Personal contact with HIV-positive persons is associated with reduced HIV stigma: cross-sectional analysis of general population surveys from 26 countries in sub-Saharan Africa

Citation

Published Version
10.7448/IAS.20.1.21395

Permanent link
http://nrs.harvard.edu/urn-3:HUL.InstRepos:27769560

Terms of Use
This article was downloaded from Harvard University’s DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA

Share Your Story
The Harvard community has made this article openly available. Please share how this access benefits you. Submit a story.

Accessibility
Personal contact with HIV-positive persons is associated with reduced HIV stigma: cross-sectional analysis of general population surveys from 26 countries in sub-Saharan Africa

Brian T. CHAN\textsuperscript{1,2,6}, Alexander C. TSAI\textsuperscript{2,3,4}

\textsuperscript{1}Division of Infectious Diseases, Brigham and Women’s Hospital, Boston, MA, USA

\textsuperscript{2}Harvard Medical School, Boston, MA, USA

\textsuperscript{3}MGH Global Health, Massachusetts General Hospital, Boston, MA, USA

\textsuperscript{4}Mbarara University of Science and Technology, Mbarara, Uganda

\textsuperscript{5}Corresponding author: Brian T. Chan, MD, MPH

Brigham and Women's Hospital

15 Francis St, PBBA-4
Boston, MA 02115; USA

Phone: (+1) 617-732-8881; Fax: (+1) 617-732-6829

E-mail: bchan@partners.org

E-mail addresses of authors:

BTC: bchan@partners.org

ACT: actsai@partners.org

Keywords: Stigma; HIV; Africa; contact hypothesis; social distancing
Abstract

Introduction: HIV-related stigma hampers treatment and prevention efforts worldwide. Effective interventions to counter HIV-related stigma are greatly needed. Although the “contact hypothesis” suggests that personal contact with persons living with HIV (PLHIV) may reduce stigmatizing attitudes in the general population, empirical evidence in support of this hypothesis is lacking.

Methods: Social distance and anticipated stigma were operationalized using standard HIV-related stigma questions contained in the Demographic and Health Surveys and AIDS Indicator Surveys of 26 African countries between 2003-2008. We fitted multivariable logistic regression models with country fixed effects, specifying social distance as the dependent variable and personal contact with PLHIV as the primary explanatory variable of interest.

Results: We analyzed data from 206,717 women and 91,549 men living in 26 sub-Saharan African countries. We estimated a statistically significant negative association between personal contact with PLHIV and desires for social distance (adjusted odds ratio [AOR]=0.80; p<0.001; 95% Confidence Interval [CI], 0.73-0.88). In a sensitivity analysis, a similar finding was obtained with a model that used a community-level variable for personal contact with PLHIV (AOR=0.92; p<0.001; 95% CI, 0.89-0.95).

Conclusions: Personal contact with PLHIV was associated with reduced desires for social distance among the general population of sub-Saharan Africa. More contact interventions should be developed and tested to reduce the stigma of HIV.
Introduction

To help guide efforts to end the AIDS epidemic by 2030, the Joint United Nations Programme on HIV/AIDS has put forth a set of “90-90-90” targets to be achieved by 2020: the diagnosis of 90% of all people living with HIV (PLHIV), the provision of antiretroviral therapy (ART) to 90% of those diagnosed, and the achievement of an undetectable viral load for 90% of those on treatment [1]. Unfortunately, progress towards these targets has been uneven, and the median CD4+ count at presentation to care and HIV treatment initiation has increased only slightly during the past decade [2]. HIV-related stigma has been identified as a critical impediment to HIV prevention and treatment efforts worldwide [3,4], given its association with both reduced uptake of voluntary counseling and testing [5,6] and increased sexual risk-taking behavior [7,8]. Dimensions of HIV-related stigma in the general population include negative attitudes toward PLHIV (including desires for social distance [9]) and enacted stigma (behaviors targeting PLHIV either through word or action [10,11]). Furthermore, persons in the general population may experience anticipated stigma, or the expectation that negative consequences such as rejection or condemnation [9] would result if one’s hypothetical HIV infection were disclosed to others.

