# Predictors of HIV prevention knowledge and sexual behaviors among students at Makerere University Kampala, Uganda

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## ABSTRACT

**Background:** Prior reviews argue that unsafe sexual behaviors and poor HIV knowledge significantly increase the probability of acquiring HIV infections among adolescents. This study assessed the predictors of HIV prevention knowledge and sexual behaviors among Makerere University students in Uganda.
**Methods:** We performed a cross-sectional survey. We performed a normality test using Shapiro Wilk test on knowledge score. Results revealed that knowledge score was not normally distributed. The study used two sample Wilcoxon Rank Sum and Kruskal Wallis Rank tests to assess the effect of HIV knowledge on demographic characteristics and sexual behaviors. Post-hoc tests were conducted using Bonferroni correction. Spearman rank correlation test was used for continuous variables while Chi-square and Fisher's tests were used for categorical variables to assess the relationship between demographic characteristics and sexual behaviors. We used an iteratively re-weighted least square generalized linear model with an identity function to conduct multivariate regression analysis with knowledge score as the outcome variable.
**Results:** We report results for 1337 students. The mean age was 21.2SD (1.6) and more than half 700(52.4%) were male students. The median HIV prevention knowledge score of students was 13 IQR (11-15) in the range of 0 to 18. Males significantly scored higher than females (13.0 IQR (12-15) vs. 12.0 IQR (10-14) p=0.000), an increase in age was associated with higher knowledge scores (Rho = 0.101, p = 0.000). Students in the third year of study significantly scored higher than those in the first year, and government-sponsored students scored higher than the privately sponsored students. HIV knowledge was also significantly associated with sexual experience, and condom use at univariate level but insignificant at multiple level analysis. Males were more likely to have ever had sex (31.7% vs. 12.7%) and ever used a condom (63% vs. 55%) than females respectively
**Conclusion:** Our findings suggest that Makerere University students possessed good knowledge on HIV. There is evidence of an association between student's knowledge, and demographic characteristics and a few sexual behaviors. Future behavioral and educational programs that target both sexually and non-sexually experienced students should address the gender differences.

*Key words: Sexual Health, HIV/AIDS, Knowledge, sexual behaviors, university students*

## BACKGROUND

Uganda started experiencing high rates of HIV infection in the late 1980s, and the infection reached its apex in the early 1990s [1]. The spread of HIV in the country is unevenly distributed among the population with women and urban dwellers at higher risk of infection [1]. The prevalence of HIV among Ugandans aged 15-49 increased from 6.4% in 2004 to 7.3 in 2011 [1,2]. Among the youth aged 20-29 years, the prevalence was estimated at 6.4% in 2011 [1]. It was estimated that in 2015, 4% of the country's population was living with HIV and 28,000 persons died of HIV-related illnesses [3].

Uganda is implementing various HIV/AIDS prevention programs that include; the comprehensive AIDS approach (Abstinence, Being faithful and Condom use), Prevention of Mother to Child Transmission (PMTCT), and voluntary medical male circumcision [1]. On the other hand, UNAIDS has listed five pillars for achieving a target of less than 500,000 new infections by 2020 like comprehensive sexuality education, economic empowerment and access to sexual and reproductive health services for young adults [3-5].

Earlier studies showed that 99% of Ugandans aged 15-49 years have ever heard about HIV and over 90% are aware of the mode of HIV transmission [1]. The proportion of comprehensive knowledge increased from 28 % in 2004 to 36% in 2011 among women aged 15-49 and from 36 % in 2004-05 to 43% in 2011 among men of the same age [1].

Adolescence is a crucial development step that may lead to the potential of unsafe sexual behaviors [6,7]. Risky lifestyles such as unprotected sex and inconsistent condom use are significantly associated with higher risk of HIV infections among adolescents [8-10]. Poor HIV/AIDS knowledge among the youth has also been indicated as a causal factor for increased HIV infections [5,11]. Studies demonstrated that university students are sexually adventurous, are often in multiple sexual relationships, and are less inclined to use condoms consistently [10,12].

Most HIV/AIDS prevention interventions in Uganda target the general population, and a few target high-risk populations, such as university students. Studies in Uganda have shown mixed evidence of the association between knowledge of HIV and unsafe sexual practices [13-17] [18-22]. We set out to assess the predictors of HIV knowledge on sexual behaviors among university students. The study adds to a growing body of literature on HIV prevention knowledge and sexual behaviors in similar settings and is one of the first endeavors to provide a quantitative score of knowledge on HIV in the country.

## METHODS

### Study design and setting

We performed a cross-sectional survey. The survey took place at Makerere University Kampala (MUK) among students aged 18 to 30 years from March to April 2015. MUK is the largest university in Uganda and has a student population of over 4000. The University offers health services including HIV counseling and testing (HCT) to students in Uganda.

### Sample size and sampling procedure

The sample size was calculated using the formula for a two-sample T-test. The study assumed a mean knowledge score difference of 0.7, a standard deviation $\delta_1=\delta_2=4$, a 5% level of significance, and 90% power. A sample size of 686 was computed for each group leading to a total sample size of 1,372 participants. A sampling frame was generated from lists of university students obtained from the university where a random sample was taken. Eligibility of study participants included being a continuing student, aged between 18 to 30 years, possessing an Android smart-phone, and willing to provide written informed consent. Trained research assistants approached potential participants at hostels and screened them for inclusion, and then invited them to complete a self-administered tool in a private place. A total of 1,512 students completed the questionnaires. We report results of 1,337 students that provided complete information on the demographic characteristics and the outcome variable (HIV knowledge score).

### Questionnaire

The questionnaire was developed and pre-tested before the main survey and contained three sections: socio-demographic characteristics; HIV prevention knowledge; and sexual and HIV prevention behavior.

The socio-demographic characteristics included questions on gender, age, university residence, home residence, marital status, year of study, religion, tuition status, and employment.

HIV/AIDS prevention knowledge was assessed using the 18 items version of the HIV knowledge questionnaire (KQ18) [23] to measure the student's knowledge. The HIV KQ18 is a brief self-administered measure of an individual's HIV-related knowledge and was designed to provide a more concise and well-established measure of HIV-related knowledge in street outreach, fieldwork, and intervention settings. The instrument contains 18 forced-choice statements ("true", "false", "don't know") related to knowledge on sexual transmission and the instrument yields a summary score by summing an individual's correct score across the 18 questions, with higher scores significant of greater HIV-related knowledge and with a scale of 0 to 18 [23].

The sexual and HIV prevention behaviors section of the questionnaire used questions modified from the Uganda AIDS Indicator Survey (UAIS). The UAIS is a nationally

representative, population-based, HIV serological survey implemented by Uganda Ministry of Health. The UAIS is designed to obtain national and subnational estimates of the prevalence of HIV and syphilis infection, data on attitudes towards HIV/AIDS, and sexual behavior. We collected data on: sexual intercourse, condom usage, alcohol use, sex with multiple partners, HIV testing, circumcision, willingness to circumcise, and knowledge of places where to acquire condoms.

### Data collection and quality control

Data was collected using a pre-tested survey tool that was self-administered by the respondents. The trained interviewers helped to explain unfamiliar terminologies to the participants and made sure that students completed the required sections. Investigators went through the questionnaires daily to check for consistency and incompleteness.

