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The Gendered Relationship Between HIV Stigma And HIV Testing Among Men And Women In Mozambique: A Cross-sectional Study to Inform A Stigma Reduction And Male-Targeted HIV Testing Intervention

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THE GENDERED RELATIONSHIP BETWEEN HIV STIGMA AND HIV TESTING AMONG MEN AND WOMEN IN MOZAMBIQUE: A CROSS-SECTIONAL STUDY TO INFORM A STIGMA REDUCTION AND MALE-TARGETED HIV TESTING INTERVENTION

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ABSTRACT:

Objectives*:* Increasing and sustaining engagement in HIV care for people living with HIV are critical to both individual therapeutic benefit and epidemic control. Men are less likely to test for HIV compared to women in sub-Saharan African countries, and ultimately have delayed entry to HIV care. Stigma is known to impede such engagement, placing an importance on understanding and addressing stigma to improve HIV testing and care outcomes. This study aimed to assess the gendered differences in the relationship between stigma and HIV testing.

Design and Setting: A cross-sectional, household probability survey was implemented between November and December 2016 in the Sofala province of Mozambique.

Participants: Data were restricted to men and women participants who reported no prior diagnosis of HIV infection (N=2,731).

Measures: Measures of socio-demographic characteristics, stigma, and past exposure to HIV interventions were included in gender-stratified logistic regression models to estimate the relationship between stigma and recent testing for HIV, as well as to identify other relevant correlates.

Results*:* Significantly fewer men (38.3%) than women (47.6%; p<0.001) had recently tested for HIV. Men who reported previous engagement in community group discussions about HIV had an increased odds of testing in the past 12 months compared to those who had not participated (aOR=1.88; 95% CI 1.51-2.35). Concerns about stigma was not a commonly reported barrier to HIV testing; however, men who expressed anticipated individual HIV stigma had a 40% lower odds of recent HIV testing (aOR=0.60; 95% CI 0.42-0.86). This association was not observed among women.

Conclusions*:* Men have lower uptake of HIV testing in Mozambique when compared to women. Even amidst the beneficial effects of HIV messaging, individual stigma is negatively associated with recent HIV testing among men. Intervention efforts that target the unique challenges and

needs of men are essential in promoting men's engagement into the HIV care continuum in sub-Saharan Africa.

Key words: HIV test; Mozambique; HIV care continuum; gender

ARTICLE SUMMARY:

Strengths and limitations of this study:

- This large, household probability survey explores the barriers to HIV testing, including stigma, that are distinct among men and women in a high HIV burden area district of Mozambique.
- HIV stigma was assessed using comprehensive measures to capture five relevant stigma domains: shame/blame/isolation, inequity, discrimination, community, and anticipated individual stigma towards PLHIV.
- Stigma domains and other potential correlates of recent HIV testing were stratified by gender to provide evidence for strategies to improve HIV testing and care among men.
- As a cross-sectional analysis, temporality was not established.

INTRODUCTION:

Global efforts are underway to achieve the Joint United Nations Programme on HIV/AIDS (UNAIDS) 2020 targets in which 90% of all people living with HIV (PLHIV) will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy (ART), and 90% of all people receiving ART be virally suppressed (90-90-90 strategy). This strategy aims to change the epidemic trajectory through treatment as prevention.[1] Despite the emphasis on the role of HIV testing in the HIV care continuum, challenges remain in achieving global targets by 2020.[2]

In sub-Saharan Africa, substantial investments have targeted and been successful in achieving high coverage of HIV testing among women in the context of antenatal care services and services to prevent mother-to-child transmission (PMTCT).[3, 4] However, fewer efforts have directly targeted HIV prevention, testing, and care for men and those that do include men often

succeed in reaching women with greater frequency than men.[5] In sub-Saharan Africa, HIV testing rates tend to be lower among men than women, that is often coupled with late entry to HIV care, poor retention in care and ART adherence, and greater mortality rates while on antiretroviral therapy among men compared to women.[5,6] These gender gaps indicate a need to shift towards addressing the unique barriers to HIV testing uptake and engagement in HIV prevention and care continuums among men in sub-Saharan Africa.

Observational studies have provided evidence of the role of HIV stigma in HIV testing and care in sub-Saharan Africa.[7,8] People continue to associate HIV with death, despite treatment advances, and assign shame and blame to PLHIV.[9,10] Perceived HIV stigma can induce feelings of fear that prevent individuals from learning their HIV status, entering HIV-related facilities, and engaging in HIV-related services due to unwanted, negative attention of being identified as living with HIV.[9] As men are less likely to seek testing, a critical evaluation of the relationship between stigma and other factors on the uptake of HIV testing among men should be explored to inform HIV testing interventions.

As the fourth leading country in number of PLHIV, Mozambique has an estimated range of 1.6 – 2.1 million PLHIV.[11] The country has an adult HIV prevalence of 13.2%, with 34% aware of their HIV status.[12] In Mozambique, men are less likely to receive an HIV test compared to women. In 2015, only 38% of men participating in the Demographic Health Survey (DHS) reported any history of HIV testing and only 19% had been tested within the last 12 months, compared to 31% among women.[12] Reports produced by the People Living with HIV Stigma Index suggest that HIV stigma is prevalent in Mozambique, though the role of stigma in HIV testing, particularly for men, has not formally been assessed.[13]

The aim of this analysis was to identify and assess the role of HIV stigma and other correlates of recent uptake of HIV testing among men and women in a high burden province in Mozambique. This study was conducted as part of a baseline survey for a subsequent community-based stigma reduction and HIV care continuum intervention in Mozambique, which had a specific focus on improving HIV testing among men.

METHODS:

Study site and population*:* As part of a larger evaluation of a community-based intervention, a baseline, cross-sectional survey was conducted from November to December 2016. Eligibility requirements for participation in the study included providing consent to participate, being aged 18 years or older, and living in participating districts of the Sofala province in Mozambique. Sofala province is one of the most HIV affected areas of Mozambique with an adult HIV prevalence of 16.3% as of 2015 DHS.[12]

Two districts in Sofala Province, Nhamatanda and Dondo, each comprised of four facility sites and their surrounding catchment areas per district were selected for participation in the survey. Within Dondo district, the following sites were included: Canhandula, Dondo Sede, Mafambisse, and Macharote. Nhamatanda Sede, Nharuchonga, Tica, and Lamego were participating sites in Nhamatanda district. Sampling in each site was proportional to population size. Participants were recruited through random household selection.

The sample size was based on the parent study to assess the impact of a community-based intervention on community-level HIV stigma and HIV testing among men. We assumed 80% power to detect a conservative 5% difference in the change in stigma at alpha <0.05 between intervention and control, with an assumption of 20% loss to follow-up between baseline and endline. This produced a target sample of 1,500 per intervention or control group (N=3,000 total). Given the other outcomes of interest related to improvements in HIV testing among men, men were over-sampled to produce a sample comprised of two-thirds men and one-third women. Considering the estimated sample size of 1,500 per group, 66% of whom would be men, and 20% loss to follow-up, it was estimated that that there would be over 80% power to detect at least 10% difference in self-reported HIV testing among surveyed men in the intervention and control sites. A total of 3,017 enrolled in the baseline survey; however, individuals who had self-reported living with HIV at the time of survey were excluded from this analysis, producing an effective sample size of N=2,731 for this analysis (n=1,887 men and n=844 women).

Measures: Data for the baseline survey was collected through a tablet-based questionnaire administered by local interviewers. Interviewers were fluent in local languages of Sena or Ndao

as well as Portuguese, had prior experience in health research, and had been trained on human subjects protection and confidentiality. Survey administration took approximately 45 minutes. The socio-behavioral survey collected information on demographic characteristics including gender identity, exposure to HIV prevention and testing, knowledge of HIV, relationships with PLHIV, and a comprehensive set of HIV stigma measures.

To ascertain recent HIV testing (last 12 months), participants were asked if they had ever been tested for HIV within their lifetime. Those who responded positively and who had not reported a positive diagnosis on their last HIV test, were then asked a categorical question of when their last HIV test was completed. This categorical response was then reclassified to a binary response to whether they had been tested within the last 12 months. Participants who reported no recent HIV testing were additionally asked to report reasons why they had not tested and could select multiple responses from a list of 13 potential barriers to testing.

HIV stigma was assessed using several measures to capture five relevant stigma domains. The HIV stigma scale developed by Genberg and colleagues in the sub-Saharan setting was used to measure individual feelings and perceptions about PLHIV and included three subscales measuring shame/blame/isolation, inequity, and discrimination of PLHIV (alpha: 0.79).[14] The domain of shame gauged the participants' tendency to blame and disgrace PLHIV, discrimination captured the extent to which people unfairly treat PLHIV, and inequity encompassed the preconceived opinions and prejudice towards PLHIV.[14] An example statement from the discrimination subscale includes "*People living with HIV/AIDS face neglect from their families*." We developed new measures (7 items) to assess perceived HIV stigma within the community (alpha: 0.77). An example statement in this measure included, "*In this community, men who are known to be living with HIV have the same level of importance in society as men who are not living with HIV."* Both sets of measures used 4-point Likert scale response options, in which 1 represented strong disagreement and 4 represented strong agreement with the statement. To score the HIV stigma scale and community stigma measures, points from the Likert scale were summed across all items in the same measure, with the exception of those that were reverse coded, producing possible ranges in scores from 10 to 33 for shame/blame/isolation, 8 to 27 for discrimination, 5 to 19 for inequity, and 7 to 28 for perceived

community stigma. A higher score meant greater levels of HIV stigma. Measures of anticipated individual stigma towards PLHIV that are traditionally included in DHS surveys (5 items) were also included in this survey. An example question under the domain of anticipated individual HIV stigma asked, "*If you found out that one of your friends was living with HIV, would you still be friends with him/her?*"[15] These measures were included as they are the only stigma measures identified to explicitly measure the individual participant's potential stigma towards PLHIV. The five items were evaluated with dichotomous responses of yes or no and were ultimately combined into a single binary variable for "any anticipated individual stigma" based on a response that endorses stigma for at least one of these five items.

