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ORIGINAL ARTICLE

Prevalence and sociodemographic determinants of public stigma towards people with HIV and its impact on HIV testing uptake: A cross-sectional study in 64 low- and middle-income countries

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Abstract

Background: HIV stigma and discrimination are drivers of adverse HIV outcomes because they deter individuals from engaging in the HIV care continuum. We estimate the prevalence of public stigma towards people with HIV, investigate individuals' sociodemographic determinants for reporting stigmatizing attitudes, and test the impact of HIV stigma on HIV testing uptake.

Methods: This was an observational study based on an analysis of cross-sectional surveys from 64 low- and middle-income countries. We used nationally representative survey data for the population aged 15–49 years from 2015 to 2021, which was the latest available data. HIV public stigma was measured using an index of two questions about attitudes towards people with HIV. First, prevalence estimates of HIV stigma were calculated by country, across countries, and by sociodemographic characteristics. Second, country fixed-effects multivariable logistic regression models were fit to assess sociodemographic determinants of holding stigmatizing attitudes towards people with HIV. Additional logistic regression models assessed country-level income and HIV prevalence as determinants of stigma and assessed the role of HIV public stigma as a driver of testing uptake.

Results: A total of 1 172 841 participants were included in the study. HIV stigma was prevalent in all countries, ranging from 12.87% in Rwanda to 90.58% in Samoa. There was an inverse dose–response association between HIV stigma and educational level, wealth quintile, and age group, whereby higher levels of each were associated with lower odds of holding stigmatized attitudes towards people with HIV. The odds of stigmatized attitudes were lower among men and individuals with adequate knowledge of HIV. HIV stigma was lower in countries with greater gross domestic product per capita and HIV prevalence. Holding stigmatized attitudes towards people with HIV

was associated with lower testing uptake, including having ever tested or having tested in the last year.

Conclusion: HIV stigma is present to a highly varying degree in all countries studied, so different approaches to reducing stigma towards people with HIV are required across settings. Action to eliminate HIV stigma is crucial if we are to progress towards ending HIV because holding stigmatized attitudes towards people with HIV was associated with reduced testing.

KEYWORDS

HIV, low- and middle-income countries, social determinants of health, sociodemographic inequities, stigma, testing

INTRODUCTION

HIV stigma and discrimination are recognized as key barriers to addressing the HIV epidemic because they affect the lives, health, and wellbeing of people with HIV and, in turn, of society as a whole [1]. The Joint United Nations Programme on HIV/AIDS (UNAIDS) Global AIDS Strategy 2021–2026 set the goal of ending stigma and discrimination towards people living with and affected by HIV [2, 3]. Similarly, the World Health Organization (WHO) recognizes the importance of international goal setting to reduce stigma. The WHO global health sector strategies on, respectively, HIV, viral hepatitis, and sexually transmitted infections (STIs) 2022–2030 set 2030 country targets that "less than 10%" of people with HIV experience HIV-related stigma. Despite progress in the treatment and prevention of HIV, people with HIV continue to experience negative attitudes, beliefs, and behaviours based on their HIV status, leading to a range of negative social and health outcomes, including decreased access to healthcare, reduced quality of life, and increased vulnerability to HIV transmission. The impact of stigma and discrimination is not limited to individual experiences but also extends to public health and societal outcomes, hindering efforts to end the HIV epidemic [4].

HIV-related stigma refers to negative attitudes and beliefs held by individuals or society towards people with HIV. Stigma can occur in different forms. One form is public stigma, which is the stigma held by members of society towards people with HIV, including in interpersonal relationships [5–7]. Discrimination refers to actions that restrict the rights, opportunities, and access to resources of people with HIV based on these negative attitudes and beliefs.

Stigma and discrimination towards people with HIV impact the HIV response throughout the HIV care continuum. Stigma and discrimination can deter individuals from testing for HIV, which means that people with HIV either do not get tested at all or experience delays in being diagnosed with HIV. This has additional major cascading effects, resulting in people not accessing HIV treatment and ultimately not achieving viral suppression [8–11], the key pillars of the global 95–95–95 HIV targets for ending AIDS [2]. Stigma and discrimination towards people with HIV can also deter individuals from accessing HIV prevention and broader sexual health services [11]. Additionally, stigma and discrimination deteriorate the health-related quality of life of people with HIV [12, 13] and exacerbate multimorbidity, including poor mental health [11, 14, 15]. Social rejection based on HIV serostatus may also drive mental health deterioration through social isolation, low self-esteem, and adverse socioeconomic outcomes, deepening social and health inequalities by HIV status [14, 15].

Knowledge of the occurrence of stigmatized and discriminatory attitudes towards people with HIV and the characteristics of this population can provide insights for targeted interventions to reduce stigma and discrimination towards ending HIV and achieving long-term wellbeing [16]. Here, we measure the societal prevalence of stigmatized and discriminatory attitudes towards people with HIV in 64 countries and assess individuals' sociodemographic determinants for reporting public HIV stigma. Finally, we quantify the impact of this reported public stigma on HIV testing.

