Socioeconomic Status and HIV infection among Women in Kenya

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Abstract

Previous studies examining the effect of socioeconomic status on HIV in Africa have produced mixed, and sometimes contradictory results. This study looks at independent effects of education attainment and household wealth on HIV infection among women in Kenya. The sample includes 3,118 women tested for HIV in the 2003 Kenya Demographic and Health Survey. Education was positively associated with HIV infection for women in rural areas, and negatively associated with HIV for women in urban areas. However, the effect was not statistically significant after controlling for wealth. Wealth had a significant, positive association with HIV infection even after controlling for education. An interaction between wealth and ethnic group was only significant for Kalenjin women, indicating that greater wealth increased their odds of infection as compared to Kikuyu women. The results suggest that wealth and education have different effects on HIV risk, although the effect of wealth is more salient.

Introduction

The HIV/AIDS epidemic continues to be one of the greatest challenges facing sub-Saharan Africa today. Approximately 63% of the estimated 38.6 million people living with HIV/AIDS live in sub-Saharan Africa.[1] The bi-causal link between HIV/AIDS and economic development has been well documented in this region.[2, 3] This disease undermines development in many ways, including the loss of: productivity, supply of human capital, agricultural production, and food security. Poverty has been associated with the spatial distribution of HIV infection, high-risk sexual behaviors, the capacity to cope with the impacts of HIV, and access to treatment.[2] As a result, one of the strategies utilized by some HIV prevention programs in sub-Saharan Africa has been to empower women to become more economically independent through education, micro-finance loan schemes and skills training.[3, 4]

At the individual, household and community levels, evidence for a direct association between socio-economic status (SES) and HIV infection has been mixed. In a recent review of rigorous studies examining the effect of SES on HIV risk among women in sub-Saharan Africa, the author identified 30 cross-sectional studies and five cohort studies.[5] Of the cross-sectional studies, ten found a positive association between household SES and HIV infection, while seven found a negative association. One study found a mixed effect by marital status and twelve studies found no association between SES and HIV infection. Three of the cohort studies found no association between high SES and HIV infection, one found a positive association and one found a negative association.

The positive association between SES and HIV infection identified in some studies seems contradictory to the social gradient of health hypothesis. Generally, individuals with low SES tend to have worse health outcomes than those with higher SES due to factors such as their lack

of access to health care services and information, more harmful health behaviors, and exposure to more harmful environmental factors.[6, 7] The global distribution of HIV seems to follow this pattern since incidence and prevalence rates are much higher in developing countries than in developed countries.[8] Within many sub-Saharan African countries, it is not clear why this pattern seems to be reversed. Considering that heterosexual sex is the primary mode of HIV transmission in sub-Saharan Africa, these findings might suggest behavioral differences by SES. On the other hand, many of the studies that found a positive association between HIV and SES were based on cross-sectional studies that looked at HIV prevalence rather than incidence. One limitation of these studies is that they are subject to a survival bias. This bias would occur if women with higher SES tended to survive longer after being infected with HIV, perhaps due to greater access to resources. However, one might also argue that a longer duration of HIV serostatus would likely deplete their income and wealth over time.

Are women with higher SES really at greater risk for HIV in sub-Saharan Africa? According to Wojciki's review article, [5] many studies found either no association or a negative association between HIV infection and SES. There are a at least two possible explanations for the seemingly contradictory results. First, the measures of SES were not consistent in each study. They included monthly/yearly household income, male partner's level of education, male partner's occupation, wife's level of education and wife's occupation. If SES indicators operate through different mechanisms in their effect on HIV risk, then the choice of the dependent variable could significantly influence the results.

Previous studies have clarified some of hypothesized effects of education and wealth on HIV infection. Recent evidence from Uganda and Zambia indicates that women with higher education were initially at greater or equal risk for HIV, but they were also more responsive to

prevention messages. Over time, a shift occurred in which higher education became protective against HIV infection.[9-12] One of the hypothesized explanations for the initial positive association is that more educated people have a larger number of lifetime sexual partners due to greater autonomy and mobility.[12] Women, in particular, are more likely to delay marriage to achieve their educational goals, which increases their exposure to multiple sexual partnerships as compared to less educated women.

A study by Michelo and colleagues[10] found that HIV prevalence was significantly reduced among higher educated Zambian men and women between 1995 and 2003, particularly in urban areas. Among urban women with more than 11 years of education, HIV prevalence changed from 46% in 1995 to 40% in 1999 and 29% in 2003. For women with less than 7 years of education however, the prevalence increased slightly (27% in 1995, 27% in 1999 and 32% in 2003). In Uganda, de Walque and colleagues,[9] examined the association between HIV infection and education using a cohort population-based sample in a rural district in South Uganda. In the initial study period (1989 to 1990), there was no significant association between education and HIV infection for men and women, after adjusting for other covariates. In the later study period (1999 to 2000), higher educational attainment was significantly associated with lower HIV prevalence for women. Authors hypothesize that this reduction was due to the diffusion of HIV prevention messages, which were first adopted by more highly educated individuals. In support of this claim, they found that condom use increased during the study period, especially among higher educated individuals. Similarly, a study of 4624 non-spousal partnerships in four African cities (Yaunde, Cameroon; Cotonou, Benin; Ndola, Zambia and Kisumu, Kenya) also found that condom use was associated with higher levels of education for men and women.[13]

