FULL TITLE: Reaching for the "first 95": a cross-country analysis of HIV self-testing in 177,572 people in nine countries in sub-Saharan Africa

RUNNING HEAD: HIV self-testing in sub-Saharan Africa

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Abstract

Objectives

HIV self-testing (HIVST) offers a promising approach to increase HIV diagnosis and advance progress towards the UNAIDS 95-95-95 targets. We aimed to understand patterns of HIVST awareness and utilization in nine sub-Saharan African (SSA) countries, with the goal of identifying populations to target in disseminating this technology.

Design

Cross-sectional study.

Methods

We pooled individual-level population-based data from nine Demographic and Health Surveys (DHS) in SSA conducted 2015-2019 (Burundi, Cameroon, Guinea, Malawi, Senegal, Sierra Leone, South Africa, Zambia, Zimbabwe). Primary outcomes were HIVST awareness and utilization. We used logistic regression with survey fixed effects to explore the relationship between sociodemographic characteristics and these outcomes. Models were adjusted for sex, age, rural/urban residence, education, wealth, and marital status. We accounted for complex survey design.

Results

The study sample included 177,572 people (66.0% women, mean age 29±10 years), of whom 86.6% (95%CI 86.4-86.7) were unaware of HIVST, 11.7% (95%CI 11.6-11.9) were aware of but never used HIVST, and 1.7% (95%CI 1.6-1.8) had used HIVST. In adjusted models, women were less likely to be aware of HIVST (OR 0.75, 95%CI 0.71-0.79), but more likely to have used HIVST (OR 1.17, 95%CI 1.03-1.32) compared to men. Rural residents, those who were least educated, and poorest were less likely to have heard of or used HIVST.

79

80 **Conclusions**

81 HIVST awareness and uptake were low. Rural, less educated and lower income populations were
82 least likely to have heard of or used HIVST. Efforts to scale-up HIVST in these settings should
83 aim to reach these less advantaged groups.

84

85 Keywords: HIV, Self-testing, HIV testing, HIV seroprevalence, Sub-Saharan Africa

Introduction

HIV prevention programs have sought to reduce new HIV infections worldwide by promoting widespread HIV testing, linkage to care and ultimately high rates of viral suppression to prevent onward transmission. Recently, UNAIDS showed that only 76% of people with HIV in eastern and southern Africa – the global region with the highest HIV prevalence – knew their serostatus as of the end of 2017 [1]. HIV self-testing (HIVST) offers a promising approach to increase progress toward the 95-95-95 targets, which seek to ensure that 95% of people living with HIV (PLHIV) are aware of their serostatus, 95% of PLHIV receive antiretroviral therapy (ART) and 95% of those on ART are virally suppressed, by 2030 [2]. HIV self-tests have the advantage of providing a greater level of flexibility and privacy in contexts where HIV-related stigma is highly prevalent [3,4]. As such, HIVST offers an innovative approach to increase testing uptake among people who are reluctant to test in formal health care settings [5].

Given the potential benefits of HIVST, the World Health Organization (WHO) recommended as of 2016 that HIVST be offered as an additional HIV testing modality in this region [6]. Since the WHO published these guidelines, the Self-Test Africa (STAR) initiative has sought to increase HIVST in SSA and shape national policies that will promote more widespread scale-up of HIVST [7,8]. This initiative started in 2015 with implementation in three SSA countries (Malawi, Zambia, and Zimbabwe), followed by many others, and has resulted in 77 countries introducing policies that promote HIVST as of 2019 [8,9]. However, one study of HIVST awareness and uptake in Zimbabwe and Malawi found low levels of awareness (12.6%) and use (1.2%)[10], despite a high willingness to test (84.5%) among Zimbabwean men, the only sub-group in whom willingness was assessed [10]. Aside from this study, relatively little is known about the current levels of HIVST awareness and uptake in much of the region. In addition, to the best of our knowledge, there is little available evidence about the relationship between HIV-related stigma and HIVST,

whereas prior research has shown that HIV-related stigma may be associated with reduced uptake of regular HIV testing [4,11].

In this study, we sought to evaluate awareness and utilization of HIVST among people 15 years or older in nine countries in SSA with variable HIV prevalence. Our secondary aim was to understand the factors that are correlated with the awareness and utilization of self-testing, including sociodemographic characteristics, and HIV-related stigma. The findings of this study could lead to potential targets for future intervention strategies to scale-up HIVST.

Methods

Data source

This study used data from nine Demographic and Health Surveys (DHS) conducted in SSA countries. The DHS Program provides technical assistance to countries for standardized household surveys which include the following population-based research topics: maternal and child health, nutrition, mortality, health services, malaria, and HIV [12]. DHS aims to provide high quality data for national and international planning and decision making [12]. We included surveys based on the following criteria: 1) the country was located within the SSA region; 2) the survey included questions about HIVST; and 3) HIV biomarker data were available. We included the most recent survey in each country. This led to a sample of nine surveys, from which we pooled individual-level data: Burundi (2016/2017), Cameroon (2018), Guinea (2018), Malawi (2015/2016), Senegal (2017), Sierra Leone (2019), South Africa (2016), Zambia (2018), and Zimbabwe (2015).

Measures

The primary outcome measures were HIVST awareness and use. The questions were asked in the following forms: “Have you heard of test kits people can use to test themselves for HIV?” and

"Have you ever tested yourself for HIV using a self-test kit?". A secondary outcome was ever being tested for HIV: "I don't want to know the results, but have you ever been tested for HIV?". Sociodemographic variables included sex (male/female), age (5-year age categories), type of residence (rural/urban), educational level (no education/primary/secondary/higher), wealth (poorest/poorer/middle/richer/richest), marital status (never in union/married/living with partner/widowed/divorced or separated), HIV status (negative/positive), and HIV-related stigma score (1-6). An HIV-related stigma score was created out of six separate questions about HIV-related stigma (Supplemental Digital Content (SDC) 1), as has been done previously in studies using the DHS to interrogate HIV-related stigma [13].

Statistical analyses

Women aged 15-49 and men aged 15-54 were included, as these were the age groups that were available in all countries. Analyses were limited to the participants who responded to the HIVST questions, except for "ever tested for HIV", where the total study population was included in the analyses, as all participants responded to this question. Second, proportions of HIVST awareness and utilization were explored by participant characteristics such as sex, age, rural/urban residence, educational level, wealth, marital status, HIV status, and HIV-related stigma. Third, correlates of HIV self-testing behavior were explored in two multivariable logistic regression analyses with survey fixed effects. The first model ("Model 1") was adjusted for age, sex, educational level, household wealth and marital status. A second model ("Model 2") also included HIV-related stigma. Fourth, we additionally performed modified Poisson regression analysis and present prevalence ratios for Models 1 and 2.

We conducted three supplementary analyses. First, we assessed variation in awareness and use of self-testing at the country level by performing disaggregated regression analyses by country. Second, in order to compare HIVST use with regular HIV testing, we re-ran our multivariable

regression model for the outcome of having ever tested for HIV. Third, we explored whether outcomes of HIVST use are related to the level of HIVST awareness, therefore we conducted multivariable regressions for HIVST use, but only among those who were also aware of HIVST. Analyses were performed in SPSS and STATA. A complex sample package was used to account for the complex survey design. Standard DHS survey weights were used to adjust for non-response and sample imbalance. In this study we present unweighted numbers and weighted percentages.

Results

Baseline characteristics

The total study sample consisted of 192,712 respondents, of which 177,572 people (92.6%) responded to the HIVST questions. Sociodemographic differences between responders and non-responders can be found in a Supplementary Appendix (see Table, SDC 2). Among those who responded to the HIVST questions, 66.0% (n=117,127) were women, the mean age was 29 ± 10 years (Table 1) and HIV prevalence in this population was 6.2% (n=7,033) (Table 2). Of this pooled sample, 63.9% (95% CI 63.6-64.1) had ever been tested for HIV, 13.4% (95% CI 13.3-13.6) were aware of HIVST and only 1.7% (95% CI 1.6-1.8) had ever used a self-test kit to test for HIV (Table 1). Of the people who were aware of HIVST, a pooled estimate of 12.7% had ever used HIVST (Table 1).

Awareness of HIVST

Proportions of HIVST awareness by sociodemographic characteristics can be found in a Supplementary Appendix (see Table, SDC 3). In multivariate regression models we found that women (OR 0.75, 95% CI 0.71-0.79), young adolescents (15-19 years: OR 1.00 vs. 50-54 years: OR 1.67, 95% CI 1.45-1.94), and people living in rural areas (OR 0.81, 95% CI 0.75-0.88) were

188 less likely to be aware of HIVST than men, older age groups, and urban residents, respectively
189 (Table 3, SDC 4). Moreover, there were significant differences in the association between HIVST
190 awareness and educational level (no education vs. primary: OR 1.03, 95% CI 0.96-1.11;
191 secondary: 1.81, 95% CI 1.68-1.95; higher: OR 4.89, 95% CI 4.45-5.37) and wealth (poorest vs.
192 poorer: OR 1.26, 95% CI 1.16-1.37; middle: OR 1.45, 95% CI 1.32-1.58; richer: OR 1.70, 95%
193 CI 1.54-1.88; richest: OR 2.36, 95% CI 2.12-2.62) with less educated and less wealthy people
194 being less aware of HIVST (Fig 1, Table 3). When adding HIV-related stigma to the model
195 (Model 2, n=166,089), stigma was significantly inversely associated with HIVST awareness (0
196 vs. 6: OR 0.82, 95% CI 0.70-0.94) (Table 3). Prevalence ratios showed similar results to odds
197 ratios (Table 3, SDC 4).
198
199 **Use of HIVST**
200 We display the proportions using HIVST use overall and by key sociodemographic characteristics
201 in a Supplementary Appendix (see Table, SDC 3). Multivariate logistic regression analysis
202 showed women had greater odds of having ever used HIVST compared to men (OR 1.17, 95%
203 CI 1.03-1.32) (Table 4). Moreover, we found that young adolescents (15-19 years: OR 1.00 vs.
204 50-54 years: OR 1.86, 95% CI 1.23-2.80), rural residents (OR 0.74, 95% CI 0.62-0.89), those
205 with lower educational attainment (no education vs. primary: OR 0.79, 95% CI 0.65-0.97;
206 secondary: OR 1.64, 95% CI 1.36-1.98; higher: OR 4.20, 95% CI 3.43-5.16), and less wealthy
207 people (poorest vs. poorer: OR 1.28, 95% CI 1.04-1.59; middle: OR 1.22, 95% CI 0.96-1.55;
208 richer: OR 1.48, 95% CI 1.17-1.86, richest: OR 1.66, 95% CI 1.31-2.11) were less likely to have
209 used HIVST compared to older age groups, urban residents, higher educated, and wealthier
210 people, respectively (Fig 1, Table 4, SDC 4). The second model additionally included HIV-related
211 stigma (Model 2, n=166,089) and showed that, consistent with HIVST awareness, people who
212 self-reported a high level of HIV-related stigma were less likely to have ever used a self-test (0:

OR 1.00 vs. 6: OR 0.23, 95% CI 0.15-0.35) (Table 4). Prevalence ratios showed similar results to odds ratios (Table 4, SDC 4).