Statistical Analyses*:* This analysis aimed to identify the correlates of HIV testing among HIV-uninfected individuals in Mozambique and to evaluate whether gender modified the relationship between stigma, other variables of interest, and the outcome of recent HIV testing. Descriptive analysis that was stratified by gender was conducted to assess characteristics of the study sample, including prevalence of recent HIV testing and stigma scores. Chi-squared tests were implemented to assess differences by gender for categorical variables; t-tests were implemented to assess differences across continuous variables.

A bivariate analysis was initially performed to identify potential correlates of recent HIV testing among the total sample. Additional models were stratified by gender to determine variables that would be appropriate to include in the final model for each gender. The independent variables tested in the models included HIV prevention experience, HIV knowledge, and stigma among participants, while demographics, such as age and education level, were considered as potential confounders in the model. The five domains of stigma were tested separately in the models: scores for shame/blame/isolation, discrimination, and inequity subscales, as well as perceived community stigma, were tested as continuous variables, while anticipated individual stigma was tested as a binary variable.

Using variables identified in the bivariate models based on $p<0.10$, a final multivariate logistic regression model was built to present adjusted odds ratios, which allowed for the controlling of potential confounders in the analysis. The logistic regression model was stratified by gender to

present potential associations that differed between men and women for having recently tested for HIV. Multivariable models were run for the combined sample, as well as separately for each gender. Of the variables that presented a difference in relationship by gender, interaction terms were added in the combined multivariate model to evaluate their statistical significance. Variance inflation factor was calculated to test for collinearity in the final models. The Hosmer-Lemeshow test was also conducted to test for goodness-of-fit. All analyses were conducted in STATA 14 and adjusted for potential clustering of participants induced by the sampling methodology using complex survey design procedures.[16]

Patient and Public Involvement: No patients were involved in this study. As a cross-sectional household survey, the public were involved in community information sharing sessions before and after the study to support recruitment and sharing of study results, respectively. Members of the public were selected for participation in the survey via probability based sampling. Results of the study have been shared with development agencies supporting HIV programming in Mozambique.

Human Subjects*:* The study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board and the National Committee of Bioethics for Health (CNBS) in Mozambique.

RESULTS:

Table 1 provides a description of demographic characteristics by the gender of participants (no participants identified as transgender or gender non-binary). Men and women participants were similar in age, education, and income level. However, among the 2,731 self-reported HIV uninfected individuals (1,887 men and 844 women), men tended to have slightly higher levels of employment than women (Table 1).

Table 2 describes participants' exposure to HIV testing, prevention resources, and perceptions of HIV stigma. More than half of the participants did not test for HIV in the year prior to the baseline survey, which was significantly higher among men (61.7% vs. 52.4%, $p<0.001$). Women were more likely than men to have had a recent HIV test, while men were more

commonly exposed to HIV information than women via the radio, informational fliers, and community discussion groups ($p<0.001$). With respect to the domains of stigma, participants had generally low levels of perceived stigma including shame/blame/isolation, discrimination, or inequity towards PLHIV. Women were more likely than men to endorse at least one form of anticipated individual stigma towards PLHIV (16.3% vs. 12.7%, $p=0.013$) and reported higher on average scores than men in having perceived shame/blame/isolation, feelings of inequity, and perceived community stigma towards PLHIV (Table 2).

When asked to report the reasons for not having tested for HIV in the last 12 months, over half of participants who reported no recent test indicated it was because they felt healthy (55%), lacked time for HIV testing (26%), and had low perceived risk (21%). Men were more likely to report feeling healthy and not having time to get tested than women. Figure 1 displays the five most common reasons for failure to test among men and women. Concerns related to stigma and perceived gender norms associated with HIV testing were not commonly reported reasons for lack of recent HIV testing. For example, 1.7% of participants reported that they had not recently tested for HIV due to concerns about negative treatment by healthcare workers, as well as concerns that neighbors or families suspect that they are living with HIV infection (0.4%), or concerns that people would believe they were unfaithful or misbehaving (0.5%).

Insert Figure 1

In the multivariable logistic regression model that included the combined sample of men and women (Table 3), the odds of recent HIV testing were almost 2 times higher among women than men (aOR=1.95; 95% CI 1.55-2.46). Other correlates of recent HIV testing included being married, attaining secondary education or technical school or university, past receipt of informational fliers about HIV, and past participation in community group discussions about HIV were also significantly associated with recent HIV testing. Participants who endorsed at least one form of anticipated individual stigma towards PLHIV had a 34% reduced odds of recent HIV testing, compared to those with none (aOR=0.66; 95% CI 0.50-0.89). The subscale measuring feelings of inequity for PLHIV had a modest positive association with HIV stigma,

wherein for each point higher on the scale, there was a 1.06 increased odds in recent HIV testing (aOR=1.06; 95% CI 1.01-1.11).

To explore effect modification by gender in the relationship between stigma and recent HIV testing and to identify unique correlates of recent HIV testing, gender disaggregated multivariable logistic regression models were implemented (Table 4). Among men, higher education and engagement in community discussion groups (aOR=1.88; 95% CI 1.51-2.35) were associated with increased odds of recent HIV testing. Men who endorsed at least one form of anticipated individual stigma towards PLHIV had a 40% lower odds of recent HIV testing (aOR=0.60; 95% CI 0.42-0.86), whereas there was a modest association between the inequity subscale and HIV testing among men (aOR=1.07; 95% CI 1.01-1.13).

Women with secondary education and who were currently married were more likely to report recent HIV testing. Among women, having seen or read any informational fliers about HIV was associated with an increased odds of recent HIV testing (aOR=1.78; 95% CI 1.24-2.55). The shame subscale was negatively associated with recent HIV testing, where there was a 6% reduced odds of recent HIV testing for each point increase on the perceived shame subscale (aOR=0.94; 95% CI 0.89-0.99).

DISCUSSION:

Stigma has a well-documented role in inhibiting engagement across the HIV prevention and care continuums and greater understanding, particularly for men who are less engaged in the HIV care continuum, is critical to meeting global epidemic targets.[17] This study found that endorsement of anticipated individual stigma among men was associated with a 40% reduced odds of recent HIV testing – a finding that was unique to men. The measures of anticipated individual stigma captured how participants felt they would personally react to PLHIV; given the magnitude of the association among men, this suggests that men may avoid HIV testing to avoid similar treatment by others. Conversely, exposure to HIV informational messages through community discussions and fliers was positively associated with recent HIV testing for men, as well as for women. These findings suggest that interventions to improve HIV testing for men

may be optimized by providing both stigma reduction efforts as well as communication about the benefits and importance of HIV testing.

While anticipated individual HIV stigma was found to be associated with decreased odds of recent HIV testing among men, concerns related HIV stigma was not often a reported reason for not completing HIV testing within the last 12 months. Rather, participants predominantly reported that they did not seek testing because they felt they were not at risk for HIV, felt healthy, or did not have time. There are two (not mutually exclusive) potential explanations for these disparities in findings. Within social epidemiology, stigma is widely viewed and measured as a latent trait, as it was in this analysis that utilized comprehensive scales to measure various forms of HIV stigma.[14, 15] Thus, specific concerns related to stigma as a reason for failing to test for HIV may be very different in perceived significance from what may be captured by more comprehensive scales that capture the multitude manifestations of HIV stigma. Second, it is possible that stigma serves as an overarching issue that impacts individual efforts to overcome barriers to HIV testing. In this sense, stigma that is present ubiquitously among individuals may prevent them from resolving more immediate barriers related to time or perceived risk for HIV acquisition. Addressing both immediate barriers to HIV testing as well as reducing stigma are important areas of focus for HIV testing interventions for men, who do not have the same normative access to HIV testing that women do through antenatal programs.