MATERIALS AND METHODS

Study design and participants

We conducted an analysis of cross-sectional surveys covering 64 low- and middle-income countries using the latest available data from the period 2015 to 2021 from Demographic and Health Surveys (DHS) [17] from round VII or Multiple Indicator Cluster Surveys (MICS) from

round 6. DHS and MICS provide nationally representative survey microdata collected through probabilistic sampling. We included surveys from the latest DHS and MICS rounds as they share common questions on HIV public stigma and provide the most recent data.

We constructed an analysis sample that included all women and men aged between 15 and 49 years at the time of the survey who had data on the main outcome variable (in a few countries, the questionnaire's HIV module was only asked to a nationally representative sub-population). Eleven countries only had data from women, and one country only had data from ever-married men and women. The included countries were those classified as low- or middle-income countries at the time of survey implementation according to the World Bank country classification by income level [18]. Appendix A1 provides details on the sample characteristics and size for each country.

Outcomes

The main outcome variable was stigmatizing and discriminatory attitudes towards people with HIV, also referred to as HIV public stigma or, here onwards, HIV stigma. HIV stigma was measured as an index of two questions about attitudes towards people with HIV. Previous efforts by UNAIDS to monitor HIV stigma and discrimination have used this measurement approach [19].

Response to the main outcome was dependent on the respondent having ever heard of HIV (i.e., individuals who had never heard of HIV were filtered out of the survey module on HIV). The first question asked whether the respondent would buy fresh vegetables from a shopkeeper or vendor who is HIV positive, for which the possible responses were 'yes', 'no', or 'don't know/not sure/it depends'. The second question asked whether the respondent thought that children living with HIV should be allowed to attend school with children who do not have HIV. The possible responses included 'yes', 'no', or 'do not know/not sure/it depends'. There were minor variations in the questions across surveys: in a few countries, the questions referred to 'AIDS' instead of 'HIV' or to 'students' instead of 'children', according to the English, Spanish, Portuguese, or French questionnaire versions.

We defined HIV stigma as clearly stated stigmatizing and discriminatory attitudes towards people with HIV, following the UNAIDS measurement approach [19]. Thus, a response denoting stigmatized or discriminatory attitudes towards people with HIV to any of the two questions (i.e., they would not buy vegetables from a shopkeeper who is HIV positive or thought children living with HIV should not attend school with children who do not have HIV) was classified as holding HIV public stigma. All remaining responses reporting no stigmatized attitudes and/or doubt (i.e., 'don't know/not sure/it depends') were classified as 'no HIV stigma/don't know'. There were missing data when a respondent refused to answer either or both of the two questions on HIV stigma.

Two secondary outcomes measured HIV testing uptake: having ever tested for HIV and having tested for HIV in the past year.

Correlates

We assessed five sociodemographic variables as determinants of holding stigmatized and discriminatory attitudes towards people with HIV. These variables included sex (woman or man), age (15–19, 20–29, 30–39, and 40–49 years), educational level (none or pre-primary, primary, secondary, and higher), wealth quintile (ranging from poorest to highest quintile), and geographical location (urban and rural).

We measured individuals' knowledge about HIV through an index of six variables, following a similar approach used by the DHS and MICS programmes [20]. These variables were included in the index based on the available data in the DHS and MICS databases and were based on questions consistently asked across surveys, allowing for cross-country comparability. The questions were about whether one can avoid HIV by having only one faithful uninfected partner, can get HIV from a mosquito bite, can avoid HIV by using a condom correctly every time, can get HIV by sharing food with a person who has HIV, whether a healthy-looking person may have HIV, and fear of getting HIV in contact with the saliva of an infected person. Individuals who responded correctly to all questions on knowledge of HIV were classified as having comprehensive basic knowledge; an incorrect response to any question classified the respondents as not having a comprehensive basic knowledge of HIV.

Gross domestic product (GDP) per capita and HIV prevalence were measured at the country level using data from the World Bank Development Indicators database for the years 2019 and 2021 [21]. GDP was measured in 2017 international dollars per capita adjusted for purchasing power parity. Data on country population size for the year 2019 were taken from the United Nations Population Division population estimates database [22].

Statistical analysis

Analyses excluded individuals with missing data on HIV public stigma and individuals outside the age range of

interest (15–49 years, which is the common age group surveyed in DHS and MICS except for a few countries that included respondents aged >49 years).

Prevalence estimates of HIV public stigma were first calculated by country and then pooled across all 64 countries and by groups based on sociodemographic characteristics. All prevalence estimates were weighted using individual-level weights. Cross-national pooled prevalence estimates (overall and by sociodemographic characteristics) were additionally weighted using country-level weights for the sample data to represent the population of the included countries. This country weight was calculated using the country population as the reciprocal of the likelihood of being sampled. The population for each country matched the sex (women and men or only women) and age groups (15–49 years) of the country sample (Appendix A1). The country total samples included cases with missing data to account for non-response bias in the country-level weight.

