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Cango Lyec (Healing the Elephant): HIV Prevalence and Vulnerabilities Among Adolescent Girls and Young Women in Postconflict Northern Uganda

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Objectives: Adolescent girls and young women younger than 25 years (AGYW) account for disproportionate HIV infections in sub-Saharan Africa. Impacts of war in Northern Uganda continue to affect HIV-related health and wellbeing of young people postconflict. Prevalence and incidence of HIV infection were estimated, and factors associated with HIV prevalence among sexually active AGYW in Northern Uganda were investigated.

Methods: Cango Lyec is a cohort involving conflict-affected populations in Northern Uganda. Nine randomly selected communities in Gulu, Nwoya, and Amuru districts were mapped. House-to-house census was conducted. Consenting participants aged 13–49 years were enrolled over 3 study rounds (2011–2015), of whom 533 were AGYW and had ever had sex. Data were collected on trauma, depression, and sociodemographic–behavioral characteristics. Venous blood was taken for HIV and syphilis serology. Multivariable logistic regression determined baseline factors associated with HIV prevalence.

Results: HIV prevalence among AGYW was 9.7% (95% CI: 7.3 to 12.6). AGYW living in Gulu (adjusted risk ratio, aRR: 2.48; 95% CI: 1.12 to 5.51) or Nwoya (aRR: 2.65; 95% CI: 1.03 to 6.83) were more likely than in Amuru to be living with HIV. Having self-reported genital ulcers (aRR: 1.93; 95% CI: 0.97 to 3.85) or active syphilis (aRR: 3.79; 95% CI: 2.35 to 6.12) was associated with increased risk of HIV infection. The likelihood of HIV was higher for those who experienced sexual violence in the context of war (aRR: 2.37; 95% CI: 1.21 to 4.62) and/or probable depression (aRR: 1.95; 95% CI: 1.08 to 3.54). HIV incidence was 8.9 per 1000 person-years.

Conclusion: Ongoing legacies of war, especially gender violence and trauma, contribute to HIV vulnerability among sexually active AGYW. Wholistic approaches integrating HIV prevention with culturally safe initiatives promoting sexual and mental health in Northern Uganda are essential.

Key Words: adolescent girls and young women, HIV/AIDS, conflict-affected people, Northern Uganda, HIV prevalence, trauma, mental health

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INTRODUCTION

Adolescent Girls and Young Women in Northern Uganda

Adolescent girls (13–19) and young women (20–24) (AGYW) continue to experience unacceptably high risk of HIV infection.[1] An estimated 360,000 AGYW aged 15–24 years are infected with HIV yearly, almost 1,000 daily.[1] This is 44% higher than among young men the same age.[1] In 2019, AGYW represented 1 in 4 new infections in sub-Saharan Africa, despite accounting for just 10% of the population.[2] HIV vulnerability among AGYW is rooted in harmful gender norms and inequalities manifesting in violence and negative social determinants of health.[3,4] Global leaders remain concerned that sexual and reproductive health needs of AGYW are not being met.[4] In 2016, the United Nations General Assembly pledged to "eliminate gender inequalities

and end all forms of violence and discrimination against women and girls" to reduce new HIV infections among AGYW to below 100,000 annually.[3] In Uganda, HIV prevalence among AGYW aged 15–24 years is 3.3%, compared with 0.8% among young men.[5] However, HIV-related health and wellbeing of AGYW in postconflict Northern Uganda is less understood.

Impact of the War on Young People

From 1986 to 2006, prolonged conflict between the Ugandan government and Lord's Resistance Army was characterized by widespread displacement of families from ancestral territories; human rights violations; destruction of social, cultural, and economic systems; and child abductions.[6,7] Approximately 66,000 children were abducted by the Lord's Resistance Army, resulting in what has been described as the"longest child hostage crisis in human history"[6] Between 2003 and 2006, tens of thousands more children, adolescents, and women engaged in"night-commuting,"walking as far as 6 miles each night to reach urban areas and larger internally displaced persons' (IDP) camps to escape attacks from fighting forces.[8,9] They, however, faced risk of sexual violence due to vulnerabilities during commutes and within IDP camps.[10] Heightened HIV vulnerability of AGYW surviving bush and IDP camps stems primarily from elevated risk of rape and sexual violence, including by armed forces.[11,12] AGYW who were abducted faced forced"marriages"to rebel commanders; due to perception that they were less likely to be living with HIV.[13,14] Rape outside forced marriages was rare.[12–14] Those who were born or grew up during 2 decades of war—including children born in captivity—have been deemed a"lost generation,"as a result of war-related trauma and impact of breakdown of family, livelihoods, cultural norms, and other social structures.[6]

Postconflict Era

Postconflict, most of the 2 million IDPs who lived in camps at the height of the crisis have returned to their homelands, driven by cultural ties to the land and region, or have resettled in new locations. However, as conflict-affected AGYW navigate new environments outside of the bush and IDP camps where they have spent most of their lives, district officials are concerned that they face new and undocumented vulnerabilities to HIV infection.[15] Potential vulnerabilities include, sexual coercion, harmful gender norms that affect young people's sexual behavior and perpetuate male dominance and violence against women, and increased mobility from more remote communities to access mobile markets for household necessities. Four years following the signing of the cessation of hostilities agreement, a 2010 cross-sectional study involving 384 young (aged 15–29 years) transit camp residents in Gulu district estimated HIV prevalence to be 15.6% among AGYW, compared with 9.9% among young men, although differences were not significant.[16] AGYW who were children during the war are now transitioning to adolescence and adulthood in challenging environments. Economic pressures to enter sex work are exacerbated by stigmas against those who endured war-related sexual violence, including forced marriage and

motherhood in the bush.[13] Enduring impacts on traditional livelihoods and social structures, as well as limited resources such as health care, employment, and education in ancestral villages, has contributed to an influx of people to towns, especially Gulu city.[17] As ancestral homes are redeveloped, AGYW remaining in town without parental supervision may be vulnerable to predation.[18] Those remaining in town are younger and poorer and may face considerable vulnerabilities, such as lack of skills, resources, and family or social connections, contributing to elevated HIV risk.[17]