Unlike the relationships identified for men, we found that women endorsed greater feelings of stigma towards PLHIV compared to men; however, stigma did not appear to be associated with women's testing behaviors. The subscales measuring shame was found to be modestly associated with reduced HIV testing among women, though did not have the same magnitude of association with HIV testing as individual forms of stigma among men. However, the magnitude of association is small and it is unclear if this finding is truly an association or simply the result of a sufficiently large sample size that resulted in a statistically significant p-value.[18]

One likely explanation for the gender differential in recent HIV testing and the lack of correlation with stigma among women is the availability of HIV testing in routine antenatal care. Other research from Sofala Province estimated that at least 74% of women routinely receiving

antenatal care services in the Sofala province had tested for HIV in 2009 – an estimate that has likely increased in recent years.[19] It may be that, unlike for men, antenatal care services allow women to access HIV testing within the context of other reproductive care. With women visiting health facilities for antenatal care, following and providing regular HIV prevention and care services, amongst other services, is more common for women than for men.[20] In theory, male partners may access HIV testing at antenatal care sites through their partner; however, in practice, men's engagement in antenatal care services are low in Mozambique.[21] Given that specialty services for men are not common within health facilities, increasing testing opportunities in locations that men frequent, such as hosting workplace testing events, and providing self-testing services at home or within the community are strategies to improve HIV testing among men.[22]

Community discussion groups were found to be positively associated with recent HIV testing in this study and have previously been successful in influencing a change in gender attitudes, gender roles, and HIV stigma that also play a part in the uptake of HIV prevention and care services.[23] Considering the higher proportion of men than women exposed to HIV prevention messages, increasing and effectively distributing HIV prevention resources that deliver information on HIV via fliers and community discussion groups among others are important for future interventions targeting men. Contrary to these findings, an association was not observed between hearing discussions about HIV on the radio and recent HIV testing. The content of the radio programs that participants had heard was not documented and it may be the case that some radio programs contained negative messages or misinformation. A closer evaluation of the content of the radio programs would allow for better understanding of its relationship with recent testing for HIV. As radio is one of the most dominant forms of communication within Mozambique, with over 90% of households reportedly owning a radio, developing positive messages for radio dissemination may play an important role in encouraging HIV testing and reducing misinformation and stigma.[24]

The findings should be viewed in light of study limitations. As a cross-sectional analysis, temporality was not established and the direction of the associations cannot be established. Given that stigma takes long periods of time to develop and change, we presume that stigma influences

recent HIV testing behaviors; however, there is the possibility that HIV testing experiences could have changed participants perspectives about stigma. With the exception of the perceived community stigma measures, other stigma measures were established a decade ago and items may need to be added or adjusted to account for changing social dynamics and programming as the epidemics progresses. Finally, social desirability bias could have influenced our estimates of stigma and HIV testing.

CONCLUSION:

Stigma is and should be widely recognized as a potent social determinant in health seeking behaviors that compromises health among populations, particularly as it relates to HIV testing and care.[25, 26] Of the various forms of stigma, anticipated individual stigma was found to be strongly associated with reduced uptake of recent HIV testing among men. The availability of HIV testing within antenatal care services provides opportunities for women to engage in HIV testing, while challenges to engage men in HIV testing and, broadly, the HIV care continuum persist. Findings from this study suggest that efforts to improve HIV testing among men should focus on addressing both stigma reduction and immediate barriers to HIV testing, and may be able to build on the positive effects of community-based HIV prevention and care activities. As HIV testing and diagnosis are essential to linking individuals to treatment and care, acting on the individual, social, and structural barriers that disparately impact men and women will be necessary to achieving the ambitious goal of 90-90-90 to end the HIV epidemic in sub-Saharan Africa.

Conflict of Interest Statement:

The authors declare that they have no competing interests.

Authorship:

LVL, ECM, PD, and ALW designed the study concept. JD and DP oversaw data collection. ALW, JHH, and JC had full access to study data. JHH conducted statistical analysis and wrote the initial draft of the manuscript with oversight and support by ALW. All authors review and provided scientific input.

Date Sharing Statement:

Technical appendix, statistical code, and dataset available upon request to the authors.

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TABLES:

Table 1. Demographic characteristics of participants in Sofala Province, Mozambique (N=2,731)

	Total (N=2,731)	Men (n=1,887)	Women (n=844)	*p*-Value
Age (SD), years	35.5 (15.5)	37.3 (16.2)	31.6 (12.8)	<0.001
Average monthly income (SD), MZN	10700 (380000)	14221 (460000)	2944 (4500)	0.480
District of residence				
Nhamatanda	1385 (50.7%)	951 (50.4%)	434 (51.4%)	0.621
Dondo	1346 (49.3%)	936 (49.6%)	410 (48.6%)	
Highest level of education completed				
None or primary	1396 (56.5%)	1004 (55.6%)	392 (59.0%)	0.087
Secondary	1004 (40.6%)	744 (41.2%)	260 (39.2%)	
Technical school or university	70 (2.8%)	58 (3.2%)	12 (1.8%)	
Current employment status				
Unemployed	1031 (37.8%)	532 (28.2%)	499 (59.1%)	<0.001
Employed	1699 (62.2%)	1354 (71.8%)	345 (40.9%)	
Marital status				
Never married	560 (20.5%)	456 (24.2%)	105 (12.3%)	<0.001
Married	1931 (70.7%)	1334 (70.6%)	598 (70.9%)	
Separated	240 (8.8%)	98 (5.2%)	143 (16.8%)	
Mean number of children (SD)	4 (5)	4 (6)	4 (2)	

Table 2. Exposure to HIV interventions and HIV stigma among men and women in Sofala Province, Mozambique

	Total (N=2,731)	Men (n=1,887)	Women (n=844)	*p*-Value
HIV testing and exposure to HIV information				
Tested in the last 12 months				
No	1602 (58.8%)	1161 (61.7%)	441 (52.4%)	<0.001
Yes	1121 (41.2%)	721 (38.3%)	400 (47.6%)	
Tested ever in lifetime				
No	807 (29.6%)	670 (35.6%)	137 (16.3%)	<0.001
Yes	1919 (70.4%)	1214 (64.4%)	705 (83.7%)	
Know of an HIV testing center				
No	156 (5.7%)	130 (6.9%)	26 (3.1%)	<0.001
Yes	2572 (94.3%)	1755 (93.1%)	817 (96.9%)	
Seen or read HIV informational fliers				
No	993 (36.4%)	546 (29.0%)	447 (53.1%)	<0.001
Yes	1733 (63.6%)	1338 (71.0%)	395 (46.9%)	
Heard any HIV discussion on the radio				
No	704 (25.8%)	378 (20.1%)	326 (38.7%)	<0.001
Yes	2022 (74.2%)	1506 (79.9%)	518 (61.3%)	
Participated in HIV community discussion groups				
No	2023 (74.2%)	1294 (68.7%)	729 (86.5%)	<0.001
Yes	704 (25.8%)	590 (31.3%)	114 (13.5%)	
Of all the people you know, how many have HIV infection? (SD)	4 (12)	4 (14)	3 (5)	0.005
HIV stigma measures				
HIV shame subscale (SD)[1]	16.8 (3.9)	16.7 (3.8)	17.0 (4.1)	0.044
Discrimination of PLHIV subscale (SD)[1]	16.1 (3.4)	16.1 (3.5)	16.3 (3.2)	0.080
Inequity for PLHIV subscale (SD)[1]	8.6 (2.4)	8.3 (2.2)	9.2 (2.5)	<0.001
Perceived community stigma of PLHIV (SD)[1]	19.8 (3.7)	19.6 (3.4)	20.2 (4.1)	<0.001

Any anticipated individual stigma towards PLHIV				
No	2336 (86.2%)	1636 (87.3%)	700 (83.7%)	0.013
Yes	374 (13.8%)	238 (12.7%)	136 (16.3%)	

Note: [1]Scores of stigma subscales ranged from 10 to 33 for shame, 8 to 27 for discrimination, 5 to 19 for inequity, and 7 to 28 for community stigma.

Table 3. Correlates of recent HIV testing (last 12 months) among all participants (N=2,332)

	Crude		Adjusted	
Variable	**OR (95% CI)**	***p*-Value**	**Adj. OR (95% CI)**	***p*-Value**
Demographic characteristics				
Women (ref. men)	1.46 (1.24, 1.72)	<0.001	1.95 (1.55, 2.46)	<0.001
Age	0.98 (0.98, 0.99)	<0.001	0.98 (0.98, 0.99)	<0.001
Highest level of education completed (ref: none or primary)				
Secondary	1.75 (1.48, 2.07)	<0.001	1.48 (1.21, 1.79)	<0.001
Technical school or university	4.79 (2.80, 8.20)	<0.001	4.18 (2.37, 7.37)	<0.001
Currently employed (ref: unemployed)	1.11 (0.95, 1.30)	0.194	1.03 (0.85, 1.26)	0.746
Marital status (ref: never married)				
Married	1.10 (0.90, 1.33)	0.350	1.63 (1.28, 2.08)	<0.001
Separated	0.75 (0.55, 1.04)	0.082	1.31 (0.85, 2.02)	0.228
HIV testing and exposure to HIV information				
Seen or read HIV informational fliers	1.83 (1.56, 2.16)	<0.001	1.75 (1.42, 2.16)	<0.001
Heard any HIV discussion on the radio	1.14 (0.96, 1.36)	0.144	0.99 (0.80, 1.23)	0.945
Participated in HIV community discussion groups	1.78 (1.50, 2.12)	<0.001	1.73 (1.42, 2.12)	<0.001
HIV stigma measures				
HIV shame subscale	0.96 (0.94, 0.98)	<0.001	0.97 (0.95, 1.00)	0.071
Discrimination of PLHIV subscale	0.98 (0.96, 1.00)	0.081	0.99 (0.96, 1.02)	0.545
Inequity for PLHIV subscale	1.00 (0.97, 1.04)	0.783	1.06 (1.01, 1.11)	0.014
Perceived community stigma of PLHIV	1.04 (1.01, 1.06)	0.002	1.01 (0.99, 1.04)	0.263

Any anticipated individual stigma towards PLHIV (ref: no)	0.51 (0.40, 0.65)	<0.001	0.66 (0.50, 0.89)	0.005

Table 4. Adjusted associations with testing for HIV in the last 12 months by gender

