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Prevalence and determinants of HIV testing among adolescent girls and young women in 28 sub-Saharan African countries

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Abstract

Background HIV and AIDS remain a major global public health issue with the largest burden in sub-Saharan African (SSA) (SSA) countries. Adolescent girls and young women (AGYW) in the sub-Saharan African region experience intersecting vulnerabilities that may increase their exposure to HIV, while also constraining their engagement with treatment and care. HIV testing is crucial in the AIDS response for both prevention and treatment, therefore, necessitating understanding of HIV testing practices, especially among priority populations. We examined HIV testing and associated factors among AGYW (15–24 years) in 28 SSA countries.

Methods We analysed Demographic and Health Survey datasets from 28 SSA countries from 2010–2022 focusing on data collected from AGYW aged 15–24 (n=58,263) who had screened for HIV in the last survey conducted in each country. We merged all weighted datasets from 28 countries to generate the prevalence of HIV testing among AGYW in each country and to provide an overall prevalence in SSA. We then conducted bivariate and multivariable binary logistic regression analysis to examine factors associated with HIV testing and presented the results in crude odds ratio [cOR] and adjusted odds ratio [aOR] with corresponding confidence intervals (CIs).

Results Our results showed that the overall prevalence of HIV testing among AGYW across the 28 SSA countries was 63%, with Zambia and Mali having the highest and lowest prevalence at 76% 6.70% respectively. Being in the age bracket 20–24 [aOR=2.22, 95% CI=2.08–2.37], comprehensive HIV knowledge [aOR=3.76, 95% CI=2.60–5.43], higher formal education [aOR=2.23, 95% CI=2.02–2.46], and three and above lifetime sexual partners [aOR=1.41, 95% CI=1.29–1.55] were all associated with HIV testing. Also, past year experience of STI [aOR=1.25, 95% CI=1.11–1.41], being employed [aOR=1.08, 95% CI=1.02–1.16], pregnancy history [aOR=1.09, 95% CI=1.03–1.14], high household wealth index [aOR=2.26, 95% CI=1.97–2.59] and being in a union [aOR=3.23, 95% CI=2.97–3.51] were associated with HIV testing.

Conclusion Concerningly, 21 countries, representing 75% of the countries included in the current study, have HIV testing coverage below 50% for AGYW. Collaborative efforts are needed to fast-track HIV screening/testing for AGYW considering their disproportionate vulnerability to HIV exposure.

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Introduction

HIV and AIDS remain a major global public health issue with a record 79.3 million infections and 36.3 million AIDS-related deaths since the start of the epidemic [1]. The World Health Organisation's (2021) estimation indicates HIV could still claim an additional 7.7 million lives over the next ten years [2]. There are concerns that this projection may even be lower since it predates the emergence of an even more virulent HIV strain [3], which spreads faster, doubles the rate of immune system decline and triples the risk of AIDS [4–6].

Although relative progress continues to be recorded in reducing new HIV infections and AIDS-related deaths in sub-Saharan Africa, this sub-region continues to be disproportionately impacted by HIV [1, 7]. Globally, despite progress in reducing AIDS-related deaths, the number of new HIV infections, continues to drive the HIV epidemic [7–10]. Before the COVID-19 pandemic, the global AIDS response may have been threatened by 'response fatigue.' This threat has now been aggravated by the impact of the COVID-19 pandemic through disruptions to and funding of HIV/AIDS services and a potential increase in HIV risk practices and vulnerabilities including among young people [11–13]. Current estimates show that every day, 4000 people, including 1100 young people aged 15–24 years acquire HIV [11]. This trend, if not addressed, will triple the estimate of new HIV infections by 2025 from 370,000 new infections to 1.2 million new infections [11].

As a result, the progress that has been made to date in reducing AIDS-related deaths through anti-retroviral therapy, may be reversed or halted by the rising number of new HIV infections [11]. Thus, primary prevention through prophylactic and therapeutic strategies remains crucial to the global AIDS response. HIV testing (used interchangeably with HIV screening in this paper) is one of the most vital primary prevention strategies for reducing new HIV infections. Awareness of one's HIV status, especially for people living with HIV, is one of the key indicators of progress in the global AIDS response. Notably, about 6.1 million people did not know that they were living with HIV in 2020 [7]. Not being aware of one's status has implications for transmission of HIV as well as for HIV treatment and care.