Fewer studies have examined the effect of wealth on HIV status in sub-Saharan Africa. The mechanism for this relationship is less clear than that for education because it reflects shared resources. Household wealth may be not be reflective of a woman's access to resources if her contribution to household income is negligible, or if she has less power in decision-making regarding the allocation of resources.[5] One explanation for the positive association between wealth and HIV infection could be that wealthier women are at higher risk due to the sexual behaviors of their husbands or partners. Some evidence for this hypothesis is provided by a study examining wealth and sexual behaviors among men in Cameroon using the 2004 Cameroon Demographic and Health Survey. Kongnyuy and colleagues[14] found that net of other demographic factors, men in the richest third of the population were less likely to have used a condom in the last sex with a non-spousal partner, more likely to have multiple concurrent sex partners, and more likely to have at least five lifetime sex partners. However, in a Zambian study using 2001-2002 DHS data, no association was found between household wealth and extramarital sex among men. [15] Research in Benin and Cote d'Ivoire suggests that while wealthier men might be more likely to report extramarital sexual behavior, they are also more likely to use condoms, resulting in the net non-significant effect. [16, 17] Further studies are needed to explore the mechanisms through which wealth independently influences HIV risk for men and women in sub-Saharan Africa.

A second explanation for the inconsistent results obtained in studies of SES and HIV is the variation in adjustment for confounders and interaction effects. Some particular variables that should be included are age, urban/rural residence, marital status, and ethnic background. SES, as measured by income and wealth, is expected to increase with age during the most productive years of the life course. Age is also related to the distribution of HIV, with the highest prevalence

rates observed for women between the ages of 25 and 40. [18] One study in Kenya found differences in the association between SES and HIV by age in an urban population in Kisumu. SES was measured using a composite variable of education status, occupation and household utilities. Results showed that HIV was negatively associated with SES for females between the ages of 15 and 24, but positively associated with SES for older males and females (ages 25 to 49).[19] Rural or urban residence should be included in analyses because women in urban areas are more likely to have greater incomes and higher education attainment, but they are also exposed to higher HIV prevalence rates than women in rural areas.[12] There are also large regional differences in HIV prevalence within urban and rural areas in many African countries. In Kenya, differences in HIV prevalence by provincial regions could be attributed to the concentration of particular ethnic groups in certain regions, or varying levels of development and employment opportunities.

Regarding marital status, single women of lower SES might be at greater risk for entering into risky sexual partnerships for economic reasons, while married women with wealthier partners might be at greater risk of HIV if their husbands have multiple sexual partners [4] Marriage has particularly been associated with increased HIV risk for adolescent girls. In a study conducted in urban areas of Kenya and Zambia, Clark found that young married women were significantly more likely to be infected with HIV than their unmarried counterparts, and their husbands were three times more likely to be HIV-positive than partners of unmarried girls.[20] As mentioned previously, single women with higher education attainment might also be at greater risk for multiple sexual partnerships due to delayed marriage.

Ethnic background can serve as a proxy for cultural practices which interact with SES in their effect on HIV risk. In many parts of Africa, ethnicity represents groups with shared norms,

language, traditions, and reproductive and mating strategies.[16, 21] Cultural practices that increase women's risk for HIV include widow inheritance, early marriage, polygamy, and women's lack of autonomy in sexual relationships. In addition, some practices equate certain sexual partnerships with wealth or prestige through bride price and dowry prerequisites for marriage.

The purpose of this study is to elucidate the effects of SES on HIV infection among women in Kenya. Two research questions will be tested: (1) What are the independent effects of education and household wealth on HIV infection, net of other factors? and (2) How does the effect of wealth change after controlling for education? My hypothesis is that education will be negatively associated with HIV infection, especially in urban areas. The HIV prevalence has declined substantially in Kenya over the past decade, which suggests that people are taking more precautions to prevent infection.[18] If this is the case, then women in urban areas would have greater exposure to HIV information and more favorable attitudes towards behavior change than those in rural areas in accordance with the diffusion of innovation theory.[22] I expect that women with higher education, especially those in urban areas, would be more likely to adopt safer sexual practices during high-risk sex than those with lower education. Alternatively, I would expect women in wealthier households to have a higher prevalence of HIV. If wealth is associated with having multiple partners, then married women in wealthier households would be at greater risk due to their husbands' sexual behaviors. Single women of higher SES status are more likely to partner with wealthier men, which would also place them at greater risk for HIV infection. For the second research question, I hypothesize that the association between wealth and HIV will remain significant after controlling for education, because the hypothesized effect is through the partner's behavior. As explained previously, ethnicity is considered a proxy variable for cultural factors that might explain the variation in HIV risk by household wealth. Since norms that relate

wealth to sexual behaviors and relationships differ by ethnicity, I expect to find a significant interaction effect between wealth and ethnicity. I hypothesize that the effect of wealth on HIV status will be more important for ethnic groups that engage in riskier cultural practices such as polygamy (Luo, Luhyia and Kalenjin).[18]

Methods

The study was conducted using the 2003 Kenya Demographic and Health Survey (DHS). The Kenya DHS is a nationally representative survey with a sample of 8,561 Kenyan households, including women between the ages of 15 and 49 and men between the ages of 15 and 59.[18] The sample design involved systematic sampling of households in 400 clusters (129 urban and 271 rural) representing the national population. A response rate of 94% was obtained for the women's questionnaire. Further details regarding the sampling design can be found in the 2003 KDHS report.[18]

