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HIV Testing is Associated with Increased Knowledge and Reductions in Sexual Risk Behaviors among Men in Cape Town, South Africa

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Abstract

HIV testing benefits those who test positive, allowing them to receive treatment but the benefits for those who test negative remain controversial. We evaluated the impact of testing on HIV knowledge and sexual risk among men in South Africa. Men were recruited from townships outside Cape Town and completed a survey that assessed testing history, knowledge, and sexual behaviors. Among the 820 participants, 516 (63%) reported being tested (82% tested negative, 6% tested positive, and 12% unknown). Compared to those who had never been tested for HIV, men who tested for HIV were more knowledgeable about HIV transmission but did not differ on sexual risk behavior. Knowledge moderated the effect of testing on sexual risk such that men reported fewer sexual partners (IRR = 0.91, 95% CI = 0.84, 0.98) and fewer unprotected anal sex events (IRR = 0.81, 95% CI = 0.66, 1.00) if they had been tested for HIV and were knowledgeable about HIV transmission. For men testing HIV-negative, knowledge predicted fewer sexual risk behaviors. Having been tested for HIV is associated with enhanced knowledge, which moderates sexual risk behavior among South African men living in Cape Town. Results suggest that HIV testing may increase knowledge and lead to reductions in sexual risk even when results are negative.

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Keywords

HIV testing; men; South Africa; knowledge; sexual risk behavior

INTRODUCTION

South Africa has the highest prevalence of HIV than any other region in the world with an estimated 6.4 million people living with HIV (van der Linde, 2013). The incidence of HIV has stabilized since 2006 but remains high with more than 500,000 new infections among South African adults annually (UNAIDS, 2010). Nearly 18% of South African adults between the ages of 15 and 49 are infected with HIV (World Health Organization, 2011). South African women account for a greater proportion of HIV+ individuals than men (44% vs. 56%) (UNAIDS/WHO Working Group on Global HIV/AIDS and STI Surveillance, 2008). Because men are less likely to be tested for HIV, the prevalence of HIV among men may be underestimated. Data from the 2008 South African National HIV Prevalence, Incidence, Behaviour, and Communication Survey shows that more women (30%) were tested for HIV (and know their results) in the past 12 months compared with men (20%) (Shisana et al., 2009). A household survey among 3,416 adults in Soweto, South Africa show that 65% of women but only 29% of men reported ever having been tested for HIV (Venkatesh et al., 2011).

To reduce the spread of HIV, significant investments have been made by the South African government and other local and international agencies to promote voluntary HIV counseling and testing (VCT) to all South Africans (South Africa National AIDS Council, 2006). One goal of the South African National Strategic Plan on HIV, STIs, and TB is to reduce by half the number of new HIV infections by 2016 (South African National AIDS Council). Toward that end, the South African government included yearly VCT for all South Africans among its prevention strategies. To date, more than half of all South Africans have been tested for HIV (Shisana et al., 2009). Uptake of VCT has been slower among men than women with 57% of women but only 43% of men having ever been tested (Shisana et al., 2009).

HIV testing clearly benefits those who test positive, allowing them to receive antiretroviral treatment. HIV testing has been shown to be an effective strategy to reduce the spread of HIV by making people aware of their HIV status and promoting safer sex behaviors (Denison, O'Reilly, Schmid, Kennedy, & Sweat, 2008; Marks, Crepaz, Senterfitt, & Janssen, 2005; Weinhardt, Carey, Johnson, & Bickham, 1999). Testing also facilitates earlier access to support services, health care and antiretroviral treatment which is becoming increasingly available to South Africans (UNAIDS, 2010).

