“I am not shy anymore”: A Qualitative Study of the Impact of an Interactive mHealth Intervention on Sexual Health Knowledge, Attitudes, and Behaviors of South African Adolescents with Perinatal HIV

Scarlett Bergam (scarlettbergam@gmail.com)
University of Kwazulu-Natal https://orcid.org/0000-0001-6550-8508

Thobekile Sibaya
University of Kwazulu-Natal

Nompumelelo Ndlela
University of Kwazulu-Natal

Mpume Kuzwayo
University of Kwazulu-Natal

Messaline Fomo
Emory University School of Public Health

Madeleine H Goldstein
Children's Healthcare of Atlanta Inc

Vincent C. Marconi
Emory University School of Medicine

Jessica E. Haberer
Harvard Medical School

Moherndran Archary
University of Kwazulu-Natal

Brian C. Zanoni
Emory University School of Medicine

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Abstract

Background: South Africa has the highest burden of adolescents with perinatally-acquired HIV (APHIV) in the world. APHIV in South Africa have limited access to sexual and reproductive health (SRH) education and services specific to their HIV status. When lacking comprehensive SRH education, APHIV are prone to sexual risk behaviors that can lead to unintended pregnancy, sexually transmitted infections, and HIV transmission. The use of mHealth interventions has been shown to deliver information, foster social support, and improve decision-making skills. In this study, we evaluate how an mHealth intervention influences sexual health knowledge and behaviors in APHIV.

Methods: We purposively enrolled adolescents from the intervention arm of a randomized clinical trial assessing a multi-module, moderated WhatsApp-based intervention—Interactive Transition Support for Adolescents Living with HIV (InTSHA)—within a government supported clinic in KwaMashu, an urban township of KwaZulu-Natal, South Africa. We conducted in-depth interviews based on World Health Organization guidelines for asking adolescents about SRH. We thematically analyzed data through an iterative, team-based coding approach combining deductive and inductive elements to contextualize SRH attitudes, knowledge, and behaviors before and after receiving the InTSHA intervention.

Results: Of the 21 participants, 13 (61.9%) were female and the mean age was 16.6 years. Most participants reported first learning about SRH as young teenagers in school through non-targeted and negative ways, seeking clarification through peers and the internet rather than clinicians or caregivers. Participants reported that InTSHA provided a holistic and destigmatizing perspective on relationships, gender, and sexuality specific to growing up with HIV in South Africa. They praised the ability to give and receive information from peers in a moderated setting through the mHealth intervention, building their confidence, decision-making skills, and communication with partners and caregivers throughout their everyday lives. Despite reporting some technological challenges, adolescents agreed that InTSHA was convenient, confidential, and user-friendly.

Conclusions: South African APHIV receive incomplete and conflicting sexual education from peers, caregivers, teachers, and technology that can be supplemented by mHealth curricula targeted for the unique needs of APHIV. Future, scaled-up mHealth interventions can destigmatize SRH by expanding access to sexual education and peer support, supplementing adolescents' existing SRH education.

Introduction

More than one million adolescents ages 10 to 19 are living with HIV in sub-Saharan Africa (SSA), with the majority residing in South Africa (1). Health policy has largely overlooked social health inequities among adolescents with perinatally-acquired HIV (APHIV) (2), who face risks related to their sexual and reproductive health (SRH) (3). Preventing the population-level spread of HIV requires expanding access to SRH resources and education for youth worldwide, especially South African APHIV (4).

Youth in SSA have high rates of unprotected sex, sexually-transmitted infections, and unintended pregnancy, likely arising from a confluence of limited information, inadequate services, and negative peer influences (5). Across SSA, adolescent SRH services are inequitably distributed by region, gender, education, urban-rural residence, economic status, and HIV status (6). In a national survey of South African adolescents, the mean age for first-time sexual intercourse was 15.2 years (7). Only 40.3% reported contraception use (7), which was dependent on knowledge, relationship status, age difference, accessibility of contraception, and healthcare worker attitudes (8,9). Peer interactions have an established effect on youth sexual behaviors (10). Sexual partners are often introduced to young women through female friends, and having older friends predicts having older partners (11). Group acceptance, often leading to peer pressure, plays a role in predicting health outcomes (12). Further, gender inequalities in APHIV manifest as SRH inequities. Across Africa, 15–19 year-old adolescent girls have over twice the HIV prevalence of their male counterparts (3.3% and 1.5%, respectively) (6), calling for creative interventions to address this unmet need (13).

