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Cell phone usage among adolescents in Uganda: acceptability for relaying health information

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Abstract

The increase in cell phone use has manifested a growing interest in using this technology for health promotion. The portability and 'always on' features of the cell phone, along with increasing capability for the devices to carry and transfer data suggest that they will reach more people than computers and the Internet in coming years. Self-reported quantitative survey data from 1503 secondary school students in Mbarara, Uganda collected in 2008–2009 suggest that 27% currently have cell phones and about half (51%) of all students and 61% of those who owned a cell phone believe that they would access a text messaging-based HIV prevention program if it were available. Other forms of program delivery modality (e.g. Internet, religious organizations, schools) were preferred to text messaging however. We are in need of effective HIV prevention programs that can reach large audiences at low cost and are culturally relevant for the East African context. Researchers are encouraged to consider translation of effective HIV prevention programs for cell phone delivery in Africa.

The use of cell phones has increased dramatically across the globe in the past decade. Industry reports suggest that there are billions of mobile phone users [1]. In 2005, pooled data from the United Nations Development Programme (UNDP), the World Bank and the International Telecommunications Union suggest a prevalence of 60 cell phone users and 17 Internet users per 1000 people across 45 Sub Saharan African countries [2]; data from the World Bank estimate that mobile phone usage has increased from 16% of the adult population in 2002 to 80% in 2006 in Uganda as reported by mobileactive.org (http://mobileactive.org/countries/uganda). The portability and 'always on' features of the cell phone, along with increasing capability for the devices to carry and transfer data suggest that they will reach more people than computers and the Internet in coming years.

Health educators and care providers are curious about whether cell phones can facilitate delivery of health promotion and disease prevention initiatives. Cell phones offer unprecedented reach to persons who otherwise may not access or be aware of health care or services. Many public health researchers argue that unless we can substantially expand the reach of our health promotion and disease prevention on a large scale, we lack the ability to increase the impact of our programs [3, 4]. Furthermore, cell phones offer the potential for programs to add features (e.g. text messaging for appointment reminders, booster content to reinforce education) that are easy and simple for organizations, institutions and clinics to adopt. It is not enough to reach

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large numbers of people with health promotion and disease prevention endeavors; in order for program effects to be sustained over time, you must make program elements easy to adopt and easy to standardize [5].

A review of 14 programs using mobile phones to promote smoking cessation, physical activity, diabetes and asthma self management and adherence to hypertension medication suggests that delivery of text messages via mobile phones can have positive short term behavioral effects [6]. Another review of 25 studies using mobile phones reported positive effects in behavioral outcomes associated with smoking and with changes in biomedical outcomes such as reduced HbA1c and lower cholesterol [7]. These previous reviews establish the beginning of a research direction in text messaging. However, this delivery modality has not been applied extensively in a HIV prevention context. As such, in this paper, we are interested in describing the cell phone use among adolescents in Mbarara, Uganda, in an effort to understand if cell phones might have potential for integration into HIV/AIDS prevention efforts there.

HIV/AIDS continues to be a major contributor to morbidity and mortality in Uganda [8, 9, 10]. The prevalence rate for HIV among adults aged 15–49 years is an estimated 6.4% [11]. Ugandan adolescents are more affected by HIV infection than Ugandan adults [12]. Those 10–24 years of age comprise 33% of the total Ugandan population but nearly 50% of the country's HIV/AIDS cases.

Heterosexual intercourse remains the main mode of transmission for adolescents in Uganda (75–80%) [13]. Adolescents are engaging in sexual intercourse at rates similar to the United States (64% of Ugandan teens have had sexual intercourse by the age of 18, 70% of US teens by age 19) [14, 15] but the consequences are higher for Ugandan adolescents given the elevated HIV/AIDS rates in this country.

Uganda ranks 87th among 222 countries in terms of mobile phone ownership, with an estimated 4.2 million mobile phones owned in 2007 [16]. Costs for outgoing SMS messages in Uganda are estimated at 7 cents per message (mobileactive.org); however, users do not pay for incoming SMS or voice calls. While access to and use of mobile broadband is growing, there is little evidence of uptake of these Internet-enabled phones (mobileactive.org) or multi-media messaging to date in Uganda.