The benefits of testing, for those who test negative, remain controversial (Denison et al., 2008; Weinhardt et al., 1999). More importantly, research in sub-Saharan Africa shows that testing negative for HIV may actually increase risky sexual behaviors (Sherr et al., 2007). Risky sexual behaviors following VCT are more pronounced among men who test negative for HIV than women (Cremin et al., 2010; Sherr et al., 2007). Interviews with Zambians who tested negative for HIV (64% men) revealed a lack of prevention education, social support, or skills-training to assist these individuals to remain HIV negative (Sikasote,

Grant, Chinn, Macwang'i, & Murray, 2011). Acknowledging the importance of providing prevention information following VCT as a method of reducing the number of HIV infections, the South African Government has included sexual risk reduction education for individuals who test positive *or* negative as a goal (South African National AIDS Council). Because VCT is typically emphasized as an entry point for HIV treatment and care, less emphasis is placed on using VCT as a longer-term sexual risk reduction strategy for those testing negative (Denison et al., 2008).

Providing information about HIV transmission and prevention is consistent with behavioral change theory; for example, in the Information-Motivation-Behavioral Skills (IMB) model (W. A. Fisher, Fisher, & Harman, 2003) information (e.g., HIV transmission knowledge) may influence risk behavior directly (as well as indirectly, through behavioral skills). Empirical support for a direct link between information and risk behavior in the broader HIV literature has been mixed and the inconsistent findings may reflect methodological problems as well as the complexity of the behavior (J. D. Fisher, Fisher, & Shuper, 2009). Moreover, many of these studies have tested the influence of information on sexual risk behaviors in countries with relatively high base rates of HIV knowledge. Few studies have investigated the role of information in countries where HIV transmission knowledge is lacking; in such settings, knowledge provision could be more beneficial. Prior research among high school students in Cape Town found that knowledge regarding how to use a condom and how STIs are transmitted directly predicted condom use at last sexual occasion (Eggers, Aaro, Bos, Mathews, & de Vries, 2013). Furthermore, Villar-Loubet et al. (Villar-Loubet et al., 2013) found that HIV-related knowledge mediated the effects of an HIV intervention on consistent condom use. Such findings suggest that HIV knowledge may be an important predictor of sexual risk behavior in the South African context.

Therefore, the purpose of this study was to use cross-sectional data to examine HIV knowledge as a moderator of the association between uptake of HIV testing and sexual risk behaviors among South African men living in Cape Town. We hypothesized that prior HIV testing would be associated with reductions in sexual risk behaviors when men had greater knowledge about HIV. Because prior research found reductions in sexual risk behaviors for individuals who tested positive for HIV, but the evidence for those who test negative is inconclusive (Holtgrave & McGuire, 2007; Weinhardt et al., 1999), we conducted exploratory analyses to examine the association between HIV knowledge and sexual risk behavior separately for men who reported having a positive, negative, or unknown HIV status. Examining the extent to which HIV transmission and prevention knowledge is associated with sexual risk behaviors among men who had ever been tested for HIV may highlight the potential benefits of VCT for other South Africans and underscore the importance of post-testing prevention counseling.

MATERIALS AND METHODS

Participants and Procedures

Participants were 820 men (mean age = 30, 99% Black-African, 8% married, 34% had at least a high school education, and 4% employed) from four primarily Xhosa-speaking African townships just outside Cape Town, South Africa. Men were recruited using the

chain referral method in which 8 to 10 “seeds” who drank at informal drinking establishments (known as shebeens) in each of 12 distinct sections of the four townships were invited to participate in a multilevel alcohol and HIV risk reduction intervention at a local community center in one of the townships (see (Kalichman et al., 2013) for details on the larger trial). These “seeds” recruited other men to participate in the study. To be eligible for the intervention, men needed to: (1) be age 18 or older and (2) reside within the township section. Eligible participants (79% of the men approached) were given details about the study and if interested in participating, they provided written informed consent. Participants completed paper-and-pencil surveys and were reimbursed R100 (13 US dollars) for their time. Baseline surveys, conducted between September 1, 2008 and November 30, 2010, were used to test our hypotheses. All baseline data were collected prior to men’s participation in the multilevel alcohol and HIV risk reduction intervention. All procedures were approved by the Institutional Review Boards of participating institutions.