The survey covered topics such as fertility, marriage, sexual activity, fertility preferences, family planning knowledge and use, child and maternal mortality, maternal and child health, knowledge and behaviors related to AIDS and other STDs. Each of the 4,303 eligible women were asked to submit a blood sample which was tested for the HIV virus. HIV tests were conducted for 76% of eligible women. The most common reason for non-response was refusal. At the bivariate level, it appeared that refusal was related to demographic and behavioral factors. Refusal rates were higher among groups with higher HIV prevalence rates. If women who refused to be tested were more likely to be HIV-positive, then this might suggest an underestimation of the prevalence for these types of women. Groups with higher refusal rates included widows, women living in urban areas, those with more education and those in the highest wealth quintile. Alternately, refusal rates were lower for women who reported behaviors

that increase risk for HIV. Coverage rates were higher among women who had ever had sex, those with multiple sexual partners, and those who had high-risk sex in the previous 12 months. Results of multivariate analyses conducted by the KDHS research team showed that respondents who were not tested for HIV did not differ significantly from those who were tested according to demographic and behavioral characteristics.[18] In fact, the adjusted HIV prevalence based on the regression analysis was lower by a fraction of a percent because those who were not tested had slightly lower HIV risk. Therefore, the differential refusal rate is not expected to significantly bias the study results.

The analytic sample for this study is limited to 3,273 women who received an HIV test. The dataset was created by merging the women's questionnaire datafile, which includes demographic and behavioral information, with the HIV datafile. Files were merged using the unique caseid number assigned to each woman. A total of 155 cases were excluded from the analyses for the following reasons: 2 cases were eliminated because their HIV test results could not be determined, 1 case had missing data on education, and 152 women from the North Eastern region were dropped because there were no HIV cases in this region. This resulted in a sample size of 3,118 women. Probability weights were used for all descriptive statistics to account for differential probabilities of being selected for the sample due to household size. For multivariate analyses, I used the survey estimation procedure in Stata version 9.0 to account for the stratified clustered sampling design. To do this, I specified the probability weight and cluster variables and identified my analytic sample as the subpopulation.

The dependent variable for this study was HIV infection status (positive or negative). Two measures of SES were used as the main independent variables. At the individual level, education was measured as the total number of years of education attained. Wald tests were

conducted to evaluate whether the effect of education is curvilinear or nonlinear in the multivariate analyses. The test statistics were not statistically significant so education was included as a continuous variable.

At the household level, SES was measured using the DHS wealth index.[18] This index is a composite measure of the cumulative living standard of a household and is calculated using data on a household's ownership of selected assets, types of water access and sanitation facilities. A wealth factor score is assigned to each household and converted to an index score between 1 and 5, representing quintiles of the wealth distribution. Descriptive statistics indicated that wealth was disproportionately distributed in Nairobi with 92% of the population in the wealthiest quintile and 3% in the fourth highest quintile. Nairobi is the most developed urban city in Kenya, which might explain the unequal wealth distribution as compared to other regions. Within Nairobi, however, there is great variation in wealth including areas of extreme poverty. The Kenya DHS includes another variable that describes socioeconomic status in Nairobi and is coded as highest, middle, poor or slum. In this sample, 55% of women in Nairobi were poor, 25% were in slum areas and the rest were in the middle or highest SES. A separate analysis was conducted for Nairobi residents only, predicting the effect of SES in Nairobi on HIV status after adjusting for age, ethnicity, marital status. SES in Nairobi was not associated with HIV status (OR=1.25, p=.0.305), even after adjusting for education (OR=1.24, p=0.417). Therefore, I used the wealth index in all subsequent analyses based on the assumption that accounting for SES variation in Nairobi would not significantly influence the results.

The analyses controlled for age, area of residence, ethnicity, marital status, and region. The age of the respondent was recoded into a set of dummy variables for the following age groups: 15-24, 25-34, 35-44, and 45-49. The first cutoff was made at age 24 in order to control

for the likelihood that the youngest women may not have completed their education. School enrollment data from Kenya indicates that only 4% of women were still enrolled in school between the ages of 21 and 24.[18] Further tests were conducted by creating a variable for age below or above 25 and interacting it with education. After adjusting for other covariates, this interaction term was not statistically significant so it was not included in the final analysis. Area of residence is a dichotomous variable with two categories, urban and rural residence. Ethnicity is also a nominal variable with 15 categories. For this study, ethnicity was recoded into dummy variables including the 6 largest ethnic groups (Kikuyu, Kamba, Luo, Luhyia, Kalenjin, and Kisii) and an "other" category. Marital status was collapsed into three categories which were also recoded into dummy variables. The categories are: never married , married or cohabiting, and formerly married (widowed, divorced, or separated). Cohabiting and married women were combined in one category because they are considered to be in a stable union. Only 10%of the women in this category were in non-marital unions (cohabiting).

Region was coded into 7 dummy variables representing 6 provinces in Kenya and Nairobi, the capital city. As mentioned earlier, the North Eastern province was excluded from the analyses. The seven remaining regions are: Nairobi, Central, Coast, Eastern, Nyanza, Rift Valley, and Western.

Multivariate analysis was conducted using logistic regression to estimate the probability of HIV infection. The four regression models included the following independent variables: (1) education plus other covariates, (2) wealth plus other covariates, (3) education and wealth plus other covariates, (4) Model 3 plus an interaction between wealth and ethnicity. The regression equation for Model 4 is shown below.

Model 4: $\log(p/1-p) = a + b_1E + b_2W + b_3A + b_4U + b_5Et + b_6M + b_7S + b_8R + b_9EU + b_8WEt$

This equation models the probability of a positive HIV result (p) versus a negative result (1-p) as a function of a set of the predictor variables. The intercept is represented as *a* and the predictors include educational attainment (E) and the wealth index score (W). The other covariates are the respondent's age (A), area of residence (U), ethnicity (Et), marital status (M), SES in Nairobi (S), and (R) region. The model also includes an interaction between education and urban/rural residence, and an interaction between wealth and ethnicity.

