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Does It Really Matter Where You Live? A Multilevel Analysis of Social Disorganization and Risky Sexual Behaviours in Sub-Saharan Africa

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ABSTRACT

Background: The aim of this study is to examine individual and contextual factors associated with high-risk sexual behaviour in sub-Saharan Africa. Heterosexual relationships represent the major route of HIV/AIDS infection in Africa. Thus, understanding sexual behaviour is an essential step toward any effort to reduce the spread of the HIV/AIDS epidemic.

Methods: We applied multilevel logistic regression analyses on Demographic and Health Survey (DHS) data for 262,727 respondents (level 1) nested with 10,914 communities (level 2) from 26 sub-Saharan countries (level 3).

Results: In all 26 countries studied, men were significantly more likely than women to have reported premarital sex. Except for Congo and Ethiopia, men were also significantly more likely to have reported non-spousal sex. At the community and country levels, there was statistically significant clustering of reported high-risk sexual behaviour. The following individual factors were associated with higher odds of reporting premarital and non-spousal sex: male gender, higher educational attainment and higher wealth status. The following contextual factors were associated with higher odds of reporting premarital and non-spousal sex: ethnic diversity, urban residence and small household size.

Conclusion: We found that community and societal measures of social disorganization are important predictors of high-risk sexual behaviour. Thus, interventions aimed at reducing high-risk sexual behaviour should be implemented not only at the level of the individual but also at the community and societal levels.

BACKGROUND

Sub-Saharan Africa remains the region most heavily affected by HIV, accounting for 67% of all people living with HIV and for 75% of AIDS deaths in 2007 (UNAIDS, 2008). At the end of 2007, an estimated 22 million adults and children in sub-Saharan Africa were living with HIV (UNAIDS, 2008). During that year, an estimated 1.5 million Africans died from AIDS (UNAIDS, 2008). The epidemic has left behind some 11.6 million orphaned African children (UNAIDS, 2008).

While the nature of the causes and transmission of HIV/AIDS is complicated due to many biological, social, cultural and economic factors, the HIV/AIDS crisis is to a large extent a crisis of sexual behaviour (Lema et al., 2008). High-risk sexual behaviour, including exposure to multiple partners, increases the risks for HIV/AIDS and other sexual transmitted infections (STIs), and STIs facilitate the transmission of HIV (Bollen et al., 2008, Cohen, 2004, Da Ros and Schmitt Cda, 2008, Galvin and Cohen, 2004). Risky sexual behaviours can lead to serious health consequences both for the person involved and for any number of unseen partners.

The prevalence of high-risk sexual behaviour in sub-Saharan Africa is a major public health concern, mostly because of the increasing incidence of HIV/AIDS (Djamba, 2003). About 9 in 10 young people age 15–19 in Sub-Saharan Africa have heard of HIV/AIDS, but most are not familiar with the "ABCs" of prevention: abstinence, being faithful (monogamy) and condom use (Bankole et al., 2004). Many adolescents, especially in rural areas, do not know where to obtain condoms (Bankole et al., 2004).

Focusing on the individual alone ignores the broader social context within which sexual behaviours occur (Bajos, 1997). Many studies have been undertaken to understand factors associated with risky sexual behaviours. A small number of them using multilevel analyses have shown that social and community-level factors are associated with risky sexual behaviour (Benefo, 2008, Uthman, 2008, Uthman and Kongnyuy, 2008). Neighbourhoods constitute a key determinant of health, as they shape individual opportunities and expose residents to multiple risks and resources over the life course (Leventhal and Brooks-Gunn, 2000, Sampson, 2003).

Conceptual Model

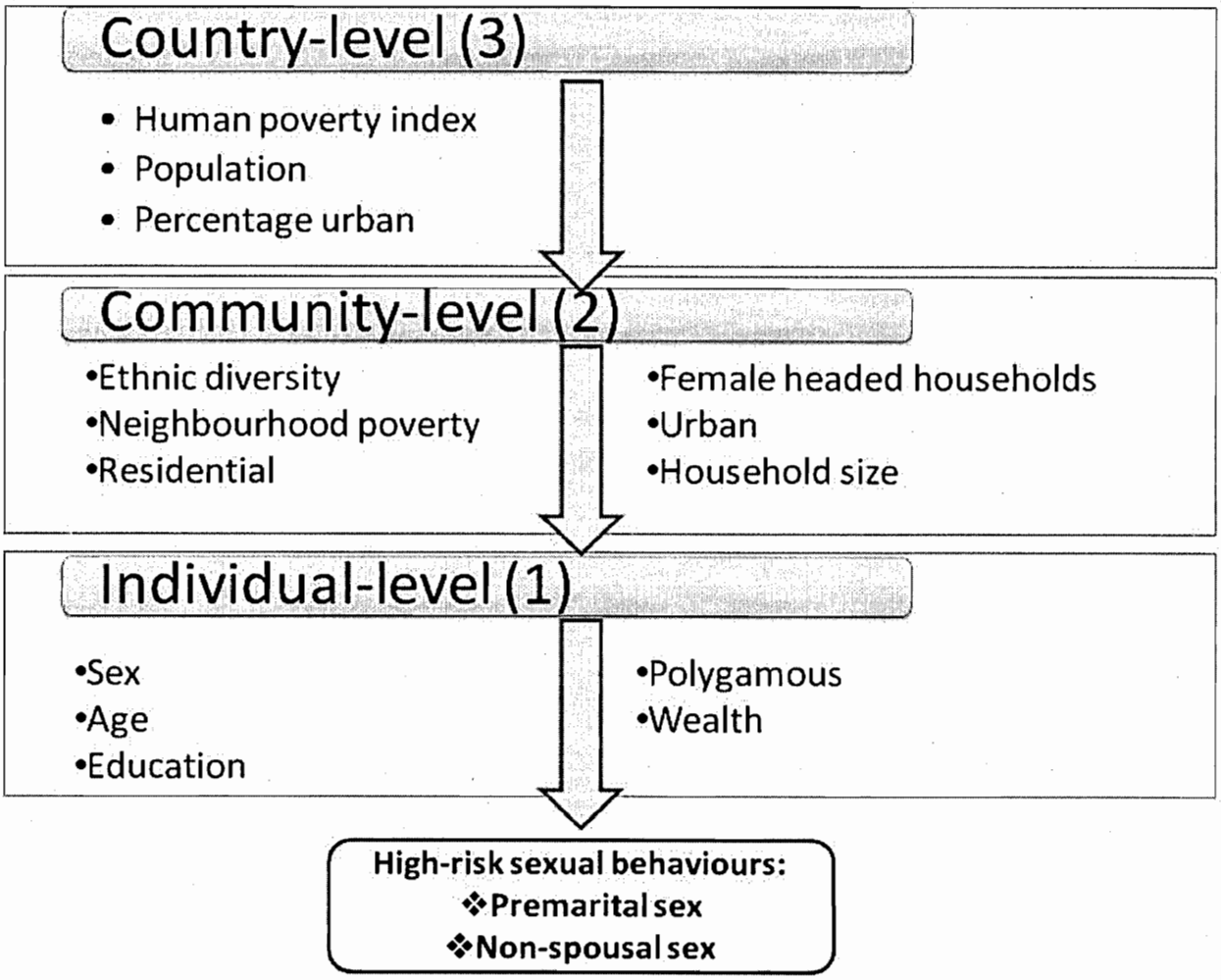
This analysis draws upon social disorganization theory (Shaw and McKay, 1942). This framework presents at a high level how neighbourhoods directly and indirectly influence high-risk sexual behaviours (see Figure 1). This framework conceptualizes high-risk sexual behaviour as a multifaceted phenomenon grounded in the interplay of individual, family, community and societal factors. The model takes into account measures of social disorganization and their role in influencing high-risk sexual behaviour. Social disorganization identifies neighbourhood poverty, residential instability, family disruption, population density, and proximity to urban areas as key structural factors that diminish community-level self-regulatory capacity (Shaw and McKay, 1942).