It has been theorized that ART scale-up may counter HIV-related stigma by weakening the associations between HIV and economic incapacity, social exclusion, and imminent death [12,13]. Nevertheless, despite the expansion of ART in sub-Saharan Africa in the 21st century, HIV-related stigma in the general population remains highly prevalent [14,15]. Unfortunately, policy-makers have available relatively few evidence-based interventions proven to substantially reduce stigma on either an individual or population-based level [16-18].

Further development and refinement of anti-stigma interventions will therefore be crucial for the achievement of the 90-90-90 targets in sub-Saharan Africa and around the world. One approach that holds promise is directly involving PLHIV in the development and
implementation of anti-stigma interventions. Contact interventions to reduce HIV-related stigma among health care professionals have been trialed in multiple LMICs, including one study conducted in five African countries [19] as well as examples from China [20,21], Thailand [22], and India [23]. Furthermore, direct contact with PLHIV as part of a multi-pronged intervention to reduce stigma in the general population has been studied in countries including Thailand [24] and Vietnam [25].

The mechanism by which interventions involving PLHIV may reduce stigma is summarized by the “contact hypothesis.” Originally put forth by Allport [26], the contact hypothesis suggests that discriminatory attitudes toward groups seen as the “other” may be reduced by interpersonal interactions [27,28]. Such interactions are purported to lead to greater knowledge and reduced stereotyping of members of the stigmatized group [27], in turn lessening fear and prejudice [29]. In the HIV context, it has been theorized that personal contact with PLHIV, especially PLHIV who have benefited from the salubrious effects of ART [13,30], should result in decreased fear, misunderstanding, and branding of PLHIV as the “other” [31,32].

However, there is limited evidence to support the hypothesis that personal contact with PLHIV reduces HIV-related stigma. In a 1990-1992 cross-sectional study of people living in the United States, history of direct contact with PLHIV was associated with less support for coercive policies targeting PLHIV, less blame towards PLHIV, and less avoidance of PLHIV [33]. In India, contact with PLHIV was associated with decreased stigma and discriminatory attitudes among health providers [34]. On the other hand, Broockman and Kalla [35] did not find evidence to support the contact hypothesis in their study of prejudice reduction against transgender persons. Notably, no studies have been conducted in general population samples in low- and middle-income countries (LMICs) or since the advent of widespread ART. A recent analysis of data from 31 sub-Saharan African countries found that ART scale-up was associated with declines in desires for social distance in the general population which were more pronounced in
countries with relatively high HIV prevalence [15]. This analysis provided indirect evidence that personal contact with PLHIV on ART might diminish the links between HIV on the one hand and economic incapacity and social death on the other hand, leading to a subsequent decline in social distancing.

Understanding the extent to which personal contact with PLHIV is associated with reduced HIV-related stigma in the general population of sub-Saharan Africa is important for policymakers, as finding a strong association would support the development and testing of anti-stigma interventions that prominently involve PLHIV. To help answer this question, we analyzed cross-sectional, individual-level data pooled from the Demographic and Health Surveys (DHS) and AIDS Indicator Surveys (AIS). Our primary aim was to estimate the association between personal contact with PLHIV and either desires for social distance or anticipated stigma, using data from general population samples in sub-Saharan Africa during a period of ART scale-up.