Although HIV infection among AGYW has received increased attention globally, concerns remain that those in postconflict settings will be left behind if the drivers of risk are not well-understood. At present, there is a paucity of research about the burden and drivers of HIV among AGYW in postconflict contexts. As such, we measured incidence and prevalence of, and investigated factors associated with, HIV infection among AGYW who have ever had sex in Northern Uganda to inform targeted recommendations for HIV prevention.

METHODS

Study Design and Sample

Cango Lyec (Healing the Elephant) is an open cohort involving conflict-affected populations in mid-Northern Uganda. Study methods have been previously reported.[19,20] In brief, 8 study communities randomly selected in the districts of Gulu, Nwoya, and Amuru were mapped and house-to-house census conducted to enumerate the entire population. Consenting participants aged 13–49 years were enrolled over 3 study rounds (2011–2015), including 852 AGYW, of whom 533 (63.2%) had ever had sex. All eligible members (aged 13–49 years) of the households in the 9 communities who were present during census and consented/assented to be part of the study were enrolled. A census was conducted first to determine eligibility, and a survey team consented eligible household members to participate in the interview and blood draw. There was no sampling performed at the household level. Of the 2954 eligible individuals present at the time of census in the Cango Lyec study, 2448 enrolled in this study for a participation rate of 82.9%. Among AGYW, the participation rate was 77.3%. An analysis of attrition was conducted among AGYW, and the enrolled sample was found to be representative of the census.

Ethical Considerations

Ethical approvals for Cango Lyec were obtained from University of British Columbia-Providence Healthcare Research Ethics Board (Canada), Makerere University College of Health Sciences-School of Public Health Ethics Committee (Uganda), and Uganda Virus Research Institute-Science and Ethics Committee (Uganda). The Uganda National Council for Science and Technology issued a letter of approval based on non-objection from the Office of the President of Uganda. Subsequently, each Resident District Commissioner provided administrative approval affirming that the study was welcome in that district. All participants provided written informed consent through signature or thumbprint following a rigorous

consenting process. First, research assistants visited houses and explained all study information to household members. Permission to recruit was sought from heads of each household. Then, if a household member showed willingness, they were taken through the consenting process and were assured they could withdraw at any point. Questions were encouraged, and a copy of the consent form was provided. Unemancipated minors (as defined by the Uganda National Council of Science and Technology) were asked to provide individual informed assent if written consent was provided by parent/guardian. Minors who did not want to participate were not enrolled.

Data Collection and Measures

HIV-1 infection was determined by blood specimen collection at baseline and again annually over the study period. Two ELISA tests, Vironostika HIV Uni-Form II plus O (bioMerieux SA, Marcy l'Etoile, France) and Murex HIV-1.2.O (Diasorin S.P.A, Dartford, United Kingdom) were used in parallel to test for HIV infection at the Uganda Virus Research Institute IAVI-laboratory. Western blot (Genetic Systems; Bio-Rad Laboratories) served as tiebreaker if ELISA results were discordant. Indeterminate Western blot results were resolved using a qualitative Roche COBAS AmpliPrep/COBAS TaqMan HIV-1 polymerase chain reaction test (RT). Trained HIV counsellors provided pretest/posttest counselling, and participants were encouraged, but not required, to receive results and share results with their partners. Participants who tested positive and received results were referred for antiretroviral treatment at the health facility of their choice. HIV testing was conducted regardless of prior known HIV status or clinical records.

A team of experienced health professionals independently undertook forward–backward translation of survey instruments into Luo. Inconsistencies were discussed and revised until intended meaning was achieved. All AGYW were given the option to be interviewed by interviewers of the same sex. Participants were given the choice of where the interview would take place; often an open area (eg, under a mango tree) was preferred for greater confidentiality. Interviewer-administered questionnaires asked about sociodemographics, war-related trauma, mental health, and sexual vulnerabilities. Interviewers received extensive training on confidentiality protocols. Assurance of confidentiality formed part of the consenting process. Blood was taken for HIV and syphilis serology.

Sociodemographic characteristics included district of residence (Amuru/Gulu/Nwoya), age (years), study round (1/2/3), ethnicity (Acholi/other), education (≤primary/≥secondary), marital status (married/not married), polygamous marriage (yes/no), religion (Roman Catholic/Protestant/Other), youth-headed household (yes/no), and female-headed household (yes/no).

Several war-related trauma and mental health measures were assessed. Community displacement status included displaced settlements (eg, those created to accommodate IDP during the war), transient settlements (eg, those created to accommodate IDP returning to war-affected communities requiring rebuilding), and permanent settlements (eg, those that existed before the war and residents were never

displaced). Participants reported whether they had ever been abducted (yes/no) and if they experienced sexual abuse during abduction (yes/no).

