Understanding the urban-rural disparity in HIV and poverty nexus: the case of Kenya

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Abstract

Background

The relationship between HIV and poverty is complex and recent studies reveal an urban-rural divide that is not well understood. This paper examines the urban-rural disparity in the relationship between poverty and HIV infection in Kenya, with particular reference to possible explanations relating to social cohesion/capital and other moderating factors.

Methods

Multilevel logistic regression models are applied to nationally-representative samples of 13,094 men and women of reproductive age from recent Kenya Demographic and Health Surveys.

Results

The results confirm a disproportionate higher risk of HIV infection among the urban poor, despite a general negative association between poverty and HIV infection among rural residents. Estimates of intra-community correlations suggest lower social cohesion in urban than rural communities. This, combined with marked socio-economic inequalities in urban areas is likely to result in the urban poor being particularly vulnerable. The results further reveal interesting cultural variations and trends. In particular, recent declines in HIV prevalence among urban residents in Kenya have been predominantly confined to those of higher socio-economic status.

Conclusion

With current rapid urbanization patterns and increasing urban poverty, these trends have important implications for the future of the HIV epidemic in Kenya and similar settings across the sub-Saharan Africa region.

Key words: Kenya; HIV-poverty nexus; multi-level modelling; urban-rural differences; theory of economics of sexual behaviour; social cohesion-HIV theory.

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Introduction

The link between HIV infection and poverty has attracted considerable research attention in recent years[1,2,3], but the relationship is complex and findings from existing studies remain inconclusive. The complex nature of the relationship has been partly attributed to AIDS being at the core of a "vicious circle". Piot et al[4] emphasizes the need for a distinction between what may be referred to as the "downstream" impact of AIDS on poverty, vis-à-vis the "upstream" influence of poverty HIV risk. This paper focuses on the later. As with most health outcomes, some have argued that poverty increases vulnerability to HIV infection.[5,6,7] However, most empirical evidence from sub-Saharan Africa (SSA) support the view that those who are wealthier tend to have higher prevalence of HIV.[1,8,9] Indeed, Holmqvist[10] noted that 'globally HIV is associated with underdevelopment and poverty, but within Africa the relation is rather the opposite'(p.10).

Despite empirical evidence suggesting a general positive gradient between wealth and HIV prevalence in SSA, some recent studies have highlighted increased vulnerability to HIV infection among the urban poor.[2,3] In particular, results of a recent cross-national analysis of poverty and the risk of HIV infection across 20 countries of sub-Saharan Africa revealed that while poverty was associated with reduced odds of HIV infection in rural areas, the opposite was the case in urban areas where the poor had a disproportionate higher risk than the non-poor.[3] The study further observed that the disproportionate higher risk among women than men was intensified among the urban poor in SSA. A separate study in Kenya focusing on two urban slums in Nairobi confirmed increased vulnerability among the urban poor, but a narrower gender gap was observed among the urban poor living in slums.[2] Important

contributions to the on-going debate on the association between poverty/wealth and the risk of HIV infection underscore the important role of inequality, rather than wealth or poverty per se, in fuelling the spread of HIV in sub-Saharan Africa.[4,10]

Various prepositions have been put forward to explain the negative or positive association between poverty and HIV prevalence in SSA. Many have argued that wealthier people, particularly men, tend to attract multiple partners.[8,11,12] On the other hand, credible arguments also exist for increased risk among those living in poverty, especially women.[13-16] One possible explanation for increased vulnerability among the poor is derived from the theory of economics of sexual behaviour which postulates that people living in poverty are more inclined to take risks today, given their adverse future life chances.[10] Indeed, Oster[17] established that high rates of non-HIV mortality suppressed HIV behavioral response in Africa. The theory of economics of sexual behaviour and social capital theory (Income inequality being associated with lower levels of social capital, and social capital being negatively associated with HIV) were proposed by Holmqvist[10] as possible explanations for an apparent association between income inequality and HIV. However, the explanations remained inconclusive and further research was recommended to help clarify the mechanism.

