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ORIGINAL PAPER

Risk Factors Associated with HIV, Sexually Transmitted Infections (STI), and HIV/STI Co-infection Among Youth Living in the Slums of Kampala, Uganda

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Abstract
The purpose of this analysis was to examine the associated factors of self-reported HIV/STI co-infection among youth living in the slums of Kampala. The study sample consists of a cross-sectional survey. Participants comprised a convenience sample (N = 1134) of youth living on the streets or in the slums (age 12–18). Multinomial logistic regression analyses were used to determine the association between hypothesized risk factors and levels of HIV/STI co-infection, adjusting for sociodemographic variables. Among the sample of youth who were sexually active (n = 586), 9.9% (n = 58) of youth reported HIV/STI co-infection. Among youth with HIV (13.8%), 71.6% reported a co-infection with another STI. In the multivariable analysis, youth with HIV/STI co-infection were more likely to engage in problem drinking (OR 2.55; 95% CI 1.08, 6.02) and drinking alcohol without problematic alcohol behavior (OR 3.43; 95% CI 1.60, 7.36). HIV/STI co-infection rates are high among youth living in the slums of Kampala and warrant urgent attention.

Keywords AIDS/HIV · Adolescents · Alcohol · Sexually transmitted infection

Introduction

HIV prevalence is high (6.5%) among individuals living in Uganda [1], and Uganda is one of the few countries where HIV rates are increasing rather than decreasing [2]. HIV prevalence is even higher (13.9%) among youth living in the slums of Kampala [3], as they are particularly vulnerable due to food scarcity, lack of parental oversight, and limited infrastructure [4–9]. To exacerbate this issue, co-infection of sexually transmitted infections (STI) and HIV is a serious concern among these youth and appear highly prevalent. In a systematic review analyzing the prevalence of STI co-infections among people living with HIV, there was a 11.3% prevalence of co-infection with STIs among individuals in Africa [10]. HIV/STI co-infection may result in severe complications, including increased mortality from co-infection with STIs such as hepatitis C [11]. HIV and co-infection with herpes simplex virus type 2 (HSV-2) has also been associated with a higher detectable HIV viral load, potentially complicating the clinical treatment of HIV and potentially increasing the transmissibility of HIV [12]. Moreover, the presence of certain STIs among HIV-negative individuals, such as HSV-2 and syphilis, may increase the risk of HIV acquisition [13].

Multiple risk factors likely associated with HIV/STI co-infection have been identified in the literature such as alcohol use, inconsistent condom use, and commercial sex work. Alcohol use, as an example, is a well-known risk factor for the acquisition of HIV and STIs independently, and several recent studies have linked alcohol use with HIV/STI co-infection [14, 15]. Among individuals with HIV, co-infection with another STI was statistically significantly

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associated with greater alcohol use and problem drinking [14]. Additionally, alcohol and drug use was also found to be associated with HIV/STI co-infection among patients attending an STI clinic in Spain [15].

Inconsistent condom use is a key risk factor for HIV and STI acquisition, as well as for HIV/STI co-infection [10, 13]. Although studies have documented an increase in condom use among individuals in Uganda [16, 17], little is known about condom use behaviors among youth living in the slums of Kampala, Uganda. Furthermore, a higher number of sexual partners has been linked to HIV/STI co-infection in Europe [18] and Asia [19].

Other high-risk behaviors, such as engaging in commercial sex work, have been linked to a high prevalence of HIV/STI co-infection [20]. Limited ability to negotiate condom use with clients and forced sex or rape episodes seem to largely explain the link between commercial sex work and HIV/STI co-infection [20–22]. Moreover, youth living in the slums of Kampala who engage in commercial sex work (13.7%) have also reported clients paying more for unprotected sex [3]. The youth in the slums of Kampala who engage in sex work have a 13% prevalence of self-reported HIV, and the majority also report ever using alcohol [3].

Additionally, experiences of early life adversities may increase the risk of HIV and STI acquisition. Approximately 34% of youth living in the slums of Kampala report child physical abuse [8]. Studies have linked child maltreatment experiences, specifically parental physical abuse and sexual abuse, with more risky sexual behaviors in adolescence, thus increasing the risk of HIV/STI acquisition among youth [23–25]. The association between child maltreatment and risky sexual behaviors may be best explained through emotional dysregulation theory [24, 26]. Child maltreatment negatively impacts the youth's emotional regulation, and individuals who have experienced maltreatment are less likely to adequately control emotional responses. As such, youth with previous adverse experiences may be less likely to control impulses when experiencing negative emotions, and this may be the mechanism leading to an increased risk in sexual behaviors and ultimately, HIV/STI acquisition [26–28].

There are no studies that exist, to our knowledge, that examine self-reported HIV/STI co-infection and associated risk factors among youth (12–18 years of age) who live in the slums of Kampala or in the broader region. By determining the factors associated with HIV/STI co-infection, the results may inform prevention interventions which concurrently target HIV/STIs. Furthermore, this analysis intends to highlight which risk factors have the strongest impact on HIV/STI acquisition for this vulnerable population. As mentioned previously, this population is particularly vulnerable due to their dire environmental and social living conditions [4–9]. Youth living in the slums of Kampala also report high levels of alcohol use, problem drinking, and homelessness [29]. Therefore, predictors of HIV/STI co-infection may differ in this population compared to populations with more access to preventive services. The purpose of this analysis is to (1) compute the prevalence of self-reported HIV/STI co-infection among sexually active youth living in the slums of Kampala, and (2) assess the associated risk factors (condom use at last sexual encounter, multiple sexual partners, problem drinking, sex work engagement, parental physical abuse, and sexual abuse) for HIV/STI co-infection, HIV infection only, and STI infection only compared to the absence of HIV or other STI infection. The results from this analysis may inform prevention strategies to reduce HIV/STI co-infection among vulnerable youth in Kampala and in similar settings.

