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Mobile Phone Voice, Short Message System, Internet and Social Media Uses among Hard-to-Reach Children in Kampala, Uganda

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MOBILE PHONE VOICE, SHORT MESSAGE SYSTEM, INTERNET AND SOCIAL MEDIA USES AMONG HARD-TO-REACH CHILDREN IN KAMPALA, UGANDA

BY

EGIDE LOUIS

INTRODUCTION: Research shows that many youth groups in Uganda own mobile phones. However, the extent to which youth who live in the slums of Kampala own and uses mobile phones has not been sufficiently explored. With the expansion of mobile technology, mobile health has emerged as a potential cost-effective tool that can allow this youth access health-related data and information.

AIM: This study sought to determine the prevalence of mobile phone ownership and uses, document changes from the previous sampling event, and assess the association between mobile phone uses and psychosocial factors in this high-risk population.

METHODS: A convenience sample (n=1134) was obtained in 2014 from urban youth living on the streets, 12-18 years of age, and who were participating in a Uganda Youth Development Link drop-in center for disadvantaged street youth. Mobile phone use variables consisted of talking/texting, internet use for browsing, and social media. Statistical analyses were performed to determine the likelihood of owning a mobile phone and uses, and its association with youth risk factors.

RESULTS: Mobile phone ownership, internet use and social media utilization were 49.1%, 25.5%, and 23.4%, respectively. Compared to the previous study, little change occurred in mobile phone ownership but internet uses for searching and social media increased by double digit percentages. Daily talking and texting was significantly more prevalent in children who

reported having STDs ($p<0.0001$) and trading sex for money ($p=0.001$), among others, and significantly associated with having STDs (aOR 1.75, 95% CI 1.32-2.32), being drunk (aOR 3.16, 95% CI 2.26-4.42), trading sex for money (aOR 1.97, 95% CI 1.39-2.80), and feeling sad (aOR 1.70, 95% CI 1.25-2.30). Similar results were obtained with internet for searching and social media uses but with less significant associations.

DISCUSSION: Based on that about a half of the children own a mobile phone and that a substantial number of them use it daily for talking or texting, the next step would be to design m-Health programs that would take advantage of mobile phone voice and texting capabilities specifically to inform on potential interventions for behavioral change and mental health.

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MOBILE PHONE VOICE, SHORT MESSAGE SYSTEM, INTERNET AND SOCIAL MEDIA USES AMONG HARD-TO-REACH YOUTH IN KAMPALA, UGANDA

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Author's Statement

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CHAPTER I

INTRODUCTION

1.1.Background

Sub-Sahara Africa (SSA) is home to roughly 1.05 billion people, or 14% of the World population (United Nations, 2018), and more than half reside in rural areas (World Bank, 2013). Rural communities are often isolated and live in poverty with little or no education compared to those in cities. Furthermore, the lack of transportation and poor road conditions, if they exist, make it hard for governmental and other institutions to reach people in these areas. However, rural communities are not the only ones facing harsh life conditions in SSA. This is because an estimated 60% of urban population in SSA lives in slums where an increased number of children were reported to be vulnerable to abuse, exploitation and disease with little or no access to basic health care services (Save the Children, 2015). In Uganda particularly, 53.6% of the population were reported to be living in slums (World Bank, 2014). Mobile health has grown substantially in SSA during the last decade and its potential to improve the quality of life in these resource-constrained populations appears to be high.

Mobile health, or mHealth, refers to the use of mobile and wireless technologies such as mobile phones and Portable Device Assistants (PDAs) to allow access to health-related data and information (WHO, 2011). It is particularly important to SSA because hard-to-reach communities such as those in rural areas and urban slums can access information at low cost and in real time (Mays and White, 2014). In 2017, about 200 mHealth projects were active and this number represented a 58% increase from 2016 (GSMA Intelligence, 2017). These initiatives target a wide range of activities including communicating information for behavior change,

health promotion and interventions, disseminating knowledge, making clinic appointment or medication reminders, monitoring and managing diseases, and data collection and tracking for research (Premji, 2014).

Owning a mobile phone or having access to one is key to most mHealth activities in SSA. The mobile phone is particularly important because of its many communication tools including voice and voicemail, instant messaging (IM) or short messages system (SMSs), internet for searches and for social network interactions. Mobile phone users can access voice-based mHealth data and information by calling toll free telephone numbers, health call centers and emergency call centers (Roberts et al., 2015). The advantage of this means of communication is that the information can be translated in local languages and dialects especially when receiving patients or participants are illiterate. That is the case of mobile phone users in the Democratic Republic of Congo who access family planning information by calling a toll-free hotline (Corker, 2010).

The short messages system and SMS-based applications on mobile phones specifically designed for mHealth are perhaps the most used tools in SSA. They have been used for influenza surveillance in Kenya (Njuguna et al., 2014) and monitor pregnancy and reduce maternal and child mortality rates in rural Rwanda (Ngabo, 2012). Specifically in Uganda, SMSs are frequently used in public educational campaigns to promote awareness of HIV/AIDs (Chib et al., 2013) and remotely monitor disease symptoms in rural communities (Lester et al., 2016). Unlike voice and SMS, internet browsing and social media utilization on mobile phones are still limited in SSA but a few cases of health-related searches or information sharing have been reported. That is the case of social workers communicating through Whatsup and performing Google

searches for health-related information so they can serve better their community (Van Heerden et al., 2017) and midwives connecting to online communities and creating a Facebook group to share patient care information in rural South Africa (Pimmer et al., 2014).

The knowledge of mobile phone ownership and uses (voice, SMS, etc.) in a group of people will help decide early on mHealth activities that have the highest chance of succeeding. A number of relevant studies, especially those involving youth, have been carried in SSA countries. A survey of youth between 8 and 25 years of age in Ghana, Malawi, and South Africa found that mobile phone ownership was respectively 63%, 35% and 17% (Hampshire et al., 2015). In the same study, participants reported searching the internet on their mobile phones to seek help when there were sick (35%) or sought health-related information about symptoms and potential cure (18%). Also, a study of secondary school students in Mbarara, Uganda demonstrated that about 27% had a mobile phone and the ownership increased with grades and age but did not vary with sex (Mitchell et al., 2011). Of those who owned a cell phone, 34% reported sending text messages daily and text messaging rate did not vary with grade, sex, or age. Similar results were obtained by Van Heerden et al. (2010) and Rokicki and Fink (2017). A recent survey by the Uganda National Information Technology found that 60.7% of youth, 15 to 24 years of age, reported owning a mobile phone and among mobile phone owners in this group, 28.0% reported owning a smartphone (CIPESA, 2018). This age group had the highest smartphone ownership in the nation and comparatively, only 15.8% of those who owned a mobile phone nationwide reported owning a smartphone.

While research indicates that youth groups in Uganda own mobile phones and may use them for different activities including mHealth-related communications, the extent to which these findings extend to youth who live in the slums of Kampala has not been sufficiently explored. This youth were found to have high-risk behaviors and exposures and can be hard to reach using communication means other than mobile phones especially since most of them do not attend school (Swahn et al., 2012). Swahn et al. (2014) reported on mobile phone ownership and use in this youth population. The study was based on a cross-sectional survey of youth, 14 to 24 years (n=415) in 2011. Results showed that 46.9% reported owning a mobile phone, while 9% and 5% reported using the internet and social media, respectively. Mobile phone ownership and daily use for talking was significantly more common among those who reported taking care of themselves at night, using drugs and trading sex for money and material things. In 2014, the primary author revisited this population and collected similar data on demographic and psychosocial characteristics (n=1134). This time, however, the survey included younger participants, 12 to 18 years old, and more questions on internet and social media uses and on youth psychosocial characteristics. The analysis of this data and results are the basis of the present thesis.

1.2 Purpose of the Study

The goals this study were to determine the prevalence of mobile phone ownership and different uses (voice/voicemail, SMS, internet searching, and social media) among children who live in the slums of Kampala, identify demographic and psychosocial characteristics of children that are likely to own and use a mobile phone and document changes in results, if any, since the 2011 survey. This study also examined the association between demographic and psychosocial factors and mobile phone uses. This work seeks to answer the following research questions:

1) What was the prevalence of mobile phone ownership and uses in this population in 2014?
2) What are the youth demographic and psychosocial characteristics that differentiate mobile phone ownership and uses?
3) How mobile phone ownership and uses changed since the 2011 sampling event?
4) What are the effects of the use of a more recent and larger sample and younger participants on mobile phone ownership and uses, and of the additional survey questions on youth characteristics, internet and social media uses?
5) Is there any association between mobile phone uses and youth psychosocial factors?