Applications of cell phone technology in disease prevention efforts have focused on health promotion in general. Only one study was directly related to the HIV context, focusing on the use of cell phones for improvements in adherence to HIV medication [17]. More qualitative and descriptive work has been published on the use of cell phones for prevention of HIV and other sexually transmitted infections. These include programs to improve communication between patients and clinics, to improve medication adherence and to facilitate contact or partner tracing [18]. Levine and colleagues reported on a program to offer sexual health information via text messaging to persons who sent inquiries to SexInfo, a cell phone service with a library of pre-programmed text message responses [19]. There is a growing amount of gray literature documenting the promise of cell phones for HIV prevention in developing country and resource poor settings [20]. Reports on cell phone initiatives in Uganda include detail on Text To Change (TTC), a mobile phone initiative launched in 2008 to increase access to HIV testing. Although this program has not been evaluated in a controlled trial, program evaluation data indicate that of 15 000 users of Zain, one of three mobile providers in Mbarara, Uganda, invited to participate in an SMS HIV prevention program, 16% agreed, and subsequently registered to receive daily text messages. During assessment of program implementation, requests for tests at a local clinic increased by 100% (http://www.texttochange.com/ZAIN-TTC.pdf).
TTC has also partnered in Uganda with the Healthy Initiatives for the Private Sector (HIPS) program, and after offering TTC to workers in three companies, were able to collect baseline information on knowledge, awareness and practices related to male circumcision, family planning and HIV/AIDS from 1380 people. As with the Mbarara TTC program, substantial increases in demand for testing at clinics in the area where the HIPS/TTC program was

offered were documented (http://mobileactive.org/files/file_uploads/TTC-HIPS%20Uganda.pdf).

This more qualitative and descriptive body of literature suggests cell phones have promise and potential as a delivery mechanism for HIV prevention programs. We have few systematic evaluations of phone efficacy or evidence beyond industry reports of phone usage, particularly for adolescents. We also lack an understanding of whether using cell phones for HIV prevention will allow us to reach adolescents at risk for HIV and whether they might even participate in or engage with HIV-related content delivered on the phone. In order to better understand the potential to deliver cell phone-based HIV prevention programs to adolescents in resource limited settings, we aim to address the following questions in the current article:

1. Which adolescents are likely to own a cell phone and use text messaging in Mbarara, Uganda? Characteristics examined will include school related characteristics (e.g. class), demographic characteristics (e.g. biological sex, age), sexual intercourse and HIV related behaviors (e.g. ever had sex) and psychosocial and somatic health (e.g. social support).
2. As a measure of actual access: How many adolescents have previously accessed health information via text and what characteristics describe these adolescents? (based on list of participant characteristics outlined above)
3. As a measure of potential access: How many adolescents would be likely to access an HIV prevention program via text if one were available and what characteristics describe these adolescents? (based on list of participant characteristics outlined above)

Methods

Institutional Review Board (IRB) approval for the Mbarara Adolescent Health survey was received by Mbarara University IRB in Uganda as well as Chesapeake IRB in the United States. Data were collected between September and October, 2008 and March and April, 2009. Parents provided informed consent for day students and headmasters provided consent for boarding students. All students also provided written assent to participate.

Location and participants

Mbarara municipality, with a population of 69 000 (based on the 2002 census), is the sixth largest urban center in Uganda [21]. The greater Mbarara district is second in population only to the Kampala district, yet it falls in the bottom half of districts in terms of population density. Mbarara municipality is therefore best described as serving mainly a rural population in sub-Saharan Africa. Access to education in Mbarara is mixed. Data indicate that Mbarara district's net secondary enrollment rate in 2004 was slightly lower than the national average (11.3 versus 14.6%) [21].

Survey data were collected as part of 'CyberSenga', an ongoing study to develop and test an Internet-based HIV prevention program for adolescents in Uganda. Participants were recruited from five secondary schools in Mbarara, Uganda. The schools were purposefully selected to represent a wide range of school and student characteristics (Table I). Three schools were government-sponsored (public), one was an all-girls Catholic school and another was a mixed-sex Muslim school. All five schools provide education to students in classes Secondary 1 through Secondary 6 (roughly equivalent to grades 8–12 in the United States).

