The link between population sexual behavior and HIV prevalence in sub-Saharan Africa

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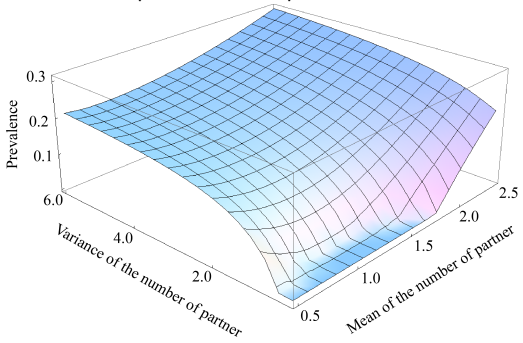
Introduction

- The patterns of sexual partnering and structure of sexual networks should shape STI transmission, and mathematical modeling studies have shown that measures of HIV infection, such as basic reproduction number (R_0), epidemic size and HIV prevalence, as well as network statistics such as concurrency, are associated with the mean and variance of the number of sexual partners (figure 1).
- Though the theoretical links between population behavior and STI epidemiology are manifest and well-established, there is a question as to whether such predicted associations can be observed empirically, because of the validity of self-reported sexual data.
- We examined the behavior-epidemic link through an ecologic study design by analyzing empirical data on HIV infection and casual-sex behavior. Specifically, we addressed two questions: 1) Are mean and variance of the number of casual-sex partners associated with HIV prevalence across SSA? 2) Are self-reported casual-sex data internally consistent to convey credible information content?

Figure 1: Theoretical relationship between mean, variance of the number of partner and HIV prevalence.



Methods

Countries were included based on availability of DHS HIV-serological survey. Based on a recent analysis of the empirical distributions of the number of casual-sex partners over the last 12 months (Omori, Chemaitelly, & Abu-Raddad, 2015), we tabulated mean and variance of casual-sex partners stratified by marital status (married/unmarried) and sex (male/female), in addition to HIV population prevalence. Spearman rank correlation was used to investigate correlations between country-specific HIV prevalence and country-specific means and variances. Spearman rank correlation was also used to investigate correlations between the different means, between the different variances, and between the means and variances.

Results and Discussion

Table 1: Associations between HIV prevalence and self-reported population casual-sex behavior, and between different measures of casual-sex behavior.

	Married males		Unmarried males		Married females		Unmarried females		HIV prevalence
	Mean	Variance	Mean	Variance	Mean	Variance	Mean	Variance	
Married males									
Mean		0.76* (0.48, 0.91)	0.87* (0.68, 0.95)	0.73* (0.36, 0.95)	0.79* (0.55, 0.91)	0.58* (016, 0.88)	0.80* (0.59, 0.90)	0.093 (−0.38, 0.60)	0.32 (−0.060, 0.61)
Variance			0.52* (0.13, 0.80)	0.67* (0.25, 0.93)	0.54* (0.18, 0.76)	0.48* (0.0074, 0.82)	0.32 (−0.097, 0.67)	−0.065 (−0.51, 0.44)	0.053 (−0.36, 0.46)
Unmarried males									
Mean				0.69* (0.34, 0.90)	0.62* (0.28, 0.84)	0.44* (0.014, 0.78)	0.89* (0.74, 0.95)	0.051 (−0.39, 0.56)	0.38 (−0.040, 0.65)
Variance					0.60* (0.24, 0.86)	0.46* (0.0019, 0.83)	0.56* (0.18, 0.81)	0.10 (−0.37, 0.59)	0.38 (0.0031, 0.67)
Married females									
Mean						0.86* (0.61, 0.98)	0.70* (0.37, 0.89)	0.093 (−0.34, 0.54)	0.20 (−0.24, 0.57)
Variance							0.52* (0.14, 0.80)	0.24 (−0.22, 0.66)	0.15 (−0.30, 0.54)
Unmarried females									
Mean								0.13 (−0.33, 0.60)	0.40* (−0.039, 0.69)
Variance									0.081 (−0.40, 0.52)

Asterisks indicate statistically significant correlation (*p<0.05). The numbers in brackets denote the bootstrapped 95% confidence interval for correlation coefficient.

- Correlations between HIV prevalence and means and variances of the number of casual-sex partners were positive, but small (<0.5) and statistically insignificant. The correlations with the mean for unmarried females (p<0.05 but with bootstrap CI overlapping with zero), and the mean and variance for unmarried males (p-value 0.05), were of borderline significance.
- In contrast, the majority of correlations across means and variances were positive, large (0.5), and statistically significant. Correlations between the different means were positive, very large (≫0.5), and statistically significant. Correlations between the different variances were positive, large, and statistically significant apart from those with the variance of unmarried females. Correlations between means and variances were also positive, large and statistically significant apart also from those with the variance of unmarried females. All correlations between the means, as well as variances, and the variance of unmarried females were weak (~0) and statistically insignificant.
- Population casual-sex behavior was not predictive of HIV prevalence across these countries. Contrary to theoretical predictions (such as Figure 1), and what naively to be expected for an STI, HIV prevalence was not correlated with the means nor variances of the number of casual-sex partners. This finding casts a shadow of doubt about the validity of self-reported sexual data, or their utility to understand STI patterns.
- The strong correlations observed across means and variances of casual-sex partners suggest the opposite conclusion that self-reported sexual data are inherently self-consistent and convey credible information content. As expected in a sexual network, the means and variances in a given population stratum (say females) were found to be correlated with those in other strata (say those of males).
- Unmarried female behavior is puzzling. The mean of partners for unmarried females was associated with HIV prevalence, the only behavioral measure with p<0.05. On the other hand, variance for unmarried females was also the only behavioral measure that correlated poorly with the rest of behavioral measures.

Conclusions

Self-reported population sexual behavior was not found predictive of HIV prevalence, but appears inherently self-consistent and with valid information content. Unmarried female behavior seems puzzling, but could be playing an influential role in STI transmission patterns.

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