Results of this study are intended to serve as a guide for future research in designing appropriate mHealth activities including the feasibility of implementing prevention and intervention initiatives in this hard-to-reach and high-risk youth population.

CHAPTER II

LITERATURE REVIEW

2.1. Health and Healthcare Access in Sub-Sahara Africa

In the 1960's, a majority of SSA countries became independent. With independence, an urban class was born helped by a growing number of an educated class and a bourgeoning of new businesses and services. In the 1990's and early 21st century, these countries experienced urban sprawl, which was fueled by an exodus of masses of people from villages searching for a better life in cities. Coupled with poor urban planning and the lack of basic necessities such as clean drinking water, sanitation and education, a class of "urban poor," mostly uneducated and for jobs in the city, was created in slums within and around urban centers. In 2012, over 60% of urban population in SSA lives in slums and an increased number of youth living in these areas are vulnerable to abuse, exploitation and disease with little or no access to basic healthcare services (Save the Children, 2015).

The burden of disease, health concern, injuries, and poverty in SSA is higher than any in other regions of the World (World Health Organization, 2014). In addition, Africa bears 71% of the global distribution of infectious diseases, as measured as a percent of the total QALYs. Malnutrition affects 23% of the population (FAO, 2017) and roughly 54 million, or one in every three children under five, are malnourished (UNICEF, 2018). In response, the second World Health Organization (WHO) Global Health Initiative in 2014 called for affordable and practical technologies for low- and middle-income countries (WHO, 2014). A year later, the United Nations (UN) development goal 9c set the target to provide "universal and affordable access to

the internet in the least developed countries by 2020." (United Nations, 2015). Although an ambitious goal, the growing number of mobile and wireless technologies, and mobile phones in SSA in recent years has offered a great opportunity for health providers and public health professionals to reach and be able to provide healthcare services to far-to-reach rural communities and underserved urban populations via mobile devices, mainly mobile phones (Mays and White, 2014).

2.2. Mobile and Telecommunication Technologies in Sub-Sahara Africa

The potential for improving healthcare services delivery in remote areas and underserved populations in SSA is high given a relatively high number of subscribers to mobile technology and adoption of mobile internet. As an example, 44% of the population in this region subscribed to mobile technology in 2017 and this number is projected to reach 52% by the end of 2025, the largest increase in the UN World regions (GSMA Intelligence, 2018). Also, more and more people, even in remote areas, consider mobile telecommunication tools not only as a means of communication but also a way of getting on the internet and access available tools to enhance their lives. This desire is evidenced by the high access to internet connections via mobile phones. The mobile internet (as in smartphones) penetration rate in SSA was 22% in 2017 and is expected to reach 40% by 2025. Similarly, the total number of smartphone connections were about 250 million at the end of 2017. Smartphone adoption in the region is expected to double from 34% in 2017 to 68% at the end of 2025. Such impressive growth appears to be driven primarily by increased migration from 2G to faster 3G and 4G networks in the Region, availability of simple and affordable mobile phones, and consumer appetite for social media utilization for a wide range of services.

As indicated above, the prevalence of mobile and wireless technologies in SSA is relatively high compared to a few years ago. This translates into having millions of people, who never had a land-line telephone or had no prospect of acquiring one in the future, own and use mobile phones or smartphones daily as a mean of communication and accessing data over the internet. Moreover, the technology, which used to be for privileged and well-to-do urban elites and government officials is now available in rural communities and underserved populations in slums around cities.

2.3. Mobile Health in Sub-Sahara Africa

2.3.1. History and Definition

Electronic health or eHealth has been defined as sharing electronic health-related information using communication tools such as computers, mobile phones, and Portable Device Assistants (PDAs) (WHO, 2011). These tools enable physicians, medical laboratories and insurance companies to share patient disease diagnostics, laboratory work results, prescriptions and medical records through the internet web portals or other specifically-designed software applications (Silva et al., 2015). Physicians are able to alert their patients of abnormal test results and suggest the course of action while insurance companies design disease and weight management practices to deal with health conditions based on patient laboratory results. On the other hand, patients can check or download test results and associated doctor's comments, make appointments online from their personal computers or hand-held devices such as PDAs, tablets, and mobile phones regardless of the time and place. However, as it can be seen, little or no response or action is sought from the patient or participant. mHealth emerged as a component of

eHealth particularly to give health providers, researcher and field staff tools to overcome healthcare access challenges especially for hard-to-reach populations (Sundin et al., 2015; Lee et al., 2018). It allows interaction and an active role from the patient or participants.

Several definitions of mHealth or mobile health have been suggested in the literature. Mobile health was first defined in 2000 as unwired e-med (Laxminarayan and Istepanian, 2000). Later it was referred to it as a set of mobile communications and network technologies for healthcare systems (Istepanian and Lacal, 2003). Perhaps, a general but more complete definition is by the WHO, who defined mHealth as the practice of medicine and public health supported by mobile and wireless technologies such as mobile phones and PDAs. On the other hand, patients or survey participants can also interact or provide responses to their health providers or workers irrespectively of their location and time of the day. By reaching millions in SSA, mHealth has the potential to provide low-cost solutions to access health-related information including monitoring diseases and collection of data for research (LeFevre et al., 2017). Mobile phone has been considered central to mHealth because accessing or exchanging health information is done using a set of communication tools including voice or voicemail, instant messaging (IM) or short messages system, micro-blogging such as Twitter, or social networking platforms such as Facebook.

2.3.2. Status of mHealth Activities

About 200 mHealth services were active in Sub-Sahara region in 2017 and this number represents a 58% increase from 2016 (GSMA Intelligence, 2017). Furthermore, a WHO Global Observation for eHealth survey of 114 states found that that 81% of African countries surveyed

reported to have at least one mHealth initiative (WHO, 2011). These initiatives are being implemented for several purposes including (1) communicating information for behavior change, (2) making clinic appointment or medication reminders, (3) monitoring and managing diseases and pandemics, (4) collecting and tracking data, and (5) educating health professionals or patients (Premji, 2014). While SSA currently has a relatively high number of mHealth activities, these efforts are not all successful.

The majority of mHealth activities have a short timeframe or do not expand beyond the initial pilot phase or feasibility study (WHO, 2011). For example, out of the 36 mHealth initiatives in Uganda in the 2008-2009 timeframe, only 13 moved beyond the pilot phase (Lemaire, 2011). The implementation and sustainability of these initiatives have been hampered by several factors including inadequate funding, lack of government buy-in and ownership, pilot studies not thought through before they start and therefore not scalable, and insufficient skilled health workers and technicians (Tomlinson et al., 2013).

Some mHealth initiatives have implemented in several SSA countries. Their sustainability has been made possible by substantial investments from overseas and partnerships between governments, international agencies such as WHO, and foundations such as Melinda and Gates, UN Foundation, GSMA, and in some cases mobile operators and pharmaceutical companies (Deloite, 2014). The largest and most successful ventures appear to be those that are under partnerships between governments and corporate sponsors (Sundin et al., 2016). The latter provide money in exchange for rights in advertisement and publicity. Table 1 shows examples of some a few known mHealth in SSA and where they were implemented.

2.3.3. Mobile Phone in mHealth Activities

2.3.3.1. ROLE OF MOBILE PHONES AND USES

As indicated in Section 2.3.1, mHealth is enabled by mobile phones, smartphones, PDAs, and other wireless devices including specially-designed applications running on any of these platforms. Of these tools, however, mobile phones appear to be the primary platform as they have become quickly accessible to millions in SSA. Back in 2009, mobile phone was predicted to become a central element of future mobile health SSA (Vital Wave Consulting, 2009). The continuous increase in mobile phone penetration and expansion of faster network coverage across the subcontinent seen in recent years confirms that mobile phone is the right tool for mHealth, particularly in remote areas and underserved populations around cities. In these areas, mobile phones reduce time, distance and potentially the cost of health information access and delivery (Aranda-Jan et al., 2014). About 11% of the population in SSA accessed health services via their mobile phones and this number is expected to increase (GSMA Intelligence, 2017).

Mobile phone uses in mHealth activities are versatile. They include voice and voicemail, instant messaging (IM) or short messages systems (SMS), micro-blogging such as Twitter, social networking/media such as Facebook and Myspace, email, and internet-based applications or decision Support Systems specifically developed for communication purposes. Currently, most smartphone vendors are equipping mobile phones with open software development kits (SDKs), which allow developers to create mHealth applications (Lane et al., 2010), basically converting phones into medical kits (Ventola, 2014). Mhealth initiatives that rely on basic mobile phones as the primary platform use existing voice communication telephone networks, voice and voicemail (WHO, 2011). Example of primarily voice-based mHealth services that are offered are health

call centers (Corker, 2010; Van Zyl, 2015), toll free telephone numbers, and emergency services (Roberts et al., 2015). The advantage is that the information can be translated in local languages and dialects especially when the receiving patients or participants are illiterate.