Eligibility criteria included (i) current enrollment in classes Secondary 1 (S1) through Secondary 4 (S4) in one of the five participating secondary schools (n = 4359), (ii) caregiver/adult consent and (iii) student assent. Headmasters provided the project coordinator with current class enrollment lists for students from S1 to S4 as eligible participants. The class lists were arranged in an alphabetic order and a random sample was generated using a computer random sequencing program (http://www.random.org/sequences/). The project coordinator addressed the entire student body prior to sample selection to explain the study. Next, an appointment was made to meet with the selected

Table I. *Characteristics ofadolescents by school (n = 1503)*

Category	Characteristic		Participating schools				
			A	B	C	D	E
School	Eligible enrolled students		763	1148	391	1122	935
	Ownership		Government	Government	Private	Government	Government
	Religion		None	Protestant	Muslim	Protestant	Catholic
	Male: Female ratio		56:44	100:0	58:42	100:0	0:100
		Percentage of all students (n = 1503)	Participating students (n = 313)	(n = 321)	(n = 248)	(n = 309)	(n = 312)
	Section						
	Boarding	86 (1288)	45 (141)	100 (321)	83 (205)	100 (309)	100 (312)
	Day	14 (215)	55 (172)	0	17 (43)	0	0
	Class						
	S.1	50 (750)	49 (152)	51 (164)	50 (124)	50 (153)	50 (157)
	S.2	25 (374)	25 (80)	24 (78)	25 (61)	25 (78)	25 (77)
	S.3	25 (379)	26 (81)	25 (79)	25 (63)	25 (78)	25 (78)
Personal	Cell phone owner	27 (405)	28 (87)	23 (73)	37 (93)	21 (65)	28 (87)
	Sent text message in past year	93 (376)	91 (79)	90 (66)	88 (82)	100 (65)	97 (84)
	Ages, years						
	12–14	42 (635)	19 (61)	45 (146)	33 (81)	50 (154)	62 (193)
	15–17	51 (774)	65 (204)	51 (163)	59 (146)	47 (145)	37 (116)
	18+	6 (94)	15 (48)	4 (12)	8 (21)	3 (10)	1 (3)
	Sex (boys)	62 (933)	53 (166)	100 (321)	55 (137)	100 (309)	0
	Father's education						
	Less than secondary school	12 (176)	20 (64)	12 (39)	16 (39)	5 (17)	5 (17)
	Secondary school (A & O)	33 (497)	52 (163)	24 (77)	42 (105)	27 (85)	21 (67)
	Tertiary institution	17 (255)	9 (30)	21 (67)	10 (24)	16 (49)	27 (85)
	University graduate	38 (575)	18 (56)	43 (138)	32 (80)	51 (158)	46 (143)
	Mother's education						
	Less than secondary school	19 (282)	29 (92)	21 (66)	21 (52)	13 (39)	11 (33)
	Secondary school (A & O)	43 (653)	55 (172)	36 (117)	50 (123)	38 (117)	40 (124)
	Tertiary institution	16 (242)	6 (18)	18 (57)	12 (30)	20 (61)	24 (76)
	University graduate	22 (326)	10 (31)	25 (81)	17 (43)	30 (92)	25 (79)

students to further explain the study. If the student declined to participate, could not be located, or was not reachable on the day of the survey, in most cases, they were given a second opportunity to complete the survey. Non-completers were replaced with the next student on the randomization list. Additional details about the recruitment process are available upon request.

The sample size was identified based upon a power analysis to identify one Popular Opinion Leader for each class (S1–S4) in each of the five schools. Based upon the total class size, in four of the five schools, 312 students were randomly selected to participate in each school along with 248 participants from the fifth school; due to the differences in the total enrollment in the schools. A total of 1738 adolescents 12–18 years of age were randomly recruited to complete a self-administered pen and paper sexual health survey.

Of the total 1738 students who were invited to participate, 1523 completed surveys were received. A total of 232 students who were invited did not participate: one actively refused to participate and 183 passively refused by not showing up at the time of the survey. Twenty-two students started the survey but walked out before completing it.

Twenty-three were not eligible on the day of the survey because they were lacking parental consent and three were expelled from school between the time they were recruited and the time the survey was implemented.

