

# Unawareness of HIV Infection Among Men Aged 15–59 Years in 13 Sub-Saharan African Countries: Findings From the Population-Based HIV Impact Assessments, 2015–2019

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**Background:** Identifying men living with HIV in sub-Saharan Africa (SSA) is critical to end the epidemic. We describe the underlying factors of unawareness among men aged 15–59 years who ever tested for HIV in 13 SSA countries.

**Methods:** Using pooled data from the nationally representative Population-based HIV Impact Assessments, we fit a log-binomial regression model to identify characteristics related to HIV positivity among HIV-positive unaware and HIV-negative men ever tested for HIV.

**Results:** A total of 114,776 men were interviewed and tested for HIV; 4.4% were HIV-positive. Of those, 33.7% were unaware of

their HIV-positive status, (range: 20.2%–58.7%, in Rwanda and Cote d’Ivoire). Most unaware men reported they had ever received an HIV test (63.0%). Age, region, marital status, and education were significantly associated with HIV positivity. Men who had HIV-positive sexual partners (adjusted prevalence ratio [aPR]: 5.73; confidence interval [95% CI]: 4.13 to 7.95) or sexual partners with unknown HIV status (aPR: 2.32; 95% CI: 1.89 to 2.84) were more likely to be HIV-positive unaware, as were men who tested more than 12 months compared with HIV-negative men who tested within 12 months before the interview (aPR: 1.58; 95% CI: 1.31 to 1.91). Tuberculosis diagnosis and not being circumcised were also associated with HIV positivity.

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**Conclusion:** Targeting subgroups of men at risk for infection who once tested negative could improve yield of testing programs. Interventions include improving partner testing, frequency of testing, outreach and educational strategies, and availability of HIV testing where men are accessing routine health services.

**Key Words:** PHIA, HIV household survey, HIV unawareness, HIV positivity, MLHIV, HIV testing

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## INTRODUCTION

Inadequate testing and treatment coverage among men living with HIV (MLHIV) in sub-Saharan Africa (SSA) has slowed progress toward the Joint United Nations Programme on HIV/AIDS (UNAIDS) goal of reaching HIV epidemic control by 2030.<sup>1</sup> In particular, men contribute disproportionately to the gap in achieving the global target of 95% of people living with HIV (PLHIV) knowing their status.<sup>1,2</sup> As of 2019, there were approximately 9.8 million MLHIV in SSA. Although progress in treatment coverage has increased in the region, reductions in new infections and deaths due to AIDS-related illness have been slower among men than in women.<sup>2,3</sup> In 2019, men accounted for a lower proportion (only 38%) of PLHIV compared with women, but men contributed 57% to the burden of AIDS-related deaths.<sup>1,2</sup>

When compared with women, men test less frequently for HIV, less frequently know their status, less regularly access HIV services, and more commonly present with advanced disease.<sup>4–9</sup> MLHIV who are undiagnosed are at risk for poor health outcomes, including coinfection with tuberculosis (TB), other disease comorbidities, and increased AIDS-related mortality.<sup>9,10</sup> In 2019, treatment coverage was 12% and viral load suppression was 10% higher among women living with HIV than among MLHIV globally.<sup>8</sup> This treatment gap among MLHIV contributes to further transmission and a higher number of new HIV infections among their partners.<sup>3,4</sup> Once diagnosed and on treatment, a decreased viral load will result in reduced transmission. The Population-based HIV Impact Assessments (PHIAs) have shown that adult men who knew their HIV status had high rates of antiretroviral therapy use (90.2%) and viral suppression (85.0%).<sup>10</sup>

Access to and acceptability of testing is the first critical step in ensuring MLHIV are diagnosed and treated. Recent efforts have intensified to find and test high-risk men to initiate them on HIV treatment. The US President's Emergency Plan for AIDS Relief (PEPFAR); the Global Fund to Fight AIDS, TB, and Malaria; and other agencies supporting the HIV response have heavily invested in HIV testing strategies focused on men in SSA.<sup>10,11</sup> Typical approaches have included provider-initiated counseling and testing in health facilities and voluntary counseling and testing.<sup>12</sup> Partner-initiated and index testing have emerged to reach a high volume and yield of new cases among men.<sup>12,13</sup> Self-testing has helped in increasing testing uptake, as part of community-based testing.<sup>14,15</sup> In addition, men lack universal entry points for HIV testing compared with women who use reproductive or family health services more readily.<sup>4</sup> To address this, other approaches to reach men include differentiated service delivery models,

mobile testing sites in places where men work and frequent, and male-centered clinics offering comprehensive outpatient services for all men regardless of HIV status.<sup>16,17</sup>