Luo versions of the Harvard Trauma Questionnaire (HTQ)[21] and Hopkins Symptom Check List-25 (HSCL-25)[22] administered by trained interviewers assessed exposure to trauma and mental health concerns. Scores were summed in the field and immediate referrals to mental health care through the study nurse were made for those with summed responses of ≥25 (HSCL-25) or ≥28 (HTQ), as well as those who reported feeling hopeless about the future, thoughts about ending their life, and feelings of worthlessness. Referral cutoffs were determined by Uganda-based psychologists and psychiatrists. Participants were given choice of preferred service for referral. Data were not kept on uptake of referrals to care.

Both scales have been validated for research in Northern Uganda and other war-affected countries in sub-Saharan Africa.[23–28] HTQ part I includes 16 questions regarding prior traumatic life events (Experienced/Witnessed/Heard about it/No). Scores were dichotomized (<12 vs. ≥12 severe traumatic events) based on evidence demonstrating this threshold is predictive of post-traumatic stress disorder (PTSD) and depression in Northern Uganda.[25] HTQ part IV includes 16 questions addressing trauma symptoms measured using a 4-point severity scale over a one-week recall period to identify symptoms indicative of probable PTSD.[21] Sums of all answered items in Part IV were divided by the number of answered items; for research purposes, scores ≥2.0 were classified as meeting criteria for screening positive for PTSD.[22] Two additional variables assessed in the HTQ included recently experiencing ill health without access to medical care (yes/no) and sexual assault within the context of war (yes/no). The latter included rape outside of abduction but related to war, for example, gang rape in IDP camps. The HSCL-25 identified recent suicidal ideation and symptoms indicative of recent probable depression. Again, for research purposes, the mean scores of ≥1.75 on HSCL-25 Part II were classified as meeting criteria for screening positive for recent probable depression.[22] In this study, Cronbach alpha coefficient was $\alpha = 0.85$ (HTQ Part IV) and $\alpha = 0.82$ (HSCL-25 Part II), indicating high internal consistency.

Sexual vulnerabilities related to sexual debut included age at sexual debut (dichotomized at 16 years), age difference of first sex partner (dichotomized at 10 years), condom use at sexual debut (yes/no), and coerced sexual debut (yes/no). Recent (past year) sexual vulnerabilities included number of sexual partners (0/1/2+), condom use (not always/always), self-reported genital ulcers (yes/no), and sex for exchange (defined as receiving money, shelter, food, gifts, or alcohol for sex). Participants were asked about their age at first pregnancy (dichotomized at 16 years) and if their most recent male partner was circumcised (yes/no). Active syphilis was determined using rapid plasma reagin test and confirmatory Treponema pallidum hemagglutination test in the event of a positive screen. Active syphilis was treated with a single dose of azithromycin.

Statistical Analysis

Fisher exact tests for categorical variables and Student *t* test for continuous variables were used to compare

TABLE 1. Baseline Characteristics Among Adolescent Girls and Young Women Younger Than 25 Years (AGYW) in the Cango Lyec Cohort (2011–2015)

Variable	HIV Serostatus			P
	Negative (N = 477)	Positive (N = 51)	Total (N = 528)	
Sociodemographic characteristics				
District, %				0.103
Amuru	127 (94.8)	7 (5.2)	134 (100.0)	
Gulu	243 (88.4)	32 (11.6)	275 (100.0)	
Nwoya	107 (89.9)	12 (10.1)	119 (100.0)	
Community, %				0.057
Olwal (7110)	25 (86.2)	4 (13.8)	29 (100.0)	
Jengari (7120)	55 (96.5)	2 (3.5)	57 (100.0)	
Torokal (7130)	47 (97.9)	1 (2.1)	48 (100.0)	
Okwir (7210)	19 (95.0)	1 (5.0)	20 (100.0)	
Layibi (7220)	141 (88.1)	19 (11.9)	160 (100.0)	
Awach paibona (7230)	39 (95.1)	2 (4.9)	41 (100.0)	
Awach trading center (7231)	44 (81.5)	10 (18.5)	54 (100.0)	
Anaka (7320)	71 (92.2)	6 (7.8)	77 (100.0)	
Alero (7330)	36 (85.7)	6 (14.3)	42 (100.0)	
Age, %				0.006
Median (IQR)	20.0 (18.0–22.0)	21.0 (19.0–23.0)	20.0 (18.0–22.0)	
Range	13.0–24.0	16.0–24.0	13.0–24.0	
Dichotomized age, %				0.129
13–19	186 (93.0)	14 (7.0)	200 (100.0)	
20–24	291 (88.7)	37 (11.3)	328 (100.0)	
Study round, %				0.105
1	347 (89.9)	39 (10.1)	386 (100.0)	
2	81 (88.0)	11 (12.0)	92 (100.0)	
3	49 (98.0)	1 (2.0)	50 (100.0)	
Ethnicity, %				0.820
N-Miss	1	0	1	
Acholi	420 (90.1)	46 (9.9)	466 (100.0)	
Other tribes	56 (91.8)	5 (8.2)	61 (100.0)	
Highest education obtained, %				0.157
N-Miss	8	1	9	
Primary or less	305 (88.9)	38 (11.1)	343 (100.0)	
Secondary or more	164 (93.2)	12 (6.8)	176 (100.0)	
Marital status, %				1.000
N-Miss	10	2	12	
Not married	158 (90.8)	16 (9.2)	174 (100.0)	
Maried	309 (90.4)	33 (9.6)	342 (100.0)	
Polygamous marriage, %				0.253
N-Miss	10	2	12	
No	383 (91.2)	37 (8.8)	420 (100.0)	
Yes	84 (87.5)	12 (12.5)	96 (100.0)	
Religion, %				0.247
Roman catholic	344 (90.5)	36 (9.5)	380 (100.0)	
Protestant	68 (86.1)	11 (13.9)	79 (100.0)	
Other	65 (94.2)	4 (5.8)	69 (100.0)	
Youth-headed household, %				0.275
No	317 (89.3)	38 (10.7)	355 (100.0)	
Yes	160 (92.5)	13 (7.5)	173 (100.0)	
Female-headed household, %				0.496
No	360 (90.9)	36 (9.1)	396 (100.0)	
Yes	117 (88.6)	15 (11.4)	132 (100.0)	
War-related trauma and mental health				