Of the 1523 completed surveys, 17 students completed the survey without being invited. In the first school, the survey was fielded; students were not matched to the recruitment list to protect anonymity. This process was subsequently changed after it was discovered that students not on the list had shown up, provided assent and completed the survey. Because the surveys were completely blind to protect participants' anonymity, it was impossible to identify the errant surveys. Although we could have randomly deleted 17 surveys, we chose to maximize the amount of data available. Thus, 1506 of the 1738 students invited, completed the survey yielding a response rate of 86.7%. Per-school response rates ranged from 67.7 to 99.4%.

The survey was written in English, which is the official language of Uganda and the language of instruction in the schools. It is important to note, however, that there are 43 living languages in Uganda [22]; as such, all students had a primary language different from English. It took an average of 1 hour to complete the survey.

Given the sensitivity of the survey content, measures were taken to ensure participants' privacy: students sat at least 3 meters (9 feet) from each other; names were not collected on the survey instrument nor could the survey be linked to the name or the assent forms with an ID and surveys were completed in the absence of the teachers and school administrators.

Measures

Main explanatory variable: cell phone usage

Participants were queried about whether they owned a mobile phone, and if so, how often they had sent an SMS/text message on their mobile phone in the last 12 months. Response options were (i) never, (ii) less than once a month, (ii) once or twice a month, (iv) once or twice a week, (v) everyday/almost every day and (vi) decline to answer.

Main outcome variables

Actual access of health information via text messaging Participants were asked 'In the last 12 months, whether you sent an SMS/text message on your mobile phone to get information about: (i) health and disease, (ii) sports, (iii) latest news, (iv) television schedules and programmes, (v) gossip and (vi) something else.' Response options were yes/no.

Interest in accessing HIV/AIDS information via text messaging All participants were asked 'If there was a health education program about HIV/AIDs prevention for teenagers, how likely would you go to it if it was . . . (i) at school, (ii) at a religious organization, (iii) over e-mail, (iv) over text (SMS) messages and (v) on the Internet'. Response options were (i) extremely likely, (ii) somewhat likely, (iii) neutral, (iv) somewhat unlikely, (v) not at all likely and (vi) decline to answer. For the purpose of analysis, responses about interest in accessing HIV information via text messages were dichotomized to represent extremely or somewhat likely versus less likely (including neutral).

Additional variables of interest

Sexual intercourse and HIV. Sex and condom use was queried by first asking participants 'Have you ever had sex?' Those that said yes were also asked whether they 'Had ever had sex with a condom?'. Response options were yes/no.

HIV information was queried with eight items designed to measure the respondent's knowledge about HIV and AIDS. Items came from the Uganda Demographic Health Survey and the Guttmacher Survey of Adolescents Sexual Health. A sample item is 'The HIV/AIDS virus can be transmitted through a male sperm/semen'. Response options were (i) strongly disagree, (ii) somewhat disagree, (iii) neither agree or disagree, (iv) somewhat agree, (v) strongly agree and (vi) decline to answer. A sum variable was created with higher scores reflecting more knowledge about HIV/AIDS with scores ranging from 14 to 32 (M = 23.3, SD = 3.3). Since we were interested in potential risk markers, we dichotomized this sum score at 1 SD below the mean (or less) versus higher, to identify adolescents having low information about HIV.

Psychosocial and somatic health. Self-rating of physical health was measured using one item from the SF-36 [23]. Specifically participants were asked 'How would you rate your physical health?' with response options (i) poor, (ii) fair, (iii) good, (iv) excellent and (v) decline to answer. Responses were coded as poor physical health versus all other.

Participants were asked to indicate 'How likely do you think it is that you will have a bright future?' Response options were (i) very unlikely, (ii) unlikely, (iii) somewhat likely, (iv) likely, (v) very likely and (vi) decline to answer. Responses were coded as very unlikely/unlikely to have a bright future versus all other.

Social support was measured using eight items from the Multidimensional Scale of Social Support [24]. A sample item is 'There is a special person in my life who cares about my feelings'. Response options used in the current study were (i) strongly disagree, (ii) somewhat disagree, (iii) neither disagree or agree, (iv) somewhat agree, (v) strongly agree and (vi) decline to answer. A sum variable was created with higher scores reflecting more social support with scores ranging from 8 to 40 (M = 32.9, SD = 6.3). A variable representing low social support was then created for participants with scores 1 SD below the mean or less, versus higher.

