

Knowledge of specific HIV transmission modes in relation to HIV infection in Mozambique

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Abstract

Background: In prior research, Africans who knew about blood-borne risks were modestly less likely to be HIV-infected than those who were not aware of such risks.

Objectives/Methods: I examined the association between knowledge of specific HIV transmission modes and prevalent HIV infection with data from the 2009 Mozambique AIDS Indicator Survey.

Results: Respondents displayed high awareness of blood exposures and vaginal sex as modes of HIV transmission. However, only about half of respondents were aware of anal sex as a way HIV can be transmitted. After adjustments for demographics and sexual behaviors, respondents who knew that HIV could spread by contact with infected blood or by sharing injection needles or razor blades were less likely to be infected than those who did not know about these risks. Respondents who knew about sexual risks were as, or more, likely to be HIV infected as those who did not know about sexual risks. Also, children of HIV-uninfected mothers were less likely to be infected if their mothers were aware of blood-borne HIV risks than if their mothers were unaware.

Conclusion: HIV education campaigns in Mozambique and elsewhere in sub-Saharan Africa should include a focus on risks from blood exposures and anal sex.

Introduction

A wide variety of blood exposures is independently associated with incident and prevalent HIV infection in sub-Saharan Africa¹⁻⁹. Anal sex has also been repeatedly associated with HIV infection in heterosexual Africans¹⁰⁻¹⁵, with some exceptions¹⁶⁻¹⁷. Knowledge of blood-borne HIV risks varies markedly across the region, with awareness much higher in West, central and East Africa than in southern Africa¹⁸. This geographic variation in knowledge corresponds closely to differences in HIV prevalence, such that countries in which many people know about blood-borne risks have much lower HIV prevalence than countries in which few know about these risks. Although HIV education campaigns in West, central and East Africa have included a focus on blood-borne risks, campaigns in southern Africa have not, likely leading to deficits in southern Africans' knowledge. At the individual level, persons who know about blood-borne risks are modestly less likely to be HIV-infected than those who are not aware of such risks, independent of demographics and sexual behaviors¹⁸.

In contrast, belief in condom use as a strategy for avoiding HIV infection is positively associated with HIV infection at both the individual and national levels in sub-Saharan Africa¹⁸. That is, those who believe condoms are an effective strategy for preventing HIV transmission are more likely to be HIV-infected than

those who do not believe condom use protects against HIV, independent of demographics and sexual behaviors.

Although long assumed to be rare, anal sex is not uncommon in sub-Saharan Africa, as modest to large proportions of heterosexual men and women report engaging in it^{10-15,19-27}. Research based on nonprobability samples suggests that many Africans are unaware that anal sex is a significant risk for HIV transmission. While 87% of young adult Nigerians in one study knew anal sex is an HIV risk²⁸, only 54% of men in Cape Town, South Africa in 1999¹⁹ and 29% of adolescents in a Western Cape (South Africa) township with very high HIV prevalence shared that perception²⁶. Some South African women in a qualitative study explained the lack of risk involved with anal sex²⁹. Moreover, Kenyan prostitutes viewed vaginal sex as equally or more risky than anal sex²¹. Throughout the last 13 years, researchers have noted that HIV education campaigns targeting heterosexuals in sub-Saharan Africa lack warnings about the risk of anal sex^{10,15,19,23,24,27,30}.

In this paper, I report on the relationship between knowledge of HIV transmission routes and prevalent HIV infection in Mozambique, a country with high HIV prevalence not included in prior analyses. I analyzed data from the 2009 Moza-

mibique AIDS Indicator Survey (AIS), a special version of the Demographic and Health Surveys (DHS) conducted in poor countries. The 2009 Mozambique AIS differs from prior DHS with respect to how knowledge of HIV transmission risks was measured. In the 2009 Mozambique AIS respondents were asked directly about several specific blood-borne and sexual transmission routes. The 2009 Mozambique AIS also involved HIV testing of children, enabling examination of the association between mothers' knowledge of blood-borne HIV transmission routes and HIV infection in their children.

Methods

2009 Mozambique AIDS Indicator Survey (AIS) data

In the 2009 Mozambique AIS, the household participation rate was 99%, and 95% of eligible women (age 15-64) and 90% of eligible men (age 15-64) participated³¹. Ninety-two percent of adult respondents and 87% of children between ages 0 and 11 years provided dried blood spot specimens for HIV testing. HIV serostatus was determined with an enzyme-linked immunosorbent assay (ELISA) test and confirmed by a different ELISA test. Specimens with discrepant ELISA results were confirmed by a further ELISA test.