TABLE 1. (*Continued*) Baseline Characteristics Among Adolescent Girls and Young Women Younger Than 25 Years (AGYW) in the Cango Lyec Cohort (2011–2015)

| | HIV Serostatus | | | |
Variable	Negative (N = 477)	Positive (N = 51)	Total (N = 528)	*P*
Community displacement status, %				0.880
Permanent	267 (90.8)	27 (9.2)	294 (100.0)	
Displaced	44 (89.8)	5 (10.2)	49 (100.0)	
Transient	166 (89.7)	19 (10.3)	185 (100.0)	
Ever abducted, %				0.060
N-Miss	1	0	1	
No	412 (91.4)	39 (8.6)	451 (100.0)	
Yes	64 (84.2)	12 (15.8)	76 (100.0)	
Sexually abused in abduction, %				0.157
N-Miss	2	1	3	
Never abducted	412 (91.4)	39 (8.6)	451 (100.0)	
No	55 (84.6)	10 (15.4)	65 (100.0)	
Yes	8 (88.9)	1 (11.1)	9 (100.0)	
≥12 traumatic events, % (HTQ*)				0.185
No	453 (90.8)	46 (9.2)	499 (100.0)	
Yes	24 (82.8)	5 (17.2)	29 (100.0)	
Probable PTSD, %				0.802
No	433 (90.4)	46 (9.6)	479 (100.0)	
Yes	44 (89.8)	5 (10.2)	49 (100.0)	
Probable depression, %				0.002
No	418 (92.1)	36 (7.9)	454 (100.0)	
Yes	59 (79.7)	15 (20.3)	74 (100.0)	
Suicide ideation, %				0.066
N-Miss	1	0	1	
No	406 (91.4)	38 (8.6)	444 (100.0)	
Yes	70 (84.3)	13 (15.7)	83 (100.0)	
Rape or sexual abuse, % (HTQ*)				<0.001
N-Miss	2	0	2	
No	435 (92.0)	38 (8.0)	473 (100.0)	
Yes	40 (75.5)	13 (24.5)	53 (100.0)	
Ill Health without medical care, % (HTQ*)				0.051
N-Miss	2	0	2	
No	344 (92.0)	30 (8.0)	374 (100.0)	
Yes	131 (86.2)	21 (13.8)	152 (100.0)	
Sexual vulnerabilities				
Age at sexual debut, %				0.074
N-Miss	4	1	5	
16 or older	263 (92.6)	21 (7.4)	284 (100.0)	
Younger than 16	210 (87.9)	29 (12.1)	239 (100.0)	
First sex partner 10 years or older, %				1.000
N-Miss	41	10	51	
No	398 (91.3)	38 (8.7)	436 (100.0)	
Yes	38 (92.7)	3 (7.3)	41 (100.0)	
Condom use at sexual debut, %				0.456
N-Miss	3	0	3	
No	188 (89.1)	23 (10.9)	211 (100.0)	
Yes	286 (91.1)	28 (8.9)	314 (100.0)	
Coerced sexual debut, %				0.410
N-Miss	2	0	2	
No	405 (90.8)	41 (9.2)	446 (100.0)	
Yes	70 (87.5)	10 (12.5)	80 (100.0)	

TABLE 1. (*Continued*) Baseline Characteristics Among Adolescent Girls and Young Women Younger Than 25 Years (AGYW) in the Cango Lyec Cohort (2011–2015)

	HIV Serostatus			
Variable	Negative (N = 477)	Positive (N = 51)	Total (N = 528)	P
Age at first pregnancy, %				0.057
N-Miss	96	6	102	
16 or older	227 (91.9)	20 (8.1)	247 (100.0)	
Younger than 16	154 (86.0)	25 (14.0)	179 (100.0)	
Number of partners in past year, %				0.004
N-Miss	2	0	2	
0	33 (89.2)	4 (10.8)	37 (100.0)	
1	418 (91.7)	38 (8.3)	456 (100.0)	
2+	24 (72.7)	9 (27.3)	33 (100.0)	
Condom use in the past year, %				0.566
Always	85 (88.5)	11 (11.5)	96 (100.0)	
Not always	392 (90.7)	40 (9.3)	432 (100.0)	
Most recent sex partner is circumcised, %				0.115
N-Miss	12	1	13	
No	388 (91.3)	37 (8.7)	425 (100.0)	
Yes	77 (85.6)	13 (14.4)	90 (100.0)	
Sex in exchange for gifts in the past year, %				1.000
N-Miss	4	0	4	
No	453 (90.2)	49 (9.8)	502 (100.0)	
Yes	20 (90.9)	2 (9.1)	22 (100.0)	
HIV and STIs, %				
Genital ulcers				0.012
N-Miss	7	0	7	
No	438 (91.2)	42 (8.8)	480 (100.0)	
Yes	32 (78.0)	9 (22.0)	41 (100.0)	
Any STI symptoms, %				0.069
N-Miss	7	0	7	
No	295 (92.2)	25 (7.8)	320 (100.0)	
Yes	175 (87.1)	26 (12.9)	201 (100.0)	
Syphilis, %				0.001
N-Miss	1	0	1	
No	468 (91.2)	45 (8.8)	513 (100.0)	
Yes	8 (57.1)	6 (42.9)	14 (100.0)	