Demographic characteristics

Participants self-reported their biological sex and age (categorized as 12–14, 15–17 and 18+ years), as well as their father's and mother's highest level of education (coded as university graduate versus all other for the purposes of bivariate and multivariate analyses). Participants were also asked about their Internet use. 'When we say 'Internet', we also mean going online, using the World Wide Web and surfing. Have you ever used the Internet?' Response options were yes/no.

School variables

Participants provided their current class (secondary 1–secondary 4) and their section in school (i.e. whether they were a boarding student living on campus or a day student living at home and attending school during the day).

Data cleaning and statistical methods

All surveys were double entered by project staff to ensure accuracy. Any discrepancies were reconciled by returning to the original survey for confirmation of the correct response. Missing and non-responsive (don't know) data were imputed using best-set regression [25]. To protect against imputing truly non-responsive surveys (e.g. participants who dropped out half way through the survey), a two-stage data validity check was put into place. At the first step, each case was required to have valid data for at least 50% of all the variables in the dataset. Based on this criterion, 20 respondents were dropped. At the second step, responsivity within each scale was examined. Variables within scales were imputed only for those cases, which had valid data for at least 80% of the variables. This two-stage effort maximized the amount of data available for analyses. For example, if the entire sample had been subjected to an 80% valid data requirement across the entire survey, more than half of respondents would have been dropped.

All analyses were conducting using Stata/SE 11.0 [26]. A combination of descriptive, bivariate and multivariate analyses was conducted. First, we provide basic descriptive statistics on adolescent characteristics—both overall and by school. Next, we used chi-square tests to examine the statistical differences by school, demographic, sexual intercourse and HIV and psychosocial and somatic health indicators based on (i) whether adolescents own a cell phone or not and (ii) if they own a cell phone, whether they had sent a text message via cell phone or not. For both of these, logistic regression was used to identify the unadjusted odds ratio per characteristic. Finally, we explored the characteristics related to receptivity to HIV/AIDS prevention via text messaging for the same school, demographic, sexual intercourse and HIV and psychosocial and somatic health indicators. Specifically, we used chi-square cross-tabulations and logistic regression as we did above and then built a final parsimonious logistic regression model using all variables significant at the bivariate level to identify those characteristics most closely associated with receptivity.

Results

Demographic characteristics

The analytical sample consisted of 1503 students (see Table I). The majority of adolescents (86%) attended boarding school while the remaining attended day sections. Over half (62%) were boys, 42% were between ages 12 and 14, while 51% were ages 15–17. Sample composition varied by school.

Who is likely to own a cell phone?

Twenty-seven percent ($n = 405$) of survey respondents reported owning a cell phone (see Table I). Rates of ownership were fairly consistent across the five schools sampled, ranging from a low of 21% to a high of 37%. Cell phone ownership increased with class ($\chi^2 = 76.79$, $P < 0.001$) and age ($\chi^2 = 26.71$, $P < 0.001$). (see Table II). Girls (25%) and boys (28%) were equally likely to own cell phones ($\chi^2 = 1.06$, $P = 0.30$), as were adolescents in both boarding (27%) and day (27%) sections at school ($\chi^2 = 0.02$, $P = 0.88$).

Who is likely to use text messaging?

Of adolescents who owned a cell phone, the majority (93%) had sent a text message in the past 12 months ($n = 376$, Table I). Frequency of texting varied however: 34% said they texted everyday/almost every day, 35% once or twice a week, 21% once or twice a month and 9% less than once a month. Text messaging was similar for boys and girls, across age, section in school and class (Table II).

What characteristics describe adolescents who are accessing health information via text?

Nineteen percent of adolescents who had sent or received text messages in the past year indicated that they sent a text message on their cell phone to get information about health and disease in the last 12 months. In comparison, adolescents more commonly sent a text message to seek information about gossip (29%), television programmes (30%), the latest news (45%) and sports (64%). Accessing health and disease information via text messaging was equally reported by males and females, adolescents of different ages, in different classes and day versus boarding sections in school. Similarly, none of the psychosocial and somatic health or sexual intercourse and HIV characteristics examined discriminated between adolescents accessing health information via text versus not. One exception was use of the Internet: adolescents who used the Internet were less likely to have accessed health information via text than those who did not use the Internet (16 versus 25%, $\chi^2 = 3.67$, $P = 0.05$).