Results

Table 1 shows the weighted, overall percentage distribution of the demographic and socioeconomic status predictors included in the regression models, and the HIV prevalence for each category. Percentages are based on weighted totals because they are the best estimates for the population. Unweighted totals are shown because they indicate the actual number of cases in each category. Of the 3,118 women included in the sample, more than two thirds were below the age of 35 and the majority resided in rural areas (78%). The sample had a larger representation of married or cohabiting women (60%) than never married (29%), or formerly married women (12%).

Approximately one-third women had completed primary education (36%), 12% had a high school diploma and 5% had some post-high school training. Since the wealth index was calculated using the entire KDHS household sample, the wealth distribution was slightly unequal in this sub-sample of women. Slightly more women were in the highest wealth quintile (23%) and fewer women were in the lowest quintile (15%). Based on the SES measure for women living in Nairobi, more than three-quarters were either poor, or residing in a slum area.

The HIV prevalence for all women in this sample was 8.9%, but there was great variation across various demographic characteristics. For example, the prevalence for formerly married women (24%) was three times the prevalence for married women (8%). Women between the ages of 25 and 34 had a higher prevalence than women in the youngest and oldest age groups. The proportion of women who tested HIV-positive was higher in urban (13%) than rural areas (8%). This is consistent with the high HIV prevalence in Nairobi (12%), the largest metropolitan city in Kenya. HIV prevalence in Nyanza province (18%) was much higher than other regions, partly due to the large population of Luo women. Approximately 26% of Luo women were infected with HIV, which is at least three times the prevalence for all other ethnic groups.

At the bivariate level, SES appears to be positively associated with HIV infection in this sample. Approximately 12% of women in the highest wealth quintile were infected with HIV as compared to 7% in the third quintile and 4% in the lowest quintile. However, women in the second lowest quintile had a slightly higher prevalence than those in the third quintile (9% and 7% respectively). For education attainment, women with no education had a lower prevalence (5%), than those in the more highly educated groups. However, there was no significant difference in the HIV prevalence for women with less than primary (9%), completed primary (10%), high school (9%) and some college education (9%).

Results obtained using binomial logistic regression analysis are shown in Table 2. Model 1 provides odds ratios and 95% confidence intervals for the relationship between household wealth and HIV status after controlling for age, region, area of residence, ethnicity, and marital status. Wealth was positively associated with HIV infection at the $P<0.05$ level (OR=1.26; 95% CI=1.11,1.43). The odds of HIV infection for a woman in the highest wealth quintile were 2.5 times the odds for a woman in the lowest quintile. Factors that were significantly associated with

HIV status after controlling for wealth were marital status, age, and ethnicity. The odds of HIV infection were greater for formerly married versus never married women (OR=5.87; 95% CI=3.06,11.26), and for women in the 25 to 34 age group compared to those in the 15 to 24 age group (OR=1.96; 95% CI=1.27,3.02). In addition, odds of infection were higher for women of Luo ethnicity (OR=6.33; 95% CI=3.36,11.95) and for Luhyia women (OR=2.33; 95% CI=1.12, 4.86) as compared to Kikuyus.

Model 2 in Table 2 provides the results of the logistic regression model examining the effect of education on HIV, after adjusting for other covariates. For rural residents, each additional year of education increases the odds of HIV infection by 7% (OR=1.07; 95% CI=1.01,1.13). Therefore, in rural areas, the odds of infection for a woman with a high school education were 2.3 times ($2.5=1.07^{12}$) the odds for a woman with no education. The interaction term between area of residence and education was statistically significant, indicating that the odds of infection decrease slightly with education for women in urban areas (0.963=1.07*0.9). This implies that for an urban woman with high school education, the odds of infection are only two-thirds the corresponding odds for a women with no education ($0.64=.963^{12}$). Figure 1 shows a median spline graph of this interaction which plots the probability of HIV infection by education attainment, for rural and urban residence. The graph represents married women between the ages of 25 and 34 with average values on the other covariates. As the figure shows, the level of infection was higher in urban areas than rural areas for women with a high school education or less. However, while the probability of infection increased almost linearly with education for women in rural areas, higher education reduced the probability of infection for women in urban areas with at least 5 years of education. A crossover occurred at approximately 12 years of education, indicating that for women with some college education, the probability of

infection was generally higher in rural areas than in urban areas. After controlling for education, the effects of other covariates were almost identical to those obtained in Model 1.

The third column of Table 2 shows results from Model 3, which includes education, wealth, and other covariates. Education attainment (OR=1.04; 95% CI=0.97,1.11) was no longer statistically significant after controlling for wealth, while the interaction between education and urban residence (OR=0.92; 95% CI=0.85,1.00) was marginally significant. Household wealth, on the other hand, continued to have a significant positive association with HIV infection after controlling for education (OR=1.23; 95% CI=1.06,1.41). A one quintile shift in the wealth index was associated with a 23% increase in the odds of infection. Results for the other covariates were similar to those obtained in Model 1. In Model 4, an interaction term was added between wealth and ethnicity to test whether the effect of wealth on HIV infection is the same for all ethnic groups. The Wald test statistic for the set of dummy variables was statistically significant (F=2.85, P=0.01), indicating that the interaction term significantly improves the fit of the model.