Country-level differences and supplementary analyses

Regression analyses of HIVST awareness and use disaggregated by country showed results were largely stable across countries, with few notable exceptions. First, men in Sierra Leone and urban residents in Senegal were less likely to be aware of HIVST compared to women and rural residents, respectively. For HIVST use we found that women had lower odds of having ever used HIVST in Cameroon. Moreover, we found HIVST use was greater in wealthier people in many countries, whereas we found the opposite relationship in Sierra Leone (see Figure, SDC 5; see Tables, SDC 6). Country fixed effects showed that Cameroon, Sierra Leone, South Africa and Zambia are leading countries with respect to both awareness and use of HIVST (see Table, SDC 6). Multivariable regression models investigating "ever tested for HIV" and sociodemographic characteristics showed similar results to the findings for HIVST use, further details are described in a Supplementary Appendix (see Tables, SDC 7). We additionally investigated HIVST use among those who are aware. Overall, regression analyses showed similar patterns in terms of HIVST use when restricting to those who were aware of HIVST, as for HIVST use among the entire study population (see Table, SDC 8).

Discussion

This study of pooled individual-level data across nine nationally representative population-based surveys in SSA demonstrated that less than one in seven people were aware of HIVST and far fewer had ever used HIVST. We found that less advantaged populations, including those that are rural, less educated and lower income, were less likely to be aware of or use HIVST, further reinforcing inequality in access to important new testing modalities that can improve timely linkage to needed HIV care. These findings not only highlight an important, untapped opportunity

to speed progress toward the "first 95;" that is, the UNAIDS target that 95% of people know their HIV status, but also offer specific policy-relevant insight about how to target dissemination of this technology [2].

These findings are important because HIV diagnosis is a necessary precursor to treatment and viral suppression, which can in turn prevent disease transmission [14]. As reported in recent studies, HIVST improves HIV testing uptake in general [9,15]. Our results showed that implementation of HIVST is still far from achieving its maximal potential, with 98% of the study population having never self-tested. The consistent increase in self-testing across wealth and educational levels suggest that focusing on traditionally disadvantaged groups has the potential to increase HIVST uptake overall. This is especially important given that these lower socioeconomic groups have been shown to have a higher risk of acquiring HIV [16]. Additionally, these interventions should aim to reach rural populations. Moreover, we found that results of HIVST use were comparable to those for usual modalities of HIV testing, indicating these two testing methods might be reaching similar populations. Our findings are consistent with Johnson *et al*[10] but show that they are generalizable across nine countries in SSA – countries in this study represent about 40.7% of the HIV epidemic in the SSA region (see Table, SDC 9) [17,18]. Our finding that these less advantaged groups are also less likely to use HIVST are also similar to a recent single-country study undertaken in rural Malawi [19]. Literature about HIVST use and awareness outside of SSA has shown low HIVST awareness (14%) in Northern Thailand, though nearly 40% of MSM in Beijing, China had used HIVST in one study [20,21].

Our study demonstrates a gap between HIVST knowledge and uptake. It is important to understand how this gap has emerged, in order to improve HIVST implementation. As such, future research should focus on identifying what factors prevent people who are aware of HIVST from self-testing. Greater awareness of these barriers could inform the design of programs and policies that can translate HIVST awareness into actual use. Prior studies report that barriers to

HIVST include HIVST costs, concerns about parents finding out they are sexually active, the fear of a positive test result and perceived unreliability of the test [22,23]. These concerns may contribute to the low self-testing rates found in this study.

In addition, we examined HIV-related stigma because HIVST, in particular because of privacy considerations of testing at home, might be particularly attractive for people who have a more stigmatized view of HIV. Interestingly, we did not observe higher self-testing rates among this group, indeed we found the opposite relationship. This finding could have multiple explanations. First, people with high levels of HIV-related stigma might not self-test because they avoid any type of HIV-related testing due to shame or resentment around this subject [11,13]. Alternatively, people with high levels of stigma might not admit to self-testing, as they do not want to be associated with the disease.

Since the WHO recommended self-testing as an additional HIV testing service in 2016[6], countries in SSA have begun to develop national policies to implement and disseminate this technology. Thus, it is important to acknowledge that these surveys were conducted during a period when most countries had policies that were recently introduced or still in development [24–28]. In a Supplementary Appendix we provided a brief overview of HIVST access per country at the time these surveys were conducted (see Table, SDC 10). This lack of access may be one reason for the low rates of HIVST awareness and use in this population. However, our study showed that a meaningful proportion of people did have access to self-test kits, perhaps in part through distribution of HIVST via validation trials or internet-based ordering [29,30].

This study has several important strengths and limitations. First, an important strength of this study is the large sample size. Second, the survey questions used in this study are evaluated broadly and have high response rates. The latter limits the risk of non-response bias; because DHS covers wide-ranging topics, people might not necessarily decline because of HIV-related

arguments. However, while DHS questions are consistent across surveys, they have not been validated as a true measure of HIVST awareness or utilization in these populations. Another limitation of this study is that we used self-reported outcomes that may be subject to both response bias and recall bias; people might not answer truthfully or may not remember past events accurately. Furthermore, data were limited to certain SSA countries, as not all SSA countries had recent DHS available and the two HIVST questions were not asked in all surveys. Thus, while the findings are robust across these nine countries, it is not clear to what extent they will be generalizable to all countries in this region.

In conclusion, HIVST awareness in this population is limited and a very small proportion of people have ever used HIVST. Across all contexts, less advantaged groups such as rural, poor and less educated populations have also been neglected in the dissemination of HIVST. Future interventions should seek to expand HIVST services in SSA with a particular focus on these least advantaged groups and with the goal to advance progress toward achieving the "first 95." Finally, a greater understanding of what drives the observed knowledge-uptake gap for HIVST will be critical to maximize the potential of this promising new testing modality.

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Ethics

DHS protocols received ethical approval from the ICF Institutional Review Board (IRB) and were reviewed by an IRB from the relevant countries. This study was exempt from ethical clearance by the Ethical Review Committee of Maastricht University, the Netherlands.

Data sharing statement

DHS data is publicly available by request at the DHS website: https://dhsprogram.com/data/available-datasets.cfm.

Author contributions

EVE, RDV, MM, GH, TB, and JMG contributed to conceptualizing the framework of this study. EVE analyzed the data, additional Poisson analyses were performed by MM. EVE, JMG and RDV verified the underlying data. EVE and JMG wrote the first draft of the manuscript. All authors contributed to reviewing and editing of the manuscript and consented to publication.

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Table 1. *Survey characteristics*[1]

Country	Year	Sample size	% Female	Mean age ± SD	% HIV-positive	% Ever tested (95% CI)	% Aware of HIVST (95% CI)	% Use of HIVST (95% CI)	HIVST use/awareness proportion[2]
Burundi	2016/2017	23 553	70.0%	29 ± 10	0.9%	64.6 (64.0-65.2)	4.1 (3.8-4.3)	0.3 (0.2-0.4)	7.3%
Cameroon	2018	19 422	67.6%	28 ± 10	2.7%	68.3 (67.7-69.0)	16.5 (16.0-17.1)	2.6 (2.4-2.9)	15.8%
Guinea	2018	12 200	71.4%	29 ±10	1.6%	19.3 (18.7-20.0)	8.7 (8.3-9.3)	0.8 (0.7-1.0)	9.2%
Malawi	2015/2016	31 481	76.4%	28 ± 10	9.0%	81.8 (81.3-82.2)	10.6 (10.2-10.9)	1.0 (0.9-1.1)	9.4%
Senegal	2017	22 199	71.3%	28 ± 10	0.5%	43.0 (42.4-43.7)	5.3 (5.0-5.6)	0.2 (0.1-0.2)	3.8%
Sierra Leone	2019	20 923	69.1%	29 ± 10	1.8%	49.0 (48.3-49.7)	20.9 (20.4-21.5)	3.5 (3.3-3.8)	16.7%
South Africa	2016	11 481	71.0%	30 ± 10	22.2%	83.4 (82.7-84.1)	25.3 (24.5-26.1)	3.0 (2.7-3.4)	11.9%
Zambia	2018	24 986	53.5%	29 ± 10	11.4%	84.0 (83.6-84.5)	20.7 (20.2-21.2)	2.9 (2.7-3.1)	14.0%
Zimbabwe	2015	11 327	26.8%	28 ± 11	11.1%	58.4 (57.5-59.3)	14.8 (14.2-15.5)	1.4 (1.2-1.7)	9.5%
Total		177 572	66.0%	29 ± 10	6.2%	63.9 (63.6-64.1)	13.4 (13.3-13.6)	1.7 (1.6-1.8)	12.7%

*Abbreviations: SD= standard deviation; HIVST= HIV self-testing. [1]Percentages are weighted with DHS sampling weights, numbers are presented unweighted. [2]HIVST proportion= use of HIVST / awareness of HIVST x 100%.