SMS or texting on mobile phones, smartphones, or implemented as an application specifically-designed for mHealth is perhaps the most used tool of mHealth communication. A smartphone SMS-based mHealth application for influenza surveillance in Kenya (Njuguna et al., 2014), an SMS-participatory surveillance of medical conditions and symptoms in rural Uganda (Lester et al., 2016), and a mobile phone SMS-based alert system to monitor pregnancy in rural Rwanda (Ngabo, 2012) are just a few examples. SMS use and success, however, are dependent on how well participants know how to read, write and send messages. Therefore, a low literacy rate among participants can be a limitation of SMS-based health delivery. Internet browsing and social media utilization on mobile phones are still limited but a few cases of health-related searches or sharing have been reported. That is the case of health workers communicating through Whatsup and performing Google searches for health information so they can serve better their community (Van Heerden et al., 2017) and midwives connecting to online communities and creating a Facebook group to share patient care information in South Africa (Pimmer et al., 2014).

2.3.3.2. MOBILE PHONE USES IN INFORMAL MHEALTH ACTIVITIES

Some healthcare solutions that are achieved using mobile and telecommunication technologies are not necessarily designed and implemented within a structured mHealth program or study. In this case, individuals seek medical help or health information using only mobile phones. This informal use of mobile phone for mHealth, referred to as a "bottom-up" approach, augments access to healthcare information by millions of people (Ansley-Watkings, 2018). This type pf mHealth is amplified by the fact that mobile phones are often shared among friends, patients, neighbors, and between members of household.

Informal mHealth activities are everywhere in SSA but most of them remain undocumented. Examples of those that have been published include: 1) Patients with chronic diseases and pregnant women in South Africa reminding themselves to take medication and upcoming doctor's visits in rural South Africa (Ansley-Watkings, 2018); 2) A medical officer in a village in Tanzania takes a picture of the skin conditions and seeks a second opinion via a mobile app on a smartphone from colleagues far away thus saving his patients a 5-hour bus drive to the city (Hu, 2014); 3) Nurses or community health workers in Kenya are called or texted with health-related questions or needs such as for assistance in labor and delivery or emergency transport to a hospital (Jennings et al., 2013); and 4) Community health workers communicating through Whatsup and performing Google searches for health information so they can serve better their community (Van Heerden et al., 2017).

2.3.3.3. YOUTH MOBILE PHONE OWNERSHIP AND MHEALTH USES

Mobile phone ownership in SSA youth varies from country to country and are used for a wide range of health-related purposes. For example, in a survey of youth between 8 and 25 years of age in Ghana, Malawi, and South Africa and their use in health-related practices, 39% of youth reported owning a mobile phone and 84% reported having at least one in the household (Hampshire et al., 2015). However mobile phone ownership varied between countries with 63% in South Africa, 35% in Ghana, and 17% in Malawi. In the same study, participants reported searching the internet on their mobile phones to seek help when there were sick (35%) or sought health-related informed about symptoms and potential cure (18%). Several of them reported using social media and surfed the internet on their mobile phones searching for health-related information. In another mHealth study aimed at increasing knowledge of sexual and reproductive health for 498 secondary school girls in Ghana, students used their own mobile phones or of that a family member to receive and respond to questions via SMS (Rokicki and Fink, 2017).

In a study of South Africa adolescents, 10 to 19 years of age, 69% reported owning a mobile phone. Also, 62% and 67% reported using mobile phone for making voice calls and sending SMSs, respectively (Van Heerden, 2010). A survey of 1502 high school students in Uganda, 27% reported owning a cell phone and the ownership increased with grades and age but did not vary with sex (Mitchell et al., 2011). Of those who owned a cell phone, 34% reported sending text messages daily and text messaging rate did not vary with grade, sext, or age. Also in Uganda, Swahn et al. (2014) found that 46.9% of youth living in the slums of Kampala owned a mobile phone and ownership did not varied by sex. However, mobile phone ownership was more common among youth older than 18 years of age and among those who reported taking care of

themselves at night, who reported current drug use and who reported trading sex for money and other things.

REFERENCES

Anstey-Watkins JOT, Goudge J, Gómez-Olivé FX, Griffiths F. 2018. Mobile phone use among patients and health workers to enhance primary healthcare: A qualitative study in rural South Africa. Soc Sci Med. 198:139-147. DOI:10.1016/j.socscimed.2018.01.011.

Chib, A., Wilkin, H., & Hoefman, B. 2013. Vulnerabilities in mHealth implementation: A Ugandan HIV/AIDS SMS campaign. Global Health Promotion, 20(2012), 26–32. http://doi.org/10.1177/1757975912462419

Aranda-Jan CB, Mohutsiwa-Dibe N and Loukanova S. 2014. Systematic review of what works, what does not work, and why of implementation of mobile health (mHealth) projects in Africa. BMC Public Health 14:188. https://doi.org/10.1186/1471-2458-14-188.

Collaboration on International ICT Policy for East and Southern Africa (CIPESA). 2018. Uganda National Information Technology Survey (NITA) 2017/2018 Report. March 2018. https://www.nita.go.ug/sites/default/files/publications/National%20IT%20Survey%20April%2010th.pdf [last accessed November 2, 2018].

Corker J. 'Ligne Verte' toll-free hotline: Using cell phones to increase access to family planning information in the Democratic Republic of Congo. Cases Public Health Commun Mark. 2010; 4:23–37.

Deloite. 2014. The mHealth opportunity in Sub-Sahara Africa. The path towards practical application. The Netherlands. https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/technology-media -telecommunications/deloitte-nl-mHealth.pdf. [Last accessed October 16, 2018].

FAO. 2017. The state of food security and nutrition in the World. Building resilience for peace and food security. FAO, Rome, Italy. http://www.fao.org/3/a-I7695e.pdf. [last accessed 10 October 2018].

GSMA Intelligence. 2017. Mobile industry impact report: Sustainable Development Goals. https://www.gsmaintelligence.com/research/?file=622ab899f558a6ab3b7f14881f0f031e&download. [last accessed 10 October 2018].

GSMA Inteligence. 2018. The mobile economy, Sub-Sahara Africa 2018. The Mobile Economy 2018. London EC4N 8AF. United Kingdom. https://www.gsmaintelligence.com/research/2018/07/the-mobile-economy-sub-saharan-africa-2018/683/. [Last accessed October 16, 2018].

Hampshire K, Porter SA, Owusu SA, Mariwah S, Abane A, Robson E, Munthali A, DeLannoy A, Bango A, Gunguluza N, and Milner J. 2015. Informal m-health: How are young people using mobile phones to bridge healthcare gaps in Sub-Saharan Africa? Soc. Sci. and Medec.142:90-99. https://doi.org/10.1016/j.socscimed.2015.07.033.

Hu, N. 2014. How smartphones are changing dermatology. Retrieved from http://www.globalhealthhub.org/2014/08/04/mHealth-dermatology/ [Last accessed September 11, 2018].

Istepanian RSH and Lacal J. 2003. Emerging mobile communication technologies for health: Some imperative notes on m-health. In: Proc. 25th Annual Int. Conf. of the IEEE Engineering in Medicine and Biology Society. Vol. 2, pp. 1414-1416. https://ieeexplore.ieee.org/document/1279581.

Jennings L, Ongech J, Simiyu R, Sirengo M and Kassaye S. 2013. Exploring the use of mobile phone technology for the enhancement of the prevention of mother-to-child transmission of HIV program in Nyanza, Kenya: a qualitative study. BMC Public Health 2013, 13:1131. http://www.biomedcentral.com/1471-2458/13/1131.

Lane, ND, Miluzzo E, Lu H, Peebles D, Choudhury T, Campbell AT. 2010. A survey of mobile phone sensing. *IEEE Commun. Mag.* 48 (9): 140-150.

Laxminarayan S and Istepanian RSH. 2000. UNWIRED E-Med: The next generation of wireless and internet telemedicine systems. IEEE Trans. Info. Technol. biomedical 4(3): 189-193. https://www.ncbi.nlm.nih.gov/pubmed/11026588.

Lefevre AE, Shillcutt, SD et al. 2017. Defining a stage-based process for economic and financial evaluations of mHealth programs. Cost Effect. and Res. Alloc.15:5. ttps://doi.org/10.1186/s12962-017-0067-6

Lee S, C. Begley CE, Morgan R, Chan W and Kim S. 2018. m-Health policy readiness and enabling factors: Comparisons of Sub-Saharan Africa and Organization for Economic Cooperation and Development Countries. Telemedecine and e-health 24 (12). DOI: 10.1089/tmj.2017.0278.