After including the interaction, the effect of wealth on HIV infection was no longer statistically significant for Kikuyu women, who were the omitted category (OR=1.03; 95% CI=0.81,1.31). In addition, the effect of wealth was not significantly different for Luo, Luhyia, Kamba, Kisii or other ethnic groups as compared to Kikuyus. On the other hand, the interaction between wealth and ethnicity was statistically significant for Kalenjin women (OR=2.36, 95% CI=1.54,3.60) as compared to Kikuyus. Figure 2 shows a median spline graph of the probability of HIV infection by wealth quintiles for selected ethnic groups. This graph represents married women living in rural areas who are between the ages of 25 and 34 and have average values on the other covariates. As shown in the graph, Luo women had a higher probability of HIV infection than Kalenjin or Kamba women at every level of the wealth distribution. The lines for

Luo and Kamba women are parallel to each other and the difference in the probability of infection between women in the lowest and the fourth quintiles is not significantly different. For Kalenjins, however, there is sharper increase in the probability of infection as wealth increases, especially between the second and fourth wealth quintiles.

In order to compare changes in the size of the coefficient across models, I estimated Y-standardized regression coefficients. It is necessary to standardize the coefficients for comparison purposes because the variance of the latent dependent variable changes when additional variables are included in the model. Table 3 shows the Y-standardized coefficients and associated p-values for selected variables. In Model 1, net of all factors, each additional unit increase in wealth corresponds to a tenth of an increase in the standard deviation of HIV infection (Y-std coefficient=0.11, p=0.000). The size of the coefficient does not change substantially after controlling for education in Model 3 (Y-std coefficient=0.10, p=0.005). The y-standardized coefficient shown for wealth in Model 4 represents the effect for Kikuyu women, who were the omitted category for ethnicity (Y-std coefficient=0.02, p=0.792). This suggests that for Kikuyu women, net of all factors, a one quintile shift in wealth only corresponds to a 2% standard deviation increase in HIV infection. Including the interaction term in Model 4 reduced the wealth coefficient for Kikuyus by 80% when compared to the y-standardized coefficient for wealth in Model 3. Similarly, the y-standardized coefficient for education only changed very slightly from 0.03 in Model 2 (p=0.032) to 0.02 in Models 3 (p=0.244) after controlling for wealth. When wealth is not included in the model as in Model 2, women with a high school degree were more than a third of a standard deviation higher than women with no education with respect to HIV infection (0.360=.03*12). Therefore, net of other covariates, the expected effect

of 12 years of education in Model 2 (Y-std coefficient=0.36) is similar to the effect of a 4 quintile shift in wealth in Model 1 (Y-std coefficient=0.4).

Discussion

Previous studies that have examined the relationship between SES and HIV prevalence in sub-Saharan Africa have produced mixed results. Some find no association between SES and HIV, others find a positive association and some find a negative association. This study builds on this literature by using a national probability sample of 3,118 Kenyan women between the ages of 15 and 49 to investigate the effect of household wealth and education attainment on HIV infection.

This study has several limitations related to the study design and data. The cross-sectional design limits the ability of making causal interpretations of the observed associations. For example, since dependent variable is HIV prevalence rather than incidence, it is vulnerable to selection bias. For example, HIV-positive women with greater wealth and education might be overrepresented in the sample because they tend to survive longer after being infected. Due to the long latent period between infection and AIDS mortality, a cross-sectional survey captures women at different stages of the disease. Therefore, there may be patterns that are more salient among those who are more recently infected that are not detected in this study. The measure of wealth used in this study is also a limitation because it does not provide an accurate depiction of the woman's actual access to resources or disposable income. The study is also subject to bias due to unobserved heterogeneity because it does not control for any unobserved factors that might be associated with both SES and HIV infection. Nonetheless, the findings obtained in this study contribute to our knowledge regarding the relationship between SES and HIV infection in Kenya.

Compared to the overall HIV prevalence rate of 9%, women in the lowest wealth quintile had a lower prevalence of 4%, while those in the wealthiest quintile had a higher prevalence of 12%. The HIV prevalence rates for women with at least some primary, complete primary, high school or some college education were similar to the national prevalence, while women with no education had a lower prevalence of 5%. These results suggest that there might be a cohort difference in HIV risk, since women with no education are more likely to be in the oldest age cohort which was raised during a time when educational opportunities for women were limited.

Due to the variation in HIV prevalence across other demographic characteristics, multivariate analyses were conducted to adjust for age, ethnicity, region, area of residence, and marital status. In the model including education without adjusting for wealth, education had a significant positive association with HIV infection for women living in rural areas. Alternately, higher education was associated with decreased odds of HIV infection for women in urban areas. These findings are consistent with results obtained by Michelo and colleagues in Zambia[10] in which education was protective against HIV risk in urban areas. The results provide some support for the hypothesis that in urban areas, women with more education have been better equipped to make the necessary behavior changes to reduce their risk of infection. In rural areas, women with more education may be at higher risk by having more sexual partners before marriage, but they might not have the necessary information, access to condoms, or power in their relationships to engage in preventive behavior.

After controlling for wealth, the size and direction of the education effect remained stable, and was only marginally significant for women in urban areas. This indicates that effect of education on HIV status operates through different mechanisms than wealth. The lack of strong statistical significance might be due to the positive correlation between education and

wealth, which reduces the variance in the distribution of education within the wealthier quintiles. The persistent positive association between wealth and HIV status, even after controlling for education, suggests that at least some aspects of the wealth mechanisms are independent of women's individual-level status differentials based on potential gains to education. Additional studies are needed similar to the Kongnyuy et. al.[14] analysis of wealth and sexual behavior among men in Cameroon. Studies of couples would be particularly helpful in understanding the pathways through which wealth influences HIV risk.