Table 2. *Participant characteristics of the pooled sample*[1]

	N	% of population
Sex		
Men	60 445	34.0%
Women	117 127	66.0%
Age groups		
15-19 years	40 410	22.3%
20-24 years	31 998	18.0%
25-29 years	28 153	16.2%
30-34 years	24 096	13.8%
35-39 years	20 741	11.8%
40-44 years	15 796	8.9%
45-49 years	12 944	7.2%
50-54 years[2]	3 434	1.9%
Residence type		
Urban	68 254	39.6%
Rural	109 318	60.4%
Highest educational level[3]		
No education	41 352	23.2%
Primary	57 159	32.3%
Secondary	69 277	38.5%
Higher	9 782	6.0%
Household wealth index		
Poorest	31 094	16.9%
Poorer	33 444	18.2%
Middle	36 220	19.4%
Richer	36 741	21.4%
Richest	40 073	24.1%
Marital status		
Never in union	65 155	36.4%
Married	90 628	51.3%
Living with partner	9 637	5.5%
Widowed	3 251	1.8%
Divorced/separated	8 901	5.1%
HIV status[4]		
HIV-	106 108	93.8%
HIV+	7 033	6.2%
HIV-related stigma score[5,6]		
0	9 417	5.5%
1	20 894	12.4%
2	36 112	21.6%
3	42 870	26.5%
4	23 569	14.3%
5	16 585	9.9%
6	16 644	9.9%
Total	177 572	100.0%

[1]Percentages are weighted with DHS sampling weights, numbers are presented unweighted. [2]The age group 50-54 years only includes male participants. [3]Total number of responses= 178 541 (100.0%); missing responses= 1 (0.0%). [4]Total number of participants who consented to HIV testing= 113 271 (63.4%); not consented to HIV testing= 65 270 (36.6%). [5]Total number of responses= 167 082 (93.6%); not asked in the South African survey (n= 11 459, 6.4%). [6]The HIV-related stigma score consists of six questions, one point was given for every question answered with 'yes', indicating the presence of HIV-related stigma.

Table 3. *Multivariable logistic regression analysis of the association between awareness of HIVST and participant characteristics from DHS surveys across nine countries in SSA*[1,2]

	Awareness of HIVST			
	Model 1		Model 2	
	OR (95% CI)	**PR (95% CI)**	**OR (95% CI)**	**PR (95% CI)**
Sex				
Men	REF	REF	REF	REF
Women	0.75 (0.71-0.79)	0.80 (0.78-0.82)	0.74 (0.70-0.79)	0.79 (0.77-0.81)
Residence type				
Urban	REF	REF	REF	REF
Rural	0.81 (0.75-0.88)	0.89 (0.86-0.93)	0.83 (0.76-0.91)	0.91 (0.87-0.94)
Highest educational level				
No education	REF	REF	REF	REF
Primary	1.03 (0.96-1.11)	1.04 (0.99-1.09)	1.03 (0.96-1.11)	1.04 (0.98-1.09)
Secondary	1.81 (1.68-1.95)	1.69 (1.61-1.77)	1.78 (1.65-1.92)	1.65 (1.57-1.74)
Higher	4.89 (4.45-5.37)	3.13 (2.96-3.31)	4.84 (4.39-5.35)	3.07 (2.89-3.26)
Household wealth index				
Poorest	REF	REF	REF	REF
Poorer	1.26 (1.16-1.37)	1.22 (1.15-1.29)	1.23 (1.12-1.34)	1.20 (1.13-1.27)
Middle	1.45 (1.32-1.58)	1.38 (1.30-1.45)	1.40 (1.27-1.54)	1.34 (1.26-1.42)
Richer	1.70 (1.54-1.88)	1.57 (1.48-1.66)	1.62 (1.45-1.80)	1.51 (1.42-1.60)
Richest	2.36 (2.12-2.62)	2.01 (1.89-2.13)	2.29 (2.04-2.57)	1.97 (1.85-2.10)
HIV stigma severity score				
0	..	..	REF	REF
1			0.96 (0.87-1.06)	0.97 (0.91-1.04)
2			1.00 (0.91-1.09)	0.98 (0.94-1.06)
3			1.06 (0.97-1.16)	1.05 (0.99-1.12)
4			1.01 (0.91-1.12)	0.99 (0.93-1.06)
5			0.84 (0.74-0.95)	0.84 (0.78-0.91)
6			0.82 (0.70-0.94)	0.82 (0.76-0.88)
Total number of respondents	177 570		166 089	

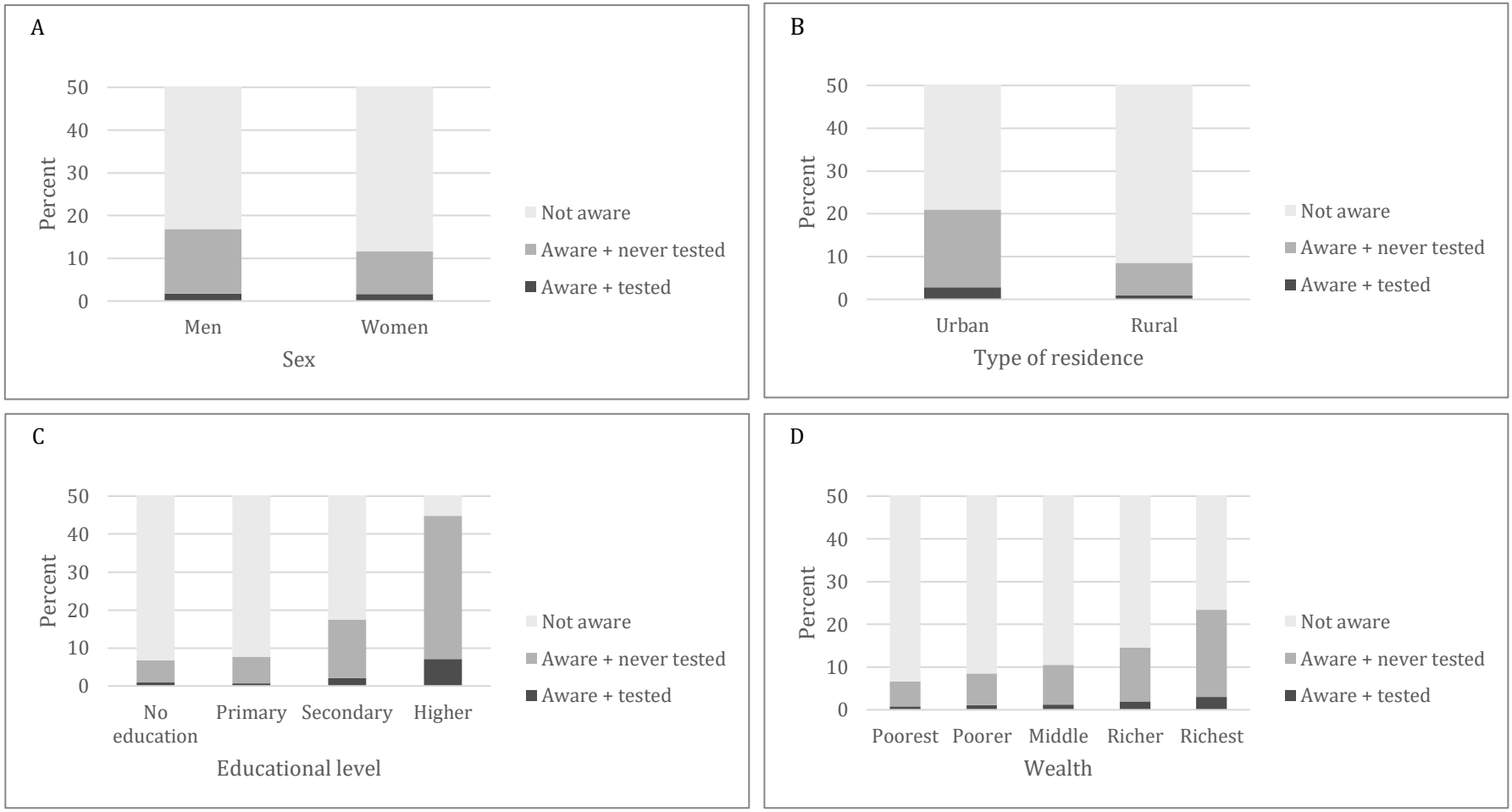
Abbreviations: HIVST= HIV self-testing; OR= Odds ratio; CI= Confidence Interval; PR= Prevalence ratio.
[1]Analyses were performed using DHS sample weights, total number of respondents are presented unweighted. [2]Analyses were additionally adjusted for age and marital status.

Table 4. *Multivariable logistic regression analysis of the association between use of HIVST and participant characteristics from DHS surveys across nine countries in SSA*[1,2]

	Use of HIVST			
	Model 1		**Model 2**	
	OR (95% CI)	**PR (95% CI)**	**OR (95% CI)**	**PR (95% CI)**
Sex				
Men	REF	REF	REF	REF
Women	1.17 (1.03-1.32)	1.18 (1.09-1.29)	1.21 (1.07-1.38)	1.18 (1.08-1.29)
Residence type				
Urban	REF	REF	REF	REF
Rural	0.74 (0.62-0.89)	0.78 (0.70-0.87)	0.76 (0.62-0.92)	0.78 (0.70-0.88)
Highest educational level				
No education	REF	REF	REF	REF
Primary	0.79 (0.65-0.97)	0.83 (0.71-0.96)	0.78 (0.63-0.96)	0.79 (0.68-0.93)
Secondary	1.64 (1.36-1.98)	1.64 (1.44-1.88)	1.56 (1.29-1.90)	1.54 (1.34-1.77)
Higher	4.20 (3.43-5.16)	4.12 (3.53-4.81)	3.72 (3.01-4.60)	3.57 (3.04-4.19)
Household wealth index				
Poorest	REF	REF	REF	REF
Poorer	1.28 (1.04-1.59)	1.16 (0.99-1.37)	1.16 (0.92-1.46)	1.07 (0.90-1.27)
Middle	1.22 (0.96-1.55)	1.17 (1.00-1.38)	1.09 (0.85-1.41)	1.05 (0.88-1.24)
Richer	1.48 (1.17-1.86)	1.38 (1.17-1.62)	1.33 (1.04-1.69)	1.24 (1.04-1.49)
Richest	1.66 (1.31-2.11)	1.61 (1.35-1.91)	1.51 (1.18-1.95)	1.47 (1.22-1.78)
HIV stigma severity score				
0	..	..	REF	REF
1			0.98 (0.75-1.29)	0.92 (0.76-1.12)
2			1.06 (0.82-1.38)	0.94 (0.78-1.13)
3			1.15 (0.90-1.47)	1.02 (0.86-1.22)
4			1.48 (1.12-1.96)	1.43 (1.18-1.72)
5			0.44 (0.31-0.63)	0.44 (0.35-0.56)
6			0.23 (0.15-0.35)	0.20 (0.15-0.27)
Total number of respondents	177 570		166 089	

Abbreviations: HIVST= HIV self-test's; OR= Odds ratio; CI= Confidence Interval; PR= Prevalence ratio.
[1]Analyses were performed using DHS sample weights, total number of respondents are presented unweighted. [2]Analyses were additionally adjusted for age and marital status.