Importantly, adolescent girls and young women are disproportionately impacted by HIV and AIDS, in terms of prevalence and new infections. Young women aged 15–24 years are twice as likely to be living with HIV than young men [7]. Also, around 4200 adolescent girls and young women aged 15–24 years contracted HIV weekly in 2020 [7]. In sub-Saharan Africa, girls accounted for six out of seven new HIV infections in 2020 among adolescents aged 15–19 years [7]. Likewise, globally, women and girls disproportionately accounted for 63% of new HIV infections in 2020 [8]. Higher incidence and prevalence of HIV among adolescent girls and young women can be attributable to a number of intersecting socio-cultural and biological factors. This is more so in sub-Saharan Africa where dominant conservative cultures, such as patriarchal norms, reinforce practices that increase women's exposure to HIV [14, 15]. Biologically, women are more likely to acquire HIV than men. The large bare mucosal surface of the vagina, and the cervical cells with an elevated presence of HIV co-receptors, compared to the foreskin cells in men, increase women's chances of HIV acquisition [16, 17]. Also, AGYW are also more likely to experience physical and/or sexual violence which further increases the potential for HIV acquisition [8].

Due to structural factors, AGYW in sub-Saharan Africa, who are disproportionately impacted by HIV, may also be less likely to access testing and treatment services. Previous studies [18–24] have enumerated various factors influencing HIV screening and testing among AGYW in SSA, and diasporic AGYW from SSA [25]. Prominent among these factors are testing anxiety and fear [18], age [19, 21–23], marital status [19, 21], formal education level [20, 23], comprehensive knowledge of HIV [19–21], media exposure and internet access [19, 23], STI knowledge and history [19, 21, 23], pregnancy history [20, 22, 23], discriminatory attitudes towards HIV [19, 20], number of lifetime partners [20], condom use practices [22] among others. Qualitative studies among AGYW in sub-Saharan Africa [24] and diasporic AGYW from sub-Saharan African countries [25] show that fear or anxiety of testing positive and the associate stigma and discrimination as well as anticipated stigma at the health service constrain this population from accessing HIV screening even when screening services are available and accessible. As the evolving COVID-19 pandemic continues to impact HIV testing services [11], adolescent girls and young women may be less likely to access testing and treatment services. It is important to understand trends and factors associated with HIV testing among adolescent girls and young women in sub-Saharan Africa to inform culturally-appropriate responses for acceptable, feasible, and effective population-specific services.

Our study extends the geographical scope of the study of Sonny and Musekiwa [26] which used Demographic and Health Survey Data to examine trends and factors associated with HIV testing among adolescent girls and young women (AGYW) in Lesotho. In the present study, we expand the geographical scope to sub-Saharan Africa,

in this line of inquiry and among the same population, also using datasets from National Demographic and Health Surveys.

Data and methods

Study design and participants

The study utilized extracted data from the most recent Demographic and Health Survey for 28 SSA countries and the identified surveys had been conducted between the years of 2010 and 2022.

Data collection was conducted using a cross-sectional study design [27]. DHS is known for its well national representativeness and is conducted in more than low- and middle-income countries (LMICs) 85 countries. Questions regarding participants socio-demographic characteristics, maternal and child health and other sexual and reproductive health-related indicators such as HIV/STIs testing, family planning use, abortion, intimate and sexual partner violence etc., are usually asked among women aged 15–49 using a questionnaire survey design [19]. The considered inclusion criteria for this present study are adolescent girls and young women between the age of 15–24 who completed the last DHS survey conducted in each country. This resulted in 58,263 adolescent girls and young women in these 28 countries, as shown in Table 1. More information on DHS methodology including sampling pre-test has been published elsewhere [28]. DHS data has high reputation for quality has been analysed in previous studies on sexual and reproductive health in the SSA sub-region [29–31]. The DHS datasets employed in this study are publicly available on the DHS website. The data were accessed 15–25 March 2023 and authors had no access to information that could identify participants.

Table 1 Distribution of countries included in the study by year of survey, weighted sample size, and HIV prevalence of adolescent girls and young women who screened for HIV in SSA

Survey countries	Survey Year	Weighted sample	Percentage
Central Africa			
Angola	2016	2,676.50	5.17
Congo	2012	2,157.62	4.17
Congo DR	2014	2,968.48	5.74
Cameroon	2019	2,817.74	5.45
Chad	2015	1,518.13	2.93
Gabon	2012	1,078.79	2.08
Western Africa			
Burkina-Faso	2010	6,623	3.68
Benin	2018	1,427.34	2.76
Cote d'Ivoire	2012	3,976	2.21
Gambia	2013	934.020196	1.81
Ghana	2014	1,360.21	2.63
Guinea	2018	1,020.53	1.97
Liberia	2013	1,524.22	2.95
Mali	2018	5,864.42	11.33
Niger	2012	1,103.13	2.13
Sierra Leone	2013	2,941.18	5.68
Togo	2014	4,139.09	8
Eastern Africa			
Burundi	2017	1,972.59	3.81
Ethioipia	2016	1,539.11	2.97
Kenya	2014	11,555	6.43
Malawi	2016	1,559.52	3.01
Rwanda	2015	1,367.38	2.64
Southern Africa			
Lesotho	2014	1,151.32	2.23
Madagascar	2021	2,927.75	5.66
Mozambique	2011	3,001.19	5.8
South Africa	2016	471.074206	0.91
Zambia	2018	2,661.73	5.14
Zimbabwe	2015	1,558.45	3.01

