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ABSTRACT

Introduction: The aim of this study was to assess the factors associated with HIV testing among in sexually active women and men in Senegal. Knowledge of HIV status is the gateway to antiretroviral treatment. Despite the adoption of the provider-initiated HIV testing strategy, the rate of HIV testing is still very low in sub-Saharan Africa.

Methods: A secondary analysis of the 2017 Senegal Demographic and Health Survey (DHS) was performed using data on sexually active women age 15-49 and men age 15-59. The outcome variable was the proportion of women and men who reported ever being tested for HIV in the last 12 months before the survey. Descriptive, bivariate, and multivariable logistic regression analyses were performed to identify the sociodemographic, HIV knowledge, media exposure, and behavioral factors associated with HIV testing in Senegal.

Results: The study found that 62% of women and 27% of men were tested for HIV in the last 12 months before the survey. In multivariate analysis, among men the factors independently associated with being tested for HIV were: older age group (50-54); a high level of education; being in the richest household wealth quintile; being married; knowing about the efficacy of HART during pregnancy; and owning a mobile phone. Among women factors independently associated with HIV testing were: older age group (30-34); a high level of education; being in the richest household wealth quintile; being married; knowing about the efficacy of HART during pregnancy; having any sexually transmitted infection (STI) in last 12 months; fearing stigma; owning a mobile phone; and having any number of ANC visits, versus none. By region of residence, compared with the West zone, men in the North and South-East zones were significantly less likely to have been tested for HIV in the 12 months before the survey. Similarly, women in the North, Center, and South-East zones were less likely to be tested for HIV compared with the West zone.

Conclusion: Although HIV remains a public health threat, 73% of men and 38% women in Senegal were not tested for HIV in the last 12 months. Low prevalence of HIV testing makes it difficult to interrupt the transmission chain within the community and to reach the UNAIDS goal for 2020 of 90% of HIV-positive people being aware of their status, 90% of those receiving antiretroviral therapy, and 90% of those virally suppressed. Innovative community-based strategies are needed to address barriers and improve access to HIV testing, particularly for men and for the youngest and poorest populations, and to narrow the disparities in awareness of HIV status in Senegal.

Keys words: HIV, screening, associated factors, Senegal

1 INTRODUCTION

Despite significant progress in recent decades, the HIV epidemic is still a major public health threat worldwide, with an estimated 37 million persons living with HIV in 2017, including 1.8 million children. Africa bears the heaviest burden, with more than 25 million people affected (UNAIDS 2018). In Senegal, the AIDS response has achieved notable success since the first case was diagnosed in 1986, with a low and stable prevalence rate of 0.4% in adults age 15-49 (UNAIDS 2018), a steady decline in new infections as well as in HIV-related deaths, and a significant increase of 57% in antiretroviral therapy coverage in 2017 (HIV/AIDS National Council of Senegal 2018). In Senegal, HIV is a female epidemic, with a prevalence of 0.5% in women versus 0.4% in men (National Statistic and Demographic Agency of Senegal and ICF 2018).

The significant advances related to the adoption of early antiretroviral treatment from diagnosis (Insight Start Study Group 2015) justify the ambitious goal set by the UNAIDS to reach the target of three 90s for 2020—meaning 90% of people with HIV are aware of their HIV status, 90% of those are on antiretroviral therapy, and 90% of those are virally suppressed (Declaration of Paris, UNAIDS 2014). UNAIDS predicts that reaching these targets by 2020 would enable the world to end the AIDS epidemic by 2030 (World Health Organization 2015). In Senegal, the "Test All, Treat All, and Retain in Senegal" strategy, called TATARSEN, was implemented in 2016 and was scaled up at the national level in 2017.

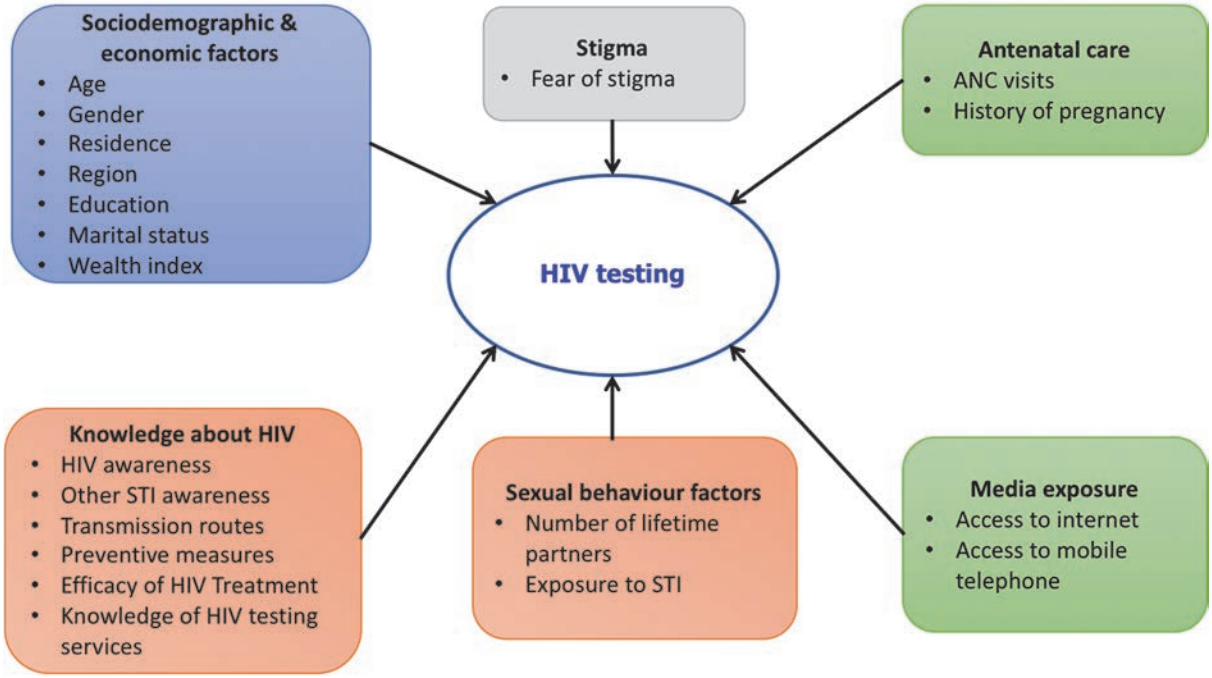
Awareness of HIV testing is key, by enabling initiation of early treatment and allowing the reduction of HIV-related morbidity and mortality as well as the interruption of the transmission chain. In 2017, however, 25% of all people living with HIV worldwide did not know their HIV status, equivalent to about 9.4 million people living with HIV but unaware of their serological status (UNAIDS 2018). The challenge is to increase access to and uptake of HIV testing services (HTS) for those who remain undiagnosed and for those at greatest ongoing risk for HIV infection (World Health Organization 2015).