Lemaire J. 2011. Scaling up mobile Health: Elements necessary for the successful scale up of mHealth in developing countries. Geneva: Advanced Development for Africa. https://www.k4health.org/sites/default/files/ADA_mHealth%20White%20Paper.pdf. [Last accessed October 16, 2018].

Lester J, Paige S, Chapman CA, Gibson M, Holland Jones J, Switzer WM, et al. 2016. Assessing Commitment and Reporting Fidelity to a Text Message-Based Participatory Surveillance in Rural Western Uganda. PLoS ONE 11(6): e0155971. https://doi.org/10.1371/journal.pone.0155971

Mayes J and White A. 2014. How smartphone technology is changing healthcare in developing countries. J. Global Health. 1-7. https://www.ghjournal.org/how-smartphone-technology-is-changing-healthcare-in-developing-countries/.

Mitchell KJ, Bull S, Kiwanuka J, Ybarra ML. 2011. Cell phone usage among adolescents in Uganda: acceptability for relaying health information. Health Educ Res. 26(5):770-81. doi: 10.1093/her/cyr022.

Ngabo F, guimfack JN, Nwaigwe F, et al. 2012. Designing and implementing an innovative SMS-based alert system (RapidSMS-MCH) to monitor pregnancy and reduce maternal and child deaths in Rwanda. Pan Afr Med J. 13:31. http://www.panafrican-med-journal.com/content/article/13/31/full/

Njuguna HN, Caselton, DL, Arunga GO, Emukule GO, Kinyanjui DK, Kalani PM, Kinkade C, Muthoka PM, Katz MK, and Mott JA. 2014. A comparison of smartphones to paper-based questionnaires for routine influenza sentinel surveillance, Kenya, 2011–2012. BMC Med Inform Decis Mak. 14: 107. doi:10.1186/s12911-014-0107-5

Premji S. 2014. Mobile health in maternal and newborn care: Fuzzy logic. Int. J. Environ. Res. Pub. Health. 11(6):6494–6503. doi:10.3390/ijerph110606494.

Pimmer C, Brysiewicz P, Linxen S, Walters F, Chipps J, Gröhbiel U. 2014. Informal mobile learning in nurse education and practice in remote areas—a case study from rural South Africa. Nurse Educ.Today 34(11): 1398–1404. doi: 10.1016/j.nedt.2014.03.013.

Roberts S, Birgisson N, Julia Chang D, Koopman C. 2015. A pilot study on mobile phones as a means to access maternal health education in eastern rural Uganda. J Telemed Telecare. 2015 Jan;21(1):14-7. doi: 10.1177/1357633X14545433. Epub 2014 Jul 24.

Rokicki S and Fink G. 2017. Assessing the reach and effectiveness of mHealth: Evidence from a reproductive health program for adolescent girls in Ghana. BMC Public Health. 17: 969. DOI 10.1186/s12889-017-4939-7.

Save The Children. 2015. The urban disadvantage. State of the World's mother's reports. https://www.savethechildren.org/content/dam/usa/reports/advocacy/sowm/sowm-2015.pdf.

Silva BM, Rodrigues JJ, de la Torre Díez I, López-Coronado M and Saleem K. 2015. Mobile-health: A review of current state in 2015. J Biomed Inform. 56:265-72. doi: 10.1016/j.jbi.2015.06.003.

Sundin P, Callan J and Mehta K. 2016. Why do entrepreneurial mHealth ventures in the developing world fail to scale? Journal of Medical Engineering & Technology 407 (7): 444-457. DOI:10.1080/03091902.2016.1213901.

Swahn MH, Palmier JB, Kasirye R, and Yao H. 2012. Correlates of suicide ideation and attempt among youth living in the slums of Kampala. Int J Environ Res Public Health. 9(2):596–609. doi: 10.3390/ijerph9020596.

Swahn MH, Braunstein S, Kayisire, R. 2014. Demographic and psychosocial characteristics of mobile phone ownership and usage among youth living in slums of Kampala, Uganda. West J. Emerg. Med. 15(5): 600-603. doi: 10.5811/westjem.2014.4.20879.

Tomlinson M, Rotheram-Borus MJ, Swartz L, Tsai AC. 2013. Scaling up mHealth: Where Is the Evidence? PLoS Med 10(2): e1001382. doi:10.1371/journal.pmed.1001382

UNICEF. 2018. Levels and trends in child malnutrition**.** Joint Child Malnutrition Estimates. Key findings of the 2018 edition Joint Child Malnutrition Estimates 2018 edition. Geneva, Switzerland. http://www.who.int/nutgrowthdb/2018-jme-brochure.pdf. [Last accessed October 16, 2018].

United Nations. 2015. Transforming our world: the 2030 Agenda for Sustainable Development. Sustainable Development Knowledge Platform.

United Nations. 2018. World Population Prospects (2017 Revision) - United Nations population estimates and projections. 2018. On lime at http://worldpopulationreview.com/continents/sub-saharan-africa-population. [Last accessed September 24, 2018].

Van Heerden, AC, Norris SA, and Richter L. 2010. Using mobile phones for adolescent research in low- and middle-income countries. Preliminary findings from the birth to twenty cohort, South Africa. J. Adolescent Health. 46(3): 302-304. doi: 10.1016/j.jadohealth.2009.09.008

van Heerden, A, Harris, DM, van Rooyen, H, Barnabas, RV, Ramanathan, N, Ngcobo, N, et al., 2017. Perceived mHealth barriers and benefits for home-based HIV testing and counseling and other care: qualitative findings from health officials, community health workers, and persons living with HIV in South Africa. Soc. Sci. Med. 183, 97–105. DOI: 10.1016/j.socscimed.2017.04.046

Van Zyl MA, Brown LL, and Pahl K. 2015. Using a call center to encourage linkage to care following mobile HIV counseling and testing. Aids Care, 27(7): 921-925. doi: 10.1080/09540121.2015.1015483.

Ventola CL. 2014. Mobile devices and apps for health care professionals: Uses and benefits. Pharmacy Therapeutics. 39 (5): 356-364.

Vital Wave Consulting (VWC). 2009. mHealth for development: The opportunity of mobile technology for healthcare in the developing World. UN Washington DC. Foundation-Vodafone Foundation Partnership. http://www.globalproblems-globalsolutions-files.org/unf_website /assets/publications/technology/mHealth/mHealth_for_Development_full.pf

World Bank. 2013. Global monitoring report: Sub-Sahara Africa. Rural-urban dynamics and the millennium development goals.

World Bank. 2014. Population living in slums (% of urban population) in 2014. https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?view=chart [Last accessed on November 4, 2018].

World Health Organization. 2011. mHealth: New horizons for health through mobile technologies: Second global survey on eHealth. Geneva: World Health Organization.

World Health Organization. 2014. Call for innovative health technologies for low-resource settings. Retrieved from http://www.who.int/medical_devices/innovation/call_2014/en/

MOBILE PHONE VOICE, SHORT MESSAGE SYSTEM, INTERNET AND SOCIAL MEDIA USES AMONG HARD-TO-REACH CHILDREN IN KAMPALA, UGANDA

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ABSTRACT

Introduction: Research shows that many youth groups in Uganda own mobile phones. However, the extent to which youth who live in the slums of Kampala own and uses mobile phones has not been sufficiently explored. With the expansion of mobile technology, mobile health has emerged as a potential cost-effective tool that can allow this youth access health-related data and information. This study sought to determine the prevalence of mobile phone ownership and uses, document changes from the previous sampling event, and assess the association between mobile phone uses and psychosocial factors in this high-risk population.

Methods: A convenience sample (n=1134) was obtained in 2014 from urban youth living on the streets, 12-18 years of age, and who were participating in a Uganda Youth Development Link drop-in center for disadvantaged street youth. Mobile phone use variables consisted of talking/texting, internet use for browsing and social media. Statistical analyses were performed to determine the likelihood of owning a mobile phone and uses, and its association with youth risk factors.

Results: Mobile phone ownership, internet use and social media utilization were 49.1%, 25.5%, and 23.4%, respectively. Compared to the previous study, little change occurred in mobile phone ownership but internet uses for searching and social media increased by double digit percentages. Daily talking and texting was significantly more prevalent in children who reported having STDs ($p<0.0001$) and trading sex for money ($p=0.001$), among others, and significantly associated with having STDs (aOR 1.75, 95% CI 1.32-2.32), being drunk (aOR 3.16, 95% CI 2.26-4.42), trading sex for money (aOR 1.97, 95% CI 1.39-2.80), and feeling sad (aOR 1.70, 95% CI 1.25-2.30). Similar results were obtained with internet for searching and social media uses but with less significant associations.