Study variables

Dependent variable

The primary outcome variable of this study was HIV testing. The DHS asked respondents "ever been tested for HIV" and those who answered "yes" were coded as "1" whilst those respondents who answered "no" were coded as "0". Similar categorizations were used in previous studies in Africa [30, 32].

Independent variables

Eleven independent variables were included in this study, and these were selected based on their relationship with the outcome variables and their availability in the dataset [32]. The variables included were age, marital status, place of residence, level of education, household wealth index, number of lifetime sexual partners, condom use during last sex, past year experience of STIs, work status, HIV discriminatory attitude, and comprehensive HIV knowledge. The age of respondents was categorized as 15–19 years and 20–24 years. Marital status was 'never in union', 'currently in union', and 'formerly in union'. Place of residence was urban and rural; while level of education was categorised as no education, primary education, secondary and higher education. Categorisation of wealth index was based on DHS operationalisation of household wealth index which was measured based on the items available in each household. Principal components analysis was then used to group the available items into 'poorest', 'poorer', 'middle', 'richer', and 'richest' which represented the household wealth index, and this same measure was adopted in this current study [33]. Number of lifetime sexual partners was grouped into '1', '2', and '3 and above' while condom use during last sex was categorised as 'no' or 'yes'. Past years' experience of STIs, working status were both categorized into 'no' and 'yes' [20, 32].

Finally, both HIV discriminatory attitude and comprehensive knowledge of HIV were developed from series of questions in the survey. For HIV discriminatory attitudes in the survey, respondents were asked question such as "willingness to buy fresh vegetables from an HIV-infected person, wanting to keep the positive HIV status of a family member secret, not willing to care for a family member sick with AIDS, and willingness to let an HIV-infected female teacher continue teaching in school. An affirmative response to these survey items indicated an accepting attitude towards people living with HIV (PLWHIV). We recoded each variable so that the same value showed a non-discriminatory attitude for all questions. Experience of STI was also included among the independent variables, in the survey these adolescent girls and young women were asked if they have had any STI in the past year with responses being "Yes" or "No", and it was employed in this study as reported in the DHS. Based on the composite variables created, discriminatory attitude was categorized into "no discriminatory attitude" (if no on all variables), "some discriminatory attitude" (if yes on one or two variables), and "more discriminatory attitude" (if yes on three or four variables). We also generated respondent's comprehensive knowledge of HIV from six questions in the DHS survey (each has two options "no" and "yes": "Can reduce risk of getting HIV/AIDS through using of condoms during sex?", "Can reduce risk of getting HIV by having one sex partner only", "a healthy-looking person can have HIV?", "Can get HIV by witchcraft or supernatural means?", "Can get HIV from a mosquito bite?" and "Can get HIV by sharing food with a person who has HIV/AIDS?"). Responses to the six questions were combined to generate a measure of comprehensive knowledge about HIV/AIDS. Participants who answered all six questions correctly were coded as 'Yes – 1' (having comprehensive knowledge). Participants who provided an incorrect response to any of the six questions were coded as 'No – 0' (not having comprehensive knowledge) [34].

Statistical analyses

The study employed three steps to analyse the included datasets in this study using STATA 17.0 version. All generated weighted datasets in the 28 countries were merged to first generate prevalence of HIV testing among adolescent girls and young women in each country with overall prevalence in SSA. This was represented using a bar graph (Fig. 1). Second, STI testing and included variables were cross-tabulated and these results were presented in Table 2 showing percentages, frequency distributions, and chi-square (X^2) results. Last, two models were developed using binary logistic regression analysis. "Model I" accounted for the unadjusted model (cOR) which is bivariate logistic regression. "Model II" was the adjusted model (aOR) also known as multivariable logistic regression analysis and accounted for the independent variables included in the study. The binary regression analysis results were presented in cOR and aOR with corresponding confidence intervals (Cis). The non-response and under-sampling were accounted for by applying the survey sample weight. All analyses were performed with STATA 17.0 (StataCorp College Station, TX, USA).

Results

Figure 1 shows the prevalence of HIV testing among adolescents and young women across 28 SSA countries. The overall prevalence among this population was 63%. For country-level prevalence, Zambia had the highest prevalence of AGYW who have had an HIV test, with 76% while Mali had the lowest percentage with 6.7%.

