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## HIV INFECTION AMONG ADOLESCENTS RESIDING IN URBAN INFORMAL SETTLEMENTS OF KENYA

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## Abstract

Adolescents comprise approximately 15% of new HIV infections in Kenya. Impoverished living conditions in informal settlements place residents at high risk for HIV infection. We assessed factors associated with HIV infection among adolescents residing in urban informal settlements in Kisumu. We recruited 3,061 adolescent boys and girls aged 15–19. HIV prevalence was 2.5% overall, all newly identified cases were among girls and infection was positively associated with not completing a secondary education ( $p < .001$ ). Girls who had ever been pregnant ( $p < .001$ ) or out-of-school without completing a secondary education ( $p < .001$ ) were more likely to be HIV-positive. Our findings of higher HIV prevalence among adolescent girls who had been pregnant or did not complete secondary school highlight the need to facilitate access to HIV testing, HIV pre-exposure prophylaxis, and sexual and reproductive health services as components of a comprehensive prevention strategy to decrease HIV infections in this priority population.

## Keywords

HIV; adolescents; sexual behavior; pregnancy; education; informal settlements; Kenya

## INTRODUCTION

There were 1.75 million adolescents living with HIV worldwide in 2020, 89% of whom reside in sub-Saharan Africa (SSA; UNICEF, 2021). Of the estimated 150,000 adolescents newly infected with HIV in 2020, 77% were girls (UNICEF, 2021). In SSA, new infections were nearly six times higher among adolescent girls than boys (UNICEF, 2021).

Adolescents in Kenya are at increased risk for HIV. In 2017, of the estimated 1.5 million persons living with HIV (PLWH) in Kenya, approximately 105,200 were adolescents (National AIDS Control Council, 2018b). Adolescents represented approximately 15% of new HIV infections, with an estimated 8,000 of the 52,800 total new HIV infections in 2017 (National AIDS Control Council, 2018b). Kisumu County had the second highest HIV prevalence nationally in 2017 at 17.5% (National AIDS and STI Control Programme, 2018b). Out of the 122,301 PLWH in Kisumu in 2017, there were 9,211 adolescents, representing 7% of total HIV cases (National AIDS Control Council, 2018b). Among the 4,012 new HIV infections, adolescents comprised 20% with 884 new infections in Kisumu in 2017 (National AIDS Control Council, 2018b).

Kenyans who live in peri-urban areas and urban informal settlements, i.e., slums, have high rates of morbidity and mortality and are often at higher risk for HIV infection (Kabiru et

al., 2011; Kerubo et al., 2015; National AIDS Control Council, 2018a; Truong et al., 2021, 2022). Informal settlements are characterized by impoverished living conditions which contribute to poor health (Kabiru et al., 2011; Kerubo et al., 2015; Mberu et al., 2015).

Recent data on the HIV prevalence among adolescents residing in informal settlements in Kenya are limited. HIV prevalence was 1.8% among adolescents participating in the Community Health Initiative, an HIV community-based testing program implemented in 2018 in the Kisumu informal settlements (Truong et al., 2022). We assessed the prevalence of HIV infection among adolescents residing in the urban informal settlements in Kisumu, Kenya.

## METHODS

*Maneno Yetu* (“Our Words”) is a mixed-methods study designed to enhance our understanding of the sexual and reproductive health of adolescents. The study recruited a community-based sample of adolescents aged 15–19 residing in the study communities of Obunga, Manyatta, Bandani, and Nyalenda in Kisumu. The cross-sectional surveys were conducted between February 2020 and May 2021. The enactment of COVID-19 mitigation measures, including local lockdowns in Kisumu, forced a sixmonth suspension of field activities from March through September 2020.

We recruited adolescents using respondent-driven sampling (RDS) whereby members of the target population recruit other members to participate (Heckthorn, 1997, 2002; McCreesh et al., 2012; Salganik & Heckathorn, 2004). RDS has been used effectively to reach populations of youth who might be missed by traditional household- and school-based sampling (Decker et al., 2014). The recruitment process has been described in detail previously (Truong et al., 2023). Adolescents who were 15 to 19 years old, resided in the study community being surveyed at the time and recruited by an adolescent who had completed the survey were eligible to participate. Eighteen initial participants, or “seeds” in RDS, were selected across the four study communities from among adolescents who participated in the qualitative component of the study (Miller et al., 2021; Zamudio-Haas et al., 2021). The seeds were distributed across the following demographic categories: 15–17-year-old girls, 15–17-year old-boys, 18–19-year-old girls, and 18–19-year-old boys. Upon completing the survey, participants were given up to five referral coupons to distribute to adolescent peers in their community.