In Senegal, Law No. 2010-03 of 9 April 2010 on HIV/AIDS sets the conditions for HIV screening using rapid diagnostic tests (RDTs), even at the health post level, which must be offered anonymously and free of charge. The current strategy is based on voluntary individual testing initiated by patients or care providers (HIV/AIDS National Council of Senegal 2018). Despite all the progress made, Senegal is still very far from achieving the 2020 target of 90% of people with HIV being aware of their HIV status, with only 69% of persons living with HIV diagnosed (HIV/AIDS National Council of Senegal 2018).

In the literature, HIV test uptake was found associated with several individual factors, including age and gender—young people are less likely to seek HIV testing (Molla et al. 2015; Asaolu et al. 2016; Staveteig et al. 2017), while females are more likely to be tested (Takarinda et al. 2016; Staveteig et al. 2017; Neilan et al. 2018). Another factor is a person's sexual orientation and behavior (Agha 2012; Jean et al. 2012; Musheke et al. 2013; Center et al. 2016; UNAIDS 2018). Other identified key factors correlated with HIV testing include area of residence (Jean et al. 2012; Molla et al. 2015), level of education (Molla et al. 2015; Takarinda et al. 2016; Staveteig et al. 2017), and knowledge of HIV (Jean et al. 2012; Abiodun et al. 2014; Molla et al. 2015; Asaolu et al. 2016; Nabukenya and Matovu 2018). Also, stigma and discrimination, whether perceived or experienced, has been identified as a real barrier to access to HIV testing services (Sambisa, Curtis, and Mishra 2010; Molla et al. 2015; Nabukenya and Matovu 2018).

To date, no major study of HIV testing has been carried out at the national level in Senegal, and little is known about the correlates of HIV testing. Identifying the factors associated with HIV testing is a critical step in guiding the Senegalese AIDS program to develop policies and strategies, improve progress toward the first UNAIDS 90 indicator, and reach the 2020 target. This study assesses factors associated with HIV testing among sexually active women and men in Senegal to better guide screening strategies in the country A conceptual framework has been developed for HIV testing after a literature review and analysis of associated factors. This conceptual framework is illustrated in Figure 1.