Methods

Setting

The current paper is based on the Kampala Youth Survey 2014. The objective of the study was to examine alcohol use, sexual behaviors, and HIV among youth living in the slums of Kampala who were 12–18 years of age. The youth were attending a Uganda Youth Development Link (UYDEL) drop-in center, which has numerous services for youth living on the streets and slums, including vocational training, substance use programs, and child rights protection services [30]. Study participants were recruited at six drop-in centers in the surrounding neighborhoods of UYDEL.

Data Collection

Over the 15 day (March 19 to April 2) data collection period, 1628 youth were approached for participating in the survey. Among these youth, 131 declined yielding a participation rate of 92%. A total of 1497 surveys were collected, including 43 pilot cases. Three hundred and twenty (320) surveys were lost due to technical issues with the offline server, yielding 1134 completed surveys for the final analytic sample of youth between the ages of 12 and 18 (44% male, 56% female) (Fig. 1).

Each social worker and peer educator received training on the study methodology. Each of the survey questions were translated into Luganda (local language) if needed, and the social workers and peer educators recruited potential participants among attendants at their specific drop-in center. Face-to-face interviews were conducted by social workers and peer educators employed by UYDEL with previous experience working with youth within the targeted drop-in centers and communities. The survey was administered to the participants on Google Nexus 7 tablets. The use of tablets as an mHealth technology allowed for easier administration

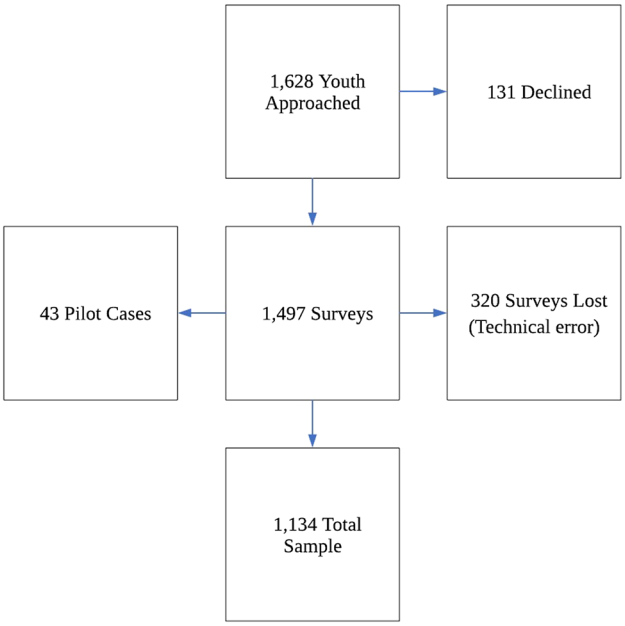

Fig. 1 Flowchart of recruitment strategies and final surveys for the Kampala Youth survey 2014

of the survey and streamlined data collection. Participants were informed about the study and read (or were read) the consent forms to indicate their willingness to take the survey. All participants provided verbal consent to participate in the study. Youth who "cater for their own livelihood" are considered emancipated in Uganda and are able to provide their own consent for the survey without parental consent. Since these youth were considered emancipated, waiver of parental consent was applicable. Participation was limited to youth ages 12–18 present in-person on the day of the field visit. There were no other exclusion criteria. Recruited youth received a small snack as incentive for participating in the survey. Both the Georgia State University Institutional Review Board and the Uganda National Council for Science and Technology approved this study.

The Kampala Youth Survey 2014 was mostly based on previously validated questionnaires, including the Global School-based Student Health Survey (GSHS) [31] Kampala Youth Survey 2011 [3–6, 32], MAMPA (Monitoring Alcohol Monitoring in Africa) 2012 Questionnaire, AUDIT (Alcohol Use Disorders Identification Test) Questionnaire [33], CAGE (Cut-Annoyed-Guilty-Eye) Questionnaire [34], iMPPACS, Uganda AIDS Indicator Survey [35], and the Demographic Health Survey (Uganda) [36]. The GSHS is administered across several countries to assess the behavioral risk and protective factors for alcohol use, mental health, sexual risk behaviors, and other behavioral and social outcomes [31]. The Kampala Youth Survey 2011 collected information from a smaller sample of service-seeking youth in the Kampala region regarding sexual risk behaviors, alcohol use behaviors, and violence perpetration and victimization measures [3–6, 32]. The AUDIT is used to determine the presence of alcohol use disorders [33], and the CAGE questionnaire is used to determine problematic alcohol use (indicated by a score of greater than 2 on the sum of its 4 binary measures) [34]. Project iMPPACS was a mass media prevention campaign and survey that targeted safer sex messages and HIV prevention messages [37]. The AIDS indicator survey is a tool used to monitor HIV/AIDS prevalence and associated risk factors across several countries [35]. The Demographic Health Survey collects a wide range of health-related information on their surveys which are also administered across many countries [36]. Additionally, demographic information was collected and included age, sex, education, and religion.