This paper aims to contribute to the on-going debate on the HIV and poverty nexus with particular reference to the urban - rural disparity in Kenya. The focus on urban-rural disparity is motivated by recent research findings which highlight increased vulnerability among the urban poor[2,3] and relevance of prevailing theoretical explanations outlined

above. [10] A social cohesion-HIV theory postulates that socially cohesive societies are healthier since they are better able to mobilise resources in pursuit of joint goals to avoid or control risk; have a stronger community life and suffer fewer corrosive effects of inequality.[18,19] In this paper, we focus on an individual country (Kenya), as opposed to general patterns across countries in SSA in previous research enables a more in-depth examination of context specific factors (i.e. the role of cultural and societal factors, e.g. based on ethnic background and community effects), leading to more policy relevant conclusions. The focus on Kenya is further motivated by existence of marked socio-economic inequality in the country which is particularly prominent in urban areas.[20] Furthermore, availability of multiple national surveys with HIV-test data enables an examination of trends over time.

The specific objectives are to:

i. examine urban-rural disparities in the relationship between poverty and HIV prevalence in Kenya;
ii. examine societal effects and key moderating factors in the HIV-poverty link; and
iii. establish possible explanations for the urban-rural disparity in the poverty-HIV nexus

Data and methods

The Data

The data used in this study come from the Kenya Demographic and Health Surveys (KDHS) conducted in 2003 and 2008. These surveys encompass nationally representative samples of women (aged 15-49) and men (aged 15-54) of reproductive age. Specific details on the

sampling design and data collection procedures are available elsewhere.[21,22] In each survey, the urban and rural samples tested for HIV are large enough to permit analysis by urban/rural residence. Furthermore, the comparative nature of the KDHS surveys make it possible to pool data across years to understand general trends. The distribution of the sample by year of survey, gender and urban/rural residence is given in Table 1.

(TABLE 1 ABOUT HERE)

The recent KDHS surveys, provide a unique opportunity for population-based studies of factors associated with the HIV/AIDS epidemic, allowing for anonymous linkage of HIV test data to individual-level survey data with background demographic and socio-economic characteristics. The HIV testing protocol in the DHS endures a strict ethical review procedure that provides for informed, confidential and voluntary testing of adults of reproductive age.[23]

Methods of analysis

The analysis involves bivariate and multivariate examination of the association between HIV prevalence and poverty, with particular reference to the urban-rural disparity. The multivariate analysis features multilevel models to examine the extent of clustering of HIV positive individuals within urban and rural communities (i.e clusters). The KDHS data have a multilevel structure with individuals in households nested within clusters. Thus, individual constitute Level-1 while clusters constitute the second level (n=400 in each survey). The multilevel models considered the general form of a random coefficients two-level logistic regression model, allowing the effect of poverty on HIV prevalence to vary across rural and urban clusters. However, the models presented are based on random intercepts models,

there being no evidence of significant variations in the effect of poverty on HIV prevalence across communities. Thus, the two-level random intercepts logistic regression model used may be expressed as:

$$Logit\ \pi_{ij} = X'_{ij}\beta + u_j \qquad (1)$$

Where:
$\boldsymbol{\pi_{ij}}$ is the probability of HIV positivity for an individual *i*, in the j^{th} cluster;
X'_{ij} is the vector of covariates which may be defined at the individual or cluster level;
β is the associated vector of usual regression parameter estimates; and
the quantities u_j are the residuals at cluster level which are assumed to have normal distribution with mean zero and variance σ^2_u .[24]

The analysis was undertaken in MLwiN and estimates based on second order PQL estimation.[24]

The estimates of community/cluster level variances have been used to derive intra-community correlation coefficients or variance partition coefficient[24] to examine the degree of homogeneity within urban or rural communities in Kenya. This enabled testing of the social capital/cohesion theory. Our hypothesis is that there is lower social cohesion, hence, less clustering in urban than rural communities, partly due to ethnic groupings being more homogenous in rural than urban communities. The intra-community (ρ_u) correlation coefficients is given by:

$$\rho_u = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_e^2} \qquad (2)$$

where: σ_u^2 - is the total variance at cluster/community level; and
σ_u^2 - is the total variance at individual level.