Figure 1 Conceptual framework for HIV testing



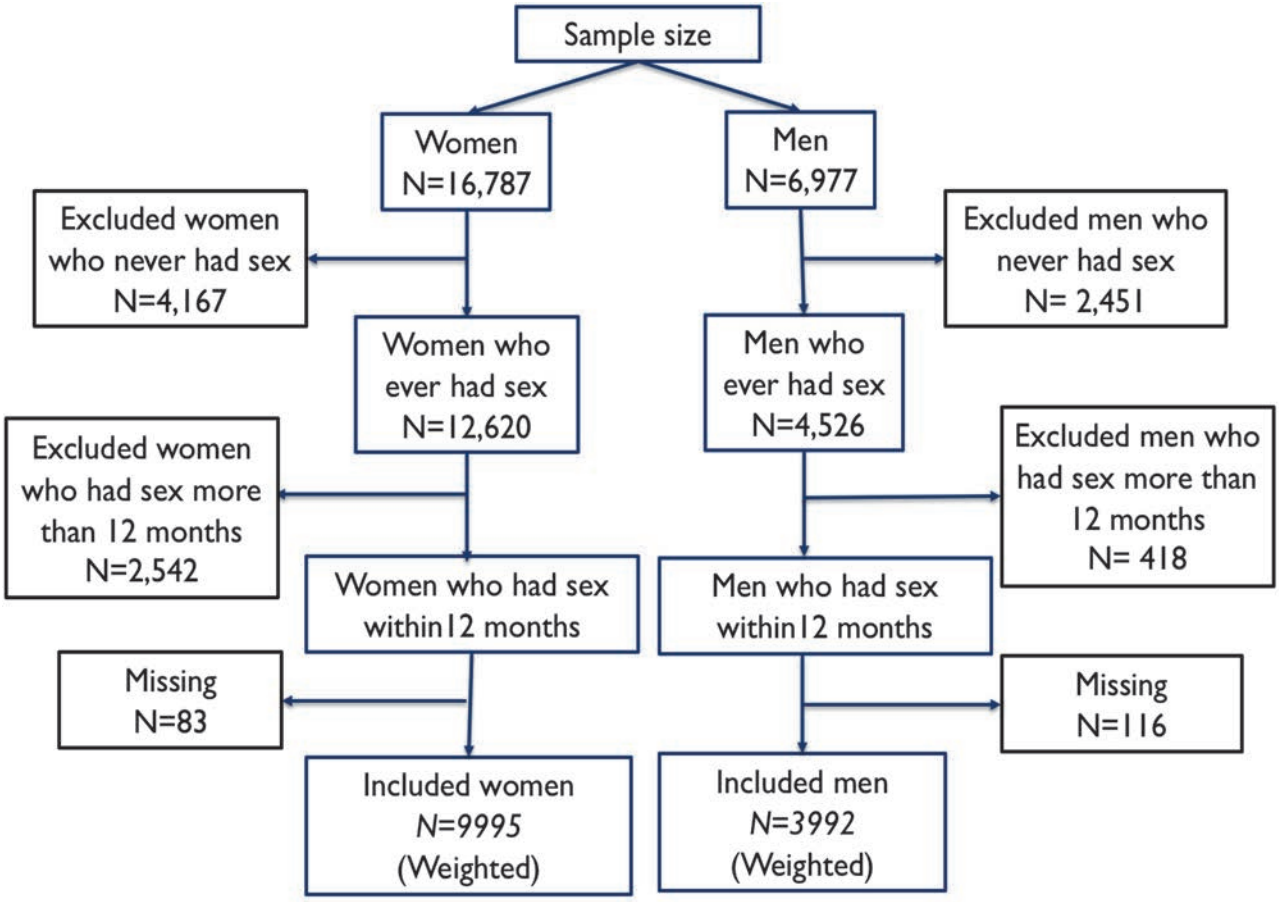
2 METHODS

2.1 Data Sources

The main data source used was the 2017 Senegal Demographic Health Survey, which is a population-based nationally representative survey in which participants were selected using a two-stage stratified cluster sampling design according to DHS sampling methodology (ICF International 2012). For the 2017 Senegal DHS, the following methodology was applied (National Statistic and Demographic Agency of Senegal and ICF 2018): At the first stage, 400 clusters were selected independently with probability proportional to size from the list of enumeration areas (EAs) established during the 2013 General Census of Population and Housing, Agriculture and Breeding (RGPHAE). In the second stage, a sample of 22 households per cluster, in both urban and rural areas, was selected by equal probability systematic sampling. A total of 8,800 households (4,092 in urban areas and 4,708 in middle rural) were selected. In each selected household, a questionnaire was completed to identify women age 15-49, men age 15-59, and children under age 5. Every eligible woman was interviewed with the DHS Woman's Questionnaire, and in those households selected for the men's interview, every eligible man was interviewed with the DHS Man's Questionnaire.

In our study, a secondary analysis of the Senegal 2017 DHS data was performed. Participants from urban and rural areas were selected from all the 14 administrative regions of Senegal. The study focused on sexually active women age 15-49 and men age 15-59. Participants who never had sex or did not have sex within 12 months before the survey were excluded from the analysis, and accounted for 6,709 women and 5,320 men. After weighting and considering missing responses, the sample size for our study was 9,995 women and 3,992 men. The diagram flow of the population of study is represented in Figure 2.

Figure 2 Population flow diagram



2.2 Key Variables

2.2.1 Outcome variable

The outcome variable was: ever tested for HIV in the last 12 months. It was measured on the basis of responses to the survey question asked of sexually active men and women: "Have you ever been tested for HIV in the last 12 months?"

2.2.2 Independent variables

As shown in the conceptual framework, the study considered explanatory variables related to sociodemographic and economic factors, sexual behavior, HIV knowledge, stigma, media exposure, and antenatal care.

Sociodemographic and economic variables included: age (15-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59); wealth index in quintiles (poorest, poor, middle, rich, richest); and area of residence (urban, rural). Another related variable was residence, with the country's 14 administrative regions grouped in four geographic zones: West (Dakar, Thiès); North (Saint-Louis, Louga, Matam); Center (Diourbel, Fatick, Kaolack, Kaffrine); South-East (Tambacounda, Kedougou, Ziguinchor, Sedhiou, Kolda). For the analysis, the geographic zone was used rather than the administrative region. Other variables related to

sociodemographic factors were marital status (married, never been in union, divorced, widowed); and level of education (no education, primary, secondary, higher).

Factors related to sexual risk behaviors were: number of lifetime partners (1, 2 and more, don't know/missing); and history of STI (had any STI in the last 12 months, "*Yes/No*"). Factors concerning knowledge of HIV were: sought knowledge of a place to get HIV test ("*Yes/No*"); knowledge about efficacy of HART during pregnancy (taking drugs to avoid HIV transmission to baby during pregnancy, "*Yes/No*"); and knowledge about HIV and sexually transmitted infections (ever heard of STIs, ever heard of AIDS, knowledge about mother-to-child transmission of HIV). Participants were considered as having a good knowledge of mother-to-child transmission of HIV (MTCT) if they knew the three main transmission routes (pregnancy, delivery, breastfeeding).

To assess perceived HIV-related stigma, the variable was: "people hesitate to take HIV test because of the reaction of other people" ("*Yes/No*"). For media exposure, the variables were: access to the Internet ("*Yes/No*"); and ownership of a mobile phone ("*Yes/No*").