Discussion: Based on that about a half of the children own a mobile phone and that a substantial number of them use it daily for talking or texting, the next step would be to design m-health programs that would take advantage of mobile phone voice and texting capabilities specifically to inform on potential interventions for behavioral change and mental health.

INTRODUCTION

An estimated 60% of urban population in Sub-Sahara Africa (SSA) lives in slums where an increased number of children were reported to be vulnerable to abuse, exploitation and disease with little or no access to basic health care services.[1] In Uganda particularly, 53.6% of the population were reported to be living in slums.[2] Mobile health has grown substantially in SSA during the last decade and its potential to improve the quality of life in these resource-constrained populations appears to be high.

Mobile health, or mHealth, refers to the use of mobile and wireless technologies such as mobile phones and Portable Device Assistants (PDAs) to allow access to health-related data and information.[3] It is particularly important to SSA because hard-to-reach communities such as those in rural areas and urban slums can access information at low cost and in real time.[4] In 2017, about 200 mHealth projects were active and this number represented a 58% increase from 2016.[5] These initiatives target a wide range of activities including communicating information for behavior change, health promotion and interventions, disseminating knowledge, making clinic appointment or medication reminders, monitoring and managing diseases, and data collection and tracking for research.[6]

Owning a mobile phone or having access to one is key to most mHealth activities in SSA. The mobile phone is particularly important because of its many communication tools including voice and voicemail, instant messaging (IM) or short messages system (SMSs), internet for searches and for social network interactions. Mobile phone users can access voice-based mHealth information by calling toll free telephone numbers, health call centers and emergency call

centers.[7] The advantage of this means of communication is that the information can be translated in local languages and dialects especially when receiving patients or participants are illiterate. That is the case of mobile phone users in the Democratic Republic of Congo who access family planning information by calling a toll-free hotline.[8]

The short messages system and SMS-based applications on mobile phones specifically designed for mHealth are perhaps the most used tools in SSA. They have been used for influenza surveillance in Kenya[9] and monitor pregnancy and reduce maternal and child mortality rates in rural Rwanda.[10] Specifically in Uganda, SMSs are used in educational campaigns that promote awareness of HIV/AIDs[11] and remotely monitor disease symptoms in rural communities.[12] Unlike voice and SMS, internet browsing and social media utilization on mobile phones are still limited in SSA but a few cases of health-related searches or information sharing have been reported. That is the case of social workers communicating through Whatsup and performing Google searches for health-related information so they can serve better their community[13] and midwives connecting to online communities and creating a Facebook group to share patient care information in rural South Africa.[14]

The knowledge of mobile phone ownership and uses (voice, SMS, etc.) in a group of people will help decide early on mHealth activities that have the highest chance of succeeding. A number of relevant studies, especially those involving youth, have been carried in SSA countries. A survey of youth between 8 and 25 years of age in Ghana, Malawi, and South Africa found that mobile phone ownership was respectively 63%, 35% and 17%.[15] In the same study, participants reported searching the internet on their mobile phones to seek help when there were sick (35%) or sought

health-related information about symptoms and potential cure (18%). Also, a study of secondary school students in Mbarara, Uganda demonstrated that about 27% had a mobile phone and the ownership increased with grades and age but did not vary with sex.[16] Of those who owned a cell phone, 34% reported sending text messages daily and text messaging rate did not vary with grade, sex, or age. Similar results were obtained in other SSA countries.[17,18] A recent survey by the Uganda National Information Technology found that 60.7% of youth, 15 to 24 years of age, reported owning a mobile phone and among mobile phone owners in this group, 28.0% reported owning a smartphone.[19] This age group had the highest smartphone ownership in the nation and comparatively, only 15.8% of those who owned a mobile phone nationwide reported owning a smartphone.

While research indicates that youth groups in Uganda own mobile phones and may use them for different activities including mHealth-related communications, the extent to which these findings extend to youth who live in the slums of Kampala has not been sufficiently explored. This youth were found to have high-risk behaviors and exposures and can be hard to reach using communication means other than mobile phones especially since most of them do not attend school.[20] Swahn et al.[21] reported on mobile phone ownership and use in this youth population. The study was based on a cross-sectional survey of youth, 14 to 24 years (n=415) in 2011. Results showed that 46.9% reported owning a mobile phone, while 9% and 5% reported using the internet and social media, respectively. Mobile phone ownership and daily use for talking was significantly more common among those who reported taking care of themselves at night, using drugs and trading sex for money and material things. In 2014, the primary author revisited this population and collected similar data on demographic and psychosocial characteristics

(n=1134). This time, however, the survey included younger participants, 12 to 18 years old, and more questions on internet and social media uses and on youth psychosocial characteristics. The goals of the present study were to determine the prevalence of mobile phone ownership and different uses (voice/voicemail, SMS, internet searching, and social media) among children who live in the slums of Kampala, identify demographic and psychosocial characteristics of children that are likely to own and use a mobile phone and document changes in results, if any, since the 2011 survey. This study also examined the association between demographic and psychosocial factors and mobile phone uses. Results of this study are intended to serve as a guide for future research in designing appropriate mHealth activities including the feasibility of implementing prevention and intervention initiatives in this hard-to-reach and high-risk youth population.

METHODS

Survey Participants and Recruitment

This is a secondary analysis of a cross-sectional survey called the "Kampala Youth Survey," that was conducted in 2014. The survey was done to quantify and describe high-risk behaviors and exposures in a convenience sample of urban youth (12 to 18 years of age) living on the streets or in the slums and who were participating in a Uganda Youth Development Link (UYDEL) drop-in center for disadvantaged street youth. UYDEL is a not for profit organization that operates 8 centers with a primary goal of reducing risk behaviors such as HIV acquisition and drug use among youth, primarily ages 12-18, living in the slums. The details of the survey have been described elsewhere.[22-24] Brief, face-to-face surveys, lasting approximately 30 minutes each, were administered by trained UYDEL staff across eight drop-in centers across Kampala.

Participating youth received snacks and transportation for completing the survey. There was no identifying information was collected and the surveys were completely anonymous. Surveys were administered in English or Uganda's local language Luganda, and to the extent possible, in private locations, to ensure privacy of survey questions and responses. Recruitment took place using word-of-mouth, and youth were invited to participate following the approved assent and consent process. The participation rate was 90.9%. Analyses are based on the 1134 completed surveys.

Survey Measures

The questionnaire was modeled from existing surveys and has been described elsewhere.[20-24] Measures included demographic characteristics, family context, alcohol and drug use, injuries, violence and suicidal behaviors and sexual behavior including victimization and are available from the authors upon request. Information about mobile phone ownership and uses were based on the following questions: Do you have your own a mobile phone (yes or no)? If yes, 1. How often do you talk on your mobile phone (daily, weekly, monthly, or never)? 2. How often do you send or receive SMS/text messages on your mobile phone (daily, weekly, monthly, or never)? 3. How often do you use the internet for browsing and searching (daily, weekly, monthly, or never)? and 5. Do you use the internet for social media such as Facebook (yes or no)?

Ethical Approvals

The study was approved by the Institutional Review Board at Georgia State University and by the Uganda National Council for Science and Technology. Funding to conduct the study was obtained from the National Institutes of Health.

Data Analysis

The analytic sample consisted of 1134 participants. Mobile phone was divided into three categories: Talking and/or sending and receiving text messages, internet use for browsing and searching, and internet use for social media. Each of the "Talking/texting" and "internet use for browsing" variables consisted of two levels: 1. Those who reported that they owned a mobile phone and used it daily and 2. Those who did not own a phone or they own one but used it weekly or less often. The internet for social media use variable use was divided into "yes" and "no" levels. The "yes" level was when participants reported owning a mobile phone and used social media and "no" when participants did not own a mobile phone or owned a phone but did not use social media.

Statistical analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). The chi-square test was used to test differences in each of the three mobile phone uses (talking/texting, internet browsing, internet for social media) by levels of demographic and psychosocial characteristics (yes vs. no) and a 2-sided p value <0.05 was considered significant. Logistic regressions were used to determine the association between each of the three mobile phone uses and demographic and risk factors. The referent outcome comparison in the talking/texting and internet browsing models was to "not owning a mobile phone or owning one but using it weekly or less often." The referent level internet use for the social media was "not having a phone or having one but not using social media."