*Harvard Trauma Questionnaire.

distributions of study variables by HIV serostatus. Unadjusted and adjusted modified Poisson regression models[29] assessed associations between HIV status, and sexual vulnerabilities, war-related trauma, and mental health variables. Multivariable logistic regression determined baseline factors associated with HIV prevalence among AGYW who have ever had sex, adjusting for study round, age, and location. A final multivariable model was obtained through stepwise model selection based on the Akaike information criterion. Only those variables significant at a *P* value cutoff of 0.25 in bivariable analysis were included in multivariable model selection. All analyses used R 4.2.2.[30] *P* values of <0.05 were considered statistically significant. Relative risks (RRs) and corresponding 95% confidence intervals (CI) were calculated to measure the strength of associations. The proportion of missing data in the outcome variable was 0.9%. Among independent variables, the largest proportion of missingness was 2.4%.

To capture all responses and minimize systematic bias, available case analysis was used for missing data. A previous publication investigated HIV incidence among all Cango Lyec participants.[20] To further contextualize HIV among AGYW who have ever had sex, we explored the incidence rate among this subgroup of participants. HIV incidence was estimated among HIV-negative sexually active AGYW participants who had at least 1 follow-up visit between January 2011 and April 2015. The time to seroconversion was assumed to have taken place at the midpoint between the last HIV-negative test and the first HIV-positive test.

RESULTS

HIV status was available for 528 of 533 eligible participants (99.1%), constituting the study sample.
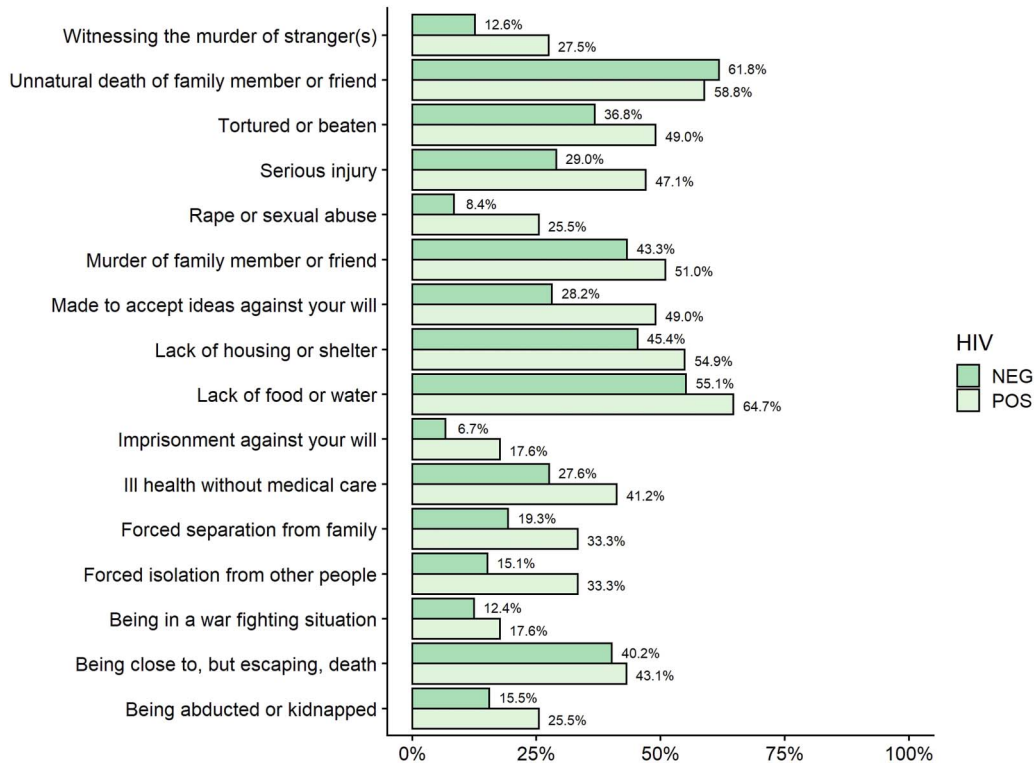
FIGURE 1. Relative frequency of trauma events experienced stratified by HIV status (positive/negative). For instance, 15.5% of HIV-negative participants reported having been abducted or kidnapped, compared with 25.5% among HIV-positive participants. [full color online]

AGYW included in the analysis were born between 1986 and 2002, with median year of birth being 1992 (Table 1). The median age at cessation of hostilities (2006) was 14 years (interquartile range [IQR]: 12–17). The median age at entry into the study was 20 years (IQR: 18–22), with most of the participants living in Gulu district (n = 275; 52.1%). Most participants (466; 88.4%) identified as Acholi and 380 (72.0%) identified as Roman Catholic. Only 176 (33.9%) completed secondary education. In total, 342 (66.3%) were married and 96 (18.6%) were in a polygamous marriage. Living in a youth-headed household was reported by 173 participants (33.8%), and a female-headed household by 132 participants (25.0%). Most lived in a permanent settlement (n = 294; 55.7%), compared with a displaced (n = 49; 9.3%) or transient (n = 185; 35.0%) settlement.