### Data management and statistical analysis

Data was double-entered and cross-validated to check for any errors in Epidata version 3.1. Data cleaning and analysis were conducted in Stata version 13.0 (Stata Corporation, College Station, Texas, USA) and R studio (open source version 1.0.136, R Foundation for Statistical Computing, Vienna, Austria). Descriptive analyses were performed using medians, and proportions. The study performed Shapiro Wilk test to check for normality. Normality tests indicated that the outcome variable (knowledge score) was not normality distributed, and non-parametric tests were conducted. We conducted a two-sample Wilcoxon Rank Sum test and Kruskal Wallis Rank test for more than 2 samples to assess the relationship between HIV prevention knowledge, and student's demographic characteristics and sexual behaviors. Spearman rank correlation test was done for continuous covariates. Library (PMCMR) in R studio software [24] was used to perform post-hoc tests using Bonferroni adjustment. Chi-square and Fisher's tests of association were also conducted to assess the association between student's behaviors and sexual behaviors. We used an iteratively reweighted least square (ILRS) generalized linear model with an identity function [25] to conduct multivariable regression analysis with knowledge score as the outcome variable. Dummy variables were generated for covariates with more than two categories. We used a 5% level of significance.

### Ethical consideration

The study received ethics approval from the Joint Clinical Research Centre (JCRC) Institutional Review Board and the Uganda National Council of Science and Technology (UNCST). Participants provided written informed consent before being interviewed. Participants were allowed to withdraw consent at any stage of the interview.

## RESULTS

### Socio-demographic characteristics

Socio-demographic characteristics are summarized in table 1.The mean age of the respondents was 21.2 SD (1.6) in the range of 18 to 30. More than half of the respondents 700(52.4%) were males, and most of them 713(53.3%) resided in university halls. Over half of the students, 801(59.9%) were residents of urban areas, and the majority of the participants 1,208(90.3%) reported being single. A larger proportion of our participants 1,223(91.5%) were Christians. A total of 562(42.0%) respondents were in the first academic year and 471 (35.2%) were in the second year. More than half of the students 946(70.8%) were privately-sponsored, and 1,181(88.3%) were not involved in any form of work.

### HIV/AIDS prevention knowledge

The median knowledge score of students was 13.0 IQR [11-15] in the range of 0 to 18 which translates to 72.2% median pass rate. Table 2 shows the distribution of individual HIV KQ18 questions by correct scores. The table results show that HIV questions qn10 (12%), qn12 (36%), qn9 (40%), and qn17 (50%) had the lowest proportion of correct scores respectively while questions qn14 (94%), qn6 (93%), qn2 (89%) had the highest proportion of correct scores respectively.

### Association between socio-demographic characteristics and HIV prevention Knowledge

Table 1 results also show the association between student's HIV prevention knowledge score and socio-demographic characteristics. The results revealed that males scored higher than females (13.0 IQR [12-15] vs. 12.0 IQR [10-14] p=0.000), increase in age was significantly associated with higher knowledge scores (Rho = 0.101, p = 0.000). University residence exhibited a significant relationship with HIV knowledge score ($x^2$ =13.2, p =0.004). Post-hoc test results showed that only scores of students residing on campus halls 13 IQR [11-15] vs. those residing at off-campus hostels 13 IQR [11-14] and parent's home 12 IQR [10-14] were significantly different from each other. The academic year of study also showed a significant association with HIV prevention knowledge ($x^2$ =20.1, p = 0.000). The post-hoc test

**TABLE 1. Socio-demographic characteristics of study population showing associations with HIV knowledge scores reporting means and proportions**

| Characteristic | Overall, N (%) | Knowledge score by group | |
|---|---|---|---|
| **Age , mean (SD)** | 21.2 (1.6) | Rho=0.101*, p = 0.000 | |
| **Gender** | **N (%)** | **Median (IQR)** | **Statistic , p value** |
| Male | 700(52.4) | 13 (12-15) | Z=6.3*, p = 0.000 |
| Female | 637(47.6) | 12 (10-14) | |
| **University residence** | | | |
| Hall on campus | 713(53.3) | 13 (11-15) | $x^2$ =13.2*, p =0.004 |
| Off-campus hostel | 423(31.6) | 13 (11-14) | |
| Own home/Rental | 58(4.3) | 13 (11-14) | |
| At parent's home | 143(10.7) | 12 (10-14) | |
| **Home area of residence** | | | |
| Urban | 801(59.9) | 13 (11-15) | $x^2$ =3.7, p =0.156 |
| Semi-urban | 385(28.8) | 13 (11-14) | |
| Rural | 151(11.3) | 13 (11-14) | |
| **Marital status** | | | |
| Single | 1,208(90.3) | 13 (11-14) | $x^2$ =2.9, p =0.402 |
| Married | 10(0.8) | 14 (11-15) | |
| Divorced | 6(0.5) | 13.5 (8-15) | |
| Others | 113(8.4) | 13 (12-15) | |
| **Year of study** | | | |
| First | 562(42.0) | 13 (10-14) | $x^2$ =20.1*, p =0.000 |
| Second | 471(35.2) | 13 (11-14) | |
| Third | 275(20.6) | 13 (11-15) | |
| Fourth | 29(2.2) | 14 (12-15) | |
| **Religion** | | | |
| Christian | 1,223(91.5) | 13 (11-15) | $x^2$ =2.4, p =0.304 |
| Muslim | 95(7.1) | 12 (10-14) | |
| Other | 19(1.4) | 13 (12-15) | |
| **Sponsorship** | | | |
| Private | 946(70.8) | 13 (11-14) | $x^2$ =13.6*, p =0.001 |
| Government | 380(28.4) | 13 (12-15) | |
| Other | 11(0.8) | 12 (10-13) | |
| **Work** | | | |
| None | 1,181(88.3) | 13 (11-14) | $x^2$ =5.4, p =0.066 |
| Work part-time | 150(11.2) | 13 (12-15) | |
| Work full time | 6(0.5) | 15 (14-15) | |

*Rho -Spearman's rank correlation coefficient | IQR-Inter Quartile Range | Z- Computed Z statistic | $x^2$ - Computed Chi-square statistic | * means significant at 5% level of significance*

indicated that only students in the third year 13 IQR [11-15] significantly scored higher than those in the first year 13 IQR [10-14]. Student's sponsorship also posed a significant association with knowledge score ($x^2$ =13.6, p =0.001) with results from post-hoc tests indicating that government-sponsored students significantly scoring higher than privately sponsorship students. Home area of residence, marital status, religion, and work showed no significant relationship with student's knowledge score.

