

The gap between knowledge and practice of risky sexual behaviors for HIV among University students and staff in Moshi Town in Tanzania

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Abstract

Knowledge on HIV spread is important in combating HIV/AIDS, however its impact can only be realized if put into practice. This study was carried out in a Higher Learning Institution in Moshi Township in Kilimanjaro Region to assess the level of awareness of university communities about HIV/AIDS and its link with practice of risky sexual behaviors (RSB). We have found an adequate level of knowledge on the spread, risk behaviors and methods for protection leading to attendance to voluntary testing and counseling by 61% of respondents. Conversely, we have observed great extent of practice of RSBs including early sexual debut (16.7 years), having multiple and extramarital partners, involvement in practices that lead to unprotected sexual intercourse. We report an obvious gap between knowledge and behavior. This study therefore recommends that serious operational interventions must be put in place targeting the most sexually active groups, the youth in preliminary schools to sensitize on RSBs and ways to avoid them before they are engaged in sexual activities.

Introduction

In the 30 years since HIV/AIDS was first discovered, the disease has become a devastating pandemic, taking the lives of 30 million people around the world. It is estimated that 22.5 million of people were living with HIV in 2007.¹ Youth are among the groups mostly affected by HIV/AIDS and this is due to their practice of risky sexual behaviors (RSB).² In many parts of the world, the spread of the HIV pandemic is

still fueled by ignorance on its epidemiology and risk behaviors associated with its spread. Understanding the factors that compel people to engage in unprotected sex given the severe consequences is of major importance in reducing the spread of HIV. As a result of continued interventions and awareness creation among population, the current global HIV prevalence is reported to be less than 5.6%.³

Although HIV rates are showing signs of leveling off in recent years,⁴ the decrease in HIV prevalence rates is not as fast as expected for the corresponding financial and time effort invested into its prevention. There is generally lack of accurate information, especially in the African context, on sexuality, sex education at home and school and colleges which contribute to sexual risk behavior practice among the youth.⁵ At least 50% of young people globally are estimated to be sexually active by the age of 16 years and these are at a high risk of acquiring HIV infection.⁶ The HIV/AIDS, to a large extent is a crisis of sexual behavior whereby unsafe sex is the most responsible behavior for contracting HIV infection in Sub-Saharan Africa.^{1,3} In Tanzania, majority of youth engage themselves in RSBs that expose them to unwanted pregnancy and sexually transmitted infections including HIV.⁷

In order to sustain the initial success obtained in the control of HIV AIDs, the target group for HIV/AIDS prevention is logically the young population, *i.e.*, youth from the onset of puberty up to the age of marriage. Young people are also relatively easy to reach for preventive interventions via educational institutions where they spend many years of their lives. Accordingly, since higher learning institutions are the most likely arena for initiating sexual contacts, it is important to determine the most important factors that shape sexual behaviors in such settings.

The pattern of sexual practice among university respondents lags behind knowledge and attitude towards HIV awareness and thus prevention. This study was therefore aimed at assessing the level of awareness of university society about HIV/AIDS and RSB among the society. Based on the above-mentioned context, a baseline survey was designed and conducted at the Stefano Moshi Memorial University College (SMMUCo), Tumaini University in Tanzania, to collect data regarding knowledge and attitudes among respondents regarding HIV/AIDS.

Materials and Methods

Study area, sampling and data collection

SMMUCo is a multi-campus university col-

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Contributions: EK planned the study, developed questionnaires, collected data and wrote the manuscript; ES and GM assisted in planning the survey, data collection and proof reading the manuscript; TS analyzed data; JM was involved in data collection and entry; JC was involved in questionnaire development, data analysis and extensive review of the manuscript.

Conflict of interests: the authors declare no potential conflict of interests.

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lege with campuses located in different parts of Kilimanjaro Region, namely Mwika, Masoka and Moshi town. SMMUCo is a constituent College of Tumaini University. Random selection of participants described below was used to obtain a sample size of 426.

