HIV Testing Uptake and Prevalence Among Adolescents and Adults in a Large Home-Based HIV Testing Program in Western Kenya

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Objective: To describe HIV testing uptake and prevalence among adolescents and adults in a home-based HIV counseling and testing program in western Kenya.

Methods: Since 2007, the Academic Model Providing Access to Healthcare program has implemented home-based HIV counseling and testing on a large scale. All individuals aged ≥13 years were eligible for testing. Data from 5 of 8 catchments were included in this analysis. We used descriptive statistics and multivariate logistic regression to examine testing uptake and HIV prevalence among adolescents (13–18 years), younger adults (19–24 years), and older adults (≥25 years).

Results: There were 154,463 individuals eligible for analyses as follows: 22% adolescents, 19% younger adults, and 59% older adults. Overall mean age was 32.8 years and 56% were female. HIV testing was high (96%) across the following 3 groups: 99% in adolescents, 98% in younger adults, and 94% in older adults ($P < 0.001$). HIV prevalence was higher (11.0%) among older adults compared with younger adults (4.8%) and adolescents (0.8%) ($P < 0.001$). Those who had ever previously tested for HIV were less likely to accept HIV testing (adjusted odds ratio: 0.06, 95% confidence interval: 0.05 to 0.07) but more likely to newly test HIV positive (adjusted odds ratio: 1.30, 95% confidence interval: 1.21 to 1.40). Age group differences were evident in the sociodemographic and socioeconomic factors associated with testing uptake and HIV prevalence, particularly, gender, relationship status, and HIV testing history.

Conclusions: Sociodemographic and socioeconomic factors were independently associated with HIV testing and prevalence among the age groups. Community-based treatment and prevention strategies will need to consider these factors.

Key Words: HIV, home-based HIV testing, prevalence, adults, adolescents, Africa

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INTRODUCTION

Early diagnosis and treatment of HIV has long been advocated as one of the most effective ways to mitigate HIV transmission and reduce HIV morbidity and mortality rates.[1–3] More importantly, recent advances in HIV prevention have raised hopes for "treatment as prevention."[4–6] Current research agendas are thus increasingly centered on studies that define ways to promote high coverage of HIV testing, repeated HIV testing, linkage to care, and retention in care.[4,5] In all, HIV testing remains a critical gateway to HIV prevention and treatment.

Over the years, countries within the sub-Saharan region have embraced different HIV testing strategies, defined by the target group and point of entry.[5,7,8] These strategies include (1) patient-initiated testing such as voluntary counseling and testing services and mobile voluntary counseling and testing services; (2) provider-initiated testing including provider-initiated counseling including prevention of mother-to-child transmission services; and (3) home-based HIV counseling and testing (HBCT). Compared with other testing strategies, HBCT has been shown to be effective in enhancing testing uptake,[9,10] and timely enrollment of HIV-infected persons in care.[8] This is attributed to the advantages of testing in the privacy of one's home, although addressing the challenges present in institutionalized testing sites such as distance and transport costs, stigma associated with testing centers, limited counselors, and confidentiality issues.[7,11,12] In addition, discussion on prevention and behavior change may be effectively explored in the context of the family and targeting all age groups.

As population-level primary HIV prevention requires broad-based testing and linkage strategies, it is imperative to understand issues affecting HIV testing uptake and prevalence

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across the life cycle. The issues and characteristics of different age groups such as adolescents, younger adults, and older adults need to be addressed as HIV programs define effective population-based testing and prevention strategies. Furthermore, the acceptability of repeated testing through HBCT and other testing points remain of pertinent concern.[5]

The objectives of this study were therefore to (1) describe HIV testing uptake and prevalence in adolescents, younger adults, and older adults; and (2) compare factors associated with HIV testing uptake and HIV prevalence among the 3 age groups.

METHODS

Study Area

The United States Agency for International Development–Academic Model Providing Access to Healthcare (AMPATH) partnership has enrolled >150,000 HIV-infected patients and currently provides HIV care and treatment to >76,000 HIV-infected patients in 65 Ministry of Health facilities across western Kenya. In 2007, AMPATH partnership initiated the home-based HIV counseling and testing (HBCT) program. At the time of the study, HBCT had been rolled out in 8 of its catchment areas. We defined a catchment area as an area assigned to the AMPATH program by the Ministry of Health for provision of health care services. The catchment areas included Kosirai, Turbo, Burnt Forest, Chulaimbo, Webuye, Teso, Port Victoria, and Kapseret. For this study, we focused on 5 catchment areas namely: Burnt Forest, Chulaimbo, Teso, Port Victoria, and Kapsaret. This was because Kosirai and Turbo were considered as the HBCT pilot areas, and the data are incomplete and unreliable. Webuye catchment site was also dropped in our current analysis since it was missing important covariates (education, employment status) because those data were not collected. A detailed description of the HBCT program is documented elsewhere.[13] In brief, trained counselors conducted home visits and offered HIV counseling and testing to all consenting persons 13 years and older and to children younger than 13 years whose mother was either known to be dead, HIV infected, or of unknown HIV or vital status. Rapid HIV tests were performed on persons older than 18 months, whereas children younger or 18 months old were referred to AMPATH Partnership for DNA polymerase chain reaction testing for HIV. Posttest counseling was provided to all persons tested, and those found HIV positive were referred for HIV care.