I included respondents' data in analysis if they reported never having been tested previously for HIV and also reported awareness of HIV/AIDS. HIV counseling may, in some places, involve education about blood-borne and sexual risks³², which may confound the relationship between knowledge and serostatus³³. Respondents who did not report awareness of HIV/AIDS were not asked about ways that it could be transmitted. Ninety-seven percent of female respondents and 99% of male respondents reported they had heard of HIV/AIDS.

Respondents who reported awareness of HIV/AIDS were asked whether it was possible to transmit HIV through each of several types of direct and indirect interpersonal contact. I focused on knowledge of four types of contact: sharing injection needles/blades; contact with infected blood; unprotected vaginal sex (i.e., vaginal sex without a condom); and unprotected anal sex. I coded "don't know" responses to these questions as "no".

For the analyses of mother's knowledge and child's serostatus, I included biological mother-child pairs in which the mother was HIV-uninfected, to eliminate confounding by vertical transmission. The 2009 Mozambique AIS data and documentation are available at <http://www.measuredhs.com>.

2003 Mozambique Demographic and Health Survey (DHS) data

In the 2003 Mozambique DHS, the household participation rate was 95%, and 91% of eligible women (age 15-49 years) and 81% of eligible men (age 15-64 years) participated³⁴. Women were recruited as respondents from all households, but men were recruited as respondents only from one-third of households.

Respondents did not provide blood specimens for HIV testing. As I did with the AIS data, I included respondents' data in analysis if they reported never having been tested previously for HIV and also reported awareness of HIV/AIDS. Ninety-seven percent of female respondents and 99% of male respondents in the 2003 DHS reported they had heard of HIV/AIDS.

Respondents who reported awareness of HIV/AIDS were asked "Do you know how you can avoid HIV/AIDS?" Those answering affirmatively were then asked "How can you prevent HIV/AIDS?" Interviewers encouraged and recorded multiple responses, and responses were coded by DHS staff. To compare with the 2009 Mozambique AIS and other DHS, I focused on two measures: whether a respondent had a response that was coded as "only use sterilized syringes/needles" and "always use a condom". I coded "don't know" responses to the open-ended question as "no" for each of these measures.

Statistical analysis

With the 2009 Mozambique AIS data, I computed cross-classifications, odds ratios, and the associated 95% confidence intervals (CI) for the relationships between each knowledge measure and prevalent HIV infection, separately for women and men. To examine the associations further, I calculated the odds ratios, with HIV status as the dependent variable and a knowledge measure as the independent variable, adjusted for age (in whole years), urban/rural residence, number of whole years of education, wealth (in quintiles), reported number of sex partners in the prior 12 months, and whether the respondent reported having had a sexually transmitted disease in the prior 12 months. In addition, I calculated adjusted odds ratios (AORs) in the manner just described but adjusting for each of the three other knowledge measures as well. I also computed the Pearson (ϕ) correlation between each pair of knowledge measures. I used SPSS 7.5 (SPSS Inc., Chicago, USA) to perform the analyses. I compared the adjusted odds ratios for Mozambique with similar DHS results from four countries in Southern Africa (Lesotho, Malawi, Swaziland, and Zimbabwe) based on knowledge measures derived from free responses to an open-ended question about ways to avoid HIV infection¹⁸.

Online search of HIV prevention education efforts focused on blood-borne risks

In July of 2011, I sought evidence of public HIV education campaigns focused on blood-borne risks in Mozambique by searching two online databases: the Google search engine and the Media/Materials Clearinghouse. For the Google search, I used the key words "Mozambique", "HIV", and "razor". I examined the resources identified until I found 30 consecutive resources to be irrelevant (for a total 320 resources examined). I repeated this search in September of 2011 at the Google's Mozambican site, with the equivalent key words in Portuguese: "Moçambique", "VIH," and "lâmina" (290 resources examined). I also extended this search by adding, in turn, the names of the 14 HIV prevention programs

and campaigns mentioned in the AIS questionnaire (for questions about respondents' familiarity with the programs and campaigns)³¹. My Google search was not exhaustive, especially given the limited scope induced by the key word "razor". However, the razor blade is perhaps the most ubiquitous sharp instrument involving possible blood exposure in daily life in Mozambique. Any public education campaign about blood-borne HIV risks that excludes explicit mention of razor blades is probably superficial or very narrow. For the Media/Materials Clearinghouse search, I inspected all materials pertaining to Mozambique. I also examined any sources related to Mozambique that I had found in an earlier search of the US National Library of Medicine Gateway¹⁸.