Selection of participants and randomization procedure

Sensitization to participate in the survey was done to all community members using posters and in a general university meeting 4 weeks before commencement of the study. Out of 1030 community members, 674 (more than 50% of the total community) agreed to participate in the study. Since the planned sample

size was 400, a sample size of 460 was adopted. A randomization procedure was followed to obtain the required participants. A randomization list was computer generated using MS-Excel for all groups in the three university campuses; students, faculty members and administrative staff. Sequentially numbered, sealed envelopes containing either a YES or NO were picked by all who agreed to participate. There were 460 YES labels and the remaining had NO labels inside.

Data collection

A social survey design was adopted whereby data was collected using a set of pre-formulated questions in a structured questionnaire. The questionnaire was used to collect information concerning demographic characteristics of respondents, HIV and AIDS awareness, sexual practices, attitude towards HIV prevention, HIV-related risk behaviors. Orientation to the questionnaire was done to the participants to maximize accuracy on responses. For this survey, respondents completed anonymous, self-administered questionnaires that included identically worded questions about their sexual experience, number of sexual intercourse partners, current sexual intercourse, and condom use. As far as HIV/AIDS and sexuality issues are concerned, privacy and confidentiality was strictly observed by ensuring no personal identifiers (names, parents' names etc) were not included in the questionnaire. Respondents were asked to fill in the questionnaire and collect the filled questionnaire anonymously.

Data analysis

Data entry, coding, cleaning and analysis were done using specialized computer software: Microsoft Excel and Access 2010 for entry; SPSS software version 18 and STATA (StataCorp., College Station, TX, USA) for analyses. Data were analyzed in various ways to obtain the needed information. Descriptive analysis was generally done to assess distributions of explanatory variables and to graphically evaluate their association with the outcome. For quantitative variables, this was achieved by creating histograms and whereas for categorical variables, by creating their frequency tables (proportions) and or bar charts. Bivariate analysis was done to test unconditional or independent associations and the effect of each explanatory variable on the outcome (condom use) in order to get crude effects [odds ratios (ORs)] on the outcome. Multivariate analysis was done to test association of each explanatory variable with the outcome (condom use) after allowing or accounting for the effect of other explanatory variables in order to get adjusted effects on the outcome. The use of both tests was important in order to ascertain strength of tested associations.

Results

Demographic characteristics

Demographic characteristics on age groups, nationality, religion and education are shown in Figure 1 and Table 1. Out of all respondents (426), 61% were males and the rest 39% were females. We found that 64.7% of the respondents were singles, whereas 33% were married. Other small proportions of marital status groups were found as follows: cohabited (1.4%), divorced (0.7%) widows/widowers (0.2%).

Age at first intercourse

When males and females were compared by using two-sample t test [means equality of age (years)] by age at first sexual intercourse, females were shown to engage themselves sexual intercourse earlier than males (15.7 vs 17.7 years) a difference that was found to be strongly statistically significant ($P=0.0018$), Table 2.

Results for the risk associated with the different factors on condom use are presented in Table 3. It was alarmingly notable that single participants were 4.4 times more likely to use condoms than married couples [OR=4.44; 95% confidence interval (CI) 1.52, 12.98, $P=0.006$]. About one quarter (25%) of the participants

reported to have had sex while either they were, or their partners were drunk within last six months.

Results for the involvement in RSBs are presented in Table 4. More than sixty percent (64.1%) of participants reported to have had sex at the age of 10-20 years of age. One third (33.3%) reported to have sex at an age of 21 to 30 years. Our survey indicates that less than half (42.3%) of participants who were involved in this survey responded to the question of type of sexual practices. Results for this question are presented in Table 4 which shows that majority of participants practice ordinary (vaginal) sex while a considerable number of participants, about one fifth (20%) are involved in other types of sexual practices including anal and oral sex. Further, results show that 69.4% of respondents had tested for HIV. However, more than sixty percent (60.8%) of those who had tested for HIV had done so not more than twice.

About one third of participants (26.9%) reported to actively practice sex while at the college. Irrespective of other details, participants reported different partnerships they were involved with. The main sexual relationships reported are indicated in Figure 2 as follows; student and student (34.%) of the respondents, respondents and people outside the College (43%), staff and people outside the

Table 1. Demographic characteristics.