The level-1 residuals, e_{ij}, for multilevel logistic regression model are assumed to have a standard logistic distribution with mean zero and variance $\pi^2/3$, where π is the constant 3.1416.[25]

HIV status is the outcome/dependent variable while poverty/wealth index is the key explanatory variable of interest, with particular reference to urban/rural settings in Kenya. Our poverty measure is derived from the work of Rutstein and Johnston[26], based on Principal Components Analysis (PCA). In this paper, the resulting PCA scores have been used to classify the rural and urban populations in Kenya into three equal classes: poor, average and rich tertiles, corresponding to the lower, middle and upper 33%, respectively. This poverty measure is relative within urban and rural environments to account for potential differences between urban and rural settings in the meaning of assets used to derive the index.

In addition to poverty/wealth index, a number of factors, perceived to be associated with HIV status, are incorporated in the models as control or moderating factors. These are added in the models sequentially to establish potential pathways of the relationships of interest. At each modelling stage, interactions between poverty and key factors are considered to assess whether the association between poverty and HIV prevalence differs significantly by key population sub-groups.

Results

Initial preliminary analyses based on DHS-derived wealth quintiles suggested a positive gradient between wealth and the risk of HIV infection for both males and females resident

in urban and rural areas, consistent with patterns observed in some of the earlier studies. However, overall patterns by urban/rural residence were confounded by the fact that urban residence were more likely to be classified in higher wealth quintiles (based on overall DHS wealth index) and also had relatively higher HIV prevalence. Consequently, a more refined wealth classification was derived by urban/rural residence, recognizing the differences in indicators of wealth in urban and rural areas. The patterns based on the revised classification were consistent with patterns recently observed across countries of SSA[3], suggesting a positive wealth gradient in HIV risk in rural areas, but a reverse pattern in urban areas where HIV risk was highest among the poor for both males and females. The bivariate and multivariate analyses presented below are based on the refined wealth classification, based on tertiles rather than quintiles to ensure sufficient cases for each category.

Bivariate analysis of HIV and poverty relationship by urban-rural residence

Bivariate analyses examined the association between poverty and the risk of HIV infection by various demographic and socio-cultural characteristics of the population, separately for urban and rural residents. Results for background demographic and socio-economic characteristics are presented in Table 2.

(TABLE 2 ABOUT HERE)

Overall, the results suggest that while there appeared to be no evidence of a significant association between wealth and HIV prevalence in the combined sample (poor – 6.5%; middle – 6.1%; rich – 6.9%), the association was significant in both urban and rural areas, albeit in the opposite direction. Among urban residents, HIV prevalence was highest among the poor (10.8%) and lowest among the rich (6.9%), while the pattern was reversed in rural

areas (poor – 5.1%; middle – 5.6%; rich – 6.9%). Indeed, the disproportionate higher prevalence of HIV in urban than rural Kenya is largely due to differences in prevalence between the urban and rural poor.

The trends suggest that the urban poor disadvantage has increased in recent years: while in 2003 the gap between poor and rich was not significant (two percentage points), in 2008, the poor in urban areas had about double the risk of HIV infection as their rich counterparts (11% vs 5%), suggesting that the recent decline in HIV risk in urban areas is largely among the rich.

The results reveal interesting gender disparities: the rich-poor gap in urban area is more apparent among women (with poor women being particularly vulnerable); while in rural areas, the evidence for positive gradient between wealth and risk of HIV infection is stronger for men.