The interviewer-administered surveys were conducted in a private setting within community venues such as schools, churches, and community centers. Data on demographic characteristics, sexual behaviors, HIV testing history, and use of antiretroviral therapy (ART) were collected. Having sex was defined as engaging in vaginal or anal intercourse. Forced sexual contact was defined as any unwanted sexual contact not limited to vaginal or anal intercourse. Gender-based violence was defined as ever experiencing physical, sexual, or emotional violence in a relationship with a partner, boyfriend/girlfriend, or husband/wife.

Participants who reported being HIV-negative were offered rapid testing using Alere Determine HIV-1/2 (Abbott Laboratories, Abbott Park, IL) for initial screening and First

Response HIV 1–2.0 Card Test (Premier Medical Corporation Ltd., Sarigam INA, India) for confirmation testing. HIV testing eligibility criteria were in accordance with the Kenya national HIV testing guidelines (National AIDS and STI Control Programme, 2015). Adolescents age 15 years not previously identified as HIV-positive and who had not been tested within the past three months, unless they reported a recent risk, were eligible for HIV testing and able to provide their own consent. Individuals newly identified as HIV-positive were referred for care at health facilities of their choice and offered same-day linkage to ART initiation, following the Kenya national treatment guidelines (National AIDS and STI Control Programme, 2018a).

Statistical analysis of survey, testing, and linkage data was performed using STATA Statistical Software: Release 12 (StataCorp LP, College Station, TX). We generated frequency distributions and conducted comparisons of participant characteristics by HIV status using chi-square tests. HIV-positive status was defined as participants who were either previously or newly identified as HIV positive. We calculated the previously unidentified fraction (PUF), defined as the proportion of newly identified PLWH out of all previously identified and newly identified PLWH (Truong et al., 2019, 2021, 2022).

To assess factors associated with HIV infection among all participants, we utilized multivariate logistic regression. Perinatally infected adolescents were excluded from this analysis. Variable selection for the multivariate model was based on a priori knowledge and bivariate analysis using a  $p$  value .20 cut-off level. The final model included sex, age group, community, school status, and ever received or given payment/goods for sex. The adjusted odds ratio (aORs) and 95% confidences (CIs) demonstrate strength of associations between the variables and HIV positivity. Subanalysis by sex for select factors associated with HIV infection was conducted using bi-variate logistic regression. All comparison tests and models used a significance level of  $\alpha < 0.05$ .

The study received approval from the University of California San Francisco and the Kenya Medical Research Institute institutional review boards.

## RESULTS

We enrolled 3061 adolescents, of whom 57.4% were girls, 50.4% were aged 15–17 years, and 85.4% were attending school, as shown in Table 1. The proportion of girls was higher in Nyalenda (61.2%) and Manyatta (61.0%) than in Bandani (53.9%) and Obunga (46.5%) ( $\chi^2 = 38.35$ ;  $p < .001$ ). The proportion of participants aged 15–17 was highest in Nyalenda (61.1%) compared to Manyatta (49.1%), Bandani (47.7%), and Obunga (35.0%) ( $\chi^2 = 95.77$ ;  $p < .001$ ). A large majority of adolescents were attending school in Nyalenda (91.7%), Manyatta (90.3%), and Bandani (81.7%), and was lower in Obunga (67.0%) ( $\chi^2 = 231.14$ ;  $p < .001$ ).

Approximately one-third of participants reported ever having sex. Median age at first sexual intercourse was 16 years (IQR 15–17); 99 (16.3%) girls and 173 (31.7%) boys reported sexual intercourse before age 15. Adolescents reported ever having received payments/goods

for sex (10.8%), experienced forced sexual contact (20.6%), and experienced gender-based violence (42.1%).

There were 2,992 adolescents eligible for HIV testing, of whom 99.5% accepted and 19.5% were first-time testers. Seven adolescents were newly identified as HIV-positive; all of whom were girls and five were aged 18–19 years. Five of the participants newly identified as HIV-positive initiated ART, one was linked to care but delayed treatment initiation, and one relocated to another county but did not follow through with the linkage referral. Three of the girls had received payment or goods for sex, one had given payment or goods for sex, two experienced forced sexual contact and five experienced gender-based violence.