Data Analysis

The analytic sample consisted of only sexually active youth (n = 586) to enable comparability of the outcome categories. Youth were classified as being sexually active if they answered "Yes" to the question, "Have you ever had sexual intercourse?" The outcome was created using four mutually exclusive categories: HIV/STI co-infection, HIV infection only, STI infection only, and no HIV/STI infection. HIV infection was self-reported and determined by the question, "Have you ever been told by a doctor/nurse or HIV counselor that you have HIV?" The presence of an STI was also self-reported and determined by the question, "Have you ever been told by a doctor/nurse or HIV counselor that you have a sexually transmitted infection such as syphilis, herpes, bola bola, or gonorrhea?" Answers were dichotomized into "Yes" or "No."

Condom use at last sexual encounter was assessed using, "Did you use a condom the last time you had sexual intercourse?" Previous research has shown that assessing condom use at last sexual encounter is a reliable measure of inconsistent condom use [38]. Multiple sexual partners was assessed using, "With how many different people have you had sexual intercourse with in your life?" Problem drinking was operationalized using the CAGE questionnaire [34]. The CAGE questionnaire consists of four questions: "Have you ever felt you should cut down on your drinking?"; "Have people annoyed you by criticizing your drinking?"; "Have you ever felt bad or guilty about your drinking?"; and "Have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover (eye opener)?" Each question was marked as a "1" for a response of "Yes," and responses of "No" received a "0." Responses were totaled and for scores of 2 or more were considered problem drinking [34]. Commercial sex work engagement was operationalized using the question, "Are you currently engaged in commercial sex work?"

Familial factors were assessed to determine the association of early life adversities and maltreatment with HIV/STI co-infection. Parental physical abuse was assessed using, "Did your parents ever beat you so hard you had bruises or marks?" Sexual abuse was assessed using, "Has someone ever raped you or forced you to have sex with him or her?"

Hypothesized risk factors (condom use at last sex, multiple sexual partners, problem drinking, problem drinking, parental physical abuse, sexual abuse) were selected based on previous empirical evidence [14–23, 27, 28]. Potential confounders and demographics were also assessed (sex, age, and education). Descriptive statistics were computed among the 4 outcome categories and hypothesized risk factors and demographic characteristics. Bivariate and multivariable multinomial logistic regression was used to determine the association between hypothesized risk factors, demographic characteristics, and the outcome (HIV/STI co-infection, HIV infection only, STI infection only compared to no infection). Additional pairwise analyses were computed to analyze the 4 levels of the outcome with each group as the reference group. Odds ratios and 95% confidence intervals are presented from the bivariate and multivariable analyses. All analyses were performed using SAS 9.4.

Results

Among the youth who were sexually active (n = 586), 9.9% (n = 58) reported HIV/STI co-infection, 3.9% (n = 23) reported HIV infection only, 42.4% (n = 251) reported a STI infection only, and 43.4% (n = 254) reported no infection (Table 1). Overall, the HIV prevalence was 13.8% (n = 81) among all sexually active youth. Among individuals with HIV, 71.6% reported a co-infection with another STI. Most of the youth who reported HIV/STI co-infection were female (74.1%), and 38.6% reported having a secondary education or higher. The bivariate and multivariable analyses are presented in Table 2. In the bivariate analysis, females were more likely to report an STI only (OR 1.69; 95% CI 1.18, 2.41) compared to males. Additionally, females were also more likely to report HIV/STI co-infection (OR 2.61; 95% CI 1.38, 4.93) compared to males. In the multivariable analysis, females were more likely to report an STI infection only (OR 1.77; 95% CI 1.17, 2.68) compared to males. Education was not associated with infections in the bivariate or multivariable analyses.

Youth living with an HIV/STI co-infection also reported the lowest rates of condom use at last sex (55.2%) compared to youth with an HIV infection only (69.6%), STI only (67.7%), and no infection (66.5%). However, condom use at last sex was not associated with HIV and STI infections in the bivariate or multivariable analyses. The prevalence of reporting 5 or more sexual partners was 27.9% among youth who reported STI infection only and 32.8% among youth who reported HIV/STI co-infection. Youth who reported 3-4 sexual partners were more likely to report an STI only (OR 2.45; 95% CI 1.60, 3.75) compared to youth who reported 1-2 sexual partners. Youth who reported 5 or more sexual partners were more likely to report an STI only (OR 3.36; 95% CI 2.08, 5.41) and HIV/STI co-infection (OR 3.35; 95% CI 1.68, 6.68) compared to youth who reported 1-2 sexual partners. However, in the multivariable analysis, youth who reported a higher number of sexual partners were more likely to report an STI only, and the association between multiple partners and HIV/STI co-infection was not observed in the multivariable analysis. Youth who reported having 3–4 sexual partners (vs. 1–2 sexual partners) were more likely to report STI only (OR 2.35; 95% CI 1.46, 3.79), and youth who reported having 5 or more partners were more likely to report an STI only (OR 2.80; 95% CI 1.55, 5.06).