To improve testing coverage for men, it is useful to examine testing behaviors among men. Characteristics of men who have never been tested have been previously described. A study using Demographic and Health Survey data from 6 African countries found that although a higher proportion of men than women had never tested for HIV, most men accepted a test when offered.<sup>18</sup> Factors associated with never having tested for HIV included never being married, not having children, and lower education, after adjusting for age.<sup>18</sup> With resources dedicated to reach young men who have not tested before,<sup>10</sup> additional strategies are needed to identify those men who once tested negative but remain at risk for infection and may need more frequent testing. Identifying those who have previously tested by characterizing subgroups of men at risk for infection could improve yield of testing programs. In addition, men who ever tested are generally older and more sexually active; thus, their risk of being positive may be higher than those who never received an HIV test.<sup>19</sup>

The PHIAs are nationally representative household-based surveys to measure key indicators of progress in controlling the HIV epidemic. With the availability of self-reported testing behavior and HIV biomarker status, which includes laboratory detection of antiretrovirals (ARVs), the PHIAs provide a unique opportunity to examine factors associated with undetected HIV infection among men.

This analysis used pooled PHIA data from 13 countries in SSA to describe men aged 15–59 years who were unaware of their HIV-positive status and to describe risk factors among unaware MLHIV who ever tested. The goal of the findings is to develop targeted interventions to optimize testing strategies to reach MLHIV who are unaware of their HIV-positive status.

## METHODS

For the analysis, we pooled PHIA data from Cameroon, Cote d'Ivoire, Eswatini, Ethiopia, Kenya, Lesotho, Malawi, Namibia, Rwanda, Tanzania, Uganda, Zambia, and Zimbabwe. Countries were grouped together using standard UN regional definitions.<sup>20</sup> Data collection started for the first survey in October 2015, and completion of fieldwork for the last survey was in March 2019.

## Data Collection Procedures

The PHIAs used a 2-stage cluster sampling design to obtain nationally representative samples of households in each country, stratified by designated geographical zones.<sup>21</sup> The design and implementation of the PHIA surveys have been described elsewhere.<sup>22,23</sup> Face-to-face interviews were conducted to capture demographic, behavioral, and clinical information, including self-reported knowledge of HIV status and testing history. Individuals were eligible to participate if they slept in the household the night before the interview and were at least 15 years of age. The analysis was restricted to 15–59 years because this age group was shared across all 13 countries.

The surveys included home-based HIV testing and counseling, return of results, community active linkage-to-care where possible, and laboratory-based confirmation of HIV-positive and indeterminate results by each national testing algorithm. In addition to HIV diagnostic testing, most countries provided CD4 and HIV viral load testing. Testing for coinfections such as syphilis and hepatitis B/C varied depending on the country. Participants testing positive at the household received a point-of-care CD4 count in the household, laboratory-based HIV viral load, and were screened for ARV drugs indicative of the first-line and second-line HIV treatment regimens in each country. HIV viral load results were returned to participants through health facilities of their choice. Viral load suppression was defined as <1000 HIV RNA copies per milliliter.

### Definition of Variables

Final HIV status classification in the PHIA was determined by the result of the rapid test result at the household, followed by laboratory confirmation. Unawareness and awareness of HIV-positive status was determined based on responses provided in the survey questionnaire, final HIV classification status in the survey, and detection of ARVs. Participants who tested positive for HIV during the survey were considered aware if they reported in the interview being HIV-positive or ARVs were detected in their blood. Participants who tested positive for HIV during the survey were considered unaware if they reported having a negative or unknown HIV status and ARVs were not detected in their blood. The outcomes of interest used in this analysis were *unawareness of HIV-positive status* and *HIV positivity*. HIV positivity was defined as receiving an HIV-positive result among HIV-positive unaware and HIV-negative men who ever tested. Ever tested was categorized as those who reported yes to ever testing for HIV.

The wealth category of “upper 60%” included the top 3 wealth quintiles and “lower 40%” included the bottom 2 wealth quintiles, with wealth relative to others in their country. Partner status was defined for sexual partnerships in the past 12 months and includes 4 categories assigned sequentially: no partners in that period; positive if think, told, or tested together as positive for one or more of their partners; unknown status for one or more of their partners; and negative for think, told, or tested together as negative for all of their partners. Hazardous drinking was determined by the Alcohol Use Disorder Identification Test (AUDIT-C) score of 4 or more based on points assigned to 3 alcohol use questions.<sup>24</sup> Medical circumcision was defined if the male participant reported being circumcised by a health care provider such as a doctor, nurse, or midwife, and traditional circumcision was defined as being circumcised by a traditional practitioner, religious leader, or relative/friend. Tested in the past 12 months was defined as those participants who reported testing for HIV within 12 months before the interview and receiving results.

### Statistical Analysis

Data were weighted to account for sample selection probabilities and to adjust for nonresponse and noncoverage.