RESULTS

Forty-nine percent (49.1%) of children reported owning a mobile phone and of those who owned a mobile phone, 42.7% reported using it for daily for talking (Table 1). Compared to the previous study, mobile phone ownership increased by 2.1% while the number of participants who reported using a mobile phone daily for talking decreased by 2.8%. In terms of using other technology, 25.5% of youth reported using the internet and 23.1% reported using social media. These numbers represent 16.2% and 18.5% increases from the previous study, respectively.

The demographic and psychosocial characteristics of mobile phone uses are presented in Table 2. It appeared that a total of 501 children (44.2%) owned a mobile phone and used it every day for talking or texting. Only 9.4% of children reported using a mobile phone for internet daily searches and 19.9% reported using a mobile for social media interactions. Owning a mobile phone and use it daily for talking or texting did not vary significantly by sex ($p=0.244$) and the same was true for mobile phone uses for internet searches and for social media. However, more girls (54.2%) than boys reported using their mobile phone for daily talking or texting. Comparatively, less girls (46.2%) reported using a mobile phone for daily internet searches and about the same fraction (46.9%) reported using one for social media.

Youth who reported owning and using a mobile phone for daily talking/texting, surfing the internet, and using the internet to access social media were more likely to be older (16-18 years of age) ($p<0.0001$). Among mobile phone owners, older youth represented 92.8% of those who reported using the mobile phone for daily talking/texting, 92% of those who reported performing internet searches, and 90% who reported using a mobile phone for social media. Among the

older youth group, 61% reported owning a mobile phone and use it for daily talking and texting compared to 10% among younger youth. Similarly, among the older group 13% and 27% reported owning a mobile phone and used the internet for searching and social media, respectively, compared to 2% and 6% among younger youth.

Children who reported having been told by a doctor/nurse or HIV counselor that they have a sexually transmitted disease (STD) had a significantly higher prevalence of owning and using mobile phones daily for talking and texting (48.1%) than those who reported not owning a phone or who had a phone but used it weekly or less often (28.3%), $p \leq 0.0001$. The same was true for children who reported taking care of themselves at night (26.6% vs. 18.5% vs, p=0.001), be physically abused by a parent (37.0% vs. 31.1%; p=0.038), being drunk during the past month (38.5% vs. 13.7%; p<0.0001), ever being raped (22.4% vs.12.6%; p<0.0001), traded sex for material things (35.1% vs. 15.8%; p<0.0001), currently involved in commercial sex (11.3% vs. 4.0%, p<0.0001), feeling sad or hopeless for 2 weeks or more during the past year (67.7% vs. 49.9%; p<0.0001), feeling lonely in the past month (84.3% vs. 78.5%; p=0.013), having thoughts of hurting self (42.2% vs. 29.3%; p<0.0001), having thoughts of killing self (28.9% vs. 19.3%; p=0.001), and having attempted suicide in the past year (26.6% vs. 18.4%; p=0.001).

Daily internet use for browsing and searching was more prevalent in youth who reported having STDs (56.6% vs. 34.9%; p<0.0001), being drunk in the past month (37.7% vs. 23.2%; p=0.001), traded sex for material things (37.7% vs. 22.8%; p=0.001) and being sad or hopeless (69.8% vs. 56.2%; p=0.007). Internet use for social media was more likely to be used by youth who reported having the same risk factors, and also those who reported taking care of themselves at

night (29.2% vs. 20.2%; p=0.003), being physically abused by a parent (40.0% vs. 32.0%; p=0.024), having thoughts of hurting self (44.9% vs. 32.5%; p=0.001), having thoughts of killing self (31.6% vs. 21.6%; p=0.002), and having attempted suicide in the past year (28.7% vs. 20.3%; p=0.007).

We also examined the associations between mobile phone use for talking and texting, internet use for browsing and internet use for social media and demographic, high-risk behaviors and exposures. Unadjusted and adjusted odds ratios, and 95% CIs obtained from logistic regressions were used to assess the association between mobile phone uses with sex, age group, and psychosocial characteristics (Table 3). Adjusted odds ratios were calculated only for risks factors that were found to be significantly associated with the outcome variables in the bivariate analyses. Among age groups, the older youth (16-18 years of age) were independently associated with mobile phone ownership and uses for daily talking or texting (OR 14.7, 95% CI 10.12-21.36), internet searches (OR 5.91, 95% CI 2.95-11.84), and internet for social media (OR 5.54, 95% CI, 3.53-8.70).

Eleven of the 15 risk factors considered in this study were independently associated with mobile phone ownership and daily use for talking/texting as indicated by significant adjusted odds ratios. After adjusting for other psychological factors, owning a mobile phone and use it daily for talking or texting was significantly associated with reporting having STDs (aOR 1.75, 95% CI 1.32-2.32), being drunk in the past month (aOR 3.16, 95% CI 2.26-4.42), trading sex for material things (aOR 1.97, 95% CI 1.39-2.80) and feeling sad or hopeless (aOR 1.70, 95% CI 1.25-2.30).

Mobile phone use for internet was found to be independently associated with having STDs (OR 2.43, 95% CI 1.62-3.64), being drunk in the past month (OR 2.01, 95% CI 1.32-3.06), trading sex for money and material things (OR 2.06, 95% CI 1.35-3.13). It was associated only with reporting having STDs (aOR 2.10, 95% CI 1.35-3.28) in the multivariate analyses. Similarly, mobile phone use for social media was independently associated with 10 of the 15 rick factors but only associated with being drunk in the past month (aOR 2.07, 95% CI 1.44-2.98), trading sex for material things ((aOR 1.63, 95% CI 1.10-2.41) and feeling sad or hopeless (aOR 1.55, 95% CI 1.06-2.27).

DISCUSSION

The goal of this study was to determine the prevalence of mobile phone ownership and uses in children who live in the slums of Kampala, identify demographic and psychosocial characteristics of children that are likely to own and use a mobile phone, and document changes in results since the previous survey in 2011. This study also examined the association between demographic and psychosocial factors and different mobile phone uses. The present work is based on samples that were collected in 2014. The findings demonstrated that nearly half (49.1%) of the children reported owning a mobile phone, a fraction that is smaller than the 53% estimate in the general Ugandan population, 15 years and older, in 2014.[19] However, we expected mobile phone ownership to be lower than the national average because this population is marginalized with little resources to afford a mobile phone. Moreover, our sample contained young participants, 12 to 15 years old, who are unlikely to have enough money to buy themselves a mobile phone.

The mobile ownership increase (2.1%) from the previous study is small considering that mobile phone subscriptions in the country increased by 41.2% in the same period.[25] This is probably because our sample consisted of younger participants, 12 to 18 years old, compared to the previous study which had 14-24 years old youth. As it has been demonstrated in this population, younger participants significantly reported lower mobile phone ownership and use than older participants.[21] Results also showed that internet use (mobile and fixed) for browsing and searches and for social media remained low but increased by double digit percentages, 16.2 and 18.5% respectively, from the previous study. However, these increases are still small considering that the internet use in the country increased by 128% during the same 3-year period.[25] Nonetheless, these results are a sign that children in this population are embracing internet searching and social media utilization at a fast pace.

Older children were significantly more likely to own a mobile phone and use it for talking or texting than younger ones, and similar results were obtained in the previous study. Moreover, among the younger group, only 10% reported owning a mobile phone and use it daily talking or texting compared to 61% among older children. A lower percentage in this younger group was expected because of issues associated with poverty and therefore mobile phone affordability in this population. Similar results were obtained in the previous study despite differences in age ranges and age group definitions.

Children who owned a mobile phone used it primarily for talking or texting and less for internet browsing and social media. Internet browsing and social media uses on a mobile phone are still limited in this population because a mobile phone equipped with internet, or smartphone, is more

298 expensive than a regular mobile phone and therefore less affordable by these children. It is
299 important to note, however, that a recent national survey found that the prevalence of
300 smartphones among youth who reported owning a mobile phone was the highest than that of any
301 other age group.[25] Therefore, voice/voicemail-based tools and SMS-based tools can be
302 considered first when planning and designing intervention initiatives to help this population
303 while smartphone ownership and use for internet searches and social media may be as important
304 in the future.
305
306 The prevalence of mobile phone ownership and daily use for talking in the previous study was
307 significantly higher in those who reported 13 of 15 youth psychosocial characteristics considered
308 in this study. Mobile phone ownership and daily use for talking was significantly prevalent in
309 only those who reported 3 out of 13 characteristics including self-monitoring at night, being
310 drunk in the past month, and trading sex for money or material things. A larger sample size may
311 have contributed to more differences in prevalence being significant for most of the children
312 characteristics compared to the previous study. Since mobile phone ownership and daily talking
313 or texting significantly prevailed in children who reported many risky behaviors (e.g.,
314 drunkenness, commercial sex, trade sex for money) and psychological characteristics (e.g.,
315 loneliness, though of killing self, suicide attempt), mHealth initiatives tailored to changing
316 behaviors and addressing psychological issues will likely help more children in this population.
317
318 Multiple psychosocial covariates were statistically associated with mobile phone ownership and
319 daily use for talking and texting in the bivariate analyses but only with having STDs, being
320 drunk, trading sex for money and material things, and felling sad or hopeless in the multivariate

analyses. Similar findings were obtained with the mobile phone uses (internet searches and social media) but with less significant associations. As mobile and internet technologies and mobile phone penetration in SSA countries, and Uganda in particular, continue to increase, we expect mobile phone ownership and uses in this population to increase accordingly, although at a lower pace. Nonetheless, with about half reporting owning a mobile phone, a facility-based counseling program supplemented by voice and SMS-based mHealth educational programs that disseminate information, provide incentives and social support to overcome psychological and social barriers will likely lead to many children in this population adopt desirable behaviors and improve their mental health. This joint Counseling and mHealth initiative could start with children who reported having STDs, being drunk, trading sex for money or material things and feeling sad or hopeless because these corelates were associated with mobile phone daily use. However, a national initiative is needed to provide long-term solutions to a long range of issues because, in addition to psychological factors, these children live in crowded small areas, often rampant poverty, and poor hygiene and sanitation.