Results

In the 2009 Mozambique AIS, over 90% of respondents reported that HIV could spread through shared needles/razors and nearly 80% reported that HIV could be spread through contact with infected blood (Table 1). Approximately 90% of women and men reported vaginal sex as an HIV transmission route. In contrast, only 48% of women and 58% of men thought that HIV could spread through anal sex.

Before adjustments for demographics and sexual behavior variables, respondents who believed that HIV spread through vaginal or anal sex were more likely to be infected than those who did not believe HIV spread in that way (Table 1). In unadjusted analyses, respondents who reported that HIV could be transmitted through blood contact or reusing sharps were about as likely to be infected as respondents who did not think HIV was transmitted in that way.

Urban residence, education, and wealth were moderately positively associated with knowledge of blood-borne HIV risks (results not shown), and these same factors were positively related to HIV infection as well³¹. Consequently, the AORs between the knowledge measures and HIV infection in Tables 2 and 3 provide better estimates of the relationship between the knowledge measures and HIV infection.

After adjustments for demographic factors and sexual behavior variables, the measures of knowledge of blood-borne risks become inversely related to HIV infection. That is, respondents who reported that HIV can spread through shared needles/

razors and blood contact were less likely to be infected than those who reported that HIV does not spread through such means, once demographics and sexual behaviors were held constant. The adjustments for potential confounders also caused the positive associations for knowledge of vaginal sex risk in women and knowledge of anal sex risk in men to disappear. However, the adjusted associations for knowledge of anal sex risk in women and knowledge of vaginal sex risk in men remained meaningfully positive. In particular, men who believed HIV spreads through vaginal sex were almost twice as likely to be infected as men who did not believe this (Table 3).

The adjusted odds ratios for knowledge of shared needles/razors as transmission risks are generally similar to those for knowledge of avoiding shared razors as an HIV prevention strategy in four other countries in southern Africa (Tables 2 and 3). The adjusted associations for knowledge of vaginal sex risk also approximate those for knowledge of condoms as a prevention strategy from the other southern African countries.

The blood-borne risk knowledge measures correlated moderately with each other ($r = 0.26-0.29$) as did the sexual risk knowledge measures ($r = 0.23-0.29$). The associations between one blood-borne risk knowledge measure and one sexual risk knowledge measure were weaker ($r = 0.12-0.23$). Nonetheless, when all four knowledge measures were included in analysis together (last column in Tables 2 and 3), the associations between each knowledge measure and HIV infection were almost the same as when the knowledge measures were analyzed separately.

HIV uninfected mothers' knowledge of blood-borne HIV risks was also inversely related to their children's HIV status. Children whose mothers knew that contact with blood is an HIV risk were less likely to be infected (0.4%; 11/2511) than children whose mothers did not know about this risk (1.2%; 7/591; OR 0.37, 95% CI 0.14–0.95). Similarly, children whose mothers knew that sharing needles and razors was a risk were also less likely to be infected (0.5%, 16/2918) than children whose mothers were unaware of this risk (1.1%, 2/185; OR 0.50, 95% CI 0.12–2.21).

In the 2003 Mozambique DHS, 9.8% of women (1110/11381) and 18.9% (413/2709) of men recalled "only use sterilized

Table 1 Knowledge of specific HIV transmission modes and relationship with prevalent HIV infection, Mozambique, 2009.

Knowledge measure	Women		Men					
	N	% acknowledging	HIV prevalence acknowledged?		N	% acknowledging	HIV prevalence acknowledged?	
			Yes	No			Yes	No
Needles/razors	3383	90.4	12.2	12.0	3391	92.6	8.5	7.6
Blood contact	3378	77.3	11.7	13.8	3390	78.7	8.6	7.8
Vaginal sex	3381	87.1	12.5	10.3	3385	91.9	8.8	4.4
Anal sex	3378	47.9	13.6	10.9	3383	58.2	8.9	7.7

Table 2 Associations between measures of knowledge of HIV transmission modes and prevalent HIV infection, Mozambican women, 2009.

