI)	39/79 = 49.4% (38.3% - 60.4%)		49/92 = 53.3% (43.1% - 63.5%)		51/76 = 67.1%[c] (56.5 - 77.7%)	

[a] Never had sex defined as reporting of neither an age at first sex nor an episode of forced sex
[b] Significantly different from FTFI (p=0.054) and CAPI (p=0.080)
[c] Significantly different from FTFI (p=0.025) and CAPI (p=0.069)