	Men (n=1,714)		Women (n=618)	
Variable	**Adj. OR (95% CI)**	***p*-Value**	**Adj. OR (95% CI)**	***p*-Value**
Demographic characteristics				
Age	0.99 (0.98, 0.99)	0.001	0.98 (0.96, 1.00)	0.030
Highest level of education completed (ref: none or primary)				
Secondary	1.41 (1.12, 1.79)	0.004	1.67 (1.15, 2.42)	0.007
Technical school or university	4.29 (2.31, 7.98)	<0.001	2.88 (0.71, 11.65)	0.139
Currently employed (ref: unemployed)	1.06 (0.83, 1.36)	0.639	1.05 (0.74, 1.48)	0.781
Marital status (ref: never married)				
Married	1.48 (1.12, 1.97)	0.006	2.02 (1.22, 3.34)	0.006
Separated	1.38 (0.77, 2.47)	0.274	1.52 (0.75,3.09)	0.250
HIV testing and exposure to HIV information				
Seen or read HIV informational fliers	1.81 (1.40, 2.35)	<0.001	1.78 (1.24, 2.55)	0.002
Heard any HIV discussion on the radio	1.11 (0.85, 1.46)	0.449	0.84 (0.58, 1.21)	0.340
Participated in HIV community discussion groups	1.88 (1.51, 2.35)	<0.001	1.23 (0.76, 1.99)	0.408
HIV stigma measures				
HIV shame subscale	0.99 (0.96, 1.02)	0.481	0.94 (0.89, 0.99)	0.021
Discrimination of PLHIV subscale	0.98 (0.95, 1.01)	0.224	1.02 (0.96, 1.09)	0.435
Inequity for PLHIV subscale	1.07 (1.01, 1.13)	0.017	1.05 (0.97, 1.14)	0.247
Perceived community stigma of PLHIV	1.01 (0.98, 1.04)	0.564	1.03 (0.98, 1.07)	0.234
Any anticipated individual stigma towards PLHIV (ref: no)	0.60 (0.42, 0.86)	0.006	0.84 (0.50, 1.40)	0.497

Figure 1: Five most common reasons for failing to test for HIV in the last 12 months among men and women in Sofala Province, Mozambique.

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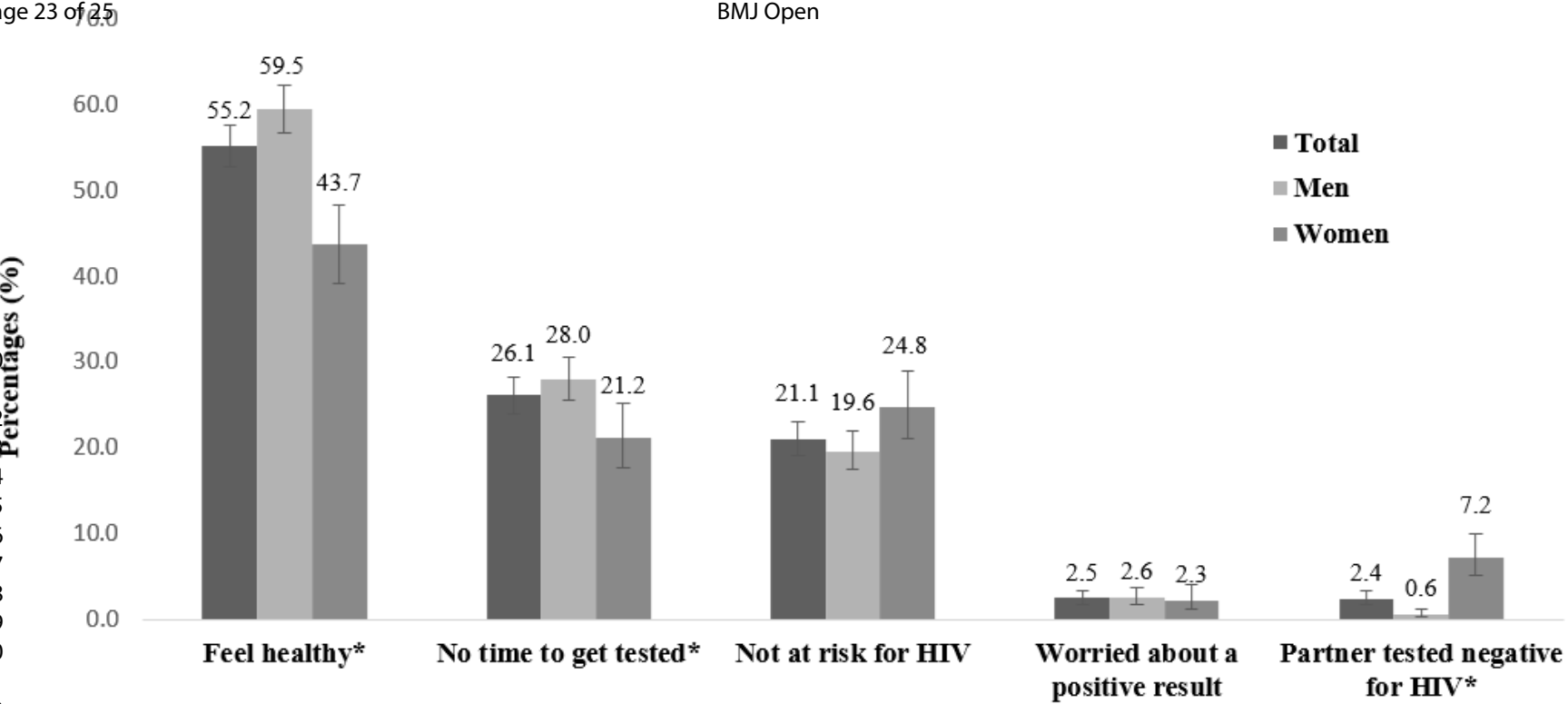

Note: * indicates for statistical significance of $p<0.05$. Error bars represent 95% CI.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-7*
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	7-8
		(*c*) Explain how missing data were addressed	7-8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7-8
		(*e*) Describe any sensitivity analyses	7-8
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8 + Tables
		(b) Indicate number of participants with missing data for each variable of interest	8+ Tables
Outcome data	15*	Report numbers of outcome events or summary measures	8+ Tables

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9 + Tables
		(*b*) Report category boundaries when continuous variables were categorized	7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

The Gendered Relationship Between HIV Stigma And HIV Testing Among Men And Women In Mozambique: A Cross-sectional Study to Inform A Stigma Reduction And Male-Targeted HIV Testing Intervention

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THE GENDERED RELATIONSHIP BETWEEN HIV STIGMA AND HIV TESTING AMONG MEN AND WOMEN IN MOZAMBIQUE: A CROSS-SECTIONAL STUDY TO INFORM A STIGMA REDUCTION AND MALE-TARGETED HIV TESTING INTERVENTION

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ABSTRACT:

Objectives*:* Increasing and sustaining engagement in HIV care for people living with HIV are critical to both individual therapeutic benefit and epidemic control. Men are less likely to test for HIV compared to women in sub-Saharan African countries, and ultimately have delayed entry to HIV care. Stigma is known to impede such engagement, placing an importance on understanding and addressing stigma to improve HIV testing and care outcomes. This study aimed to assess the gendered differences in the relationship between stigma and HIV testing.

Design and Setting: A cross-sectional, household probability survey was implemented between November and December 2016 in the Sofala province of Mozambique.

Participants: Data were restricted to men and women participants who reported no prior diagnosis of HIV infection (N=2,731).

Measures: Measures of socio-demographic characteristics, stigma, and past exposure to HIV interventions were included in gender-stratified logistic regression models to estimate the relationship between stigma and recent testing for HIV, as well as to identify other relevant correlates.

Results*:* Significantly fewer men (38.3%) than women (47.6%; p<0.001) had recently tested for HIV. Men who reported previous engagement in community group discussions about HIV had an increased odds of testing in the past 12 months compared to those who had not participated (aOR=1.92; 95% CI 1.51-2.44). Concerns about stigma was not a commonly reported barrier to HIV testing; however, men who expressed anticipated individual HIV stigma had a 35% lower odds of recent HIV testing (aOR=0.65; 95% CI 0.44-0.96). This association was not observed among women.

Conclusions*:* Men have lower uptake of HIV testing in Mozambique when compared to women. Even amidst the beneficial effects of HIV messaging, individual stigma is negatively associated with recent HIV testing among men. Intervention efforts that target the unique challenges and

needs of men are essential in promoting men's engagement into the HIV care continuum in sub-Saharan Africa.

Key words: HIV test; Mozambique; HIV care continuum; gender

ARTICLE SUMMARY:

Strengths and limitations of this study:

- This large, household probability survey explores the barriers to HIV testing, including stigma, which are distinct among men and women in a high HIV burden area district of Mozambique.
- HIV stigma was assessed using comprehensive measures to capture five relevant stigma domains: shame/blame/isolation, inequity, discrimination, perceived community stigma, and anticipated individual stigma towards PLHIV.
- Stigma domains and other potential correlates of recent HIV testing were stratified by gender to provide evidence for strategies to improve HIV testing and care among men.
- As a cross-sectional analysis, temporality was not established.

INTRODUCTION:

Global efforts are underway to achieve the Joint United Nations Programme on HIV/AIDS (UNAIDS) 2020 targets in which 90% of all people living with HIV (PLHIV) will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy (ART), and 90% of all people receiving ART be virally suppressed (90-90-90 strategy). This strategy aims to change the epidemic trajectories in many countries through treatment as prevention.[1] Despite the emphasis on the role of HIV testing in the HIV care continuum, challenges remain in achieving global targets by 2020.[2]

In sub-Saharan Africa, substantial investments have targeted and been successful in achieving high coverage of HIV testing among women in the context of antenatal care services and services to prevent mother-to-child transmission (PMTCT).[3, 4] However, fewer efforts have directly targeted HIV prevention, testing, and care for men and those that do include men often

succeed in reaching women with greater frequency than men.[5] In sub-Saharan Africa, HIV testing rates tend to be lower among men than women, which is often coupled with late entry to HIV care, poor retention in care and ART adherence, and greater mortality rates among men on treatment compared to women.[5, 6] These gender gaps indicate a need to shift attention towards addressing the unique barriers of HIV testing uptake among men and their engagement in HIV prevention and care continuums in sub-Saharan Africa.