We also performed an iteratively reweighted least square (ILRS) generalized linear model analysis. Table 3 shows findings from the multivariable regression analysis. The results show that after adjusting for other demographic characteristics, female students still significantly scored lower

**TABLE 2. Distribution of individual HIV KQ18 questions by correct answers**

| HIV knowledge questions(KQ18) | Proportion | 95% CI |
|---|---|---|
| 1. Coughing and sneezing DO NOT spread HIV | 0.74 | 0.72-0.76 |
| 2. A person can get HIV by sharing a glass of water with someone who has HIV | 0.89 | 0.88-0.91 |
| 3. Pulling out the penis before a man climaxes/cams keeps a woman from getting HIV during sex | 0.76 | 0.74-0.78 |
| 4. A woman can get HIV if she has anal sex with a man | 0.67 | 0.64-0.70 |
| 5. Showering, or washing one's genitals/private parts, after sex keeps a person from getting HIV | 0.89 | 0.87-0.90 |
| 6. All pregnant women infected with HIV will have babies born with AIDS | 0.93 | 0.92-0.94 |
| 7. People who have been infected with HIV quickly show serious signs of being infected | 0.88 | 0.86-0.89 |
| 8. There is a vaccine that can stop adults from getting HIV | 0.74 | 0.71-0.76 |
| 9. People are likely to get HIV by deep kissing, putting their tongue in their partner's mouth, if their partner has HIV | 0.40 | 0.37-0.42 |
| 10. A woman can get HIV if she has sex during her period | 0.12 | 0.10-0.14 |
| 11. There is a female condom that can help decrease a woman's chance of getting HIV | 0.832 | 0.81-0.85 |
| 12. A natural skin condom works better against HIV than does a latex condom | 0.36 | 0.34-0.39 |
| 13. A person will NOT get HIV if she or he is taking antibiotics | 0.80 | 0.78-0.82 |
| 14. Having sex with more than one partner can increase a person's chance of being infected with HIV | 0.94 | 0.93-0.95 |
| 15. Taking a test for HIV one week after having sex will tell a person if she or he has HIV | 0.53 | 0.50-0.55 |
| 16. A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV | 0.87 | 0.85-0.88 |
| 17. A person can get HIV from oral sex | 0.50 | 0.47-0.52 |
| 18. Using Vaseline or baby oil with condoms lowers the chance of getting HIV | 0.61 | 0.58-0.63 |

than males (β=-0.82, p = 0.000), students residing at parent's home significantly scored lower than those residing in campus halls (β=-0.56, p=0.032), third-year students significantly scored higher than first-year students (β=0.62, p=0.009) and government-sponsored students significantly scored higher than privately sponsored students (β=0.54, p=0.002).

## Sexual and HIV preventive behaviors

Table 4 shows the distribution of sexual and HIV preventive behaviors. A total of 586 (47.9%) students reported never having at the time of the interview, and more than a half of the students 402 (55.1%) reported using a condom at the last sexual intercourse. Additionally, 55.1% of the students having had had sex with their boyfriends/girlfriends and only 8.8% reported having had a sexual encounter. A smaller proportion of respondents (6.0%) reported being drunk at their last sexual intercourse and only 21 (3.0%) students were paid in exchange for sex.

The majority of the students 1, 086 (82.5%) self-reported knowing their HIV status. More than half of the male students 420 (60.4%) reported being circumcised and 106 (44.7%) of those uncircumcised were willing to get circumcised. Results also indicate that majority of the students 1,089 (82.7%) were aware of the places where to acquire condoms and 1,037 (79.2%) students were willing to acquire condoms from those locations.

## Association between student's HIV prevention knowledge, and risky sexual behaviors

Table 4 also shows the association between student's HIV knowledge and sexual behaviors. Sexual experience showed a significant relationship with HIV knowledge ($x^2$=17.7, p =0.000). Bonferroni post-hoc test results shown that scores of students who had ever had sex 13 IQR [12-15] were significantly scored higher than those who had never 12.5 IQR [10-14] and those who preferred not to answer 13 IQR [11-14]. The results also suggested that condom use experience at last sexual intercourse were significantly correlated with knowledge score ($x^2$=15.0, p =0.001). Post-hoc results showed that scores of students who preferred not to answer 12 IQR [10-14] were significantly lower than those who never used a condom 13 IQR [12-15] and those who used a condom 13 IQR [11-15]. However, no significant difference existed between those who used and never used a condom. Alcohol use at last sexual intercourse ($x^2$=13.1, p =0.001) was also significantly related knowledge score. Post-hoc results suggest that students who preferred not to answer 12 IQR [10-14] significantly scored lower than those who used 14 IQR [12-15] and never used alcohol 13 IQR [11-15]. However, there was no significant difference between those who used and never used alcohol at last sexual intercourse. Additionally, results from post-hoc test suggested there was no significant knowledge difference between those who were paid and not paid in exchange for sex.

Post-hoc tests also showed that HIV knowledge

**TABLE 3. Multivariate regression analysis of association between knowledge score and demographic characteristics**

| Characteristic | Coefficient (SE) | 95% CI |
|---|---|---|
| **Age** | -0.03 (0.06) | (-0.15,0.09) |
| **Gender** | Ref=Male | |
| Female | -0.82(0.16)* | (-1.14,-0.51) |
| University residence | Ref= on campus hall | |
| Off-campus hostel | 0.14 (0.18) | (-0.21,0.48) |
| Own home/Rental | -0.31 (0.39) | (-1.07,0.44) |
| At parent's home | -0.56 (0.26)* | (-1.07,-0.05) |
| **Home area of residence** | Ref=Urban | |
| Semi-urban | -0.41 (0.17) | (-0.74,-0.07) |
| Rural | -0.23 (0.24) | (-0.71,0.25) |
| **Marital status** | Ref=Single | |
| Married | 0.85 (0.92) | (-0.95,2.64) |
| Divorced | -0.47 (1.12) | (-2.67,1.73) |
| Others | 0.37 (0.27) | (-1.15,0.90) |
| **Year of study** | Ref= First year | |
| Second | 0.35 (0.18) | (-0.01, 0.70) |
| Third | 0.62 (0.24)* | (0.16, 1.08) |
| Fourth | 0.90 (0.56) | (-0.20, 1.99) |
| **Religion** | Ref=Christian | |
| Muslim | -0.24 (0.29) | (-0.82, 0.03) |
| Other | 0.05 (0.64) | (-1.20, 1.29) |
| **Sponsorship** | Ref= Private | |
| Government | 0.54 (0.18)* | (0.19, 0.89) |
| Other | -0.80 (0.83) | (-2.43, 0.83) |
| **Work** | Ref= None | |
| Work part-time | 0.27 (0.24) | (-0.21, 0.74) |
| Work full time | 0.94 (1.13) | (-1.27, 3.15) |

** means significant at 5% level of significance*

for students who were aware of places where to pick condoms 13 IQR [11-15] was significantly higher than those who weren't aware 12 IQR [9-13]. Similarly, HIV knowledge was significantly higher among students who were willing to acquire condoms 13 [11-15] than those who were not 12 IQR [10-14]. Our findings show no evidence to suggest that knowledge of HIV status, circumcision, relationship with the person at last sexual intercourse, and duration of last sexual intercourse were related to HIV knowledge score.

We further conducted an IRLS generalized linear model analysis. The results from the ILRS model are presented in Table 5. The findings show that after adjusting for other sexual behaviors showed that only knowledge of the place where to pick condoms and willingness to use condoms remained significantly associated with HIV knowledge scores. Students who knew where to pick condoms significantly scored higher than those never knew (β=1.9, p=000), and similarly, students who were willing to use condoms significantly scored higher those who were unwilling (β=0.9, p=0.029).