439 **Figure 1. Proportions of HIV self-testing awareness and utilization per A) sex, B) type of residence, C) educational level, and D) wealth index**



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Supplemental Digital Content

Supplemental Digital Content 1 – Questions about HIV-related stigma (Text)

An HIV-related stigma score was created out of six separate questions about HIV-related stigma. Participants were asked to answer with yes or no to the following six statements: “Would be ashamed if someone in the family had HIV”, “would buy vegetables from vendor with HIV”, “children with HIV should be allowed to attend school with children without HIV”, “people hesitate to take HIV test because reaction of other people if positive”, “people talk badly about people with or believed to have HIV”, and “people with or believed to have HIV lose respect from other people”. All variables were recoded into binary variables, where “yes” indicated the presence of HIV-related stigma. The sum of affirmative responses was used to form a 6-item stigma scale. The questions about HIV-related stigma were asked in all surveys except South Africa.

454 ***Supplemental Digital Content 2 – Differences between responders and non-responders (Table)***

	Responders		Non-responders		Chi-square
	N	**%**	**N**	**%**	***p*-value**
Sex					<0.001**
Men	60 445	34.0%	1 522	9.7%	
Women	117 127	66.0%	13 618	90.3 %	
Age groups					<0.001**
15-19 years	40 410	22.3%	3 886	25.8%	
20-24 years	31 998	18.0%	2 356	15.3%	
25-29 years	28 153	16.2%	2 247	14.7%	
30-34 years	24 096	13.8%	2 127	14.1%	
35-39 years	20 741	11.8%	1 773	12.0%	
40-44 years	15 796	8.9%	1 489	9.8%	
45-49 years	12 944	7.2%	1 181	7.6%	
50-54 years[2]	3 434	1.9%	81	0.5%	
Country					<0.001**
Burundi	23 553	13.2%	896	6.3%	
Cameroon	19 422	11.0%	540	3.6%	
Guinea	12 200	6.9%	2 525	16.7%	
Malawi	31 481	17.6%	559	4.3%	
Senegal	22 199	12.7%	1 269	5.8%	
Sierra Leone	20 923	11.8%	1 461	8.8%	
South Africa	11 481	6.4%	437	3.3%	
Zambia	24 986	14.0%	429	2.8%	
Zimbabwe	11 327	6.4%	7 024	48.5%	
Residence type					<0.001**
Urban	68 254	39.6%	4 837	29.0%	
Rural	109 318	60.4%	10 303	71.0%	
Highest educational level					<0.001**
No education	41 352	23.2%	4 857	30.2%	
Primary	57 159	32.3%	3 793	26.1%	
Secondary	69 277	38.5%	5 744	39.0%	
Higher	9 782	6.0%	746	4.7%	
Household wealth index					<0.001**
Poorest	31 094	16.9%	3 803	25.2%	
Poorer	33 444	18.2%	3 141	21.5%	
Middle	36 220	19.4%	2 720	18.9%	
Richer	36 741	21.4%	2 728	17.3%	
Richest	40 073	24.1%	2 748	17.1%	
Marital status					<0.001**
Never in union	65 155	36.4%	4 606	29.9%	
Married	90 628	51.3%	8 610	56.7%	
Living with partner	9 637	5.5%	505	3.5%	
Widowed	3 251	1.8%	488	3.4%	
Divorced/separated	8 901	5.1%	931	6.4%	
HIV status					<0.001**
HIV-	106 108	93.8%	9 427	87.3%	
HIV+	7 033	6.2%	1 379	12.7%	
HIV stigma severity score					<0.001**
0	9 417	5.5%	775	11.7%	
1	20 894	12.4%	1 633	24.1%	
2	36 112	21.6%	1 794	25.9%	

3	42 870	26.5%	1 982	28.1%	
4	23 569	14.3%	538	7.8%	
5	16 585	9.9%	130	1.9%	
6	16 644	9.9%	28	0.4%	
Total number of respondents	177 572	100.0 %			

Abbreviations: HIVST= HIV self-testing.
*p < .05. ** p < .001. [1]Percentages are weighted with DHS sampling weights, numbers are presented unweighted. [2]The age group 50-54 years only includes male participants.

Supplemental Digital Content 3 – Proportions of HIVST (Table)

Table 2
Proportions of participant characteristics, and HIV-related stigma among people who are not aware of HIVST, are aware but have never tested with HIVST and people who have tested with HIVST[1]

	HIVST						
	Not aware		**Aware + not tested**		**Aware + tested**		**Chi-square**
	N	**%**	**N**	**%**	**N**	**%**	***p*-value**
Sex							<0.001**
Men	50 545	83.2%	8 920	15.1%	980	1.8%	
Women	103 770	88.3%	11 493	10.0%	1 864	1.7%	
Age groups							<0.001**
15-19 years	37 086	91.6%	3 047	7.6%	277	0.8%	
20-24 years	27 668	86.1%	3 809	12.1%	521	1.8%	
25-29 years	23 732	84.0%	3 814	13.8%	607	2.2%	
30-34 years	20 437	84.4%	3 147	13.4%	512	2.2%	
35-39 years	17 715	85.0%	2 626	13.0%	400	2.0%	
40-44 years	13 577	85.9%	1 930	12.3%	289	1.8%	
45-49 years	11 225	86.3%	1 530	12.2%	189	1.5%	
50-54 years[2]	2 875	84.1%	510	14.4%	49	1.5%	
Country							<0.001**
Burundi	22 600	95.9%	878	3.8%	75	0.3%	
Cameroon	16 241	83.5%	2 680	13.9%	501	2.6%	
Guinea	11 203	91.3%	896	7.9%	101	0.8%	
Malawi	28 123	89.4%	3 055	9.6%	303	1.0%	
Senegal	20 916	94.7%	1 232	5.1%	51	0.2%	
Sierra Leone	16 421	79.1%	3 759	17.4%	743	3.5%	
South Africa	8 840	74.7%	2 317	22.2%	324	3.0%	
Zambia	20 362	79.3%	4 051	17.8%	573	2.9%	
Zimbabwe	9 609	85.2%	1 545	13.4%	173	1.4%	
Residence type							<0.001**
Urban	54 978	79.1%	11 518	18.1%	1 758	2.8%	
Rural	99 337	91.5%	8 895	7.6%	1 086	0.9%	
Highest educational level							<0.001**
No education	38 438	93.3%	2 526	5.8%	388	0.9%	
Primary	52 760	92.3%	3 995	7.0%	404	0.7%	
Secondary	57 719	82.6%	10 218	15.3%	1 340	2.1%	
Higher	5 396	55.2%	3 674	37.7%	712	7.1%	
Household wealth index							<0.001**
Poorest	28 969	93.4%	1 868	5.8%	257	0.8%	
Poorer	30 483	91.5%	2 616	7.5%	345	1.1%	
Middle	32 290	89.5%	3 502	9.3%	428	1.2%	
Richer	31 465	85.5%	4 612	12.6%	664	1.9%	
Richest	31 108	76.6%	7 815	20.3%	1 150	3.0%	
Marital status							<0.001**
Never in union	56 404	86.1%	7 774	12.2%	977	1.7%	
Married	79 054	86.9%	10 084	11.4%	1 490	1.7%	
Living with partner	8 327	86.4%	1 123	11.6%	187	1.9%	
Widowed	2 899	89.3%	325	9.9%	27	0.9%	
Divorced/separated	7 631	85.3%	1 107	12.8%	163	1.9%	
HIV status							<0.001**
HIV-	92 211	86.6%	12 233	11.7%	1 664	1.7%	

HIV+	5 709	79.7%	1 167	17.9%	157	2.4%	
HIV stigma severity score							<0.001**
0	8 130	86.1%	1 134	12.3%	153	1.6%	
1	18 209	86.8%	2 383	11.7%	302	1.6%	
2	32 217	88.9%	3 477	9.8%	418	1.3%	
3	36 686	85.4%	5 412	12.6%	772	2.0%	
4	20 494	86.9%	2 422	10.4%	653	2.7%	
5	14 853	89.6%	1 585	9.6%	147	0.9%	
6	14 886	89.3%	1 683	10.2%	75	0.5%	
Total number of respondents	154 315		20 413		2 844		

Abbreviations: HIVST= HIV self-testing.

*p < .05. ** p < .001. [1]Percentages are weighted with DHS sampling weights, numbers are presented unweighted. [2]The age group 50-54 years only includes male participants.

Awareness of HIVST

Proportions of participant characteristics, HIV-related stigma, and HIVST awareness are presented in Supplemental Digital Content 3, Table 2. HIVST awareness was lower for women (11.7%, compared to 16.9% men, $p < 0.001$), young adolescents (15-19 years= 8.4% vs. 50-54 year= 15.9%, $p < 0.001$), rural residents (8.5% vs. 20.1% urban residents, $p < 0.001$), people who were less educated (no education= 6.7% vs. higher= 44.8%, $p < 0.001$), people in the poorest wealth quintile (poorest= 6.6% vs. richest= 23.3%, $p < 0.001$), and people who did not have HIV (13.4% vs. 20.3% of those living with HIV, $p < 0.001$). Finally, people were also less likely to be aware of HIVST if they scored higher on the HIV-related stigma scale (0= 13.9% vs. 6= 10.7%, $p < 0.001$).