Observational studies have provided evidence on the role of HIV stigma in HIV testing and care.[7,8] Qualitative and quantitative research have demonstrated that HIV is often associated with death, despite treatment advances, and that shame and blame are frequently assigned to PLHIV.[9, 10] Perceived HIV stigma can induce feelings of fear that prevent individuals from learning their HIV status, entering HIV-related facilities, and engaging in HIV-related services due to unwanted, negative attention of being identified as living with HIV, and has been associated with a two-fold increased odds of late presentation for HIV care in low-resource settings.[9, 11] A global meta-analysis estimated that HIV stigma was associated with 32% reduced odds of ART adherence, as well as worse outcomes related to depression, social support, and access to and usage of health and social services.[12] Complementary meta-analysis of qualitative data revealed that HIV-related stigma compromised general psychological processes, such as adaptive coping and social support, which are critical determinants of participants' ability to overcome the structural and economic barriers associated with poverty in order to successfully engage in care and adhere to ART.[13] Noted as a major barrier to HIV testing in sub-Saharan Africa, fear of HIV-related stigma is potentially exacerbated by low perceived HIV risk and financial concerns for the cost of HIV testing and care.[14] As men are less likely to seek testing, a critical evaluation of the relationship between stigma and other factors on the uptake of HIV testing among men should be explored to inform HIV prevention and care continuum interventions.

As the fourth leading country in number of PLHIV, Mozambique has an estimated range of 1.6 – 2.1 million PLHIV.[15] The country has an adult HIV prevalence of 13.2%, with 34% aware of their HIV status.[16] Data from the national AIDS Indicator Survey found that men had almost twice the odds of being unaware of their HIV status, compared to women, and regional data

demonstrate increased risk of advanced HIV disease and severe immunosuppression at diagnosis, clinical loss-to-follow-up, and death among men who are living with HIV.[17-19] Low awareness of one's status is likely attributable to low HIV testing rates; in 2015, only 38% of men participating in the Demographic Health Survey (DHS) reported any history of HIV testing and only 19% had been tested within the last 12 months, compared to 31% among women.[16] HIV testing services have expanded substantially across the country over the last decade and, with improved access, GIS data mapped to serial cross-sectional surveys among women have found that distance to HIV testing services is no longer a barrier to HIV testing at the regional level.[20] As such structural barriers are minimized, addititional research to understand lingering barriers to HIV testing – the first entry point to HIV prevention and care continua – are needed. Reports produced by the People Living with HIV Stigma Index suggest that HIV stigma is prevalent in Mozambique, and qualitative data from Mozambique highlight the potential impact of moral stigma – the perception that HIV is associated with immoral behaviors – on HIV testing.[21, 22] Gender-based differences in the association between stigma and HIV testing have not formally been assessed, but are necessary to understand differential uptake of HIV testing and awareness of HIV status.

The aim of this analysis was to identify and assess the role of HIV stigma and other correlates for recent uptake of HIV testing among men and women in a high burden province in Mozambique. This study was conducted as part of a baseline survey for a subsequent community-based stigma reduction and HIV care continuum intervention in Mozambique, which had a specific focus on improving HIV testing among men.

METHODS:

Study site and population*:* As part of a larger evaluation of a community-based intervention, a baseline, cross-sectional survey was conducted from November to December 2016. Eligibility requirements for participation in the study included providing signed consent to participate, being aged 18 years or older, and living in participating districts of the Sofala province in Mozambique. Sofala province was selected for the community-based interventions as it is one of the most HIV affected areas of Mozambique with an adult HIV prevalence of 16.3% as of the 2015 DHS.[16]

Two districts in Sofala Province, Nhamatanda and Dondo, each comprised of four facility sites and their surrounding catchment areas per district were selected for participation in the survey. Within Dondo district, the following sites were included: Canhandula, Dondo Sede, Mafambisse, and Macharote. Nhamatanda Sede, Nharuchonga, Tica, and Lamego were participating sites in Nhamatanda district. Sites were selected based on matching catchment area population size, with final selection based on security and availability of clinical data that was required for the parent study. Sampling in each site was proportional to population size and determined through household probability selection. In this process, a designated data collector would begin with a random start in their assigned location, then approach the door of every third house counted on each side of the street. Data collectors were required to interview only a family member of the same gender; if no head of household of the data collector's gender was available, the data collection staff would coordinate availability to ensure a staff member of the same gender could administer the interview. Each interviewer continued until they surveyed their quota of participants in each location. Prior to research implementation, the local research team briefed community leaders about the participant selection process and obtained approval and buy-in for the survey implementation within their communities.

The sample size was based on the parent study to assess the impact of a community-based intervention on community-level HIV stigma and HIV testing among men. We assumed 80% power to detect a conservative 5% difference in the change in stigma at alpha <0.05 between intervention and control, with an assumption of 20% loss to follow-up between baseline and endline. This produced a target sample of 1,500 per intervention or control group (N=3,000 total). Given the other outcomes of interest related to improvements in HIV testing among men, men were over-sampled to produce a sample comprised of two-thirds men and one-third women. Considering the estimated sample size of 1,500 per group, 66% of whom would be men, and 20% loss to follow-up, it was estimated that that there would be over 80% power to detect at least 10% difference in self-reported HIV testing among surveyed men in the intervention and control sites. A total of 3,017 enrolled in the baseline survey; however, individuals who had self-reported living with HIV at the time of survey were excluded from this analysis, producing an effective sample size of N=2,731 for this analysis (n=1,887 men and n=844 women).

Measures: Data for the baseline survey was collected through a tablet-based questionnaire administered by local interviewers. Interviewers were fluent in local languages of Sena or Ndao as well as Portuguese, had prior experience in health research, and had been trained on human subjects protection and confidentiality. Survey administration took approximately 45 minutes. The socio-behavioral survey collected information on demographic characteristics including gender identity, exposure to HIV prevention and testing, knowledge of HIV, relationships with PLHIV, and a comprehensive set of HIV stigma measures.

To ascertain recent HIV testing (last 12 months), participants were asked if they had ever been tested for HIV within their lifetime. Those who responded positively and who had not reported a positive diagnosis on their last HIV test, were then asked a categorical question of when their last HIV test was completed. This categorical response was then reclassified to a binary response to whether they had been tested within the last 12 months. Participants who reported no recent HIV testing were additionally asked to report reasons why they had not tested and could select multiple responses from a list of 13 potential barriers to testing.

HIV stigma was assessed using several measures to capture five relevant stigma domains. The HIV stigma scale developed by Genberg and colleagues in the sub-Saharan setting was used to measure feelings and perceptions about PLHIV and included three subscales measuring shame/blame/isolation, discrimination, and inequity of PLHIV (alpha: 0.79).[23] The domain of shame gauged the participants' tendency to blame and disgrace PLHIV, discrimination captured the extent to which participants believe PLHIV are unfairly treated, and inequity encompassed the preconceived opinions and prejudice towards PLHIV.[23] An example statement from the discrimination subscale includes "*People living with HIV/AIDS face neglect from their families*." While this scale was originally conceptualized as a way to identify individual discrimination, the framing of the discrimination statements leaves it open to participant interpretation of whether this is the participant's own anticipated behaviors or the anticipated behaviors of others.

We developed new measures (7 items) to assess perceived HIV stigma within the community (alpha: 0.77). An example statement in this measure included, "*In this community, men who are*

known to be living with HIV have the same level of importance in society as men who are not living with HIV." These sets of measures used 4-point Likert scale response options, in which 1 represented strong disagreement and 4 represented strong agreement with the statement. To score the community stigma measures and the HIV stigma scale, comprised of the three subscales, points from the Likert scale were summed across all items in the same measure, with the exception of those that were reverse coded, producing possible ranges in scores from 7 to 28 for perceived community stigma, 10 to 33 for shame/blame/isolation, 8 to 27 for discrimination, and 5 to 19 for inequity. A higher score meant greater levels of HIV stigma.

Measures of anticipated individual stigma towards PLHIV that are traditionally included in DHS AIDS Indicators Survey (5 items) were also included in the survey to explicitly measure the individual participant's anticipated stigmatizing behaviors towards PLHIV. An example question under the domain of anticipated individual HIV stigma asked, "*If you found out that one of your friends was living with HIV, would you still be friends with him/her?*"[24] A total of five items were evaluated with dichotomous responses of yes or no and were ultimately combined into a single binary variable "any anticipated individual stigma," which is based on whether a participant endorses at least one of the five pertinent items. Appendix 1 displays the full set of stigma measures included in the survey.

Statistical Analyses*:* This analysis aimed to identify the correlates of HIV testing among HIV-uninfected individuals in Mozambique and to evaluate whether gender modified the relationship between stigma, other variables of interest, and the outcome of recent HIV testing. Descriptive analysis that was stratified by gender was conducted to assess characteristics of the study sample, including prevalence of recent HIV testing and stigma scores. Chi-squared tests were implemented to assess differences by gender for categorical variables; t-tests were implemented to assess differences across continuous variables.

A bivariate analysis was initially performed to identify potential correlates of recent HIV testing among the total sample. Additional models were stratified by gender to determine variables that would be appropriate to include in the final model for each gender. The independent variables tested in the models included HIV prevention experience, HIV knowledge, and stigma among

participants, while demographics, such as age and education level, were considered as potential confounders in the model. The five domains of stigma were tested separately in the models: scores for shame/blame/isolation, discrimination, and inequity subscales, as well as perceived community stigma, were tested as continuous variables, while anticipated individual stigma was tested as a binary variable.

