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Peer reviewed

ORIGINAL PAPER

The Association of HIV Counseling and Testing with HIV Risk Behaviors in a Random Population-based Survey in Kisumu, Kenya

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Abstract HIV testing has been promoted as a key HIV prevention strategy in low-resource settings, despite studies showing variable impact on risk behavior. We sought to examine rates of HIV testing and the association between testing and sexual risk behaviors in Kisumu, Kenya. Participants were interviewed about HIV testing and sexual risk behaviors. They then underwent HIV serologic testing. We found that 47% of women and 36% of men reported prior testing. Two-thirds of participants who tested HIV-positive in this study reported no prior HIV test. Women who had undergone recent testing were less likely to report high-risk behaviors than women who had never been tested; this was not seen among men. Although rates of HIV testing were higher than seen in previous studies, the majority of HIV-infected people were unaware of their status. Efforts should be made to increase HIV testing among this population.

Keywords HIV-1 · Voluntary counseling and testing · HIV risk behaviors · HIV prevention · Kenya

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Introduction

Voluntary counseling and testing (VCT) traditionally involves an individual actively seeking out HIV testing at a specific testing facility and includes targeted pre- and post-test counseling. This model of VCT has played an essential role in the public health response to HIV in both resource-rich and resource-limited countries. In Kenya, VCT has been promoted as a cost-effective prevention tool, with the potential to stimulate behavior change in individuals who learn their HIV status. With the increasing availability of anti-retroviral therapy (ART) in Kenya over the past 5 years, VCT has taken on the additional role as a point of entry into care. Despite increased access to treatment, the number of HIV-infected people still far outstrips the country's resources, with ART reaching less than 25% of eligible adults [1]. Effective prevention measures remain crucial to controlling the epidemic.

VCT efficacy data has shown variable effects on HIV risk behavior, with significant behavior changes seen mainly in HIV-infected individuals [2]. However, there have been only a few studies carried out in sub-Saharan Africa, where unique cultural, economic and health contexts affect HIV testing uptake and response to results. The studies that did take place in sub-Saharan Africa, including a large randomized-controlled trial with sites in Kenya, support high quality VCT as a prevention intervention, with potential for risk-reducing behavior change in HIV-infected individuals and sero-discordant couples [3, 4].

A key component of ensuring VCT efficacy includes the establishment of high-quality counseling centers, which can take into account the circumstances in which people get tested, along with the local factors influencing their desire and ability to alter risk behaviors upon learning their HIV status [5]. Counselors need to personalize the post-test

message in order to communicate effectively with the client and impact behavior change [6]. The rapid scale-up of HIV services throughout Kenya has included a substantial increase in the number of VCT centers, leading to increased uptake of testing [1, 7]. Many, but not all sites have implemented quality assurance systems as recommended by the Kenya Ministry of Health, to monitor health outcomes, coordination of care, and content of pre- and post-test counseling [6].

The desire to identify HIV-infected individuals who may benefit from HIV-care and treatment has led to individuals undergoing HIV testing in a variety of settings, including mobile or home-based VCT, diagnostic testing in the hospital wards and provider initiated testing in outpatient clinics [8]. There are also a significant number of individuals tested as part of research trials. Ideally, testing in any context includes comprehensive and personalized counseling, however, the rapid expansion and lack of universal oversight to ensure quality of counseling has led some researchers and public health officials to speculate on the differential effect and impact of HIV testing at various sites. In addition, the motivation for testing through VCT may be different from provider-initiated testing or diagnostic testing performed in the setting of a concurrent illness. While VCT efficacy has been evaluated in controlled research settings, there have been no population-based studies looking at HIV testing as offered and experienced in the various settings available to the community. Thus, we sought to evaluate the correlation between HIV risk behaviors and prior HIV testing in a random population-based sample in a high HIV prevalence city in the Nyanza province of western Kenya.

Methods

Study Site

This study took place in the Municipality of Kisumu, Kenya from July to October 2006. Kisumu is the country's third largest city, with a population of approximately 500,000 people. It is situated in the Nyanza Province of western Kenya, alongside Lake Victoria. The majority of Kisumu residents are of Luo ethnicity, and the municipality consists of both rural and urban households.