The social disorganization thesis argues that communities with strong informal social networks are able to monitor and regulate sexual behaviour (Benefo, 2008). Consequently, structural factors that increase the complexity of community social organization and undermine informal social networks expand the range of sexual behaviours pursued by residents (Bishai et al., 2006, Browning and Olinger-Wilbon, 2003). Poverty reduces the resources necessary to sustain basic institutions like the family and organizations in neighbourhoods (Browning, 2002). Social disorganization theory hypothesises that the disruptive effects of immigration, industrialization and urbanization lead to changes in the social structure of neighbourhoods via ethnic diversity, residential instability and neighbourhood poverty. The resultant structural changes diminish the social cohesion of neighbourhoods and reduce the power of social norms and informal social control to regulate deviant behaviour. This can result in sexual HIV risk behaviours. The theory proposes that high ethnic diversity gives rise to social isolation. This in turn leads to structural barriers and cultural adaptations that undermine social organization.

Shaw and McKay (1942) also traced social disorganization to conditions endemic to the urban areas that were the only places the newly arriving poor could afford to live, especially a high rate of turnover in the population (residential instability). These high levels of residential turnover can disrupt existing social networks. Urbanization has been found to be negatively associated with the coherence of normative environment (Billy and Moore, 1992). Increasing urbanization may give rise to an environment facilitating higher levels of sexual activity by creating greater anonymity, which lowers the risk of being "found out" (Billy and Moore, 1992).

Non-traditional family structures, such as female-headed households, have been linked to social disorganization. The effect of social disorganization has been pointed out by research conducted on Zambian men's non-spousal sex (Benefo, 2008), and other research has found that Ugandan men in ethnically heterogeneous communities are more likely to report non-spousal sex (Bishai et al., 2006).

Figure 1. Conceptual model for determinants of high-risk sexual behaviour.



To the best of our knowledge, there has been no multilevel study to date that examined the separate and independent association of individual, neighbourhood and country factors associated with risky sexual behaviour. Thus, the aim of this study is to answer the following

research questions:

1. Do neighbourhoods and countries differ in high-risk sexual behaviours?
2. Are neighbourhood-level and country-level measures of social disorganization associated with high-risk sexual behaviours, after adjustment for individual-level variables?

Answers to these questions can inform and help policymakers to consider appropriate policy options to reduce the prevalence of high-risk sexual behaviours in sub-Saharan Africa. Furthermore, because heterosexual relationships are the major route of HIV/AIDS infection in Africa, understanding high-risk sexual behaviour is an essential step toward reducing the spread of the HIV/AIDS epidemic (Djamba, 2003).

SUBJECTS AND METHODS

Data

This study used data from 26 Demographic and Health Surveys (DHS) conducted between 2003 and 2008 in sub-Saharan Africa (Benin, Burkina Faso, Cameroon, Chad, Congo, Democratic Republic of Congo, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe)—the most recent available as of November 2009. Methods and data collection procedures have been published elsewhere (MEASURE DHS, 2009). Selection of the countries in this study was determined by availability of comparable data on sexual behaviour. In the DHS, interviewers administered a standardized questionnaire to participants in each country, yielding comparable data across countries. Country-level data were collected from the reports published by the United Nations Development Programs (UNDP, 2009).

Definitions

In our study, the term "community" describes clustering within the same geographical living environment. Communities were based on sharing a common primary sample unit (PSU) within the DHS data. The DHS sampling frame for identifying PSUs is usually the most recent census. In urban areas, this results in census enumeration blocks being identified for sampling purposes. In rural areas, village areas are normally used to identify a PSU. Where a village is identified as having less than 50 households, it is normally joined with a larger neighbouring village to ensure that there are at least 50 households in each PSU. If a village has more than 500 households, it is normally still only viewed as one PSU, although it will be segmented, with a sub-sample of the segments selected for household listing and interviewing. We used the terms "neighbourhood" and "community" interchangeably in this study.