Second, fixed-effects multivariable logistic regression models were fit to assess sociodemographic characteristics and HIV knowledge as determinants of public stigma towards people with HIV. Models estimated adjusted odds ratios (aORs) in a full model with all potential individual-level correlates described above and data for 58 countries (i.e., those with no missing data in any covariate). Models were adjusted by a country and a year indicator variable to control for potential unobserved heterogeneity between countries and variability over time. The estimated aOR and 95% confidence intervals (CIs) account for individual-level weights.

Additional country fixed-effects multivariable logistic regression models test the impact of HIV public stigma on testing uptake while adjusting for sociodemographic and HIV knowledge characteristics. We fit two models with two different HIV testing outcomes: first, having ever tested for HIV and, second, having tested for HIV during the past 12 months. Models estimated the aOR, including country and year indicators variables and individual-level weights.

Finally, to account for the potential impact of country-level HIV prevalence and income on HIV stigma and HIV testing uptake, we fit pooled logistic regression models with robust standard errors clustered by country. Here, pooled regression models were used to avoid confounding from the effects of country-level predictors with no within-country variability from the effects of the country dummies.

In further models, we assessed robustness to model specification by excluding from the analyses countries with a response rate below 70% on the HIV stigma variable and countries where respondents were only women or only ever-married women and men. Missing data were handled with pairwise deletion. Analyses were carried out using Stata/MP 17.0 [23].

RESULTS

Participants and data characteristics

A total of 1 172 841 individuals were included in the study, representing, when weighted, a population of over 1.6 billion individuals (1 609 558 193) across 64 low- and middle-income countries (Table 1). Response rates for the main outcome on HIV stigma varied from 99.77% (in Rwanda) to 39.01% (in Pakistan), with 87.50% of countries with a response rate of over 70% (data not shown). Response to the main outcome was dependent on the respondent having ever heard of HIV. In countries with a lower prevalence of people having ever heard of HIV, the response rate to questions on HIV stigma was lower. The prevalence of having ever heard of HIV ranged from 56.14% in Pakistan to 99.91% in Belarus. Yet, in 58 countries (90.63% of the countries included in the sample) over 80% of the population had heard of HIV and in 45 countries (70.31% of the countries included in the sample) over 90% of the population had heard of HIV.

Prevalence estimates of HIV public stigma towards people with HIV

The weighted prevalence of stigmatized and discriminatory attitudes towards people with HIV varied substantially across countries (Figure 1), with a difference of up to 77.71 percentage points between the countries with the highest and lowest prevalence rates (Figure 2). Prevalence ranged from 12.87% (95% CI 12.39–13.35) in Rwanda to 90.58% (95% CI 89.51–91.54) in Samoa.

Overall HIV public stigma towards people with HIV across countries was 42.44% (95% CI 33.97–51.38) (Figure 3). The prevalence of stigmatized attitudes towards people with HIV was lower among people residing in urban areas than in those in rural areas (38.05% [95% CI 28.06–49.16] vs. 46.47% [95% CI 38.14–55.00], respectively; $p = 0.01$), lower among individuals with higher than lower educational levels (29.11% [95% CI 20.43–39.63] vs. 53.85% [95% CI 44.02–63.39], respectively; $p < 0.01$), lower among the richest than among the poorest (34.11% [95% CI 25.29–44.19] vs. 50.83% [95% CI 42.33–59.28], respectively; $p < 0.01$), and lower among those aged 40–49 years than among those aged 15–19 years (41.83% [95% CI 33.06–51.14] vs. 46.93% [95% CI 38.46–55.59], respectively; $p = 0.05$). No difference

TABLE 1 Descriptive statistics of the sample.

Characteristic	Frequency	Percent or mean (SD), unweighted
Total individual-level sample	1 172 841	100%
Total country-level sample	64	100%
HIV stigma		
No/do not know	568 423	48.47%
Yes	604 418	51.53%
Ever taken a test for HIV		
No	605 223	60.54%
Yes	394 566	39.46%
Taken test for HIV past year		
No	812 505	81.30%
Yes	186 861	18.70%
Sex		
Woman	846 685	72.19%
Man	326 156	27.81%
Geographical location		
Urban	487 138	41.95%
Rural	674 118	58.05%
Educational level		
None or pre-primary	274 492	23.47%
Primary	401 215	34.31%
Secondary	312 222	26.70%
Higher	181 524	15.52%
Wealth quintile		
Poorest	213 199	18.18%
Second	229 425	19.56%
Middle	239 090	20.39%
Fourth	241 894	20.62%
Richest	249 233	21.25%
Age group, years		
15–19	215 709	18.39%
20–29	385 564	32.87%
30–39	328 859	28.04%
40–49	242 709	20.69%
Knowledge HIV		
No comprehensive knowledge	922 281	83.26%
Comprehensive knowledge	185 432	16.74%
Year		
2015	10 201	0.87%
2016	95 260	8.12%
2017	196 761	16.78%
2018	247 268	21.08%
2019	392 169	33.44%
2020	147 330	12.56%
2021	83 852	7.15%
GDP per capita 2017 international dollars	1 160 560	7064.176
	(63 countries)	(5272.30)
HIV prevalence	1 083 451	1.42
	(53 countries)	(2.38)

Abbreviation: GDP: gross domestic product; SD: standard deviation.

was observed between men and women in the unadjusted prevalence of HIV public stigma (38.95% [95% CI 31.27–47.21] vs. 43.98% [95% CI 33.69–54.82], respectively; $p = 0.35$).