Study Design

This retrospective study utilized data collected during HBCT between November 2009 and January 2012 in Burnt Forest, Chulaimbo, Teso, Port Victoria, and Kapsaret AMPATH catchment areas. All individuals aged ≥13 years were included in the analysis.

Ethical Considerations

Ethical approval was obtained from the Institutional Research and Ethics Committee at Moi University School of Medicine, Eldoret, Kenya, and Indiana University's Institutional Review Board in Indianapolis, Indiana. HBCT was rolled out as a clinical program, and hence ethical approval was provided for retrospective analysis of de-identified data.

Data Analysis

All statistical analyses were performed using SAS version 9.3 and STATA version 11.0. The primary outcome variables were HIV testing uptake (accepted vs. refused) and HIV prevalence (positive vs. negative). Explanatory variables considered were (1) Sociodemographic characteristics including age in years, gender (male vs. female), orphan status for adolescents [no (nonorphan) vs. yes (single/double orphan)], relationship status (single vs. in a relationship); (2) Socioeconomic characteristics namely education level (less than secondary vs. secondary and above), occupation (nonemployed vs. employed and casual laborer), number of household members, HBCT catchment area (Kapsaret vs. Burnt Forest, Chulaimbo, Teso, and Port Victoria); (3) HIV testing data including having had a previous HIV test (yes vs. no), the previous HIV result (positive vs. negative, accepting HIV counseling (yes vs. no), accepting HIV testing (yes vs. no), and the current HIV testing result (positive, negative, indeterminate). For adolescents, occupation status was not included because the majority (93.2%), were unemployed given that they were attending school. In addition, orphan status was only captured for adolescents.

We used both descriptive and inferential statistics. Analysis of variance was used for mean group comparison (age). Medians and interquartile ranges were also calculated for continuous variables (household size). The χ^2 tests were performed for categorical variable including comparison of HIV testing uptake and HIV prevalence across the defined age groups. Bivariate and multivariate logistic regression was used to identify factors independently associated with testing uptake and HIV prevalence although controlling for intrahousehold effect. We calculated robust standard errors, to account for intracluster correlation among households where appropriate. The adjusted odds ratios (AOR) provided for each variable was obtained by controlling for all other variables included in the model because most were sociodemographic or socioeconomic in nature and thus potential confounders of each other. A P value of less than 0.05 was considered statistically significant.

RESULTS

Sociodemographics and Socioeconomic Status

There were 273,213 adults and children captured through HBCT data. Of these, 154,463 were aged 13 years and older and were eligible for analysis including 34,733 (22.5%) individuals aged 13–18 years, 28,642 (18.5%) individuals aged 19–24 years, and 91,088 (59.0%) individuals aged 25 years and older. Overall, the mean age was 32.8 (SD = 17.3) years and 56.3% were female.

Table 1 summarizes the sociodemographic and socioeconomic characteristics by age group. Similar proportions of younger adults (41.1%) and older adults (42.1%) were male;

but 50.1% of adolescents were female. The majority (97.1%) of adolescents and (61.0%) younger adults were single although 75.9% of older adults were in a relationship. Among adolescents (the only group for which orphan status was collected), a considerable proportion were orphaned; 20.1% were single orphans and 4.0% double orphans. Only 9.2%, 29.7%, and 21.1% of adolescents, younger adults, and older adults, respectively, had attained a secondary education level and greater.

Compared with older adults (30.1%), a higher proportion of younger adults (55.8%) were unemployed ($P < 0.001$). Chulaimbo and Teso catchment areas had slightly higher proportions of adolescents compared with younger adults and older adults. Kapsaret had a higher proportion of younger adults and Burnt Forest a higher proportion of adults (Table 1).

Testing Uptake

There were some differences in HIV testing history and uptake across the 3 age groups as shown in Table 2. A lower percentage (9.7%) of adolescents compared with younger adults (46.5%) and older adults (40.3%) had ever tested for HIV ($P < 0.001$). Overall, 99.0% of the population accepted HIV counseling, and 95.9% accepting testing for HIV. HIV testing uptake was high across the 3 groups as follows: 99.1% among adolescents, 98.3% among younger adults, and 93.9% among older adults ($P < 0.001$).