Methods

The DHS and AIS are nationally representative, population-based surveys conducted approximately every five years in over 90 LMICs [36]. The standardization of DHS/AIS questions, including those on HIV-related stigma, allows for the analysis of temporal trends in attitudes and behaviors within countries [15,37] as well as comparative analyses across countries [14,38]. Details of DHS/AIS sampling procedures are available on the DHS website and in reports published for each country [39]. We pooled individual-level data from 26 DHS/AIS conducted in countries in sub-Saharan Africa between 2003 and 2008 into a single dataset, using a de-normalization procedure to take into account the survey weights for each country-level dataset [36]. This time frame was chosen because this was a period of increasing ART availability and because the DHS/AIS measure for personal contact with PLHIV (described below) was largely phased out after 2008.
This dataset was then merged with country-level data on HIV prevalence from the UNAIDS AIDSInfo online database [40]. UNAIDS estimates country HIV prevalence using a modeling approach that incorporates data from antenatal clinics and nationally-representative population-based surveys that include blood testing [41,42]. For cases in which the DHS data spanned two years (e.g. 2003-2004), we abstracted country HIV prevalence from the first year of the survey. There were five countries with a DHS survey in 2003 (Ghana, Kenya, Madagascar, Mozambique, and Nigeria), but UNAIDS data on HIV prevalence were not available prior to 2004. For these countries, we matched the UNAIDS data from 2004 with the DHS from 2003.

Measures

The primary outcomes of interest were desires for social distance and anticipated stigma. The DHS/AIS include three questions which measure desires for social distance: 1) “If a member of your family became sick with AIDS, would you be willing to care for her or him in your own household?”; 2) “Would you buy fresh vegetables from a shopkeeper or vendor if you knew that this person had the AIDS virus?”; and 3) “In your opinion, if a female teacher has the AIDS virus but is not sick, should she be allowed to continue teaching in the school?” Negative responses to these questions reflect expressions of social distance [9], often motivated by instrumental concerns about casual transmission of HIV or preoccupations with the symbolic association of HIV with perceived deviance [43]. We defined a respondent as having a desire for social distance if he or she had a negative response to at least one of these three questions. The DHS/AIS include one question on anticipated stigma, “If a member of your family got infected with the AIDS virus, would you want it to remain a secret or not?” Positive responses to this question reflect fear of disclosing a hypothetical HIV infection [44], in particular the expectation of rejection or condemnation were a family member’s serostatus revealed to others [45].
The primary exposure of interest was *personal contact with PLHIV*, which was ascertained by one question, “Do you personally know someone who is suspected to have the AIDS virus or who has the AIDS virus?” Because of the possibility of reverse causality, in that persons without desires for social distance towards PLHIV may be more willing to maintain relationships with PLHIV (or admit that they know PLHIV), we also created a community-level summary variable representing the percentage of participants in a primary sampling unit (PSU) reporting personal contact with PLHIV (exclusive of the index participant). In the DHS/AIS, the PSU is the smallest clustering unit of analysis, typically a village in rural areas and a ward or residential neighborhood in urban areas. In the remainder of the manuscript we refer to this level of analysis as the “village” for ease of exposition. Villages with fewer than five participants were removed from the analysis.

Socio-demographic variables (age, gender, educational attainment, marital status, household asset wealth [46,47], and employment status), year of DHS/AIS, an HIV knowledge variable equal to the number of correct responses to six questions about HIV prevention and transmission (see Additional File 1), and country HIV prevalence were included in the regression models as potential confounders of the relationship between personal contact with PLHIV and stigma.

**Statistical analysis**

We used descriptive statistics to characterize the sample. For the primary analyses, we fitted multivariable logistic regression models with cluster-correlated robust standard errors [48-50] and country fixed effects, alternately specifying social distance or anticipated stigma as the dependent variable, and personal contact with PLHIV as the primary exposure of interest. A statistically significant regression coefficient was considered evidence that an association existed between HIV-related stigma and personal contact with PLHIV. We then fitted multivariable regression models to the data from each country sample separately. As a
sensitivity analysis, we fitted multivariable ordered logistic regression models with an ordinal composite variable for individual-level social distance, with values ranging from zero (answering no to all three questions) to three (answering yes to all three questions), as the outcome of interest.

Of note, the observed association between personal contact and HIV stigma could result from reverse causality. For example, persons who do not hold stigmatizing attitudes toward PLHIV may be more willing to be in relationships with PLHIV. To address this possibility, in another sensitivity analysis, we fitted multivariable logistic regression models using the percentage of respondents in the study participant’s village reporting personal contact with PLHIV as the exposure of interest [5,51,52]. All analyses were performed using Stata software (Version 13.1, StataCorp, College Station, TX, USA).