Parameters	No.	Percent (%)
Religion		
Muslim	22	5.2
Christian	404	94.8
Total	426	100.0
Nationality		
Tanzanian	412	96.7
Kenyan	2	0.5
Ugandan	1	0.2
Non response	11	2.6
Total	426	100.0
Education level		
Primary	18	4.2
Secondary/higher certificate	53	12.4
Diploma	56	13.1
Advanced diploma	20	4.7
Bachelor*	237	55.6
Masters	16	3.8
Ph.D	3	0.8
Non response	23	5.4
Total	426	100.0

*Included those with Bachelor's degrees and undergraduate students.

Table 2. Analyses on age at first sexual intercourse.

Gender	Two-sample t test [means equality of age (years) at first sexual intercourse]			
	No.	Mean	Std. Dev.	P value
Female	94	15.7	2.6	0.0018
Male	153	17.7	2.4	0.0018

Std. Dev., standard deviation.

College (21%) and staff to staff (2%). Our survey also sought to find out the extent of extramarital partnerships as an important RSB. To this question, majority (84.5%) reported not to have extramarital partners while 15.5% agreed to have partners outside marriages (Figure 3).

Opinion on condom use

Participants were asked about reasons and feelings for not using condom as a protective measure; responses are presented in Table 3 and Figure 4. Interestingly, about one third of respondents (27.4%) gave a reason of not using condom as being less pleasure whereas about one-fifth (21%) did not use condoms because it was an important sign of love to their partners. Analyses showed that males had more excuses for condom use than females ($\chi^2=8.3$; $P<0.05$) whereas education level was strongly associated with condom use ($\chi^2=32.2$; $P<0.01$). Results in Table 3 indicate that there was a high chance for not using condom by those who felt it was against marriage morals (OR=2.52; 95% CI: 1.14, 5.59, $P=0.023$).

Knowledge on HIV/AIDS and source of information

When important sources of information about HIV/AIDS to participants by their levels of education were analyzed, it was evident that TV and radio were the main sources of information (46.9%) across all levels of education (Figure 5). Next to this were scientific journals (26.5%) and health practitioners (17.5%). Statistical analyses for the influence of education or knowledge on precautions against HIV infection was statistically associated with level of education ($\chi^2=15.14$; $P<0.05$). The main precautions reported against contracting HIV included abstinence (10.3%), condom use (22.1%), faithfulness (13.1%), and having few sexual partners (1.2%).

Discussion

Majority of study participants were in the age group of between 21-40 years, an age associated with highest sexual activity. This observation was perfectly matched with the finding that most participants were actively involved with sexual activities at the time of the survey. The timing of the current survey was such as to understand this particularly sexually active group in an academic society in order to design sound intervention plans. We found that two thirds of the respondents were single (unmarried). Being unmarried is considered to be a risk factor for acquiring HIV infection and therefore the study population in the current study may be perceived as a high-risk population. Marital status is known to influence

perception of the risk of HIV infection as well as sexual behavior. For example, while unmarried women may have some ability to negotiate safer sex, married women usually may not have a similar opportunity, as they are worried of being suspected of promiscuity by their spouses. The consequence is that married women may acquiesce in unsafe sexual practices, even if they suspect or know of their partner's extramarital relations. Although HIV cannot be spread through sexual intercourse in stable monogamous relationships between uninfected partners, among married women the presence and the nature of their partners'

casual or extramarital sexual practices largely determines the risk of HIV transmission.

Majority (98.3%) of respondents had sexual exposure in their life, and the mean age at sexual debut was observed to be between 15.7 and 17.7 years in females and males respectively. Our finding is slightly different from observations made previously.⁸ Studies from other countries reported even lower means of the age at sexual initiation. For example, previous research in Jamaica and Zimbabwe reported a mean age of 9 years,^{9,10} while a mean age of 14 years was reported in Kenya.

Despite the observation that about a half of

Table 3. Bivariate and multivariate analyses on risks associated with different factors on use of condoms.