With every year increase in age, individuals were somewhat less likely to accept testing (AOR: 0.97, 95% CI: 0.97 to 0.98); there was a more pronounced effect among younger adults (AOR: 0.83, 95% CI: 0.78 to 0.88) (Table 3). Adolescents however were more likely to agree to HIV testing

TABLE 1. Sociodemographic and Socioeconomic Characteristics of Adolescents (Aged 13–18), Younger Adults (Aged 19–24), and Older Adults (Aged 25 Years and older) in HBCT

Variables	Total, N (%) N = 154,463	Adolescent, n (%) n = 34,733	Younger Adults, n (%) n = 28,642	Older Adults, n (%) n = 91,088
Age, mean, (SD)	32.82 (17.25)	15.26 (1.74)	21.50 (1.68)	43.07 (15.47)
Gender				
Male	67,442 (43.7)	17,330 (49.9)	11,774 (41.1)	38,338 (42.1)
Female	87,021 (56.3)	17,403 (50.1)	16,868 (58.9)	52,750 (57.9)
Missing	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Orphan status				
Non orphaned	—	22,649 (65.2)	—	—
Single orphan	—	6014 (17.3)	—	—
Double orphan	—	1189 (3.4)	—	—
Unknown	—	1357 (3.9)	—	—
Missing	—	3524 (10.1)	—	—
Relationship status				
Single	69,937 (45.3)	33,698 (97.0)	17,394 (60.7)	18,845 (20.7)
In a relationship	71,530 (46.3)	1017 (2.9)	11,115 (38.8)	59,398 (65.2)
Missing	12,996 (8.4)	18 (0.1)	133 (0.5)	12,845 (14.1)
Education level				
None	47,237 (30.6)	13,802 (39.7)	4885 (17.1)	28,550 (31.3)
Primary	76,334 (49.4)	17,751 (51.0)	15,256 (53.3)	43,327 (47.6)
Secondary and above	30,890 (20.0)	3180 (9.2)	8500 (29.7)	19,210 (21.1)
Missing	2 (0.0)	0 (0.0)	1 (0.0)	1 (0.0)
Occupation				
Employed	65,412 (42.3)	—	9363 (32.7)	54,502 (59.8)
Casual workers	12,439 (8.1)	—	3075 (10.7)	8674 (9.5)
Unemployed	73,724 (47.7)	—	15,694 (54.8)	27,229 (29.9)
Missing	2888 (1.9)	—	510 (1.8)	683 (0.8)
Number of household members				
Median (IQR)	9.0 (7–11)	10 (8–12)	9 (7–11)	9 (7–11)
Missing	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
HBCT catchment				
Burnt forest	36,837 (23.9)	8053 (23.2)	6664 (23.3)	22,120 (24.3)
Chulaimbo	29,558 (19.1)	7884 (22.7)	4524 (15.8)	17,150 (18.8)
Teso	24,333 (15.8)	6065 (17.5)	4545 (15.9)	13,723 (15.1)
Port Victoria	32,012 (20.7)	6945 (20.0)	6085 (21.2)	18,982 (20.8)
Kapsaret	31,723 (20.5)	5786 (16.7)	6824 (23.8)	19,113 (21.0)
Missing	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

En-dash indicates data not collected.

TABLE 2. HIV Testing and Prevalence Among Adolescents (Aged 13–18), Younger Adults (Aged 19–24), and Older Adults (Aged 25 Years and older) in HBCT

Variables	Total, N (%) N = 154,463	Adolescent, n (%) n = 34,733	Younger Adults, n (%) n = 28,642	Older Adults, n (%) n = 91,088
Ever tested for HIV	53,416 (34.6%)	3375 (9.7)	13,305 (46.5)	36,736 (40.3)
Missing	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Previously infected with HIV	6241 (4.0%)	126 (0.4)	461 (1.6)	5654 (6.2)
Missing	10,054 (6.5%)	3359 (9.7)	1338 (4.7)	5357 (5.9)
Counseled	152,955 (99%)	34,552 (99.5)	28,511 (99.5)	89,892 (98.7)
Missing	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Tested	148,051 (95.9%)	34,410 (99.1)	28,141 (98.3)	85,500 (93.9)
Missing	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Tested HIV positive	5477 (3.7%)	162 (0.5)	928 (3.3)	4387 (5.1)
Missing	6039 (3.9%)	314 (0.9)	484 (1.7)	5241 (5.8)
Total HIV prevalence	11,718 (7.6)	288 (0.8)	1389 (4.8)	10,041 (11.0)

per year increase in age (AOR: 1.56, 95% CI: 1.40 to 1.74). Females were more likely to accept testing than males (AOR: 1.08, 95% CI: 1.02 to 1.15); however, this was primarily among older adults (AOR: 1.14, 95% CI: 1.07 to 1.21). In younger adults, females were less likely to test than males (AOR: 0.69, 95% CI: 0.65 to 0.73), and there was no effect of gender in adolescents. Among adolescents, orphans were less likely to agree to HIV testing (AOR: 0.67, 95% CI: 0.52 to 0.87). Only among older adults was relationship status a factor in the testing uptake; older adults in a relationship were more likely to accept testing (AOR: 1.26, 95% CI: 1.16 to 1.38).