An additional exploration of the effect of wealth on HIV was conducted in this study by including an interaction term between wealth and ethnicity. The interaction effect significantly improved the fit of the model and it reduced the effect of a one quintile shift in wealth on a one-standard deviation change in HIV infection by 90% for Kikuyu women. The interaction coefficients were not statistically significant for most of the other ethnic groups, indicating that they were not different from Kikuyus in this respect. For Kalenjin women, however, wealth was associated with increased odds of HIV infection. Sexual behaviors in Africa are largely influenced by culture, which is determined by ethnicity. Previous research suggests that wealthier men in some African countries have a higher probability of engaging in riskier sexual practices [14, 17] This pattern could increase HIV risk for women in wealthier households, particularly in ethnic groups that tend to have a higher tolerance of extramarital affairs, a higher prevalence of polygamy, or a tendency for younger women to marry older men. While it is not clear why this effect was only important for Kalenjin women, the results imply that there might be specific cultural behaviors and relationship patterns that place Kalenjin women at higher risk in the wealthiest households. Further analysis of behavioral characteristics of Kalenjin men and women would be helpful in providing some insights to explain this effect.

HIV prevalence rates in Kenya and other sub-Saharan African countries vary greatly by demographic and socioeconomic characteristics, and it is important to identify and understand these differentials to ensure that prevention efforts are targeted towards the groups at greatest risk. Findings from this study indicate that while more educated women may be better able to change their sexual behaviors to prevent HIV risk, there may be other factors related to household wealth that are more important predictors of their HIV risk, particularly for Kalenjin women. Additional studies are needed to identify cultural and social practices related to socioeconomic status that influence sexual behaviors.

Table 1. HIV Prevalence and Percentage Distribution of Selected Demographic Characteristics for 3,118 Kenyan Women in 2003 (weighted percentages and unweighted frequencies).

Characteristic	HIV Positive		Per cent of Total
	Per cent[a]	Percentage Base (N)[b]	
Region			
Nairobi	11.9	355	8.1
Central	7.6	522	14.0
Coast	6.6	384	8.2
Eastern	6.0	381	16.0
Nyanza	18.1	465	16.3
Rift Valley	6.8	567	24.3
Western	5.7	444	13.1
Ethnic Group			
Kikuyu	6.6	752	22.2
Luo	25.7	357	12.6
Luhyia	7.8	531	16.2
Kamba	8.2	312	11.9
Kalenjin	4.9	287	11.4
Kisii	7.1	208	6.2
Other	5.0	671	19.5
Area of residence			
Rural	7.9	2183	78.3
Urban	12.5	935	21.7
Marital Status			
Never married	4.8	926	29.1
Married/Cohabiting	8.2	1855	60.2
Formerly Married	24.1	337	10.7
Age			
15-24	6.1	1365	43.8
25-34	12.5	949	30.0
35-44	11.2	606	19.6
45-49	4.0	198	6.6
Wealth Quintiles			
Lowest	4.4	458	15.9
Second	9.0	568	19.7
Third	7.2	579	19.8
Fourth	9.9	627	21.4
Highest	12.4	886	23.1
Education			
No education	5.1	367	11.2
Less than primary	9.4	1019	35.3
Complete primary	9.5	1132	36.6
High school	9.2	393	11.5
Some college	8.7	207	5.4
Total	8.9	3118	

[a] Based on weighted N's
[b] Unweighted N

Source: Kenya Demographic and Health Survey (2003)

Table 2. Effect Parameters (Odds Ratios and 95% Confidence Intervals) for Weighted Models of Determinants of HIV Infection, Kenyan Women, 2003 (N=3,118).

	Model 1 Wealth		Model 2 Education		Model 3 Wealth & Education		Model 4 All with Interaction	
	Odds Ratio (95% CI)		Odds Ratio (95% CI)		Odds Ratio (95% CI)		Odds Ratio (95% CI)	
Wealth	**1.26**	(1.11-1.43)			**1.23**	(1.06-1.41)	1.03	(0.81-1.31)
Education	-		**1.07**	(1.01-1.13)	1.04	(0.97-1.11)	1.04	(0.97-1.11)
Area of Residence								
Rural	-		-		-		-	
Urban	1.14	(0.70-1.83)	**3.69**	(1.79-7.61)	**2.30**	(1.02-5.16)	**2.62**	(1.14-6.04)
Education * Urban			**0.90**	(0.83-0.98)	0.92	(0.85-1.00)	0.92	(0.84-1.00)
Marital Status								
Never Married	-		-		-		-	
Married	1.49	(0.88-2.53)	1.47	(0.87-2.48)	1.49	(0.88-2.52)	1.49	(0.88-2.53)
Former Married	**5.87**	(3.06-11.26)	**5.77**	(3.02-11.03)	**5.74**	(3.00-10.96)	**5.88**	(3.06-11.31)
Region								
Central	-		-		-		-	
Nairobi	0.59	(0.26-1.31)	0.61	(0.27-1.38)	0.64	(0.29-1.42)	0.66	(0.29-1.50)
Coast	0.58	(0.23-1.50)	0.54	(0.21-1.40)	0.59	(0.23-1.51)	0.61	(0.23-1.60)
Eastern	0.58	(0.25-1.36)	0.57	(0.23-1.37)	0.60	(0.25-1.42)	0.66	(0.28-1.53)
Nyanza	0.93	(0.43-2.04)	0.81	(0.35-1.87)	0.97	(0.43-2.16)	0.91	(0.39-2.14)
Rift Valley	0.73	(0.38-1.41)	0.73	(0.38-1.42)	0.77	(0.40-1.48)	0.80	(0.40-1.58)
Western	0.51	(0.20-1.33)	0.43	(0.17-1.11)	0.52	(0.20-1.36)	0.52	(0.18-1.45)
Age								
15-24	-		-		-		-	
25-34	**1.96**	(1.27-3.02)	**1.91**	(1.24-2.93)	**1.98**	(1.28-3.03)	**1.93**	(1.26-2.96)
35-44	1.44	(0.86-2.43)	1.46	(0.86-2.47)	1.47	(0.87-2.52)	1.45	(0.84-2.48)
45-49	0.44	(0.17-1.11)	0.47	(0.18-1.26)	0.47	(0.18-1.23)	0.45	(0.17-1.19)
Ethnic Group								
Kikuyu	-		-		-		-	
Luo	**6.33**	(3.36-11.95)	**6.73**	(3.46-13.11)	**6.41**	(3.34-12.30)	**5.08**	(1.39-18.59)
Luhyia	**2.33**	(1.12-4.86)	**2.43**	(1.16-5.08)	**2.33**	(1.12-4.89)	**1.65**	(0.42-6.46)
Kamba	2.11	(0.92-4.87)	2.11	(0.87-5.13)	2.17	(0.91-5.16)	1.23	(0.21-7.05)
Kalenjin	1.27	(0.53-3.03)	1.12	(0.46-2.71)	1.24	(0.52-2.97)	0.15	(0.03-0.79)
Kisii	1.58	(0.63-3.97)	1.50	(0.58-3.94)	1.53	(0.60-3.91)	1.00	(0.19-5.44)
Other	1.18	(0.57-2.45)	1.23	(0.57-2.63)	1.23	(0.57-2.63)	0.92	(0.24-3.52)
Wealth * Ethnic Group								
Wealth*Kikuyu	-		-		-		-	
Wealth*Luo							1.08	(0.80-1.46)
Wealth*Luhyia							1.12	(0.77-1.62)
Wealth*Kamba							1.19	(0.73-1.95)
Wealth*Kalenjin							**2.36**	(1.54-3.60)
Wealth*Kisii							1.18	(0.63-2.20)
Wealth*Other							1.07	(0.73-1.55)