Our study chose the PSU as the unit of analysis for two reasons. First, the PSU is the most consistent measure of community across all the DHS surveys (Harries, 1995), and thus the most appropriate identifier of community for this cross-region comparison. Second, it has been shown that for most of the DHS conducted to date, the sample size per cluster met the optimum

size with a tolerable precision loss (Galvin and Cohen, 2004) (The bias introduced by using cluster averages based on about 25 women as a proxy for the PSU population averages is very small—only about 4% (Browning, 2002)).

Ethical Consideration

This study is based on an analysis of existing survey data with all identifier information removed. The survey was approved by the Institutional Review Board of ICF Macro in Calverton, Maryland, USA, and in some cases by country-specific ethics-related committees. All study participants gave informed consent before participation and all information was collected confidentially.

Variables

Outcome Variable

Premarital sex and non-spousal sex were used as measures of risky sexual behaviours. For the present study, the analysis is limited to sexually experienced respondents who have been married at least once. The term "premarital sex" was defined as having first sexual intercourse before age at first marriage. This was derived from a comparison of age at first intercourse and age at first marriage. Non-spousal sex was measured in the last 12 months, among women and men age 15-49 currently in union and who had sex in last 12 months.

Explanatory Variables

Individual-level factors: The following individual-level factors were included as control variables: Age of the respondent at the time of interview (15-24, 25-34, 35 or older); sex (male or female); education (no education, primary, secondary or higher); and polygamous (yes or no). The DHS did not collect direct information on household income and expenditure. We used the DHS wealth index as a proxy indicator for socioeconomic status. The methods used in calculating the DHS wealth index have been described elsewhere (Filmer and Pritchett, 2001,

Montgomery et al., 2000, Vyas and Kumaranayake, 2006, Rustein and Johnson, 2004). Briefly, an index of economic status for each household was constructed using principal components analysis based on the following household variables: number of rooms per house; ownership of car, motorcycle, bicycle, fridge, television and telephone; and kind of heating device. From this information, the DHS wealth index quintiles (poorest, poor, middle, rich and richest) were calculated and were used in the subsequent modelling.

Community-level factors:

1. ***Neighbourhood poverty:*** percentage of households in the lowest quintile of the wealth index (Rustein and Johnson, 2004).
2. ***Female-headed households:*** percentage of households headed by women in an area.
3. ***Residential mobility:*** proportion of households occupied by persons who had moved from another dwelling in the previous five years (Osgood and Chambers, 2003, Sampson, 1985, Warner and Pierce, 1993).
4. ***Place of residence:*** urban or rural, as administratively defined by each country.
5. ***Population density:*** median household size in a community.
6. ***Ethnic diversity:*** an index created using a formula (see equation 1, below) that captures both the number of different groups in an area and the relative representation of each group (Simpson, 1949):

$$\text{Ethnic diversity index} = 1 - \sum_{i=1}^{n} \left[\frac{x_i}{y} \right]^2 \qquad \textbf{(1)}$$

where:

x_i = population of ethnic group i of the area,

y = total population of the area, and

n = number of ethnic groups in the area

Scores can range from 0 to approximately 1. The larger the index, the greater the

diversity in an area. For clarity of interpretation, the score is multiplied by 100; if an area's entire population belongs to one ethnic group, then an area has a diversity index of 0. An area's diversity index increases to 100 if the population is evenly divided into ethnic groups.

Country-level factors: The country-level variables include human poverty index (HPI), country population size and percentage urban areas in a country. HPI uses indicators of the most basic dimensions of deprivation: a short life, lack of basic education and lack of access to public and private resources.

Statistical Analyses

Descriptive Analyses

In the descriptive statistics, the distributions of respondents by the key variables were expressed as percentages. We used Pearson's chi-squared test for analyzing contingency tables. All cases in the DHS data were given weights to adjust for differences in probability of selection and to adjust for non-response. Pooled sample weights were used for descriptive statistics in this study, using Stata 11 for Windows (StataCorp, 2009).

Modelling Approaches

We specified a three-level multilevel model for our two binary outcomes (premarital and non-spousal sex) that had a structure of an individual (level 1) living in a community (level 2) within a country (level 3). We constructed four models. The first model, an empty or unconditional model without any exposure variables, was specified to decompose the amount of variance that existed between community and country levels. The second model contained individual-level variables: age and educational attainment. The third model was extended to include community-level variables. The fourth model additionally contained the country-level variable.

Fixed Effects (Measures of Association)

The results of fixed effects (measures of association) were shown as odds ratios (ORs) with their 95% confidence intervals (CIs).

Random Effects (Measures of Variation)

Measures of random effects included an intra-cluster correlation (ICC) and a variance partition coefficient (VPC). The ICC was calculated by the linear threshold according to the formula used by Snijders and Bosker (Snijders and Bosker, 1999).

Model Fit and Specifications

Regression diagnostics were used to judge the goodness-of-fit of the model. They included the tolerance test for multicollinearity, its reciprocal variance inflation factors (VIF) (Tu et al., 2004, Tu et al., 2005), presence of outliers and estimates of adjusted R square of the regression model. The largest VIF greater than 10 or the mean VIF greater than 6 represent severe multicollinearity (Hocking, 1996). Regression estimates were calculated by means of the re-weighted iterative generalised least square algorithm using MLwiN 2.20 (Rasbash et al., 2008). In the multilevel logistic regression models, second order penalized quazi-likelihood (PQL) estimation was used (Goldstein, 2003). The statistical significance of covariates were calculated using the Wald test (Rasbash et al., 2008). All significance tests were two-tailed and statistical significance was defined at the 5% alpha level.