War-Related Trauma

The number of AGYW reporting experiences of war-related trauma and mental health sequelae were as follows: 76 (14.4%) reported abduction, and of these, 9 (12.2%) had experienced sexual abuse in abduction and 53 (10.1%) experienced sexual violence in the context of war. Twenty-nine (5.5%) had experienced ≥12 traumatic events, and 83 (15.7%) had thought about suicide. In addition, 49 (9.3%) screened positive for PTSD and 74 (14.0%) screened positive for depression. Frequencies of specific traumatic experiences stratified by HIV status are presented in Figure 1 and captured within the HTQ score in statistical models.

Sexual Vulnerability and Health Characteristics

At sexual debut, 239 AGYW (45.7%) were younger than 16 years, 41 (8.6%) had a sexual partner who was 10 years or older, 211 (40.2%) did not use a condom, and 80 (15.2%) experienced coerced debut. In total, 179 (42.0%) had been pregnant at an age younger than 16 years. In the past year, 33 (6.3%) had ≥2 sexual partners, 432 (81.8%) had not always used condoms, and 22 (4.2%) had transactional sex. Just 90 (17.5%) reported that their most recent partner was circumcised. In total, 41 (7.9%) reported having genital ulcers and 201 (38.6%) had STI-related symptoms in the past year. Syphilis prevalence among young women at baseline was 2.7% (n = 14).

Prevalence and Correlates of HIV Infection

In total, 51 sexually active AGYW (9.7%; 95% CI: 7.3 to 12.6) in the Cango Lyec study were living with HIV at baseline (Table 2). In comparison, the prevalence among all AGYW, regardless of sexual activity, was 6.3% (95% CI: 4.8 to 8.2). Unadjusted relationships between study variables and HIV, as well as associations adjusted for age, district of residence, and study round are summarized in Table 2. In the final multivariable model (Table 3), AGYW who had ever had sex and were living in Gulu (aRR: 2.48; 95% CI: 1.12 to 5.51) or Nwoya (aRR: 2.65; 95% CI: 1.03 to 6.83) districts were more likely than those in Amuru to be living with HIV. Older age was associated with increased risk of living with HIV (aRR: 1.14; 95% CI: 1.02 to 1.28). The likelihood of living with HIV was higher among those who experienced sexual violence in the context of war (aRR:

TABLE 2. Logistic Regression Modeling for Determinants of HIV Among Adolescent Girls and Young Women Younger Than 25 Years (AGYW) in the Cango Lyec Cohort (2011–2015)

Variable	Units	Unadjusted			Adjusted[1]		
		RR	CI.95	*P*	RR	CI.95	*P*
Sociodemographic Characteristics							
District	Amuru	Ref			Ref		
	Gulu	2.23	1.01; 4.91	0.047	2.19	0.97; 4.97	0.060
	Nwoya	1.93	0.79; 4.74	0.152	1.88	0.74; 4.77	0.186
Study round	1	Ref			Ref		
	2	1.18	0.63; 2.22	0.600	1.16	0.59; 2.26	0.666
	3	0.20	0.03; 1.41	0.106	0.21	0.03; 1.55	0.127
Age		1.17	1.05; 1.31	0.006	1.17	1.04; 1.32	0.011
Ethnicity	Acholi	Ref			Ref		
	Other tribes	0.83	0.34; 2.01	0.680	0.79	0.31; 1.99	0.613
Highest education obtained	Primary or less	Ref			Ref		
	Secondary or more	0.62	0.33; 1.15	0.127	0.55	0.28; 1.05	0.070
Marital status	Not married	Ref			Ref		
	Married	1.05	0.59; 1.85	0.868	1.05	0.57; 1.93	0.884
Polygamous marriage	No	Ref			Ref		
	Yes	1.42	0.77; 2.62	0.263	1.38	0.71; 2.69	0.349
Religion	Roman catholic	Ref			Ref		
	Protestant	1.47	0.78; 2.76	0.231	1.34	0.67; 2.65	0.409
	Other	0.61	0.22; 1.66	0.336	0.51	0.18; 1.44	0.205
Youth headed household	No	Ref			Ref		
	Yes	0.70	0.38; 1.28	0.250	0.73	0.39; 1.38	0.330
Female headed household	No	Ref			Ref		
	Yes	1.25	0.71; 2.21	0.442	1.12	0.61; 2.05	0.719
War-related trauma and mental health							
Community displacement status	Permanent	Ref			Ref		
	Displaced	1.11	0.45; 2.75	0.820	1.50	0.55; 4.10	0.428
	Transient	1.12	0.64; 1.95	0.694	1.23	0.68; 2.22	0.498
Ever abducted	No	Ref			Ref		
	Yes	1.83	1.00; 3.33	0.049	1.65	0.86; 3.16	0.134
≥12 traumatic events (HTQ*)	No	Ref			Ref		
	Yes	1.87	0.80; 4.35	0.146	1.64	0.64; 4.25	0.306
Probable PTSD	No	Ref			Ref		
	Yes	1.06	0.44; 2.55	0.892	1.05	0.41; 2.67	0.920
Probable depression	No	Ref			Ref		
	Yes	2.56	1.47; 4.43	<0.001	2.58	1.39; 4.79	0.003
Suicide ideation	No	Ref			Ref		
	Yes	1.83	1.02; 3.28	0.043	1.93	1.02; 3.64	0.043
Rape or sexual abuse (HTQ†)	No	Ref			Ref		
	Yes	3.05	1.74; 5.36	<0.001	3.35	1.76; 6.39	<0.001
Ill Health without medical care (HTQ*)	No	Ref			Ref		
	Yes	1.72	1.02; 2.91	0.042	1.73	0.98; 3.04	0.057
Sexual vulnerabilities							
Age at sexual debut	16+	Ref			Ref		
	<16	1.64	0.96; 2.80	0.069	1.61	0.91; 2.83	0.102
Condom use at sexual debut	No	Ref			Ref		
	Yes	0.82	0.48; 1.38	0.452	0.75	0.43; 1.31	0.309
Coerced sexual debut	No	Ref			Ref		
	Yes	1.36	0.71; 2.60	0.353	1.57	0.77; 3.19	0.213
Age at first pregnancy	16+	Ref			Ref		
	<16	1.72	0.99; 3.01	0.055	1.82	1.01; 3.30	0.048
Number of partners in past year	0	Ref			Ref		
	1	0.77	0.29; 2.04	0.600	0.76	0.27; 2.13	0.598