HIV prevalence overall was 2.5% and was higher among girls than boys (3.0% vs. 1.8%) and participants aged 18–19 than 15–17 (3.0% vs. 1.9%). The PUF was 9.2% overall, representing seven newly identified cases of a total of 76 adolescents living with HIV. The PUF was 13.5% among girls.

Of the 69 adolescents previously identified with HIV, 45 were girls, 41 were aged 18–19 and 68 were on ART. Twenty-three adolescents reported HIV acquisition through perinatal transmission, of whom eight were girls aged 15–17, nine were girls aged 18–19, three were boys aged 15–17 and three were boys aged 18–19. Of the remaining 47 adolescents, seven were diagnosed within the past year, two were diagnosed in the past one to two years, 12 were diagnosed more than two years ago, and 26 were uncertain about or did not disclose the timing of their diagnosis. Nine of the adolescents (7 girls and 2 boys) had received payment or goods for sex, six (4 girls and 2 boys) had given payment or goods for sex, 11 (8 girls and 3 boys) experienced forced sexual contact, and 26 (15 girls and 11 boys) experienced gender-based violence.

Multivariable analysis of factors associated with HIV infection is presented in Table 2. HIV infection was positively associated with being out-of-school without completing secondary school as compared to being in school (aOR = 4.48; 95% CI [2.02, 9.91];  $p < .001$ ). Participants aged 18–19 were slightly more likely to be HIV positive compared to those aged 15–17 but the difference was not statistically significant (aOR = 1.78; 95% CI [0.99, 2.23];  $p = .054$ ;  $p = .054$ ).

Among the girls, 166 (9.4%) had ever been pregnant and 127 (7.2%) were out-of-school without completing secondary school. Of the 52 girls who were HIV-positive, 16 had ever been pregnant and 14 were out-of-school without completing secondary school. Girls who had ever been pregnant were more likely to be HIV-positive than those who had not been pregnant (OR = 4.61; 95% CI [2.50, 8.50];  $p < .001$ ), as were girls who were out-of-school without completing secondary school compared to those in school or completed secondary school (OR = 5.16; 95% CI [2.69, 9.87];  $p < .001$ ). There was no difference in HIV-positive status between girls who completed secondary school and those who were in school (OR = 0.92; 95% CI [0.28, 3.04];  $p = .90$ ).

Among the boys, 64 (4.9%) were out-of-school without completing secondary school. One of the 24 boys who were HIV-positive was out-out-school without completing secondary

school. No statistically significant association was observed between school status and HIV positivity among boys.

## DISCUSSION

Among *Maneno Yetu* participants, HIV prevalence was higher among girls than boys and all newly identified HIV infections were among girls. These observations point to the important need to offer girls HIV testing in this setting. The PUF of 13.5% among adolescent girls was comparable to the 14.3% observed in the Community Health Initiative implemented in the Kisumu informal settlements (Truong et al., 2021, 2022). The PUF is a useful measure to identify populations that require additional testing strategies and can be used as a metric to monitor and adjust testing strategies as communities move towards epidemic control. The observed association between HIV-positivity and community of residence was likely driven by the higher proportion of female participants from Manyatta and Nyalenda than Bandani and Obunga. Our findings align with other data from SSA showing adolescent girls comprise a substantially higher proportion of new HIV infections than boys (UNICEF, 2021). ART use was nearly universal, as 96% of HIV-positive adolescents were currently on or initiated ART, thus successfully reaching the UNAIDS treatment target and Fast Track commitment to end AIDS by 2030 (UNAIDS, 2014, 2016).

HIV prevalence was higher among adolescents who had discontinued their education prior to completing secondary school. Cost of an education poses a financial burden for many families. Inability to pay school fees leads to many adolescents, especially girls, being forced to drop out of school (Zamudio-Haas et al., 2021). School attendance has been shown to decrease risk of HIV acquisition (Baird et al., 2012; Jukes et al., 2008; Stoner et al., 2017).