Knowledge measure	Bivariate OR	AOR single measure ¹		
		Mozambique	4 southern African countries ²	AOR all measures ³
Needles/razors	1.02 (0.72–1.45)	0.89 (0.62–1.27)	0.80 (0.70–0.92)	0.93 (0.63–1.37)
Blood contact	0.83 (0.65–1.05)	0.81 (0.63–1.03)	—	0.80 (0.62–1.03)
Vaginal sex	1.24 (0.89–1.72)	1.06 (0.76–1.49)	1.26 (1.13–1.42)	1.04 (0.72–1.49)
Anal sex	1.28 (1.04–1.58)	1.18 (0.95–1.46)	—	1.21 (0.96–1.51)

Note: 95% confidence intervals in parentheses

¹Adjusted for age, urban/rural residence, education, wealth, reported number of sex partners in the prior 12 months, and reported sexually transmitted disease in the prior 12 months

²Summary of results from Lesotho, Malawi, Swaziland, and Zimbabwe for similar knowledge measure

³Includes same adjustments as for single measure AOR, but also adjusted for the 3 other knowledge measures

Table 3 Associations between measures of knowledge of HIV transmission modes and prevalent HIV infection, Mozambican men, 2009.

Knowledge measure	Bivariate OR	AOR single measure ¹		
		Mozambique	4 southern African countries ²	AOR all measures ³
Needles/razors	1.13 (0.70–1.83)	0.91 (0.55–1.49)	0.86 (0.71–1.04)	0.87 (0.52–1.45)
Blood contact	1.11 (0.82–1.51)	0.95 (0.70–1.30)	—	0.93 (0.67–1.30)
Vaginal sex	2.10 (1.16–3.80)	1.85 (0.99–3.45)	1.21 (1.07–1.37)	1.93 (1.02–3.64)
Anal sex	1.18 (0.92–1.51)	1.03 (0.79–1.34)	—	0.98 (0.75–1.28)

Note: 95% confidence intervals in parentheses

¹Adjusted for age, urban/rural residence, education, wealth, reported number of sex partners in the prior 12 months, and reported sexually transmitted disease in the prior 12 months

²Summary of results from Lesotho, Malawi, Swaziland, and Zimbabwe for similar knowledge measure

³Includes same adjustments as for single measure AOR, but also adjusted for the 3 other knowledge measures

syringes/needles” as a way to prevent HIV. However, 55% (6253/11381) of women and 68% (1845/2709) of men recalled “always use a condom” as a way to prevent HIV.

There was no online evidence of public HIV education campaigns that focused on blood-borne transmission risks in Mozambique. Some participants in a face-to-face community HIV education program that was implemented in Mozambique credited the program with informing them about some blood-borne risks^{35–36}. However, none of the descriptions of the program at the program’s website (<http://www.steppingstones-feedback.org>), or elsewhere online indicate that this topic is formally covered in the program.

Discussion

Adult Mozambicans displayed very high awareness of some blood exposures and vaginal sex as modes of HIV transmission when directly asked about such contact in the 2009 Mozambique AIDS Indicator Survey. However, only a little more than half of respondents were aware of anal sex as a way HIV can be transmitted. After adjustments for demographics and sexual behaviors, knowledge of blood-borne risks was inversely associated with prevalent HIV infection. That is, respondents who knew that HIV could spread by contact with infected blood or by sharing injection needles or razor blades were less likely to be infected than those who did not know about these risks. Knowledge of sexual risks was negligibly to positively related to prevalent HIV

infection. The positive association was strongest in men: those acknowledging unprotected vaginal sex as a risk were almost twice as likely to be infected with HIV as those not acknowledging. These associations between knowledge of blood-borne and sexual risks and prevalent HIV infection in Mozambique are similar in magnitude to those observed in four other southern African countries based on roughly parallel knowledge measures. In addition, mothers’ knowledge of blood-borne risks was inversely associated with HIV infection in their children, which suggests that persons aware of such risks not only are more likely to take corresponding preventive measures for themselves but for those in their care as well. Moreover, there was no online evidence that public HIV education campaigns in Mozambique have included a meaningful focus on blood-borne risks.

The very high proportion of Mozambicans who were aware of blood-borne HIV risks (approximately 90%) in the 2009 AIS contrasts sharply with the very low proportions of 2003 Mozambique DHS respondents and DHS respondents in four other southern African countries who mentioned such risks (8–23%)¹⁸. This difference seems to be due to assessing knowledge in the 2009 Mozambique AIS by *recognition* of specific risks and in the other DHS by *recall* of risks. In South Africa and Swaziland, the discrepancies between levels of knowledge of blood-borne HIV risks when measured by recognition^{18,26,37} and recall^{18,38–42} are even larger. These combined results refute my earlier hypothesis¹⁸ that southern Africans and perhaps

Africans generally know that contaminated blood can transmit HIV only when the exposure is visible and large. Instead, these results indicate that southern Africans are typically aware of a variety of blood-borne HIV risks (including shared needles and razors that might not involve large or visible blood contamination), but only when specifically prompted.