RESULTS

Sample Characteristics

Table 1 lists the countries, year of data collection, final sample and number of communities sampled per country. As mentioned, the surveys were conducted between 2003 and 2008. The median number of women and men sampled was 9,513 (range: 4,916 to 33,385) and 3,838 (range: 1,887 to 15,486), respectively. The number of communities sampled ranged from 196 to 886. The number of respondents per community ranged from 10 to 36.

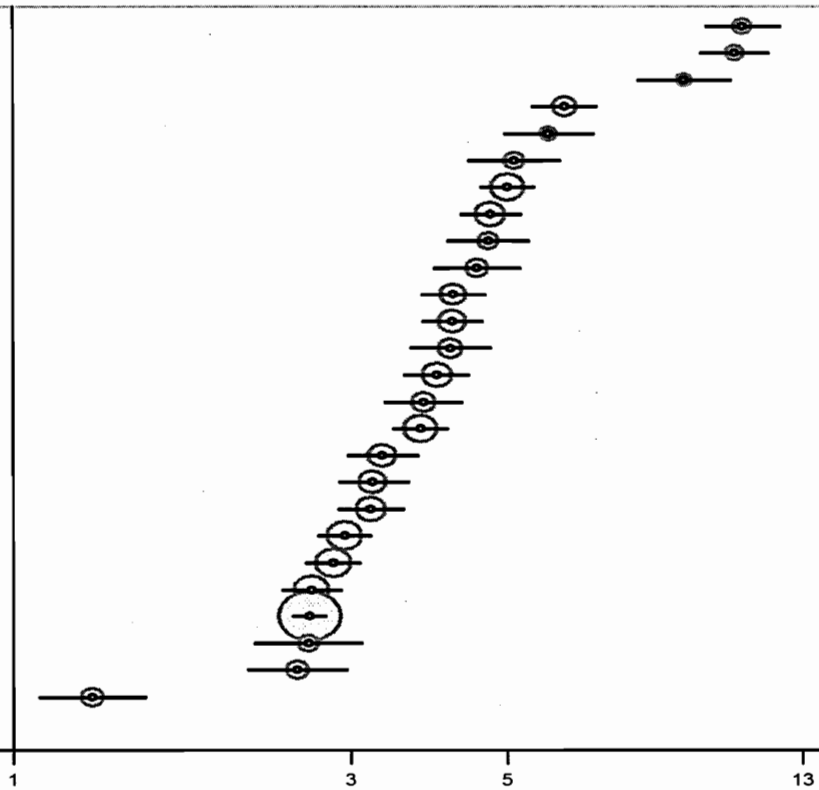
Table 1. Description of Demographic and Health Surveys data 2003-2008 in sub-Saharan Africa among men and women.

Country	Survey year	Sample size		Number of communities	Median number of respondents per community
		Women	Men		
Benin	2006	17,794	5,321	750	21
Burkina Faso	2003	12,477	3,605	400	27
Cameroon	2004	10,656	5,280	466	21
Chad	2004	6,085	1,887	196	31
Congo	2005	7,051	3,146	225	29
Congo DR	2007	9,995	4,757	300	33
Ethiopia	2005	14,070	6,033	535	24
Ghana	2008	4,916	4,568	411	14
Guinea	2005	7,954	3,174	295	27
Kenya	2003	8,195	3,578	400	18
Lesotho	2004	7,095	2,797	405	13
Liberia	2007	7,092	6,009	298	28
Madagascar	2004	7,949	2,432	300	25
Malawi	2004	11,703	3,261	521	21
Mali	2006	14,583	4,207	407	36
Mozambique	2003	12,418	2,900	604	19
Namibia	2007	9,804	3,915	500	10
Niger	2006	9,223	3,549	342	28
Nigeria	2008	33,385	15,486	886	34
Rwanda	2005	11,321	4,820	462	20
Senegal	2005	14,602	3,761	376	31
Swaziland	2006	4,987	4,156	275	12
Tanzania	2004	10,329	2,635	475	19
Uganda	2006	8,531	2,503	368	21
Zambia	2007	7,146	6,500	319	26
Zimbabwe	2005	8,907	7,175	398	24

Figure 2 shows percentages of respondents who reported premarital sex. The percentages vary widely by country. The percentage of men who reported premarital sex ranged from 24% in Niger to 90% in Congo. The percentage of women who reported premarital sex ranged from 5% in Niger to 79% in Congo. In all 26 countries, men were significantly more likely than women to have reported premarital sex. In Senegal and Guinea men were more than 10 times more likely to have reported premarital sex than were women.

Figure 2. Gender differences and percentages of respondents who reported premarital sex (ranked by odds ratio).

Country	Overall (%)	Men (%)	Women (%)	odds ratio (95% CI)
Guinea	29.9	68.9	17.1	10.74 (9.57, 12.05)
Senegal	18	54.6	10.3	10.45 (9.38, 11.64)
Chad	18.2	51.4	10.6	8.88 (7.66, 10.28)
Rwanda	27.8	55.7	17.2	6.03 (5.46, 6.67)
Niger	9.5	24.1	5.2	5.73 (4.98, 6.60)
Madagascar	58.8	84.6	51.7	5.12 (4.43, 5.92)
Benin	46.4	75.9	38.5	5.02 (4.61, 5.46)
Zambia	59.8	78.8	44	4.75 (4.31, 5.22)
Lesotho	37.7	65.6	28.8	4.70 (4.14, 5.35)
Kenya	64.2	85.4	56.3	4.54 (3.96, 5.20)
Burkina Faso	26.8	53	21.1	4.20 (3.80, 4.64)
Ethiopia	18.6	36.9	12.3	4.19 (3.81, 4.59)
Uganda	51.2	77.1	44.7	4.16 (3.66, 4.73)
Malawi	44.1	70.5	37.5	3.98 (3.60, 4.41)
Tanzania	45.9	72.3	40.6	3.82 (3.38, 4.31)
Zimbabwe	47.6	67.5	35.5	3.77 (3.46, 4.12)
Mozambique	53.7	76.4	49.3	3.34 (2.98, 3.74)
Ghana	56.4	71.6	43.8	3.24 (2.90, 3.61)
Liberia	69.8	82.8	60	3.21 (2.90, 3.57)
Mali	27.8	47.1	23.2	2.95 (2.71, 3.21)
Cameroon	51.3	69.1	44	2.84 (2.60, 3.10)
Congo DR	57.7	73.4	51	2.65 (2.41, 2.91)
Nigeria	32.9	48.9	26.7	2.63 (2.50, 2.76)
Congo	82.3	90.9	79.2	2.62 (2.20, 3.11)
Namibia	71.5	83.6	66.9	2.53 (2.16, 2.96)
Swaziland	79.1	81.4	77.2	1.29 (1.09, 1.54)

