

A multinomial spatio-temporal model for sexual risk behaviour with application to adolescent girls and young women in 13 sub-Saharan African countries

Statistics and Epidemiology Group Meeting

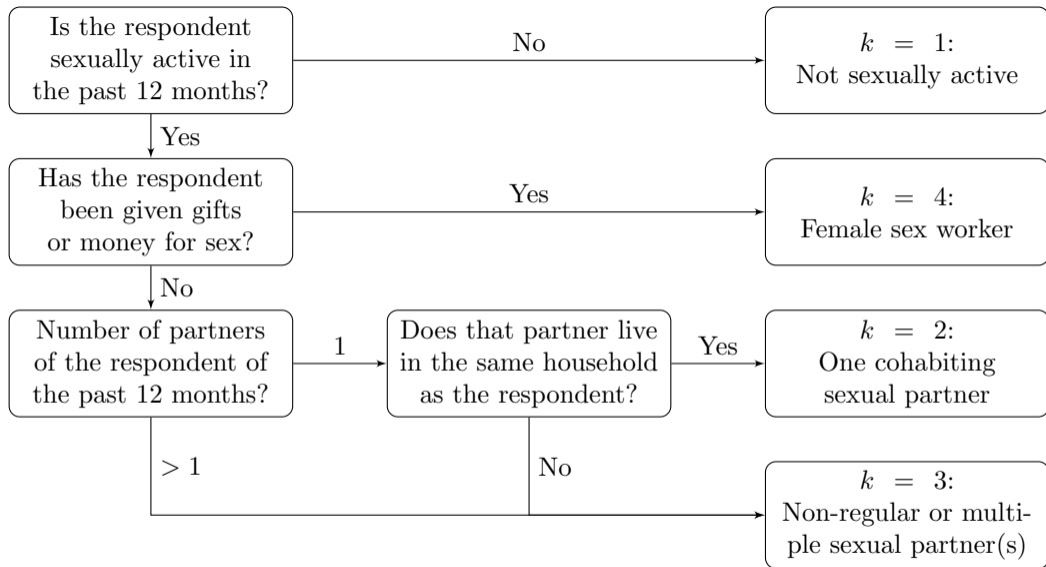
Adam Howes

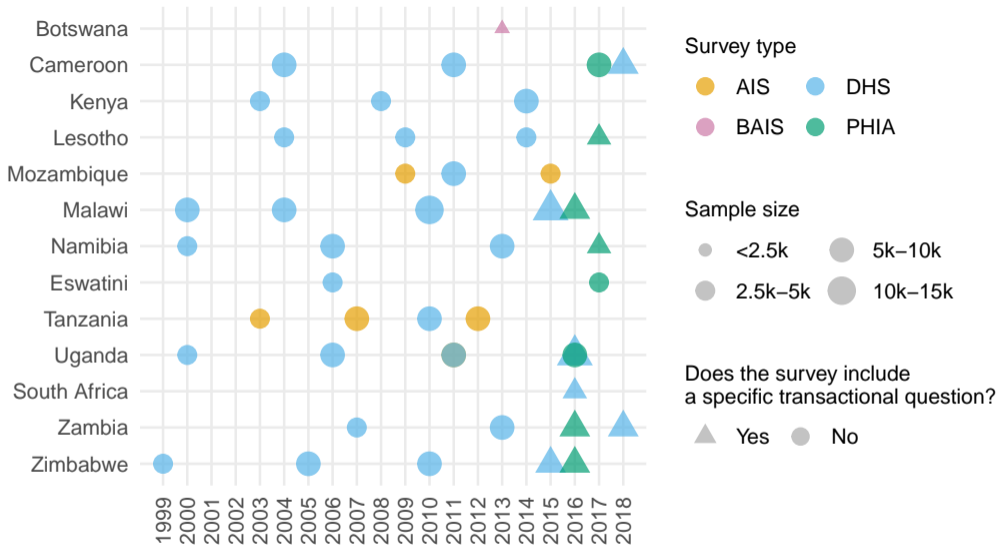
Imperial College London

January 2022

Category	Description	Risk ratio	Notes
None	Not sexually active	0	Ignores incidence from e.g. drug injection (assumed to be negligible).
Low	One cohabiting sexual partner	1	Baseline category.
High	Non-regular sexual partner(s)	1.72	From ALPHA network pooled analysis. Supported by Jia et al.
Very high	Young women from key populations	13	Sabin et al.