## Association between socio-demographic characteristics on sexual and HIV preventive behaviors

Table 6 spells out the association between socio-demographic characteristics, and sexual and HIV preventive behaviors. Older students were more likely to have ever had sex compared to younger students (31.4% vs. 17.3%), and males were more likely to have ever had sex than females (31.7% vs. 12.7%). Students staying in their own homes were more likely to have ever had sex than their counterparts. Year of study and religion were the only socio-demographic characteristics that were not significantly associated with ever having had sex. Condom use was significantly associated with age, sex, the home area of residence, year of study,

**TABLE 4. Distribution of sexual and HIV preventive behaviors and their associations with HIV knowledge score**

| Characteristic | Overall, N(%) | Knowledge score by group | |
|---|---|---|---|
| | | Median (IQR) | Statistic, p value |
| **Ever had sex, n (%)** | N=1,222 | | |
| Ever | 275(22.5) | 13 (12-15) | $x^2$ =17.7*, p =0.000 |
| Never | 586 (47.9) | 12.5 (10-14) | |
| Prefer not to answer | 361(29.5) | 13 (11-14) | |
| Number of days last had sex , median (IQR) | 30 (7-120) | Rho = -0.05, p=0.423 | |
| **Condom use at last sexual intercourse, n (%)** | N=730 | | |
| No | 169 (23.1) | 13 (12-15) | $x^2$ =15.0*, p =0.001 |
| Yes | 402 (55.1) | 13 (11-15) | |
| Prefer not answer | 159 (21.8) | 12 (10-14) | |
| **Relationship with person of last sexual intercourse, n (%)** | N=724 | | |
| Live in Partner | 71 (9.8) | 14 (12-15) | $x^2$ =10.7, p =0.057 |
| Boyfriend/Girlfriend, not live in | 399 (55.1) | 13 (11-15) | |
| Casual acquaintance | 64 (8.8) | 13 (11.5-15) | |
| Prostitute | 7 (1.0) | 13 (11-15) | |
| Other | 12 (1.7) | 13.5 (12.5-15) | |
| Prefer not to answer | 171 (23.6) | 13 (10-15) | |
| **Alcohol use at last sexual intercourse, n (%)** | N=710 | | |
| No | 553 (77.9) | 13 (11-15) | $x^2$ =13.1*, p =0.001 |
| Yes | 43 (6.1) | 14 (12-15) | |
| Prefer not to answer | 114 (16.1) | 12 (10-14) | |
| **If yes, who was drunk, n (%)** | N=49 | | |
| Respondent | 8 (16.3) | 14 (13.5-14.5) | $x^2$ =2.9, p =0.414 |
| Partner | 11 (22.4) | 15 (12-16) | |
| Both | 15 (30.6) | 14 (10-15) | |
| Prefer not to answer | 15(30.6) | 13 (10-14) | |
| **Pay (got paid) in sex exchange, n (%)** | N=698 | | |
| No | 588 (84.2) | 13 (11-15) | $x^2$=23.5*, p =0.000 |
| Yes | 21 (3.0) | 12 (10-15) | |
| Prefer not to answer | 89 (12.8) | 12 (9-14) | |
| **Knowledge of HIV status, n (%)** | N=1,316 | | |
| No | 177 (13.5) | 13 (11-14) | $x^2$ =6.2, p =0.050 |
| Yes | 1,086 (82.5) | 13 (11-15) | |
| Prefer not to answer | 53 (4.0) | 12 (10-14) | |
| **Circumcision [Males], n (%)** | N=695 | | |
| No | 237 (34.1) | 13 (12-15) | $x^2$ =1.8, p =0.403 |
| Yes | 420 (60.4) | 13 (11-15) | |
| Prefer not to answer | 38 (5.5) | 12.5 (11-15) | |
| **Willingness to get circumcised, n (%)** | N=237 | | |
| No | 117 (48.9) | 13 (11-15) | $x^2$=0.7, p =0.711 |
| Yes | 107 (44.8) | 14 (11-14) | |
| Prefer not to answer | 15 (6.3) | 13 (11-14) | |
| **Knowledge of places where to pick condoms, n (%)** | N=1,317 | | |
| No | 118 (9.0) | 12 (9-13) | $x^2$=43.1*, p =0.000 |
| Yes | 1,089 (82.7) | 13 (11-15) | |
| Prefer not to answer | 110 (8.3) | 11.5 (9-14) | |
| **Willingness to acquire a condom, n (%)** | N=1,309 | | |
| No | 150 (11.5) | 12 (10-14) | $x^2$=41.5*, p =0.000 |
| Yes | 1,037 (79.2) | 13 (11-15) | |
| Prefer not to answer | 122 (9.3) | 11 (9-14) | |

** means significant at 5% level of significance | IQR-Inter Quartile Range | $x^2$-Chi-square value*

**TABLE 5. Multivariate regression analysis of association between knowledge score and HIV prevention and sexual behaviors**

| Characteristic | Coefficient (SE) | 95% CI |
|---|---|---|
| **Ever had sexual intercourse** | Ref=Ever | |
| Never | 0.05 (0.25) | (-0.45,0.54) |
| Prefer not answer | omitted | |
| **Condom use at last sexual intercourse** | Ref= Not used | |
| Yes | -0.40 (0.28) | (-0.95,0.15) |
| Prefer not answer | -0.54 (0.43) | (-1.38,0.30) |
| **Alcohol use at last sexual intercourse** | Ref=No | |
| Yes | 0.19 (0.48) | (-0.75, 1.14) |
| Prefer not answer | 0.11 (0.45) | (-0.81,1.04) |
| **Pay (got paid) in sex exchange** | Ref=No | |
| Yes | -1.28 (0.68) | (-2.62,0.06) |
| Prefer not answer | -1.42* (0.45) | (-2.31,-0.54) |
| **Knowledge of places where to pick condoms** | Ref= No | |
| Yes | 1.90* (0.44) | (1.02,2.77) |
| Prefer not to answer | 1.74* (0.71) | (0.35,3.13) |
| **Willingness to acquire a condom** | Ref=No | |
| Yes | 0.91* (0.42) | (0.10,1.73) |
| Prefer not to answer | -0.16 (0.65) | (-1.43,1.11) |

*Other sexual and prevention variables were excluded due to collinearity*
** means significant at 5% level of significance*

student's sponsorship and work. More males reported condom use compared to females (63.3% vs. 55.1%), and students in the third year of study were more likely to use condoms compared to those in other academic years. Knowledge of HIV status showed no significant association with the socio-demographic characteristics. Circumcision was significantly associated with marital status, year of study, religion, work and home area of residence. Students from urban centers and those not in relationships were more likely to be circumcised than their counterparts. Willingness to get circumcised was only significantly related to student's sponsorship type and home area of residence.

## DISCUSSION

In this study, we assessed the predictors of HIV prevention knowledge and sexual behaviors among students aged 18 to 30 years at Makerere University Kampala, Uganda.

Our findings showed that median knowledge score was 13.0 IQR (11-15) on a scale of 0 to 18, an indication that averagely students scored about 72%. This reveals that Makerere University student's HIV knowledge was relatively good. This finding correlates very well with a study conducted in Belgium that reported a fair knowledge score of 20 IQR [19-21] among university students [26], and other similar studies elsewhere [27,28], but it differs with prior reviews in Ethiopia [29] and Sudan [30] that reported a generally poor performance among university students.

Our study also shows that students performed poorly on HIV transmission questions, and this result is consistent with a prior study in Ethiopia [29] that revealed low knowledge on HIV transmission among adolescents. This finding is, however, inconsistent with results of a related study that conducted among high school students in Belgium and showed a higher knowledge score on HIV transmission questions [31]. Low HIV transmission knowledge scores suggest that Makerere University students are at a high risk of contracting HIV. Our study recommends the implementation of student-tailored HIV transmission educational programs in order to close this knowledge gap.