Overall, individuals with at least a secondary school education were more likely to accept testing (AOR: 1.33, 95% CI: 1.22 to 1.45). Although the same was observed among both younger adults (AOR: 1.49, 95% CI: 1.17 to 1.90) and older adults (AOR: 1.35, 95% CI: 1.23 to 1.49), adolescents were less likely to accept testing if they had completed secondary school education (AOR: 0.56, 95% CI: 0.33 to 0.95). There were variations in the acceptability of testing by catchment area in the overall population and across the 3 age groups. In the total population, individuals from Chulaimbo (AOR: 0.44, 95% CI: 0.39 to 0.48) and Port Victoria (AOR: 0.62, 95% CI: 0.56 to 0.69) were less likely to accept testing compared with people in Kapsaret although those from Teso (AOR: 2.01, 95% CI: 1.72 to 2.34) and Burnt Forest (AOR: 1.12, 95% CI: 1.01 to 1.26), and were more likely to accept testing, respectively.

Individuals who had ever had a previous HIV test were much less likely to accept testing (AOR: 0.06, 95% CI: 0.05 to 0.07). This effect was consistent across the 3 age categories (Table 3).

HIV Prevalence

There were 6241 (4.0%) individuals in the 5 catchments who were already known to be HIV positive at the time of HBCT as follows: 0.4% of adolescents, 1.6% of younger adults, and 6.2% of older adults ($P < 0.001$) (Table 2). There were an additional 5477 (3.7%) individuals newly identified as HIV positive through HBCT as follows: 0.5% of adolescents, 3.3% of younger adults, and 5.1% of older adults. Combining the 2 groups yielded an overall HIV prevalence in these catchments of 7.6%, including 0.8% of adolescents, 4.8% of younger adults, and 11.0% of older adults (Table 2).

Factors associated with HIV prevalence in the total population and by age category are presented in Table 4. In the total population and among adolescents, there was no age effect on HIV prevalence. However, younger adults were more likely to test HIV positive for every year increase in age (AOR: 1.22, 95% CI: 1.16 to 1.27). Generally, females were more likely to be HIV positive (AOR: 1.30, 95% CI: 1.23 to 1.38), and this was particularly the case for adolescents (AOR: 2.83, 95% CI: 1.76 to 4.56) and younger adults (AOR: 2.48, 95% CI: 2.05 to 3.01). Older adults showed no effect of gender on HIV prevalence. Adolescents who had been orphaned were more likely to be infected with HIV (AOR: 2.30, 95% CI: 1.49 to 3.55). Being in a relationship was positively associated with having HIV (AOR: 1.65, 95% CI: 1.51 to 1.81), especially among adolescents (AOR: 4.29, 95% CI: 2.16 to 8.53) and younger adults (AOR: 1.51, 95% CI: 1.27 to 1.80). Among older adults, however, those in a relationship were less likely to be HIV positive (AOR: 0.79, 95% CI: 0.72 to 0.85). In terms of HIV prevalence by marital status for older adults, it was 4.7% among the single, 4.4% married, 14.9% cohabiting, 9.2% separated, 9.7% divorced, and 7.0% widowed.

Individuals with at least secondary school education were less likely to be HIV positive (AOR: 0.73, 95% CI: 0.67 to 0.80). This effect was mainly noted among younger adults (AOR: 0.44, 95% CI: 0.35 to 0.56) and older adults (AOR: 0.67, 95% CI: 0.61 to 0.74). Overall, both being formally employed (AOR: 1.38, 95% CI: 1.27 to 1.49) and engaging in casual work (AOR: 2.15, 95% CI: 1.93 to 2.39) were associated with a higher likelihood of a HIV-positive test result. Individuals living in larger households were slightly less likely to test HIV positive (AOR: 0.95, 95% CI: 0.94 to 0.96). There were also variations in the prevalence of HIV in the 5 catchments. Unsurprisingly, individuals from Chulaimbo (AOR: 3.34, 95% CI: 3.00 to 3.73) and Port Victoria (AOR: 2.96, 95% CI: 2.66 to 3.30) catchment areas (adjacent to Lake Victoria) were more likely to test HIV positive. A similar effect was seen across the age groups.