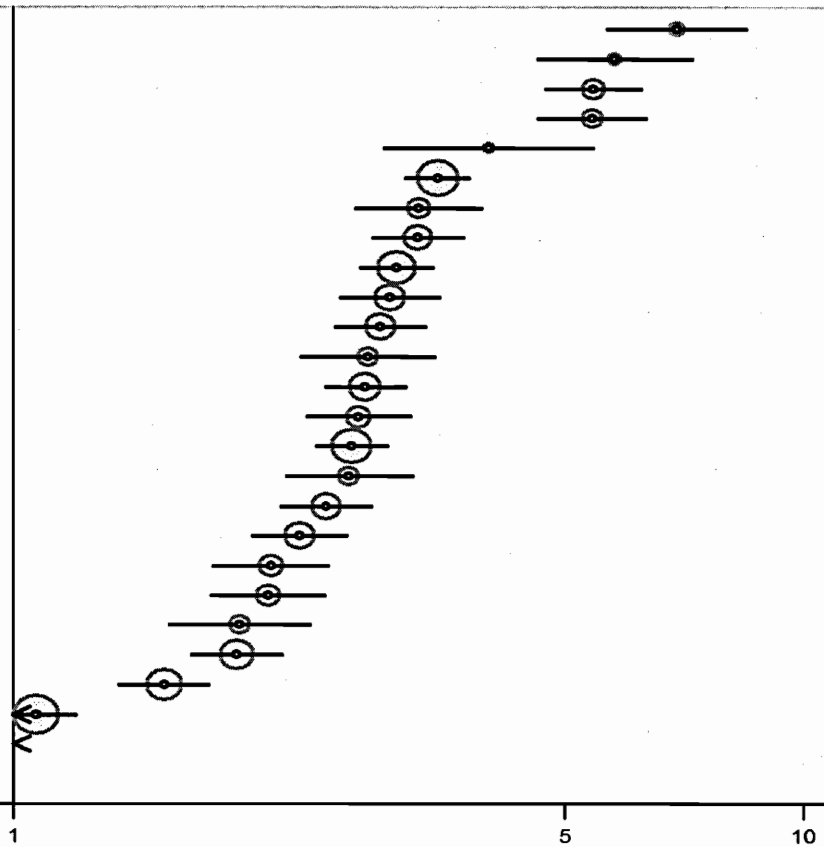


Note: Reference category for the odds ratio is women

Figure 3 shows percentages of respondents who reported non-spousal sex. The percentage of men who reported non-spousal sex ranged from 2% in Ethiopia to 68% in Congo. The percentage of women who reported non-spousal sex ranged from 1% in Niger to 67% in Congo. Except for Congo and Ethiopia, men were significantly more likely than women to have reported non-spousal sex. Men from Ethiopia, however, were less likely than women to have reported non-spousal sex. There was no statistically significant difference between men and women in Congo.

Figure 3. Gender differences and percentages of respondents who reported non-spousal sex (ranked by odds ratio).

Country	Overall (%)	Men (%)	Women (%)	odds ratio (95% CI)
Burkina Faso	3.6	11.8	1.9	6.93 (5.67, 8.47)
Chad	5.6	16.2	3.2	5.79 (4.64, 7.23)
Senegal	8.2	22.9	5.2	5.44 (4.75, 6.23)
Guinea	9.2	22.2	5	5.42 (4.64, 6.33)
Niger	1.8	4.2	1.1	4.01 (2.97, 5.43)
Cameroon	25.2	43	17.9	3.46 (3.16, 3.79)
Ghana	10.8	16.8	5.8	3.27 (2.73, 3.92)
Mali	7	15	5.1	3.27 (2.87, 3.72)
Nigeria	4.8	9.1	3.2	3.07 (2.77, 3.40)
Zambia	11.3	17.2	6.4	3.01 (2.61, 3.47)
Congo DR	10.7	18.7	7.3	2.93 (2.57, 3.33)
Swaziland	16.3	24	10.1	2.82 (2.32, 3.43)
Mozambique	14.8	28	12.2	2.80 (2.49, 3.15)
Madagascar	11.3	20.8	8.7	2.74 (2.36, 3.19)
Liberia	23.6	33.8	15.9	2.69 (2.43, 2.99)
Malawi	4.7	9.1	3.6	2.67 (2.23, 3.21)
Tanzania	15.9	28	13.5	2.50 (2.19, 2.85)
Zimbabwe	9.2	13.8	6.5	2.31 (2.01, 2.65)
Namibia	13.3	20.3	10.7	2.12 (1.80, 2.51)
Kenya	8.8	13.6	7	2.11 (1.79, 2.49)
Rwanda	4.3	6.5	3.5	1.94 (1.58, 2.38)
Lesotho	25.3	35.3	22.1	1.92 (1.68, 2.19)
Uganda	20	26	18.5	1.55 (1.36, 1.77)
Congo	66.9	67.9	66.5	1.07 (0.95, 1.20)
Ethiopia	39.6	1.6	52.7	0.01 (0.01, 0.02)



Note: Reference category for the odds ratio is women

Table 2 presents descriptive statistics for the final pooled sample. For this analysis, information on 262,727 respondents (level 1) nested with 10,914 communities (level 2) from the 26 sub-Saharan countries (level 3) was pooled into one data set. Most of the respondents were women (67%), and most respondents lived in rural areas (67%). Respondents were fairly evenly divided across the age, education and wealth strata. More than half of the respondents were in polygamous relationships (55%). The median community household size was 6.3 persons. The median neighbourhood poverty level was 5.9%, while 21.4% of households were female-headed, and residential instability was 17.9%. The median community ethnic diversity index was 0.0. At the country level, the median human poverty index was 36.2, median population size was 14.4 million, and the median percentage urban was 35.2%.