Sociodemographic determinants of HIV public stigma towards people with HIV and impact on testing uptake

In multivariable logistic regression models, the estimated aOR of HIV stigma (Table 2) showed that men had, on average, lower odds of reporting stigmatized and discriminatory attitudes towards people with HIV than did women (aOR 0.91 [95% CI 0.89–0.92]). There was an inverse, dose–response association between HIV public stigma and educational level, wealth quintile, and age group, whereby higher levels of education (higher education vs. none or pre-primary: aOR 0.41 [95% CI 0.35–0.48]), wealth (richest vs. poorest quintile: aOR 0.54 [95% CI 0.45–0.65]), and age (40–49 vs. 15–19 years: aOR 0.66 [95% CI 0.57–0.75]) were associated with lower odds of holding stigmatized attitudes towards people with HIV. There was a strong association between HIV stigma and knowledge of HIV: individuals with comprehensive knowledge of HIV had lower odds of reporting stigmatized and discriminatory attitudes towards people with HIV (aOR 0.34 [95% CI 0.30–0.38]). No difference in the odds of stigmatized attitudes was observed between individuals residing in rural versus urban areas (aOR 1.03 [95% CI 0.94–1.13]).

Holding stigmatized and discriminatory attitudes towards people with HIV was associated with lower

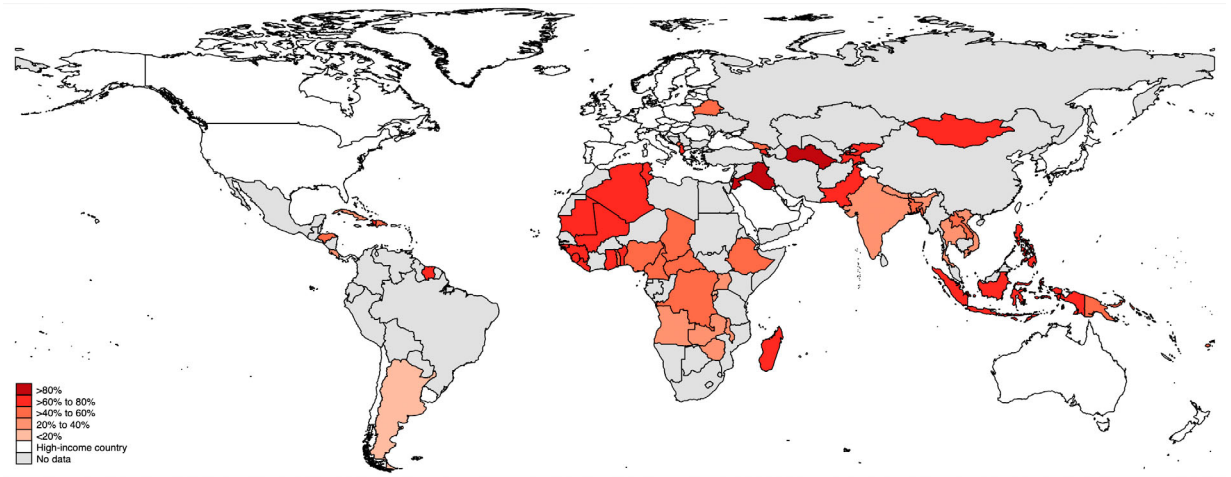

FIGURE 1 Map of prevalence estimates of stigma towards people with HIV among the population aged 15–49 years. Latest available data from 2015 to 2021. *Note*: High-income countries per the World Bank country income classification as of 2021.