Use of condom	OR*	Bivariate		Multivariate		
		95% CI	P value	OR ^o	95% CI	P value
Age (years) at first sexual intercourse						
10-20	1.00	-	-	1.00	-	-
21-30	0.48	[0.22, 1.08]	0.075	0.79	[0.28, 2.21]	0.658
Gender						
Female	1.00	-	-	1.00	-	-
Male	1.83	[0.95, 3.53]	0.071	1.93	[0.78, 4.74]	0.153
Possibility of HIV prevention						
Possible	1.00	-	-	-	-	-
Not possible	0.12	[0.01, 0.98]	0.048	-	-	-
Feelings to condom use						
Unpleasant	1.00	-	-	1.00	-	-
Unreligious	0.53	[0.16, 1.73]	0.289	0.49	[0.11, 2.14]	0.341
Against marriage morals	2.52	[1.14, 5.59]	0.023	2.48	[0.84, 7.38]	0.101
Marital status						
Married	1.00	-	-	1.00	-	-
Single	4.44	[1.52, 12.98]	0.006	4.35	[1.30, 14.56]	0.017

OR, odds ratio; CI, confidence interval. *Crude OR; ^oadjusted OR.

Table 4. Types of sexual practices and risk related behaviors.

Parameters	No.	%
Age group for/at first sexual intercourse (years)		
10 to 20	175	64.1
21 to 30	91	33.3
31 to 40	6	2.2
61 to 70	1	0.4
Total	273	100.0
Types of sexual practices		
Masturbation	20	11.1
Vaginal sex	148	82.2
Anal and oral sex	12	6.7
Total	180	100.0
Incidence of sexual intercourse while drunk		
Respondent	9	8.5
Respondent's partner	8	7.5
Both	10	9.5
None of the sexual partners	79	74.5
Total	106	100
HIV testing behaviour		
Had tested	249	69.4
Not tested	110	30.6
Total	359	100.0

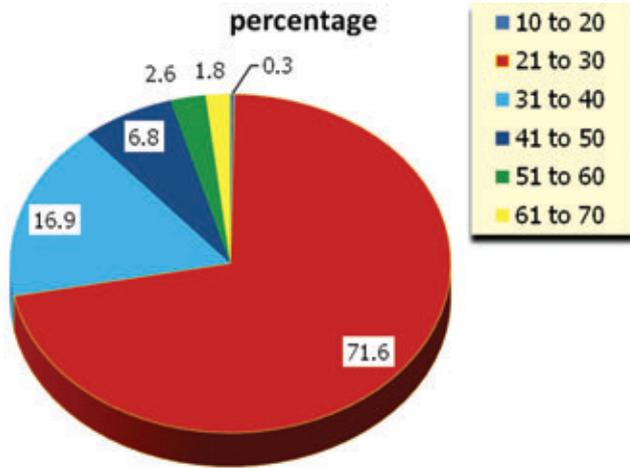


Figure 1. Distribution of study population by age.

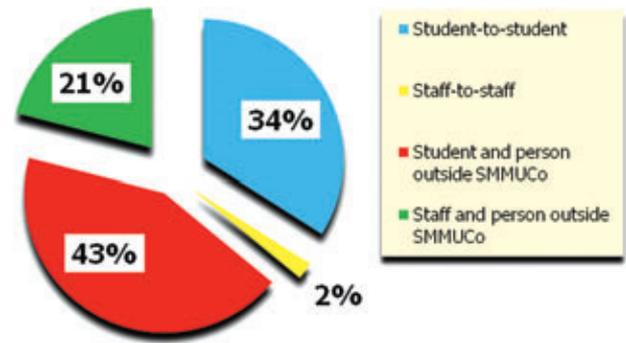


Figure 2. Sexual partners in and/or out of Stefano Moshi Memorial University College (SMMUCo).

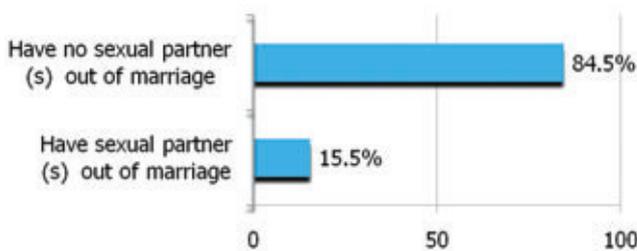


Figure 3. Sexual partners other than spouses.