Using variables identified in the bivariate models based on $p<0.10$, a final multivariate logistic regression model was built to present adjusted odds ratios, which allowed for the controlling of potential confounders in the analysis. The logistic regression model was stratified by gender to present potential associations that differed between men and women for having recently tested for HIV. Multivariable models were run for the combined sample, as well as separately for each gender. Of the variables that presented a difference in relationship by gender, interaction terms were added in the combined multivariate model to evaluate their statistical significance. Variance inflation factor was calculated to test for collinearity in the final models. The Hosmer-Lemeshow test was also conducted to test for goodness-of-fit. All analyses were conducted in STATA 14 and adjusted for potential clustering of participants induced by the sampling methodology using complex survey design procedures.[25]

Patient and Public Involvement: No patients were involved in this study. As a cross-sectional household survey, the public were involved in community information sharing sessions before and after the study to support recruitment and sharing of study results, respectively. Members of the public were selected for participation in the survey via probability-based sampling. Results of the study have been shared with development agencies supporting HIV programming in Mozambique.

Human Subjects*:* The study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board and the National Committee of Bioethics for Health (CNBS) in Mozambique.

RESULTS:

Table 1 provides a description of demographic characteristics by the gender of participants (no participants identified as transgender or gender non-binary). Men and women participants were similar in age, education, and income level. However, among the 2,731 self-reported HIV uninfected individuals (1,887 men and 844 women), men tended to have slightly higher levels of employment than women (Table 1).

Table 2 describes participants' exposure to HIV testing, prevention resources, and perceptions of HIV stigma. More than half of the participants did not test for HIV in the year prior to the baseline survey, which was significantly higher among men (61.7% vs. 52.4%, p<0.001). Women were more likely than men to have had a recent HIV test, while men were more commonly exposed to HIV information than women via the radio, informational fliers, and community discussion groups (p<0.001). With respect to the domains of stigma, participants had generally low levels of perceived stigma including shame/blame/isolation, discrimination, or inequity towards PLHIV. Women were more likely than men to endorse at least one form of anticipated individual stigma towards PLHIV (16.3% vs. 12.7%, p=0.013) and reported higher on average scores than men in having perceived shame/blame/isolation, feelings of inequity, and perceived community stigma towards PLHIV (Table 2).

When asked to report the reasons for not having tested for HIV in the last 12 months, over half of participants who reported no recent test indicated it was because they felt healthy (55%), lacked time for HIV testing (26%), and had low perceived risk (21%). Men were more likely to report feeling healthy and not having time to get tested than women. In a separate analysis, men who were currently employed were more likely to report lack of time as a barrier to HIV testing (ref: unemployed; OR=1.46; 95% CI 1.09-1.95, *p*=0.010; data not displayed). Figure 1 displays the five most common reasons for failure to test among men and women. Concerns related to stigma and perceived gender norms associated with HIV testing were not commonly reported reasons for lack of recent HIV testing. For example, 1.7% of participants reported that they had not recently tested for HIV due to concerns about negative treatment by healthcare workers, as well as concerns that neighbors or families suspect that they are living with HIV infection (0.4%), or concerns that people would believe they were unfaithful or misbehaving (0.5%).

Insert Figure 1

In the multivariable logistic regression model that included the combined sample of men and women (Table 3), the odds of recent HIV testing were almost 2 times higher among women than men (aOR=1.79; 95% CI 1.39-2.30). Other correlates of recent HIV testing included being married, attaining secondary education or technical school or university, past receipt of informational fliers about HIV, knowing two or more people who were living with HIV, and past participation in community group discussions about HIV were also significantly associated with recent HIV testing. Modest associations were observed among participants all male and female participants in terms of anticipated individual stigma and inequity for PLHIV: participants who endorsed at least one form of anticipated individual stigma towards PLHIV had a 26% reduced odds of recent HIV testing, compared to those with none (aOR=0.74; 95% CI 0.54-1.01). The subscale measuring feelings of inequity for PLHIV had a modest positive association with HIV stigma, wherein for each point higher on the scale, there was a 1.07 increased odds in recent HIV testing (aOR=1.07; 95% CI 1.02-1.13).

To explore effect modification by gender in the relationship between stigma and recent HIV testing and to identify unique correlates of recent HIV testing, gender disaggregated multivariable logistic regression models were implemented (Table 4). Among men, higher education, knowing two or more people who were living with HIV (aOR=1.38; 95% CI 1.08-1.76), and engagement in community discussion groups (aOR=1.92; 95% CI 1.51-2.44) were associated with increased odds of recent HIV testing. Men who endorsed at least one form of anticipated individual stigma towards PLHIV had a 35% lower odds of recent HIV testing (aOR=0.65; 95% CI 0.44-0.96), whereas there was a modest positive association between the inequity subscale and HIV testing among men (aOR=1.10; 95% CI 1.03-1.17).

Women with secondary education and who were currently married were more likely to report recent HIV testing. Having seen or read any informational fliers about HIV was also associated with an increased odds of recent HIV testing among women (aOR=1.83; 95% CI 1.25-2.66).

DISCUSSION:

Stigma has a well-documented role in inhibiting engagement across the HIV prevention and care continuums and greater understanding, particularly for men who are less engaged in the HIV care continuum, is critical to meeting global epidemic targets.[26] This study found that endorsement of anticipated individual stigma among men was associated with a 35% reduced odds of recent HIV testing – a finding that was unique to men. The measures of anticipated individual stigma captured how participants felt they would personally react to PLHIV; given the magnitude of the association among men, this suggests that men may avoid HIV testing to avoid similar treatment by others. Conversely, exposure to HIV informational messages through community discussions and fliers was positively associated with recent HIV testing for men, as well as for women. These findings suggest that interventions to improve HIV testing for men may be optimized by providing both stigma reduction efforts as well as communication about the benefits and importance of HIV testing.

While anticipated individual HIV stigma was found to be associated with decreased odds of recent HIV testing among men, concerns related HIV stigma was not often a reported reason for not completing HIV testing within the last 12 months. Rather, participants predominantly reported that they did not seek testing because they felt they were not at risk for HIV, felt healthy, or did not have time. There are two (not mutually exclusive) potential explanations for these disparities in findings. Within social epidemiology, stigma is widely viewed and measured as a latent trait, as it was in this analysis that utilized comprehensive scales to measure various forms of HIV stigma.[23, 24] Thus, specific concerns related to stigma as a reason for failing to test for HIV may be very different in perceived significance from what may be captured by more comprehensive scales that capture the multitude manifestations of HIV stigma. Second, it is possible that stigma serves as an overarching issue that impacts individual efforts to overcome barriers to HIV testing, as suggested by other authors.[13] In this sense, stigma that is present ubiquitously among individuals may prevent them from resolving more immediate barriers related to time or perceived risk for HIV acquisition. Addressing both immediate barriers to HIV testing as well as reducing stigma are important areas of focus for HIV testing interventions for men, who do not have the same normative access to HIV testing that women do through antenatal programs.

Unlike the relationships identified for men, we found that women endorsed greater feelings of stigma towards PLHIV compared to men; however, stigma did not appear to be associated with women's testing behaviors. One likely explanation for the gender differential in recent HIV testing and the lack of correlation with stigma among women is the availability of HIV testing in routine antenatal care. Other research from Sofala Province estimated that at least 74% of women routinely receiving antenatal care services in the Sofala province had tested for HIV in 2009 – an estimate that has likely increased in recent years.[27] It may be that, unlike for men, antenatal care services allow women to access HIV testing within the context of other reproductive care. With women visiting health facilities for antenatal care, following and providing regular HIV prevention and care services, amongst other services, is more common for women than for men.[28] In theory, male partners may access HIV testing at antenatal care sites through their partner; however, in practice, men's engagement in antenatal care services are low in Mozambique.[29] Given that specialty services for men are not common within health facilities, increasing testing opportunities in locations that men frequent, such as hosting workplace testing events, and providing self-testing services at home or within the community are strategies to improve HIV testing among men.[30] These testing interventions may reduce barriers associated with anticipated HIV stigma, as well as observed barriers related to time constraints and perceptions of being healthy.

Community discussion groups were found to be positively associated with recent HIV testing in this study and have previously been successful in influencing a change in gender attitudes, gender roles, and HIV stigma that also play a part in the uptake of HIV prevention and care services.[31] Considering the higher proportion of men than women exposed to HIV prevention messages, increasing and effectively distributing HIV prevention resources that deliver information on HIV via fliers and community discussion groups among others are important for future interventions targeting men. Contrary to these findings, an association was not observed between hearing discussions about HIV on the radio and recent HIV testing. The content of the radio programs that participants had heard was not documented and it may be the case that some radio programs contained negative messages or misinformation. A closer evaluation of the content of the radio programs would allow for better understanding of its relationship with recent testing for HIV. As radio is one of the most dominant forms of communication within

Mozambique, with over 90% of households reportedly owning a radio, developing positive messages for radio dissemination may play an important role in encouraging HIV testing and reducing misinformation and stigma.[32]

Finally, knowing multiple individuals who are living with HIV was positively associated with recent HIV testing among men. In this case, witnessing the benefits of testing and prompt ART initiation may buffer against stigma and motivate men to initiate or increase the frequency of HIV testing. These findings are consistent with other prospective research conducted in South Africa, which demonstrated that knowing others who were living with HIV decreased individual stigma of HIV over time and, ultimately increased uptake of community voluntary counseling and testing.[33]

The findings should be viewed in light of study limitations. With the exception of the perceived community stigma measures, other stigma measures were established a decade ago and items may need to be added or adjusted to account for changing social dynamics and programming as the epidemics progresses. The community stigma measure was developed for the purpose of this assessment and has not been validated, though psychometric testing is underway. As a cross-sectional analysis, temporality was not established and the direction of the associations cannot be established. Given that stigma takes long periods of time to develop and change, we presume that stigma influences recent HIV testing behaviors; however, there is the possibility that HIV testing experiences could have changed participants' perspectives about stigma. Further, there is the possibility that greater HIV stigma may increase HIV testing as a means to prevent the disease, as may be the case for women who endorsed greater stigma. Such a relationship has not been borne out in the scientific literature. The observation that current marriage is one of the strongest correlates of recent HIV testing among women, likely because it is also correlated with number of child births, rather suggests that the effects of stigma may be overcome by routine HIV testing in the context of prenatal care for women. Finally, social desirability bias could have influenced our estimates of stigma and HIV testing.