Use of HIVST

Proportions of HIVST utilization by participant characteristics, and HIV-related stigma can be found in Supplemental Digital Content 3, Table 2. Among those who ever used a self-test, sex appeared to be significantly different, but differences were minor (1.7% women vs. 1.8% men, $p < 0.001$). Those who were less likely to have ever tested themselves for HIV using a self-test kit were young adolescents (15-19 years= 0.8% vs. 50-54 years= 1.5%; $p < 0.001$), rural residents (0.9% vs. 2.8% urban residents, $p < 0.001$), people who were less educated (no education= 0.9% vs. higher=7.1%, $p < 0.001$), people who were less wealthy (poorest= 0.8 vs. richest= 3.0%, $p < 0.001$), and people who were not infected with HIV (1.7% vs. 2.4% of people with HIV, $p < 0.001$) (Supplemental Digital Content 3, Table 2; Fig 1). Last, there was no clear trend in self-testing rates and the HIV-related stigma score, but people with high HIV-related stigma reported lower levels of HVIST use (0= 1.6%; vs. 6= 0.5%, $p < 0.001$) (Supplemental Digital Content 3, Table 2).

Supplemental Digital Content 4 – Multivariable logistic regression, full version (Tables)

Table 3

Multivariable logistic regression analysis of the association between awareness of HIVST and participant characteristics from DHS surveys across nine countries in SSA[1]

	Awareness of HIVST			
	Model 1		Model 2	
	OR (95% CI)	PR (95% CI)	OR (95% CI)	PR (95% CI)
Sex				
Men	REF	REF	REF	REF
Women	0.75 (0.71-0.79)	0.80 (0.78-0.82)	0.74 (0.70-0.79)	0.79 (0.77-0.81)
Age groups				
15-19 years	REF	REF	REF	REF
20-24 years	1.56 (1.46-1.68)	1.50 (1.44-1.58)	1.53 (1.42-1.64)	1.49 (1.42-1.56)
25-29 years	1.82 (1.69-1.97)	1.72 (1.63-1.81)	1.82 (1.67-1.98)	1.72 (1.63-1.82)
30-34 years	1.90 (1.75-2.07)	1.78 (1.68-1.87)	1.91 (1.75-2.10)	1.78 (1.68-1.89)
35-39 years	1.88 (1.72-2.05)	1.76 (1.66-1.87)	1.88 (1.71-2.07)	1.78 (1.67-1.89)
40-44 years	1.80 (1.64-1.98)	1.74 (1.63-1.85)	1.83 (1.65-2.03)	1.75 (1.64-1.88)
45-49 years	1.75 (1.59-1.94)	1.66 (1.55-1.78)	1.78 (1.60-1.99)	1.70 (1.58-1.83)
50-54 years[2]	1.67 (1.45-1.94)	1.68 (1.52-1.85)	1.72 (1.47-2.00)	1.71 (1.54-1.90)
Residence type				
Urban	REF	REF	REF	REF
Rural	0.81 (0.75-0.88)	0.89 (0.86-0.93)	0.83 (0.76-0.91)	0.91 (0.87-0.94)
Highest educational level				
No education	REF	REF	REF	REF
Primary	1.03 (0.96-1.11)	1.04 (0.99-1.09)	1.03 (0.96-1.11)	1.04 (0.98-1.09)
Secondary	1.81 (1.68-1.95)	1.69 (1.61-1.77)	1.78 (1.65-1.92)	1.65 (1.57-1.74)
Higher	4.89 (4.45-5.37)	3.13 (2.96-3.31)	4.84 (4.39-5.35)	3.07 (2.89-3.26)
Household wealth index				
Poorest	REF	REF	REF	REF
Poorer	1.26 (1.16-1.37)	1.22 (1.15-1.29)	1.23 (1.12-1.34)	1.20 (1.13-1.27)
Middle	1.45 (1.32-1.58)	1.38 (1.30-1.45)	1.40 (1.27-1.54)	1.34 (1.26-1.42)
Richer	1.70 (1.54-1.88)	1.57 (1.48-1.66)	1.62 (1.45-1.80)	1.51 (1.42-1.60)
Richest	2.36 (2.12-2.62)	2.01 (1.89-2.13)	2.29 (2.04-2.57)	1.97 (1.85-2.10)
Marital status				
Never in union	REF	REF	REF	REF
Married	1.06 (1.00-1.12)	1.01 (0.97-1.04)	1.05 (0.99-1.12)	1.00 (0.96-1.04)
Living with partner	1.06 (0.96-1.17)	1.05 (0.99-1.12)	1.02 (0.91-1.15)	1.03 (0.96-1.11)
Widowed	0.94 (0.80-1.10)	0.94 (0.84-1.05)	0.94 (0.79-1.11)	0.94 (0.84-1.06)
Divorced/separated	1.16 (1.06-1.28)	1.08 (1.01-1.15)	1.11 (1.01-1.23)	1.04 (0.97-1.12)
HIV stigma severity score				
0	..	..	REF	REF
1			0.96 (0.87-1.06)	0.97 (0.91-1.04)
2			1.00 (0.91-1.09)	0.98 (0.94-1.06)
3			1.06 (0.97-1.16)	1.05 (0.99-1.12)
4			1.01 (0.91-1.12)	0.99 (0.93-1.06)
5			0.84 (0.74-0.95)	0.84 (0.78-0.91)
6			0.82 (0.70-0.94)	0.82 (0.76-0.88)
Total number of respondents	177 570		166 089	

Abbreviations: HIVST= HIV self-testing; OR= Odds ratio; CI= Confidence Interval; PR= Prevalence ratio.

[1]Analyses were performed using DHS sample weights, total number of respondents are presented unweighted. [2]The age group 50-54 years only includes male participants.

Table 4

Multivariable logistic regression analysis of the association between use of HIVST and participant characteristics from DHS surveys across nine countries in SSA[1]

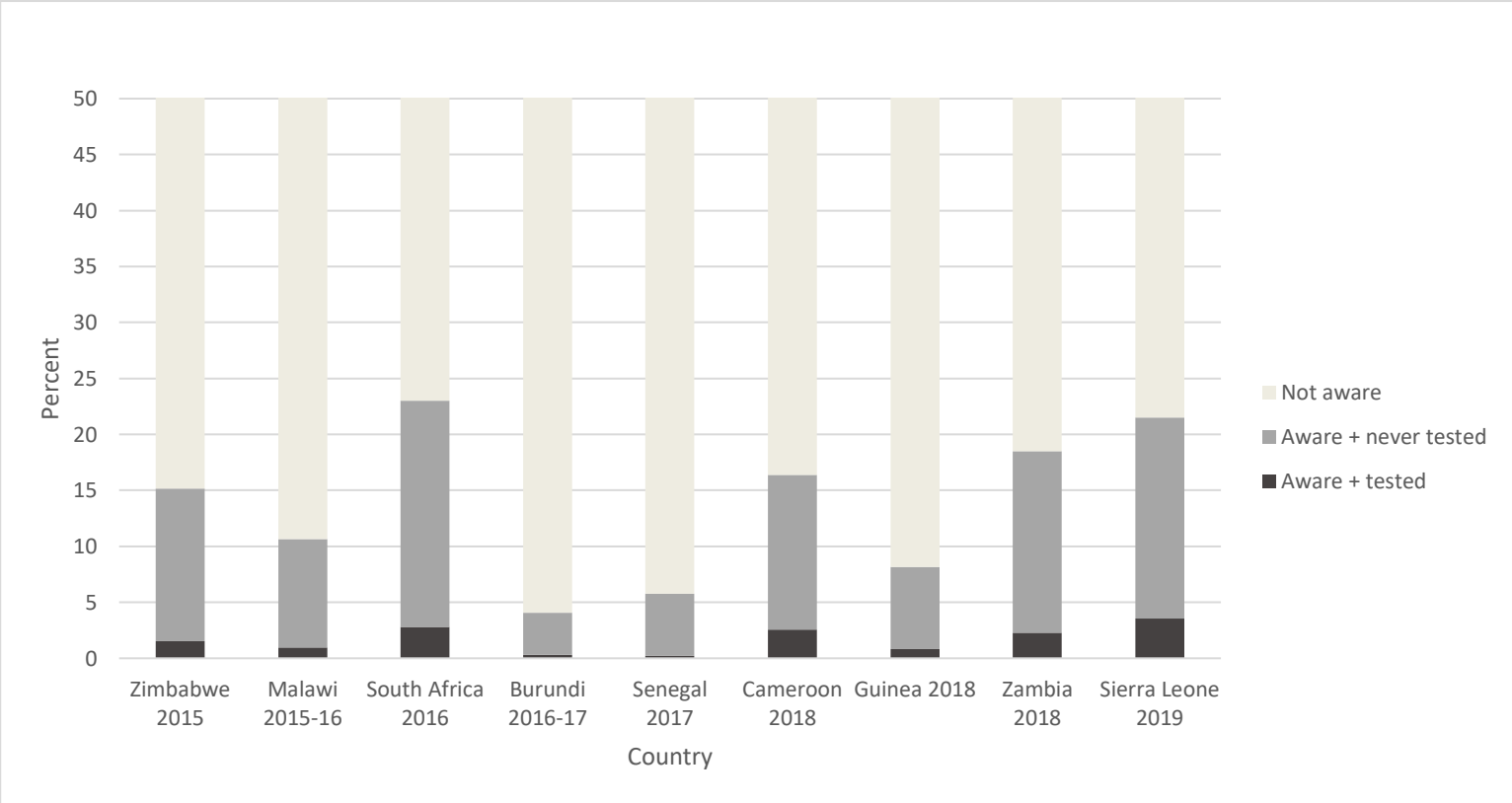
	Use of HIVST			
	Model 1		Model 2	
	OR (95% CI)	PR (95% CI)	OR (95% CI)	PR (95% CI)
Sex				
Men	REF	REF	REF	REF
Women	1.17 (1.03-1.32)	1.18 (1.09-1.29)	1.21 (1.07-1.38)	1.18 (1.08-1.29)
Age groups				
15-19 years	REF	REF	REF	REF
20-24 years	1.96 (1.61-2.38)	2.01 (1.73-2.34)	1.86 (1.51-2.27)	1.94 (1.66-2.27)
25-29 years	2.21 (1.79-2.71)	2.49 (2.13-2.91)	2.16 (1.73-2.70)	2.47 (2.09-2.92)
30-34 years	2.38 (1.90-2.97)	2.68 (2.27-3.18)	2.30 (1.80-2.94)	2.60 (2.17-3.12)
35-39 years	2.28 (1.82-2.87)	2.55 (2.14-3.05)	2.21 (1.73-2.83)	2.52 (2.08-3.05)
40-44 years	2.19 (1.72-2.79)	2.56 (2.12-3.09)	2.23 (1.72-2.89)	2.57 (2.10-3.15)
45-49 years	1.89 (1.46-2.45)	2.10 (1.70-2.58)	1.82 (1.37-2.41)	2.09 (1.67-2.62)
50-54 years[2]	1.86 (1.23-2.80)	1.99 (1.44-2.76)	1.84 (1.19-2.84)	2.00 (1.43-2.80)
Residence type				
Urban	REF	REF	REF	REF
Rural	0.74 (0.62-0.89)	0.78 (0.70-0.87)	0.76 (0.62-0.92)	0.78 (0.70-0.88)
Highest educational level				
No education	REF	REF	REF	REF
Primary	0.79 (0.65-0.97)	0.83 (0.71-0.96)	0.78 (0.63-0.96)	0.79 (0.68-0.93)
Secondary	1.64 (1.36-1.98)	1.64 (1.44-1.88)	1.56 (1.29-1.90)	1.54 (1.34-1.77)
Higher	4.20 (3.43-5.16)	4.12 (3.53-4.81)	3.72 (3.01-4.60)	3.57 (3.04-4.19)
Household wealth index				
Poorest	REF	REF	REF	REF
Poorer	1.28 (1.04-1.59)	1.16 (0.99-1.37)	1.16 (0.92-1.46)	1.07 (0.90-1.27)
Middle	1.22 (0.96-1.55)	1.17 (1.00-1.38)	1.09 (0.85-1.41)	1.05 (0.88-1.24)
Richer	1.48 (1.17-1.86)	1.38 (1.17-1.62)	1.33 (1.04-1.69)	1.24 (1.04-1.49)
Richest	1.66 (1.31-2.11)	1.61 (1.35-1.91)	1.51 (1.18-1.95)	1.47 (1.22-1.78)
Marital status				
Never in union	REF	REF	REF	REF
Married	1.07 (0.93-1.23)	1.06 (0.95-1.18)	1.07 (0.92-1.25)	1.05 (0.94-1.18)
Living with partner	1.08 (0.86-1.37)	1.11 (0.94-1.31)	1.02 (0.80-1.31)	1.08 (0.90-1.31)
Widowed	0.57 (0.35-0.92)	0.55 (0.37-0.82)	0.50 (0.30-0.84)	0.52 (0.34-0.80)
Divorced/separated	1.07 (0.85-1.35)	1.10 (0.92-1.31)	1.00 (0.78-1.29)	1.01 (0.84-1.23)
HIV stigma severity score				
0	..	..	REF	REF
1			0.98 (0.75-1.29)	0.92 (0.76-1.12)
2			1.06 (0.82-1.38)	0.94 (0.78-1.13)
3			1.15 (0.90-1.47)	1.02 (0.86-1.22)
4			1.48 (1.12-1.96)	1.43 (1.18-1.72)
5			0.44 (0.31-0.63)	0.44 (0.35-0.56)
6			0.23 (0.15-0.35)	0.20 (0.15-0.27)
Total number of respondents	177 570		166 089	