Measures

Surveys assessed (a) demographic information (e.g., age, ethnicity), (b) HIV testing history, (c) HIV knowledge, (d) sexual behaviors (number of sexual partners, unprotected vaginal and anal sex), and (e) additional measures (e.g., alcohol use) as part of the larger study.

HIV Testing—HIV testing was assessed using two items: (a) Have you ever been tested for HIV? (yes, no) and (b) If you have been tested, what were the results of your most recent test? (positive, negative, don’t know, or refuse to answer). Responses to these two questions were used to categorize people into groups based on whether they had ever been tested for HIV (1 = yes, 0 = no) and HIV status (1 = positive, 2 = negative, 3 = don’t know or refuse to answer).

HIV Knowledge—Knowledge of HIV transmission and prevention was assessed using 10 items adapted from the Brief HIV Knowledge Questionnaire (Carey & Schroder, 2002). These items have been used in prior research conducted in South Africa (Kalichman & Simbayi, 2003; Simbayi et al., 2004). Correct responses were coded as 1 and incorrect or uncertain responses were coded as zero. Items were summed to create an HIV knowledge score ($\alpha = 0.71$; mean = 7.69, SD = 2.13, range = 1 – 10) with higher scores indicating more knowledge about HIV transmission and prevention.

Sexual Risk Behaviors—Participants were asked questions regarding their sexual risk behavior (number of sexual partners, unprotected vaginal sex, unprotected anal sex) during the past 30 days. Number of sexual partners was assessed by asking participants the number of women or men they had sex with in the past 30 days (total number of partners). Unprotected vaginal or anal sex (in past 30 days) was assessed by asking participants how often they had (a) vaginal sex without a condom (unprotected vaginal sex) and (b) anal sex without a condom (unprotected anal sex).¹

¹Few men ($n = 213$) reported engaging in anal sex in the past 30 days. Among these 213 men, 176 (83%) reported having sex with women only, 2 (1%) reported having sex with men only, 22 (10%) reported having sex with both men and women, and 7 did not respond to the questions regarding the number of male and female sex partners in the past 30 days.

Data Management and Analysis

All continuous variables (age, HIV knowledge, number of sexual partners, unprotected vaginal sex, unprotected anal sex) were examined for outliers. For all sexual behavior variables (number of sexual partners, unprotected vaginal sex, unprotected anal sex), responses more than 3 standard deviations above or below the mean were recoded to be equivalent to the value 3 standard deviations from the mean plus 1 (Tabachnick & Fidell, 2007). Summary statistics (means and standard deviations, frequencies) were used to describe sample characteristics, HIV knowledge, and sexual risk behaviors for the overall sample. Differences between individuals who had been previously tested or not tested for HIV were examined using a series of bivariate analyses (chi-square or t-test). Demographic variables that were significantly different between those who had or had not been tested for HIV were included in subsequent analyses.

Regression analyses were used to test our hypothesis that HIV knowledge moderated the association between prior HIV testing and sexual risk behavior. Specifically, the number of sexual partners, unprotected vaginal sex events, and unprotected anal sex events were predicted from prior HIV test (yes, no), HIV knowledge (mean centered), and the interaction between HIV testing and knowledge (Tested×Knowledge). Three separate models were used to examine whether HIV knowledge moderated the association between prior HIV testing and sexual risk behaviors (number of sexual partners, unprotected vaginal sex, unprotected anal sex). Exploratory analyses evaluated the association between HIV knowledge and sexual risk behaviors, stratified by HIV status (positive, negative, or unknown). Outcome variables were examined for skewness. All outcome variables were skewed and clustered at zero, with the variance surrounding the means indicating a high degree of overdispersion; therefore, negative binomial regression analysis was used to model these variables. All data analyses were conducted using Stata 12 (StataCorp, 2011).