Problem drinking was also prevalent among youth with an HIV/STI co-infection (32.8%). Additionally, a high percentage of youth reported ever drinking alcohol but were not classified as problem drinkers (37.9%). With the reference outcome being no infection, youth who reported problem drinking were more likely to report an STI only (OR 2.40; 95% CI 1.53, 3.77) or HIV/STI co-infection (OR 3.25; 95% CI 1.56, 6.78) compared to those who did not report drinking alcohol. Youth who reported drinking alcohol, but not problem drinking, were also more likely to report having an STI only (OR 2.26; 95% CI 1.47, 3.49) or having an HIV/STI co-infection (OR 3.71; 95% CI 1.86, 7.40) compared to youth who did not report drinking alcohol. These associations also remain statistically significant in the multivariable analysis, although the magnitude of these associations are attenuated in the multivariable analysis.

The prevalence of engaging in commercial sex work was the highest among youth reporting HIV/STI co-infection (29.3%) and among youth reporting STI only (17.9%) compared to youth reporting HIV infection only (4.4%) and no infection (6.7%). With the reference outcome being no infection, youth who engaged in commercial sex work were more likely to report an STI only (OR 3.05; 95% CI 1.69, 5.49) or HIV/STI co-infection (OR 5.78; 95% CI 2.73, 12.23) compared to youth who did not report engaging in commercial sex work. These associations, however, were not statistically significant in the multivariable analysis.

Sexual abuse was also highly prevalent among youth with an HIV/STI co-infection (44.8%) compared to youth with a HIV only, STI only, and no infection. With the reference outcome being no infection, youth who experienced sexual abuse were more likely to report an STI only (OR 1.88; 95% CI 1.24, 2.85) or HIV/STI co-infection (OR 3.58; 95% CI 1.95, 6.56) compared to youth who had not experienced sexual abuse. However, these associations were not statistically significant in the multivariable analysis.

Table 1 Demographic characteristics and risk factor prevalence among youth living in the slums of Kampala with no HIV/STI, HIV only, STI only, and HIV/STI co-infection, (n = 586)

Demographic/risk factor variable	Total (n = 586) 100%	No infection (n = 254) 43.3%	STI only (n = 251) 42.8%	HIV only (n = 23) 3.9%	HIV/STI Co-infection (n = 58) 9.9%
Gender, n (%)					
Male	240 (41.0%)	121 (47.6%)	88 (35.1%)	16 (69.6%)	15 (25.9%)
Female	346 (59.0%)	133 (52.4%)	163 (64.9%)	7 (30.4%)	43 (74.1%)
Age, M (SD)	17.0 (1.3)	17.0 (1.3)	17.0 (1.1)	16.8 (1.2)	16.7 (1.7)
Education, n (%)					
Less than primary	196 (33.9%)	81 (32.1%)	95 (38.5%)	3 (13.0%)	17 (29.8%)
Completed primary	120 (20.7%)	48 (19.1%)	48 (19.4%)	6 (26.1%)	18 (31.6%)
Secondary or higher	263 (45.4%)	123 (48.8%)	104 (42.1%)	14 (60.9%)	22 (38.6%)
Behavioral factors					
Condom use at last sex					
Yes	387 (66.0%)	169 (66.5%)	170 (67.7%)	16 (69.6%)	32 (55.2%)
No	199 (34.0%)	85 (33.5%)	81 (32.3%)	7 (30.4%)	26 (44.8%)
Number of sexual partners					
1–2 partners	311 (53.1%)	168 (66.1%)	103 (41.0%)	12 (52.2%)	28 (48.3%)
3–4 partners	149 (25.4%)	52 (20.5%)	78 (31.1%)	8 (34.8%)	11 (19.0%)
5 or more partners	126 (21.5%)	34 (13.4%)	70 (27.8%)	3 (13.0%)	19 (32.8%)
Problem drinking					
Yes	296 (50.5%)	160 (63.0%)	106 (42.2%)	11 (47.8%)	19 (32.8%)
No, but drinker	153 (26.1%)	50 (19.7%)	75 (29.9%)	6 (26.1%)	22 (37.9%)
Non-drinker	137 (23.4%)	44 (17.3%)	70 (27.9%)	6 (26.1%)	17 (29.3%)
Engaged in sex work					
Yes	80 (13.7%)	17 (6.7%)	45 (17.9%)	1 (4.4%)	17 (29.3%)
No	506 (86.4%)	237 (93.3%)	206 (82.1%)	22 (95.6%)	41 (70.7%)
Familial factors					
Parental physical abuse					
Yes	229 (39.2%)	100 (39.4%)	92 (36.8%)	11 (47.8%)	26 (44.8%)
No	356 (60.9%)	154 (60.6%)	158 (63.2%)	12 (52.2%)	32 (55.2%)
Sexual abuse					
Yes	153 (26.1%)	47 (18.5%)	75 (29.9%)	5 (21.7%)	26 (44.8%)
No	433 (73.9%)	207 (81.5%)	176 (70.1%)	18 (78.3%)	32 (55.2%)

Seven observations deleted due to missing responses for HIV and STI questions (1.2% of total sample, n = 593)

Discussion

Our results demonstrate that young, sexually active youth ages 12 to 18, living in the slums of Kampala, Uganda have a high prevalence of HIV/STI co-infection. Among those with HIV, 71.6% reported co-infection with an STI. This prevalence is nearly 7 times higher than the reported prevalence of co-infection with an STI among HIV-positive persons in the literature (11.3%) [7]. In the bivariate analyses, HIV/STI co-infection was more common among females and associated with having 5 or more sexual partners, problem drinking, engaging in sex work, and sexual abuse. In the multivariable analysis, HIV/STI co-infection remained statistically significantly associated with problematic alcohol use.