Normalized weights in Rwanda and Kenya were rescaled to population weights for consistency with the remainder of the countries, by multiplying the weights by a factor of the total estimated population size over the number of interview respondents. All estimates were weighted, and we used Taylor series expansion to obtain robust variance estimators for the complex survey data. Weighted  $\chi^2$  and *t* test analyses were conducted to identify associations between unawareness of HIV-positive status and sociodemographic, risk and testing behaviors among HIV-positive men and HIV-negative men who had ever tested.

We fit a log-binomial regression model to identify associations between HIV positivity among HIV-positive unaware and HIV-negative men who ever tested. Covariates included in the adjusted model were based on previous literature, plausible hypotheses, bivariate analyses, and if shared across all countries. The number of sexual partners was not included because of collinearity and was not found to contribute to model fit. We calculated weighted crude and adjusted prevalence ratios examining the potential predictors of interest and accompanying 95% confidence intervals (CIs). The level of significance was set to  $\alpha = 0.05$  in the fitted models. All analyses were conducted in SAS version 9.4 and SAS-callable SUDAAN, version 11.0.3.

### Implementation and Ethics

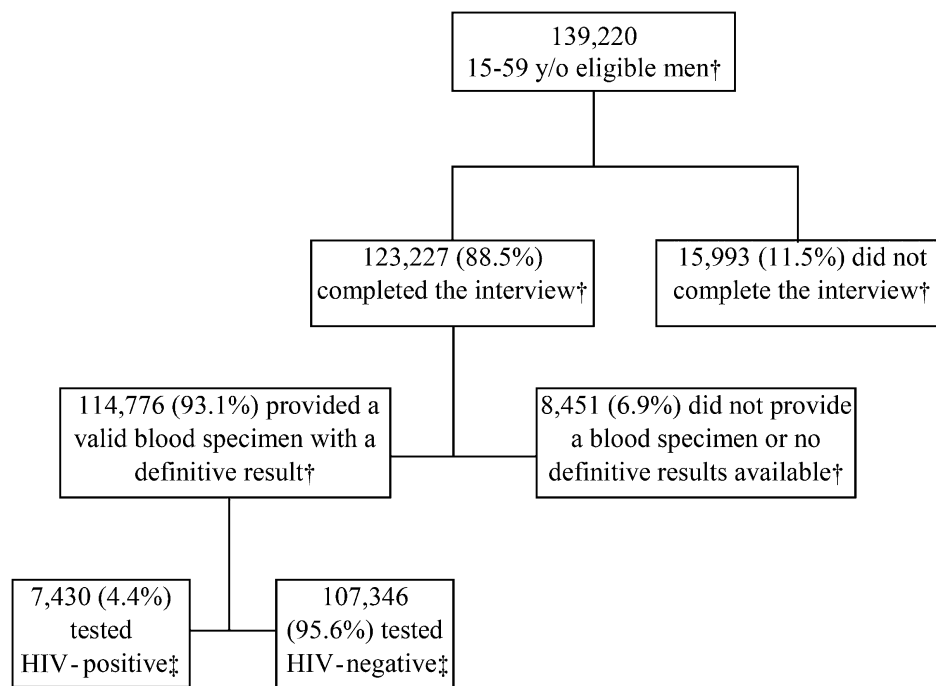
The PHIA was funded by PEPFAR with technical assistance through the US Centers for Disease Control and Prevention (CDC) under the terms of the cooperative agreement #U2GGH001226. The surveys were implemented by cooperative agreement grantees/federal entities, including country Ministries of Health, ICAP at Columbia University, and the University of California San Francisco. Each survey was approved by human subjects and institutional review boards of each country, cooperative agreement grantees/federal entities implementing the survey, and CDC.

## RESULTS

There were 409,855 eligible respondents in the pooled sample from the 13 countries in SSA, of whom 139,220 were men aged 15–59 years. The household response rate was 90.8%, and 123,227 (88.5%) of the eligible men aged 15–59 years were interviewed. Of those interviewed, 114,776 (93.1%) provided a valid blood specimen with a definitive HIV testing result, for an overall response rate of 74.8%. Among those with definitive results, 7430 (4.4%) tested HIV-positive (Fig. 1).

HIV prevalence and the proportion of unawareness of HIV-positive status among MLHIV are presented in Table 1. Overall, southern African countries had the highest prevalence, followed by southeastern, eastern, and western African countries. Higher unawareness was found in western African countries compared with southern, southeastern, and eastern Africa countries, except Tanzania, where 46.8% of men were unaware of their HIV-positive status.