**Results**

206,717 women and 91,549 men from 26 sub-Saharan African countries with complete data for the variables of interest were included in the analyses. Survey refusal rates among men and women in the DHS/AIS were typically less than 10%, and no survey had a refusal rate more than 20%. DHS/AIS respondent characteristics are stratified by gender in Table 1. Across all surveys, 62% of respondents endorsed at least one measure of social distance, while 44% endorsed anticipated stigma. The scale reliability coefficient for the three social distancing questions was 0.61. Although it is difficult to interpret p-values in light of the large sample size, women appeared more likely to endorse desires for social distancing (65% vs. 56%; $\chi^2=1,800$, p<0.001) and anticipated stigma (47% vs. 38%; $\chi^2=1,900$, p<0.001). Women were only slightly less likely to have had personal contact with PLHIV (35% vs. 37%; $\chi^2=129$, p<0.001).
In a multivariable regression model fitted to the pooled data (Table 2), we estimated a statistically significant negative association between personal contact with PLHIV and desires for social distance (adjusted odds ratio [AOR]=0.80; p<0.001; 95% Confidence Interval [CI], 0.73-0.88). Evaluated at the mean of the other covariates, a history of personal contact with PLHIV was associated with a 4% absolute decrease in the predicted probability of a desire for social distance, from 69% to 65%. In the country-specific analyses, the adjusted odds ratio for the association between personal contact with PLHIV and desires for social distance were less than one in 23 of 26 countries, and of these 15 were statistically significant (Figure 1; Additional File 2). The sensitivity analysis using an ordinal composite variable for social distancing yielded similar findings (AOR=0.752; p<0.001; 95% CI, 0.69-0.82) compared with the binary outcome.

Turning next to the sensitivity analysis that used the village-level summary variable for personal contact with PLHIV, we found that study participants who lived in villages where a greater percentage of people reported knowing PLHIV were themselves less likely to endorse HIV-related stigma. For every 10% increase in the percentage of people in the village who reported knowing someone with HIV, there was an 8% reduced odds of social distancing (AOR=0.92; p<0.001; 95% CI, 0.89-0.95). Evaluated at the mean of the other covariates, study participants who lived in a village where 10% of respondents reported knowing PLHIV (25th percentile across villages) had a 71% predicted probability of endorsing a desire for social distance, whereas study participants who lived in a village where 58% of respondents reported knowing PLHIV (75th percentile across villages) had a 64% predicted probability of endorsing a desire for social distance.

In contrast to the findings about social distance, there was no apparent association with anticipated stigma. In multivariable regression models, we did not estimate a statistically significant association between personal contact with PLHIV and anticipated stigma using either the individual-level (AOR=0.99; p=0.69; 95% CI, 0.92-1.05) or village-level personal contact variable (AOR=1.01; p=0.33; 95% CI, 0.98-1.03).
Table 1: Characteristics of DHS/AIS participants from 26 sub-Saharan African countries, by gender

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (n=298,266)</th>
<th>Women (n=206,717)</th>
<th>Men (n=91,549)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), y</td>
<td>29.0 (10.2)</td>
<td>28.3 (9.4)</td>
<td>30.5 (11.6)</td>
</tr>
<tr>
<td>Achieved more than primary education</td>
<td>33%</td>
<td>29%</td>
<td>43%</td>
</tr>
<tr>
<td>Married</td>
<td>62%</td>
<td>65%</td>
<td>55%</td>
</tr>
<tr>
<td>Household asset index, mean (SE) *</td>
<td>14,416 (200)</td>
<td>15,254 (242)</td>
<td>12,526 (356)</td>
</tr>
<tr>
<td>Employed</td>
<td>63%</td>
<td>60%</td>
<td>69%</td>
</tr>
<tr>
<td>Knows someone who has “AIDS virus”</td>
<td>36%</td>
<td>35%</td>
<td>37%</td>
</tr>
<tr>
<td>Endorsed desire for social distance</td>
<td>62%</td>
<td>65%</td>
<td>56%</td>
</tr>
<tr>
<td>Endorsed anticipated stigma</td>
<td>44%</td>
<td>47%</td>
<td>38%</td>
</tr>
</tbody>
</table>

All t-tests / chi-square tests for differences by gender yielded p-values of less than 0.001.