Overall, individuals who had ever had a previous HIV test were more likely to test HIV positive (AOR: 1.30, 95%

TABLE 3. Multivariate Model of the Factors Associated With HBCT Uptake in Adolescents (13–18 Years), Younger Adults (Aged 19–24 Years), and Older Adults (Aged 25 Years and older)

	Total Population		Adolescents	
Variables	**UOR (95% CI)**	**AOR (95% CI)**	**UOR (95% CI)**	**AOR (95% CI)**
Age (per yr)	0.98 (0.98 to 0.99)	0.97 (0.97 to 0.98)	1.14 (1.07 to 1.22)	1.56 (1.40 to 1.74)
Gender				
Female	0.63 (0.60 to 0.66)	1.08 (1.02 to 1.15)	0.88 (0.71 to 1.10)	1.09 (0.85 to 1.40)
Male	1	1	1	1
Orphan status				
Yes	XX	XX	0.68 (0.52 to 0.88)	0.67 (0.52 to 0.87)
No	XX	XX	1	1
Relationship status				
Relationship	0.46 (0.43 to 0.49)	1.07 (0.99 to 1.16)	0.57 (0.34 to 0.95)	0.71 (0.43 to 1.16)
Single	1	1	1	1
Education level				
Secondary and above	1.11 (1.04 to 1.19)	1.33 (1.22 to 1.45)	0.86 (0.60 to 1.22)	0.56 (0.33 to 0.95)
Less than secondary	1	1	1	1
Occupation status				
Employed	1.65 (1.56 to 1.74)	1.06 (0.99 to 1.14)	XX	XX
Casual worker	1.34 (1.22 to 1.48)	1.04 (0.92 to 1.17)	XX	XX
Not employed	1	1	—	—
Location (HBCT catchment area)				
Burnt forest	1.65 (1.51 to 1.81)	1.12 (1.01 to 1.26)	0.84 (0.63 to 1.12)	0.65 (0.46 to 0.91)
Chulaimbo	0.43 (0.40 to 0.46)	0.44 (0.39 to 0.48)	1.74 (1.24 to 2.44)	2.35 (1.56 to 3.54)
Teso	2.14 (1.91 to 2.41)	2.01 (1.72 to 2.34)	3.83 (2.36 to 6.22)	3.21 (1.80 to 5.73)
Port Victoria	0.60 (0.56 to 0.65)	0.62 (0.56 to 0.69)	2.30 (1.56 to 3.38)	2.81 (1.80 to 4.39)
Kapsaret	1	1	1	1
Ever tested for HIV				
Yes	0.05 (0.05 to 0.06)	0.06 (0.05 to 0.07)	0.16 (0.13 to 0.20)	0.07 (0.06 to 0.10)
No	1	1	1	1

	Younger Adults		Adults	
Variables	**UOR (95% CI)**	**AOR (95% CI)**	**UOR (95% CI)**	**AOR (95% CI)**
Age (per yr)	0.80 (0.76 to 0.85)	0.83 (0.78 to 0.88)	1.01 (1.01 to 1.02)	1.00 (0.98 to 1.01)
Gender				
Female	0.33 (0.26 to 0.41)	0.57 (0.45 to 0.73)	0.69(0.65 to 0.73)	1.14 (1.07 to 1.21)
Male	1	1	1	1
Orphan status				
Yes	XX	XX	XX	XX
No	XX	XX	XX	XX
Relationship status				
Relationship	0.55 (0.46 to 0.66)	1.09 (0.88 to 1.35)	1.05 (0.97 to 1.13)	1.26 (1.16 to 1.38)
Single	1	1	1	1
Education level				
Secondary and above	1.71 (1.37 to 2.13)	1.49 (1.17 to 1.90)	1.17 (1.09 to 1.26)	1.35 (1.23 to 1.49)
Less than secondary	1	1	1	1
Occupation status				
Employed	0.98 (0.81 to 1.19)	1.27 (1.04 to 1.55)	1.13 (1.07 to 1.20)	1.18 (1.09 to 1.28)
Casual worker	1.51 (1.07 to 2.14)	1.35 (0.91 to 2.01)	1.18 (1.06 to 1.31)	1.15 (1.01 to 1.32)
Not employed	1	1	1	1
Location (HBCT catchment area)				
Burnt forest	1.66 (1.22 to 2.26)	1.35 (0.97 to 1.88)	1.82 (1.64 to 2.02)	1.18 (1.03 to 1.35)
Chulaimbo	0.39 (0.31 to 0.49)	0.41 (0.31 to 0.53)	0.37 (0.34 to 0.41)	0.37 (0.33 to 0.42)
Teso	2.96 (1.92 to 4.58)	3.09 (1.90 to 5.03)	1.89 (1.67 to 2.14)	1.72 (1.45 to 2.03)
Port Victoria	0.83 (0.64 to 1.08)	0.93 (0.70 to 1.24)	0.53 (0.49 to 0.58)	0.51 (0.45 to 0.57)

TABLE 3. (*Continued*) Multivariate Model of the Factors Associated With HBCT Uptake in Adolescents (13–18 Years), Younger Adults (Aged 19–24 Years), and Older Adults (Aged 25 Years and older)

	Younger Adults		Adults	
Variables	**UOR (95% CI)**	**AOR (95% CI)**	**UOR (95% CI)**	**AOR (95% CI)**
Kapsaret	1	1	1	1
Ever tested for HIV				
Yes	0.15 (0.12 to 0.19)	0.20 (0.16 to 0.26)	0.04 (0.04 to 0.05)	0.05 (0.04 to 0.06)
No	1	1	1	1

XX, not included in the analysis.