Poverty is also a driving factor for adolescents to engage in transactional sex despite the HIV risk (Wamoyi et al., 2016; Zamudio-Haas et al., 2021). Nearly one-fifth of HIV-positive participants and more than half of girls newly identified with HIV received payment or goods in return for sex. Adolescents engage in transactional sex for a variety of reasons, including to procure basic needs such as food and menstrual hygiene products, pay school fees for themselves and their siblings, and obtain material goods such as clothes and mobile phones (Duby et al., 2021; Zamudio-Haas, 2021). Sexual activity in this context is often unprotected because of limited ability to negotiate condom use due to the transactional nature of these relationships, thereby placing girls at increased risk for unintended pregnancy and HIV infection (Zamudio-Haas, 2021).

Sexual initiation at a young age is likely a contributing factor to the high HIV prevalence among adolescents. Among *Maneno Yetu* participants, nearly one-fifth of girls and one-third of boys reported having sex before age 15, higher percentages than the 14% of young women and 18% of young men from Kisumu County participating in the Kenya Demographic and Health Survey (Kenya National Bureau of Statistics, 2014; National AIDS Control Council, 2016). In some cases, sexual initiation may not have been consensual (Nguyen et al., 2019; Swedo et al., 2019). Nearly half of participants experienced gender-based violence and one-fifth experienced forced sexual contact, observations that mirror

global data for adolescents in low and middle-income countries (LMIC; World Health Organization, 2018).

In our study, girls who had been pregnant were more likely to be HIV-positive. Even though Kenyan adolescents express a greater fear of becoming pregnant than acquiring HIV or sexually transmitted infections, 50% of sexually active unmarried adolescents do not use any forms of contraception, including condoms, which places them at risk for HIV infection (Kenya National Bureau of Statistics, 2014; Miller et al., 2021). Currently, few LMIC are likely to reach the UN Assembly's target of ensuring that the HIV and SRH needs of 95% of girls and women of reproductive age are met by 2025 (UNAIDS, 2021).

The *Maneno Yetu* study successfully recruited a large sample of adolescents in urban informal settlements in Kenya using RDS. To the best of our knowledge, our study enrolled more adolescents than previously achieved by other studies that used this sampling approach to specifically recruit this age group. Using RDS enabled us to reach adolescents who were still in school as well as those who were out-of-school and generate a community-level estimate of HIV prevalence among adolescents.

We acknowledge several limitations with the study. The experiences of *Maneno Yetu* participants, including HIV risk factors and ART uptake among HIV-positive adolescents, may not reflect those of adolescents residing in other settings in Kenya. Participants may have underreported sexual behaviors such as engagement in premarital and transactional sex, and history of pregnancy and forced sexual contact because the survey was interviewer-administered and adolescent sexuality stigma is highly prevalent in Kenya and other SSA cultures. Social desirability bias may have been reduced by the fact that the survey was administered by interviewers who were young women and men with whom participants might perceive as a peer they could relate to and thereby provided more candid responses.

In Kenya and other SSA countries, adolescents continue to be at high risk for HIV acquisition (UNAIDS, 2022; UNICEF, 2021). Adolescents residing in informal settlements often face additional disadvantages, such as poverty and gender-based violence, that affect their ability to complete secondary education and access SRH services. Our findings highlight the need to facilitate access to HIV testing, HIV pre-exposure prophylaxis and SRH services, including family planning and support for persons affected by forced sexual contact and gender-based violence, as components of a comprehensive prevention strategy to decrease HIV infections in this priority population.

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**TABLE 1.**Characteristics of *Maneno Yetu* Participants by HIV Status ( $N = 3,061$ ), Kisumu, Kenya