Surprisingly, we did not detect an association between condom use at last sex and HIV/STI co-infection in our study; however, inconsistent condom use is a key risk factor for HIV and STI infection in other populations [10]. It is possible that we did not detect an association due to potential underreporting bias, or it's possible that other risk factors may predict HIV/STI co-infection more strongly than inconsistent condom use in this population. Moreover, our finding may also reflect the young population examined which comprised youth ages 12 to18 years. Future studies should examine multiple aspects of condom use among youth living in the slums of Kampala, including accessibility to condoms and social norms regarding condom use.

Having multiple sexual partners was associated with STI infection only and HIV/STI co-infection in the bivariate

Table 2 Bivariate and multivariable associations between demographic characteristics, risk factors and HIV/STI co-infection, HIV only, and STI only among youth living in the slums of Kampala, (n = 586)

	Unadjusted OR			Adjusted OR		
	STI only	HIV only	HIV/STI co-infection	STI only	HIV only	HIV/STI co-infection
Gender						
Male	1.00	1.00	1.00	1.00	1.00	1.00
Female	**1.69 (1.18, 2.41)**	0.40 (0.16, 1.00)	**2.61 (1.38, 4.93)**	**1.77 (1.17, 2.68)**	0.39 (0.14, 1.07)	1.99 (0.96, 4.15)
Age	1.05 (0.91, 1.21)	0.90 (0.66, 1.24)	0.88 (0.72, 1.09)	1.01 (0.86, 1.19)	0.78 (0.54, 1.13)	0.92 (0.72, 1.19)
Education						
Less than primary	1.00	1.00	1.00	1.00	1.00	1.00
Completed primary	0.85 (0.52, 1.40)	3.37 (0.81, 14.10)	1.79 (0.84, 3.79)	0.88 (0.52, 1.49)	3.46 (0.80, 15.00)	1.87 (0.84, 4.15)
Secondary or higher	0.72 (0.49, 1.07)	3.07 (0.86, 11.01)	0.85 (0.43, 1.70)	0.77 (0.50, 1.18)	3.67 (0.96, 14.06)	1.03 (0.49, 2.17)
Behavioral factors						
Condom use last sex						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.06 (0.73, 1.53)	1.15 (0.56, 2.90)	0.62 (0.35, 1.11)	1.04 (0.70, 1.55)	1.12 (0.43, 2.93)	0.62 (0.33, 1.16)
Multiple sexual partners						
1–2 partners	1.00	1.00	1.00	1.00	1.00	1.00
3–4 partners	**2.45 (1.60, 3.75)**	2.15 (0.84, 5.55)	1.27 (0.59, 2.72)	**2.35 (1.46, 3.79)**	1.83 (0.64, 5.19)	1.02 (0.44, 2.41)
5 or more partners	**3.36 (2.08, 5.41)**	1.24 (0.33, 4.61)	**3.35 (1.68, 6.68)**	**2.80 (1.55, 5.06)**	1.18 (0.26, 5.35)	1.97 (0.77, 5.04)
Problem drinking						
Yes	**2.40 (1.53, 3.77)**	1.98 (0.70, 5.66)	**3.25 (1.56, 6.78)**	**1.80 (1.08, 2.98)**	1.96 (0.62, 6.14)	**2.55 (1.08, 6.02)**
No, but drinker	**2.26 (1.47, 3.49)**	1.75 (0.61, 4.96)	**3.71 (1.86, 7.40)**	**1.97 (1.23, 3.15)**	1.46 (0.48, 4.39)	**3.43 (1.60, 7.36)**
Non-drinker	1.00	1.00	1.00	1.00	1.00	1.00
Engaged in sex work						
Yes	**3.05 (1.69, 5.49)**	0.63 (0.08, 4.99)	**5.78 (2.73, 12.23)**	1.00 (0.48, 2.09)	0.64 (0.06, 6.37)	1.70 (0.61, 4.77)
No	1.00	1.00	1.00	1.00	1.00	1.00
Familial factors						
Parental physical abuse						
Yes	0.90 (0.63, 1.29)	1.41 (0.60, 3.23)	1.25 (0.70, 2.23)	0.68 (0.47, 1.01)	1.04 (0.41, 2.59)	0.91 (0.49, 1.71)
No	1.00	1.00	1.00	1.00	1.00	1.00
Sexual abuse						
Yes	**1.88 (1.24, 2.85)**	1.22 (0.43, 3.46)	**3.58 (1.95, 6.56)**	1.29 (0.79, 2.09)	1.49 (0.47, 4.73)	1.80 (0.88, 3.69)
No	1.00	1.00	1.00	1.00	1.00	1.00

Referent category is the absence of infection

Statistically significant associations are bolded

Final adjusted model statistics: AIC (Akaike Information Criterion): 1222.404, Likelihood Ratio Test: $\chi^2 = 106.7$, $df = 36$, $p < 0.0001$

analyses; however, these associations were not statistically significant in the multivariable analysis. Multiple sexual partners may not be a driving factor of HIV/STI co-infection among this population. Future studies should examine the context of sexual partners. For example, multiple concurrent sexual partners may be strongly linked to HIV/STI co-infection compared to simply the total number of sexual partners [39].