TABLE 2. (*Continued*) Logistic Regression Modeling for Determinants of HIV Among Adolescent Girls and Young Women Younger Than 25 Years (AGYW) in the Cango Lyec Cohort (2011–2015)

Variable	Units	Unadjusted			Adjusted[1]		
		RR	CI.95	P	RR	CI.95	P
	2+	2.52	0.86; 7.43	0.093	2.35	0.72; 7.64	0.157
Condom use in past year	Always	Ref			Ref		
	Not always	0.81	0.43; 1.52	0.507	0.76	0.39; 1.49	0.425
Most recent sex partner is circumcised	No	Ref			Ref		
	Yes	1.66	0.92; 2.99	0.092	1.55	0.82; 2.94	0.179
HIV and STIs							
Genital ulcers	No	Ref			Ref		
	Yes	2.51	1.32; 4.78	0.005	2.49	1.21; 5.14	0.014
Any STI symptoms	No	Ref			Ref		
	Yes	1.66	0.98; 2.78	0.057	1.57	0.90; 2.73	0.109
Syphilis	No	Ref			Ref		
	Yes	4.89	2.51; 9.51	<0.001	4.61	1.94; 10.94	<0.001

2.37; 95% CI: 1.21 to 4.62) and/or probable depression (aRR: 1.95; 95% CI: 1.08 to 3.54). Having self-reported genital ulcers (aRR: 1.93; 95% CI: 0.97 to 3.85) or active syphilis (aRR: 3.79; 95% CI: 2.35 to 6.12) were associated with increased risk of HIV infection among AGYW who had ever had sex.

HIV Incidence

HIV incidence was 8.9 per 1,000 person-years (95% CI: 3.8 to 17.5) among 463 AGYW. A total of 8 seroconversions occurred, over 900 person-years of observation, and assumed to have taken place at the midpoint between the last HIV-negative test and the first HIV-positive test. The median age of seroconversion was 20.6 (IQR: 18.4 to 21.2).

DISCUSSION

HIV Prevalence

HIV prevalence among conflict-affected AGYW aged 13–24 years who are sexually active was 9.7% (95% CI: 7.3 to 12.6) and 6.3% (95% CI: 4.8 to 8.2) overall, regardless of sexual activity. This is substantially higher than HIV prevalence of 3.3% reported among AGYW regardless of sexual activity aged 15–24 years in Uganda.[5] Understanding high prevalence of HIV among AGYW postconflict requires recognition of atrocities they have endured in the context of war and its aftermath, including lack of basic necessities, witnessing and experiencing violence, and forced separation from family. It is critical that evidence-based prevention strategies, such as PrEP, and their guidelines consider these unique and high-risk contexts. Barriers in the postconflict context may also prevent AGYW living with HIV from engaging in testing and care. Estimates suggest that nearly half of AGYW living with HIV across Uganda remain undiagnosed, and more than a quarter of those on ART were not virally suppressed.[5] Tailored HIV interventions for AGYW, based on postconflict realities and Acholi cultural strengths, are urgently required.

Sexual Violence–Related Harms

The likelihood of living with HIV was more than 2 times higher among AGYW who experienced sexual violence in the context of war compared with those who did not experience sexual violence in the context of war. Global evidence demonstrates that gender-based violence and inequalities continue to drive the HIV epidemic.[2] In Northern Uganda, increased risk of HIV resulting from experiences of sexual violence must be understood within the legacy of war. In this study, the prevalence of having experienced sexual violence in the context of war was 10% overall and 25.5% among AGYW living with HIV. All participants were born during the war and were an average of 14 years old at cessation of hostilities. Exposure to sexual violence during the civil war—including defilement, forced marriage, forced motherhood, rape by armed forces on both sides of the conflict, and rape by other residents in IDP camps—is well-documented.[11,13,31–33] Scholars have argued that heightened sexual violence against AGYW may become normalized during protracted conflict.[6,34,35] Others have identified serious long-term physical and mental health consequences of war-related sexual violence among women in Northern Uganda.[31,33,36] Furthermore, both sexual violence and war-related "bush" experience remain highly stigmatized, with consequences for mental health and social relationships, that may further exacerbate HIV-related risk.[7,13,31,37–39] As a result, wholistic approaches responding to root causes of HIV-related vulnerability must involve AGYW in their design and development and embed support to heal from unresolved and untreated sexual violence.[40]

Mental Health–Related Harms

Sexually active AGYW who screened positive for probable depression were almost twice as likely to be living with HIV. Nearly 30% of AGYW who had ever had sex and were living with HIV in this study screened positive for probable depression. Although the directionality of the

TABLE 3. Final Multivariable Logistic Regression Model Obtained Through Stepwise Variable Selection*