Figure 2 shows men’s HIV status unawareness regarding their testing behavior. Of the 7430 HIV-positive men, 33.7% were unaware of their HIV-positive status, based on



**FIGURE 1.** Flow chart of interview completion and blood sampling among men aged 15–59 years in 13 sub-Saharan countries, 2015–2019\*. \*All frequencies are unweighted. †Unweighted percentages. ‡Weighted percentages.

self-report and/or laboratory detection of ARVs. Fourteen percent ( $n = 390$ ) of HIV-positive men who reported being as unaware of their positive status were reclassified as being aware after ARVs were detected in their blood. Most of the unaware HIV-positive men reported they had ever had an HIV test, 63.0% ( $n = 1289$ ). Of the unaware men who ever tested, 92.1% ( $n = 1166$ ) reported they were HIV-negative and 7.9% ( $n = 123$ ) reported that they never received their

results, did not know the results, or results were missing. Of the unaware HIV-positive men who reported being HIV-negative, 60.9% ( $n = 665$ ) reported testing and receiving their HIV results more than 12 months before the date of the interview. Most unaware HIV-positive men were not virally suppressed ( $n = 1,860$ , 91.1%); 47.7% had a CD4 count less than 350 cells/uL ( $n = 912$ ) and 17.9% ( $n = 351$ ) had a CD4 count of less than 200 cells/uL (results not shown).

**TABLE 1.** HIV Prevalence and Unawareness by Country of HIV-Positive Status Among Men Aged 15–59 Years, in 13 Sub-Saharan Countries, 2015–2019

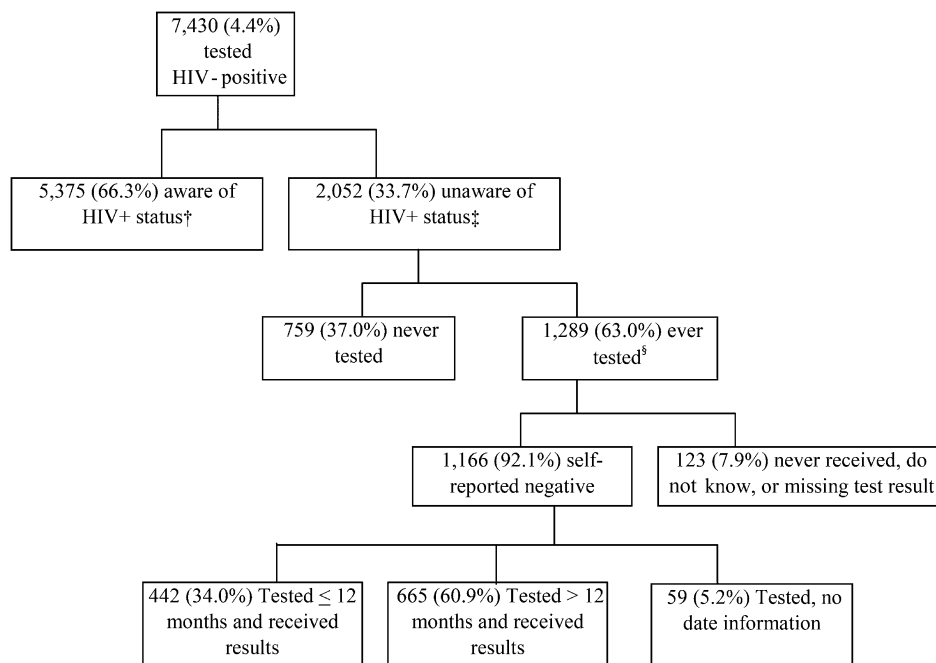
Region*	Country	HIV+				HIV+ Unaware			
		%	N‡	LCL	UCL	%	N‡	LCL	UCL
Western	Cameroon 2017–2018†	2.3	11,332	2.0	2.6	49.8	267	45.7	54.0
	Cote d'Ivoire 2017–2018	1.6	8580	1.2	2.0	58.7	124	51.6	65.9
Eastern	Ethiopia 2017–2018	1.9	7314	1.5	2.3	30.5	146	25.9	35.1
	Kenya 2018	3.1	11,185	2.7	3.4	28.5	394	25.2	31.7
	Rwanda 2018–2019	2.2	13,277	1.9	2.5	20.2	285	17.4	23.0
	Tanzania 2016–2017	3.5	12,271	3.1	3.8	46.8	517	42.3	51.2
Southeastern	Uganda 2016–2017	4.7	11,903	4.3	5.1	33.3	542	29.8	36.8
	Malawi 2015–2016	8.4	6956	7.8	9.1	28.8	679	25.6	31.9
	Zambia 2016	9.3	8142	8.5	10.0	30.3	779	27.0	33.5
Southern	Zimbabwe 2015–2016	11.8	8006	11.0	12.7	28.6	1084	25.7	31.5
	Eswatini 2016–2017	20.4	4023	18.6	22.1	20.8	871	18.2	23.5
	Lesotho 2016–2017	20.8	4762	19.6	22.0	23.4	1019	21.2	25.6
	Namibia 2017	9.2	7025	8.4	10.0	21.1	720	17.9	24.3
	<b>Total</b>	4.4	114,776	4.2	4.5	33.7	7427	32.5	34.9

LCL: lower confidence limits; UCL: upper confidence limits.

\*Countries grouped by region using standard regional definitions: <https://unstats.un.org/unsd/methodology/m49/>.