Study Design

This is a population-based, cross-sectional study examining HIV risk behaviors, HIV testing, knowledge and beliefs regarding antiretroviral therapy, and prevalence of sexually transmitted infections. The study protocol, consent and questionnaire were approved by the ethical committees of the Kenya Medical Research Institute and the University of California, San Francisco prior to study initiation. A detailed description of the sampling methods has been presented elsewhere [9]. Households were randomly selected within 23 sentinel clusters identified as representative of Kisumu's population plus an additional 17 census enumeration districts. A community mobilizer visited each household, followed 2 days later by the study team. All men and women aged 15–49 who had slept in the house the night before the first study visit were eligible for participation.

After agreeing to participate and giving written informed consent, each participant was privately interviewed on socio-demographic characteristics, HIV and ART-related knowledge, sexual history with spousal and non-spousal partners, HIV testing history, and HIV risk perception. Interviews were conducted by trained research staff in the participant's preferred language: English, Kiswahili or Dholuo. Participants were asked about potential HIV risk behaviors, including sex with a non-spousal partner in the past year, unprotected non-spousal sex, anal sex and transactional sex ("have you given or received gifts or money for sex?"). In order to capture potential change in behavior, participants were asked to report whether they had ever engaged in risk behaviors, and whether they had engaged in them within the past year. The interviewer recorded participant responses in a pre-programmed questionnaire in the personalized digital assistant (PDA). Venous blood samples were collected for HIV testing.

The interviews and specimen collections were carried out at a private location in or near the homes of the study participants. Study participants with symptoms suggestive of a sexually transmitted infection (STI) were treated immediately by the study nurse using Kenyan guidelines for STI syndromic management. Approximately 1–2 weeks after specimen collection, trained VCT counselors offered HIV and STI counseling and test results both within the selected clusters and at a central location in Kisumu. Those who tested HIV-positive were referred to HIV care and treatment sites in the Kisumu area, including a site affiliated with our research group.

HIV testing

HIV testing was performed according to Kenya Ministry of Health guidelines. Specimens were first tested using two different rapid assays in parallel (Rapid Uni-Gold^{TM}, Trinity Biotech, Ireland; and Determine^{TM}, Inverness medical innovations, Delaware, USA). HIV seropositivity was defined as two positive rapid tests, and seronegativity was defined as two negative rapid tests. Discordant or indeterminate rapid assay results were resolved with HIV ELISA (Vironostika HIV Uni-Form II Ag/Ab).

Data Management and Analysis

The interview data was uploaded from the PDAs and backed up on a daily basis. HIV results were double entered and checked for errors. Univariate and multivariate logistic regression models were used to determine characteristics associated with previous HIV testing and risk behavior. To control for the possibility of intra-class correlation within the clusters, we used a robust sandwich variance estimator for cluster-correlated data to calculate the relative risks and confidence intervals. Because there was no difference in demographic characteristics among the clusters and adjusted results did not differ from unadjusted results, we present unadjusted odds ratios for the demographic characteristics associated with HIV testing and HIV-seropositivity. Adjusted risk ratios are presented for the association of HIV testing and risk behaviors. Pearson's chi-square and comparative fit index were used to determine which variables were included in our final model. Using principal factor analysis, we looked at all questionnaire items related to high-risk sexual behavior. Eigenvalues were used to determine if the variance and distribution of the variables would allow for the creation of composite variables to both summarize high-risk behavior and increase our statistical power. Sexual risk behaviors were combined into two composite, dichotomous variables for "risk behavior ever reported" or "risk behavior within the past year". Individual variables included in the composite were unprotected sex with one or more non-spousal partners, anal sex and transactional sex. A response of "yes" to any of the risk behavior questions was categorized as "yes" for overall risk behavior within the time period. Initial analysis showed statistical interaction between sex and risk behaviors, so results were analyzed and presented separately. Age and education were significantly associated with HIV-infection, and were therefore, controlled for in our analysis of sociodemographic and behavioral risk factors associated with prior HIV testing; these results are presented as adjusted odds ratios and adjusted risk ratios.

Results

Demographics and HIV Seroprevalence

A total of 1,655 people (90% of 1,844 people contacted), 749 men and 906 women from 681 households in Kisumu participated in the study. Sociodemographic characteristics were similar for the 1,508 (91%) participants who provided a blood sample and the 147 who refused serologic testing. Reflecting the population of Kisumu, the majority of the participants were Luo (77%) and Christian (95%). Seventy-one percent of participants were between 15 and 29 years

of age. The majority (53%) had only a primary school education. Less than half (42%) of the sample was employed at the time of the study.