Abbreviations: HIVST= HIV self-test's; OR= Odds ratio; CI= Confidence Interval; PR= Prevalence ratio.

[1]Analyses were performed using DHS sample weights, total number of respondents are presented unweighted. [2]The age group 50-54 years only includes male participants.

505 ***Supplemental Digital Content 5 – HIV self-testing awareness and utilization by country (Figure)***

506



507

508 **Figure 1. Proportions of HIV self-testing awareness and utilization per country**

Supplemental Digital Content 6 – HIV self-testing regression analyses disaggregated by country (Tables)

Table 5

Multivariable regression analysis by country to examine the association between awareness of HIVST and participant characteristics

	Awareness of HIVST																	
	West-Africa										Eastern and Southern Africa							
	Guinea		Senegal		Sierra Leone		Burundi		Cameroon		Malawi		South Africa		Zambia		Zimbabwe	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex																		
Men	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Women	1.16	0.89-1.51	1.25	1.00-1.56	1.22	1.07-1.41	0.51	0.41-0.63	0.54	0.45-0.64	0.71	0.63-0.81	0.80	0.69-.93	0.57	0.50-0.64	0.55	0.46-0.65
Age groups																		
15-19	REF				REF		REF		REF		REF		REF		REF		REF	
20-24	1.53	1.17-2.00	1.15	0.91-1.44	1.58	1.34-1.85	1.65	1.29-2.12	1.80	1.47-2.20	1.34	1.09-1.65	1.91	1.53-2.37	1.62	1.37-1.92	1.54	1.23-1.95
25-29	2.13	1.57-2.89	1.15	0.88-1.51	2.14	1.85-2.47	1.60	1.16-2.21	2.51	2.02-3.11	1.51	1.17-1.95	1.80	1.41-2.28	1.73	1.40-2.13	2.52	1.90-3.35
30-34	2.12	1.56-2.90	1.35	1.03-1.76	2.33	1.93-2.83	1.76	1.28-2.43	2.53	1.97-3.24	1.57	1.23-2.01	1.71	1.34-2.18	1.91	1.51-2.41	2.52	1.92-3.31
35-39	2.04	1.46-2.84	1.52	1.13-2.06	1.97	1.61-2.41	1.74	1.21-2.50	2.70	2.07-3.51	1.52	1.14-2.01	1.75	1.38-2.23	1.84	1.48-2.28	2.70	1.99-3.67
40-44	2.11	1.40-3.18	1.28	0.94-1.75	1.98	1.58-2.49	1.61	1.08-2.40	2.83	2.16-3.71	1.37	1.03-1.82	1.55	1.19-2.01	1.95	1.53-2.50	2.03	1.41-2.92
45-49	2.44	1.61-3.69	1.42	1.02-1.98	2.02	1.62-2.52	1.70	0.97-2.98	2.83	2.08-3.84	1.20	0.88-1.64	1.49	1.13-1.98	1.94	1.52-2.47	1.81	1.24-2.62
50-54[2]	1.13	0.57-2.23	2.12	1.20-3.74	1.86	1.28-2.69	1.60	0.91-2.80	3.44	2.36-5.02	1.30	0.75-2.26	1.20	0.75-1.93	1.71	1.29-2.27	1.84	1.19-2.83
Residence type																		
Urban	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Rural	0.76	0.55-1.05	1.64	1.28-2.10	1.10	0.85-1.43	0.58	0.42-0.79	0.94	0.73-1.21	0.71	0.60-0.85	0.74	0.63-0.88	0.79	0.64-0.98	0.72	0.57-0.92
Highest educational level																		
No education	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Primary	1.72	1.29-2.31	1.32	1.10-1.58	1.03	0.87-1.21	0.94	0.76-1.17	2.62	1.91-3.59	1.03	0.84-1.27	1.12	0.60-2.08	1.55	1.17-2.04	1.44	0.54-3.87
Secondary	3.48	2.67-4.53	1.85	1.52-2.26	1.68	1.45-1.94	1.52	1.14-2.02	4.80	3.55-6.48	1.65	1.34-2.03	2.41	1.40-4.15	2.53	1.91-3.35	2.47	0.93-6.56
Higher	9.21	6.79-12.50	4.80	3.50-6.59	4.72	3.88-5.74	2.93	1.83-4.69	11.57	8.33-16.09	5.44	3.78-7.82	5.61	3.18-9.88	7.39	5.47-9.99	7.49	2.81-19.95
Household wealth index																		
Poorest	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Poorer	0.78	0.53-1.15	1.38	1.05-1.83	1.04	0.85-1.28	1.00	0.73-1.35	1.55	1.06-2.26	1.11	0.93-1.32	1.46	1.18-1.81	1.60	1.33-1.94	1.59	1.20-2.11
Middle	1.21	0.82-1.80	1.72	1.25-2.36	1.24	0.97-1.57	0.99	0.71-1.37	2.07	1.39-3.08	1.13	0.94-1.35	1.68	1.34-2.12	2.03	1.67-2.46	1.47	1.09-1.98
Richer	1.09	0.72-1.66	1.77	1.23-2.55	1.30	0.98-1.74	1.05	0.75-1.48	2.67	1.75-4.08	1.09	0.88-1.34	2.24	1.74-2.88	3.41	2.69-4.33	1.87	1.33-2.61
Richest	1.45	0.93-2.26	1.33	0.89-2.00	1.79	1.26-2.54	1.78	1.26-2.53	3.79	2.48-5.77	1.72	1.40-2.11	2.69	2.02-3.58	5.19	4.06-6.63	2.72	1.89-3.92
Marital status																		
Never in union	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Married	1.28	1.02-1.62	1.43	1.15-1.77	0.88	0.77-1.01	0.75	0.57-0.97	1.00	0.85-1.17	1.19	0.99-1.44	1.10	0.94-1.30	1.02	0.89-1.16	0.95	0.76-1.18
Living with partner	1.94	1.18-3.18	0.15	0.02-1.34	0.85	0.66-1.09	0.99	0.74-1.32	0.83	0.67-1.02	1.23	0.91-1.65	1.23	0.99-1.51	1.24	0.65-2.36	1.15	0.66-2.00
Widowed	1.19	0.58-2.44	1.25	0.44-3.57	0.73	0.50-1.06	0.78	0.38-1.63	0.88	0.56-1.40	1.05	0.68-1.61	0.88	0.53-1.47	1.05	0.74-1.47	1.16	0.62-2.15
Divorced/ separated	1.34	0.81-2.23	1.50	0.90-2.49	0.96	0.74-1.24	1.22	0.76-1.97	1.06	0.86-1.31	1.18	0.92-1.51	1.69	1.25-2.30	1.19	0.95-1.49	1.00	0.72-1.38
Total (weighted)	12 340		22 635		21 130		23 532		19 587		31 424		11 459		25 046		11 388	
Total (unweighted)	12 200		22 199		20 923		23 553		19 422		31 481		11 481		24 986		11 327	

[1]Analyses were performed using DHS sample weights. [2]The age group 50-54 years only includes male participants.