For women, an additional variable was considered: number of ANC visits (none, 1 and more). The modality "none" included women who did not have a birth in the last 5 years as well as pregnant women who made no ANC visit.

2.3 Statistical Analysis

The analysis was performed using STATA/SE 15.1 software. As stated above in the section on data source, a two-stage sampling design was adopted. To account for the survey's multi-stage sampling design, all data were weighted to adjust for disproportionate sampling and nonresponse. For women and men, individual weights were applied. *SVYSET* command was used in Stata to adjust for the effect of complex sample design.

In the descriptive analysis, variables were presented in terms of the frequency and percentage of data for women and men. Intergroup comparisons were made using Chi2 test. The threshold of significance was set at 5%, and 95% confidence intervals (CI) were considered.

To assess the factors associated with HIV testing, two adjusted logistic regressions analyses were performed for women and for men, and adjusted odds ratios were calculated with their 95% confidence intervals. For women, we fit a logistic model of HIV testing with the following 12 independent variables: 5-year age groups, zone, educational level, wealth quintile, marital status, knowledge of mother to child transmission of HIV, drugs to avoid HIV transmission to baby during pregnancy, any STI in last 12 months, lifetime number of sex partners, self-stigma, mobile telephone ownership, and number of ANC visits. For men, a logistic model of HIV testing was fitted with the same independent variables as for women, except for the number of ANC visits.

Collinearity was checked and some variables were excluded due to high collinearity with another variable. The variables "residence," "knowledge of a place to get HIV test," and "use of Internet" were removed from both the models for women and men. For women, the variable "knowledge of a place to get HIV test" was removed because of empty cells, and collinearity was found between "residence" and "wealth class".

For men, collinearity was found between “residence” and “wealth class,” “knowledge of a place to get HIV test” and “zone,” and “use of Internet” and “educational level”.

3 RESULTS

3.1 Background Characteristics of the Study Population

Table 1 summarizes the sociodemographic characteristics of women age 15-49 and men age 15-59 who were sexually active in the 12 months preceding the 2017 Senegal DHS. The greatest proportion of women, 20%, were age 30-34, and the greatest proportion of men, 16%, were age 35-39. A majority of women (56%) were rural, while most men (53%) were urban.

Nearly 6 of every 10 women (58%) had no education versus 43% of men. The proportion with education beyond the secondary level was low among both women (3%) and men (9%). The great majority of women (94%) and men (74%) were married.

Regarding the household wealth index, 45% of men were in the richer and richest quintiles versus 36% in the poorer and poorest quintiles. For women, the distribution by wealth quintile was more even, with 41% in the richer and richest quintiles versus 39% in the poorer and poorest quintiles.

Men had a slightly higher level of knowledge about HIV and sexually transmitted infections (STIs) than women (99% versus 97%). Surprisingly, awareness of mother-to-child transmission of HIV was also higher among men than women (53% versus 50%), even though a higher proportion of women than men (81% versus 64%) knew a place to get an HIV test. Further, a high proportion of both men (77%) and women (78%) believed that people hesitate to take an HIV test because of the reaction of other people if they are found HIV-positive. Media exposure was higher for men, with 94% owning a mobile phone versus 71% for women, and 41% having access to the Internet compared with 22% of women.

Among women, 61% had one or more ANC visits for their most recent pregnancy and 39% had no birth during the past five years or did not attend ANC at all. The HIV testing rate in the 12 months before the survey was higher for women than men, at 62% versus 27% (see Figure 3).

Figure 3 **Percentage of women age 15-49 and men age 15-59 sexually active and ever tested for HIV within 12 months preceding the survey (weighted), Senegal DHS 2017**

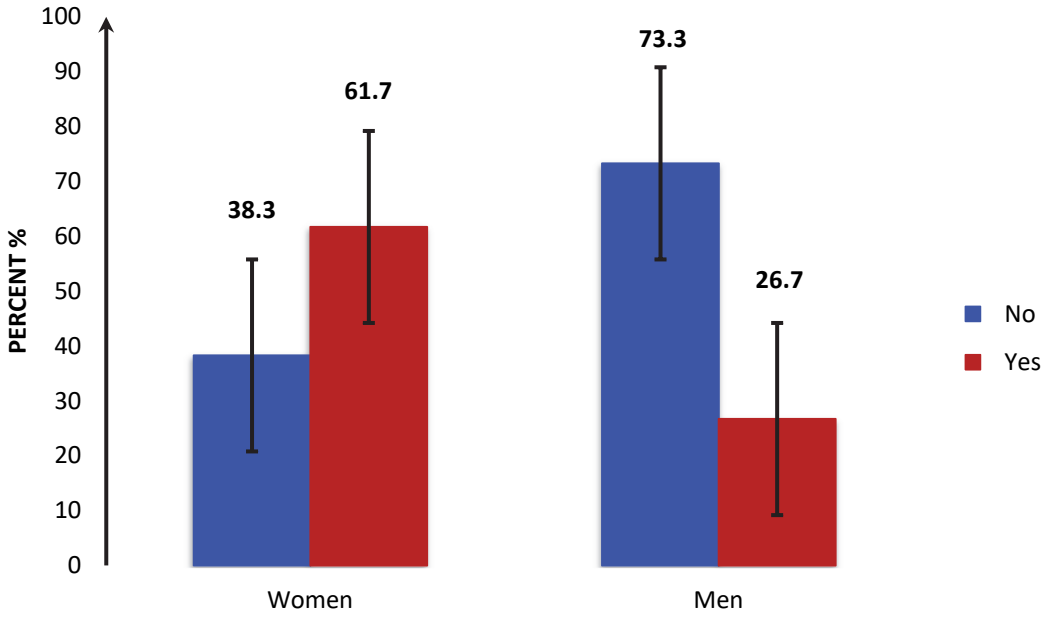


Table 1 **Distribution of sociodemographic, economic and behavioral characteristics, knowledge about HIV and other STIs, media exposure, and stigma among women age 15-49 and men age 15-59 (weighted), Senegal DHS 2017**