CI: 1.21 to 1.40). However, this was mostly the case among adolescents (AOR: 2.97, 95% CI: 1.71 to 5.18). Younger adults who had ever tested for HIV were less likely to be HIV positive (AOR: 0.78, 95% CI: 0.67 to 0.91), and there was no effect of testing history on the HIV prevalence among older adults.

Figure 1 shows the AORs of key factors associated with HIV prevalence (gender, relationship status, and HIV testing history) across the 3 age groups and clearly demonstrates how these factors are strongest among adolescents.

DISCUSSION

Our findings provide several important insights to consider when implementing HBCT or other HIV prevention efforts such as "treatment as prevention," where testing uptake and prevalence are of paramount importance.[4] First, there was a high testing uptake, and nearly 5400 new HIV infections were identified. HIV prevalence increased with age, and the overall prevalence (7.6%) was higher than the reported national prevalence (6.3%).[14] These data support the effectiveness of HBCT at identifying people living with HIV, and care and treatment programs should be prepared for the additional workload if HBCT is employed as a testing strategy in their area. Second, there were important age cohort differences in the sociodemographic and socio-economic factors associated with HIV testing uptake and prevalence, which need to be considered by HIV program implementers. Third, individuals who had ever tested for HIV were much less likely to accept testing and those who agreed to test were more likely to be HIV infected. This suggests a possible self-selection of testing based on HIV risk history. Efforts to promote repeated testing should be integrated with other HIV prevention measures to maximize testing coverage and minimize HIV risk factors.[5]

Similar to findings from other HBCT literature, HIV testing uptake was high across the 3 age groups.[9,10,15,16] The variations in the HIV prevalence reported in HBCT with that of the national prevalence may be as a result of the sampling procedure used during the Kenya Demographic Health Survey (KDHS), which was different from our population-based testing. Although HBCT focused on testing everyone aged 13 years and older and children younger than 13 years who were considered at risk,[13] KDHS adopted a cluster sampling method targeting only 15–49 years.[14] It could also be that our HBCT program had a relatively high representation of catchment areas reported to have high HIV prevalence such as Chulaimbo and Port Victoria.[14] The true HIV prevalence in Kenya can only be determined if HIV testing efforts are strengthened to capture the entire Kenyan population and HBCT could be one of the ways to achieve this optimal testing coverage.

Like other studies in sub-Saharan Africa,[9,15] we noted important sociodemographic and socioeconomic influences in HIV testing uptake and prevalence. For example, our data indicate that older individuals may be less likely to accept testing than younger individuals. It is crucial that strategies to promote testing among younger adults be put in place because they were more likely to test positive, yet less likely to accept testing. Consistent with findings from Uganda,[15] individuals with prior knowledge of their HIV status across all age groups were reluctant to test again. Defining new strategies to encourage repeat testing even among individuals who perceive themselves to be at minimal risk is paramount.

Except for younger adults, females were more likely to accept testing and test HIV positive, as evident in the national KDHS report[14] and other findings[5] including HBCT.[10] We need to acknowledge that for older adults, these findings may have been influenced by the fact that women have other opportunities to get tested, for example through prevention of mother-to-child transmission. However, like other reports from the regions,[9,15] it was encouraging to see that younger adult males were more likely to accept testing than females. Overall, there is still a need for continued efforts to promote male HIV testing.

Among older adults, our findings suggest that those in a relationship were more likely to accept testing. This may imply that HBCT could be one of the effective strategies to promote couple counseling and testing.[5] Couples who were cohabiting reported the highest HIV prevalence which is consistent with the findings of others.[5] Similarly, those who were separated, divorced, or widowed reported higher HIV prevalence compared with those who were single and married. We speculate that these persons may have been infected during their previous marital relationships or may be engaging in high risk behaviors given their current relationship status. Previous studies in sub-Saharan Africa have reported an increased risk for being HIV-positive among those who are separated, divorced, or widowed.[17,18] Further insights to these findings are needed.

Even though HIV prevalence increased with increase in age, we noted that adolescents seem to be particularly vulnerable to HIV infection if they were female, orphaned,

TABLE 4. Multivariate Model of the Factors Associated With HIV Prevalence in Adolescents (13–18 Years), Younger Adults (Aged 19–24 Years) and Older Adults (Aged 25 Years and older)