Table 6

Multivariable regression analysis by country to examine the association between use of HIVST and participant characteristics

	Use of HIVST																	
	West-Africa								Eastern and Southern Africa									
	Guinea		Senegal		Sierra Leone		Burundi		Cameroon		Malawi		South Africa		Zambia		Zimbabwe	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex																		
Men	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Women	2.97	1.56-5.67	2.62	0.53-12.81	2.34	1.72-3.18	0.79	0.44-1.43	0.72	0.54-0.95	0.96	0.63-1.46	0.98	0.65-1.49	1.06	0.87-1.29	0.78	0.48-1.26
Age groups																		
15-19	REF		REF		REF		REF		REF		REF		REF		REF		REF	
20-24	2.50	1.29-4.84	0.91	0.15-5.58	2.20	1.54-3.14	4.79	1.55-14.81	2.09	1.26-3.49	1.22	0.69-2.16	2.56	1.31-5.01	1.84	1.22-2.77	1.59	0.75-3.36
25-29	3.53	1.94-6.42	4.36	0.72-26.58	2.21	1.52-3.21	8.03	2.08-30.94	3.44	2.08-5.67	1.27	0.65-2.48	2.24	1.21-4.15	1.84	1.12-3.03	1.89	0.96-3.74
30-34	3.80	1.90-7.60	2.55	0.51-12.77	3.15	1.97-5.03	8.57	2.00-36.73	2.96	1.72-5.08	1.57	0.76-3.24	2.43	1.33-4.44	1.55	0.92-2.62	2.99	1.51-5.93
35-39	4.11	1.83-9.26	2.49	0.34-18.39	2.23	1.44-3.47	6.62	1.09-40.13	3.42	1.95-5.99	2.00	0.98-4.08	2.31	1.16-4.59	1.41	0.83-2.39	3.15	1.48-6.69
40-44	2.56	0.86-7.61	2.92	0.39-21.93	2.96	1.79-4.92	3.24	0.57-18.35	3.70	2.11-6.49	1.05	0.48-2.33	1.63	0.77-3.46	1.60	0.95-2.69	2.24	1.03-4.88
45-49	3.22	0.98-10.54	0.35	0.02-5.41	1.66	0.99-2.79	10.31	1.87-56.67	3.64	2.10-6.30	0.42	0.12-1.46	1.87	0.93-3.74	1.60	0.88-2.92	2.26	0.93-5.50
50-54[2]	2.56	0.30-21.64	37.74	4.33-329.05	1.49	0.57-3.93	1.34	0.11-15.71	3.53	1.59-7.83	2.04	0.46-8.94	0.84	0.15-4.57	0.90	0.35-2.30	2.34	0.85-6.49
Residence type																		
Urban	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Rural	0.39	0.10-1.47	1.12	0.35-3.60	0.73	0.46-1.16	0.66	0.25-1.77	0.85	0.57-1.28	0.52	0.37-0.72	0.81	0.56-1.17	0.70	0.47-1.02	1.51	0.85-2.69
Highest educational level																		
No education	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Primary	1.57	0.73-3.34	1.00	0.29-3.41	0.93	0.66-1.33	0.99	0.39-2.52	1.54	0.89-2.67	0.84	0.44-1.62	0.17	0.05-0.61	1.00	0.50-1.98	3.50	0.45-27.26
Secondary	6.09	3.14-11.80	4.19	1.82-9.64	1.44	1.04-1.99	5.77	2.55-13.04	3.34	19.4-5.75	1.79	0.91-3.49	0.55	0.19-1.60	1.50	0.74-3.05	5.24	0.69-39.77
Higher	7.37	3.86-14.07	8.49	3.08-23.42	6.92	5.12-9.35	8.11	2.06-31.95	7.39	4.13-13.21	4.85	2.28-10.32	1.65	0.56-4.89	2.94	1.41-6.12	10.76	1.34-86.44
Household wealth index																		
Poorest	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Poorer	2.95	0.50-17.46	2.00	0.46-8.62	1.00	0.70-1.42	1.65	0.31-8.85	0.62	0.32-1.20	1.92	1.00-3.68	2.18	1.15-4.12	1.38	0.81-2.34	2.59	1.13-5.95
Middle	5.13	1.08-24.26	2.12	0.52-8.62	0.91	0.58-1.44	0.89	0.15-5.19	0.88	0.45-1.72	1.17	0.59-2.34	2.02	1.04-3.91	1.83	1.05-3.20	1.40	0.54-3.62
Richer	4.16	0.64-27.14	1.70	0.28-10.34	0.65	0.41-1.05	2.00	0.42-9.54	1.42	0.74-2.72	1.42	0.76-2.68	2.27	1.11-4.63	3.39	1.85-6.21	2.63	1.07-6.46
Richest	3.24	0.49-21.40	3.35	0.70-16.08	0.36	0.21-0.60	2.57	0.55-12.03	1.95	1.00-3.81	1.93	1.04-3.58	2.27	1.06-4.86	4.41	2.38-8.18	4.95	1.75-14.02
Marital status																		
Never in union	REF		REF		REF		REF		REF		REF		REF		REF		REF	
Married	1.58	0.79-3.16	1.33	0.50-3.56	0.86	0.65-1.15	1.02	0.46-2.29	1.24	0.93-1.66	1.28	0.73-2.25	1.25	0.85-1.86	1.04	0.75-1.44	1.04	0.65-1.66
Living with partner	1.67	0.55-5.02	0.00	0.00-0.00	1.89	1.25-2.86	0.40	0.12-1.37	0.79	0.54-1.15	1.36	0.60-3.11	1.22	0.68-2.20	1.75	0.46-6.64	0.23	0.03-1.74
Widowed	1.92	0.24-15.70	3.75	0.35-39.91	0.28	0.11-0.68	0.50	0.05-4.77	0.77	0.29-2.02	0.67	0.13-3.33	1.30	0.39-4.33	0.52	0.17-1.62	0.14	0.02-1.11
Divorced/ separated	2.49	0.66-9.40	3.74	0.65-21.45	0.90	0.53-1.52	0.44	0.05-4.05	1.16	0.72-1.85	1.71	0.85-3.45	1.46	0.75-2.83	0.93	0.57-1.51	1.27	0.60-2.69
Total (weighted)	12 340		22 635		21 130		23 532		19 587		31 424		11 459		25 046		11 388	
Total (unweighted)	12 200		22 199		20 923		23 553		19 422		31 481		11 481		24 986		11 327	

[1]Analyses were performed using DHS sample weights. [2]The age group 50-54 years only includes male participants.

Table 7

Country effect estimates[1,2]

	Aware of HIVST	Use of HIVST	Ever tested for HIV
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**
Burundi	REF	REF	REF
Cameroon	3.22 (2.77-3.75)	5.49 (3.82-7.88)	1.00 (0.91-1.08)
Guinea	1.83 (1.56-2.15)	2.01 (1.26-3.19)	0.07 (0.06-0.08)
Malawi	2.64 (2.31-3.03)	2.90 (2.03-4.16)	2.31 (2.16-2.46)
Senegal	1.02 (0.86-1.22)	0.42 (0.25-0.73)	0.31 (0.28-0.33)
Sierra Leone	5.07 (4.33-5.94)	8.33 (5.66-12.25)	0.37 (0.34-0.40)
South Africa	4.95 (4.26-5.75)	5.18 (3.54-7.59)	2.25 (2.00-2.52)
Zambia	4.49 (3.88-5.20)	6.69 (4.54-9.86)	3.66 (3.35-4.00)
Zimbabwe	2.42 (2.09-2.79)	3.12 (2.09-4.65)	1.42 (1.30-1.56)
Total number of respondents	177 570	177 570	192 710

Abbreviations: HIVST= HIV self-test's; OR= Odds ratio; CI= Confidence Interval.

[1]Analyses were performed using DHS sample weights, total number of respondents are presented unweighted. [2]Additionally adjusted for sex, age, residence type, educational level, wealth, and marital status.