A high percentage of youth who reported STI's only and HIV/STI co-infection reported problem drinking and alcohol use without problem drinking. Alcohol use was associated with both STI infection only as well as HIV/STI co-infection in the multivariable analysis. In fact, problem drinking and alcohol use in general were the only statistically significant predictors for HIV/STI co-infection compared to no infection in the multivariable analysis after adjusting for the other covariates and potential confounders (age, sex, and education). These findings are consistent with the literature linking alcohol use and problem drinking with HIV/STI co-infection among other populations [11, 12]. Additionally, problem

drinking and alcohol use may be a strong driver for HIV/STI co-infection in this population. Future studies should examine the temporal relationships between HIV/STI co-infection and problem drinking with this population, since some studies have reported bidirectional associations between problem drinking and HIV/STI co-infection. For example, problem drinking may lead to disinhibition and impaired judgment, which may increase sexual risk behaviors and thus increase risk of infection [40]. Moreover, HIV/STI co-infection may also predispose individuals to resort to alcohol use as a coping mechanism for the psychological distress of infection [41]. More research is needed to tease apart the effects of problem drinking and HIV/STI co-infection in this population, as well as tailor prevention strategies to target problem drinking as a potential risk factor and/or outcome of HIV/STI co-infection.

Commercial sex work was associated with HIV/STI co-infection in the bivariate analysis, which is consistent with previous findings of commercial sex work being associated independently with HIV and STIs among youth living in the slums of Kampala [3]. However, commercial sex work was not associated with having an STI only, HIV only, or HIV/STI co-infection in the multivariable analysis. Commercial sex work has been linked to many additional adverse health outcomes [25, 26], and interventions should aim to prevent engagement of commercial sex work and decrease involvement of youth already engaged in commercial sex work.

Lastly, we did not detect an association between parental physical abuse and reported HIV/STI's. Sexual abuse was associated with STI only and HIV/STI co-infection but only in the bivariate analysis. Other factors may be driving the high levels of HIV infection and STI's in this population rather than early life adversities and experiences.

HIV/STI interventions should address the associated risk factors among these vulnerable youth in order to prevent new HIV/STI co-infections. Currently, UYDEL, the organization that serves these youth, provides HIV and STI prevention initiatives and access to resources, such as counselling services, free condoms and HIV/STI testing, and vocational training [30]. HIV testing uptake is high in Uganda compared to other African countries, such as Nigeria, Congo, and Mozambique [42]. In Uganda, the policy for the age of consent for HIV/STI testing was lowered to 12 years of age, which helped to eliminate the barrier of seeking parental or caregiver consent for HIV testing [42]. However, Ugandan HIV policies do not address particularly vulnerable groups, such as youth engaging in sex work [43]. Moreover, the policies that are in place suffer from poor implementation from the lack of funds [43].

Additionally, these findings reinforce the need for comprehensive alcohol reduction and prevention strategies. The legal age of drinking in Uganda is 18 years old; therefore, stronger alcohol policies may prevent youth from becoming at risk from HIV/STI and other alcohol-related negative outcomes. Previous HIV and alcohol intervention strategies in sub-Saharan Africa have been implemented in a variety of venues, including STI clinics, bar/alcohol-serving venues, community health centers, and schools [40]. Moreover, alcohol and HIV intervention strategies may be more effective when targeting community and societal-level factors above and beyond simply individual change factors [40].

Limitations

Given the cross-sectional study design, the temporal relationships between variables were not able to be ascertained. However, the convenience sample and cross-sectional study design are key mechanisms to assess hard-to-reach populations, such as youth living in the slums. Additionally, HIV and STI prevalence were self-reported, potentially resulting in an underreporting of HIV/STI prevalence due to social desirability bias or self-reporting bias. Some of the survey measures were not previously validated in this specific population, which may impact our findings. The absence of laboratory specimens to ascertain HIV and STI prevalence is one of the largest limitations of the analyses. Additionally, past diagnoses may not be indicative of current prevalence, as infections may have been treated and no longer present. Future studies should investigate HIV/STI co-infection using biomarkers. Youth who report HIV infection may also be born with HIV, rather than acquire it through potential risk behavior mechanisms. One limitation of this study is we did not ask the context of HIV acquisition. Additionally, self-reporting bias and social desirability bias may also impact the reporting of other high-risk behaviors. Also, youth who were classified as "sexually active" may not have been currently sexually active at the time of the study due to the nature of the question. Future research should examine consistent time frames across the behavioral measures to adequately determine associated risk factors. Lastly, the data lost due to technical errors may not be randomly different from the final study population. However, since the data was lost due to technical errors during a narrow time period during data collection, it is likely not related to neither the exposures nor the outcomes examined, and we anticipate limited biases.

Despite the limitations of the study, this study is the first to our knowledge to present the prevalence of HIV/STI co-infection and associated risk factors among youth living in the slums of Kampala, Uganda, who are particularly vulnerable due to their environmental and social living conditions.

Conclusions

The high prevalence of youth reporting HIV/STI co-infection emphasizes the need for preventative strategies targeted at HIV/STI testing centers and warrants attention towards

increasing capacity at HIV/STI testing centers. Additionally, interventions should inform youth of the biological mechanisms of HIV acquisition among youth who have an STI. Youth who are living with HIV should also be aware of the health complications that result from a co-infection with another STI. Future studies should investigate other risk and protective factors which may contribute to HIV/STI co-infection among youth living in the slums of Kampala to further inform interventions to prevent new HIV/STI co-infections.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. IRB approvals were obtained from Georgia State University and the Uganda National Council for Science and Technology to conduct this study in Kampala. Additionally, this study is fully compliant with the provisions of the World Medical Association Declaration of Helsinki.