Poor SRH outcomes amongst APHIV call for integrated health, educational, and social services, at the intersection of HIV and sexuality, targeted to adolescent populations (2,6). Researchers, healthcare providers, and APHIV alike have recommended the use of mobile health (mHealth) interventions, such as phone applications or text message programs, to connect adolescents with sexual health education and services, due to high smartphone coverage and technological familiarity amongst young people (7,12). To mitigate concerns of security, liability, and regulation of mHealth services (14), the World Health Organization has created a guide that lays out standards for the content, context, and technical features of mHealth interventions (15). Many mHealth interventions have been implemented across SSA to help young people access information about HIV (16,17) and to help healthcare systems in providing effective comprehensive HIV care (12,18,19). Separately, mHealth interventions—such as targeted text-message conversations—have been used across contexts to deliver SRH information (20–22). However, few mHealth interventions have been targeted for APHIV about their sexual and reproductive health (23).

InTSHA (Interactive Transition Support for Adolescents Living with HIV) was developed to deliver evidence-based, accessible information to APHIV in the form of a WhatsApp-based social support group. The intervention was designed to improve retention in care and viral suppression during the transition to adult care, and included a component on sexual health. Here, we assess how urban, South African APHIV receive SRH information through and outside of InTSHA, and examine the role of InTSHA in shaping adolescents' SRH knowledge, attitudes, and behaviors.

Methods

Study Setting

The study took place in eThekwini, South Africa, located in the country's KwaZulu-Natal province. There are approximately 720,000 youth ages 15–24 living in South Africa (41), and KwaZulu-Natal has the highest prevalence of APHIV in the world (2).

InTSHA Parent Study

Between March 2021 and February 2022, we recruited 80 adolescents to the InTSHA trial who were 15–19 years old; perinatally infected with HIV; receiving ART for at least 6 months; fully aware of their HIV status; and able to access a smartphone. We excluded adolescents who were unable to read and/or speak English or *isi*Zulu or unable to provide informed consent. Participants eighteen years and over provided informed consent, whereas participants under eighteen years provided informed assent and caregiver consent. We randomly assigned study participants to one of two arms: a control group receiving the standard-of-care, and the intervention arm, involving twelve virtual group chat sessions covering various topics, such as treatment adherence, stigma and self-efficacy, relationships, goals and future planning, and sexual and reproductive health. For each intervention group chat, two facilitators—both bi-lingual, female South Africans trained in social work, education, and HIV care (authors TS and NN)—co-led the modules for the adolescents. The facilitators also ran a separate group chat for the caregivers of the participants which addressed the same material each week. Full information about InTSHA can be found in the intervention protocol (24).

Study Design and Sample Selection — SRH Qualitative Study

From September to December 2021, we used convenience sampling via telephone to select adolescents who had participated in the InTSHA intervention and completed the modules on Sexual and Reproductive Health and Gender and Sexuality (referred to as the 'SRH modules') (Fig. 1). Through purposive sampling, we attempted to ensure balanced representation of age and sex. No participants refused to participate, and enrollment continued until thematic saturation was met (i.e. no new themes or codes were identified). We adhered to the Consolidated Criteria for Reporting Qualitative Research guidelines (25) (Appendix 1).

Data Collection

Each participant completed a 30- to 60-minute in-depth interview (IDI) in a private room at KwaMashu Community Health Center. The IDI guide (Appendix 2), with questions based on the intervention content and framed by the Theory of Planned Behavior (26), was organized to explore: perceptions of sexuality, reproductive health, and cultural norms about sex; personal experiences with sexuality, relationships, and conversations about SRH, and opinions of the intervention topics and online format. Interviewers included a multi-lingual, Bachelor's-level, South African research assistant (author TS) and an English-speaking, Master's-level, American research fellow (author SB), both female, who conducted IDIs in the participant's preferred language, either English or *isi*Zulu. For each interview, one interviewer conducted and audiotaped the interview while the other took field notes. The interviewers were not associated with the clinic and are not involved in clinical care but had formed a longitudinal relationship with the participants as intervention facilitators. Participants were reimbursed 250 Rand—approximately $17 USD—for completing the IDI.