	Total Population		Adolescents	
Variables	**UOR (95% CI)**	**AOR (95% CI)**	**UOR (95% CI)**	**AOR (95% CI)**
Age (per yr)	1.01 (1.00 to 1.01)	1.00 (1.00 to 1.01)	1.41 (1.28 to 1.55)	1.03 (0.87 to 1.22)
Gender				
Female	1.51 (1.43 to 1.60)	1.30 (1.23 to 1.38)	4.80 (3.19 to 7.22)	2.83 (1.76 to 4.56)
Male	1	1	1	1
Orphan status				
Yes	XX	XX	3.15 (2.12 to 4.67)	2.30 (1.49 to 3.55)
No	XX	XX	1	1
Relationship status				
In a relationship	2.11 (1.98 to 2.24)	1.65 (1.51 to 1.81)	10.97 (7.61 to 15.81)	4.29 (2.16 to 8.53)
Single	1	1	1	1
Education level				
Secondary and above	0.63 (0.59 to 0.69)	0.73 (0.67 to 0.80)	0.94 (0.54 to 1.63)	1.05 (0.47 to 2.34)
Less than secondary	1	1	1	1
Occupation status				
Employed	1.67 (1.57 to 1.77)	1.38 (1.27 to 1.49)	xx	xx
Casual worker	1.86 (1.70 to 2.04)	2.15 (1.93 to 2.39)	xx	xx
Not employed	1	1	1	1
Household size	0.94 (0.93 to 0.95)	0.95 (0.94 to 0.96)	0.92 (0.87 to 0.96)	0.98 (0.92 to 1.06)
Location (HBCT catchment area)				
Burnt Forest	0.83 (0.74 to 0.92)	0.88 (0.78 to 1.00)	0.30 (0.12 to 0.72)	0.52 (0.19 to 1.46)
Chulaimbo	3.10 (2.84 to 3.39)	3.34 (3.00 to 3.73)	3.11 (1.83 to 5.29)	2.78 (1.31 to 5.90)
Teso	1.01 (0.90 to 1.14)	1.11 (0.97 to 1.28)	1.00 (0.52 to 1.94)	1.01 (0.41 to 2.52)
Port Victoria	2.70 (2.47 to 2.96)	2.96 (2.66 to 3.30)	2.35 (1.35 to 4.08)	2.32 (1.10 to 4.89)
Kapsaret	1	1	1	1
Ever tested for HIV				
Yes	1.70 (1.61 to 1.69)	1.30 (1.21 to 1.40)	5.14 (3.71 to 7.11)	2.97 (1.71 to 5.18)
No	1	1	1	1

	Younger Adults		Adults	
Variables	**UOR (95% CI)**	**AOR (95% CI)**	**UOR (95% CI)**	**AOR (95% CI)**
Age (per yr)	1.21 (1.16 to 1.26)	1.22 (1.16 to 1.27)	0.98 (0.97 to 0.98)	0.97 (0.97 to 0.98)
Gender				
Female	3.12 (2.65 to 3.69)	2.48 (2.05 to 3.01)	1.19 (1.12 to 1.27)	0.99 (0.92 to 1.06)
Male	1	—	1	1
Orphan status				
Yes	XX	XX	XX	XX
No	XX	XX	XX	XX
Relationship status				
In a relationship	2.71 (2.37 to 3.11)	1.51 (1.27 to 1.80)	0.74 (0.68 to 0.80)	0.79 (0.72 to 0.85)
Single	1	1	1	1
Education level				
Secondary and above	0.27 (0.22 to 0.33)	0.44 (0.35 to 0.56)	0.63 (0.58 to 0.69)	0.67 (0.61 to 0.74)
Less than secondary	1	1	1	1
Occupation status				
Employed	1.35 (1.18 to 1.55)	0.98 (0.85 to 1.15)	0.86 (0.80 to 0.92)	0.90 (0.83 to 0.98)
Casual worker	0.76 (0.59 to 0.98)	1.24 (0.95 to 1.63)	1.18 (1.07 to 1.31)	1.19 (1.06 to 1.35)
Not employed	1	1	1	1
Household size	0.95 (0.93 to 0.97)	0.98 (0.96 to 1.01)	0.97 (0.96 to 0.98)	0.98 (0.96 to 0.99)
Location (HBCT catchment area)				
Burnt Forest	0.66 (0.48 to 0.93)	0.62 (0.43 to 0.88)	0.88 (0.78 to 0.98)	0.97 (0.85 to 1.11)
Chulaimbo	6.85 (5.40 to 8.68)	6.02 (6.65 to 7.80)	3.03 (2.75 to 3.35)	3.56 (3.15 to 4.03)

TABLE 4. (*Continued*) Multivariate Model of the Factors Associated With HIV Prevalence in Adolescents (13–18 Years), Younger Adults (Aged 19–24 Years) and Older Adults (Aged 25 Years and older)

	Younger Adults		Adults	
Variables	**UOR (95% CI)**	**AOR (95% CI)**	**UOR (95% CI)**	**AOR (95% CI)**
Teso	1.25 (0.92 to 1.71)	1.12 (0.80 to 1.56)	1.06 (0.93 to 1.20)	1.19 (1.02 to 1.39)
Port Victoria	4.78 (3.77 to 6.06)	4.20 (3.24 to 5.44)	2.58 (2.33 to 2.85)	2.98 (2.64 to 3.37)
Kapsaret	1	1	1	1
Ever tested for HIV				
Yes	1.24 (1.09 to 1.41)	0.78 (0.67 to 0.91)	1.31 (1.24 to 1.46)	1.03 (0.95 to 1.11)
No	1	1	1	1

XX, not included in the analysis.

and/or in a relationship. This highlights the vulnerability of adolescents in general as a high-risk group and builds on the knowledge base regarding their HIV risks.[19,20] Safer sex intervention programs and female empowerment initiatives that involve the full participation of adolescents need to be strengthened.