* More information about the construction of the household asset index can be found in Filmer & Pritchett (1999,2001). Information about how the household asset index was specifically operationalized in the DHS/AIS is available at: [http://www.dhsprogram.com/topics/wealth-index/Index.cfm](http://www.dhsprogram.com/topics/wealth-index/Index.cfm)
Table 2: Unadjusted and adjusted odds ratios and 95% confidence intervals for variables associated with desires for social distance in the general population

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unadjusted odds ratio* (95% CI)</th>
<th>Adjusted odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal contact with PLHIV</td>
<td>0.612 (0.514-0.729)</td>
<td>0.798 (0.726-0.876)</td>
</tr>
<tr>
<td>Female</td>
<td>1.377 (1.243-1.524)</td>
<td>1.164 (1.064-1.272)</td>
</tr>
<tr>
<td>Age</td>
<td>0.999 (0.993-1.004)</td>
<td>0.992 (0.989-0.996)</td>
</tr>
<tr>
<td>Achieved secondary education</td>
<td>0.267 (0.210-0.340)</td>
<td>0.522 (0.429-0.635)</td>
</tr>
<tr>
<td>Married</td>
<td>1.265 (1.095-1.461)</td>
<td>1.063 (0.995-1.136)</td>
</tr>
<tr>
<td>Household asset index (divided by 10000) **</td>
<td>0.947 (0.938-0.955)</td>
<td>0.969 (0.963-0.975)</td>
</tr>
<tr>
<td>Employed</td>
<td>1.060 (0.985-1.141)</td>
<td>1.007 (0.971-1.045)</td>
</tr>
<tr>
<td>Year of DHS/AIS</td>
<td>0.941 (0.936-0.946)</td>
<td>0.514 (0.499-0.530)</td>
</tr>
<tr>
<td>HIV knowledge (per correctly answered question, out of 6)</td>
<td>0.601 (0.558-0.647)</td>
<td>0.685 (0.644-0.729)</td>
</tr>
<tr>
<td>Country HIV prevalence (each percent increase)</td>
<td>0.957 (0.957-0.957)</td>
<td>0.949 (0.946-0.953)</td>
</tr>
</tbody>
</table>

CI, confidence interval.

* Adjusted for country fixed effects only, where appropriate

** More information about the construction of the household asset index can be found in Filmer & Pritchett (1999,2001). Information about how the household asset index was specifically operationalized in the DHS/AIS is available at: [http://www.dhsprogram.com/topics/wealth-index/Index.cfm](http://www.dhsprogram.com/topics/wealth-index/Index.cfm)
**Figure 1. Forest plot of country-specific estimates for the association between personal contact with PLHIV and desires for social distance**

- Benin (2006)
- Cameroon (2004)
- Chad (2004)
- Congo (2005)
- Côte d’Ivoire (2005)
- Democratic Republic of the Congo (2007)
- Ethiopia (2005)
- Guinea (2005)
- Madagascar (2003-04)
- Mali (2006)
- Namibia (2006-07)
- Niger (2006)
- Rwanda (2005)
- Senegal (2005)
- Sierra Leone (2008)
- Swaziland (2006-07)
- Tanzania (2004-05)
- Uganda (2006)
- Zambia (2007)
- Zimbabwe (2005-06)