Data Analysis

A research assistant who did not participate in the interviews (author MK) transcribed and separately translated the audiotaped interviews. The primary interviewer reviewed the transcriptions for accuracy. After transcription, all participant identifiers were removed, and transcripts were stored on password-encrypted computers. Through an iterative process (27), two team members (authors SB and BZ) established a final qualitative codebook through open discussion until consensus definitions were created. We categorized interview content into five parent codes: 1) Knowledge and Attitudes about Sexuality, 2) Knowledge and Attitudes of Cultural Norms, 3) Romantic and Sexual Relationships, 4) Communication about SRH, and 5) Impressions of InTSHA. Two research team members (authors SB and MF) independently applied the coding schema to each transcript using Dedoose qualitative analysis software (28), following a structured, hierarchical coding process, to assess perspectives of SRH before and after the intervention until thematic clinsaturation was reached. Additional research team members (authors TS and BZ) reviewed the coded transcripts and codebook to ensure consistency between data and findings.

Ethical Approvals.

The Biomedical Research Ethics Committee of the University of KwaZulu-Natal, KwaZulu-Natal Department of Health, Mass General Brigham (formerly Partners HealthCare) Research Ethics Board, and Emory University Institutional Review Board approved this study.

Results

We interviewed twenty-one adolescents with a mean age of 16.6 years (range: 15–19), 61.9% of whom were female (Table 1). Most (90.4%) adolescents conducted their interviews in *isi*Zulu. Thematic coding resulted in two major themes: [1] sources of SRH knowledge for APHIV outside of InTSHA, and [2] the impact of InTSHA on SRH knowledge, attitudes, and behaviors.

Table 1
Descriptive Characteristics of Study Sample (n = 21)

Variable	n (%) or Median (Range)
Sex	
Male	8 (38.1%)
Female	13 (61.9%)
Age (years)	16.6 (15–19)
Interview Language	
isiZulu	19 (90.4%)
English	2 (9.6%)
Relationship Experience	
No relationship experience At least one relationship	10 (47.6%)
	11 (52.4%)
Education Level	
Grade 8–9	7 (33.3%)
Grade 10–12	13 (61.9%)
Not in School	1 (4.8%)

Sources Of Srh Knowledge For Aphiv Outside Of Intsha

Adolescents have a variety of personal relationship experiences.

In the IDIs, some participants discussed having never been in a romantic or sexual relationship. Many did not wish to enter relationships this early in their lives, fearing the consequences of sex or opting to focus on school and friendships instead.

"*I won't rush to have sex until I am 21 years old. I don't even desire it."* (Female, 19).

For those who already had relationship experiences, some described healthy relationships involving communication, trust, and conflict resolution. In one example, this involved HIV-status disclosure.

"We were taking the same medication [...] so I felt like I could trust him" (Female, 15).

While most relationships described were heterosexual, some described being in *"a same-gender relationship"* (Female, 15).

Others described unhealthy relationships. These involved cheating: *"My first girlfriend was seeing another guy"* (Male, 18), lack of commitment: *"She was always claiming to be busy"* (Male, 16), and pressure: "*It*

was moving too fast. I thought I was going to get pregnant" (Female, 16).

Adolescents receive piecemeal sexual education that is often incorrect and stigmatizing.

Adolescents described their limited sources of information about SRH in their everyday lives coming from caregivers, technology, and peers.

Many adolescents reported feeling a sense of discomfort at the idea of discussing SRH with family, expressing: "*I wouldn't know where to start"* (Female, 19), "*It is just not in me yet"* (Male, 16), and "*I just feel nervous"* (Male, 18). In explaining why he had not spoken to his caregivers about sex, one adolescent reported: "*They will think I am already sexually active. They won't believe that I am just curious"* (Male, 15).

Occasionally, adolescents reported desiring such conversations with caregivers, but said that "*old-fashioned and overprotective"* (Female, 16) familial norms prevent them from occurring.