	Women		Men	
Variables	Percent (%)	Number (N)	Percent (%)	Number (N)
Sociodemographic and economic characteristics				
Age in 5-year groups				
15-19	7.5	751	4.7	186
20-24	15.3	1,53	8.7	345
25-29	19.2	1,915	13.3	529
30-34	19.7	1,971	16.6	664
35-39	15.3	1,526	16.7	666
40-44	13.5	1,354	11.8	473
45-49	9.5	949	11.7	468
50-54	na	na	9.4	375
55-59	na	na	7.2	286
Place of residence				
Urban	44.4	4,441	52.5	2,095
Rural	55.6	5,554	47.5	1,897
Zone				
West	37.4	3,742	43.8	1,747
North	16.8	1,679	14.9	595
Center	29.6	2,961	20.1	801
South-East	16.1	1,613	21.3	849
Educational level				
No education	58.2	5,817	43.3	1,729
Primary	23.3	2,331	24.5	978
Secondary	15.2	1,523	23.3	932
Higher	3.2	324	8.9	354

Continued...

Table 1—Continued

Variables	Women		Men	
	Percent (%)	Number (N)	Percent (%)	Number (N)
Marital status				
Never in union	3.0	296	23.9	955
Married	93.7	9,369	74.4	2,969
Widowed	0.6	56	0.2	9
Divorced	2.7	274	1.5	59
Never married				
No	97.0	9,699	76.1	3,037
Yes	3.0	296	23.9	955
Wealth index				
Poorest	19.0	1,899	18.8	752
Poorer	19.9	1,984	17.2	685
Middle	20.3	2,025	19.0	758
Richer	19.5	1,945	21.0	840
Richest	21.4	2,141	24.0	957
Knowledge about HIV and STIs				
Ever heard of a sexually transmitted infection (STI)				
No	2.8	283	0.8	33
Yes	97.2	9,712	99.2	3,959
Ever heard of AIDS				
No	3.1	314	0.9	38
Yes	96.9	9,681	99.1	3,955
Knowledge about mother-to-child transmission				
No	50.0	4,995	47.4	1,894
Yes	50.0	5	52.6	2,098
Know a place to get HIV test				
No	19.3	1,924	36.5	1,458
Yes	80.7	8,071	63.5	2,534
Taking drugs to avoid HIV transmission to baby during pregnancy				
No	51.2	5,115	46.1	1,841
Yes	48.8	4,88	53.9	2,151
Sexual behavior				
Had any STI in last 12 months				
No	96.5	9,641	99.5	3,971
Yes	3.5	353	0.5	21
Total lifetime number of sex partners				
1	80.8	8,073	27.4	1,093
2+	19.2	1,918	70.4	2,812
Don't know/missing	0.0	4	2.2	87
Fear of stigma				
People hesitate to take HIV test because of the reaction of other people if positive				
No	21.3	2,132	22.6	903
Yes	78.7	7,863	77.4	3,089
Media exposure				
Owns a mobile telephone				
No	29.3	2,925	5.8	231
Yes	70.7	7,07	94.2	3,762
Use of Internet				
No	78.0	7,793	58.9	2,353
Yes	22.0	2,202	41.1	1,639
Number of ANC visits				
None	38.9	3,884	na	na
1+	61.1	6,112	na	na
Total	**100.0**	**9,995**	**100.0**	3,992

na: Not applicable

3.2 Bivariate Analysis

Table 2 presents the relationship between uptake of HIV testing and sociodemographic, economic and behavioral characteristics, knowledge about HIV and other STIs, and media exposure among sexually active women age 15-49 and men age 15-59. For both women and men, uptake of HIV testing was significantly associated with the level of education. Those with a higher level were more likely to get tested. Similarly, regardless of gender, the HIV testing rate increased significantly with the level of household wealth, with the richest respondents being more likely to be tested (76% for women and 41% for men). Further, for both men and women, residing in an urban area or in the West zone was significantly associated with HIV testing.

HIV testing uptake was significantly associated with age only for women, with adolescents (age 15-19) and young adults (age 20-24) less likely to be tested for HIV than adult women.

The other factors significantly influencing HIV testing were exposure to media, such as mobile phone possession or use of the Internet, and, for women, the number of ANC visits.

For women, marital status and lifetime number of sex partners were not significantly associated with the HIV testing rate, whereas for men, age, marital status, knowledge of mother-to-child transmission of HIV, and having any STI in the last 12 months were not associated with HIV testing.