CONCLUSION:

Stigma is and should be widely recognized as a potent social determinant in health seeking behaviors that compromises health among populations, particularly as it relates to HIV testing and care.[34, 35] Of the various forms of stigma, anticipated individual stigma was found to be strongly associated with reduced uptake of recent HIV testing among men. The availability of HIV testing within antenatal care services provides opportunities for women to engage in HIV testing, while challenges to engage men in HIV testing and, broadly, the HIV care continuum persist. Findings from this study suggest that efforts to improve HIV testing among men should focus on addressing both stigma reduction and immediate barriers to HIV testing, and may be able to build on the positive effects of community-based HIV prevention and care activities. As HIV testing and diagnosis are essential to linking individuals to treatment and care, acting on the individual, social, and structural barriers that disparately impact men and women will be necessary to achieving the ambitious goal of 90-90-90 to end the HIV epidemic in sub-Saharan Africa.

Conflict of Interest Statement:

The authors declare that they have no competing interests.

Authorship:

LVL, ECM, PD, and ALW designed the study concept. JC and DP oversaw data collection. ALW, JHH, and JC had full access to study data. JHH conducted statistical analysis and wrote the initial draft of the manuscript with oversight and support by ALW. All authors review and provided scientific input.

Date Sharing Statement:
Technical appendix, statistical code, and dataset available upon request to the authors.

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TABLES:

Table 1. Demographic characteristics of participants in Sofala Province, Mozambique (N=2,731)

	Total (N=2,731)	**Men (n=1,887)**	**Women (n=844)**	***p*-Value**
Age (SD), years	35.5 (15.5)	37.3 (16.2)	31.6 (12.8)	<0.001
Average monthly income (SD), MZN	10700 (380000)	14221 (460000)	2944 (4500)	0.480
District of residence				
Nhamatanda	1385 (50.7%)	951 (50.4%)	434 (51.4%)	0.621
Dondo	1346 (49.3%)	936 (49.6%)	410 (48.6%)	
Highest level of education completed				
None or primary	1396 (56.5%)	1004 (55.6%)	392 (59.0%)	0.087
Secondary	1004 (40.6%)	744 (41.2%)	260 (39.2%)	
Technical school or university	70 (2.8%)	58 (3.2%)	12 (1.8%)	
Current employment status				
Unemployed	1031 (37.8%)	532 (28.2%)	499 (59.1%)	<0.001
Employed	1699 (62.2%)	1354 (71.8%)	345 (40.9%)	
Marital status				
Never married	560 (20.5%)	456 (24.2%)	105 (12.3%)	<0.001
Married	1931 (70.7%)	1334 (70.6%)	598 (70.9%)	
Separated	240 (8.8%)	98 (5.2%)	143 (16.8%)	
Mean number of children (SD)	4 (5)	4 (6)	4 (2)	

Table 2. Exposure to HIV interventions and HIV stigma among men and women in Sofala Province, Mozambique

	Total (N=2,731)	Men (n=1,887)	Women (n=844)	*p*-Value
HIV testing and exposure to HIV information				
Tested in the last 12 months				
No	1602 (58.8%)	1161 (61.7%)	441 (52.4%)	<0.001
Yes	1121 (41.2%)	721 (38.3%)	400 (47.6%)	
Ever tested (lifetime)				
No	807 (29.6%)	670 (35.6%)	137 (16.3%)	<0.001
Yes	1919 (70.4%)	1214 (64.4%)	705 (83.7%)	
Know of an HIV testing center				
No	156 (5.7%)	130 (6.9%)	26 (3.1%)	<0.001
Yes	2572 (94.3%)	1755 (93.1%)	817 (96.9%)	
Seen or read HIV informational fliers				
No	993 (36.4%)	546 (29.0%)	447 (53.1%)	<0.001
Yes	1733 (63.6%)	1338 (71.0%)	395 (46.9%)	
Heard any HIV discussion on the radio				
No	704 (25.8%)	378 (20.1%)	326 (38.7%)	<0.001
Yes	2022 (74.2%)	1506 (79.9%)	518 (61.3%)	
Participated in HIV community discussion groups				
No	2023 (74.2%)	1294 (68.7%)	729 (86.5%)	<0.001
Yes	704 (25.8%)	590 (31.3%)	114 (13.5%)	
Median number of people known to be living HIV infection (IQR)	1 (0-5)	1 (0-4)	1 (0-4)	0.005
HIV stigma measures				
HIV shame subscale (SD)[1]	16.8 (3.9)	16.7 (3.8)	17.0 (4.1)	0.044
Discrimination of PLHIV subscale (SD)[1]	16.1 (3.4)	16.1 (3.5)	16.3 (3.2)	0.080
Inequity for PLHIV subscale (SD)[1]	8.6 (2.4)	8.3 (2.2)	9.2 (2.5)	<0.001
Perceived community stigma of PLHIV (SD)[1]	19.8 (3.7)	19.6 (3.4)	20.2 (4.1)	<0.001

Any anticipated individual stigma towards PLHIV				
No	2336 (86.2%)	1636 (87.3%)	700 (83.7%)	0.013
Yes	374 (13.8%)	238 (12.7%)	136 (16.3%)	

Note: [1]Scores of stigma subscales ranged from 10 to 33 for shame, 8 to 27 for discrimination, 5 to 19 for inequity, and 7 to 28 for community stigma.

Table 3. Correlates of recent HIV testing (last 12 months) among all participants (N=2,332)

	Crude		Adjusted	
Variable	**OR (95% CI)**	***p*-Value**	**Adj. OR (95% CI)**	***p*-Value**
Demographic characteristics				
Women (ref. men)	1.46 (1.24, 1.72)	<0.001	1.79 (1.39, 2.30)	<0.001
Age	0.98 (0.98, 0.99)	<0.001	0.98 (0.98, 0.99)	<0.001
Highest level of education completed (ref: none or primary)				
Secondary	1.75 (1.48, 2.07)	<0.001	1.48 (1.20, 1.82)	<0.001
Technical school or university	4.79 (2.80, 8.20)	<0.001	3.66 (1.96, 6.86)	<0.001
Currently employed (ref: unemployed)	1.11 (0.95, 1.30)	0.194	1.06 (0.85, 1.31)	0.610
Marital status (ref: never married)				
Married	1.10 (0.90, 1.33)	0.350	1.71 (1.31, 2.21)	<0.001
Separated	0.75 (0.55, 1.04)	0.082	1.19 (0.75, 1.89)	0.466
Number of people participant knows who are living with HIV (ref: none)				
One	1.15 (0.86, 1.53)	0.357	1.22 (0.88, 1.70)	0.228
Two or more	1.65 (1.39, 1.97)	<0.001	1.37 (1.11, 1.68)	0.003
HIV testing and exposure to HIV information				
Seen or read HIV informational fliers	1.83 (1.56, 2.16)	<0.001	1.71 (1.32, 2.17)	<0.001
Heard any HIV discussion on the radio	1.14 (0.96, 1.36)	0.144	0.93 (0.73, 1.17)	0.531
Participated in HIV community discussion groups	1.78 (1.50, 2.12)	<0.001	1.75 (1.41, 2.18)	<0.001
HIV stigma measures				

HIV shame subscale	0.96 (0.94, 0.98)	<0.001	0.98 (0.95, 1.01)	0.158
Discrimination of PLHIV subscale	0.98 (0.96, 1.00)	0.081	0.99 (0.96, 1.02)	0.534
Inequity for PLHIV subscale	1.00 (0.97, 1.04)	0.783	1.07 (1.02, 1.13)	0.005
Perceived community stigma of PLHIV	1.04 (1.01, 1.06)	0.002	1.02 (0.99, 1.05)	0.162
Any anticipated individual stigma towards PLHIV (ref: no)	0.51 (0.40, 0.65)	<0.001	0.74 (0.54, 1.01)	0.056

Table 4. Adjusted associations with testing for HIV in the last 12 months by gender