"The way I am brought up, my mother doesn't communicate. When you make a mistake, she hits you, but she won't have a deep conversation with you about being a female. Mom is not an open person" (Female, 16),

If discussions about sexuality were present at home, adolescents reported that they were often derogatory or even threatening, preventing open communication about healthy relationships. Many adolescents discussed having protective family members who often reiterate the negative consequences of sex, such as early pregnancy: "*My granny tells me to behave so I don't have a child while I'm still young"* (Female, 18) and educational disturbances: *"My mother tells me that I should just focus on my studies"* (Female, 15). Rather than suggesting abstinence or putting off relationships, adolescents said that some family members deliver messages of harm-reduction, such as "*to have one partner, not many partners"* (Male, 18) and "*to use condoms and contraception and avoid sleeping around"* (Female, 17).

Because of the limited exchange of information about SRH at home, one participant reported learning about sex through technology, including pornography and internet searches.

"I first heard about sex when me, my sister, and my friend decided to go to a boy's house to watch a porn DVD. I didn't understand, but all I knew is that we also wanted to do this thing. Us girls then decided to do a role play, one to be a man and one to be a woman. We got caught and we got a hiding" (Female, 16).

Other times, adolescents reported turning to technology as a way to learn about sexuality when they have no one else to turn to for information.

"I am not allowed to watch soap operas with lovers when my mother is around, but when I am alone, I watch them and learn from them. I also use the phone internet to learn about what is happening in real life" (Female, 16).

Due to limited information at home, APHIV reported often seeking out sex education from peers. Friends, they reported, are often a positive source of information about SRH in contrast to family or the internet. Participants reported relying on their friends to decide the right time to engage in sex: "s*ome friends say we are still too young"* (Female, 19), and: "*we tell each other how much of a burden it can be to have a child while young"* (Female, 17). Other adolescents recalled receiving advice from peers on dealing with coercion in relationships: "*my friends said to just tell him how you feel and walk away"* (Female, 17), and navigating their first relationships: *"I was shy, but I opened up to my friend and she guided me"* (Female, 18). One adolescent reported being the friend that typically gives advice to others: "*I am a person who they can communicate with easily, so I advise them depending on their situations"* (Female, 16). Others described a mutual exchange of information in a group setting: "*We sit down as guys and talk about what can build or destroy relationships"* (Male, 18), and "*My friends and I talk about girls and the way they behave"* (Male, 15).

However, these unmoderated settings for adolescents discussing SRH often lead to peer pressure, gossip, and misinformation. Adolescents reported discrimination in discussions about SRH at school, saying *"my classmates will joke about sex and just make fun of it. Sometimes they also joke around about HIV"* (Female, 18). Further, many reported a lack of confidentiality, and even the spread of false gossip, amongst classmates. One participant reflected:

"*My relationship ended so badly, because she told all her friends that I was too scared to have sex. And her friends told my friends. I was so mad, so I just left her and got out of school and got away from it all"* (Male, 18).

Some reported that peer pressure made them rush into sexual activity: "*my friends put pressure on us, telling her to kiss me"* (Male, 15). When asked to discuss the mechanisms of peer pressure, the same adolescent explained:

"*We do things for the hype. In my community, once you start doing something, you feel accepted and get compliments from friends"* (Male, 15).

Male adolescents said that sex is spoken about in an aggressive way in their community: *"they use a lot of words about sex. They end up cursing each other about it"* (Male, 16). Another adolescent described the lack of confidentiality and trust with community members, explaining: "*I cannot tell things to a person from outside, because you never know if they want to gang up on you or tell secrets about you"* (Male, 18). Overall, adolescents have a desire to discuss sex, sexuality, and health, but their current sources of information are limited.

The Impact Of Intsha On Srh Knowledge, Attitudes, And Behaviors

Adolescents described some of the lessons they learned from the SRH modules.

Many participants described gaining a holistic understanding of SRH through the mHealth intervention that changed their attitudes, knowledge, and behaviors. Table 2 shows how participants responded when asked, “What has changed for you since completing the SRH modules?”, in which adolescents describe new information, changed attitudes, and heathier behaviors in their lives after participation in the WhatsApp modules.

Table 2
Participant responses to the question “What has changed for you since completing the SRH modules?”