Table 2 shows the distribution of respondents' characteristics and chi-square analysis. The analysis showed that 65% of the respondents are aged 20–24, while about 60% are currently married/cohabiting and more than half reside in rural areas. 51% of the AGYW have secondary/higher education, and 52% reported that they have had only one sexual partner in their lifetime. In addition, majority of the AGYW reportedly did not use condom during last sex and have no past year experience of STIs, while 97% and 99% showed discriminatory attitudes towards people living with HIV and had comprehensive knowledge of HIV/AIDS respectively. The chi-square analysis showed a statistical significance between all independent variables and HIV testing among AGYW. The percentage distribution showed that 71% of these women aged 20–24 have ever tested for HIV, for marital status, the highest percentage of respondents who have ever tested for HIV are those are formerly married (73%). Also, 68% of AGYM with primary education have ever tested for HIV which is higher than 66% among those with higher education. The highest percentage of AGYW who have ever tested for HIV among from the richest households (71%), while those who have had 2 or more lifetime sexual partners have a higher percentage of those who have ever tested for HIV. The analysis further revealed that 66% of those who reported using condom during last sex have had an HIV test, while the higher percentage of those who have ever tested for HIV can be found among AGYW who had past year experience of STI, currently working, have discriminatory HIV attitudes and have a comprehensive knowledge of HIV.

Table 3 shows the logistic regression analyses of the factors associated with HIV testing among female adolescents and young adults in SSA. Model 1 shows the crude/unadjusted odds ratio of individual association with HIV testing, and the findings showed that all variables except past year experience of STI is not associated with HIV testing among the population of adolescent