Table 2. Summary statistics of sample.

Variable	Percentage* / Median (IQR)
LEVEL 1: INDIVIDUAL (n=262,727)	Percentage
Sex	
Male	33.2
Female	66.8
Age (years)	
15-24	37.3
25-34	27.1
35+	35.6
Educational attainment	
No education	21.5
Primary	37.2
Secondary or higher	41.3
Polygamous	
Yes	67.2
No	32.8
Wealth status	
Poorest	17.1
Poor	18.1
Middle	19.1
Rich	21.2
Richest	24.5
LEVEL 2: COMMUNITIES (n=10,914)	Median (IQR)
Ethnic diversity	0.0 (43.0)
Neighbourhood poverty	5.9 (33.3)
Female-headed households	21.4 (26.0)
Residential instability	17.9 (27.8)
Place of residence (%)	
Rural	67.0
Urban	33.1
Household size	6.3 (2.5)
LEVEL 3: COUNTRIES (n=26)	Median (IQR)
Human poverty index	36.2 (16.0)
Population (millions)	14.4 (28.2)
Percentage urban population	35.4 (20.7)

IQR: Interquantile range

*Pooled sample weights were applied

Premarital Sex

Table 3 shows fixed-effect (measures of association) and random-effect (measures of variation) results from multilevel analysis with premarital sex as the outcome variable. The results of the empty model showed that approximately 23% of the variance in the log odds of reporting premarital sex could be attributed to the community level (τ =0.369, p<0.0001) and 14% to the country level (τ =0.607, p<0.0001). The variations across communities and countries remained statistically significant even after controlling for individual-level, community-level, and country-level factors (Table 4), thereby lending support for the use of multilevel modelling to account for community and country variations.

Table 3 also shows results of fitting the model including individual-level, community-level, and country-level factors (Model 4). With all factors controlled for statistically, men were 274% more likely to have reported premarital sex (adjusted OR [aOR]=3.74; 95% CI 3.65 to 3.84). Respondents age 35 or older were more likely to have reported premarital sex (aOR=1.13; 95% CI 1.10 to 1.15) than were respondents age 15-24. The odds of reporting premarital sex declined with decreasing education and decreasing wealth status. Compared with respondents with secondary or higher education, respondents with no education were less likely to have reported premarital sex (aOR=0.57; 95% CI 0.55 to 0.58). Respondents from the poorest households were less likely to have reported premarital sex than those from the richest households (aOR=0.87; 95% CI 0.83 to 0.91). The association between premarital sex and polygamous relationship was not significant.

Respondents from communities with high ethnic diversity (aOR=1.08; 95% CI 1.04 to 1.12), high residential mobility (aOR=1.08; 95% CI 1.05 to 1.12) and high proportions of female-headed households (aOR=1.14; 95% CI 1.10 to 1.18) were more likely to have reported premarital sex. Respondents from neighbourhoods with high levels of poverty were 14% less likely to have reported premarital sex (aOR=0.86; 95% CI 0.83 to 0.90). Compared with rural areas, respondents from urban areas were more likely to have reported premarital sex (aOR=1.10; 95% CI 1.05 to 1.14). The odds of reporting premarital sex decreased as household size increased (aOR = 0.94; 95% CI 0.91 to 0.98). For each one-unit increase in a country's human poverty index score, the odds of reporting premarital sex decreased by 4% (aOR=0.96; 95% CI 0.93 to 0.98). The association between reported premarital sex and a country's population size and percentage urban was not statistically significant.

Table 3. Measures of variations and factors associated with premarital sex identified by multilevel logistic regression models.