What characteristics describe adolescents who are likely to want to access an HIV prevention program via text?

Fifty-one percent ($n = 525$) of all students said they were somewhat or extremely likely to access a health education program about HIV/AIDS prevention for adolescents via text. A similar percentage (52%) was receptive to receiving such information through email. The Internet was the most highly endorsed technology-based delivery method, however, with 64% somewhat or extremely likely to receive an HIV program in this way. Still, students were more receptive to HIV/AIDS prevention information through more traditional means, either from a religious organization (72%) or in school (84%).

Interest in accessing text messaging-based HIV prevention programs was associated with owning a cell phone (see Table III). Being in a day section at school also was associated with increased interest. Having a father with a university degree and use of the Internet were characteristics associated with less receptivity to accessing HIV prevention programs via text messaging. High-risk adolescents, defined as those who had had sex, self-reported poor health, poor social support or lack of HIV information were equally likely to be interested in receiving HIV prevention programs via text messaging as lower risk adolescents.

Table II. *Cell phone and text message usage by demographic characteristic*

Characteristic	Cell phone usage (n = 1503) % (n)	Unadjusted odds ratio (95% CI)	Sent text message via cell phone[a] (n = 405) % (n)	Unadjusted odds ratio (95% CI)
School characteristics				
Section				
Boarding (n = 1288)	27 (348)	1.0	93 (322)	1.0
Day (n = 215)	27 (57)	0.97 (0.70–1.35)	95 (54)	1.45 (0.43–4.97)
Class				
S.1 (n = 750)	18 (132)	1.0	89 (118)	1.0
S.2 (n = 374)	31 (116)	2.11 (1.58–2.81)***	96 (111)	2.63 (0.92–7.55)
S.3 (n = 379)	41 (157)	3.31 (2.51–4.37)***	94 (147)	1.74 (0.75–4.07)
Demographic characteristics				
Ages, years				
12–14	20 (128)	1.0	91 (117)	1.0
15–17	31 (243)	1.81 (1.42–2.32)***	94 (228)	1.43 (0.64–3.21)
18+	36 (34)	2.24 (1.41–3.57)***	91 (31)	0.97 (0.25–3.70)
Sex				
Boys (n = 933)	28 (260)	1.0	94 (244)	1.0
Girls (n = 570)	25 (145)	0.88 (0.70–1.12)	91 (132)	0.67 (0.31–1.43)
Father's education				
Less than university (n = 928)	23 (209)	1.0	90 (189)	1.0
University graduate (n = 575)	34 (196)	1.78 (1.41–2.24)***	95 (187)	2.20 (0.97–4.95)
Mother's education				
Less than university (n = 1177)	24 (285)	1.0	92 (263)	1.0
University graduate (n = 326)	37 (120)	1.82 (1.40–2.37)***	94 (113)	1.35 (0.56–3.25)
Internet use				
No (n = 721)	19 (138)	1.0	88 (121)	1.0
Yes (n = 782)	34 (267)	2.19 (1.73–2.78)***	95 (255)	2.99 (1.38–6.45)**
Sexual intercourse and HIV				
Had sex				
No (n = 1072)	23 (248)	1.0	92 (228)	1.0
Yes (n = 390)	38 (149)	2.05 (1.60–2.63)***	95 (141)	1.55 (0.66–3.60)
Condom use (if had sex)				
No (n = 211)	32 (68)	1.0	90 (61)	1.0
Yes (n = 139)	50 (70)	2.13 (1.37–3.14)***	99 (69)	7.92 (0.95–66.19)
Lack of HIV information				
No (n = 752)	28 (211)	1.0	92 (195)	[b]
Yes (n = 96)	31 (30)	1.17 (0.73–1.85)	100 (30)	
Psychosocial and somatic health				
Not likely to have a bright future				
No (n = 1,452)	27 (391)	1.0	93 (365)	1.0
Yes (n = 51)	27 (14)	1.03 (0.55–1.92)	79 (11)	0.26 (0.07–0.99)*
Poor social support				
No (n = 1180)	29 (345)	1.0	94 (323)	1.0
Yes (n = 228)	18 (41)	0.53 (0.37–0.76)***	88 (36)	0.49 (0.17–1.37)
Poor physical health				
No (n = 1296)	27 (350)	1.0	94 (328)	1.0
Yes (n = 207)	27 (55)	0.98 (0.70–1.36)	87 (48)	0.46 (0.19–1.13)

Row percentages provided. CI, confidence interval.
[a]Question asked of adolescents who reported owning a cell phone.
[b]No logistic regression model conducted because zero predicts success perfectly. ***$P \leqslant 0.001$. **$P \leqslant 0.01$. *$P \leqslant 0.05$.