†Survey year.

‡All frequencies are unweighted.



**FIGURE 2.** Flow chart of awareness/unawareness status and testing characteristics among HIV-positive men aged 15–59 years, in 13 sub-Saharan countries, 2015–2019\*. \*All weighted percentages and unweighted frequencies. †Adjusted for ARVs, 390 HIV-positive men self-reported as unaware of their positive status were reclassified as being aware after ARVs were detected in their blood. ‡Missing n = 3 from awareness variable among HIV+ men. §Missing n = 4 from ever tested variable among unaware HIV+ men.

Most unaware HIV-positive men ever tested were aged 25–34 years (36.7%), were in the upper 60% wealth category (62.8%), and employed in the past 12 months (65.8%). Seventy percent of unaware men ever tested reported not using a condom at last sex in the past 12 months, and 37.1% reported one or more sexual partners of unknown status in the past 12 months. More than half (59.8%) of unaware men ever tested engaged in hazardous drinking and were uncircumcised (46.2%). Most men, regardless of awareness status, reported receiving their last HIV test at a health clinic or facility, but more unaware men (13.6% vs. 4.3%) reported their last HIV test at a mobile voluntary counseling and testing site compared with HIV-positive men who were aware of their status. More unaware HIV-positive men than HIV-negative men had a sexually transmitted disease (STD) diagnosis and sexually transmitted infection (STI) symptoms in the past 12 months (Table 2).

Prevalence ratios of HIV positivity among ever tested men are presented in Table 3. After adjustment, compared with HIV-negative men aged 15–24 years there was an increased risk of receiving a HIV-positive result and being unaware associated with an age of 25–34 years [adjusted prevalence ratio: 1.84; 95% CI: 1.29 to 2.63], 35–44 years (aPR: 2.07; 95% CI: 1.44 to 2.99), and 45–59 years (aPR: 1.74; 95% CI: 1.18 to 2.56). Compared with HIV-negative men in eastern Africa, living in a sampled country in southeastern Africa (aPR: 2.23; 95% CI: 1.81 to 2.75) and southern Africa (aPR: 3.60; 95% CI: 2.91 to 4.44) was associated with an increased risk. The risk of receiving a HIV-positive result and being unaware was about 2 times as likely in those with no education (aPR: 1.49; 95% CI: 1.09 to 2.05), compared with those with post primary education. Compared with those never married, married men or those living together with a partner (aPR: 2.15; 95% CI: 1.55 to

3.00), divorced/separated (aPR: 3.27; 95% CI: 2.20 to 4.85), and widowed men (aPR: 4.13; 95% CI: 2.09 to 8.18) had a greater likelihood of being HIV-positive and unaware than HIV-negative. Effects for all other sociodemographic covariates (urban versus rural residence, wealth, and employment status) were not significant. Men who had one or more HIV-positive sexual partners (aPR: 5.73; 95% CI: 4.13 to 7.95), or sexual partners with unknown HIV status (aPR: 2.32; 95% CI: 1.89 to 2.84), had a higher risk of receiving a HIV-positive result and being unaware compared with HIV-negative men with all HIV-negative sexual partners. Men who had a TB diagnosis were also more likely to be HIV-positive and unaware compared with negative men who had not visited a TB clinic (aPR: 1.67; 95% CI: 1.08 to 2.59), as were uncircumcised men compared with HIV-negative men who had undergone medical circumcision (aPR: 1.35; 95% CI: 1.04 to 1.74), and men who tested more than 12 months from the interview compared with HIV-negative men who tested within 12 months before the interview (aPR: 1.58; 95% CI: 1.31 to 1.91).

## DISCUSSION

We examined unawareness of HIV-positive status among men aged 15–59 years in 13 countries in SSA with a focus on men who had ever tested for HIV. At the population level in the 13 countries, this represents an estimated 3,138,000 MLHIV aged 15–59 years, 948,000 of whom were undiagnosed for HIV. We found most MLHIV unaware of their HIV-positive status were virally unsuppressed, nearly half of whom had a CD4 count less than 350 cells/uL. In addition, a large percentage of HIV-positive unaware men reported testing more than 12 months before the interview. MLHIV who present late to the clinic with a low CD4 count have an increased probability of poor

**TABLE 2.** Distribution of Selected Characteristics Among Ever Tested Unaware/Aware HIV-Positive Men and HIV-Negative Men Aged 15–59 Years, in 13 Sub-Saharan Countries, 2015–2019