Variable	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]
LEVEL 1: INDIVIDUAL				
Female (versus male)		3.31 (3.23 to 3.39)***	3.47 (3.38 to 3.56)***	3.74 (3.65 to 3.84)***
Age (years)				
15-24		1.00 (reference)	1.00 (reference)	1.00 (reference)
25-34		1.24 (1.21 to 1.27)***	1.24 (1.21 to 1.27)***	1.25 (1.23 to 1.28)***
35+		1.12 (1.09 to 1.15)***	1.12 (1.09 to 1.15)***	1.13 (1.10 to 1.15)***
Educational attainment				
No education		0.56 (0.55 to 0.58)***	0.58 (0.56 to 0.59)***	0.57 (0.55 to 0.58)***
Primary		0.76 (0.74 to 0.78)***	0.76 (0.74 to 0.78)***	0.76 (0.74 to 0.77)***
Secondary or higher		1.00 (reference)	1.00 (reference)	1.00 (reference)
Polygamous (yes vs. no)		0.98 (0.96 to 1.00)	0.98 (0.96 to 0.99)*	0.98 (0.96 to 1.00)
Wealth status				
Poorest		0.77 (0.74 to 0.80)***	0.87 (0.83 to 0.91)***	0.87 (0.83 to 0.91)***
Poor		0.81 (0.78 to 0.83)***	0.88 (0.85 to 0.92)***	0.88 (0.85 to 0.92)***
Middle		0.83 (0.80 to 0.85)***	0.88 (0.85 to 0.91)***	0.88 (0.85 to 0.91)***
Rich		0.87 (0.85 to 0.90)***	0.90 (0.88 to 0.93)***	0.90 (0.87 to 0.93)***
Richest		1.00 (reference)	1.00 (reference)	1.00 (reference)
LEVEL 2: COMMUNITIES				
Ethnic diversity			1.08 (1.04 to 1.12)***	1.08 (1.04 to 1.12)***
Neighbourhood poverty			0.86 (0.84 to 0.89)***	0.86 (0.83 to 0.90)***
Residential mobility			1.06 (1.03 to 1.09)***	1.08 (1.05 to 1.12)***
Female-headed households (%)			1.13 (1.10 to 1.16)***	1.14 (1.10 to 1.18)***
Urban (vs. rural) area			1.08 (1.04 to 1.12)***	1.10 (1.05 to 1.14)***
Household size			0.93 (0.90 to 0.96)***	0.94 (0.91 to 0.98)**
LEVEL 3: COUNTRIES				
Human poverty index				0.96 (0.93 to 0.98)***
Population (millions)				1.00 (0.99 to 1.00)
Percentage urban population				1.02 (1.00 to 1.03)
Random effects				
Country-level				
Variance (SE)	0.607 (0.169)	0.504 (0.140)	0.484 (0.135)	0.271 (0.075)
ICC	14.2	12.2	11.7	6.8
Community-level				
Variance (SE)	0.369 (0.08)	0.346 (0.007)	0.342 (0.007)	0.422 (0.009)
ICC	22.9	20.5	20.1	17.4

[a]Model 1 is the empty model, a baseline model without any exposure variable (N= 261668)
[b]Model 2 is adjusted for sex, age, education, polygamous, and wealth (N= 244952)
[c]Model 3 is additionally adjusted for community-level factors (N= 244952)
[d]Model 4 is additionally adjusted for country-level factors (N= 244952)
Abbreviations: SE: standard error; ICC: intra-cluster correlation coefficient
***$p < 0.001$, **$p < 0.01$, and *$p < 0.05$

Non-Spousal Sex

Table 4 shows fixed-effect (measures of association) and random-effect (measures of variation) results from multilevel analysis with non-spousal sex as the outcome variable. The results of the empty model showed that approximately 32% of the variance in the log odds of reporting non-spousal sex could be attributed to the community level (τ =0.599, p=0.004) and 20% to the country level (τ =0.982, p<0.0001). As with the premarital sex outcome, the variations in the non-spousal sex outcome across communities and countries remained statistically significant after controlling for individual-level, community-level, and country-level factors (Table 4), lending support for the use of multilevel modelling to account for community and country variations.

Table 4 also shows results of fitting the model including individual-level, community-level, and country-level factors (Model 4). With all factors controlled for statistically, men were 16% more likely to have reported non-spousal sex (adjusted OR [aOR]=1.16; 95% CI 1.11 to 1.21). Respondents age 35 or older were less likely to have reported non-spousal sex (aOR=0.55; 95% CI 0.53 to 0.57) than were respondents age 15-24. The odds of reporting non-spousal sex decreased with decreasing education and decreasing wealth status. Compared with respondents with secondary or higher education, respondents with no education were less likely to have reported non-spousal sex (aOR=0.71; 95% CI 0.68 to 0.74). Respondents from the poorest households were less likely to have reported non-spousal sex than those from the richest households (aOR=). Polygamous respondents were more likely to report non-spousal sex (aOR=2.49; 95% CI 2.42 to 2.56). The association between non-spousal sex and wealth index was not statistically significant.

Table 4. Measures of variations and factors associated with non-spousal sex identified by multilevel logistic regression models.

Variable	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]
LEVEL 1: INDIVIDUAL				
Female (versus male)		1.07 (1.03 to 1.12)***	1.18 (1.13 to 1.23)***	1.16 (1.11 to 1.21)***
Age (years)				
15-24		1.00 (reference)	1.00 (reference)	1.00 (reference)
25-34		0.75 (0.73 to 0.78)***	0.75 (0.73 to 0.77)***	0.75 (0.73 to 0.78)***
35+		0.55 (0.53 to 0.57)***	0.54 (0.52 to 0.56)***	0.55 (0.53 to 0.57)***
Educational attainment				
No education		0.65 (0.63 to 0.68)***	0.68 (0.66 to 0.71)***	0.71 (0.68 to 0.74)***
Primary		0.86 (0.83 to 0.89)***	0.88 (0.85 to 0.91)***	0.89 (0.86 to 0.92)***
Secondary or higher		1.00 (reference)	1.00 (reference)	1.00 (reference)
Polygamous (yes vs. no)		2.55 (2.47 to 2.63)***	2.54 (2.47 to 2.63)***	2.49 (2.42 to 2.56)***
Wealth status				
Poorest		0.79 (0.75 to 0.83)***	0.99 (0.93 to 1.05)	1.00 (0.94 to 1.06)
Poor		0.85 (0.81 to 0.89)***	1.02 (0.97 to 1.07)	1.02 (0.97 to 1.08)
Middle		0.90 (0.86 to 0.94)***	1.03 (0.98 to 1.08)	1.03 (0.98 to 1.08)
Rich		0.96 (0.92 to 0.99)*	1.04 (0.99 to 1.08)	1.03 (0.99 to 1.08)
Richest		1.00 (reference)	1.00 (reference)	1.00 (reference)
LEVEL 2: COMMUNITIES				
Ethnic diversity			1.06 (1.01 to 1.12)*	1.08 (1.02 to 1.14)**
Neighbourhood poverty			0.91 (0.86 to 0.95)***	0.91 (0.86 to 0.96)***
Residential mobility			1.04 (0.99 to 1.08)	1.05 (1.00 to 1.09)*
Female-headed households (%)			1.29 (1.23 to 1.35)***	1.28 (1.22 to 1.34)***
Urban (vs. rural) area			1.27 (1.21 to 1.34)***	1.29 (1.23 to 1.36)***
Household size			0.94 (0.89 to 0.99)*	0.94 (0.89 to 0.99)*
LEVEL 3: COUNTRIES				
Human poverty index				0.99 (0.95 to 1.02)
Population (millions)				1.01 (0.99 to 1.02)
Percentage urban population				1.02 (0.99 to 1.05)
Random effects				
Country-level				
Variance (SE)	0.982 (0.279)	1.027 (0.292)	0.974 (0.276)	0.809 (0.230)
ICC	20.2	20.4	19.3	16.4
Community-level				
Variance (SE)	0.599 (0.013)	0.712 (0.015)	0.780 (0.015)	0.839 (0.016)
ICC	32.4	34.6	34.8	33.4