Post-mHealth Changes	Quote	Identification
Changes in Attitude	*“You have to talk to your partner and have an agreement”*	Male, 15
	“A healthy relationship has trust and communication”	Male, 16
	“I learned not to care about what people say, and not to rush things”	Male, 18
Changes in Knowledge	*“Sex at an early age is not good because you get pregnant while your peers continue at school”*	Female, 15
	“We must always use protection when having sex”	Female, 18
	“Now I know sexuality involves two people who agree to be involve in sex, or other things you can agree to do”	Female, 16
Changes in Behavior	*“I don’t harass girls anymore due to what I learned from the group”*	Male, 15
	“I learned how we shouldn’t force each other to have sex, and if someone says no, we should respect that”	Female, 19
	”It was a good thing to educate us about sex because most of us might end up doing wrong things”	Male, 15
	“I realized that if a person puts pressure, you need to distance yourself from them. Be brave enough to say you are not ready and for the person to respect your decision”	Male, 15

InTSHA is a conversation starter.

Adolescents said that the mHealth intervention allowed them to begin conversations about SRH with their caregivers, where discussion of SRH had previously been lacking. Adolescents reported that having family around when they participated in the modules could be an asset to their comprehension of the content: “*you are sometimes in the house with other people and you can chat to them as well”* (Male, 15). Referencing the simultaneous modules led with caregivers of ALHIV, one participant said: “*My auntie knows about the group, she is in the group”* (Male, 18). When asked whom they turned to when they did not understand content from the modules, one participant said “*My mother helped me and*

explained" (Male, 16). Similarly, another adolescent reported *"I asked my parents when I didn't know"* (Male, 15).

However, others viewed the lack of privacy in the home as a barrier to participation. "*I was not comfortable talking about HIV in front of the people who live with me"* (Female, 16). Another claimed phone-sharing was a challenge to confidentiality in sensitive SRH conversations— "*we fear sharing phones with parents and parents going through the phones*" (Male, 16).

Adolescents left the intervention with additional questions.

During the IDIs, adolescents were asked "What skills or knowledge would you like to develop more?" and "What do you still feel confused or uncomfortable about?". Some of their responses to remaining SRH questions and unmet health needs are highlighted in Table 3.

Table 3
Participant responses to the questions "What skills or knowledge would you like to develop more?" and "What do you still feel confused or uncomfortable about?"

Topic	Question	Identification
HIV Disclosure	"*Is it ok to tell your girlfriend that you are HIV positive?"*	Male, 15
	"Are we able to tell our partner after being together for a long time? Are we forced to disclose?"	Female, 18
HIV Transmission	*"As people taking medication, are we able to be sexually active?"*	Female, 18
	"If you take your medication daily, can the virus be transmitted?"	Male, 16
	"If a condom bursts, can the girl get the virus?"	Female, 19
Sexual Abuse	*"I want to learn more about sexual abuse"*	Male, 16
Age Gap Relationships	*"How can a young girl be in a relationship with someone old enough to be their father?"*	Male, 15
Pregnancy Prevention	*"With abortion, are there any major after-effects that you go through?"*	Female, 17
	"How long does contraception take to work?"	Female, 17
Relationships and Communication	*"We must learn how to treat each other as people"*	Female, 18
	"You must teach us the way we should behave as teenagers"	Male, 17
	"We need to know about relationships, so that when we reach the right age, we can understand what life is really like"	Female, 17
	"Youth must learn ways to build self-confidence, see their own worth, have dignity and self-respect, be straightforward about what we want, and not be influenced by peer pressure"	Female, 16

InTSHA fostered an empowering and impactful environment.

Adolescents appreciated how conversations with the group facilitators play a novel and critical role in their sexual health education:

"*We need mentors and people to counsel us as we start the journey of dating, like you from the clinic. You have more knowledge than most and can give us sound advice"* (Female, 18).

One adolescent reported that some participants needed the intervention more than others—"*Some of us want the help because we have had some experiences and want more knowledge"* (Female, 17). These ideas were expressed by the following adolescent, who said "*I feel comfortable and confident and I can always go back to the group chats"* to review content from the modules (Male, 16).