Twenty-five percent of women and 16% of men were HIV seropositive (OR = 1.7, 95% CI 1.3–2.8). The sociodemographic characteristics associated with HIV seropositivity are presented in Table 1. Education greater than primary school was associated with decreased odds of HIV infection in both men and women. Results were then controlled for age and education. For men, being single significantly decreased their odds of infection, whereas for women, identifying as separated/divorced or widowed resulted in the greatest odds of infection. Luo women were two-times more likely to be HIV infected than other ethnic groups.

HIV Testing History

Among individuals who were interviewed, 47% of women and 36% of men reported prior HIV testing. The sociodemographic characteristics associated with prior testing are shown in Table 2. For both men and women, the odds of having had an HIV test in the past 1–2 years were greatest among people aged 20–29. For women, being currently married increased the odds of having had a recent test. For both sexes, the odds of having a recent test correlated with higher levels of education.

Association Between HIV Serostatus and Prior HIV Testing

Although the overall rate of HIV testing was high, the majority of participants found to be HIV-infected were previously unaware of their status. Among study participants who tested HIV-positive in this study, 64% reported never having had an HIV test and were thus unaware of their HIV infection. Controlling for age and education, women were more likely to be unaware of their HIV status than men (Adjusted odds ratio (AOR) 1.6, 95% CI 1.2–2.1). Women who were HIV-infected were less likely to have undergone prior testing than those who were not infected (AOR 0.6, 95% CI 0.4–0.9), a finding not seen in the male participants (AOR 0.8, 95% CI 0.5–1.2). Twelve percent of women and 10% of men who had reported testing negative for HIV in the past 1–2 years were found to be seropositive at the time of the study.

HIV Risk Behaviors and Prior Testing

We looked at participants who had an HIV test within the past 2 years and evaluated their behavior within the past year compared with "ever". After controlling for age and education, having an HIV test within the past 2 years was

Table 1 Sociodemographic factors associated with HIV seroprevalence in Kisumu

Variable	Men		Women	
	HIV+	OR (95% CI)	HIV+	OR (95% CI)
Age				
15–19	7/179 (4%)	1.0	19/191 (10%)	1.0
20–24	24/172 (13%)	**3.8 (1.8–8.3)**	54/271 (20%)	**2.2 (1.2–4.0)**
25–29	29/130 (22%)	**7.3 (3.4–15.5)**	40/135 (30%)	**3.8 (1.9–7.6)**
30–39	24/118 (20%)	**6.5 (2.7–15.6)**	63/154 (41%)	**6.3 (3.4–11.6)**
40–49	25/46 (35%)	**13.5 (5.5–33.4)**	28/76 (37%)	**5.3 (2.7–10.5)**
Marital status				
Married	61/207 (30%)	1.0	79/354 (22%)	1.0
Single	18/249 (7%)	**0.3 (0.1–0.6)**	21/148 (14%)	1.0 (0.5–2.0)
Separated/divorced	5/21 (24%)	0.7 (0.2–2.1)	15/38 (39%)	**2.3 (1.2–4.3)**
Widowed	1/3 (33%)	0.8 (0.1–7.7)	27/41 (66%)	**4.4 (2.2–9.1)**
Education level				
Up to primary	43/185 (23%)	2.1 (0.8–5.3)	85/305 (28%)	**5.6 (1.8–17.6)**
Secondary	33/222 (15%)	1.6 (0.6–4.1)	46/212 (22%)	**3.7 (1.1–12.4)**
College/university	7/63 (10%)	1.0	4/47 (4%)	1.0
Currently employed				
No	25/223 (11%)	1.0	85/305 (24%)	1.0
Yes	60/257 (23%)	1.5 (0.9–2.6)	57/224 (25%)	**0.7 (0.5–0.97)**
Location				
Urban	208/588(35%)	1.0	70/302 (23%)	1.0
Rural	48/156 (31%)	1.6 (0.9–2.8)	72/279 (42%)	1.1 (0.7–1.6)
Years lived in Kisumu				
<1	8/48 (17%)	1.0	8/66 (12%)	1.0
1–5	15/117 (13%)	0.6 (0.2–1.8)	28/153 (18%)	1.5 (0.6–3.4)
>5	62/314 (20%)	0.9 (0.4–2.0)	106/362 (29%)	1.9 (0.9–4.2)
Ethnic group/tribe				
Luo	70/384 (18%)	1.4 (0.7–2.8)	119/450 (26%)	**2.0 (1.2–3.2)**
Other tribe	15/96 (16%)	1.0	23/131 (18%)	1.0
Religion				
Christian	82/452 (18%)	1.6 (0.3–8.0)	135/458 (43%)	0.8 (0.3–2.2)
Other	3/28 (11%)	1.0	7/23 (34%)	1.0
Alcohol use				
No	32/267 (12%)	1.0	115/510 (22%)	1.0
Yes	53/213 (25%)	**1.9 (1.2–3.0)**	27/71 (23%)	**2.1 (1.3–3.5)**
Drug use				
No	31/236 (12%)	1.0	122/397 (23%)	1.0
Yes	54/213 (25%)	**2.2 (1.3–3.7)**	20/62 (32%)	1.5 (1.8–2.8)
Electricity in the home				
No	66/327 (20%)	1.0	113/399 (28%)	1.0
Yes	19/153 (12%)	**0.6 (0.3–0.7)**	29/184 (13%)	1.3 (0.98–1.8)