**Discussion**

In this cross-country analysis of data from 298,266 persons living in 26 sub-Saharan African countries, we found evidence for an association between personal contact with PLHIV and reduced desires for social distance in the general population. Our findings provide evidence in support of the “contact hypothesis,” which suggests that having personal contact with a member of a stigmatized group results in decreased fear, misunderstanding, and prejudice [27,28]. This association was statistically significant, robust to statistical adjustment by sociodemographic variables, year of DHS/AIS, and HIV knowledge, and consistently estimated in most of the 26 countries under study. Although it is possible that persons who do not hold stigmatizing attitudes toward PLHIV may be more willing to maintain (or admit) relationships
with PLHIV, this appeal to reverse causality is unlikely to completely explain our findings, given that an association was found using both an individual-level and village-level variable for personal contact with PLHIV.

Our findings have important implications for policymakers as they suggest a possible mechanism for enhancing interventions to reduce negative attitudes toward PLHIV in sub-Saharan Africa. To date, there remains a relative paucity of interventions proven to effect sustained reductions in HIV-related stigma on a individual or population-based level [16-18]. Ensuring that PLHIV participate in intervention development and implementation, thereby increasing opportunities for meaningful interactions between PLHIV and other members of the general population, may enhance the efficacy of anti-stigma interventions [34]. Several examples of interventions that prominently feature PLHIV have been attempted with some success in LMICs [19-25]. Additionally, our findings suggest an additional benefit to the judicious disclosure of serostatus; however, internalized stigma has been shown to inhibit disclosure [53] and there is only limited evidence to support the efficacy of interventions designed to encourage such disclosures [54].

Although we found an association between personal contact with PLHIV and reduced desires for social distancing, we did not find a similar association between personal contact with PLHIV and anticipated stigma in the general population. What could explain these divergent findings? One plausible explanation consistent with the contact hypothesis is that although personal contact with PLHIV would be expected to reduce desires for social distancing held by respondents, it would not change their beliefs that other people continue to hold negative attitudes toward PLHIV. Thus, even if one’s personal attitudes had changed, one could still harbor persistent fears of serostatus disclosure.
There are several limitations to our study. First, our measures of social distance and anticipated stigma are self-reports of hypothetical scenarios that could be misconstrued by respondents [55,56] and our measure of personal contact with PLHIV uses an outdated term, “AIDS virus.” However, this limitation would only bias our estimates if the extent of misinterpretation systematically differed by personal contact with PLHIV, a scenario that we believe to be unlikely. Of note, the DHS is planning to revise the stigma indicators in future questionnaires, which may enhance their reliability and validity [57]. Second, our study did not include data from South Africa, the country with the world’s largest HIV epidemic. Nevertheless, our study is the most comprehensive analysis of this topic to date, including 26 countries and more than 200,000 persons. Third, our datasets are from 2003-2008 and therefore may not reflect the most current situation in sub-Saharan Africa. However, the more widespread availability of ART since 2008 should make it even more likely that personal contact with PLHIV would help to weaken links between HIV and economic incapacity, social exclusion, and inevitable death, leading to reduced fear and prejudice in the general population. Finally, although we have shown an association between personal contact with PLHIV and decreased social distancing, we cannot prove that the association is causal. Although, as stated previously, reverse causality is an unlikely explanation for our findings (e.g., it is implausible that one’s personal beliefs could influence the village-wide percentage of other persons who have had contact with PLHIV), it is possible that people who do not hold stigmatizing beliefs might be more willing to live in a village where there are more PLHIV or more people who know PLHIV. Conversely, it is possible that people who hold more stigmatizing beliefs might be less willing to live in a village with more PLHIV. Such a phenomenon could be consistent with the “white flight” phenomenon observed in high-income countries [58-60]. Nevertheless, we believe it unlikely that this scenario would entirely account for the association that was found.

In conclusion, in this cross-country analysis of data from 26 sub-Saharan African countries, we found that personal contact with PLHIV was associated with reduced desires for social distancing towards PLHIV in the general population. Our findings suggest that
interventions that target HIV-related stigma may benefit from the prominent involvement of PLHIV to reduce fear, misunderstanding, and prejudice among the general population. This is highly relevant for policymakers given the pressing need for effective anti-stigma interventions. Further study is needed to develop and empirically test the efficacy of such interventions in sub-Saharan Africa and other LMICs.