Males demonstrated a higher level of HIV knowledge than females both at univariate and multivariable analysis. This result is inconsistent with studies conducted in Iran, Belgium [31,32], and Ghana [33] that showed that females scored higher than males. Conversely, a study conducted in Ethiopia [29] revealed no gender differences in HIV Knowledge levels. Different socio-cultural norms in different countries and parts of the countries may explain these gender differences. Behavioral and educational programs that consider the gender dimensions among university students could help in closing this gap. Our study also shows that student's HIV knowledge increased

with increase in age. This result is supported by prior studies [26,31] that suggest that older students scored higher than younger students. Our study evidenced that students residing within university housings scored better than those that resided at their parent's homes. This shows that students residing on campus may be benefiting from the various HIV social campaigns that run within the confines of the university residences. Conversely, those residing outside the university's residence miss out on such campaigns which are impacting on their low level of knowledge. Additionally, one can also argue that parents are not taking a key role in discussing HIV related information with their children. Future research could exploit ways of involving parents in championing HIV campaigns among their children. Our study also revealed that government-sponsored students scored higher than the privately sponsored student. This result can be related to that of residing in university residences. Most government-sponsored students reside in university halls and tap knowledge from the various HIV campaigns as compared to private students whom majority reside outside the university. Our study didn't find any association between knowledge and marital status. We had anticipated students in marriage to be more knowledgeable than the unmarried as reported by a prior study [26].

Over half of the respondents studied had never had sex. In line with a prior study carried out in China [34], we found evidence to suggest that most of the students reported using a condom at their last sexual debut. Very few university students were engaged in sex for money. On a positive side also, alcohol use during sex was found to be very low and Knowledge of self-reported HIV status was very high among college students. Our study also suggested that more than half of our male respondents were circumcised. Circumcision reduces the risk of HIV infection by about 60% and the national prevalence rate of circumcision stands at 26%. Males from urban areas were more likely to be circumcised compared to those from rural areas as supported by a previous study in Uganda [35]. Although self-reported circumcision was high, willingness to circumcise among the uncircumcised males was below the average, contrary to earlier studies in Rwanda [36] and Uganda [35,37].

Sexual experience was significantly related to HIV knowledge scores. Students that reported prior sexual debut scored higher than those that reported having never had any sexual encounter. This seemingly paradoxical result suggests that knowledge does not necessarily translate to safer sex practices. Similar findings have also been reported among university students in Belgium [26]. This can be attributed to personal experiences where for example sexually active students tend to seek more information on the spread and control of HIV than the non-sexually active students. This shows a need for more HIV interventions tailored to both sexually experienced and non-sexually experienced students. Our study did not find any evidence to suggest that condom use at last sexual intercourse and knowledge of HIV status were related to HIV knowledge scores. Knowledge of places where to acquire condoms, and willingness to use condoms were associated with better HIV knowledge outcomes. This indicates that positive attitudes towards condom use are positively correlated with high HIV knowledge gains.

Our study suggests that increase in age is associated with sexual experience among university students. This result is supported by a prior study in Uganda [20]. This finding is rather not surprising, as African communities dictate that as you age, you're expected to marry, and implicit in this is sexual intercourse. Male students and those staying in their own homes were more likely to have ever had sex compared to the rest of the students. In contrast to a similar study in Uganda [19], we didn't find evidence of an association between sexual experience and religion. This difference may be due to the fact that this study never disaggregated Christianity to capture different dimensions as compared to a previous study in Uganda [19] that used various dimensions. Our study suggests that males are more likely to use condoms than females as opposed to a prior review in Tanzania [38] that indicated that females were more likely to use condoms than males. Condom awareness efforts targeting females are needed in universities in order to make them first consumers of condom use as this will trigger high safe sexual practices among university students.

## Research implications for intervention and policy

The present study has demonstrated the existence of gender differences in HIV prevention knowledge and sexual behaviors among university students. Designing of innovative ways that address these gender differences across similar study groups would be fundamental in achieving safe sexual behaviors and improving HIV knowledge. Our study also shows that students residing in university housings performed better than those that reside at parent's homes. Policy should identify possible ways of involving parents in improving HIV knowledge among adolescents. Our study has shown evidence that students from urban areas were more circumcised. Similarly, willingness to circumcise was higher among students residing from urban areas compared to rural areas. Policy makers need to come up with programs that target rural population aiming at creating demand for affordable and safe male circumcision.

## Study strengths and limitations

We used an internationally-validated questionnaire to measure HIV knowledge among students. This study can potentially allow cross-country comparisons of knowledge scores in similar study settings. The study questionnaires were completed by the respondents which reduced the interviewer bias that sometimes arises as a result of wrong

interpretations of questions by interviewers.

A limitation of the study is that we excluded participants who did not possess an Android smartphone and those in the final semester of their academic year. As a result, the findings may not be generalizable to all students in Makerere or students in other universities in Uganda.

## CONCLUSION

Our study findings show that Makerere University students possess a good level of knowledge on HIV prevention. The study has shown evidence of associations between HIV knowledge, and sexual experience and willingness to use condoms. Our study demonstrates the existence of significant gendered HIV knowledge and sexual behavior differences among university students. Behavioral and educational Programs that target both sexually and non-sexually experienced students should address the gender differences. Future research should aim to explore ways of involving parents in improving HIV knowledge among adolescents. Future research should also aim at assessing the HIV/AIDS knowledge levels among students that use drugs, and those with other sexual orientations.

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### Author's contributions

AN1, PN, EN, AN3, SJL, JBB conceived the study. AN1, PN, EN carried out the data collection. AN1 carried out data analysis and drafted the first version of the manuscript. AN1, ONO, PN, EN, AN3, SJL, JB edited and approved the manuscript.

### Competing interest

The authors declare no competing interests.