Supplemental Digital Content 7 – Ever tested for HIV (Tables)

Table 8

Proportions of participant characteristics, and HIV-related stigma between people who had ever tested for HIV compared to those who have never tested[1]

	Ever tested for HIV				
	No		Yes		Chi-square
	N	%	N	%	*p*-value
Sex					<0.001**
Men	29 268	47.1%	32 699	52.9%	
Women	43 376	32.8%	87 369	67.2%	
Age groups					<0.001**
15-19 years	29 755	67.6%	14 541	32.4%	
20-24 years	11 287	32.7%	23 067	67.3%	
25-29 years	7 535	24.7%	22 865	75.3%	
30-34 years	6 053	22.6%	20 170	77.4%	
35-39 years	5 931	26.0%	16 583	74.0%	
40-44 years	5 137	29.1%	12 148	70.9%	
45-49 years	5 383	38.0%	8 742	62.0%	
50-54 years[2]	1 563	44.3%	1 952	55.7%	
Country					<0.001**
Burundi	9 340	37.8%	15 109	62.2%	
Cameroon	6 515	33.4%	13 447	66.6%	
Guinea	12 424	83.8%	2 301	16.2%	
Malawi	6 152	19.8%	25 888	80.2%	
Senegal	14 044	58.5%	9 424	41.5%	
Sierra Leone	12 378	53.8%	10 006	46.2%	
South Africa	2 380	20.0%	9 538	80.0%	
Zambia	4 632	17.3%	20 783	82.7%	
Zimbabwe	4 779	26.7%	13 572	73.3%	
Residence type					<0.001**
Urban	24 685	33.8%	48 406	66.2%	
Rural	47 959	39.6%	71 662	60.4%	
Highest educational level					<0.001**
No education	25702	54.0%	20 507	46.0%	
Primary	20 159	33.2%	40 793	66.8%	
Secondary	25 030	33.6%	49 991	66.4%	
Higher	1 752	17.8%	8 776	82.2%	
Household wealth index					<0.001**
Poorest	15 783	43.9%	19 114	56.1%	
Poorer	15 090	40.5%	21 495	59.5%	
Middle	14 978	38.1%	23 962	61.9%	
Richer	13 781	34.8%	25 688	65.2%	
Richest	13 012	31.8%	29 809	68.2%	
Marital status					<0.001**
Never in union	39 454	57.3%	30 307	42.7%	
Married	28 687	27.9%	70 551	72.1%	
Living with partner	1 820	18.4%	8 322	81.6%	
Widowed	888	23.3%	2 851	76.7%	
Divorced/separated	1 795	18.2%	8 037	81.8%	
HIV status					<0.001**
HIV-	46 600	40.1%	68 935	59.9%	
HIV+	922	10.7%	7 490	89.3%	
HIV stigma severity score					<0.001**
0	2 589	26.0%	7 603	74.0%	
1	5 640	25.2%	16 887	74.8%	
2	10 640	28.4%	27 266	71.6%	
3	13 083	29.3%	31 769	70.7%	
4	10 428	42.7%	13 679	57.3%	
5	9 324	55.2%	7 391	44.8%	
6	10 737	63.7%	5 935	36.3%	
Total number of respondents[3]	72 644		120 068		

*$p < .05$. ** $p < .001$. [1]Percentages are weighted with DHS sampling weights, numbers are presented unweighted. [2]The age group 50-54 years only includes male participants. [3]The total number of respondents (n=192 712) differs from the total study sample (n=172 572), as more people answered the "ever tested for HIV" question than the HIVST question.

Table 9

Multivariable logistic regression analysis with country fixed effects to examine the association between ever tested for HIV and participant characteristics from pooled data of nine DHS surveys[1]

	Ever tested for HIV	
	Model 1	**Model 2**
	OR (95% CI)	**OR (95% CI)**
Sex		
Men	REF	REF
Women	2.60 (2.51-2.70)	2.88 (2.77-2.99)
Age groups		
15-19	REF	REF
20-24	3.65 (3.48-3.82)	3.59 (3.41-3.77)
25-29	5.04 (4.76-5.33)	4.79 (4.50-5.09)
30-34	5.07 (4.77-5.39)	4.76 (4.46-5.08)
35-39	4.21 (3.95-4.49)	3.79 (3.54-4.06)
40-44	3.37 (3.15-3.60)	2.99 (2.79-3.21)
45-49	2.20 (2.05-2.37)	1.93 (1.78-2.08)
50-54[2]	2.36 (2.10-2.64)	2.03 (1.80-2.28)
Residence type		
Urban	REF	REF
Rural	0.82 (0.77-0.87)	0.82 (0.77-0.88)
Highest educational level		
No education	REF	REF
Primary	1.67 (1.58-1.75)	1.54 (1.46-1.62)
Secondary	2.90 (2.75-3.06)	2.53 (2.39-2.68)
Higher	5.17 (4.67-5.74)	4.61 (4.14-5.15)
Household wealth index		
Poorest	REF	REF
Poorer	1.26 (1.20-1.33)	1.24 (1.18-1.32)
Middle	1.48 (1.40-1.57)	1.44 (1.35-1.52)
Richer	1.61 (1.51-1.71)	1.51 (1.41-1.61)
Richest	1.63 (1.52-1.76)	1.57 (1.45-1.70)
Marital status		
Never in union	REF	REF
Married	4.34 (4.12-4.57)	4.95 (4.69-5.23)
Living with partner	4.99 (4.60-5.42)	5.86 (5.37-6.38)
Widowed	4.05 (3.61-4.55)	4.59 (4.06-5.18)
Divorced/separated	3.86 (3.56-4.19)	4.19 (3.85-4.56)
HIV-related stigma score		
0	..	REF
1		1.20 (1.11-1.30)
2		1.26 (1.16-1.36)
3		1.28 (1.19-1.39)
4		1.12 (1.03-1.22)
5		0.90 (0.82-0.98)
6		0.74 (0.66-0.82)
Total number of respondents[3]	192 710	172 969

Abbreviations: OR= Odds ratio; CI= Confidence Interval.

[1]Analyses were performed using DHS sample weights, total number of respondents are presented unweighted. [2]The age group 50-54 years only includes male participants. [3]The total number of respondents (n=192,712) differs from the total study sample (n=172,572), as more people answered the "ever tested for HIV" question than the HIVST question.

Supplemental Digital Content 8 – HIVST use among those who are aware of HIVST (Table)

Table 10

Multivariable logistic regression analysis with survey fixed effects to examine the association between use of HIVST and participant characteristics among participants who are aware of HIVST[1]

	Use of HIVST	
	Model 1	**Model 2**
	OR (95% CI)	**OR (95% CI)**
Sex		
Men	REF	REF
Women	1.53 (1.35-1.75)	1.69 (1.47-1.93)
Age groups		
15-19 years	REF	REF
20-24 years	1.32 (1.08-1.61)	1.24 (1.01-1.53)
25-29 years	1.29 (1.05-1.57)	1.21 (0.98-1.51)
30-34 years	1.35 (1.08-1.68)	1.24 (0.97-1.58)
35-39 years	1.29 (1.03-1.62)	1.22 (0.96-1.55)
40-44 years	1.27 (1.00-1.62)	1.24 (0.96-1.61)
45-49 years	1.11 (0.85-1.44)	1.02 (0.76-1.35)
50-54 years[2]	1.13 (0.74-1.72	1.09 (0.69-1.70)
Residence type		
Urban	REF	REF
Rural	0.86 (0.73-1.03)	0.88 (0.73-1.06)
Highest educational level		
No education	REF	REF
Primary	0.75 (0.61-0.92)	0.76 (0.62-0.94)
Secondary	0.98 (0.81-1.18)	0.99 (0.81-1.20)
Higher	1.38 (1.11-1.71)	1.25 (1.00-1.56)
Household wealth index		
Poorest	REF	REF
Poorer	1.06 (0.85-1.32)	0.98 (0.78-1.24)
Middle	0.86 (0.67-1.09)	0.81 (0.63-1.04)
Richer	0.89 (0.71-1.13)	0.86 (0.68-1.10)
Richest	0.76 (0.59-0.98)	0.78 (0.61-1.01)
Marital status		
Never in union	REF	REF
Married	1.11 (0.96-1.29)	1.12 (0.96-1.31)
Living with partner	1.13 (0.89-1.44)	1.08 (0.83-1.39)
Widowed	0.64 (0.39-1.06)	0.55 (0.32-0.95)
Divorced/separated	1.02 (0.80-1.30)	0.97 (0.74-1.25)
HIV stigma severity score		
0	..	REF
1		1.00 (0.75-1.33)
2		1.09 (0.82-1.44)
3		1.12 (0.86-1.46)
4		1.62 (1.20-2.17)
5		0.49 (0.33-0.71)
6		0.23 (0.14-0.36)
Total number of respondents	23 257	20 616

Abbreviations: OR= Odds ratio; CI= Confidence Interval.

[1]Analyses were performed using DHS sample weights, total number of respondents are presented unweighted. [2]The age group 50-54 years only includes male participants.

Use of HIVST among those who are aware

Regression analysis showed that women (OR 1.53, 95% CI 1.35-1.75) and higher educated people (no education vs. higher: OR 1.38, 95% CI 1.11-1.71) had greater odds of having ever used HIVST compared to men and people with lower education. Different to the results of HIVST use among the whole population, we found no significant differences between wealth and HIVST use among people who were aware of HIVST. Moreover, people who were perceived to have higher HIV-related stigma, were less likely to have used HIVST among those aware (0 vs. 6: OR 0.23, 95% CI 0.14-0.36), compared to people with lower stigma scores (Supplemental Digital Content 8, Table 10).

Supplemental Digital Content 9 – HIV prevalence per country (Table)

Table 11

Overview: HIV prevalence per country

Country	HIV prevalence (UNAIDS estimates)[1]	Population size 2017[2]	Calculated HIV prevalence in counts
Burundi	1.10%	10.8 million	118 800
Cameroon	3.70%	24.6 million	910 200
Guinea	1.50%	12.1 million	181 500
Malawi	9.60%	17.7 million	1 699 200
Senegal	0.40%	15.4 million	61 600
Sierra Leone	1.40%	7.5 million	105 000
South Africa	18.8%	57.0 million	10 716 000
Zambia	11.5%	16.9 million	1 943 500
Zimbabwe	13.3%	14.2 million	1 888 600
Sub-Saharan Africa	4.12%	1 050 million	43 260 000

The countries included in this study represent about (17 624 400 / 43 260 000 x 100% =) 40.7% of people living with HIV in the SSA region.

Supplemental Digital Content 10 – Access to HIVST (Table)

Table 12

Overview: access to HIVST per country

Country	Survey year	HIVST accessibility that year
Burundi	2016/2017	2017: has a supportive policy, but HIVST not yet implemented[1]
Cameroon	2018	2018: HIVST policy under development[2]
Guinea	2018	2018: HIVST policy under development[2]
Malawi	2015/2016	2016: HIVST policy under development[3]
Senegal	2017	2018: HIVST policy under development[2]
Sierra Leone	2019	2020: HIVST policy under development[4]
South Africa	2016	2016: this year HIVST was included as an additional strategy in national HIV testing policy[5]
Zambia	2018	2018: HIVST policy implemented[2]
Zimbabwe	2015	2016: HIVST policy under development[3]

References

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5 Venter F, Majam M, Jankelowitz L, Adams S, Moorhouse M, Carmona S, et al. South African HIV self-testing policy and guidance considerations. *South Afr J HIV Med* 2017; 18: 775.