Characteristics	Unaware HIV+ Men	Aware HIV+ Men	P*	HIV–Negative Men	P†
Age					
Median age (Q1,Q3)	34 (28,42)	41 (34,47)	<0.0001	30 (23,38)	<0.0001
Age group					
15–24 yrs	11.8	5.6	<0.0001	28.9	<0.0001
25–34 yrs	36.7	18.3		34.4	
35–44 yrs	30.0	38.0		21.6	
45–59 yrs	21.5	38.1		15.0	
Residence‡					
Urban	39.1	38.6	0.7311	42.0	0.1583
Rural	60.9	61.4		58.0	
Region					
Western Africa	9.9	5.1	<0.0001	12.8	<0.0001
Eastern Africa	53.2	46.1		69.0	
Southeastern Africa	31.1	39.5		15.9	
Southern Africa	5.8	9.3		2.3	
Education					
None	16.8	14.2	0.0405	13.6	0.0042
Primary	44.2	46.6		40.9	
Post primary	39.0	39.2		45.5	
Marital status					
Never married	14.3	10.8	<0.0001	33.3	<0.0001
Married or living together	71.3	73.7		60.3	
Divorced/separated	12.5	10.8		5.8	
Widowed	1.8	4.7		0.5	
Wealth category					
Lowest 40%	37.2	36.0	0.4051	35.6	0.4114
Upper 60%	62.8	64.0		64.4	
Employed in the past 12 months					
Employed	65.8	60.0	0.0002	63.2	0.1772
Not employed	34.2	40.0		36.8	
Sexual partners in past 12 months					
No sexual partners	15.3	19.0	<0.0001	21.0	<0.0001
One sexual partner	55.7	59.5		56.8	
Two or more sexual partners	29.0	21.4		22.2	
Reported partner status in past 12 months					
All negative partners	53.8	23.7	<0.0001	74.7	<0.0001
At least one positive partner	9.1	62.3		1.6	
At least one unknown partner	37.1	14.0		23.7	
Condom use at last sex in past 12 months					
No sex in the past 12 mo	13.7	16.1	<0.0001	13.9	0.6823
Used condom	16.5	37.7		17.9	
Did not use condom	69.8	46.2		68.2	
Paid for sexual intercourse in the past 12 months§					
Paid sex	12.0	9.7	0.1695	8.5	0.0608
Did not pay for sex	88.0	90.3		91.5	
Alcohol use					
Hazardous drinking	59.8	51.9	0.0015	52.4	0.0275
Nonhazardous drinking	40.2	48.1		47.6	
STD diagnosis in the past 12 months#					
STD diagnosis	4.5	6.9	0.0527	2.4	0.0111
No STD diagnosis	95.5	93.1		97.6	
STI symptoms¶ in the past 12 months#					
STI symptoms	20.8	22.2	0.4529	13.9	0.0003
No STI symptoms	79.2	77.8		86.1	

**TABLE 2. (Continued)** Distribution of Selected Characteristics Among Ever Tested Unaware/Aware HIV-Positive Men and HIV-Negative Men Aged 15–59 Years, in 13 Sub-Saharan Countries, 2015-2019

Characteristics	Unaware HIV+ Men	Aware HIV+ Men	P*	HIV–Negative Men	P†
TB diagnosis					
TB diagnosis at TB clinic	4.5	20.1	<0.0001	2.3	<0.0001
No TB diagnosis at TB clinic	6.8	18.5		4.1	
Not visited a TB clinic	88.7	61.4		93.5	
Circumcision					
Medical circumcision	31.5	22.0	<0.0001	42.6	<0.0001
Traditional circumcision	22.3	18.7		29.0	
Uncircumcised	46.2	59.3		28.4	
Tested and received results					
Tested ≤12 mo	36.5	39.8	0.0618	49.4	<0.0001
Tested >12 mo	63.5	60.2		50.6	
Time since the last HIV test					
Median months (Q1,Q3)	18 (7,46)	21 (5,65)	<0.0001	12 (4,32)	<0.0001
Location of last HIV test					
Health clinic/facility	45.7	58.7	<0.0001	45.5	0.1182
Hospital outpatient clinic	13.6	13.1		11.1	
VCT facility	12.4	11.8		13.1	
Mobile VCT	13.6	4.3		13.9	
Outreach	5.5	3.9		4.4	
Hospital inpatient wards	3.0	4.2		2.5	
ANC clinic	2.4	0.9		3.9	
At home	1.7	0.8		1.8	
Other	2.1	2.1		3.8	
Total N	1289	5271		67,782	

\*P value from a weighted  $\chi^2$  and t test to test differences among unaware and aware HIV+ men.

†P value from a weighted  $\chi^2$  and t test to test differences among HIV+ unaware and HIV-negative men.

‡Ethiopia: small urban area defined as rural and large urban areas defined as urban; Lesotho: periurban and urban are defined as urban.

§Excluding Cameroon, Ethiopia, Kenya, Rwanda, Uganda, and Zimbabwe.

|| Hazardous drinking was determined by an AUDIT score of 4 or more based on points assigned to 3 alcohol use questions; excluding Cameroon, Cote d'Ivoire, Ethiopia, Kenya, Lesotho, Rwanda, and Uganda.

¶Penile discharge, painful urination, or ulcer/sore.