Characteristic	Overall	HIV–	HIV+*
	$N = 3,061$ $n$ (%)	$n = 2,984$ $n$ (%)	$n = 76$ $n$ (%)
<b>Sex</b>			
Girls	1,757 (57.4)	1,705 (57.1)	52 (68.4)
Boys	1,304 (42.6)	1,280 (42.9)	24 (31.6)
<b>Age</b>			
15–17 years	1,544 (50.4)	1,514 (50.7)	30 (39.5)
18–19 years	1,517 (49.6)	1,471 (49.3)	46 (60.5)
<b>Community</b>			
Obunga	503 (16.4)	495 (16.6)	8 (10.5)
Bandani	553 (18.1)	539 (18.0)	14 (18.4)
Nyalenda	1,002 (32.7)	975 (32.7)	27 (35.5)
Manyatta	1,003 (32.8)	976 (32.7)	27 (35.5)
<b>School status</b>			
In school	2,614 (85.4)	2,557 (85.7)	57 (75.0)
Out of school (completed secondary school)	256 (8.4)	252 (8.4)	4 (5.3)
Out of school (did not complete secondary school)	191 (6.2)	175 (5.9)	15 (19.7)
<b>Relationship status</b>			
Single/separated/divorced	1,984 (64.8)	1,939 (65.0)	45 (59.2)
Committed relationship/married	1075 (35.1)	1,044 (35.0)	31 (40.8)
Missing	2 (0.1)	2 (0.1)	0 (0)
<b>First-time tester (<math>n = 2,978</math>)</b>			
Yes	582 (19.5)	581 (19.6)	1 (14.3)
No	2,396 (80.5)	2,390 (80.4)	6 (85.7)
<b>Ever had sex</b>			
Yes	1,155 (37.7)	1,121 (37.5)	34 (44.7)
No	1,902 (62.1)	1,860 (62.3)	42 (55.3)
Missing	4 (0.1)	4 (0.1)	0 (0)
<b>Ever received payment or goods for sex</b>			
Yes	334 (10.9)	322 (10.8)	12 (15.8)
No	2,727 (89.1)	2,663 (89.2)	64 (84.2)
<b>Ever given payment or goods for sex</b>			
Yes	172 (5.6)	165 (5.5)	7 (9.2)
No	2,889 (94.4)	2,820 (94.5)	69 (90.8)
<b>Ever experienced forced sexual contact</b>			
Yes	630 (20.6)	617 (20.7)	13 (17.1)
No	2,431 (79.4)	2,368 (79.3)	63 (82.9)
<b>Ever experienced gender-based violence</b>			
Yes	1,287 (42.1)	1,256 (42.1)	31 (40.8)

Characteristic	Overall	HIV-	HIV+*
	<i>N</i> = 3,061 <i>n</i> (%)	<i>n</i> = 2,984 <i>n</i> (%)	<i>n</i> = 76 <i>n</i> (%)
No	1,774 (57.9)	1,729 (57.9)	45 (59.2)

\* HIV+ includes previously identified and newly identified participants

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**TABLE 2.**

Factors Associated With HIV Infection Among *Maneno Yetu* Participants (*n* = 3,038), Kisumu, Kenya

Characteristic	Bivariate		Multivariate	
	OR (95% CI)	<i>p</i> value	aOR (95% CI)	<i>p</i> value
<b>Sex</b>				
Girls	1.38 (0.79, 2.43)	.260	1.43 (0.78, 2.62)	.243
Boys	ref	ref	ref	ref
<b>Age</b>				
15–17 years	ref	ref	ref	ref
18–19 years	1.75 (1.00, 3.05)	.049	1.78 (0.99, 2.23)	.054
<b>Community</b>				
Obunga	ref	ref	ref	ref
Bandani	1.44 (0.55, 3.75)	.452	1.67 (0.63, 4.47)	.302
Nyalenda	1.09 (0.44, 2.69)	.853	1.73 (0.65, 4.64)	.272
Manyatta	1.52 (0.64, 3.60)	.340	2.44 (0.94, 6.33)	.066
<b>School status</b>				
In school	ref	ref	ref	ref
Out of school (completed secondary school)	0.25 (0.03, 1.80)	.168	0.20 (0.03, 1.53)	.123
Out of school (did not complete secondary school)	4.25 (2.19, 8.23)	< .001	4.48 (2.02, 9.91)	< .001
<b>Relationship status</b>				
Single/separated/divorced	1.18 (0.68, 2.05)	.554	-	—
Committed relationship/married	ref	ref		
<b>First-time tester</b>				
Yes	0.68 (0.08, 5.70)	.727	—	—
No	ref	ref		
<b>Ever had sex</b>				
Yes	1.54 (0.90, 2.64)	.116	—	—
No	ref	ref		
<b>Ever received payment or goods for sex</b>				
Yes	1.44 (0.67, 3.07)	.349	0.78 (0.33, 1.86)	.576
No	ref	ref	ref	ref
<b>Ever given payment or goods for sex</b>				
Yes	1.74 (0.68, 4.43)	.116	1.78 (0.61, 5.20)	.293
No	ref	ref	ref	ref
<b>Ever experienced forced sexual contact</b>				
Yes	0.87 (0.44, 1.74)	.698	—	—
No	ref	ref		
<b>Ever experienced gender-based violence</b>				
Yes	1.18 (0.69, 2.03)	.536	—	—
No	ref	ref		

*Note.* Excludes HIV perinatally infected participants.