The results presented in Table 2 further reveal interesting patterns observed by ethnicity: the urban poor disadvantage is particularly pronounced among the Luhya where the risk of infection among the poor in about four times higher than the rich (20% vs 4.5%). This is in sharp contrast with rural residents for whom the risk tends to be higher among the rich, albeit not significant. While for all other ethnic groups HIV risk is higher in urban than rural areas, for Luos, the risk in rural areas is just as high as in urban areas – in fact the risk is highest among the rural rich while for other ethnic groups (especially the Luyha) the highest risk is observed among the urban poor. Indeed, while the risk of HIV among the urban poor is about the same for Luos and Luhyas, the risk is about four times or higher for Luos than Luhyas among the urban rich or rural residents.

Other notable urban/rural differences in the HIV-poverty nexus are observed by other characteristics such as age, education, region and religion. However, we recognize that patterns observed in the bivariate analysis are likely to be confounded by other important factors associated with HIV risk. It is important to examine the specific associations of interest while at the same time controlling for the effect of other important factors in a multivariate analysis.

Multilevel Logistic regression analysis

Multivariate analysis based on multilevel Logistic regression (Table 3) examined the poverty risk factor in HIV infection among urban and rural residents, while simultaneously controlling for the effects of a range of demographic and socio-cultural characteristics and sexual behaviour factors. The analysis placed special focus on the role of sexual behaviours factors, including current marital status, age at first sex, premarital sex, multiples sex partners or non-condom use with non-spousal partners. These were introduced in the model in successive stages to establish the extent to which they explained observed patterns in the link between poverty status and risk of HIV infection among urban and rural residents. The first model (Model 0) examined the association between wealth status and HIV infection without controlling for any covariates, besides year of survey, gender, age and random community variations. The second model (Model 1) controlled for background cultural and socio-economic characteristics, while the final model (Model 2) included sexual behaviour factors.

(TABLE 3 ABOUT HERE)

The results presented in Table 3 provide strong evidence of an urban-rural divide in the relationship between poverty and HIV positivity in Kenya: In urban areas, the poor have significantly higher odds of HIV infection than their non-poor counterparts, while this relationship is reversed among rural residents. These patterns persist even after important socio-cultural, demographic and sexual behaviour factors are controlled for. Thus, the observed urban-urban differentials in poverty risk factor are not fully explained by basic background characteristics, nor sexual behaviour factors included in the analysis.

Furthermore, the gender disparity in HIV infection (i.e. the disproportionate high risk among women compared to men in Kenya, as other countries in sub-Saharan Africa) is somewhat more pronounced in urban than rural areas. These differences remain virtually unchanged when background demographic, socio-economic and cultural factors are controlled for, and are not explained by sexual behaviour factors included in the analysis.

The results further reveal interesting urban-rural differentials in risk factors of HIV infection with respect to region (i.e. province) of residence, educational attainment, religion, ethnicity, abstinence/timing of first sex, and premarital sex. In particular, the Luo ethnic group had particularly high odds of HIV infection (especially rural residents) that was neither explained by background characteristics nor sexual behaviour factors. With respect to educational attainment, secondary (or higher) education seemed protective among urban but not rural residents.

Further analysis explored interaction effects between poverty status and key factors in urban and rural areas. In particular, we were interested in establishing if there was a significant interaction between gender and wealth status in urban and rural areas. However, there was no evidence that any of the interactions were significant.

With respect to community variations, there was evidence of significant variations in HIV infection across communities in urban and rural areas, largely explained by regional or ethnic background. The community variations were considerably stronger among rural (than urban) residents, and remained significant in the rural areas even after important background (or sexual behaviour) factors were controlled for. Before controlling for background characteristics, the intra-community correlations (measuring the degree of community homogeneity) suggest that about 25% of the total variance in HIV prevalence in rural areas is attributable to community level factors, while in urban areas this reduces to 10%.

To further explore gender disparities, we examined the risk factors of HIV infection among females and males separately, including the wealth-residence interaction (Table 4). As in Table 3, the background and sexual behaviour factors are introduced in successive stages to establish potential pathways in the wealth-HIV associations.