#Excluding Cameroon, Cote d'Ivoire, Eswatini, Lesotho, Namibia, Rwanda, and Uganda.

health outcomes and HIV-related mortality.<sup>4–7</sup> By knowing their status and commencing treatment, MLHIV will be able to lead longer, healthier lives and prevent further onward transmission of HIV to their sexual partners.

Although recent emphasis in high-burden countries has been on identifying younger men (15–24 years) for testing, this analysis suggests that there is a larger burden of infected and undiagnosed men aged 25 years and older. Studies have found that most HIV-positive men not engaged in HIV prevention and treatment services are older than 35 years, which aligns with the age at the highest prevalence.<sup>11,18,25</sup> Our findings of low education level as a risk factor for HIV positivity in unaware men reinforce the need for focused health education strategies targeting men at risk of HIV infection. Other research in the sub-Saharan region has previously described limited health literacy, especially among those with lower education levels among men.<sup>11,17,26</sup> Importantly, a review that described barriers of HIV testing uptake in men found most men had knowledge of where to access HIV services but lacked an understand-

ing of ongoing risks of HIV transmission.<sup>26</sup> Results suggest the need to improve messaging to underscore that a previously negative test does not necessarily mean a current negative status for those at risk of infection and to thus increase the acceptability and frequency of testing for men in this target group.

HIV testing more than 12 months before the survey was predictive of HIV positivity among men in our study. This provides evidence for the need to increase the frequency and access to HIV testing for men with an ongoing risk of HIV infection and to retest annually or more frequently depending on risk. In addition, these findings of the increased risk of being HIV-positive and unaware among those diagnosed with TB and those uncircumcised demonstrate the need to increase availability of HIV testing at all service delivery points, such as outpatient departments, voluntary medical male circumcision clinics, and as part of screening for TB and sexually transmitted infections. These findings also demonstrate a missed opportunity for HIV testing for the unaware

**TABLE 3.** Crude and Adjusted Prevalence Ratios of HIV Positivity by Selected Characteristics, Among Ever Tested HIV-Positive Unaware and HIV-Negative Men Aged 15–59 Years, in 13 Sub-Saharan Countries, 2015–2019

Characteristics	HIV+ unaware*	HIV-Negative	N	cPR	LCL	UCL	aPR	LCL	UCL
Age group									
15–24 yrs	0.6	99.4	20,089	REF			REF		
25–34 yrs	1.6	98.4	22,323	2.60	1.97	3.43	<b>1.84</b>	1.29	2.63
35–44 yrs	2.1	97.9	15,223	3.36	2.53	4.47	<b>2.07</b>	1.44	2.99
45–59 yrs	2.1	97.8	11,436	3.45	2.58	4.61	<b>1.74</b>	1.18	2.56
Residence†									
Urban	1.4	98.6	28,237	REF			REF		
Rural	1.6	98.4	42,834	1.27	1.07	1.50	0.99	0.81	1.21
Region									
Western Africa	1.2	98.8	7876	1.00	0.74	1.36	1.15	0.80	1.67
Eastern Africa	1.2	98.8	37,630	REF			REF		
Southeastern Africa	3.0	97.0	13,562	2.49	2.10	2.95	<b>2.23</b>	1.81	2.75
Southern Africa	3.8	96.2	10,003	3.17	2.67	3.76	<b>3.60</b>	2.91	4.44
Education									
None	2.0	98.0	7084	1.44	1.10	1.87	<b>1.49</b>	1.09	2.05
Primary	1.7	98.2	27,481	1.26	1.06	1.50	1.13	0.91	1.41
Post primary	1.4	98.6	33,099	REF			REF		
Marital status									
Never married	0.7	99.3	24,675	REF			REF		
Married or living together	1.8	98.2	40,012	2.71	2.17	3.39	<b>2.15</b>	1.55	3.00
Divorced/separated	3.2	96.8	3753	4.85	3.55	6.62	<b>3.27</b>	2.20	4.85
Widowed	4.9	95.1	452	7.34	4.43	12.16	<b>4.13</b>	2.09	8.18
Wealth category									
Lowest 40%	1.6	98.4	26,400	1.07	0.91	1.26	-	-	-
Upper 60%	1.5	98.5	42,629	REF					
Employed in the past 12 mo									
Employed	1.6	98.4	40,922	1.12	0.95	1.32	—	—	—
Not employed	1.4	98.6	28,121	REF			REF		
Status of sexual partners in past 12 mo									
No sexual partners	1.5	98.5	13,966	1.30	0.96	1.76	1.32	0.91	2.36
All negative partners	1.1	98.9	34,274	REF			REF		
One or more positive partners	8.3	91.7	1100	7.44	5.52	10.03	<b>5.73</b>	4.13	7.95
One or more unknown partners	2.4	97.6	12,569	2.14	1.78	2.58	<b>2.32</b>	1.89	2.84
TB diagnosis									
TB diagnosis at TB clinic	2.9	97.1	1712	3.27	2.21	4.84	<b>1.67</b>	1.08	2.59
No TB diagnosis at TB clinic	2.5	97.5	3311	2.89	1.96	4.25	1.30	0.93	1.83
Not visited a TB clinic	1.5	98.5	63,850	REF			REF		
Circumcision									
Medical circumcision	1.1	98.9	25,391	REF			REF		
Traditional circumcision	1.2	98.8	15,116	1.04	0.81	1.34	0.85	0.63	1.16
Uncircumcised	2.5	97.5	26,431	2.17	1.77	2.65	<b>1.35</b>	1.04	1.74
Tested and received results									
Tested ≤12 mo	1.1	98.9	32,031	REF			REF		
Tested >12 mo	1.8	98.2	32,378	1.69	1.63	2.02	<b>1.58</b>	1.31	1.91