Table 2 Association between HIV testing uptake and sociodemographic and economic characteristics, knowledge about HIV and STI, media exposure, and stigma among women age 15-49 and men age 15-59, Senegal DHS 2017

	Ever been tested for HIV within 12 months					
	Women (Yes)			Men (Yes)		
Variables	%	CI	p-value	%	CI	p-value
Age in 5-year groups						
15-19	30.2	26.2-34.6	***	17.5	12.2-24.5	NS
20-24	59.8	56.3-63.2		22.8	17.9-28.7	
25-29	68.8	65.8-71.7		27.6	22.6-33.3	
30-34	69.4	66.5-72.2		28.3	23.7-33.4	
35-39	67.7	64.2-70.9		28.2	23.8-33.0	
40-44	60.3	56.4-64.1		27.8	22.4-33.9	
45-49	51.2	46.8-55.6		26.8	21.8-32.5	
50-54	na	na		31.9	25.0-39.6	
55-59	na	na		19.6	14.1-26.7	
Zone						
West	75.1	72.3-77.6	***	30.9	27.1-35.0	**
North	46.8	41.3-52.3		26.5	22.7-30.7	
Center	58.1	53.9-62.1		19.4	16.2-23.1	
South-East	52.5	49.5-55.6		25.0	22.1-28.0	
Place of residence						
Urban	33.6	30.4-36.9	***	32.5	29.3-35.9	***
Rural	19.1	17.0-21.4		19.0	16.9-21.2	
Educational level						
No education	54.0	51.5-56.5	***	14.0	12.1-16.1	***
Primary	69.2	66.5-71.8		22.8	19.2-26.8	
Secondary	74.1	71.0-77.0		42.7	38.9-46.5	
Higher	85.7	78.3-90.8		57.6	48.7-66.1	
Marital status						
Never in union	52.5	44.9-60.1	NS	27.7	24.0-31.7	NS
Married	61.8	59.7-63.9		26.6	24.2-29.1	
Widowed	65.6	49.4-78.8		15.6	3.8-46.3	
Divorced	64.9	56.4-72.6		19.2	10.7-32.1	

Continued...

Table 2—*Continued*

Variables	Ever been tested for HIV within 12 months					
	Women (Yes)			Men (Yes)		
	%	CI	p-value	%	CI	p-value
Never married						
No	61.9	59.9-63.9	*	26.4	24.1-28.8	NS
Yes	52.5	44.9-60.1		27.7	24.0-31.7	
Wealth index						
Poorest	42.2	38.1-46.4	***	11.3	8.9-14.2	***
Poor	52.0	48.3-55.8		19.3	16.0-23.0	
Middle	65.3	62.2-68.2		26.5	22.9-30.5	
Richer	71.2	68.1-74.2		30.1	25.7-34.8	
Richest	75.7	72.3-78.8		41.3	36.0-46.8	
Knowledge about mother-to-child transmission						
No	59.0	56.6-61.3	***	27.3	24.7-30.1	NS
Yes	64.3	61.7-66.9		26.1	23.3-29.2	
Taking drugs to avoid HIV transmission to baby during pregnancy						
No	53.6	51.0-56.2	***	17.8	15.7-20.2	***
Yes	70.1	67.8-72.3		34.3	31.4-37.3	
Knowledge of a place to get HIV test						
No	0.0		***	0.0		***
Yes	76.4	74.6-78.0		42.0	39.2-44.9	
Had any STI in last 12 months						
No	61.3	59.2-63.2	***	26.7	24.7-28.9	NS
Yes	72.6	66.7-77.7		21.4	9.9-40.5	
Total lifetime number of sex partners						
1	61.2	59.0-63.3	NS	20.0	17.0-23.5	***
2+	63.6	60.7-66.4		28.9	26.5-31.4	
Don't know/missing	60.2	14.0-93.3		39.6	29.8-50.4	
People hesitate to take HIV test because of the reaction of other people if positive (Fear of stigma)						
No	39.9	36.9-43.0	***	19.1	15.9-22.8	***
Yes	67.5	65.7-69.4		28.9	26.5-31.5	
Owns a mobile telephone						
No	48.8	45.8-51.9	***	9.5	6.2-14.4	***
Yes	67.0	65.0-68.9		27.7	25.6-30.0	
Use of internet						
No	57.2	54.9-59.4	***	16.1	14.3-18.0	***
Yes	77.5	74.6-80.2		41.9	38.4-45.6	
Numbers of ANC visit						
None	44.7	42.5-46.9	***			
1+	72.4	70.2-74.6				

NS: Not significant
*** p<0.001, ** p<0.01, * p<0.05

3.3 Factors Associated with HIV Testing

Table 3 summarizes the results of the logistic regression analyses for women and men. In the multivariable analysis for women, the following variables were significantly associated with being tested for HIV in the last 12 months: age 30-34, high level of education; classification in the richest wealth quintile, married, knowledge about the efficacy of HART during pregnancy, any STI in the last 12 months; perceived HIV stigma (people hesitate to take HIV test because of the reaction of other people), ownership of a mobile phone, and number of ANC visits. Women in the North, Center, and South-East zones were less likely to be tested compared with women in the West zone.

Among men, the following variables were significantly associated with being tested for HIV in the last 12 months: age 50-54, a high level of education, classification in the richest wealth quintile, married,

knowledge about the efficacy of HART during pregnancy, and ownership of a mobile phone. Men in the North and South-East zones were less likely to be tested compared with men in the West zone.