Interestingly, observed levels of southern Africans' knowledge of sexual risks differ relatively little based on measurement approach. In the aforementioned studies, the proportions of respondents aware of sexual HIV transmission risks tended to be only slightly less when measured with recall methods than recognition methods. The difference between the proportion of 2003 Mozambique DHS respondents who recalled "always use a condom" as a prevention strategy (62%) and the proportion of 2009 Mozambique AIS respondents who recognized vaginal sex as a transmission mode (92%) is somewhat larger, although this could be due to increases over time in Mozambicans' perceptions of vaginal sex as a risk.

The discrepancy between observed levels of knowledge of blood-borne HIV risks based on recall and recognition measurement reveals that blood-borne risks are not salient in the minds of southern Africans. In 2011, Class interviewed 23 HIV infected adults and 26 parents or other caretakers of HIV infected children in Maputo, Mozambique (Deena Class, personal communications, July 11, 2011, August 27, 2011, and September 29, 2011). Nearly all of Class' respondents noted blood-borne transmission as one mode of HIV spread. However, none of the adults attributed their infections to a blood exposure. Five of the infected children had seronegative biological mothers, indicating that these children had acquired their infections horizontally. Remarkably, only one of these mothers suspected blood-borne transmission for her child. Furthermore, none of these five mothers were told by their healthcare providers how their children might have been infected. In another study, Zimbabwean youth almost universally recognized the potential for HIV transmission through shared razors, yet ranked the avoidance of sharing razors as the least effective strategy for preventing HIV in comparison to strategies focused on sexual exposures and behaviors not known to protect against infection (avoiding deep kissing and washing hands)⁴³. Similarly, Kenyans in Nyanza province grossly underestimated how long HIV can survive on a blood-contaminated razor blade or inside a blood-contaminated needle or syringe⁴⁴. Thus, many Africans may recognize blood-borne HIV transmission as a theoretical possibility, but regard it as unlikely in practice.

Such apparent misunderstandings of blood-borne HIV transmission are not surprising given the lack of public education about blood-borne risks in sub-Saharan Africa. Just as in other African countries¹⁸, efforts to educate Mozambican traditional healers about hygienic practices began decades ago⁴⁵⁻⁴⁶ and continue to this day⁴⁷⁻⁴⁸. There was also at least one attempt to educate barbers about blood-borne risks in the early 1990s⁴⁹. However, I found no good evidence that public HIV educa-

tion campaigns in Mozambique have in the past focused on blood-borne risks to any meaningful extent. Furthermore, as in other southern African countries¹⁸, large recent and current public HIV education campaigns in Mozambique exclude mention of blood-borne risks⁵⁰⁻⁵¹ (see also: One Love Regional Campaign – Southern Africa, and Center for Communication Programs). Indeed, Class' Mozambican respondents who noted blood-borne transmission as one mode of HIV spread said they learned of these risks informally, not from HIV education campaigns, health care providers, or public health sources (Deena Class, personal communication, September 29, 2011).

Mozambicans' awareness of anal sex as a transmission risk was much lower than their awareness of vaginal sex as a risk, even though the actual risk from anal sex is much higher. Contrary to my expectation, knowledge of anal sex risk was not associated with lower rate of HIV infection. It is unclear why this is so. Further investigation of the perceived risk of anal sex (e.g., whether risk differs for men and women) and whether respondents engage in anal sex might help clarify this result.

Beliefs in vaginal sex as an HIV transmission risk and condom use as an HIV prevention strategy¹⁸ are associated with a higher likelihood of HIV infection in Mozambique and elsewhere in sub-Saharan Africa. This is consistent with the lack of association between condom use in vaginal sex and incident HIV infection^{14, 52-53}. Condom use itself may even make people more vulnerable to infection by reducing mucosal exposure to HIV and thus hindering the development of alloimmunity against HIV⁵⁴⁻⁵⁵.

To determine the modes of transmission of HIV in sub-Saharan Africa with confidence, researchers must assess blood and sexual exposures comprehensively in incident HIV cases and controls, trace their contacts corresponding to such exposures, and sequence the DNA in infected persons' HIV isolates⁵⁶⁻⁵⁸. In the meantime, HIV education campaigns in Mozambique and other poor countries should focus on blood-borne and anal sex transmission risks comprehensively and emphasize strategies for avoiding these dangers⁵⁹⁻⁶¹.

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Competing Interests

No relevant competing interests declared.

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