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# SUPPLEMENTARY FILES

## 1. Table

### TABLE 6. Association between socio-demographic characteristics and sexual and HIV preventive behaviors

| Characteristic | Ever had sex | | | Condom use at last sexual intercourse | | | Knowledge of HIV status | | | Circumcision [Males only] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ever | Never | Prefer not to answer | No | Yes | Prefer not to answer | No | Yes | Prefer not to answer | No | Yes | Prefer not to answer |
| **Age** | | | | | | | | | | | | |
| 18-21 | 133(17.3) | 427(55.4) | 210(27.3) | 73(19.0) | 210(54.5) | 102(26.5) | 119(14.6) | 665(81.7) | 30(3.7) | 116(32.3) | 205(60.6) | 17(5.0) |
| 22-30 | 142(31.4) | 159(35.2) | 151(33.4) | 96(27.1) | 192(55.6) | 57(21.9) | 58(11.5) | 421(83.9) | 23(4.6) | 121(33.9) | 215(60.2) | 21(5.9) |
| | P vale= 0.000** | | | P value = 0.001** | | | P value = 0.227 | | | P value = 0.885 | | |
| **Gender** | | | | | | | | | | | | |
| Male | 200(31.7) | 212(33.6) | 219(34.7) | 108(22.6) | 302(63.3) | 67(14.1) | 95(13.8) | 565(82.0) | 29(4.2) | 237(34.1) | 420(60.4) | 38(5.8) |
| Female | 75(12.7) | 374(63.3) | 142(29.5) | 61(24.1) | 402(55.1) | 92(36.4) | 82(13.1) | 521(83.1) | 24(4.0) | | | |
| | P vale= 0.000** | | | P value = 0.000** | | | P value = 0.866 | | | | | |
| **University residence** | | | | | | | | | | | | |
| Hall on campus | 140(21.2) | 338(51.2) | 181(27.5) | 78(21.5) | 205(56.5) | 80(22.0) | 94(13.4) | 582(82.9) | 26(3.7) | 128(33.6) | 231(60.6) | 22(5.8) |
| Off-campus hostel | 97(25.3) | 164(42.8) | 122(31.8) | 62(24.6) | 139(55.2) | 51(20.2) | 53(12.7) | 348(83.6) | 15(3.6) | 79(34.8) | 137(60.3) | 11(4.8) |
| Own home/Rental | 19(38.0) | 15(30.0) | 16(32.0) | 11(25.6) | 27(62.8) | 5(11.6) | 11(19.3) | 43(75.4) | 3(5.3) | 15(34.1) | 26(59.1) | 3(6.8) |
| At parent's home | 19(14.6) | 69(53.1) | 42(32.3) | 18(25.0) | 31(43.1) | 23(31.9) | 19(13.5) | 113(80.1) | 9(6.4) | 15(34.9) | 26(60.5) | 2(4.6) |
| | P vale= 0.002** | | | P value = 0.168 | | | P value = 0.589 | | | P value = 0.998 | | |
| **Home area of residence** | | | | | | | | | | | | |
| Urban | 147(20.1) | 366(49.9) | 220(30.0) | 91(21.6) | 234(55.6) | 96(22.8) | 102(13.0) | 649(82.7) | 34(4.3) | 133(33.6) | 248(62.6) | 15(3.8) |
| Semi-urban | 82(23.7) | 153(44.2) | 111(32.1) | 47(20.5) | 133(58.1) | 49(21.4) | 52(13.6) | 316(82.7) | 14(3.7) | 63(31.0) | 121(59.6) | 19(9.4) |
| Rural | 46(32.2) | 67(46.8) | 30(21.0) | 31(38.7) | 35(43.7) | 14(17.5) | 23(15.4) | 121(81.2) | 5(3.4) | 41(42.7) | 51(53.1) | 4(4.2) |
| | P value = 0.007** | | | P value = 0.013* | | | P value = 0.899 | | | P value = 0.019* | | |
| **Marital status** | | | | | | | | | | | | |
| Single | 240(21.6) | 551(49.7) | 318(28.7) | 145(22.7) | 354(55.4) | 140(21.9) | 161(13.5) | 984(82.8) | 44(3.7) | 222(34.8) | 385(60.4) | 30(4.7) |
| Married | 4(50.0) | 1(12.5) | 3(37.5) | 6(66.7) | 3(33.3) | 0(0.0) | 1(10.0) | 8(80.0) | 1(100.0) | 3(42.9) | 3(42.7) | 1(14.3) |
| Divorced | 0(0.0) | 2(33.3) | 4(66.7) | 1(25.0) | 1(25.0) | 2(50.0) | 0(0.0) | 6(100.0) | 0(0.0) | 0(0.0) | 4(100.0) | 0(0.0) |
| Others | 31(31.3) | 32(32.3) | 36(36.4) | 17(21.8) | 44(56.4) | 17(21.8) | 15(13.5) | 88(79.3) | 8(7.2) | 12(25.5) | 28(59.6) | 7(14.9) |
| | P value = 0.002** | | | P value = 0.054 | | | P value = 0.480 | | | P value = 0.035* | | |
| **Year of study** | | | | | | | | | | | | |
| First | 111(21.4) | 274(52.9) | 133(31.8) | 50(18.0) | 156(56.1) | 72(25.9) | 77(14.0) | 456(83.2) | 15(2.7) | 94(34.7) | 173(63.8) | 4(1.5) |
| Second | 94(22.2) | 195(46.0) | 135(31.8) | 76(27.8) | 144(52.7) | 53(19.4) | 62(13.2) | 384(81.7) | 24(5.1) | 82(36.0) | 128(56.1) | 18(7.9) |
| Third | 64(25.2) | 106(41.7) | 84(33.1) | 35(21.3) | 98(59.8) | 31(18.9) | 35(12.9) | 222(81.9) | 14(5.2) | 55(31.6) | 105(60.3) | 14(8.1) |
| Fourth | 6(23.1) | 11(42.3) | 9(34.6) | 8(53.3) | 4(26.7) | 3(20.0) | 3(11.1) | 24(88.9) | 0(0.0) | 6(27.3) | 14(60.4) | 2(9.1) |
| | P value = 0.089 | | | P value = 0.005** | | | P value = 0.408 | | | P value = 0.019* | | |
| **Religion** | | | | | | | | | | | | |
| Christian | 253(22.7) | 539(48.3) | 324(29.0) | 152(22.9) | 365(54.9) | 148(22.3) | 158(13.1) | 995(82.7) | 50(4.2) | 233(36.2) | 374(58.2) | 36(5.6) |
| Muslim | 20(22.5) | 39(43.8) | 30(33.7) | 14(25.5) | 33(60.0) | 8(14.5) | 16(17.1) | 76(80.8) | 2(2.1) | 0(0.0) | 38(61.5) | 1(2.6) |
| Other | 2(11.8) | 8(47.1) | 7(41.2) | 3(30.0) | 4(40.0) | 3(30.0) | 3(15.8) | 15(78.9) | 1(5.3) | 4(30.8) | 8(61.5) | 1(7.7) |
| | P value = 0.621 | | | P value = 0.607 | | | P value = 0.719 | | | P value = 0.000** | | |
| **Sponsorship** | | | | | | | | | | | | |
| Private | 203(23.7) | 382(44.7) | 270(31.6) | 122(22.1) | 314(56.9) | 116(21.0) | 128(13.7) | 765(82.2) | 38(4.1) | 161(33.7) | 292(61.1) | 25(5.2) |
| Government | 70(19.6) | 196(54.9) | 91(25.5) | 45(25.6) | 88(50.0) | 43(24.4) | 46(12.2) | 315(83.8) | 15(4.0) | 72(34.1) | 126(59.7) | 13(6.2) |
| Other | 2(20.0) | 8(80.0) | 0(0.0) | 2(100.0) | 0(0.0) | 0(0.0) | 3(33.3) | 6(66.7) | 0(0.0) | 4(66.7) | 2(33.3) | 0(0.0) |
| | P value = 0.003** | | | P value = 0.056 | | | P value = 0.427 | | | P value = 0.519 | | |
| **Work** | | | | | | | | | | | | |
| None | 235(21.7) | 535(49.4) | 312(28.8) | 133(21.3) | 354(56.5) | 139(22.2) | 159(13.7) | 957(82.3) | 47(4.0) | 215(36.3) | 345(58.2) | 33(5.6) |
| Work part-time | 40(29.6) | 49(36.3) | 46(34.1) | 34(34.0) | 46(46.0) | 20(20.0) | 18(12.2) | 123(83.7) | 6(4.1) | 22(22.5) | 71(72.4) | 5(5.1) |
| Work full time | 0(0.0) | 2(40.0) | 3(60.0) | 2(50.0) | 2(50.0) | 0(0.0) | 0(0.0) | 6(100.0) | 0(0.0) | 0(0.0) | 4(100.0) | 0(0.0) |
| | P value = 0.021* | | | P value = 0.038* | | | P value = 0.826 | | | P value = 0.037* | | |