Table 3 Multivariable logistic model for correlates of HIV testing within 12 months before the survey among sexually active women age 15-49 and men age 15-59, Senegal DHS 2017

Variables	Women		Men	
	AOR	95% CI	AOR	95% CI
Age in 5-year groups (15-19)				
20-24	2.1***	1.6 - 2.8	1.2	0.7 - 2.0
25-29	2.7***	2.1 - 3.4	1.7	1.0 - 2.9
30-34	2.7***	2.1 - 3.5	1.9*	1.1 - 3.5
35-39	2.9***	2.2 - 3.9	2.0*	1.1 - 3.7
40-44	2.6***	2.0 - 3.4	2.0*	1.1 - 3.6
45-49	2.4***	1.8 - 3.2	1.7	0.9 - 3.1
50-54			2.3*	1.2 - 4.5
55-59			1.1	0.6 - 2.3
Zone (West)				
North	0.4***	0.3 - 0.5	2.1***	1.5 - 2.9
Center	0.6***	0.5 - 0.8	1.3	0.9 - 1.8
South-East	0.8*	0.6 - 1.0	1.6**	1.2 - 2.1
Educational level (No education)				
Primary	1.4***	1.2 - 1.6	1.6***	1.2 - 2.1
Secondary	2.0***	1.7 - 2.4	4.3***	3.3 - 5.6
Higher	2.8***	1.7 - 4.6	6.3***	4.1 - 9.6
Wealth index (Poorest)				
Poorer	1.3***	1.1 - 1.6	1.6**	1.1 - 2.2
Middle	2.1***	1.7 - 2.6	2.1***	1.5 - 3.0
Richer	2.3***	1.8 - 2.9	2.4***	1.7 - 3.5
Richest	2.2***	1.7 - 2.9	2.6***	1.7 - 4.0
Marital status (Never been in union)				
Married	1.5*	1.0 - 2.3	1.5**	1.1 - 2.1
Widowed	2.1	0.9 - 4.9	1.3	0.3 - 5.6
Divorced	1.7*	1.0 - 3.0	0.6	0.3 - 1.4
Knowledge about mother-to-child transmission (No)				
Yes	1.0	0.8 - 1.1	0.8*	0.6 - 1.0
Taking drugs to avoid HIV transmission to baby during pregnancy (No)				
Yes	2.0***	1.7 - 2.3	1.8***	1.4 - 2.2
Had any STI in last 12 months (No)				
Yes	1.6**	1.1 - 2.1	0.9	0.3 - 2.4
Total lifetime number of sex partners (1)				
2+	1.0	0.8 - 1.2	1.3	1.0 - 1.6
Don't know/missing	5.3*	1.1 - 24.9	2.0*	1.1 - 3.5
People hesitate to take HIV test because of the reaction of other people (No)				
Yes	2.5***	2.2 - 2.8	1.2	0.9 - 1.6
Owns a mobile telephone (No)				
Yes	1.4***	1.3 - 1.6	1.9**	1.2 - 3.0
Number of ANC visits (0)				
1+	4.1***	3.6 - 4.6		

AOR: adjusted odds ratio
*** p<0.001, ** p<0.01, * p<0.05

4 DISCUSSION

Despite all the efforts made, the rate of HIV testing is still low in Senegal, but shows a tendency to improve. Our study found that men have a better knowledge of HIV than women have, especially concerning the means of transmission and treatment, and even concerning HIV transmission from mother to child. Despite having lower levels of HIV knowledge, women's HIV testing rates are much higher than for men, at 62% versus 27%. This seems to be a constant finding across studies (Takarinda et al. 2016; Staveteig et al. 2017; Neilan et al. 2018; Sanga et al. 2015). It suggests that women have better access to health facilities through several programs devoted to them, such as reproductive health care services. Likely, HIV testing during ANC explains much of the difference between women and men. In fact, ANC visits are opportunities for women to benefit from having an HIV test. Strategies specifically targeting men should be developed in Senegal in order to catch up with women in HIV testing, such as encouraging women during antenatal care to have their partners seek testing.

In our study, adolescents age 15-19 and young adults age 20-24 were less likely to be tested, for both genders. The same observation had been made by other studies. Adolescents are less likely to use HIV testing services (MacPhail et al. 2009; Musheke et al. 2013; Sanga et al. 2015; Asaolu et al. 2016; Van Handel et al. 2016; Mahande, Phimemon, and Ramadhani 2016). Several explanations can be advanced. The level of HIV knowledge among youth in sub-Saharan Africa is very low (Idele et al. 2014; Asaolu et al. 2016; Oginni et al. 2017; Alabi et al. 2018; Nabukenya et Matovu 2018) and their use of HIV testing services (HTS) is very poor (Idele et al. 2014; Sanga et al. 2015). This is a problem because teens become sexually active early (Idele et al. 2014; Sanga et al. 2015) and are thus more exposed to sexually transmitted infections. In addition, high levels of stigma can be another main cause (Musheke et al. 2013; Nabukenya and Matovu 2018). HIV-related stigma and discrimination seriously impede efforts to effectively combat the HIV pandemic. Fear of discrimination often prevents people from undergoing HCT or from disclosing their HIV status (Kitara and Aloyo 2012).

To address this gap, we advocate strengthening HIV testing campaigns in secondary schools as well as increasing school-based educational programs. The use of urinary or saliva rapid HIV tests can be promoted as they are associated with HIV testing (Myers et al. 2014; Nangendo et al. 2017). However, a study conducted in the USA has shown that the optimal age for HIV testing adolescents and young adults is 25, and screening at age 18 or younger is a less efficient strategy (Neilan et al. 2018). Another challenge could be consent for adolescents under age 18. In Senegal, the age of majority is 18, so adolescents under age 18 may not attend HTS. Another explanation of this relationship is that older age confers more economic and social power, which is why among both women and men, older people are more likely to be screened for HIV.