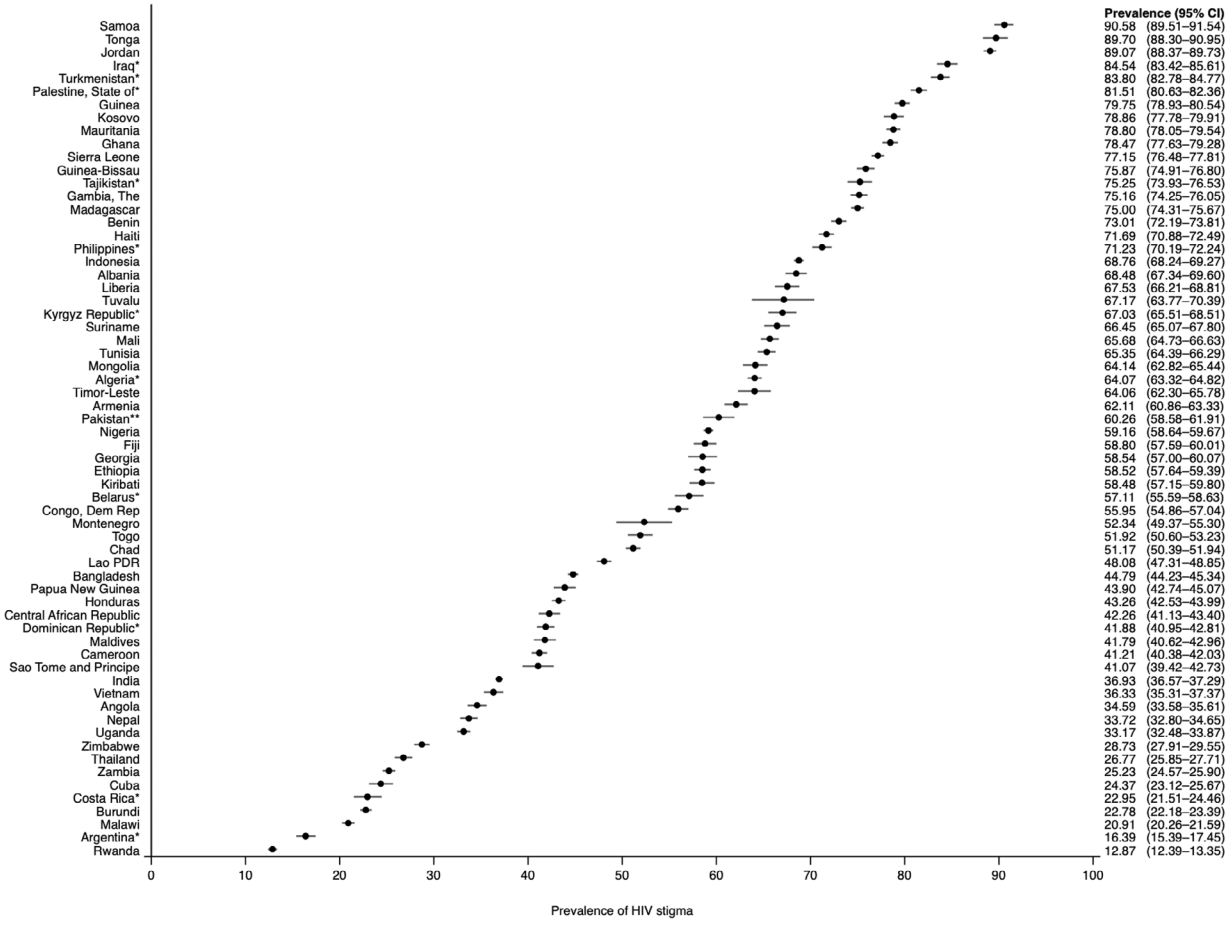

FIGURE 2 Prevalence estimates and 95% confidence intervals (CIs) of stigma towards people with HIV among the population aged 15–49 years. Latest available data from 2015 to 2021. PDR, People's Democratic Republic. *Note*: *The sample only included women. **The sample only included ever-married women and men.

testing uptake (Table 3) after adjusting for the full set of sociodemographic characteristics and HIV knowledge. Stigmatized and discriminatory attitudes were associated with lower odds of having ever tested for HIV (aOR 0.68 [95% CI 0.60–0.76]) and lower odds of having tested for HIV in the last year (aOR 0.77 [95% CI 0.68–0.87]).