Discussion

Data from secondary school students in Mbarara, Uganda suggest that 27% of secondary school students currently have cell phones and many believe that they would access a text messaging-based HIV prevention program if it were available. Overall, half (51%) of students surveyed indicate they would be somewhat or extremely likely to access an HIV prevention program if it were available via text messaging. Among the one-third of students who own a cell phone, 61% were somewhat or extremely likely to access text messaging-based HIV prevention programs if available. Adding validity to these self-predictions, 19% of adolescents who use text messaging used their cell phones to get information about health and disease in the last 12 months. Together, these data suggest that the feasibility and acceptability of cell phones for delivery of health-related messages to adolescents in Uganda is high.

One of the concerns about technology-based interventions is that we reach those who are at highest risk; partly because of economics and access to services and technology in general and partly because seekers of health promotion information tend to be healthier [27]. The current study suggests that text messaging holds promise for adolescents across the risk spectrum. Adolescents at risk for HIV because they are having sex or lacking information about HIV are equally likely as those engaging in HIV preventive behaviors (e.g. not having sex or having sex with a condom) to report interest in accessing prevention programs via text messaging. It is important to note, however, that those at highest risk may not be as able to access cell phones based on their availability and cost.

Schools and religious organizations are the two most common places adolescents would likely access HIV education information if it were available in these locations. This is probably because these are the two modes through which most current adolescent programs are accessed. Certainly, too, it could be because more adolescents have access to schools and religious organizations compared with the Internet and cell phones.

We examine interest in technology-based programs in the general sample instead of focusing just on those who currently have access to Internet and text messaging because the rate of technology access in developing countries is increasing at a phenomenal rate. Interest in accessing these programs among those who do not currently use the Internet and cell phones may reflect future demand. Given the long lag time between development and dissemination, it is important to measure not only the current user population, but also the potential future population. Further, there are advantages to technology-based programs over school and religious organization-based programs (e.g. lower cost to deliver in long-term, easier to update with current information, less cultural barriers for access, allows for de-identified access to potentially sensitive information) and thus represent the potential for future dissemination.

Even if programs were available via text messaging and the Internet, not all adolescents who would want to access them, could. On the other hand, not all adolescents who have access would necessarily choose to receive HIV prevention information via technology. Indeed, half of the respondents said they were not at all likely to access a text messaging-based HIV prevention program if it were available. We do not suggest that this should be an 'either/or' discussion. Different adolescents access information and engage with education in different ways. It is important to ensure that HIV prevention information is available in all different modes and environments adolescents might be engaging in. Also too, it is possible to use multiple different delivery modes in one program. Similar to the 'Learning about Living' project in Nigeria (http://www.mhealthsummit.org/sites/default/files/uploaded_files/Uju_Ofomata.pdf), we feel cell phones could offer important opportunities to enhance and extend existing, non-technology based programs. For example, education programs delivered face-to-face, such as in school or religious settings could be enhanced with SMS reminders and additional information about program content.

Table III. *Characteristics related to receptivity to HIV/AIDS prevention via text messaging (n = 1028)*[a]