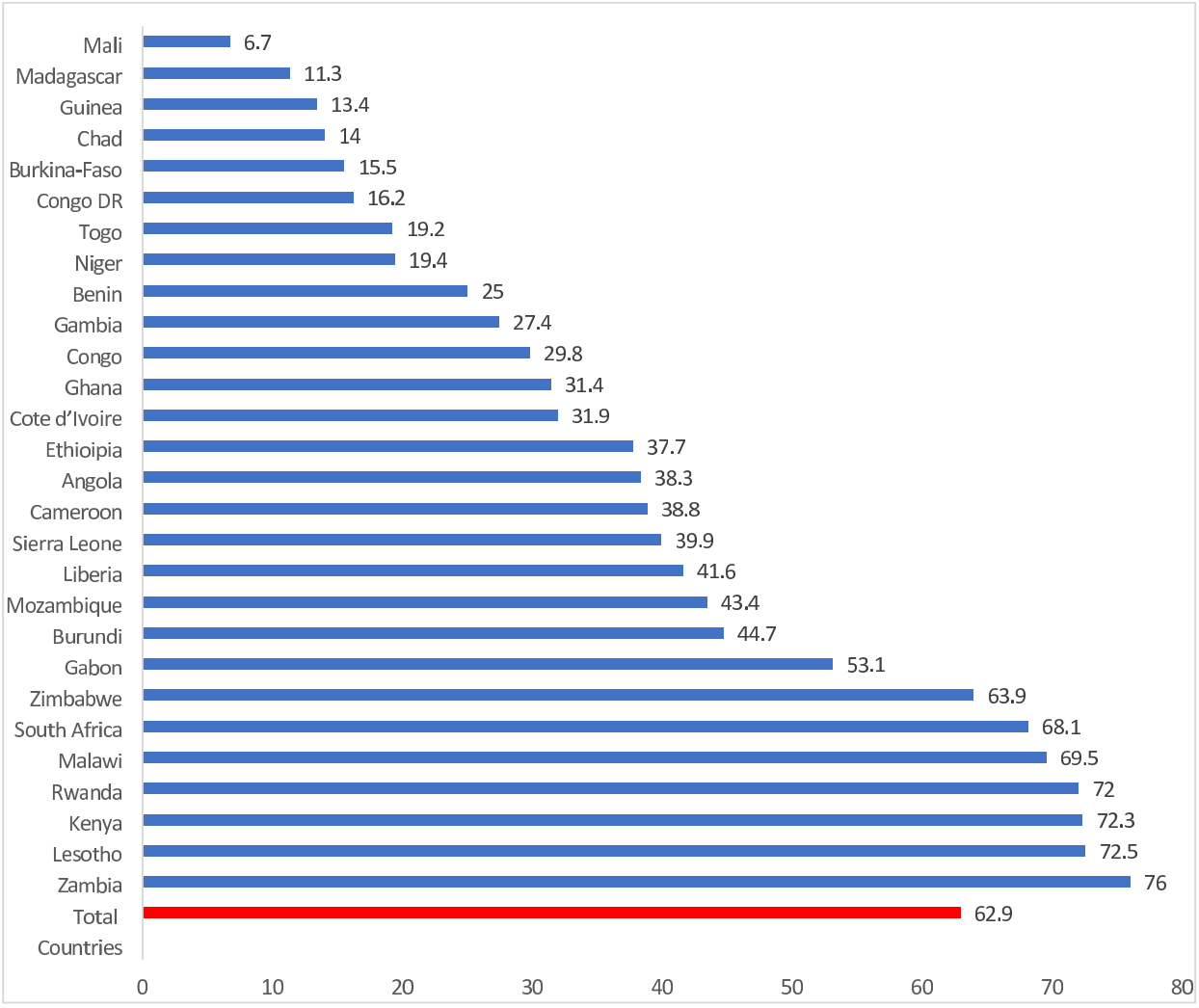

Fig. 1 Prevalence of HIV screening among adolescent girls and young women in sub-Saharan Africa

girls and young women. Model 2 shows the adjusted odds ratio, and it can be reported that that compared to teenage women, women who are aged 20–24 [aOR = 2.22, 95% CI = 2.08–2.37] are significantly more likely to have had an HIV test. We also found higher odds of HIV testing for those currently or formerly in union compared to those who have never been married. Rural residents are 24% less likely to have been tested for HIV compared to AGYW residing in urban areas [aOR = 0.76, 95% CI = 0.68–0.85]. Higher education is significantly associated with a higher likelihood of HIV testing. We also found that occupying a higher category of household wealth index is associated with a higher likelihood of HIV testing. The analysis further showed that AGYW who reported past year experience with STI are 25% more likely than those who did not report experience of STI in the past year to have been tested for HIV [aOR = 1.25, 95% CI = 1.11–1.41]. Having a comprehensive knowledge of HIV was found to be associated with HIV testing, specifically, AGYW who have comprehensive HIV knowledge are significantly more likely to have had an HIV test compared to those who do not have comprehensive knowledge [aOR = 3.76, 95% CI = 2.60–5.43]. AGYW who are employed are 8% significantly more likely to have ever been tested for HIV compared to those who are not working [aOR = 1.08, 95% CI = 1.02–1.16].

Discussion

The objective of this study was to estimate the prevalence and associated factors of HIV testing among adolescent girls and young women (AGYW) using demographic health surveys data from 28 sub-Saharan African countries. We found an overall HIV testing prevalence of 62.9%, with Zambia and Mali reporting the highest and lowest prevalence at 76% and 6.7%, respectively. The Joint United Nations Programme on HIV/AIDS (UNAIDS) strategy 'Fast Track: Ending the AIDS Epidemic by 2030', drives the global 95-95–95 goals which envision that by

Table 2 Distribution of respondents by socio-demographic characteristics and HIV screening among adolescent girls and young adult women [*n* = 58,263]

Variables	HIV Testing [%]				
	Freq.	Percent [%]	No	Yes	χ^2 ρ-value
Age					$p < 0.001$
15–19	18,099	35.0	50.4	49.6	
20–24	33,642	65.0	29.0	71.0	
Marital Status					$p < 0.001$
Never in Union	17,766	34.3	47.3	52.7	
Currently in Union	31,088	60.1	31.4	68.6	
Formerly in Union	2,887	5.6	27.4	72.6	
Place of Residence					$p < 0.001$
Urban	20,800	40.2	33.3	66.7	
Rural	30,941	59.8	38.7	61.3	
Highest Level of Education					$p < 0.001$
No Education	6,968	13.5	55.4	44.6	
Primary Education	18,448	35.7	32.5	67.5	
Secondary/Higher Education	26,326	50.9	34.5	65.5	
Household Wealth Index					$p < 0.001$
Poorest	8,547	16.5	42.4	57.6	
Poorer	9,751	18.9	39.4	60.6	
Middle	10,270	19.9	38.8	61.2	
Richer	11,485	22.2	34.3	65.7	
Richest	11,688	22.6	29.3	70.7	
Number of lifetime Sexual partners					$p < 0.001$
1	26,826	51.9	39.0	61.0	
2	12,780	24.7	33.5	66.5	
3+	12,135	23.5	34.8	65.3	
Condom Use during last sex					$p < 0.001$
No	43,163	83.4	37.2	62.8	
Yes	8,579	16.6	33.7	66.3	
Past Year Experience of STI					$p < 0.001$
No	47,855	92.7	36.5	63.5	
Yes	3,787	7.3	37.9	62.1	
Work Status					
No	25,517	49.3	37.5	62.5	
Yes	26,224	50.7	35.7	64.3	
HIV Discriminatory Attitudes					$p < 0.001$
No	1,637	3.2	44.6	55.4	
Yes	50,104	96.8	36.4	63.6	
Comprehensive HIV Knowledge					$p < 0.001$
No	347	0.7	72.6	27.4	
Yes	51,394	99.3	36.4	63.6	