Statistically significant values are shown in bold

not associated with individual HIV-risk behaviors, including sex with a non-spousal partner or unprotected sex with a non-spousal partner in the past 12 months compared with participants who had never been tested (Table 3). There was no association between HIV testing and ever having had anal sex or giving or receiving sex for money for either men or women. Women who had tested negative for HIV within the past 2 years had significantly lower relative risk of reporting anal sex within the past year (Adjusted (A)RR 0.1, CI 0.02–0.9). Men with a negative HIV test within the past 12 months had increased risk of engaging in transactional sex within the past year (ARR 2.3, CI 1.2–4.3). When looking at the composite sexual risk variable, having an HIV test within the past 1–2 years was not associated

Table 2 Demographics associated with prior HIV testing

Variable	Men		Women	
		OR (95% CI)		OR (95% CI)
Age				
15–19	50/146 (34%)	1.0	72/371 (19%)	1.0
20–24	87/209 (42%)	**2.1 (1.4–3.2)**	142/287 (49%)	**1.8 (1.3–2.6)**
25–29	64/139 (46%)	**2.5 (1.6–4.0)**	73/146 (50%)	**1.9 (1.2–2.9)**
30–39	32/127 (25%)	1.0 (0.6–1.6)	62/164 (38%)	1.1 (0.7–1.7)
40–49	23/256 (9%)	1.4 (0.8–0.5)	22/130 (17%)	0.7 (0.4–1.3)
Marital status				
Ever married	109/339 (32%)	0.8 (0.6–1.1)	285/625 (47%)	1.6 (1.2–2.2)
Currently married	98/296 (33%)	0.9 (0.7–0.2)	237/502 (47%)	**1.6 (1.2–2.1)**
Separated/divorced	8/34 (24%)	0.6 (0.3–1.3)	20/61 (33%)	0.6 (0.4–1.1)
Widowed	1/5 (20%)	0.5 (0.1–4.2)	26/62 (42%)	1.0 (0.6–1.7)
Single	149/406 (37%)	1.2 (0.9–1.7)	88/249 (35%)	0.7 (0.5–0.9)
Education level				
Up to primary	92/350 (26%)	1.0	197/501 (39%)	1.0
Secondary	115/308 (37%)	**1.7 (1.2–2.4)**	139/281 (49%)	**1.7 (1.2–2.3)**
College/university	49/79 (62%)	**5.6 (2.3–13.5)**	35/52 (67%)	**3.6 (2.0–6.6)**
Currently employed				
No	120/375 (32%)	1.0	226/571 (40%)	1.0
Yes	136/367 (37%)	1.3 (0.9–1.9)	145/306 (47%)	1.2 (0.9–1.6)
Ethnic group/tribe				
Luo	208/588 (35%)	1.3 (0.8–1.9)	280/665 (42%)	1.1 (0.8–1.5)
Other	48/156 (31%)	1.0	91/215 (42%)	1.0
Religion				
Christian	246/701 (35%)	1.6 (0.7–3.4)	356/828 (43%)	1.3 (0.6–2.5)
Other	10/43 (23%)	1.0	15/44 (34%)	1.0
Electricity in the home				
Yes	91/203 (45%)	**1.6 (1.2–2.3)**	116/353 (46%)	1.3 (0.98–1.8)
No	165/537 (31%)	1.0	255/620 (41%)	1.0