Participants explained how the modules evolved both their knowledge and ways of thinking about SRH, saying "*It gave us big lessons to push us to do the right thing"* (Female, 17). Another explained: "*I didn't know a lot about sex and now I am more educated. I was very shy but now I am not shy anymore. It helped me with confidence* (Female, 17)".

Peer support was a unique asset of the InTSHA intervention. Some of the reasons that adolescents enjoyed the WhatsApp format when discussing SRH topics included a having a shared HIV status with others in the group: *"I feel safe and comfortable talking about my status"* (Male, 17), being a typically introverted person in group settings: "*those that are like me will feel comfortable when no one is looking at them"* (Female, 18), and emphasizing comfort: "*everyone felt free and open"* (Female, 17).

One adolescent reported that the comfort he developed with the group during the initial in-person session continued during the mHealth intervention: "*I enjoyed that we worked as a team. I didn't know that people were so open like that, and have the guts to tell us what is going on in their lives"*, and continued throughout the virtual chat groups: "*They still talk to me in private. They ask me how life is"* (Male, 18).

Many reported enjoying the familiar technological platform to exchange sensitive information confidentially and comfortably within a group that they trust. One compared it to another popular social media platform: "*I am getting used to it, speaking to a person that I can't see, like on Facebook"* (Female, 18). Another explained that certain adolescents may prefer the WhatsApp format because *"some people find it hard to open up in face-to-face sessions"* (Female, 18). A participant described using various features of the app outside of the group chat, such as "*private messages to others in the group* w*hen there is a word I don't understand"* (Female, 16).

Adolescents agreed that mHealth interventions can supplement and improve their current sources of SRH information and support while initiating conversations about sexuality.

Discussion

APHIV participants reported having a variety of relationship experiences, but having non-specific, incorrect, and stigmatizing sources of information about SRH. They usually preferred peer interactions to conversations with caregivers, which are usually perfunctory or prescriptive. Describing their experiences

with InTSHA, they reported that the mHealth intervention filled gaps in their SRH education by bringing together adolescents with similar backgrounds to learn holistically about SRH through engaging, bi-directional conversations that made lasting change in their SRH attitudes, knowledge, and behaviors, including a newfound ability to talk about SRH with adults.

Current literature shows major gaps in sexual health knowledge and decision-making in youth across Sub-Saharan Africa, with APHIV in need of targeted education and greater access to SRH resources due to their unique health needs (6). Adolescents in South Africa, who primarily receive their SRH education in school, have high rates of unprotected sexual activity without awareness of the consequences, or the ability to communicate with partners and caregivers about their health needs (7). While it is clear that peers play an integral role in adolescent sexual education, few studies have described the nuances and impacts of specific peer relationships on adolescent SRH (10,11). Across sub-Saharan Africa, family members have been shown to create an uncomfortable environment about sexuality due to cultural and religious norms (29). To bridge these gaps, APHIV need holistic SRH education targeted to their unique health needs, including strategies to improve communication, decision-making skills, self-efficacy, and self-determination to begin to improve SRH knowledge and behavior (30).

Our results bring nuance into these pre-established notions of SRH education for APHIV. Not only is traditional sexual health education in schools insufficient all over the world (40), but the content and learning environment is often stigmatizing for APHIV. While classmates often spread rumors and misinformation about SRH, adolescents rely on relationships with close friends for information and support as they navigate their romantic and sexual relationships (31). However, adolescents do not usually share their HIV status with friends, just certain family members. Although caregivers are usually dismissive about SRH with their APHIV, and especially admonitory with their daughters, our results show that they have the potential to be essential sources of information and resources for their children.

mHealth interventions have been shown to either engage adolescents in HIV prevention and care (19,32) or provide adolescent sexual education (20–22,33–35), but usually not at the same time. HIV-focused mHealth interventions such as the *ILoveLife* website to prevent the spread of HIV in Uganda (17) and a text-based counseling intervention to increase ART adherence in APHIV in South Africa (32) showed success in improving knowledge and behavior change but were more didactic than interactive. Recent mHealth interventions for adolescent SRH education have included *MyQuestion*, which allowed young Nigerians to text anonymous SRH questions to trained counselors about menstruation, pregnancy, STIs, and relationships (20), and *In This toGether*, a daily text-message based program in Uganda, which provided informational support—but not peer or social support—about safe sex (35).