The interpretation of results in this study has potential limitations. These limitations include the generalization of children, questions regarding mobile phone ownership and uses and under-reporting of risk behaviors. Another limitation lies in the way some variables were defined. For example, 7% of the 114 participants who reported using internet daily for browsing and 14% of the 262 participants who reported using social media platforms did not have a mobile phone. This is an indication that a (unknown) fraction of the number of children in the "Own a mobile phone and use internet daily" and "Own a mobile phone and use social media" variables may have accessed these tools from a computer at home, a smartphone from a friend or relative, or

from commercial internet cafés. Also, comparing results of the two sampling events carry an unknown error because they differed in time of years of sampling, sample size, age groups, and in some of the youth psychosocial characteristics. However, our interpretation may have been the same even if these limitations were known in advance and considered in the analyses. Also, results of this study are specific to this population and may not be generalized to other youth living in other slumps of Kampala and beyond. Future research a larger study in which observational data on mobile phone ownership and uses (e.g., records of mobile phone usage) and psychosocial characteristics from randomly selected participants in several slumps in Kampala to minimize some of the limitations of this study and allow a geographic generalization of the results.

REFEFENCES

1. Save The Children. The urban disadvantage. State of the World's mothers report. Fairfield: 2015. https://www.savethechildren.org/content/dam/usa/reports/advocacy/sowm/sowm-2015.pdf. [last accessed 10 October 2018].

2. World Bank. 2014. Population living in slums (% of urban population) in 2014. https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?view=chart [Last accessed on November 4, 2018].

3. World Health Organization. mHealth: New horizons for health through mobile technologies: second global survey on eHealth. Geneva: World Health Organization; 2011. [last accessed 24 September 2018].

4. Mayes J, White A. How smartphone technology is changing healthcare in developing countries. J. Global Health. 2014; 1-7.

5. GSMA Intelligence. 2017 mobile industry impact report: Sustainable Development Goals. 2017. https://www.gsmaintelligence.com/research/?file=622ab899f558a6ab3b7f14881f0f031e&download. [last accessed 10 October 2018].

6. Premji S. 2014. Mobile health in maternal and newborn care: Fuzzy logic. Int. J. Environ. Res. Pub. Health. 11(6):6494–6503. doi:10.3390/ijerph110606494.

7. Roberts S, Birgisson N, Julia CD, Koopman C. 2015. A pilot study on mobile phones as a means to access maternal health education in eastern rural Uganda. J Telemed Telecare. 2015 Jan;21(1):14-7. doi: 10.1177/1357633X14545433. Epub 2014 Jul 24.

8. Corker J. 'Ligne Verte' toll-free hotline: Using cell phones to increase access to family planning information in the Democratic Republic of Congo. Cases Public Health Commun Mark. 2010; 4:23-37.

9. Njuguna, HN, Deborah L, Caselton G. A comparison of smartphones to paper-based questionnaires for routine influenza sentinel surveillance, Kenya, 2011–2012. BMC Med Inform Decis Mak. 2014; 14:107.
10. Ngabo F, guimfack JN, Nwaigwe F, et al. Designing and implementing an innovative SMS-based alert system (RapidSMS-MCH) to monitor pregnancy and reduce maternal and child deaths in Rwanda. Pan Afric Med J. 2012; 13:31 http://www.panafrican-med-journal.com/content/article/13/31/full.
11. Chib A, Wilkin H and Hoefman B. Vulnerabilities in mHealth implementation: A Ugandan HIV/AIDS SMS campaign. Global Health Promotion, 20(2012), 26–32. http://doi.org/10.1177/1757975912462419.
12. Lester J, Paige S, Chapman CA, et al. Assessing commitment and reporting fidelity to a text message-based participatory surveillance in rural Western Uganda. PLOS ONE. 2016; 11(6):1-21.
13. van Heerden A, Harris DM, van Rooyen H, et al. Perceived mHealth barriers and benefits for home-based HIV testing and counseling and other care: Qualitative findings from health officials, community health workers, and persons living with HIV in South Africa. Soc. Sci. Med. 2017; 183:97-105.
14. Pimmer C, Brysiewicz P, Linxen S, et al. Informal mobile learning in nurse education and practice in remote areas-a case study from rural South Africa. Nurse Educ. Today. 2014; 34: 1398-1404.
15. Hampshire K, Porter G, Owusu SA, et al. Informal m-health: How are young people using mobile phones to bridge healthcare gaps in Sub-Saharan Africa? Social Science and Med. 2015; 142:90-99.

16. Mitchell KJ, Bull S, Kiwanuka J et al. Cell phone usage among adolescents in Uganda: acceptability for relaying health information. Health Educ Res. 2011; 26(5):770-781.
17. Van Heerden, AC, Norris, SA, and Richter L. Using mobile phones for adolescent research in low- and middle-income countries. Preliminary findings from the birth to twenty cohort, South Africa. J. Adolescent Health. 2010; 46:302-304.
18. Rokicki S, Fink G. Assessing the reach and effectiveness of mHealth: Evidence from a reproductive health program for adolescent girls in Ghana. BMC Public Health [Open Access]. 2017; 17:969.
19. Collaboration on International ICT Policy for East and Southern Africa (CIPESA). 2018. Uganda National Information Technology Survey (NITA) 2017/2018 Report. March 2018. https://www.nita.go.ug/sites/default/files/publications/National%20IT%20Survey%20April%2010th.pdf [last accessed November 2, 2018].
20. Swahn MH, Gressard L, Palmier JB, Kasirye R, Lynch C, Yao H. Serious violence victimization and perpetration among youth living in the slums of Kampala, Uganda. West J. Emerg. Med. 2012; 13:253–9.
21. Swahn MH, Sarah B, Kayisire, R. Demographic and Psychosocial characteristics of mobile phone ownership and usage among youth living in slums of Kampala, Uganda. West J. Emerg. Med. 2014; 15(5): 600-603.
22. Swahn MH, Culbreth RE, Staton CA et al. Alcohol-related physical abuse of children in the slums of Kampala, Uganda. Int. Jour. Environm. Res. Pub Health. 2017. 1124: 1-14.
23. Swahn MH, Culbreth RE, Salazar LF et al. Prevalence of HIV and associated risks of sex work among youth in the slums of Kampala. AIDS Res. Treat. 2016. 8 pages http://dx.doi.org/10.1155/2016/5360180.

24. Uganda Youth Development Link. Available at http://www.uydel.org/ [Last accessed November 13, 2018].

Center for Disease Control and Prevention. Youth risk behavioral surveillance system (YRBSS). CDC Web site. Available at https://www.cdc.gov/healthyyouth/data/yrbs/index.htm. [Accessed October 12, 2018].

24. Center for Disease Control and Prevention. Global school-based student health survey (GSHS). CDC Web site. Available at https://www.cdc.gov/gshs/. [Last accessed October 14, 2018].

25. National Information Technology Authority. 2016. Statistical abstract. https://www.nita.go.ug/sites/default/files/publications/NITA-U%20Statistical%20Abstract%202016.pdf [Last accessed November 3, 2018].

Table 1. Comparison for mobile phone ownership, and internet search and social media uses in the slums of Kampala between 2011 and 2014 sampling events.