Statistically significant values are shown in bold

Table 3 HIV risk behaviors in participants who had undergone HIV testing in past 1–2 years, unadjusted and adjusted relative risk

Risk behavior	Men		Women	
	RR (95% CI)	ARR[a] (95% CI)	RR (95% CI)	ARR[a] (95% CI)
Sex with non-spousal partner in the past year	**1.5 (1.1–2.1)**	1.5 (1.0–2.1)	1.1 (0.8–1.6)	1.1 (0.7–1.7)
Sex with non-spousal partner without condoms	1.0 (0.6–1.6)	1.1 (0.7–1.7)	1.5 (1.0–2.3)	1.4 (0.9–2.3)
Anal sex				
Ever	0.4 (0.1–1.8)	0.4 (0.1–2.1)	1.6 (0.5–5.0)	1.4 (0.4–4.9)
Past 12 months	0.6 (0.1–1.3)	0.6 (0.1–3.1)	**0.1 (0.1–0.8)**	**0.1 (0.02–0.9)**
Given or received gifts or money for sex				
Ever	1.0 (0.7–1.5)	1.2 (0.8–2.3)	0.7 (0.5–1.0)	0.7 (0.5–1.1)
Past 12 months	**2.0 (1.1–3.6)**	**2.3 (1.2–4.3)**	1.3 (0.8–2.1)	1.4 (0.8–2.3)
Reports any risk behavior[b]				
Ever	1.1 (0.8–1.6)	1.2 (0.8–1.7)	1.1 (0.8–1.4)	1.1 (0.8–1.4)
Past 12 months	1.2 (0.8–1.7)	1.3 (0.9–1.9)	0.4 (0.2–1.2)	**0.7 (0.5–0.98)**

[a] Relative risk adjusted for age and educational level, with 95% confidence interval (CI)

[b] One or more of the following: sex for money, unprotected non-spousal sex or anal sex

Statistically significant values are shown in bold

with a difference in *ever* reporting risky sexual behavior for men or women. However, risky sexual behavior *within the past year* was less common among women who had been tested for HIV within the past 1–2 years (ARR 0.7, CI 0.5–0.98).

Discussion

To the best of our knowledge, this is the first population-based study to look at sexual risk behaviors associated with HIV testing since the rapid scale-up of counseling and testing services in Kenya. The majority of previous studies on HIV testing and behavioral change have looked solely at VCT as the testing modality. By looking at a random, population-based sample, we were able to capture people who had undergone HIV testing in various settings, and therefore, get a picture of the population level effects of HIV counseling and testing and knowing one's HIV status.

The socio-demographic characteristics and risk factors associated with HIV infection were similar to previous population-based surveys in this population [10]. History of HIV testing in our study population was significantly higher than the 12–15% found in previous surveillance reports in Nyanza [11]. This may reflect the scale-up of treatment and prevention-of-mother-to-child transmission programs (PMTCT) in Kenya as well as the promotion of VCT and other testing strategies as a point of entry into care in addition to being an HIV prevention strategy. However, although a greater proportion of the overall population is undergoing testing, our results suggest that the majority of HIV-infected people may remain unaware of their status.

Gender differences in uptake of HIV testing may be partially explained by the availability and promotion of testing in antenatal centers as part of national PMTCT efforts. Although VCT centers, particularly in antenatal settings, have worked to increase uptake and assisted disclosure among women in the setting of potential stigma and violence, there are indications that the number of women who visit a health care provider during their pregnancy may have decreased since HIV testing has been promoted at antenatal care centers [6]. HIV testing, disclosure and utilization of PMTCT services among infected women remain a significant challenge [12]. We found that although overall more women than men had previously undergone testing, HIV-infected women were less likely than HIV-infected men to be aware of their HIV status. This suggests that VCT and other testing strategies may not be reaching the women who are most at risk, and improved strategies to target at-risk women should be investigated.

Importantly, women who had prior HIV testing and knew that they were HIV-negative were less likely to have recently engaged in high-risk sexual activities compared to women who had never had HIV testing, regardless of their HIV status. Although conclusions drawn from this relationship are limited by the cross-sectional nature of the study, this finding was not seen in men. This is similar to a prior study that showed HIV-negative men were less likely to exhibit behavior change than women or sero-discordant couples [4]. Particular attention should be given to effective counseling of male clients, given the differences in risk behavior seen in this study.