RESULTS

HIV Testing History

Of the 820 men who reported their HIV testing history (1 participant did not respond to the question and was removed from further analyses), 516 (63%) reported having been tested for HIV. Among those who had ever been tested, 421 (82%) reported being HIV-negative, 32 (6%) reported being HIV-positive, and 62 (12%) did not know or choose not to disclose their test result. There were no differences between men who had or had not been tested on any demographic variable except for education (see Table 1). Compared to men who had not been tested for HIV, men who had been tested were more likely to report having at least a high school education, $p < .01$. Men who had been tested for HIV were also more knowledgeable about HIV than those who had not been tested for HIV (mean number of correct responses out of a possible total of 10 were 8 and 7 respectively), $p < .001$. There were no differences in sexual risk behavior (number of sexual partners, number of unprotected vaginal or anal sex events) between those who had or who had not been tested for HIV (see Table 1).

Sexual Risk Behaviors by HIV Testing History and Knowledge

Negative binomial regression analyses were used to examine whether HIV knowledge moderated the association between HIV testing and sexual risk behaviors. Three separate models were tested, controlling for education (see Table 2). In these analyses, we include HIV testing history (1 = tested for HIV, 0 = not tested for HIV) and HIV knowledge (mean centered continuous variable) as main effects, as well as the HIV testing history by HIV knowledge (interaction term) to test whether HIV knowledge moderates the association between HIV testing and sexual risk behaviors. Prior HIV testing and knowledge of HIV alone were not significant predictors of sexual risk behavior; however, HIV testing interacted with knowledge. Consistent with our hypotheses, as knowledge increased, men who had been tested for HIV had fewer sexual partners (incident RR = 0.91, 95% CI = 0.84, 0.98; see Figure 1) and fewer unprotected anal sex events (incident RR = 0.81, 95% CI = 0.66, 1.00; see Figure 2) in the past 30 days than those who had not been tested for HIV. Compared to those who had not been tested, men who had been tested for HIV were also more likely to have fewer unprotected vaginal sex events (incident RR = 0.89, 95% CI = 0.79, 1.01) when HIV knowledge was greater but this finding did not reach statistical significance, $p = .07$.

Exploratory Analyses

Exploratory analyses examined the impact of HIV knowledge on sexual risk behaviors separately for men who reported a negative, positive, or unknown (did not know or refused to answer) HIV test result. These analyses are restricted to the 516 men who reported having been tested for HIV. Preliminary bivariate analyses examined whether there were differences in sexual risk behaviors between men who tested negative, positive, or unknown (data not shown). These analyses revealed no differences in the total number of sexual partners, number of unprotected vaginal sex events, or number of unprotected anal sex events between men who reported a negative, positive, or unknown test result, $ps > .05$. Results from the regression models are provided in **Table 3**. Among men who reported testing negative for HIV ($n = 421$), greater HIV knowledge was a significant predictor of fewer sexual partners, unprotected vaginal sex events, and unprotected anal sex events, $ps < .05$. For the 32 men who reported an HIV-positive test result, greater HIV knowledge was associated with fewer unprotected anal sex events, $p < .01$. Finally, among men with an unknown HIV status ($n = 63$), greater HIV knowledge was associated with fewer unprotected anal sex events. Knowledge was not associated with the number of sexual partners or the number of unprotected vaginal sex events among men who reported a positive or unknown test result.