Characteristic	Not at all likely/ somewhat unlikely (and neutral) (*n* = 503) % (*n*)	Somewhat/ extremely likely (*n* = 525) % (*n*)	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)
School characteristics				
Section				
Boarding (*n* = 907)	51 (467)	49 (440)	1.0	
Day (*n* = 121)	30 (36)	70 (85)	2.51 (1.66–3.78)***	2.09 (1.36–3.21)***
Class				
S.1 (*n* = 484)	50 (240)	50 (244)	1.0	
S.2 (*n* = 248)	50 (125)	50 (123)	1.05 (0.91–1.22)	
S.3 (*n* = 296)	47 (138)	53 (158)		
Demographic characteristics				
Age, years				
12–14 (*n* = 448)	55 (248)	45 (200)	1.0	1.0
15–17 (*n* = 527)	43 (229)	57 (298)	1.61 (1.25–2.08)***	1.41 (1.08–1.84)**
18+ (*n* = 53)	49 (26)	51 (27)	1.29 (0.73–2.28)	0.83 (0.45–1.51)
Sex				
Boy (*n* = 645)	50 (324)	50 (321)	1.0	
Girl (*n* = 383)	47 (179)	53 (204)	1.15 (0.89–1.48)	
Father's education				
Less than university (*n* = 585)	45 (261)	55 (324)	1.0	
University graduate (*n* = 443)	55 (242)	45 (201)	0.67 (0.52–0.86)***	0.70 (0.54–0.92)**
Mother's education				
Less than university (*n* = 772)	48 (370)	52 (402)	1.0	
University graduate (*n* = 256)	52 (133)	48 (123)	0.85 (0.64–1.13)	
Internet use				
No (*n* = 432)	44 (190)	56 (242)	1.0	
Yes (*n* = 596)	53 (313)	47 (283)	0.71 (0.55–0.91)**	0.71 (0.55–0.93)**
Owns cell phone				
No (*n* = 736)	53 (390)	47 (346)	1.0	
Yes (*n* = 292)	39 (113)	61 (179)	1.79 (1.35–2.35)***	1.96 (1.46–2.63)***
Sexual intercourse and HIV				
Had sex				
No (*n* = 731)	50 (367)	50 (364)	1.0	
Yes (*n* = 273)	46 (125)	54 (148)	1.19 (0.90–1.58)	
Condom use (if had sex)				
No (*n* = 152)	46 (70)	54 (82)	1.0	
Yes (*n* = 97)	44 (43)	56 (54)	1.07 (0.64–1.79)	
Lack of HIV information				
No (*n* = 530)	47 (249)	53 (281)	1.0	
Yes (*n* = 49)	41 (20)	59 (29)	1.28 (0.71–2.33)	
Psychosocial and somatic health				
Not likely to have a bright future				
No (*n* = 1000)	49 (491)	51 (509)	1.0	
Yes (*n* = 28)	43 (12)	57 (16)	1.29 (0.60–2.75)	
Poor social support				
No (*n* = 823)	48 (397)	52 (426)	1.0	
Yes (*n* = 151)	50 (76)	50 (75)	0.92 (0.65–1.30)	
Poor physical health				
No (*n* = 879)	49 (427)	51 (452)	1.0	
Yes (*n* = 149)	51 (76)	49 (73)	0.91 (0.64–1.28)	

Variables significant at the bivariate level included in the final parsimonious model.
[a]A total of 475 participants did not respond to this question. ***$P \leqslant 0.001$. **$P \leqslant 0.01$.

Limitations

Rates of cell phone ownership among adolescents in Mbarara are lower than those found among adolescents living in other parts of the country or those living in South Africa [28]. As such, results are relevant primarily for the secondary school population in Mbarara and cannot necessarily be generalized to all adolescents in Uganda or sub-Saharan Africa. Those not attending schools are likely at higher risk for HIV because of factors such as poverty, lack of access to health education etc. Obtaining data via a self-administered pen and paper survey may bias our results to those students with greater English literacy. We had a large percentage of missing data that, although handled in a systematic and rigorous manner, could still bias results to some extent.

At the same time, this study has a number of strengths. It includes a large sample size across five diverse schools; the sample is in Mbarara, which is a smaller town outside of the capital; and we implemented rigorous data quality control procedures at all stages of the data collection and cleaning process.

Conclusion

With ongoing structural challenges in the dissemination of effective programs for HIV prevention, particularly ones that are appropriate for the East African context where HIV prevalence remains high, we are in need of programs that can be delivered to large numbers of people in a cost effective manner. The current data provide evidence that technology-based programs, specifically text messaging-based health programs, may be acceptable to secondary school students in Mbarara, Uganda. Researchers are encouraged to explore opportunities to integrate text messaging into HIV prevention programs designed for implementation in the developing country setting.

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Conflict of interest statement

None declared.

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