(TABLE 4 ABOUT HERE)

The results confirm a significant interaction between urban/rural residence and wealth status in the risk of HIV infection among both men and women. Being wealthy is associated with greater risk among rural than urban residents. Observed patterns support results presented in Table 3 which suggest that while wealth is associated with reduced odds of HIV infection in urban areas, the association is reversed in rural areas.

There is little evidence of gender differences in the wealth-HIV nexus. However, interesting gender differences in the risk of HIV infection are observed by religion and sexual debut. For instance, Muslim women have significantly lower (less than half) odds of HIV infection

than Roman Catholic women, whilst the odds for Muslim men tend to be higher (albeit not significant) than for Catholic men. It is interesting to note that while earlier sexual debut is associated with increased odds of HIV infection among women, the pattern is reversed for men.

For both men and women, there is a significant variation in HIV prevalence across communities that is explained by regional and ethnic differences. However, there is no evidence that the observed interaction between residence and wealth status varies significantly across communities.

Discussion and Conclusions

Main finding of this study

Overall, findings in Kenya are consistent with general patterns earlier observed in sub-Saharan Africa (SSA) based on pooled data across countries in the region, showing an urban/rural divide in the HIV-poverty nexus.[3] Poverty is associated with disproportionate higher risk of HIV infection among urban residents, while the association is reversed in the rural areas. In addition, interesting variations are observed in the urban-rural gap in the HIV and poverty nexus in Kenya by key background characteristics. In particular, the observed patterns by education and cultural factors (i.e ethnicity and religion) are worth noting. Furthermore, the societal or community effect on HIV risk is observed to be stronger in rural than urban communities.

What is already known on this topic

Despite extensive research attention on the relationship between poverty and HIV in recent years[1-9], findings remain inconclusive and mechanisms unclear. An urban-rural divide in the relationship has been observed across countries in SSA[3], with the urban poor being

particularly vulnerable.[2,3] Furthermore, these patterns have been observed to vary by gender, but the patterns are inconsistent – i.e. it is unclear whether the disproportionate disadvantage for women is heightened[3] or reduced[2] among the urban poor. The observed gender disparity in this study, suggesting that poor women in urban areas are particularly vulnerable, while the evidence of a positive gradient between wealth and HIV infection in rural areas is more apparent for men, is consistent with existing literature from other parts of sub-Saharan Africa.[12,13] It has been noted that for women living in poverty, increased vulnerability may be attributable to possible interaction between poverty and non-biological factors such as gender-based violence and transactional sex[14,16] factors that are likely to be more prevalent in urban poor settings.

What this study adds

First, this study identifies the source of inconsistency in the poverty-HIV relationship observed in previous studies. The urban-rural disparity in the relationship only becomes apparent when a refined measure of poverty that takes into account differences in meaning for indicators of poverty/wealth between urban and rural residents is used. This highlights the importance of measurement in clarifying apparent differences in HIV-poverty nexus evident in previous studies.

More importantly, the study contributes to an understanding of possible explanations for the urban-rural divide in HIV-poverty nexus. It argues that existing theoretical explanations with respect to the theory of economics of sexual behavour and social capital theory[10], offer plausible explanations for the observed urban-rural disparity in the association between poverty and HIV prevalence in Kenya, especially the disproportionate higher risk among the urban poor. The theory of economics of sexual behaviour has been used to explain why

poor people would be less inclined to adjust their behaviour when facing the risk of HIV.[17] This argument is supported by evidence from earlier studies on sexual risk taking among the urban poor in Nairobi slums.[13] Holmqvist's[10] further underscores the role of income inequality in risky sexual behaviour, especially where an element of economic transaction is involved. Thus, the greater socio-economic inequality among urban than rural residents in Kenya[20] is likely to place the urban poor at particular risk.