Informed Consent Informed consent was obtained from all individual participants included in the study. All youth provided verbal informed consent for this study.

References

1. World Health Organization Global Health Observatory Data. *Uganda Country Data and Statistics*; 2016.
2. UNAIDS. *Gap Report*; 2014.
3. Swahn MH, Culbreth R, Salazar LF, Kasirye R, Seeley J. Prevalence of HIV and associated risks of sex work among youth in the Slums of Kampala. AIDS Res Treat. 2016;2016:5360180. https://doi.org/10.1155/2016/5360180.
4. Swahn MH, Palmier JB, Kasirye R, Yao H. Correlates of suicide ideation and attempt among youth living in the Slums of Kampala. Int J Environ Res Public Health. 2012;9:596–609. https://doi.org/10.3390/ijerph9020596.
5. Swahn MH, Braunstein S, Kasirye R. Demographic and psychosocial characteristics of mobile phone ownership and usage among youth living in the Slums of Kampala, Uganda. West J Emerg Med. 2014;15:600–3. https://doi.org/10.5811/westjem.2014.4.20879.
6. 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.
7. Culbreth R, Swahn MH, Ndetei D, Ametewee L, Kasirye R. Suicidal Ideation among Youth Living in the Slums of Kampala, Uganda. Int J Environ Res Public Health. 2018. https://doi.org/10.3390/ijerph15020298.
8. Swahn MH, Culbreth RE, Staton CA, Self-Brown SR, Kasirye R. Alcohol-related physical abuse of children in the Slums of Kampala, Uganda. Int J Environ Res Public Health. 2017. https://doi.org/10.3390/ijerph14101124.
9. Self-Brown S, Culbreth R, Wilson R, Armistead L, Kasirye R, Swahn MH. Individual and parental risk factors for sexual exploitation among high-risk youth in Uganda. J Interpers Violence. 2018. https://doi.org/10.1177/0886260518771685.
10. Kalichman SC, Pellowski J, Turner C. Prevalence of sexually transmitted co-infections in people living with HIV/AIDS: systematic review with implications for using HIV treatments for prevention. Sex Transm Infect. 2011;87:183–90. https://doi.org/10.1136/sti.2010.047514.
11. Weis N, Lindhardt BO, Kronborg G, Hansen A-BE, Laursen AL, Christensen PB, Nielsen H, Moller A, Sorensen HT, Obel N. Impact of hepatitis C virus coinfection on response to highly active antiretroviral therapy and outcome in HIV-infected individuals: a nationwide cohort study. Clin Infect Dis. 2006;42:1481–7. https://doi.org/10.1086/503569.
12. Duffus WA, Mermin J, Bunnell R, Byers RH, Odongo G, Ekwaru P, Downing R. Chronic herpes simplex virus type-2 infection and HIV viral load. Int J STD AIDS. 2005;16:733–5. https://doi.org/10.1258/095646205774763298.
13. Holmes K, Sparling P, Stamm W, Piot P, Wasserheit J, Corey L, Cohen M. Sexually transmitted diseases. 4 edn. McGraw-Hill Professional, New York; 2007. ISBN 978-0-07-141748-8.
14. Kalichman SC, Eaton L, Cherry C. Sexually transmitted infections and infectiousness beliefs among people living with HIV/AIDS: implications for HIV treatment as prevention. HIV Med. 2010;11:502–9. https://doi.org/10.1111/j.1468-1293.2009.00818.x.
15. Ariza-Mejia MC, Puerta-Lopez T, Garcia-Garcia L, Menendez-Prieto B, Vera-Garcia M, Clavo-Escribano P, Ballesteros Martin J, Rodriguez-Martin C, de Miguel AG, del Romero-Guerrero J, Gil-Prieto R. Risk factors of HIV Co-infection and sexual behaviours in patients with gonococcal infection in a STI's clinic in Madrid. J AIDS Clin Res. 2013;4:240.
16. Stoneburner RL, Low-Beer D. Population-level HIV declines and behavioral risk avoidance in Uganda. Science. 2004;304:714–8. https://doi.org/10.1126/science.1093166.
17. Aral SO, Over M, Manhart L, Holmes KK. Sexually transmitted infections. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, Jha P, Mills A, Musgrove P. Editors. Disease control priorities in developing countries. World Bank, Washington, DC; 2006. ISBN 978-0-8213-6179-5.
18. de Coul ELMO, Warning TD, Koedijk FDH. Dutch STI clinics sexual behaviour and sexually transmitted infections in sexually transmitted infection clinic attendees in the Netherlands, 2007–2011. Int J STD AIDS. 2014;25:40–51. https://doi.org/10.1177/0956462413491736.
19. Zhang X, Wang C, Hengwei W, Li X, Li D, Ruan Y, Zhang X, Shao Y. Risk factors of HIV infection and prevalence of co-infections among men who have sex with men in Beijing, China. AIDS Lond Engl. 2007;21(Suppl 8):S53–7. https://doi.org/10.1097/01.aids.0000304697.39637.4c.
20. Silverman JG, Decker MR, Gupta J, Dharmadhikari A, Seage GR, Raj A. Syphilis and Hepatitis B co-infection among HIV-infected, sex-trafficked women and girls, Nepal. Emerg Infect Dis. 2008;14:932–4. https://doi.org/10.3201/eid1406.080090.
21. Wirth KE, Tchetgen Tchetgen EJ, Silverman JG, Murray MB. How does sex trafficking increase the risk of HIV Infection? An observational study from Southern India. Am J Epidemiol. 2013;177:232–41. https://doi.org/10.1093/aje/kws338.
22. U.S. Department of State Trafficking in Persons Report; 2015.