***means significant at 1% level of significance and * means significant at 5% level of significance*

## TABLE 6 (Cont'd). Association between socio-demographic characteristics and sexual and HIV preventive behaviors

| Characteristic | Willingness to circumcise [Males only] | | | Alcohol use at last sexual intercourse | | | Paid in exchange for sex | | | Knowledge of places where to pick condoms | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No | Yes | Prefer not to answer | No | Yes | Prefer not to answer | No | Yes | Prefer not to answer | No | Yes | Prefer not to answer |
| **Age** | | | | | | | | | | | | |
| 18-21 | 52(44.4) | 57(48.7) | 8(6.9) | 279(74.6) | 21(5.6) | 74(19.8) | 304(82.6) | 10(2.7) | 54(14.7) | 69(8.5) | 669(82.3) | 75(9.2) |
| 22-30 | 65(53.3) | 50(41.0) | 7(5.7) | 274(81.5) | 22(6.6) | 40(11.9) | 284(86.1) | 11(3.3) | 35(10.6) | 49(9.7) | 420(83.3) | 35(6.9) |
| | P value = 0.394 | | | P value = 0.017* | | | P value = 0.256 | | | P value = 0.285 | | |
| **Gender** | | | | | | | | | | | | |
| Male | 117(49.0) | 107(44.8) | 15(6.3) | 384(82.9) | 32(6.9) | 47(10.2) | 400(87.3) | 17(3.7) | 41(9.0) | 55(7.9) | 611(87.7) | 31(4.5) |
| Female | [Males only] | | | 169(68.4) | 11(4.5) | 67(27.1) | 188(78.3) | 4(1.7) | 48(20.0) | 63(10.2) | 478(77.1) | 79(12.7) |
| | | | | P value = 0.000** | | | P value = 0.000** | | | P value = 0.000** | | |
| **University residence** | | | | | | | | | | | | |
| Hall on campus | 66(51.2) | 57(44.2) | 6(4.6) | 275(78.1) | 18(5.1) | 59(16.8) | 289(84.3) | 11(3.2) | 43(12.5) | 49(6.9) | 596(84.4) | 61(8.6) |
| Off-campus hostel | 37(47.4) | 37(47.4) | 4(5.1) | 189(77.1) | 21(8.6) | 35(14.3) | 205(83.7) | 10(4.1) | 30(12.2) | 47(11.3) | 340(82.3) | 26(6.3) |
| Own home/Rental | 9(56.3) | 4(25.0) | 3(18.7) | 36(85.7) | 2(4.8) | 4(9.5) | 37(92.5) | 0(0.0) | 3(7.5) | 6(10.3) | 47(81.0) | 5(8.6) |
| At parent's home | 5(31.3) | 9(56.2) | 2(12.5) | 53(74.6) | 2(2.8) | 16(22.5) | 57(81.4) | 0(0.0) | 13(18.6) | 16(11.4) | 106(75.7) | 18(12.9) |
| | P value = 0.172 | | | P value = 0.208 | | | P value = 0.279 | | | P value = 0.034* | | |
| **Home area of residence** | | | | | | | | | | | | |
| Urban | 57(42.9) | 70(52.6) | 6(4.5) | 323(79.0) | 24(5.9) | 62(15.2) | 331(82.7) | 13(3.3) | 56(14.0) | 68(8.6) | 660(83.3) | 65(8.2) |
| Semi-urban | 32(49.2) | 26(40.0) | 7(10.8) | 166(74.8) | 13(5.9) | 43(19.4) | 188(85.8) | 5(2.3) | 26(11.9) | 35(9.4) | 307(82.1) | 32(8.6) |
| Rural | 28(68.3) | 11(26.8) | 2(4.9) | 64(81.0) | 6(7.6) | 9(11.4) | 69(87.3) | 3(3.8) | 7(8.9) | 15(10.0) | 122(81.3) | 13(8.7) |
| | P value = 0.016* | | | P value = 0.466 | | | P value = 0.654 | | | P value = 0.972 | | |
| **Marital status** | | | | | | | | | | | | |
| Single | 108(48.6) | 100(45.1) | 14(6.3) | 486(78.3) | 36(5.8) | 99(15.9) | 518(84.9) | 19(3.1) | 73(12.0) | 108(9.1) | 986(82.6) | 97(8.1) |
| Married | 2(66.7) | 1(33.3) | 0(0.0) | 7(77.8) | 2(22.2) | 0(0.0) | 6(66.7) | 2(22.2) | 1(11.1) | 0(0.0) | 9(90.0) | 1(10.0) |
| Divorced | 0(0.0) | 0(0.0) | 0(0.0) | 2(50.0) | 2(50.0) | 0(0.0) | 2(50.0) | 0(0.0) | 2(50.0) | 1(16.7) | 4(66.7) | 1(16.7) |
| Others | 7(50.0) | 6(42.9) | 1(7.1) | 58(76.3) | 3(3.9) | 15(19.7) | 62(82.7) | 0(0.0) | 13(17.3) | 9(8.2) | 90(81.2) | 11(10.0) |
| | P value =0.973 | | | P value = 0.002** | | | P value = 0.002** | | | P value = 0.858 | | |
| **Year of study** | | | | | | | | | | | | |
| First | 47(49.5) | 44(46.3) | 4(4.2) | 207(76.1) | 17(6.2) | 48(17.6) | 217(82.0) | 9(3.4) | 38(14.4) | 56(10.2) | 446(80.9) | 49(8.9) |
| Second | 38(45.2) | 40(47.6) | 6(7.1) | 206(78.0) | 15(5.7) | 43(16.3) | 220(84.0) | 7(2.7) | 35(13.4) | 42(9.0) | 386(82.8) | 38(8.2) |
| Third | 30(55.6) | 20(37.0) | 4(7.4) | 128(80.0) | 10(6.3) | 22(13.7) | 138(87.3) | 5(3.2) | 15(9.5) | 18(6.6) | 232(85.6) | 21(7.8) |
| Fourth | 2(33.3) | 3(50.0) | 1(16.7) | 12(86.7) | 1(7.1) | 1(7.1) | 13(92.9) | 0(0.0) | 1(7.1) | 2(6.9) | 25(86.2) | 2(6.9) |
| | P value = 0.694 | | | P value = 0.911 | | | P value = 0.757 | | | P value = 0.732 | | |
| **Religion** | | | | | | | | | | | | |
| Christian | 114(48.5) | 107(45.5) | 14(6.0) | 507(77.9) | 37(5.7) | 107(16.4) | 534(84.4) | 18(2.8) | 81(12.8) | 105(8.7) | 1,004(83.3) | 97(8.0) |
| Muslim | 0(0.0) | 0(0.0) | 1(25.0) | 41(80.4) | 4(7.8) | 6(11.8) | 49(89.1) | 1(1.8) | 5(9.1) | 10(10.9) | 74(80.4) | 8(8.7) |
| Other | 75(75.0) | 0(0.0) | 1(25.0) | 5(62.5) | 2(25.0) | 1(12.5) | 5(50.0) | 2(20.0) | 3(30.0) | 3(15.8) | 11(57.9) | 5(26.3) |
| | P value = 0.097 | | | P value = 0.188 | | | P value = 0.006** | | | P value = 0.033* | | |
| **Sponsorship** | | | | | | | | | | | | |
| Private | 79(48.5) | 70(42.9) | 14(8.6) | 423(78.8) | 33(6.2) | 81(15.1) | 448(84.5) | 15(2.8) | 67(12.6) | 84(9.0) | 773(83.2) | 72(7.8) |
| Government | 35(48.6) | 37(51.4) | 0(0.0) | 129(75.0) | 10(5.8) | 33(19.2) | 139(83.7) | 5(3.0) | 22(13.3) | 29(7.7) | 311(82.5) | 37(9.8) |
| Other | 3(75.0) | 0(0.0) | 1(25.0) | 1(100.0) | 0(0.0) | 0(0.0) | 1(50.0) | 1(50.0) | 0(0.0) | 5(7.7) | 5(45.5) | 1(9.1) |
| | P value = 0.023* | | | P value = 0.752 | | | P value =0.004** | | | P value = 0.000** | | |
| **Work** | | | | | | | | | | | | |
| None | 106(48.8) | 97(44.7) | 14(6.5) | 472(77.6) | 34(5.6) | 102(16.8) | 507(84.6) | 19(3.2) | 73(12.2) | 111(9.6) | 955(82.2) | 96(8.3) |
| Work part-time | 11(50.0) | 10(45.5) | 1(4.5) | 78(79.6) | 8(8.2) | 12(12.2) | 78(82.1) | 1(1.1) | 16(16.8) | 7(4.7) | 128(85.9) | 14(9.4) |
| Work full time | 0(0.0) | 0(0.0) | 0(0.0) | 3(75.0) | 1(25.0) | 0(0.0) | 3(75.0) | 1(25.0) | 0(0.0) | 0(0.0) | 6(100.0) | 0(0.0) |
| | P value = 0.940 | | | P value = 0.280 | | | P value = 0.046* | | | P value = 0.071 | | |