This study further argues that the apparent disadvantage among the poor being evident among urban and not rural residents is partly due to lower social cohesion/capital in urban settings. Although ecological studies in America have confirmed a social capital-HIV link, studies in South Africa using indicators of membership of social networks and different kinds of groups showed mixed results.[27] In this paper, estimates of community homogeneity have been used as indicators of social cohesion. The notably higher intra-community correlation observed in rural than urban communities suggests greater social cohesion among rural than urban communities in Kenya. This is likely to lead to increased protection for the rural poor. The social cohesion-HIV explanation for increased vulnerability among the urban poor is further supported by social disorganization theory[28], given the broken community structures, insecurity and high crime rates in informal slum settlements[29,30] that typify urban poor settings in less developed countries such as Kenya.

Besides confirming general patterns in urban-rural disparity in HIV-poverty nexus and proposing possible explanations, the current study provides further in-depth insights on context-specific patterns, useful for informing relevant national policies. In particular, patterns in HIV/AIDS-poverty nexus by urban/rural residence are observed with respect to

cultural factors, including ethnicity and religion. The cultural variations call for in-depth ethnographic research to better understand the role of cultural practices in HIV/AIDS epidemic. This will help identify sexual practices deeply rooted in cultural norms such as sexual permissiveness and practices including male circumcision, female genital mutilation and dry sex[31] that may contribute to the spread of HIV among specific ethnic communities in Kenya and other settings in sub-Saharan Africa. For instance, HIV prevalence is observed to be particularly high among the Luo, one of the few ethnic groups in Kenya that does not traditionally practice male circumcision.

The observed trends in HIV and poverty link in Kenya, especially among urban residents, has important implications for the future of the HIV epidemic in Kenya and similar settings in SSA. With on-going rapid urbanization and increasing urban poverty in Kenya, the lack of evidence of any decline in HIV prevalence among the urban poor is likely to pose significant challenges to national efforts to curb the spread of the epidemic in the country. Multifaceted efforts addressing possible multiple dimensions of the epidemic, including gender-based violence/discrimination, socio-economic inequality and improved future life chances of the urban poor are vital to help facilitate progress.

Limitations of this study

It is important acknowledge key data limitations when interpreting our findings. First, we recognize the complex nature of the relationship between poverty and HIV infection which limits our ability to establish causal links, especially since causality can run in either direction. The cross-sectional nature of data limits our ability to establish whether HIV infection preceded the current poverty status or resulted from it.

The second limitation relates to possible survivorship bias. Wealthier individuals who are HIV positive are likely to survive longer as they are more likely to access appropriate treatment and nutrition, delaying the onset of AIDS and eventual death. This will weaken any positive relationship between poverty and HIV prevalence. However, the fact that people with HIV tend to lose wealth (i.e. because of loss of employment and increased medical expenses) is expected to inflate the positive relationship between poverty and HIV, thus having a counter effect.[8]

Further bias may result from differential coverage in HIV testing by socio-economic status. Although the overall response rates for HIV testing in the 2003 and 2008 KDHS are reasonably high, the rates for those of higher socio-economic status based on wealth quintiles tended to be lower.[21] This may create bias if there was selective non-response resulting from, for instance, wealthier individuals who knew they were HIV positive being more likely to refuse HIV testing. However, lower response rates are unlikely to lead to bias if non-response was random. A comprehensive multivariate analysis of the determinants of non-response in the Kenya DHS confirmed that eligible respondents who were not tested for HIV did not differ in significant ways from those tested.[32]

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Table 1: Distribution of study sample by year of survey, urban/rural residence and gender

Year of survey	**Urban**		**Rural**		**All**
	Females	**Males**	**Females**	**Males**	
2003	981	847	2290	2070	6188
2008	1093	943	2718	2152	6906
All	2074	1790	5008	4222	13094
	3864		9230		

Table 2: Urban/rural disparities in the socio-economic inequalities of HIV infection by background demographic and socio-economic characteristics