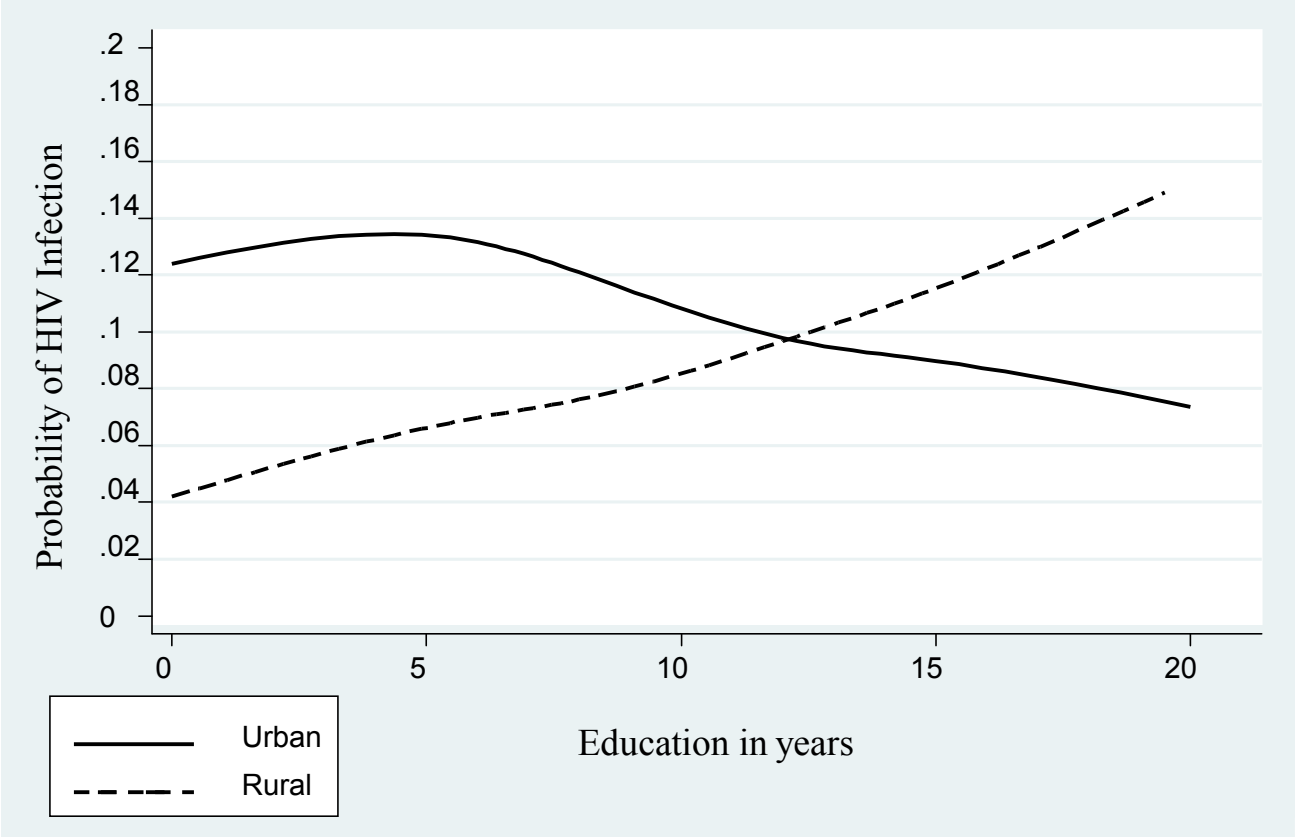
Source: Kenya Demographic and Health Survey (2003)

Table 3. Standardized Effect Parameters (Y-Standardized Coefficient and P-value) for Weighted Models of Determinants of HIV Infection, Kenyan Women, 2003 (N=3,118).