Characteristic	Proportion of Total Sample of Children Reporting (%)		
	2011 Sampling Event n (415)	2014 Sampling Event n (1134)	Difference
Mobile Phone Ownership	46.9	49.1	2.1
Mobile Phone Daily Use for Talking	45.5	42.7	-2.8
Internet Usage	9.3	25.5	16.2
Social Media Usage	4.9	23.4	18.5

Table 2. Demographic and psychosocial characteristics stratified by mobile phone uses among youth living in the slums of Kampala (*N*=1134).

Characteristic	Mobile Phone Use								
	Talking/Texting, n (%)			Internet for Searches, n (%)			Internet for Social Media, n (%)		
	Yes	No	p value*	Yes	No	p value	Yes	No	p value
Children Reporting	501 (44.2)	633 (55.8)	-	106 (9.4)	1028 (90.6)	-	226 (19.9)	908 (80.1)	
Sex (Girls)	271 (54.2)	365 (57.7)	0.244	49 (46.2)	587 (57.1)	**0.032**	106 (46.9)	530 (58.4)	**0.002**
Age (years)									
16-18	465 (92.8)	296 (46.8)	**<0.0001**	97 (91.5)	664 (64.6)		203 (89.8)	558 (61.5)	
12-15	36 (7.2)	337 (52.2)		9 (8.5)	364 (35.4)	**<0.0001**	23 (10.2)	350 (38.5)	**<0.0001**
Both parents deceased	115 (23.0)	136 (21.5)	0.554	26 (24.5)	225 (21.9)	0.533	48 (21.2)	203 (22.4)	0.717
One of both parents alive	386 (77.0)	497 (78.5)		80 (75.5)	803 (78.1)		178 (78.8)	705 (77.6)	
STDs	240 (48.1)	179 (28.3)	**<0.0001**	60 (56.6)	359 (34.9)	**<0.0001**	107 (47.6)	312 (34.4)	**0.001**
HIV/AIDS	59 (11.8)	57 (9.0)	0.126	10 (9.4)	106 (10.3)	0.776	25 (11.1)	91 (10.0)	0.644
Physical health									
Fair or poor	117 (23.4)	200 (31.7)	**0.002**	14 (13.2)	305 (29.7)	**0.001**	42 (18.6)	275 (30.4)	**0.001**
Excellent or good	384 (76.7)	431 (68.3)		92 (86.8)	723 (70.3)		185 (81.4)	632 (69.0)	
Self-monitoring/care at night	133 (26.6)	116 (18.5)	**0.001**	28 (26.4)	221 (21.5)	0.244	66 (29.2)	183 (20.2)	**0.003**
Parental physical abuse	184 (37.0)	196 (31.1)	**0.038**	32 (30.2)	348 (33.9)	0.447	90 (40.0)	290 (32.1)	**0.024**
Any drunkenness (past month)	192 (38.5)	86 (13.7)	**<0.0001**	40 (37.7)	238 (23.2)	**0.001**	88 (39.3)	190 (20.9)	**<0.0001**

Rape (ever)	112 (22.4)	79 (12.6)	**<0.0001**	25 (23.6)	166 (16.2)	0.051	49 (21.8)	142 (15.7)	**0.029**
Traded sex for money, food, or things	175 (35.1)	99 (15.8)	**<0.0001**	40 (37.7)	234 (22.8)	**0.001**	80 (35.6)	194 (21.4)	**<0.0001**
Commercial sex work (currently)	56 (11.3)	25 (4.0)	**<0.0001**	11 (10.4)	70 (6.8)	0.174	22 (9.9)	59 (6.7)	0.079
Sadness or hopelessness for 2 weeks or more	337 (67.7)	315 (49.9)	**<0.0001**	74 (69.8)	578 (56.2)	**0.007**	157 (70.1)	495 (54.7)	**<0.0001**
Loneliness (past month)	419 (84.3)	496 (78.5)	**0.013**	86 (81.1)	829 (80.6)	0.903	189 (84.4)	726 (80.2)	0.156
Thought of hurting self (past year)	210 (42.2)	184 (29.3)	**<0.0001**	45 (42.5)	349 (34.0)	0.08	101 (44.9)	293 (32.5)	**0.001**
Thought of killing self (past year)	144 (28.9)	122 (19.3)	**0.001**	32 (30.2)	234 (22.8)	0.09	71 (31.6)	195 (21.6)	**0.002**
Suicide attempt (past year)	132 (26.6)	116 (18.4)	**0.001**	30 (28.3)	218 (21.2)	0.092	64 (28.7)	184 (20.3)	**0.007**

*Statistically significant difference at p value <0.05 and are boldfaced. Percentages may not add up due to rounding.

Table 3. Bivariate and multivariate associations between mobile phone uses and demographic and psychosocial covariates among youth living in the slums of Kampala (*N*=1134).

Characteristic	Mobile Phone Use					
	Talking/Texting		Internet for Browsing		Internet for Social Media	
	OR (95% CI)*	aOR (95% CI)**	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)
Sex (Girls)	0.87 (0.68-1.10)		0.65 (0.43-0.97)		0.63 (0.47-0.84)	
Age (years)						
16-18	**14.7 (10.1-21.4)**		**5.91 (2.95-11.84)**		**5.54 (3.53-8.70)**	
12-15	1		1		1	
Both parents deceased	1.09 (0.82-1.44)		1.16 (0.73-1.85)		0.94 (0.66-1.34)	
One of both parents alive	1		1		1	
STDs	**2.35 (1.83-3.00)**	**1.75 (1.32-2.32)**	**2.43 (1.62-3.64)**	**2.10 (1.35-3.28)**	**1.72 (1.29-2.32)**	1.37 (0.98-1.91)
HIV/AIDS	1.35 (0.92-1.98)		0.91 (0.46-1.79)		1.12 (0.70-1.78)	0.88 (0.54-1.45)
Physical health						
Fair or poor	**0.66 (0.50-0.86)**		**0.36 (0.20-0.64)**		**0.52 (0.36-0.75)**	
Excellent or good	1		1		1	
Self-monitoring/care at night	**1.60 (1.20-2.12)**	0.92 (0.66-1.28)	1.31 (0.83-2.07)	0.93 (0.56-1.54)	**1.63 (1.17-2.27)**	1.11 (0.76-1.61)
Parental physical abuse	**0.77 (0.60-0.99)**		0.85 (0.55-1.31)		**1.42 (1.05-1.91)**	1.09 (0.79-1.52)

Any drunkenness (past month)	**3.98 (2.98-5.32)**	**3.16 (2.26-4.42)**	**2.01 (1.32-3.06)**	1.52 (0.93-2.46)	**2.45 (1.79-3.34)**	**2.07 (1.44-2.98)**
Rape (ever)	**2.02 (1.47-2.77)**	1.15 (0.78-1.69)	1.60 (0.99-2.59)	1.09 (0.62-1.91)	**1.50 (1.04-2.15)**	0.98 (0.63-1.53)
Traded sex for money, food, or things	**3.10 (1.90-5.04)**	**1.97 (1.39-2.80)**	**2.06 (1.35-3.13)**	1.59 (0.96-2.65)	**2.03 (1.48-2.78)**	**1.63 (1.10-2.41)**
Commercial sex work (currently)	**3.08 (1.89-5.01)**	0.75 (0.40-1.39)	1.59 (0.81-3.10)	0.62 (0.28-1.39)	1.58 (0.94-2.64)	0.57 (0.30-1.07)
Sadness or hopelessness for 2 weeks or more	**2.10 (1.65-2.68)**	**1.70 (1.25-2.30)**	1.18 (0.61-2.27)	1.66 (0.99-2.79)	**1.94 (1.42-2.66)**	**1.55 (1.06-2.27)**
Loneliness (past month)	**1.47 (1.08-2.00)**	0.97 (0.69-1.37)	1.03 (0.62-1.72)	0.66 (0.38-1.16)	1.33 (0.90-1.99)	0.93 (0.60-1.44)
Thought of hurting self (past year)	**1.76 (1.38-2.26)**	0.94 (0.65-1.37)	1.44 (0.96-2.16)	0.87 (0.49-1.56)	**1.69 (1.26-2.28)**	0.89 (0.64-1.52)
Thought of killing self (past year)	**1.69 (1.28-2.23)**	1.98 (0.64-6.11)	1.47 (0.95-2.28)	1.51 (0.32-7.23)	**1.68 (1.21-2.32)**	2.03 (0.64-6.46)
Suicide attempt (past year)	**1.61 (1.21-2.14)**	0.43 (0.12-1.22)	1.47 (0.94-2.30)	0.67 (0.15-3.23)	**1.58 (1.13-2.20)**	0.46 (0.15-1.46)

*OR= odds ratio; CI= confidence interval; **aOR = adjusted odds ratio.

Bold indicates statistically significant at p value <0.05.