***means significant at 1% level of significance and * means significant at 5% level of significance*

### 2. Research instrument

Development and Pilot Testing of a Mobile Phone Gaming Application to Increase Knowledge of HIV Prevention among Students at Makerere University, Kampala

Date: |___ ___|___ ___|___ ___ ___ ___|

Participant #: |___ ___ ___|

Cell Phone #: |_____|

## SOCIO-DEMOGRAPHICS

1. Age: |___ ___| years
2. Gender: Male |___| Female |___|
3. Residence: Hall on campus |___| Off-campus hostel |___| own home |___| At parents' |___|
4. Original place of residence: Urban |___| Semi-urban |___| Rural |___|
5. Marital status: Single |___| Married |___| Divorced |___|
6. Year: First |___| Second |___| Third |___| Fourth |___| Fifth |___|
7. Religion: Christian |___| Muslim |___| Other |___|
8. Type of sponsorship: Private |___| Government |___| Other |___|
9. Any work? None |___| Work part-time |___| Work full time |___|
10. If you are a paid employee, how much do you earn per month? |___ ___ ___ ___ ___ ___ ___ ___|
11. Asset ownership (tick all that apply): Land |___| House |___| Car |___| Motorcycle |___| Bicycle |___| Computer |___| Refrigerator |___| Microwave |___| Television |___| Radio |___|

**HIV Knowledge Questionnaire 18**: For each statement, please tick "True", "False" or "I don't know" (DK). If you do not know, please do not guess; instead tick "DK"

| | | |
|---|---|---|
| 1. | Coughing and sneezing DO NOT spread HIV? | *True* \|___\| *False* \|___\| *DK* \|___\| |
| 2. | A person can get HIV by sharing a glass of water with someone who has HIV? | *True* \|___\| *False* \|___\| *DK* \|___\| |
| 3. | Pulling out the penis before a man climaxes/cams keeps a woman from getting HIV during sex | *True* \|___\| *False* \|___\| *DK* \|___\| |
| 4. | A woman can get HIV if she has anal sex with a man | *True* \|___\| *False* \|___\| *DK* \|___\| |
| 5. | Showering, or washing one's genitals/private parts, after sex keeps a person from getting HIV | *True* \|___\| *False* \|___\| *DK* \|___\| |
| 6. | All pregnant women infected with HIV will have babies born with AIDS | *True* \|___\| *False* \|___\| *DK* \|___\| |
| 7. | People who have been infected with HIV quickly show serious signs of being infected | *True* \|___\| *False* \|___\| *DK* \|___\| |
| 8. | There is a vaccine that can stop adults from getting HIV | *True* \|___\| *False* \|___\| *DK* \|___\| |
| 9. | People are likely to get HIV by deep kissing, putting their tongue in their partner's mouth, if their partner has HIV | *True* \|___\| *False* \|___\| *DK* \|___\| |

10. A woman can get HIV if she has sex during her period — *True* |___| *False* |___| *DK* |___|
11. There is a female condom that can help decrease a woman's chance of getting HIV — *True* |___| *False* |___| *DK* |___|
12. A natural skin condom works better against HIV than does a latex condom — *True* |___| *False* |___| *DK* |___|
13. A person will NOT get HIV if she or he is taking antibiotics — *True* |___| *False* |___| *DK* |___|
14. Having sex with more than one partner can increase a person's chance of being infected with HIV — *True* |___| *False* |___| *DK* |___|
15. Taking a test for HIV one week after having sex will tell a person if she or he has HIV — *True* |___| *False* |___| *DK* |___|
16. A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV — *True* |___| *False* |___| *DK* |___|
17. A person can get HIV from oral sex — *True* |___| *False* |___| *DK* |___|
18. Using Vaseline or baby oil with condoms lowers the chance of getting HIV — *True* |___| *False* |___| *DK* |___|

**SEXUAL AND HIV PREVENTIVE BEHAVIOR**: Let me assure you again that your answers are completely confidential and will not be told to anyone. If we should come to any question that you do not want to answer, just let me know and we will go on to the next question.

1. When was the last time you had sexual intercourse (record days/weeks/months)? |___ ___ ___ | Prefer not to answer |___| Never |___|

2. The last time you had sexual intercourse, was a condom used? Yes |___| No |___| Prefer not to answer |___|

3. What was your relationship with the person you last had sex with? Live-in partner |___| Boyfriend/girlfriend, not live in |___| Casual acquaintance |___| Prostitute |___| Other |_____| Prefer not to answer |___|

4. The last time you had intercourse, did you or your partner drink alcohol? Yes |___| No |___| Prefer not to answer |___|

5. If yes to (4), were you or your partner drunk? Respondent |___| Partner |___| Both |___| Prefer not to answer |___|

6. How many different people have you had sex with since the last interview? |_____| Prefer not to answer |___|

7. Recall the time since our last interview; did you use a condom every time you had sex? always |___| only sometimes |___| rarely |___| never |___| Prefer not to answer |___|

8. Did you pay (or get paid) in exchange for sex? Yes |___| No |___| Prefer not to answer |___|

9. Do you know your HIV status? Yes |___| No |___| Prefer not to answer |___|

10. Have you tested for HIV since our last interview? Yes |___| No |___| Prefer not to answer |___|

11. Are you circumcised? Yes |___| No |___| Prefer not to answer |___|

12. If no, would you consider getting circumcised? Yes |___| No |___| Prefer not to answer |___|

13. Do you know where you can get condoms? Yes |___| No |___| Prefer not to answer |___|

14. If YES, probe for place(s) |_____|

15. Would you yourself go to acquire a condom if you needed one? Yes |___| No |___| Prefer not to answer |___|