2030, 95% of people living with HIV know their HIV status, 95% of people who know their status are on HIV treatment, and 95% of people on HIV treatment have a suppressed viral load. Though no country reported 95% HIV testing among AGYW, only four countries (Zambia, Lesotho, Kenya, and Rwanda) reported testing prevalence above 70% for AGYW, which is still not close to the 95% target. The huge disparity in HIV testing prevalence in AGYW observed among countries in SSA offers an opportunity for the countries that are lagging behind to identify best practices from the leading countries. These best practices can then be adapted to and implemented in the countries that are lagging behind to improve HIV testing among AGYW. Best practices identified from some of the leading countries for optimising HIV testing among AGYW included: providing community-based youth-friendly services in Kenya [35] and Zambia [36], making health centers and services youth-friendly in Zambia [28] and Burundi [37], as well as using integrated healthcare delivery models that provide other services that the youth need such as mental health support in Kenya [35] and family planning services in Zambia [36].

Findings from logistic regression showed that being older (20–24 years), being or ever having been in union, having some level of education (primary or secondary or higher), wealthier, having more than one lifetime sexual partner, having used a condom during the last sexual encounter, not experiencing STI symptoms in the past year, having HIV non-discriminatory attitudes, and having comprehensive HIV knowledge, were all found to be significantly associated with self-reported HIV testing among the sample in our study. We found that AGYW who are aged 20–24 years had higher odds of reporting HIV testing, compared to those who are aged 15–19 years. This finding is consistent with findings from a nationally representative sample of AGYW in South Africa [22]. It also supports results from previous studies among AGYW in Tanzania [19, 21] and Sierra Leone [23]. Plausibly, since older age may be associated with more sexual activity and thus increased risk of HIV infection, it is likely that this could explain increased odds of HIV testing among the 20–24-year-olds.

In addition, AGYW in the 20–24 years' age bracket may have more knowledge about HIV and therefore, may be more likely to have tested for HIV compared to those aged 15–19 years. Additionally, it may be that access to testing may be lower for this younger age group. In view of this, we suggest that age-appropriate HIV education is provided to both within and outside of school AGYW aged 15–19 years as a possible strategy to improve their knowledge about HIV, and the likelihood of HIV testing for this age group. This suggestion is grounded on our analysis that shows possessing comprehensive HIV knowledge increased the odds of HIV testing by two folds. Consistent with previous studies in Uganda [38, 39], Malawi [39] and Nigeria [40, 41], our study results also showed that attaining some form of education (primary, secondary or higher) increased the odds of HIV testing by three folds. This finding reinforces the importance of keeping AGYW in school as a strategy not only for increasing HIV knowledge and hence testing, but also for preventing HIV infection among this subpopulation

Table 3 Bivariate and multivariable models showing the factors associated with HIV screening among adolescent girls and young women in SSA

Variables	Model I			Model II		
	cOR	[95% CI]	*p*-Value	aOR	[95% CI]	*p*-Value
Age						
15–19	1			1		
20–24	2.51 ***	[2.39–2.64]	< 0.001	2.22 ***	[2.08–2.37]	< 0.001
Marital Status						
Never in Union	1			1		
Currently in Union	1.98 ***	[1.86–2.10]	< 0.001	3.23 ***	[2.97–3.51]	< 0.001
Formerly in Union	2.52	[2.23–2.84]	< 0.001	2.91 ***	[2.49–3.40]	< 0.001
Place of Residence						
Urban	1			1		
Rural	0.81 ***	[0.75–0.87]	< 0.001	0.76 ***	[0.68–0.85]	< 0.001
Highest Level of Education						
No Education	1			1		
Primary Education	2.63 ***	[2.42–2.85]	< 0.001	1.37 ***	[1.25–1.52]	< 0.001
Secondary/Higher Education	2.41 ***	[2.21–2.62]	< 0.001	2.23 ***	[2.02–2.46]	< 0.001
Household Wealth Index						
Poorest	1			1		
Poorer	1.10 ***	[1.01–1.19]	< 0.001	1.24 ***	[1.13–1.37]	0.001
Middle	1.05	[0.96–1.14]	< 0.001	1.32 ***	[1.20–1.46]	< 0.001
Richer	1.30 ***	[1.18–1.42]	< 0.001	1.74 ***	[1.53–1.98]	< 0.001
Richest	1.57 ***	[1.43–1.73]	< 0.001	2.26 ***	[1.97–2.59]	< 0.001
Number of lifetime Sexual partners						
1	1			1		
2	1.30 ***	[1.22–1.38]	< 0.001	1.25 ***	[1.15–1.34]	< 0.001
3+	1.37 ***	[1.27–147]	< 0.001	1.41 ***	[1.29–1.55]	< 0.001
Condom Use during Sex						
No	1			1		
Yes	1.21 ***	[1.13–1.30]	< 0.001	0.	[0.85–1.04]	0.205
Past Year Experience of STI						
No	1			1		
Yes	0.95	[0.86–0.99]	0.334	1.25 ***	[1.11–1.41]	< 0.001
Work Status						
No	1			1		
Yes	1.14 ***	[1.08 1.21]	0.039	1.08 **	[1.02–1.16]	0.014
HIV Non-Discriminatory Attitudes						
No	1			1		
Yes	1.42 ***	[1.23–1.63]	< 0.001	0.92 ***	[0.77–1.10]	0.77
Comprehensive HIV Knowledge						
No	1			1		
Yes	4.63 ***	[3.46–6.21]	< 0.001	3.76 ***	[2.60–5.43]	< 0.001
Pregnancy History of Respondents						
No	1			1		
Yes	1.12 ***	[1.08–1.16]	< 0.001	1.09 ***	[1.03–1.14]	< 0.001