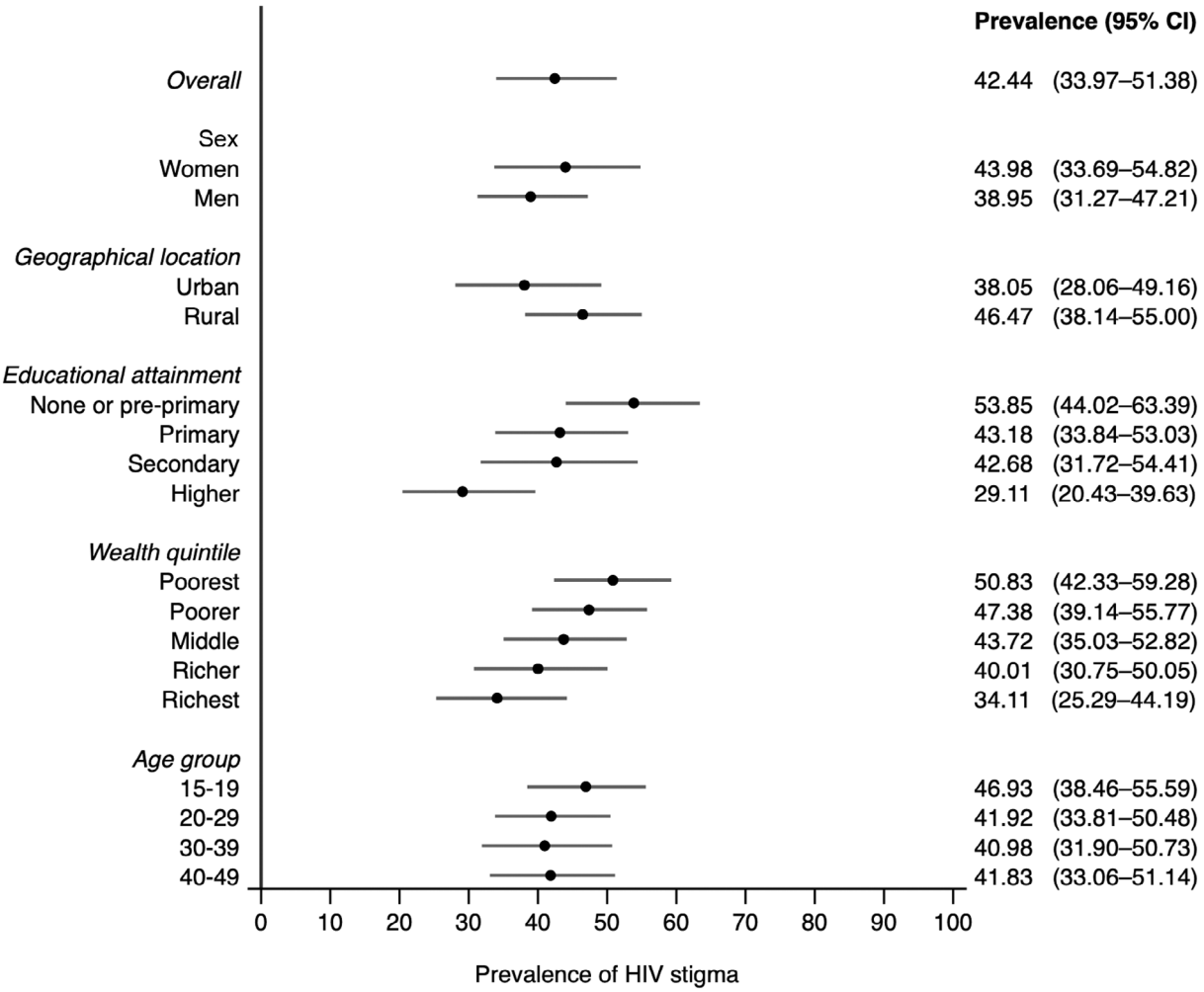

FIGURE 3 Prevalence estimates of stigma towards people with HIV across 64 low- and middle-income countries and by sociodemographic groups. Latest available data from 2015 to 2021. CI, confidence interval.

The odds of HIV public stigma towards people with HIV were, on average, lower among individuals living in either countries with high GDP per capita (aOR 0.93 [95% CI 0.91–0.95]) or high HIV prevalence (aOR 0.85 [95% CI 0.77–0.94]) (Table 4). The association between stigmatized and discriminatory attitudes towards people with HIV and HIV testing uptake did not substantially change when accounting for country income level and HIV prevalence.

Robustness checks

Sensitivity analyses excluding, first, countries ($n = 8$) with a response rate below 70% on the HIV public stigma variable and, second, countries where respondents were only women or only ever-married women and men ($n = 12$) yielded qualitatively similar conclusions to those obtained with the full sample (Appendix A3–A6).

DISCUSSION

In this large cross-sectional study of over 1.1 million individuals in 64 low- and middle-income countries, we found that stigmatized and discriminatory attitudes towards people with HIV were prevalent in all countries, and that the level of HIV public stigma was associated with sociodemographic characteristics. Disadvantaged individuals with lower educational level and wealth were associated with holding greater stigma towards people with HIV, consistent with other findings in low- and middle-income countries [24–31]. Women and adolescents were also associated with having more stigmatized attitudes. Further, holding stigmatized and discriminatory attitudes towards people with HIV was associated with lower HIV testing uptake, which is consistent with previous research [29, 30].

HIV public stigma is present in all countries. However, we observed great differences across countries in

TABLE 2 Sociodemographic characteristics and HIV knowledge as drivers of HIV public stigma across 58 low- and middle-income countries; latest available data from 2015 to 2021.