Our findings showed that individuals with an occupation (employed and casual laborers) were more likely to test HIV positive; consistent with other HBCT data.[9] We speculate that with occupation, there is more expendable income and an increased likelihood of engaging in high-risk behaviors such as, excessive alcohol consumption and multiple sexual partners. In addition, some of the casual laborers may have been engaging in transactional sex. Further research is needed to better understand these findings. Nevertheless, HIV workplace prevention programs should be intensified.[5]

Finally, as the Ministry of Health and HIV programs within western Kenya embrace population-based testing, the variation in the uptake and prevalence of HIV evident in our catchment areas provides a strong platform for developing well-tailored prevention and linkage to care programs for each site.

This study has several strengths. To our knowledge, there is no HBCT literature that provides an age comparison of factors associated with HIV testing uptake and prevalence. More importantly, our study includes adolescents who are at high risk but not a well-characterized group. The study also includes findings from 5 large catchments which cover diverse cultural and ethnic populations. Our study also had some limitations. All our sociodemographic socioeconomic variables were self-report measures; hence we cannot eliminate the possibility of reporting error. In addition, there was the potential for incorrect data entry by counselors during the HBCT exercise. Finally, we acknowledge the limitation of secondary data analyses that limited the variables we included in the analysis.

It is possible that there are disadvantages to HBCT, including perceived coercion to test among family members or from the HIV counselor. This pressure may explain the

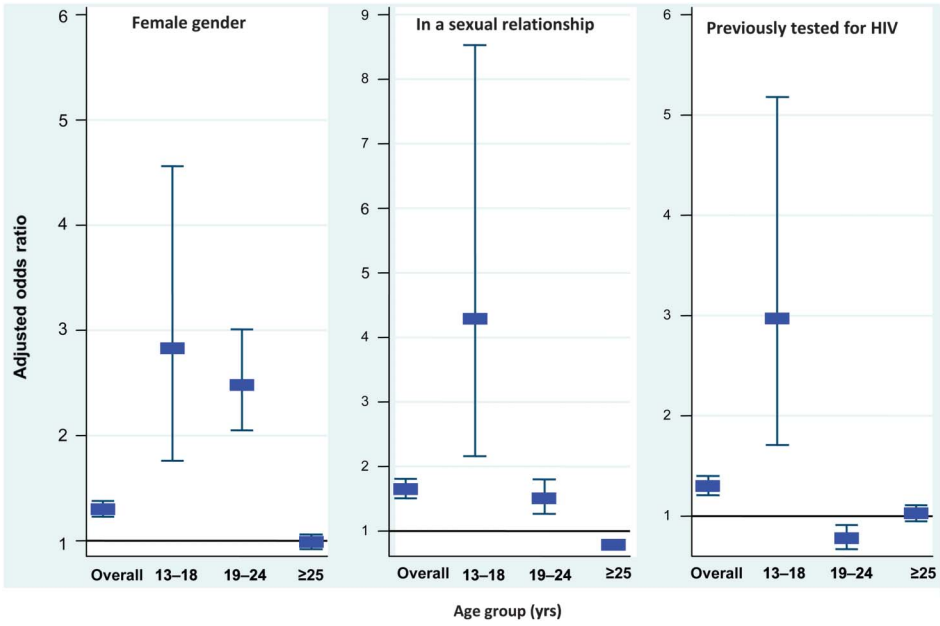

FIGURE 1. Age cohort effects of gender, relationship status, and having previously tested for HIV on HIV prevalence.

high uptake of testing. In the earlier phases of HBCT, there were reports of threats of domestic violence or even violence against the HIV counselors. However, with time and experience, the community mobilization initiatives before the testing exercise, combined with better training and more experience on the part of the mobilizers and HIV counselors, has reduced these risks as evidenced by almost no instances of violence that we are aware of over the past few years. As more and better HIV treatment is available, individuals and communities are likely to accept HIV testing more readily.

CONCLUSIONS

As we embrace "treatment as prevention," our study provides fundamental findings that may inform HIV testing and linkage programs. Our data provide evidence of sociodemographic and socioeconomic factors that influence individual's acceptance of HIV testing and their likelihood of being HIV infected. The age cohort variations in these factors give us insight into how to define well-tailored HIV prevention programs across the human life-cycle. We believe that these findings add value to the existing literature on HIV prevention and may be useful in developing and improving approaches to HIV prevention and uptake of care.

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