Competing interests

The authors declare that they have no competing interests.

Acknowledgements and funding

The authors acknowledge the following sources of support: the KL2/Catalyst Medical Research Investigator Training award (an appointed KL2 award) from Harvard Catalyst | The Harvard Clinical and Translational Science Center (National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health Award KL2 TR001100) (Chan) and NIH K23MH096620 (Tsai)

Authors’ contributions

BTC contributed to conceptualization and design of the study, acquisition of data, data analysis and interpretation, and drafting and editing of the article. ACT contributed to design of the study, data analysis and interpretation, and editing of the article. Both authors have read and approved the final manuscript.

Additional files

Additional File 1: Questions related to HIV knowledge, Demographic and Health Surveys / AIDS Indicator Surveys

Additional File 2: Country-specific unadjusted and adjusted odds ratios and 95% confidence intervals for the association between personal contact with PLHIV and desires for social distance
References


36. ICF International Inc. Demographic and Health Survey Sampling and Household Listing
   Manual. 2012. Available from:

related stigma in rural Uganda during a period of increasing HIV incidence despite
   treatment expansion. AIDS. 2015 Jan 2;29(1):83–90.

38. Tsai AC. Socioeconomic Gradients in Internalized Stigma Among 4,314 Persons with HIV
   in Sub-Saharan Africa. AIDS Behav. 2015 Feb;19(2):270–82.


40. UNAIDS. AIDSinfo. Available from:

41. Murray CJL, Ortblad KF, Guinovart C, Lim SS, Wolock TM, Roberts DA, et al. Global,
   regional, and national incidence and mortality for HIV, tuberculosis, and malaria during
   2014 Sep 13;384(9947):1005–70.

42. UNAIDS. Methodology--Understanding the HIV estimates. 2014. Available from:

43. Pryor JB, Reeder GD, Vinacco R, Kott TL. The instrumental and symbolic functions of

44. Wolfe WR, Weiser SD, Leiter K, Steward WT, Percy-de Korte F, Phaladze N, et al. The
   impact of universal access to antiretroviral therapy on HIV stigma in Botswana. Am J


52. Ng CK, Tsai AC. Proximate Context of HIV-Related Stigma and Women's Use of Skilled Childbirth Services in Uganda. AIDS Behav. 2016 Apr 22 [Epub ahead of print].


Additional File 1: Questions related to HIV knowledge, Demographic and Health Surveys / AIDS Indicator Surveys

Respondents who answered "I don't know" were coded as having an incorrect response.

Knowledge of HIV prevention:

Can people reduce their chance of getting the AIDS virus by using a condom every time they have sex?

Can people reduce their chances of getting the AIDS virus by having just one uninfected sex partner who has no other sex partners?

HIV misconceptions:

Can people get the AIDS virus by sharing food with a person who has AIDS?

Can people get the AIDS virus from mosquito bites?

Can people get the AIDS virus because of witchcraft or other supernatural means?

Is it possible for a healthy-looking person to have the AIDS virus?
**Additional File 2**: Country-specific unadjusted and adjusted odds ratios and 95% confidence intervals for the association between personal contact with PLHIV and desires for social distance.