Model 1: Unadjusted model investigating the association between respondents' characteristics and HIV testing

Model 2: Adjusted model investigating the association between respondents' characteristics and HIV testing, adjusting for each of the socioeconomic, demographic variables, number of lifetime sexual partners, condom use during sex, past year STI experience, HIV discriminatory attitudes, comprehensive HIV knowledge, pregnancy history and country of residence

95%CI 95% confidence interval, *cOR* Crude Odds ratio, *aOR* Adjusted Odds ratio

*p<0.05

**p<0.01

***p<0.001

[16]. Given relatively low levels of HIV testing, interventions targeting out-of-school AGYW may also be an important strategy for the overall HIV response in this decade of eradication. Since out-of-school AGYW may spend most of their time in the households or other of such settings in the community, it is important that HIV testing services are in these settings. Previous studies have shown that availing community-based and youth-friendly HIV testing services is effective in increasing HIV/STI testing uptake among AGYW as evidenced in SSA countries [42] and among other priority groups in other countries [43, 44]. This strategy could be considered for adoption in countries with low prevalence of HIV testing among AGYW.

As the household wealth index increased, the odds of testing for HIV also increased, consistent with previous studies in Nigeria [40] and South Africa [45]. Having a job–which is closely related to wealth index–also increased the likelihood of testing for HIV. This association is probably because the wealthier one is, the higher one's chances of getting a formal education, higher health literacy and social capital for health screening, thereby leading to an increased likelihood of testing for HIV. For instance, wealthier people are more likely to possess resources for transportation to health facilities where HIV testing is offered, and/or for purchasing HIV self-test kits. On the other hand, the meagre resources of the poor are more likely to be committed to their daily needs as compared to seeking HIV testing services. Reaching the first 95 of the 95-95–95 fast-track strategies requires an inclusive approach that brings everyone on board in spite of their economic status. Lifting AGYW out of poverty is a key strategy that countries in SSA can implement to increase HIV testing, since improved economic status is at the intersection of the other key factors that increase the likelihood of HIV testing, such as higher educational attainment and increased HIV knowledge.

We found that being in union or ever having been in union with a man was associated with higher odds of HIV testing among AGYW, as has been previously reported elsewhere [26]. This is possibly because AGYW in union may be at higher risk of sexually transmitted infections for which they could visit health facilities for care and in the process get offered HIV testing [46]. In addition, given the cultural and gender norms of many African societies, concurrent sexual relationships are not uncommon [47], and it is probable that AGYW in union understood the attendant risk of HIV infection caused by such concurrent sexual relationships in stable heterosexual partnerships [48], and therefore on their own volition were more likely to test for HIV. It is also possible that given that the high value that childbearing holds in African male-female unions, these AGYW could have been pregnant and attended antenatal care clinics where HIV testing is routinely offered. Indeed, other studies have shown that being pregnant is associated with higher odds of HIV testing [49–51]. Testing for HIV in pregnancy is important since if detected, then the mother can be offered antiretroviral therapy for her own health and well-being, as well as to prevent vertical transmission of HIV to the unborn baby.