Characteristic	Urban				Rural			
	Poor	Middle	Rich	Sig.	Poor	Middle	Rich	Sig.
Survey year								
2003	11.1	9.2	9.1	ns	5.4	4.7	7.2	**
2008	10.5	7.1	4.7	**	4.9	6.7	6.7	*
Gender								
Female	14.5	10.5	9.1	*	6.3	7.6	8.2	ns
Male	7.1	5.5	5.7	ns	3.6	3.5	5.6	**
Age group								
15-24	5.8	3.4	3.5	ns	2.5	2.9	3.4	ns
25-34	13.2	9.9	10.5	ns	6.7	8.4	10.7	*
35-44	20.1	13.7	6.8	***	8.1	8.2	9.9	ns
45+	4.8	6.9	6.5	ns	5.0	5.6	6.5	ns
Education								
None	10.8	6.5	6.3	ns	2.6	6.4	7.4	*
Primary	14.5	7.8	13.3	**	5.7	5.7	8.4	**
Secondary+	5.4	7.9	5.3	ns	5.6	5.1	5.2	ns
Region								
Nairobi	13.7	7.4	8.3	*	-	-	-	-
Central	7.6	7.9	4.7	ns	3.5	5.0	4.1	ns
Coast	4.2	8.9	3.4	ns	2.6	5.9	4.8	ns
Eastern	4.2	8.8	1.7	ns	3.2	2.4	3.5	ns
Nyanza	19.5	25.4	0.0	***	15.0	12.2	16.9	ns
Rift Valley	14.4	1.8	7.1	***	1.8	2.5	8.1	***
Western	11.3	11.4	0.0	ns	3.5	6.2	5.1	ns
Ethnic group								
Kamba	12.2	8.9	6.3	ns	4.7	2.1	4.0	ns
Kikuyu	8.1	2.5	5.1	**	3.3	4.6	4.7	ns
Luhya	20.0	6.7	4.5	***	4.4	6.2	5.7	ns
Luo	21.0	19.9	16.2	ns	20.9	20.6	24.4	ns
Other	4.9	8.6	4.3	ns	1.9	2.9	4.2	**
Religion								
Catholic	11.8	12.1	10.5	ns	5.2	4.7	4.5	ns
Protestant	12.4	6.7	6.1	***	6.0	6.1	7.1	ns
Muslim	3.6	7.1	1.4	ns	1.0	3.7	6.8	*
Other	19.2	4.8	3.8	ns	2.4	4.1	17.4	***
All	10.8	7.9	6.9	**	5.1	5.6	6.9	**

* - Chi Square p<0.05; ** - p<0.01; *** - p<0.001

Table 3 Odds ratios for HIV infection by urban rural residence

	Urban			Rural		
Fixed effects	**Model 0**	**Model 1**	**Model 2**	**Model 0**	**Model 1**	**Model 2**
Female (Ref: male)	2.02*	2.19*	2.06*	1.88*	1.98*	1.71*
Wealth status (Ref: poor)						
Middle	0.86	0.95	0.96	1.28	1.29*	1.35*
Rich	0.49*	0.62*	0.68*	1.31*	1.33*	1.41*
2008 survey (Ref: 2003)	0.86	0.88	0.90	1.15	1.01	1.03
Age (Ref:15-24)						
25-34	2.95*	3.60*	2.55*	2.92*	3.22*	1.76*
35-44	3.28*	4.28*	2.34*	3.32*	3.78*	1.68*
45+	1.67	2.04*	1.07	2.36*	2.59*	0.98
Region (Ref: Central)						
Nairobi		0.89	0.89		-	-
Coast		0.59	0.59		1.28	1.33
Eastern		0.24*	0.28*		0.87	0.88
Nyanza		1.12	1.13		1.40	1.34
Rift Valley		1.01	0.99		1.06	1.02
Western		0.85	0.84		0.84	0.95
Religion (Ref: Catholic)						
Protestant/other Christian		0.78	0.78		1.03	1.06
Muslim		0.51*	0.51*		0.69	0.74
Traditional /no religion		1.11	1.10		1.80*	1.65
Ethnicity (Ref: Kamba)						
Kikuyu		0.50*	0.54		0.77	0.70
Luhya		0.85	0.86		1.43	1.17
Luo		2.57*	2.51*		4.90*	4.24*
other		0.69	0.75		0.63	0.65
Education level (Ref: none)						
Primary		1.08	1.33		1.51	1.60
Secondary +		0.55*	0.79		1.39	1.49
Marital status (ref: div/sep.)						
Never married			0.42*			0.37*
Married – mono			0.50*			0.33*
Married – poly			0.49*			0.53*
Widowed			3.40*			2.66*
Age at first sex (Ref: 20+)						
never			0.59			0.19*
<16			1.46			0.70*
16-17			1.13			0.71
18-19			1.19			0.82
Premarital sex			1.20			1.62*
Multiple sex partners in last 12 months			1.08			1.42
Non-condom use with non-spousal partner			0.90			0.90
Random variance						
Cluster - intercept	0.37*	0.03	0.00	1.13*	0.17*	0.14*
ICC	0.10	0.01	0.00	0.26	0.05	0.04