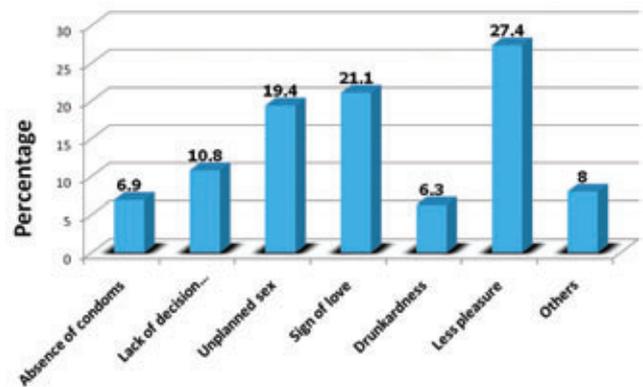


Figure 4. Reasons for not using condom.

those who report to be actively involved in sexual intercourse take precaution against acquiring HIV, a considerable proportion of them cannot take such precautions due to the influence of other factors. The factors include practicing sex while drunk in which case one quarter of the respondents report to have had sex while drunk. The relationship between alcohol drinking and sexual activity has been well established in both community and research. Alcohol use is related to earlier and increased incidences of sexual behavior, greater numbers of sexual partners, and greater intentions to engage in sex.^{8,11-13} In addition, alcohol drinking may contribute to risky sexual behavior and may also increase the likelihood HIV and other sexually transmitted infections by decreasing the likelihood of practicing safe sex that includes condom use. This proposed alcohol effect on condom use was called the transmission hypothesis.¹⁴

The observation that males are more likely to use condoms than females has a number of implications. This may be due to differences in

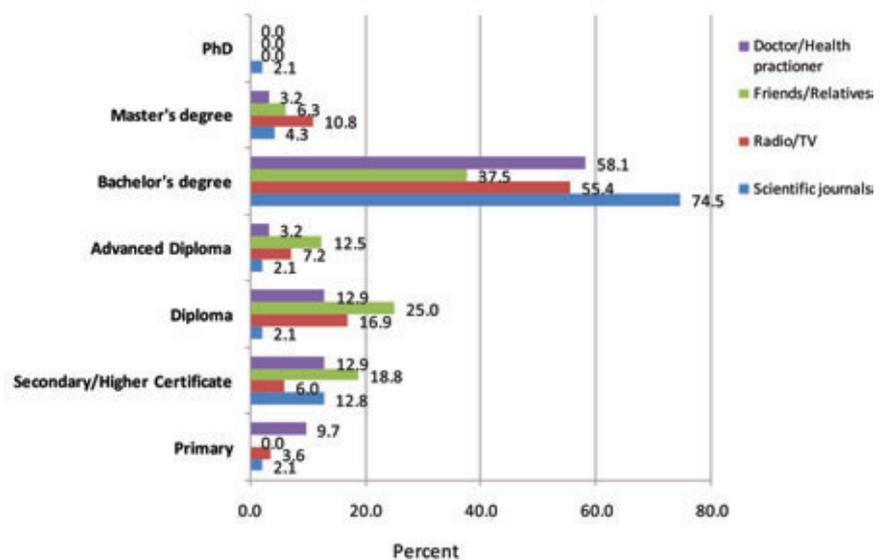


Figure 5. Source of information about HIV risky sexual behaviors and availability of anti-retroviral drugs stratified by education level.

negotiation and decision making power between males and females whereby males become determinants of sex suggesting a lack of bargaining power in HIV prevention decisions among females. A report by the Ministry of Health of Tanzania has shown that men are more likely to take advantage of their physical strength and sexual decision making authority to coerce women into sex.¹⁵ Sex in the poor countries context, involves, to a large extent, financial gifts to the female partner. Such financial influence, apart from other factors, plays a major influence on the lower likelihood for decision-making on condom use by females. Previous studies show that in Sub-Saharan Africa HIV affects women disproportionately in which case they account for 60% of the HIV infections.¹ This is often attributed to biological reasons,¹⁶ socio-economic status,¹⁷ or lack of bargaining power preventing use of preventive measures.¹⁸