Having more than one lifetime sexual partner was also associated with higher odds of testing for HIV, consistent with findings from a study in Zimbabwe [20] and Tanzania [52] and potentially linked to AGYW's awareness of the risk of HIV infection posed by having multiple sexual partners. Such awareness is commendable and calls for continued HIV education for AGYW as well as to promote HIV testing and help these countries' advancement towards achieving the first 95 (95% of people living with HIV becoming aware of their status) of 95-95–95 target, which is the gateway to UNAIDS goal to ending HIV and AIDS as a global public health threat by 2030. Condom use during the last sexual encounter also increased the odds of testing for HIV, in contrast to studies conducted in South Africa [22] and Zambia [53]. This is puzzling since one would expect that using condoms would reduce the odds of HIV testing, since condoms decrease the chances of HIV transmission. A possible explanation for this finding would be that for most AGYW, probably the last sexual encounter was with a casual/non-regular partner with unknown HIV serostatus, and thus still felt the need to test for HIV despite having used condoms. In addition, it is likely that AGYW who used condoms were more likely to test for HIV due to perceived poor quality and lack of efficacy of the condoms to prevent HIV infection, as observed from a study in Benin [54]. Whereas the increased odds of testing for HIV even with condom use is commendable, it is instructive for governments to ensure the condoms they and the private and non-governmental sectors provide are of high quality, and conduct awareness campaigns to inform the public and to inspire confidence in the dual use of condoms to prevent HIV and STIs as well as unplanned pregnancy [25].

We also noted that having had symptoms of a STI in the past year increased the odds of testing for HIV, which is consistent with a previous study in Tanzania [52]. This could have been due to the fear of testing positive for HIV, since STI-risk practices could also predispose one to HIV. Meanwhile, since untreated STIs also biologically potentiate the acquisition and transmission of HIV [55], there is a need to continue efforts to educate AGYW about HIV, including stressing the need for early detection and treatment to achieve undetectable viral load, prevention of opportunistic infections, and attaining optimal health. Moreover, there is also a need to scale up provider-initiated HIV testing for AGYW who present for treatment of STIs. Further, considering innovative

strategies that have been shown to increase the uptake of HIV testing among AGYW could also be important. For instance, a study in Tanzania demonstrated that using girl-friendly drug shops has the potential to more than double the distribution of HIV self-test kits to AGYW [56], thus potentially improving HIV testing. Another innovative strategy could be self-testing which has been found effective among other priority populations in Australia [57].

In the current study, having non-discriminatory attitudes towards HIV was correlated to HIV testing. Other studies in Lesotho [26] and Rwanda [49] have established the same. This could probably be because AGYW with non-discriminatory attitudes towards HIV are more knowledgeable about HIV, less afraid of being discriminated against or stigmatised for their HIV status, and thus may be more likely to test for HIV. This finding supports the importance of the continued fight against stigma and discrimination of people living with HIV, as stigma may result in a significant proportion of AGYW being left behind in knowing their HIV status and accessing treatment, if required.

Strengths and limitations

The strength of the study lies in the use of high quality nationally representative data with a large sample size drawn from 28 countries in SSA. The study however is not without limitations. Since HIV testing was self-reported, there is a possibility that this main finding could have been affected by both social desirability and recall bias. The design of the study being cross-sectional limits our ability to establish causality between HIV testing and the associated factors, though these factors are plausibly causal given congruence with findings from previous studies. Although the analysis included multiple variables, we cannot rule out the possibility of residual confounding from variables that were not included in the model, such as experiences of gender-based violence which may affect HIV testing among AGYW [58, 59].

Conclusion

The findings of this study highlight high between and within countries disparities in HIV testing among AGYW in SSA countries. Four of the 28 countries in our sample reported HIV screening prevalence above 70% for the AGYW subpopulation. However, concerningly, 21 countries, representing 75% of the countries included in the current study, reported HIV testing coverage below 50% for AGYW, notwithstanding that this population is a known priority population for HIV acquisition [7]. For all the countries in our study, there is a need for concerted efforts to scale up HIV testing efforts for AGYW. Stakeholders such as governments, non-governmental organisations, and global health bodies such as UNAIDS, WHO, and Africa CDC should work together in this regard. Countries should also leverage best practices from each other and adapt what works to increase HIV testing in this priority population.

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Author contributions
SRO and DOO conceptualised and designed this study. OAB and OAA sourced and analysed data. DOO, SRO, OAB, OAA, SWM, AM and AMB drafted and made critical scholarly and intellectual contribution in developing the manuscript. All authors reviewed and revised drafts of the manuscript for submission.

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Data availability
The DHS datasets employed in this study are publicly available on the DHS website and can be downloaded for free upon request via https://dhsprogram.com/data/available-datasets.cfm.

Declarations

Ethical approval
This is not required as the data used for this study was sourced from Demographic and Health Survey datasets.

Competing interests
The authors declare no competing interests.

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