Variable	Units	RR	[95% CI]	P
District	Amuru	Ref		
	Gulu	2.48	[1.12 to 5.51]	0.025
	Nwoya	2.65	[1.03 to 6.83]	0.044
Age		1.14	[1.02 to 1.28]	0.021
Study round	1	Ref		
	2	1.43	[0.76 to 2.71]	0.269
	3	0.25	[0.03 to 1.86]	0.178
Probable depression	No	Ref		
	Yes	1.95	[1.08 to 3.54]	0.028
Rape or sexual abuse (HTQ†)	No	Ref		
	Yes	2.37	[1.21 to 4.62]	0.011
Genital ulcers	No	Ref		
	Yes	1.93	[0.97 to 3.85]	0.062
Syphilis	No	Ref		
	Yes	3.79	[2.35 to 6.12]	<0.001

*District, age, and study round were included as confounders during the variable selection process.
†HTQ.

relationship between depression and HIV cannot be distinguished in this study, previous research from Gulu district in Northern Uganda identified depression as a mediating factor between war-related trauma and sexual risk behaviors among 551 adolescents aged 13–21 years 4 years postwar.[41] Mental health impacts of war-related traumas may contribute to sexual vulnerabilities such as condom-less sex, sex for exchange, and sexually transmitted infections, including HIV.[37] Simultaneously, psychological, physiological, and social impacts of becoming HIV-positive may intensify mental health concerns.[37] Finally, co-occurring depression and HIV may contribute to HIV disease progression and mortality through both biological and socio–behavioral pathways.[42,43] These findings affirm that mental health concerns and HIV go hand-in-hand and highlight importance of wholistic models of care postconflict to support health and healing.[44,45]

Sexually Transmitted Infections

Self-reported genital ulcers and laboratory diagnosed active syphilis were associated with increased risk of HIV infection among AGYW. Although these associations are well-known, this finding is deeply concerning given how treatable these STIs are and extent of HIV risk when they go untreated.[46,47] Responding to STIs among AGYW in Northern Uganda requires recognition of circumstances of access to care in the postconflict context, as well as Acholi norms and cultural practices related to sexual health. Previous work by our team focused on the *wayo* system, an Acholi socialization process involving mentoring from 3 women – the *maa* (mother), the *wayo* (paternal auntie), and the *adaa* (grandmother)—which provided girls an informal system of support, education, and safety as they developed into young women.[48] The *wayo* in particular helps guide

young girls through transitions to womanhood and serves as a trusted secret-keeper, mentor, and confidant.[48] (Re)vitalizing these systems of sexual health education and wellbeing may be a pathway to support AGYW to engage in care for STIs and reduce HIV risk.

Sociodemographics

AGYW who had ever had sex and living in Gulu or Nwoya districts were more likely than those in Amuru to be living with HIV. HIV prevalence among AGYW who had ever had sex was 11.6% in Gulu, 10.1% in Nwoya, and 5.2% in Amuru. The war was characterized by near-total displacement (90% of the population) as civilians sought to escape. AGYW and their families were displaced from land and territory during the war, and subsequently, formal education was disrupted and traditional agricultural skills were not passed on to this generation. In total, 76% of sexually active AGYW living with HIV in this study did not exceed primary school education, contributing further to poverty and unemployment. Differences in HIV prevalence by district may reflect economic pressures that have prevented AGYW from returning to their homelands after the war, and instead remaining in urban centers, such as those found in Gulu, with limited opportunity, contributing to HIV vulnerabilities of early marriage and transactional sex.[49] Despite these findings, it is important to provide trauma-informed HIV prevention in all 3 study districts as postconflict-related drivers of risk are present.

HIV Incidence

The HIV incidence among conflict-affected AGYW aged 13–24 years was 8.9 per 1000 person-years. This is substantially higher than HIV incidence of 4.6 per 1000 person-years reported among AGYW aged 15–24 years in Uganda.[5] Countering these vulnerabilities in hard-to-reach populations in war-affected Northern Uganda has laid the foundation for Cango Lyec's next phase of work. HIV prevention and treatment interventions that build on community's cultural strengths to promote resiliency and health are urgently needed.

Limitations

Although efforts were made to enroll all those eligible, some were repeatedly absent or declined to participate (505/2954 = 17.1%). It is possible that those who did not participate were more mobile, which may be associated with increased risk of HIV. It is also possible that those who refused to participate did so because of known HIV-positive status. Despite these challenges, we are confident that due to our recruitment methods and rigorous eligibility criteria, our sample is representative of people residing in study communities. Common to many longitudinal cohort studies, Cango Lyec uses self-reported data (except HIV and syphilis status) so recall bias, social desirability bias, or misclassification of exposure may have occurred and led to over or underestimation of certain measures. However, we worked to mitigate this for mental health outcomes by using validated scales with shorter recall time (HTQ and HSCL-25). Owing to the cross-

sectional nature of this analysis, we are unable to determine temporality of relationships between study variables and HIV infection or make causal inference. Finally, although the HTQ and HSCL-25 have been demonstrated to be both reliable and valid in this setting, they are nondiagnostic screening tools, which may lead to a conflation in levels of mental health concerns.

CONCLUSIONS

We observed substantially higher HIV prevalence among sexually active AGYW living in postconflict Northern Uganda, than among this age group in Uganda overall. Ongoing legacies of war—especially gender-based violence and trauma—contribute to HIV vulnerability among AGYW. AGYW in postconflict contexts will continue to be left behind if we fail to take note of the specific set of circumstances that contribute to HIV risk for this population. Wholistic approaches integrating HIV prevention with culturally safe mental health initiatives are urgently required in Northern Uganda in order for healing to take place. More importantly, AGYW's rights to live free from the crime of sexual violence and to undertake dignified livelihoods that provide for their needs must be upheld and respected.

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