While these mHealth interventions focus on the exchange of information with an expert rather than support from peers, InTSHA is unique in developing comprehensive, interactive sexual education specific to the unique sexual heath and support needs of APHIV. In our study, adolescents reported that mHealth can provide a supportive, destigmatized, mutual exchange of information and experiences about SRH. Participants reported that InTSHA successfully used WhatsApp, a familiar tool, to foster a peer group with

a shared background—HIV status, culture, and neighborhood—that evolved their SRH knowledge, attitudes, and behaviors. While InTSHA was not meant to be an all-inclusive curriculum of all SRH topics, adolescents reported that it bridged the gap between their knowledge and behavior by improving decision-making and communication skills. Adolescents left the modules with questions that they were able to ask other group members, study staff, and family members, slowly destigmatizing conversations about SRH.

It is critical to contextualize these results in current events and the sociocultural environment. During the intervention, the KwaZulu-Natal was facing the devastating effects of political unrest and new waves of the COVID-19 pandemic, which had drastic effects on HIV-care and in-person education around the world (36). However, mHealth has been shown to continue to provide support and information related to chronic disease care when traditional service delivery mechanisms are disrupted (38). Within InTSHA, participation was high in the WhatsApp groups as adolescents were able to participate from their own homes during a time when safe transportation to the clinic would have been burdensome or unsafe. Our data shows that InTSHA allowed APHIV to feel safe, open, and confident as they learned together.

This study has a number of limitations. This qualitative study consisted of 21 ALHIV who completed the mHealth intervention, InTSHA. Due to small sample size, results should not be generalized to all APHIV, and due to a short follow-up period, we cannot report on long-term knowledge or behavior change. Future studies will assess the impact of this intervention on a larger and more longitudinal scale. Further, all participants had some access to a smartphone and mobile data, without which they could not have participated in the intervention. In other populations within this same region, a mobile health intervention may not be as feasible and acceptable due to technology and data limitations. However, smartphone coverage in South Africa is estimated to be over 90%, and nearly all of the population has data coverage, pointing to the feasibility of potential scale up (39). Finally, topics discussed were often sensitive, and some adolescents appeared less open sharing details of their relationships and sexual behaviors with interviewers. This could have limited possible alternative perspectives. To combat this, all efforts were made in the interview questions, format, and confidentiality to make participants feel comfortable sharing their experiences.

Conclusion

South African APHIV receive inadequate, fragmented sexual education from a combination of peers, caregivers, and teachers that is not targeted to those living with HIV. The use of mHealth interventions for holistic sexuality education, specifically tailored to the unique SRH needs of APHIV, can destigmatize sexuality, expand access to correct SRH information, and begin conversations to improve the sexual health knowledge and behaviors of APHIV.

Declarations

Ethical Approval: Ethical approval was obtained from the Institutional Review Board (IRB) at Emory University in the USA and the Biomedical Research Ethics Committee (BREC) the University of KwaZulu-Natal in South Africa (reference number BFC057/18).

Consent to Participate: All participants provided written informed assent if under 18, and written informed consent if over 18. A caregiver also provided written informed consent if their adolescent was under 18. All consent and assent forms were read to the participants in their chosen language (isiZulu or English), and participants were given the opportunity to ask questions to ensure their understanding.

Consent for Publication: All participants gave consent for publication.

Availability of Data and Materials: Data and qualitative node summaries are available upon request.

Competing Interests: VCM reports research grants from the CDC, Gilead Sciences, NIH, Veterans Affairs, and ViiV Healthcare; honoraria from Eli Lilly and Company; has served as an advisory board member for Eli Lilly and Company and Novartis; and has participated as a study section chair for the NIH. JEH has been a paid consultant for Merck. The remaining authors have no conflicts of interest to disclose.

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Authors Contributions: SB is the primary author, drafting the manuscript throughout her Fulbright grant. Under the mentorship of principal investigators BZ and MA, authors TS, MN, and SB ran the intervention and collected data. Data analysis for the interviews was completed by SB and MF. The final manuscript was revised and approved by all team members.

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Figures

Figure 1

Study Sample (n=21)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplement1COREQChecklist.pdf
- Appendix2SRHInterviewGuide.pdf