Gender violence, a rampant practice in many communities, globally, may be a crucial factor that impact on women's inability to negotiate safer sex. Other factors that may expose to higher risk of HIV infection are related to types of sex practiced. This study discovered that 20% of the study population practice non-vaginal sex that includes anal and oral sex. Previous research has shown unprotected anal intercourse to carry a higher risk of sexual HIV transmission than unprotected vaginal intercourse,¹⁹ implying that in addition to the risk associated with other risk sexual behaviors, heterosexuality is a concern in our community as a risk behavior for HIV infection. We have observed about 16% of married respondents to participate in extramarital sexual relationships. Casual sex and having multiple sexual partners are identified as the most important risk factors for unprotected sex and thus HIV infection. Being in a marital union would be expected to be associated with greater knowledge of HIV/AIDS risk factors including protective ways against HIV infection. However we show that single, unmarried respondents were 4.4 times likely to use condoms as compared to married respondents. This observation contrasts to previous findings in Nigeria that the odds for a monogamous individual to be aware of risk sexual behaviors was greater than that of unmarried ones. Many factors could influence extramarital involvement among married couples, including education level, type of marriage, degree of spousal closeness, socio-economic welfare, cultural influence, knowledge of multiple sexual partners as a risk factor for HIV/AIDS and religion. About one fifth of the respondents reported to have sexual relationships with individuals outside the College. The results suggest that academic institutions are not closed systems and thus progress in reducing HIV-related risk behaviors among higher

learning institutions communities needs renewed educational efforts and risk reduction interventions that involve not only respective institutions but also the communities around them. Generally, majority of respondents were knowledgeable regarding HIV infection and precautions for prevention. More than two thirds had reported to have tested for HIV, although most (61%) did this less than thrice in their life. This observation indicates a clear gap between the level of knowledge on HIV and the practice of respondents with regards to HIV/AIDS. Knowledge and awareness of the devastating effects of HIV/AIDS are more or less universal, and levels of correct knowledge regarding the transmission and precautions against HIV has increased considerably in many countries recently.²⁰ It is surprising however that the reported awareness about HIV/AIDS does not correspond to a significant decline of practice of risky sexual behaviors, particularly among young adults.^{21,22} Many studies have reported similar difficulties in closing the gap that exists between HIV/AIDS awareness and practice of preventive behavior.²³⁻²⁶

Many public health studies have tried to measure the causal effect of HIV information on risk behaviors. These studies have generally compared reported behaviors in groups of people who are exposed to HIV information to those who are not in case control type of studies. Much of what is known about the extent of HIV/AIDS knowledge at the population level in Africa comes from analysis of several nationally representative Demographic Health Surveys (DHS).^{27,28} We conclude that public health information campaigns that are successful at reaching the masses may alone not be successful in combating the disease instead more efforts be directed to influence behavior change.

Limitation of the study

Based on grant requirements and logistical limitations, the survey involved one higher learning institution. Future surveys should involve more institutions to accommodate socio-economic and geo-physical differences among institutions of higher learning institutions to collect more generalizable data.

References

1. UNAIDS. 2008 Report on the global AIDS epidemic. Geneva: World Health Organization; 2008.
2. TACAIDS. Tanzania HIV/AIDS and malaria indicator survey 2007. Dar es Salaam, Tanzania: TACAIDS, ZAC, NBS, OCGS, and Macro International Inc; 2008.