	Men (n=1,714)		**Women (n=618)**	
Variable	**Adj. OR (95% CI)**	***p*-Value**	**Adj. OR (95% CI)**	***p*-Value**
Demographic characteristics				
Age	0.98 (0.98, 0.99)	0.001	0.98 (0.96, 1.00)	0.038
Highest level of education completed (ref: none or primary)				
Secondary	1.40 (1.08, 1.81)	0.010	1.66 (1.13, 2.44)	0.010
Technical school or university	3.81 (1.89, 7.65)	<0.001	2.63 (0.60, 11.43)	0.198
Currently employed (ref: unemployed)	1.06 (0.83, 1.36)	0.689	1.09 (0.75, 1.56)	0.638
Marital status (ref: never married)				
Married	1.60 (1.17, 2.19)	0.003	2.01 (1.21, 3.34)	0.007
Separated	1.10 (0.57, 2.11)	0.773	1.55 (0.74, 3.27)	0.245
Number of people participant knows who are living with HIV (ref: none)				
One	1.20 (0.80, 1.78)	0.374	1.30 (0.70, 2.40)	0.398
Two or more	1.38 (1.08, 1.76)	0.010	1.36 (0.91, 2.04)	0.133
HIV testing and exposure to HIV information				
Seen or read HIV informational fliers	1.75 (1.31, 2.34)	<0.001	1.83 (1.25, 2.66)	0.002
Heard any HIV discussion on the radio	1.05 (0.77, 1.42)	0.763	0.80 (0.55, 1.18)	0.267
Participated in HIV community discussion groups	1.92 (1.51, 2.44)	<0.001	1.15 (0.70, 1.92)	0.567
HIV stigma measures				
HIV shame subscale	0.99 (0.95, 1.02)	0.501	0.95 (0.90, 1.01)	0.112

Discrimination of PLHIV subscale	0.98 (0.94, 1.01)	0.168	1.03 (0.96, 1.09)	0.430
Inequity for PLHIV subscale	1.10 (1.03, 1.17)	0.003	1.04 (0.95, 1.09)	0.101
Perceived community stigma of PLHIV	1.01 (0.97, 1.05)	0.640	1.03 (0.99, 1.08)	0.884
Any anticipated individual stigma towards PLHIV (ref: no)	0.65 (0.44, 0.96)	0.032	1.04 (0.60, 1.80)	0.884

Figure 1: Five most common reasons for failing to test for HIV in the last 12 months among men and women in Sofala Province, Mozambique.

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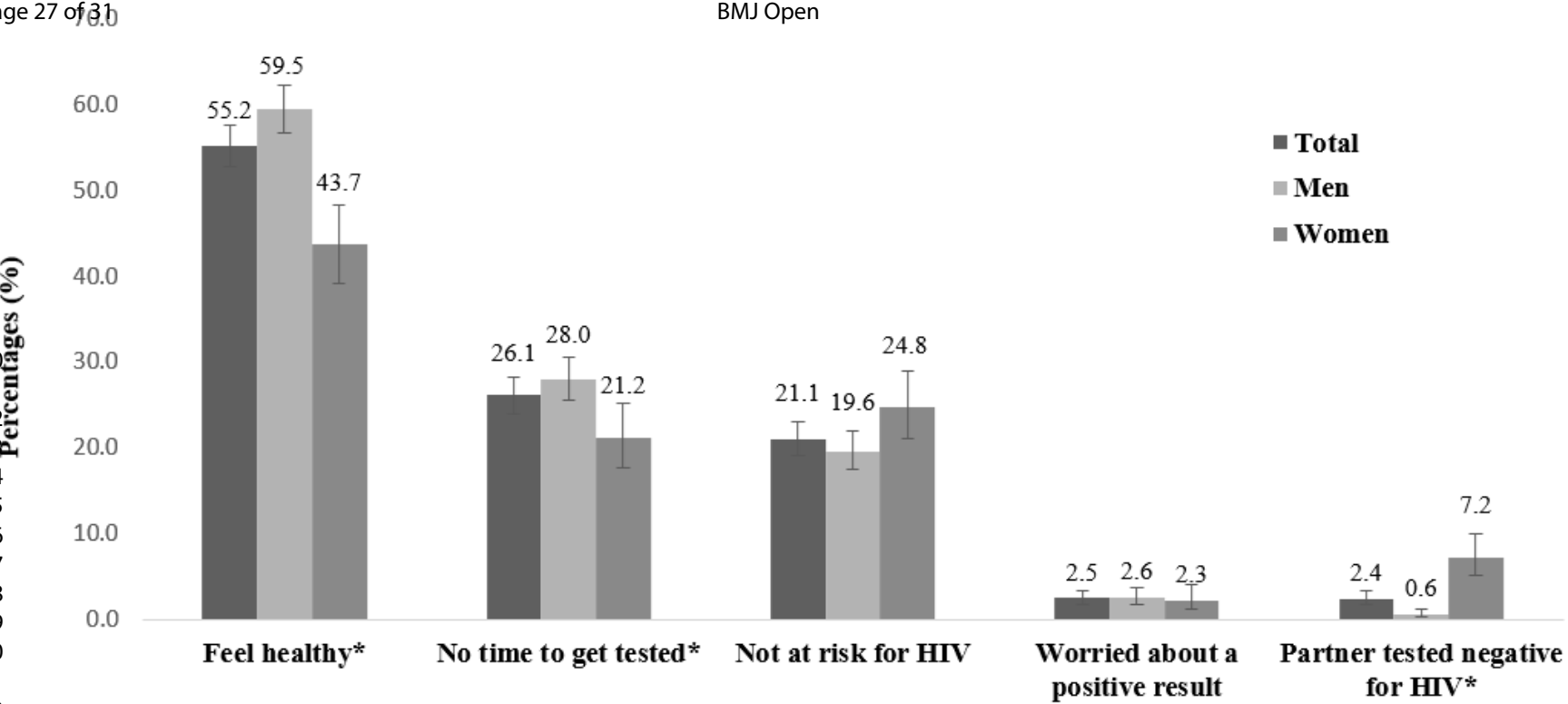

Note: * indicates for statistical significance of $p<0.05$. Error bars represent 95% CI.

THE GENDERED RELATIONSHIP BETWEEN HIV STIGMA AND HIV TESTING AMONG MEN AND WOMEN IN MOZAMBIQUE: A CROSS-SECTIONAL STUDY TO INFORM A STIGMA REDUCTION AND MALE-TARGETED HIV TESTING INTERVENTION

Judy H. Ha[1], Lynn Van Lith[2], Elizabeth C. Mallalieu[2], Jose Chidassicua[3], Dirce Pinho[3], Patrick Devos[3], Andrea L. Wirtz[4*]

Appendix: Stigma survey measures

Genberg Stigma Scale: Shame/blame/isolation subscale *(measured as 4 point Likert scale of level of agreement)*[1]
People living with HIV/AIDS should be ashamed
People with AIDS should be isolated from other people.
People who have HIV/AIDS are cursed
A person with HIV/AIDS should be allowed to work with other people[+]
People living with HIV/AIDS deserved to be punished
Families of people living with HIV/AIDS should be ashamed
It is reasonable for an employer to fire people who have HIV/AIDS
People living with HIV/AIDS are disgusting
People who have HIV/AIDS deserve compassion[+]
People with HIV should be allowed to participate fully in the social events in this community[+]
Genberg Stigma Scale: Discrimination subscale *(measured as 4 point Likert scale of level of agreement)*[1]
People living with HIV/AIDS face neglect from their families
People living with HIV/AIDS face physical abuse
People want to be friends with someone who has HIV/AIDS[+]
People living with HIV/AIDS face ejection from their homes by their families
Most people would not buy vegetables from a shopkeeper or food seller that they knew had AIDS
People who are suspected of having HIV/AIDS lose respect in the community
People who have HIV/AIDS face verbal abuse
People living with HIV/AIDS face rejection from their peers
Genberg Stigma Scale: Equality subscale *(measured as 4 point Likert scale of level of agreement)*[1]
People who have HIV/AIDS should be treated the same as everyone else[+]
People with HIV/AIDS do not deserve any support
People with HIV/AIDS should not have the same freedoms as other people
People living with HIV/AIDS should be treated similarly by healthcare professionals as people with other illnesses[+]
DHS AIDS Indicator Stigma Measures: Anticipated individual stigma *(measured as a binary yes/no item)*[2]
Would you buy fresh vegetables from a shopkeeper or vendor if you knew that this person had HIV/AIDS?
If a member of your family got infected with HIV/AIDS, would you want it to remain a secret or not?

[Continued from above] ***DHS AIDS Indicator Stigma Measures: Anticipated individual stigma*** *(measured as a binary yes/no item)*[2]
If a member of your family became sick with HIV/AIDS, would you be willing to care for him/her in your own household?
If a teacher at the school where you send your students had HIV/AIDS, would you continue to send your children there?
If you found out that one of your friends was living with HIV, would you still be friends with him/her?
New Community Stigma Measures *(measured as 4 point Likert scale of level of agreement)*
In this community, men who are known to be living with HIV are treated with respect. [+]
In this community, men who are known to be living with HIV have the same level of importance in society as men who are not living with HIV. [+]
In this community, women who are known to be living with HIV are treated with respect. [+]
In this community, women who are known to be living with HIV are considered equally valuable members of the family as those who are not living with HIV. [+]
In this community, people who are not living with HIV give support to those who are living with HIV infection. [+]
In this community, community members - including people living with and without HIV infection – work together to address the HIV epidemic. [+]
In this community, there are laws and policy to protect people who are living with HIV from discrimination. [+]

Note: [+] Indicates items that are reverse coded for scoring

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-7*
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	7-8
		(*c*) Explain how missing data were addressed	7-8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7-8
		(*e*) Describe any sensitivity analyses	7-8
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8 + Tables
		(b) Indicate number of participants with missing data for each variable of interest	8+ Tables
Outcome data	15*	Report numbers of outcome events or summary measures	8+ Tables

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9 + Tables
		(*b*) Report category boundaries when continuous variables were categorized	7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.