[a]Model 1 is empty model, baseline model without any exposure variable (N= 244940)
[b]Model 2 is adjusted for sex, age, education, polygamous, and wealth (N= 244924)
[c]Model 3 is additionally adjusted for community-level factors (N= 244924)
[d]Model 4 is additionally adjusted for country'-level factors (N= 244924)
Abbreviation: SE: standard error; ICC: intra-cluster correlation coefficient
***p < 0.001 **p < 0.01, and *p < 0.05

Respondents from communities with high ethnic diversity (aOR=1.08; 95% CI 1.02 to 1.14) and high levels of female-headed households (aOR=1.28; 95% CI 1.22 to 1.34) were more likely to have reported non-spousal sex. Compared with rural areas, respondents from urban areas were more likely to have reported non-spousal sex (aOR=1.29; 95% CI 1.23 to 1.36). Respondents from areas of high neighbourhood poverty were 9% less likely to have reported non-spousal sex (aOR=0.91; 95% CI 0.86 to 0.96). The odds of reporting non-spousal sex decreased with increasing household size (aOR=0.94; 95% CI 0.89 to 0.99). The association between residential instability and reported non-spousal sex was not statistically significant. The association between levels of non-spousal sex and the country's human poverty index, population size, and percentage urban population were not statistically significant.

DISCUSSION

Using multilevel analysis, we found that community and societal measures of social disorganization are important predictors of high-risk sexual behaviours in the sub-Saharan countries studied. These associations have been reported in previous studies from United States on short-term partnering (Browning and Olinger-Wilbon, 2003), as well as on adolescent sexual activity and contraceptive use (Billy et al., 1994, Billy and Moore, 1992, Brewster, 1993, Brewster, 1994). The association between social disorganization and high-risk sexual intercourse has also been documented in sub-Saharan Africa non-spousal (Benefo, 2008, Bishai et al., 2006).

We found that men were more likely than women to report high-risk sexual behaviour. This is in agreement with the results of previous studies that have examined the association between sex of the respondent and likelihood of reporting high-risk sexual behaviours (Bennetts et al., 1999, Ndinya-Achola et al., 1997, Olayinka et al., 2000, Thomas et al., 2009, Wang et al., 2007). For example, Ndinya-Achola and co-researchers analysed sexual behaviours of young adults who were attending a primary health care clinic in Nairobi, Kenya, and found that men were more likely than women to report having two or more partners during the past year (Ndinya-Achola et al., 1997).

Our multilevel random intercept models allow us to disentangle individual, community, and societal variation in reported high-risk sexual behaviour. We found that people living in the same neighbourhood tend to have similar behaviour. This is in part because people in the same neighbourhood are subject to common contextual influences. This contextual phenomenon expresses itself as clustering of individual attitudes within neighbourhood. That is, a portion of the health differences among people may be attributable to the areas in which they reside (Merlo et al., 2005). On these grounds, we might conclude that there is some evidence for a possible neighbourhood and country contextual phenomenon shaping high-risk sexual behaviours; and that neighbourhoods are very important in understanding individual difference in high-risk sexual behaviours. This indicates that policy and public health preventive services that operate on relatively large geographical and population-based scales are potential intervention points and should be considered in conjunction with health programs that focus on individual sexual behaviour.

Our findings should be considered in light of the following limitations: First, we did not measure the length of time that participants had spent in their neighbourhoods and the extent of their exposure to the neighbourhood environment. We were thus unable to determine whether associations of neighbourhood characteristics with high-risk sexual behaviours were due to cumulated effects. Second, another important limitation is that our data were based on self-reported sexual activity. By definition, self-reports of initiation of sexual activity cannot be externally validated, and studies have revealed considerable inconsistencies in self-reported sexual activity (Lauritsen and Swicegood, 1997, Meekers, 1995). Third, the cross-sectional nature of the data limits ability to draw casual inferences from the associations found.

Despite these limitations, the study's strengths are significant. It is a large, population-based study with national coverage from 26 countries with high response rates. Overall, the number of included countries and geographic and socioeconomic diversities constitute a good yardstick for the sub-Saharan region and help to strengthen the findings from the study. The DHS have some important advantages when compared with other surveys. Not only are they nationally representative, but also they include the same variables in the same way and thus make it possible to compare data across countries. Beyond communities, individuals are influenced by national policies which affect the proximate determinants of high-risk sexual behaviours. Understanding the relative contribution of individual, community, and societal factors is important for policymakers in order to design and carry out public health interventions.

CONCLUSION

Drawing upon the multilevel perspective, this study presented an approach to examining premarital and non-spousal sex. The existence of community and societal factors influencing high-risk sexual behaviours underscores the need to implement public health prevention strategies not only at the individual level but also tailored to the community context of the population they are aiming to protect. Future studies should investigate other factors that may account for the unexplained neighbourhood and country variations in high-risk sexual behaviours. Future research also should address the mechanisms that connect the individual and neighbourhood levels—that is, the means through which deleterious neighbourhood effects are transmitted to the residents.

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