Another factor is that after age 25 most women and men are married. With pregnancy, women gain access to antenatal care services and have more opportunities to be tested. Senegal adopted universal HIV testing during pregnancy as recommended by WHO (World Health Organization 2015). In line, as expected, our study found that women with at least one ANC visit had four times the odds of having an HIV test compared with those who had no ANC visit or did not have a birth in the last 5 years.

Women living in the West zone are more likely to be tested than women in the other zones of Senegal. The West zone includes the regions of Dakar and Thiès—the capital city and its closest region—so many health services are concentrated there, and people also have better access to the media and greater economic power. This leads to increased opportunities for HIV testing. Also, these areas are predominantly urban. However, the results for men are in the opposite direction than for women. Men living in North and South-East zones are more likely to be tested. The reason behind this discrepancy has to be examined more closely. However, studies show that, regardless of gender, people living in urban areas are more likely to be tested for HIV compared with their counterparts in rural areas (Molla et al. 2015; Jean et al. 2012; Mahande et al. 2016; Muhinda et al. 2017). HIV testing strategies must target HIV hot-spot regions, specifically in the South-East zone.

Our study highlights how difficult it is for health promotion programs to reach the poorest sections of the population. Even though HIV testing in Senegal is free, testing rates increase with educational level and wealth for both men and women. These findings are consistent with previous reports (Jean et al. 2012; Takarinda et al. 2016; Staveteig et al. 2017; Muhinda et al. 2017; Peltzer et al. 2009; Mahande et al. 2016; Molla et al. 2015; Agha 2012). On average, the odds of having HIV testing are 6.3 times higher among men and 2.8 times higher among women with a high level of education compared with men and women with no education. Higher educational attainment is associated with more comprehensive knowledge of HIV and its prevention (Peltzer et al. 2009; Owusu 2018). Women deciding alone about their own health care are more likely to be tested for HIV compared with women for whom someone else is involved in decisions on their care, whether husbands/partners or other family members.

In agreement with studies in Ethiopia and Rwanda (Musheke et al. 2013; Molla et al. 2015), we found that media exposure increases the uptake of HIV testing. For many years now in Senegal, messages extolling the benefits of early detection and treatment have been distilled through the media, particularly on television and radio. However, these campaigns have shown their limits, while other strategies exist that can reach audiences directly. In our study both men and women show greater odds of HIV testing if they own a mobile phone. Since it appears that, regardless of gender, possession of a mobile phone is a predictor of HIV testing, strategies to reach men and women through their mobile phones should be developed and implemented.

STI status is another important determinant for HIV testing (Swenson et al. 2009; Takarinda et al. 2016; Mahande, Phimemon, and Ramadhani 2016). Our study did not allow us to draw this conclusion for women, however. Even though having any STI in the last 12 months was significantly associated with being tested for HIV among women, only 3.5% of women and 0.5% of men in our sample reported having any STI in the last 12 months. Since data obtained in the survey were self-reported, the findings could be biased.

In some studies, having two or more sexual partners in the past year is associated with knowledge of HIV status (Peltzer et al. 2009; Jean et al. 2012). However, our study did not find this relationship. Instead, among both men and women, not knowing the lifetime number of partners was found to be associated with HIV testing. This fact was more significant among women. Sometimes not knowing the number of partners is an indication of having many partners.

A comprehensive knowledge about HIV has been found to be a predictor of HIV testing (Jean et al. 2012; Molla et al. 2015; Asaolu et al. 2016). Our study shows that men are slightly more knowledgeable about HIV compared with women, including awareness of MTCT. However, knowledge about MTCT was not

found to be significantly associated with HIV testing while, curiously, knowledge of drugs to prevent MTCT was associated with testing.

Our study has some limitations. Causal inferences are limited by the cross-sectional and observational design of the study. Also, key high-risk populations are not identified. No information was collected that would identify survey respondents as members of population groups such as sex workers and men having sex with men. These populations are known to be reluctant to report HIV testing (Figueroa et al. 2015; Johnson et al. 2017; Tun et al. 2018). This is related to sociocultural constraints that make these people hide their status fearing rejection and criminalization. HIV infection is often thought to be the result of personal sexual irresponsibility (Wolfe et al. 2008) and so is still looked upon as a punishment (Makoae et al. 2009).

New approaches like self-testing can increase uptake of HIV testing and must be implemented among key population groups and teenagers. However, concern remains about the sensitivity of the test, the lack of counsel, and the need for confirmation after a positive HIV self-test. Qualitative studies in these subjects provide more answers (Okoboi et al. 2019; Pilgrim et al. 2019). Nonetheless, our study is important in that it uses nationally representative population survey data. Moreover, it is the first major study on the subject in Senegal.

Conclusion

This study provides evidence that the HIV testing rate is low in Senegal and that differences in testing persist between men and women. The first UNAIDS “90” target for 2020 has not yet been reached. The main barriers to accessing HIV testing facilities concern problems in reaching men and youth, lack of education and information, low socioeconomic status, rural residence, and poor access to communication.

These findings have implications for policy and programs. Given the low uptake of HIV testing among men and youth, innovative strategies to reach the youngest group, teenagers, must be implemented by scaling up the task with community involvement and access to self-testing tools. Another strategy is scaling up access to HIV testing outside the capital city, especially among women. Furthermore, to address the gaps in knowledge about HIV, communication about HIV and its treatment should be reinforced and women empowered through providing more education and promoting income-generating activities. Also, more integration between HIV and other reproductive health programs must be realized.

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