	Model 1 Wealth		Model 2 Education		Model 3 Wealth & Education		Model 4 All with Interaction	
	Y-Std Coef.	(p-value)	Y-Std Coef.	(p-value)	Y-Std Coef.	(p-value)	Y-Std Coef.	(p-value)
Wealth	0.11	(0.000)			0.10	(0.005)	0.02	(0.792)
Education			0.03	(0.032)	0.02	(0.244)	0.02	(0.243)
Area of Residence								
Rural	-		-		-		-	
Urban	0.06	(0.600)	0.63	(0.000)	0.40	(0.043)	0.45	(0.023)
Education*Urban			-0.05	(0.011)	-0.04	(0.043)	-0.04	(0.042)

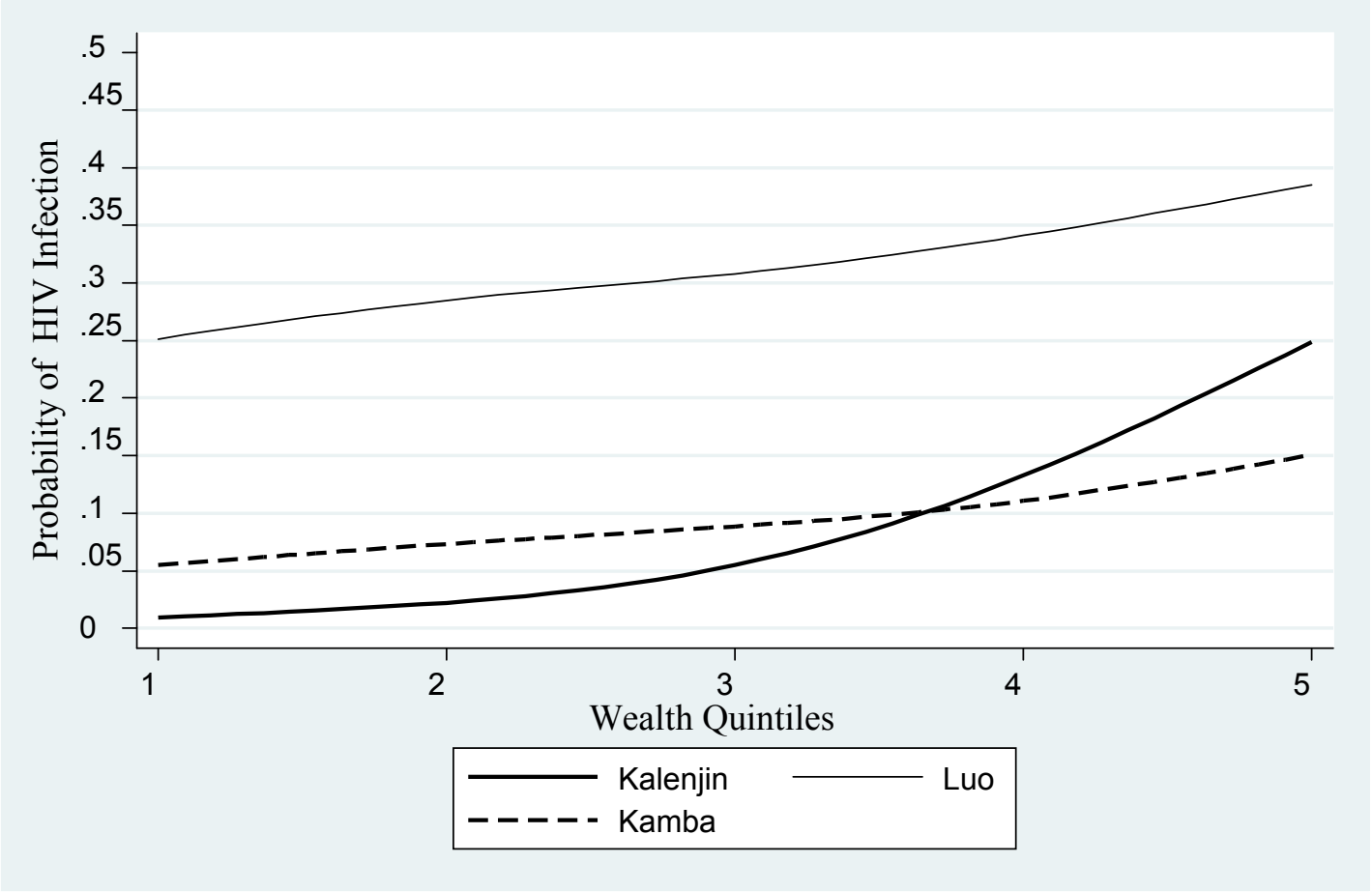
Note: As shown in Table 2, other variables included all models were age, region, ethnicity and marital status. Model 4 also includes an interaction term between wealth and ethnicity.
Source: Kenya Demographic and Health Survey (2003)

Figure 1. Median Spline Graph of Adjusted Probability of HIV Infection by Education and Area of Residence for Married Kenyan Women, Ages 25 to 34, 2003



Source: Kenya Demographic and Health Survey (2003).

Figure 2. Median Spline Graph of Adjusted Probability of HIV Infection by Education and Ethnicity for Kenyan Women who were Married, Living in Rural Residences and between Ages 25 to 34, 2003.



Source: Kenya Demographic and Health Survey (2003)

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