23. Norman RE, Byambaa M, De R, Butchart A, Scott J, Vos T. The long-term health consequences of child physical abuse, emotional abuse, and neglect: a systematic review and meta-analysis. PLoS Med. 2012;9:e1001349. https://doi.org/10.1371/journal.pmed.1001349.
24. Walsh K, Latzman NE, Latzman RD. Pathway from child sexual and physical abuse to risky sex among emerging adults: the role of trauma-related intrusions and alcohol problems. J Adolesc Health. 2014;54:442–8. https://doi.org/10.1016/j.jadohealth.2013.09.020.
25. van Roode T, Dickson N, Herbison P, Paul C. Child sexual abuse and persistence of risky sexual behaviors and negative sexual outcomes over adulthood: findings from a birth cohort. Child Abuse Negl. 2009;33:161–72. https://doi.org/10.1016/j.chiabu.2008.09.006.
26. Gratz KL, Roemer L. Multidimensional assessment of emotion regulation and dysregulation: development, factor structure, and initial validation of the difficulties in emotion regulation scale. J Psychopathol Behav Assess. 2004;26:41–54. https://doi.org/10.1023/B:JOBA.0000007455.08539.94.
27. Mueller TM, Peterson ZD. The relationships among childhood maltreatment, emotion regulation, and sexual risk-taking in men from urban STD clinics. J Aggress Maltreatment Trauma. 2012;21:277–99. https://doi.org/10.1080/10926771.2012.659802.
28. Othieno CJ, Okoth R, Peltzer K, Pengpid S, Malla LO. Risky HIV sexual behaviour and depression among University of Nairobi students. Ann Gen Psychiatry. 2015;14:16. https://doi.org/10.1186/s12991-015-0054-2.
29. Swahn MH, Culbreth R, Tumwesigye NM, Topalli V, Wright E, Kasirye R. Problem drinking, alcohol-related violence, and homelessness among youth living in the Slums of Kampala, Uganda. Int J Environ Res Public Health. 2018. https://doi.org/10.3390/ijerph15061061.
30. Uganda Youth Development Link|Official Website. http://www.uydel.org/. Accessed 31 Aug 2015.
31. World Health Organization. Global school-based student health survey.
32. Swahn MH, Dill LJ, Palmier JB, Kasirye R. Girls and young women living in the Slums of Kampala. SAGE Open. 2015. https://doi.org/10.1177/2158244015580853.
33. Conigrave KM, Hall WD, Saunders JB. The AUDIT questionnaire: choosing a cut-off score. Alcohol use disorder identification test. Addiction. 1995;90:1349–56.
34. National Institute on Alcohol Abuse and Alcoholism. American Psychiatric Association. CAGE Questionnaire; 2002.
35. USAid. Uganda AIDS indicator survey.
36. USAID. Demographic health survey.
37. Hennessy M, Romer D, Valois RF, Vanable P, Carey MP, Stanton B, Brown L, DiClemente R, Salazar LF. Safer sex media messages and adolescent sexual behavior: 3-year follow-up results from project iMPPACS. Am J Public Health. 2013;103:134–40. https://doi.org/10.2105/AJPH.2012.300856.
38. Fonner VA, Kennedy CE, O'Reilly KR, Sweat MD. Systematic assessment of condom use measurement in evaluation of HIV prevention interventions: need for standardization of measures. AIDS Behav. 2014;18:2374–86. https://doi.org/10.1007/s10461-013-0655-1.
39. Townsend L, Zembe Y, Mathews C, Mason-Jones AJ. Estimating HIV prevalence and HIV-related risk behaviors among heterosexual women who have multiple sex partners using respondent-driven sampling in a high-risk community in South Africa. J Acquir Immune Defic Syndr. 1999;2013(62):457–64. https://doi.org/10.1097/QAI.0b013e3182816990.
40. Carrasco MA, Esser MB, Sparks A, Kaufman MR. HIV-alcohol risk reduction interventions in Sub-Saharan Africa: a systematic review of the literature and recommendations for a way forward. AIDS Behav. 2016;20:484–503. https://doi.org/10.1007/s10461-015-1233-5.
41. Berger-Greenstein JA, Cuevas CA, Brady SM, Trezza G, Richardson MA, Keane TM. Major depression in patients with HIV/AIDS and substance abuse. AIDS Patient Care STDs. 2007;21:942–55. https://doi.org/10.1089/apc.2006.0153.
42. Asaolu IO, Gunn JK, Center KE, Koss MP, Iwelunmor JI, Ehiri JE. Predictors of HIV testing among youth in Sub-Saharan Africa: a cross-sectional study. PLoS ONE. 2016;11:e0164052. https://doi.org/10.1371/journal.pone.0164052.
43. Ahonsi B, Tawab N, Geibel S, Kalibala S, Okal J, Mane B, Sohaba N, Walker J, Green E. HIV/AIDS vulnerabilities, discrimination, and service accessibility among Africa's youth. Nigeria: Abuja; 2014.