	HIV stigma	
	aOR	**95% CI**
Sex		
Woman	Reference	
Man	0.91***	0.89–0.92
Geographical location		
Urban	Reference	
Rural	1.03	0.94–1.13
Educational level		
None or pre-primary	Reference	
Primary	0.72***	0.67–0.78
Secondary	0.61***	0.54–0.69
Higher	0.41***	0.35–0.48
Wealth quintile		
Poorest	Reference	
Second	0.90	0.79–1.02
Middle	0.76***	0.66–0.86
Fourth	0.62***	0.54–0.72
Richest	0.54***	0.45–0.65
Age group, years		
15–19	Reference	
20–29	0.88*	0.78–0.99
30–39	0.72***	0.63–0.82
40–49	0.66***	0.57–0.75
Knowledge of HIV		
No comprehensive knowledge	Reference	
Comprehensive knowledge	0.34***	0.30–0.38
Number of individuals	1 092 632	
Number of countries	58	

Note: Constant calculated but not shown; model adjusted by country and year indicator variables; robust standard errors.
Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.
*$p < 0.05$; ***$p < 0.001$.

the prevalence of stigma towards people with HIV, which, coupled with the sociodemographic inequalities in attitudes, may require differing complex approaches to eliminate stigma across settings where it is more entrenched and a focus on populations with greater stigma and discrimination towards people with HIV. This is consistent with the recommendations of a review of interventions for ending HIV stigma that highlighted the need to implement interventions contextualized to the setting and subpopulation [32].

Having no comprehensive knowledge about HIV disease was a key characteristic for reporting stigmatized and discriminatory attitudes towards people with HIV. Lack of knowledge may mean no understanding of the actual reality of HIV, risks, and implications for people with HIV, people affected by HIV, and communities. Thus, interventions for eliminating stigma should focus on increasing knowledge about HIV in individuals and communities, in line with the results of a meta-analysis of the effectiveness of HIV stigma-reducing interventions by increasing HIV knowledge [33]. Yet, some studies argue that information-based approaches and educational interventions alone rarely change negative attitudes but teach people to suppress them [32]. Combined interventions, including personal contact with people with HIV, skills building, counselling and support, and structural and biomedical approaches have seen positive reductions in stigma [32, 34].

In settings with a higher prevalence of HIV, reported stigma is commonly lower. This may be because of a greater likelihood of lived experiences in contact with HIV along with greater knowledge of the disease at the individual and community levels [29, 35]. Interventions for eliminating stigma could include, for example, national- and community-level campaigns, reaching entire populations, as well as campaigns targeting smaller population groups. Interventions could also be included in educational settings to target adolescents, the age group associated with higher levels of stigmatized attitudes.

This study has several strengths. It is the largest study to explore HIV public stigma towards people with HIV in the general population aged 15–49 years, including investigating the association between stigmatized and discriminatory attitudes and sociodemographic characteristics. This study used nationally representative probability samples, compared with previous studies using non-probability samples from people with HIV or healthcare workers. Further, data are comparable among countries because of the common design across nationally implemented MICS or DHS questionnaires. Finally, this is the largest study to investigate the impact of stigma on HIV testing uptake and, in turn, on ending HIV.

However, some limitations warrant consideration. First, measurement errors in the assessment of the main outcome variable may have biased our results in different ways. We used self-reported data, for which response bias could have over- or underestimated the strength of the associations. Reporting bias may have occurred if participants reported answers concealing stigmatized attitudes because of a lack of social acceptability of stigmatized attitudes. This would have biased our estimates towards the null. Estimates could have also been biased in this same direction if stigmatized attitudes were concealed

TABLE 3 HIV public stigma as driver of testing uptake across 53 low- and middle-income countries, latest available data from 2015 to 2021.

	Ever tested for HIV		Tested for HIV past year	
	aOR	95% CI	aOR	95% CI
HIV stigma				
No stigma/do not know	Reference		Reference	
Yes stigma	0.68***	0.60–0.76	0.77***	0.68–0.87
Sex				
Woman	Reference		Reference	
Man	0.38***	0.36–0.39	0.61***	0.60–0.63
Geographical location				
Urban	Reference		Reference	
Rural	0.73***	0.65–0.82	0.76***	0.66–0.87
Educational level				
None or pre-primary	Reference		Reference	
Primary	1.91***	1.72–2.12	1.50***	1.33–1.70
Secondary	2.29***	1.96–2.68	1.67***	1.38–2.03
Higher	1.79***	1.47–2.18	1.75***	1.37–2.25
Wealth quintile				
Poorest	Reference		Reference	
Second	0.87	0.75–1.00	0.91	0.75–1.11
Middle	0.82*	0.70–0.96	0.87	0.72–1.05
Fourth	0.71***	0.59–0.84	0.88	0.72–1.08
Richest	0.81*	0.66–0.99	0.79	0.61–1.01
Age group, years				
15–19	Reference		Reference	
20–29	9.87***	8.43–11.56	3.59***	3.0–4.21
30–39	21.37***	18.09–25.24	3.29***	2.79–3.88
40–49	11.95***	10.06–14.20	1.71***	1.41–2.08
Knowledge of HIV				
No comprehensive knowledge	Reference		Reference	
Comprehensive knowledge	1.34***	1.16–1.55	1.02	0.87–1.19
Number of individuals	938 537		938 163	
Number of countries	53		53	

Note: Constant calculated but not shown; model adjusted by country and year indicator variables; robust standards errors.
Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.
*$p < 0.05$.***$p < 0.001$.

under the responses reporting doubt ('don't know/not sure/it depends'), which we did not classify as HIV public stigma towards people with HIV to ensure the outcome variable could capture well-defined stigmatized and discriminatory attitudes. Stigma and discrimination is complex to measure as they are a compound of beliefs, attitudes, and behaviours. Here, given the dearth of data and the complexity of measuring this social reality, we used the approach taken by UNAIDS [19].