Although the results show several gender-related differences in the effects of HIV counseling and testing, there are limitations to the conclusions found in this study. Attempts to determine a causal relation between HIV testing and differences in HIV risk behavior are limited by the cross-sectional nature of the study. To minimize this, we looked at people who had an HIV test within the past 2 years and evaluated their behavior within the past year compared with "ever". However, we cannot comment on causality without a comparison between pre- and post-test behaviors and characteristics in a prospective trial. There were also potentially large variations in the quality of counseling and testing services received. One of the strengths of the study, however, is that it captures HIV testing as it is implemented and experienced outside of a controlled, research environment. Additionally, as the study was a secondary data analysis, the questions were not designed specifically to determine experiences with prior HIV testing, and therefore, we did not have information on the setting, quality and circumstances of the HIV tests for each individual.

Despite the limitations of the study, there are implications for further investigation and careful analysis of the motivations for testing and the coverage, quality and content of counseling for HIV testing in different settings. The potential prevention efficacy of HIV testing as experienced by the majority of Kenyans in diverse settings in the community may vary. Although coverage and availability of HIV counseling and testing have increased substantially, efforts need to be made to increase the number of HIV-infected individuals aware of their HIV-status. While analysis of their efficacy continues, VCT and other forms of HIV testing continue to be utilized as an HIV-prevention strategy. Counselors in all settings should strive to provide appropriate, targeted pre- and post-test counseling to both men and women with a focus on individual risk-reduction strategies so that the prevention benefits can be maximized for both men and women.

References

1. World Health Organization. Summary country profile for HIV/AIDS treatment scale-up: Kenya. 2005. available at http://www/who.int/countries/ken/en. Accessed February 4, 2008.

2. Denison JA, O'Reilly KR, Schmid GP, Kennedy CE, Sweat MD. HIV voluntary counseling and testing and behavioral risk reduction in developing countries: a meta-analysis: 1990–2005. AIDS Behav. 2008;12(3):363–73.

3. Allen S, Meinzen-Derr J, Kautzman M, Zulu I, Trask S, Fideli U. Sexual behavior of HIV discordant couples after HIV counseling and testing. AIDS. 2003;17(5):733–40.

4. VCT Efficacy Study Group. Efficacy of voluntary HIV-1 counseling and testing in individuals and couples in Kenya, Tanzania and Trinidad: a randomized trial. Lancet. 2000;356(9224):103–12.

5. Kalichman SC, Simbayi LC. HIV testing attitudes, AIDS stigma and voluntary counseling and testing in a black township in Cape Town, South Africa. Sex Transm Infect. 2003;79(6):442–7.

6. Taegtmeyer M, Kilonzo N, Mung'ala L, Morgan G, Theobald S. Using gender analysis to build voluntary counseling and testing in reducing sexual transmission of HIV-1 in Kenya and Tanzania. Trans R Soc Trop Med Hyg. 2006;100(4):305–11.

7. NASCOP: Kenya National Strategy for VCT Scale-up: 2003–2007. Nairobi, Kenya: national AIDS and STD control programme, Ministry of Health, 2004.

8. Matovu JK, Makumbi FE. Expanding access to voluntary HIV counseling and testing in sub-Saharan Africa: alternative approaches for improving uptake, 2001–2007. Trop Med Int Health. 2007;12(11):1315–22.

9. Cohen CR, Montandon M, Carrico AW, et al. Association of attitudes and beliefs towards antiretroviral therapy with HIV-seroprevalence in the general population of Kisumu, Kenya. PLoS ONE. 2009;4(3):e4573.

10. Buve A, Carael M, Hayes R, et al. Multicentre study on factors determining differences in rates of spread of HIV in sub-Saharan Africa: methods and prevalence of HIV-infection. AIDS. 2001;15(Suppl 4):S5–14.

11. DASCO: Nyanza HIV and VCT Surveillence: 2003 and 2005. In: Health Mo, editor. District AIDS/STDs co-ordinator (DASCO), Kenya Ministry of Health, 2005.

12. Moth IA, Ayayo AB, Kaseje DO. Assessment of utilization of PMTCT services at Nyanza Provincial Hospital, Kenya. Sahara J. 2005;2(2):244–50.