\*n = 1289.

Bold values are statistically significant at  $\alpha = 0.05$ .

†Ethiopia: small urban area defined as rural and large urban areas defined as urban; Lesotho: periurban and urban are defined as urban.

aPR, adjusted prevalence ratio; cPR, crude prevalence ratio; LCL, lower confidence limits; UCL, upper confidence limits.

HIV-positive men who accessed health services if these services were sought after onset of infection.

Tailoring available service delivery points with innovative approaches may be effective to reach men who otherwise

would be less prone to access facility-based services unless presenting with advanced stage of disease.<sup>26</sup> Differentiation delivery of services has included male-friendly services, use of clinics for men to improve confidentiality/privacy, ensure

shorter wait times, and provide extended service delivery hours, which have been met with success in increasing testing uptake in some countries.<sup>11,13,27–30</sup> The use of community-based mobile HIV testing was commonly reported among HIV-positive unaware men and could be used in combination with other options, such as self-testing, which is being scaled up in certain SSA countries.<sup>31</sup> Although few men reported testing at home, scale-up of self-testing occurred after most of the PHIA surveys used for this analysis were conducted.

The strong association found in partners reported as HIV-positive or of unknown status further strengthens partner testing and contact tracing as effective strategies to identify men who do not know their HIV-positive status.<sup>9,11</sup> Given that most unaware men were unsuppressed and reported not using a condom in the past 12 months, their partners are at risk of getting infected. These findings also highlight that men are at risk of acquiring infection by not using a condom while knowing their partner(s) is/are HIV-positive or of unknown status. This underscores the importance of basic prevention measures, including the use of pre-exposure prophylaxis and condoms in HIV-discordant couples.<sup>1</sup>

## Strengths and Limitations

The strength of this analysis is the population representative data across 13 countries with biomarkers linked to demographic and behavioral data. A limitation is that some of the data are based on surveys that started in 2015 and may not reflect the current environment. Our findings use self-report of testing and behavioral factors, which participants may not have disclosed because of social desirability bias. Although ARV testing was used to correct for those on treatment, it is likely that some previously diagnosed participants who were not on treatment did not want to disclose their HIV-positive status, potentially overestimating the true proportion of men's unawareness. Certain variables of interest were not available across all countries and the application of some of these findings may not apply because of contextual/programmatic differences between countries. Caution should also be used when generalizing findings to the western African region as data from only 2 countries were included in this study's regional analysis.

Examining characteristics associated with HIV positivity was shown to be a useful approach and such analyses have been used to develop risk screening tools as part of universal provider-initiated counseling and testing and counseling in facilities across high-burden countries, where the goal is to identify undiagnosed PLHIV and optimize testing yield.<sup>32</sup> Once validated, these tools can be adapted by region and selected demographics. However, if the risk screening tools are shown to be an effective method to reach unaware MLHIV earlier and linking them to care in different contexts, then further evaluation of the tools' predictive value is critical.<sup>11</sup>

## CONCLUSION

The results from this large sample suggest that many men in sub-Saharan Africa are likely unaware of their HIV-

positive status due to the compounding effects of sociodemographic, behavioral, and clinical influences, albeit with context-specific drivers in each country that are outside the scope of this analysis. Our results found that men who were unaware of their HIV-positive status were at increased risk of poor health outcomes and need earlier engagement of HIV services. When taken together with previous literature, our findings demonstrate that attaining the 95-95-95 UNAIDS goal among MLHIV by 2025 is challenging. Targeted scale-up of both facility-based and community-based approaches will help ensure that MLHIV are health literate, equitably reached, know their status, and are linked to HIV treatment services soon after infection. With the increased availability of standard and new approaches for testing men, more men are being reached for testing, but those at risk still need to test more often. Increased access to and frequency of HIV testing is needed to identify undetected infection in men including in settings where they are accessing services for TB and voluntary medical male circumcision. Our findings also support previous evidence that partner/couples testing and tracing partners' contacts through index testing may help identify HIV-positive men unaware of their status.

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