<table>
<thead>
<tr>
<th>Country</th>
<th>Unadjusted odds ratio (95% CI)</th>
<th>Adjusted odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin, 2006</td>
<td>0.660 (0.605-0.720)</td>
<td>0.923 (0.838-1.016)</td>
</tr>
<tr>
<td>Cameroon, 2004</td>
<td>0.838 (0.777-0.904)</td>
<td>1.020 (0.937-1.111)</td>
</tr>
<tr>
<td>Chad, 2004</td>
<td>0.663 (0.542-0.811)</td>
<td>0.856 (0.690-1.062)</td>
</tr>
<tr>
<td>Congo, 2005</td>
<td>0.578 (0.510-0.655)</td>
<td>0.759 (0.665-0.865)</td>
</tr>
<tr>
<td>Cote, 2005</td>
<td>0.713 (0.570-0.892)</td>
<td>0.952 (0.729-1.243)</td>
</tr>
<tr>
<td>Democratic Republic of Congo, 2007</td>
<td>0.582 (0.513-0.660)</td>
<td>0.773 (0.673-0.887)</td>
</tr>
<tr>
<td>Ethiopia, 2005</td>
<td>0.210 (0.177-0.250)</td>
<td>0.570 (0.464-0.699)</td>
</tr>
<tr>
<td>Ghana, 2003</td>
<td>0.913 (0.819-1.018)</td>
<td>0.990 (0.879-1.116)</td>
</tr>
<tr>
<td>Guinea, 2005</td>
<td>0.598 (0.451-0.794)</td>
<td>0.717 (0.516-0.997)</td>
</tr>
<tr>
<td>Kenya, 2003</td>
<td>0.459 (0.411-0.511)</td>
<td>0.737 (0.653-0.833)</td>
</tr>
<tr>
<td>Lesotho, 2004</td>
<td>0.565 (0.499-0.641)</td>
<td>0.874 (0.760-1.005)</td>
</tr>
<tr>
<td>Madagascar, 2003</td>
<td>0.995 (0.686-1.443)</td>
<td>1.100 (0.755-1.603)</td>
</tr>
<tr>
<td>Malawi, 2004</td>
<td>0.851 (0.772-0.937)</td>
<td>1.024 (0.923-1.135)</td>
</tr>
<tr>
<td>Mali, 2006</td>
<td>0.556 (0.457-0.676)</td>
<td>0.681 (0.537-0.862)</td>
</tr>
<tr>
<td>Mozambique, 2003</td>
<td>0.571 (0.513-0.636)</td>
<td>0.863 (0.765-0.974)</td>
</tr>
<tr>
<td>Namibia, 2006</td>
<td>0.662 (0.598-0.732)</td>
<td>0.793 (0.713-0.883)</td>
</tr>
<tr>
<td>Niger, 2006</td>
<td>0.472 (0.371-0.601)</td>
<td>0.684 (0.516-0.907)</td>
</tr>
<tr>
<td>Nigeria, 2003</td>
<td>0.811 (0.674-0.975)</td>
<td>0.844 (0.700-1.018)</td>
</tr>
<tr>
<td>Rwanda, 2005</td>
<td>0.510 (0.464-0.562)</td>
<td>0.734 (0.662-0.813)</td>
</tr>
<tr>
<td>Senegal, 2005</td>
<td>0.605 (0.497-0.736)</td>
<td>0.793 (0.627-1.001)</td>
</tr>
<tr>
<td>Sierra Leone, 2008</td>
<td>0.562 (0.446-0.708)</td>
<td>0.860 (0.666-1.112)</td>
</tr>
<tr>
<td>Swaziland, 2006</td>
<td>0.650 (0.583-0.725)</td>
<td>0.789 (0.698-0.893)</td>
</tr>
<tr>
<td>Tanzania, 2004</td>
<td>0.707 (0.621-0.804)</td>
<td>0.853 (0.744-0.979)</td>
</tr>
<tr>
<td>Uganda, 2006</td>
<td>0.551 (0.494-0.614)</td>
<td>0.687 (0.611-0.772)</td>
</tr>
<tr>
<td>Zambia, 2007</td>
<td>0.751 (0.695-0.812)</td>
<td>0.916 (0.840-0.997)</td>
</tr>
<tr>
<td>Zimbabwe, 2005</td>
<td>0.800 (0.742-0.861)</td>
<td>0.888 (0.821-0.960)</td>
</tr>
</tbody>
</table>

CI, confidence interval.

Odds ratios are adjusted for HIV knowledge, age, gender, educational attainment, marital status, household asset wealth (Filmer & Pritchett, 1999 and 2001), and employment status.