Second, measurement errors may also have occurred in other aspects of this study. For example, because some country questionnaires (mostly with older surveys) used 'AIDS' instead of 'HIV' and referred to 'students' instead of 'children attending school', measurement bias may have affected comparability in unknown directions. We included in the models a year indicator variable that could have helped control for this variability over time. Recall bias could have occurred with testing for HIV,

TABLE 4 Country-level determinants (gross domestic product [GDP] and prevalence of HIV) of HIV public stigma and testing uptake across 48 low- and middle-income countries; latest available data from 2015 to 2021.

	HIV stigma		Ever tested for HIV		Tested for HIV past year	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
HIV stigma						
No stigma/do not know			Reference		Reference	
Yes stigma			0.66***	0.58–0.75	0.74***	0.66–0.83
GDP per capita 2017 international dollars (PPP) (in thousands)	0.93***	0.91–0.95	1.03*	1.00–1.05	0.97***	0.95–0.98
HIV prevalence	0.85**	0.77–0.94	1.71***	1.30–2.26	1.37***	1.24–1.51
Number of individuals	1 020 724		884 101		883 767	
Number of countries	48		45		45	

Note: All models are adjusted for sex, geographical location, educational level, wealth quintile, age group, and knowledge of HIV. Constant calculated but not shown; robust standard errors clustered by country.

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; PPP, purchasing power parity.

*$p < 0.05$.**$p < 0.01$.***$p < 0.001$.

where individuals do not remember or were not aware of having been tested for HIV, thus misclassifying individuals because of measurement error. This would have biased our estimates towards overestimating associations between the predictors and the HIV testing outcomes. Also, the index measuring knowledge on HIV could have included other variables measuring other aspects of the HIV continuum of care, such as knowledge of antiretroviral drugs for treatment as prevention. However, more variables were not available to be included to allow cross-national comparability, and, as such, this index is a proxy based on the best available data. Further, measurement error is likely to have also occurred for capturing the respondents' gender as DHS and MICS measure these in a binary manner, ignoring within this variable non-binary individuals and trans men and women.

Third, HIV prevalence was measured nationally instead of at the community level, where the impact on attitudes may be stronger. Measurement at a higher level may pose a risk of ecological fallacy, as – within countries – it is possible that individuals reporting higher levels of stigma may have life experiences in communities with a lower prevalence of HIV. Fourth, some countries had very low response rates mostly because respondents reported never having heard of HIV. We excluded these countries in sensitivity analyses to ensure the robustness of the results and found no qualitative changes in the results. Finally, we were unable to explore the effects of other factors that could potentially be important determinants of holding stigmatized and discriminatory attitudes towards people with HIV, such as religion, age other than 15–49 years, race, ethnicity, or the role of structural and institutional discrimination arising, for example, from government-supported policies or collective discourses, such as the mass media, among others. In this study, we focused solely on measuring stigma towards people with HIV. Further studies could attempt to measure the aforementioned factors not included in this study as well as intersectional stigma and its impact on engagement with other stages of the HIV care continuum and health-related quality of life.

In conclusion, this multi-national cross-sectional study found that stigmatized and discriminatory attitudes towards people with HIV exist in all countries, with great variation among them. Attitudes varied by sociodemographic characteristics, with individuals with less education and wealth, women, and adolescents showing more negative attitudes towards people with HIV. Importantly, we found that these attitudes were linked to lower HIV testing uptake, which provides evidence that stigmatized and discriminatory attitudes are barriers to ending HIV and highlights the importance of addressing stigma and discrimination towards people with HIV. Variability in attitudes across countries and sociodemographic characteristics shows the need to design interventions for reducing stigma towards people with HIV that are contextualized to the setting and subpopulation.

AUTHOR CONTRIBUTIONS

Ana Mendez-Lopez conceptualized the study and methodology, analysed the data, and wrote the first draft. All authors reviewed the study and edited the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no competing interests related to this work. Jeffrey V. Lazarus is the co-chair of HIV Outcomes and a member of the Board of Directors of SHARE Global Health Foundation. He has received funding to ISGlobal from AbbVie, Gilead Sciences, MSD, and Roche Diagnostics.

DATA AVAILABILITY STATEMENT

This study is based on publicly available microdata that can be accessed through the MICS and DHS websites upon registration and request. Country data are readily available from the websites of the World Bank Development Indicators database and the United Nations Population Fund population estimates database.

ETHICS COMMITTEE APPROVAL

This study employed secondary public data and needed no ethics committee approval.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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