Table 4 Odds ratios for HIV infection by gender

	Women			Men		
Fixed effects	**Model 0**	**Model 1**	**Model 2**	**Model 0**	**Model 1**	**Model 2**
2008 survey (Ref: 2003)	1.02	0.97	0.99	1.05	1.01	1.00
Rural (Ref: urban)	0.37*	0.37*	0.36*	0.42*	0.42*	0.42*
Wealth status (Ref: poor)						
Middle	0.88	0.88	0.91	0.76	0.73	0.69
Rich	0.47*	0.51*	0.58*	0.47*	0.49*	0.46*
Wealth-residence interaction						
Rural -Middle	1.57	1.60*	1.61*	1.49	1.74	1.89
Rural -Rich	2.83*	2.83*	2.63*	3.13*	3.64*	3.72*
Age (Ref:15-24)						
25-34	2.40*	2.79*	1.83*	4.90*	5.92*	3.63*
35-44	2.29*	2.71*	1.31	6.80*	9.18*	4.82*
45+	1.39	1.57*	0.62*	4.03*	5.05*	2.53*
Region (Ref: Central)						
Nairobi		0.88	0.87		2.10	2.12
Coast		0.79	0.80		1.26	1.22
Eastern		0.47*	0.53*		1.04	1.04
Nyanza		1.10	0.97		2.72*	2.66*
Rift Valley		0.82	0.80		1.65	1.62
Western		0.69	0.74		1.97	1.83
Religion (Ref: Catholic)						
Protestant/other Christian		0.89	0.90		0.98	0.97
Muslim		0.44*	0.43*		1.29	1.24
Traditional /no religion		1.26	1.33		1.96*	1.80
Ethnicity (Ref: Kamba)						
Kikuyu		0.46*	0.49*		0.99	0.99
Luhya		0.94	0.93		1.04	1.04
Luo		2.58*	2.48*		5.05*	4.77*
other		0.48*	0.55*		0.86	0.86
Education level (Ref: none)						
Primary		1.06	1.28		2.42*	2.73*
Secondary +		0.74	1.11		1.65	1.91
Marital status (ref: div/sep.)						
Never married			0.38*			0.58
Married – mono			0.30*			0.62
Married – poly			0.42*			0.80
Widowed			2.70*			4.29*
Age at first sex (Ref: 20+)						
never			0.28*			0.45
<16			1.59*			0.58*
16-17			1.23			0.63*
18-19			1.37			0.63*
Premarital sex			1.30*			1.36
Multiple sex partners			0.74			1.54*
Non-condom use			0.91			0.87
Random variance						
Cluster - intercept	0.57*	0.06	0.01	0.94*	0.00	0.00
ICC	0.15	0.02	0.00	0.22	0.00	0.00