DISCUSSION

One of the South African Government's strategic objective is to prevent new HIV infections by "maximizing opportunities for testing and screening to ensure that everyone in South Africa is tested for HIV" (p.14) (South African National AIDS Council). The effectiveness of HIV testing in reducing the incidence of HIV depends upon both the uptake of VCT and the availability of prevention education. Data from this study shows that 63% (516 out of 820) of men living in Cape Town reported being tested for HIV, this represents a substantial

increase over the 2008 South African National HIV Prevalence, Incidence, Behaviour and Communication Survey that found only 30% of South African men had ever been tested (Shisana et al., 2009). Consistent with the 2012 Global AIDS Response Progress Report on South Africa (UNAIDS), this study provides preliminary evidence that efforts by the South African Government and other international agencies to increase VCT has been successful. Although many South Africans remain unaware of their HIV status, significant progress has been made. More South Africans are aware of their HIV status: recently released data from the Human Sciences Research Council (HSRC) 2012 National HIV Household Survey show that 37% of men became aware of their HIV status in 2012—a nearly four-fold increase from 2005 (Simbayi, 2013). To date, VCT services are now available at more than 90% of public health care facilities in South Africa (UNAIDS). Furthermore, South Africa's national HIV Counseling and Testing (HCT) campaign launched in April 2010, initially aimed to counsel and test 15 million South Africans, has exceeded expectations with more than 20 million South Africans aware of their HIV status through April 2012 (Mbengashe, Nevhutalu, Chipimo, Chidarikire, & Diseko, 2012; Motsoaledi, 2011).

In the current study, we evaluated whether the effect of testing on sexual risk behaviors depended on HIV transmission and prevention knowledge among South African men living in Cape Town. For VCT to be successful, sexual health education must be provided. We show that men who had been tested for HIV were more knowledgeable about HIV than men who had not been tested. But, neither HIV testing or HIV knowledge alone are effective in reducing sexual risk behaviors (see Table 2). Instead, testing interacted with knowledge such that having been tested for HIV, combined with greater HIV transmission and prevention knowledge, was associated with reduced sexual risk behaviors. The cross-sectional nature of this study prevents strong inferences regarding the directionality of the results. However, these results suggest that when HIV testing history is associated with increased knowledge the combination may lead to reductions in sexual risk behavior.

Prior research also indicated that VCT is effective for individuals who test positive for HIV but may be ineffective (or even iatrogenic) for those who test negative (Denison et al., 2008; Weinhardt et al., 1999). In this sample, there were no differences in sexual risk behaviors among men who reported a negative, positive, or unknown test result. In exploratory analyses, we found HIV knowledge to be associated with reduced sexual risk behavior among men who reported an HIV negative test result. Among men who reported a positive or unknown test result, knowledge was associated with fewer unprotected anal sex events but was not associated with the number of sexual partners or unprotected vaginal sex events. Findings among men reporting a positive or unknown test result should be interpreted with caution given our small sample of men reporting these test results in our sample. Future research might examine the effects of VCT in a larger sample of men with a positive or unknown HIV test result.

Results from this study provide evidence that HIV transmission and prevention knowledge is associated with lower sexual risk behaviors among men who report testing negative for HIV in Cape Town, South Africa. Nonetheless, there are limitations of our study that should be kept in mind when interpreting the findings. First, the men sampled may not be representative of the larger community; however, most of these men are alcohol users who

drink in public places such as bars, taverns, and shebeens (82%) which has been identified as an important risk group for targeted interventions (Kalichman, Simbayi, Kaufman, Cain, & Jooste, 2007). Second, data were gathered from self-reports, which can be vulnerable to cognitive and social factors. To minimize socially desirable responding (Weinhardt, Forsyth, Carey, Jaworski, & Durant, 1998), research staff emphasized that all data were anonymous. Previous studies conducted in South Africa have also relied on self-report measures of HIV testing (Kalichman & Simbayi, 2003; Young et al., 2010). Third, our baseline survey did not involve actual VCT but retrospective self-reports of HIV testing history and most recent HIV test results. From these retrospective self-reports, we are unable to determine precisely when the last HIV test occurred. Recent HIV testing may have improved men's HIV knowledge. Finally, cross-sectional data cannot support causal inferences. It is possible that men were knowledgeable about HIV transmission prior to VCT uptake. For example, qualitative research among Zambian men and women who tested negative for HIV indicated that safer sexual behaviors were adopted prior to VCT but VCT "improved understanding of and provided new knowledge about HIV/AIDS...and reinforced previous knowledge and behavior" (p. 435) (Sikasote et al., 2011). Longitudinal data can provide stronger evidence regarding the impact of HIV knowledge on sexual risk behaviors among men who had ever been tested for HIV.