3. UNAIDS UNIC. World Health Organization: unite for children, unite against AIDS. Geneva: World Health Organization; 2009.
4. Joint United Nations Programme on HIV/AIDS. Report on the global AIDS epidemic. Geneva: UNAIDS; 2008.
5. Maswanya E, Brown G, Merriman G. Attitudes and beliefs about HIV/AIDS behaviour and education among Tanzanian youth. *Sexual Health* 2009;6: 293-9.
6. Eaton L, Flisher AJ, Aar LE. Unsafe sexual behaviour in South African youth. *Social Sci Med* 2003;56:149-65.
7. Mwakagile D, Mmari E, Makwaya C, et al. Sexual behaviour among youths at high risk for HIV-1 infection in Dar es Salaam, Tanzania. *Sexual Transmit Infect* 2001;77:255-9.
8. Ikamba LM. Poverty: a factor that contributes to risky sexual behaviour among youths at Kichangani Ward, Tanga Municipality. Tanga Ikamba LM: Tanzania Public Health Association; 2003. p 131.
9. Wellings K, Collumbien M, Slaymaker E, et al. Sexual behaviour in context: a global perspective. *Lancet* 2006;368:1706-28.
10. Singh S, Wulf D, Samara R, Cuca YP. Gender differences in the timing of first intercourse: data from 14 countries. *Int Fam Plan Persp* 2000;21-43.
11. Crowe LC, George WH. Alcohol and human sexuality: review and integration. *Psychol Bull* 1989;105:374-86.
12. Epstein JA, Dusenbury L, Botvin GJ, Diaz T. Acculturation, beliefs about AIDS, and AIDS education among New York City Hispanic parents. *Hispanic J Behav Sci* 1994;16:342-54.
13. Temple MT, Leigh BC. Alcohol consumption and unsafe sexual behavior in discrete events. *J Sex Res* 1992;29:207-19.
14. Dingle GA, Oei TP. Is alcohol a cofactor of HIV and AIDS? Evidence from immunological and behavioral studies. *Psychol Bull* 1997;122:56.
15. Kasembe MK. Gender Audit on Tanzania National Response to HIV and AIDS. Dar es Salaam: TACAIDS/UN; 2009.
16. Royce RA, Sena A, Cates Jr W, Cohen MS. Sexual transmission of HIV. *N Engl J Med* 1997;336:1072-8.
17. Seeley JA, Malamba SS, Nunn AJ, et al. Socioeconomic status, gender, and risk of HIV infection in a rural community in South West Uganda. *Med Anthropol Q* 1994;8:78-89.
18. Dunkle KL, Jewkes R, Nduna M, et al. Transactional sex and economic exchange with partners among young South African men in the rural Eastern Cape: prevalence, predictors, and associations with gender-based violence. *Social Sci Med*

- 2007;65:1235.
19. Vittinghoff E, Douglas J, Judon F, et al. Per-contact risk of human immunodeficiency virus transmission between male sexual partners. *Am J Epidemiol* 1999;150:306-11.
 20. Tanzania Commission for AIDS (TACAIDS). Tanzania HIV/AIDS and malaria indicator survey 2007. Dar es Salaam: TACAIDS, ZAC, NBS, OCGS, and Macro International Inc; 2008.
 21. Bauni EK, Jarabi BO. Family planning and sexual behavior in the era of HIV/AIDS: the case of Nakuru District, Kenya. *Stud Family Plan* 2000;31:69-80.
 22. Nzioka C. Perspectives of adolescent boys on the risks of unwanted pregnancy and sexually transmitted infections: Kenya. *Reprod Health Matters* 2001;9:108-17.
 23. Anarfi JK. To change or not to change: obstacles and resistance to sexual behavioural change among the youth in Ghana in the era of AIDS. *Res Rev* 2003;19:27-45.
 24. Caldwell J. Reasons for limited sexual behavioural change in the sub-Saharan African AIDS epidemic, and possible future intervention strategies. Canberra: Health Transition Centre, The Australian National University; 1999.25. Hulton LA, Cullen R, Khalokho SW. Perceptions of the risks of sexual activity and their consequences among Ugandan adolescents. *Stud Family Plan* 2000;31:35-46.
 26. Rwenge M. Sexual risk behaviors among young people in Bamenda, Cameroon. *Int Fam Plan Persp* 2000;118-30.
 27. Gersovitz M. The HIV epidemic in four African countries seen through the demographic and health surveys. *J Afr Econ* 2005;14:191-246.
 28. Glick P, Sahn DE. Changes in HIV/AIDS knowledge and testing behavior in Africa: how much and for whom? *J Pop Econ* 2007;20:383-422.