Conclusions

Knowledge of HIV transmission and prevention may be necessary for the reduction of sexual risk behaviors. Evidence from this study provides support for the South African Government's initiative to provide prevention education to those who test negative for HIV (South African National AIDS Council). Ongoing post-test education and support may be required for South African men to maintain their HIV-negative status.

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Figure 1.
Interaction between HIV testing and HIV knowledge, predicting the mean number of sexual partners in the past 30 days.

Figure 2.
Interaction between HIV testing and HIV knowledge, predicting the mean number of unprotected anal sex events in the past 30 days.

Table 1

Characteristics of the sample, overall and by history of HIV testing*

	Overall	Tested for HIV	Not Tested for HIV	Test for Differences
Demographics				
Age	30 (9)	30 (9)	31 (10)	$t(817) = 1.35, p = .18$
Black (%)	99%	98%	99%	$\chi^2(1) = 2.20, p = .14$
Married (%)	8%	8%	8%	$\chi^2(1) = 0.03, p = .87$
High school or higher (%)	34%	37%	28%	$\chi^2(1) = 8.17, p < .01$
Employed (%)	4%	3%	5%	$\chi^2(1) = 1.24, p = .27$
HIV Knowledge	7.69 (2.13)	8.03 (1.91)	7.12 (2.35)	$t(818) = 6.03, p < .001$
Sexual Behaviors, past 30 days [†]				
Sexual Partners	2.69 (3.31)	2.77 (3.45)	2.57 (3.06)	$t(818) = 0.84, p = .40$
Unprotected Vaginal Sex	2.24 (4.82)	2.37 (5.06)	2.03 (4.37)	$t(818) = 0.97, p = .33$
Unprotected Anal Sex	0.45 (1.44)	0.42 (1.34)	0.50 (1.60)	$t(818) = -0.69, p = .49$

* Sample size is 820; 516 had been tested for HIV, 304 had not been tested for HIV.

[†] Adjusted means (standard deviations) are provided for all sexual behavior measures.

Regression analyses examining HIV knowledge as a moderator of the association between HIV testing and sexual behaviors*

Table 2

Predictor	Sexual Partners [†]		Unprotected Vaginal Sex [‡]		Unprotected Anal Sex [§]	
	IRR (95% CI)	P	IRR (95% CI)	P	IRR (95% CI)	P
Full sample (n = 820)						
Education	0.97 (0.82, 1.16)	.77	1.52 (1.11, 2.09)	.01	0.98 (0.58, 1.65)	.94
Tested for HIV	1.09 (0.93, 1.29)	.29	1.15 (0.84, 1.58)	.38	0.84 (0.51, 1.39)	.51
HIV Knowledge	1.00 (0.94, 1.06)	.97	1.02 (0.93, 1.12)	.66	0.90 (0.76, 1.06)	.21
Tested×Knowledge	0.91 (0.84, 0.98)	.02	0.89 (0.79, 1.01)	.07	0.81 (0.66, 1.00)	.05

* Negative binomial regression with robust variance estimation was used for all count variables (sexual partners, unprotected vaginal sex, and unprotected anal sex). HIV knowledge is a continuous variable (mean centered); all other variables were dummy coded (education: 1 = high school or beyond; 0 = less than a high school education; tested for HIV: 1 = yes, 0 = no).

[†] Overdispersion parameter: $\alpha = .55$ (95% CI = .45 to .66).

[‡] Overdispersion parameter: $\alpha = 4.18$ (95% CI = 3.63 to 4.82).

[§] Overdispersion parameter: $\alpha = 10.45$ (95% CI = 8.20 to 13.31).

IRR = incidence rate ratio; CI = confidence interval.