Table 1: HIV risk categories and risk ratios.





Statistical model

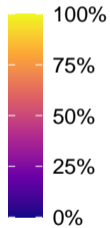
Fit 13 models of the form:

$$y_{itak}^* \sim \text{xPoisson}(\lambda_{itak}) \quad (1)$$

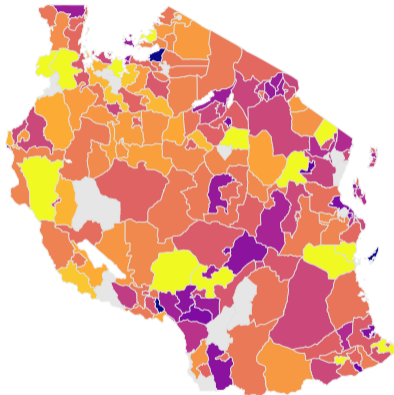
$$\log(\lambda_{itak}) = \beta_k + \alpha_{ak} + \phi_{ik} + \gamma_{tk} + \delta_{itk} + \theta_{ita}. \quad (2)$$

Model ID	Spatial structure	Temporal structure	Spatio-temporal interaction
1	None	None	X
2	IID	None	X
3	Besag	None	X
4	None	IID	X
5	IID	IID	X
5x	IID	IID	✓
6	Besag	IID	X
6x	Besag	IID	✓
7	None	AR1	X
8	IID	AR1	X
8x	IID	AR1	✓
9	Besag	AR1	X
9x	Besag	AR1	✓

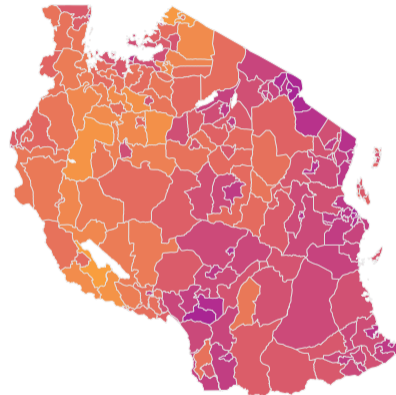
Proportion of women 20–24 cohabiting (2010)



Direct



Modelled



Benefits of smoothing

1. Get estimates even where there isn't direct data
 - Some people think of this as “making up data”
 - In some sense all estimates are “made up” though
 - Uncertainty should be higher in regions with infilling
 - Perhaps we do a bad job communicating uncertainty, or it's just hard

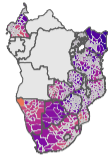
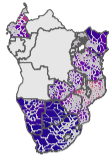
Benefits of smoothing

2. Borrow information across space, surveys, categories
 - Space-category effects, survey-category effects, space-survey-category effects (using Kronecker products)
 - Fun to think about what models might be reasonable for this and whether structured category effects might be interesting
 - e.g. some model for misclassification of individuals into categories could give a kind of structured category effect (currently it's IID always)
 - Wonder to what extent we're oversmoothing
 - e.g. might expect to see discontinuities in the data (e.g. urban centers) which we're smoothing away

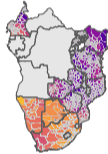
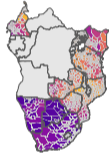
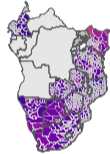
Not sexually active

One cohabiting partner

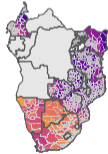
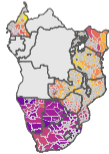
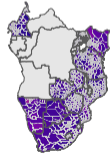
Non-regular or multiple partners(s) +



15-19

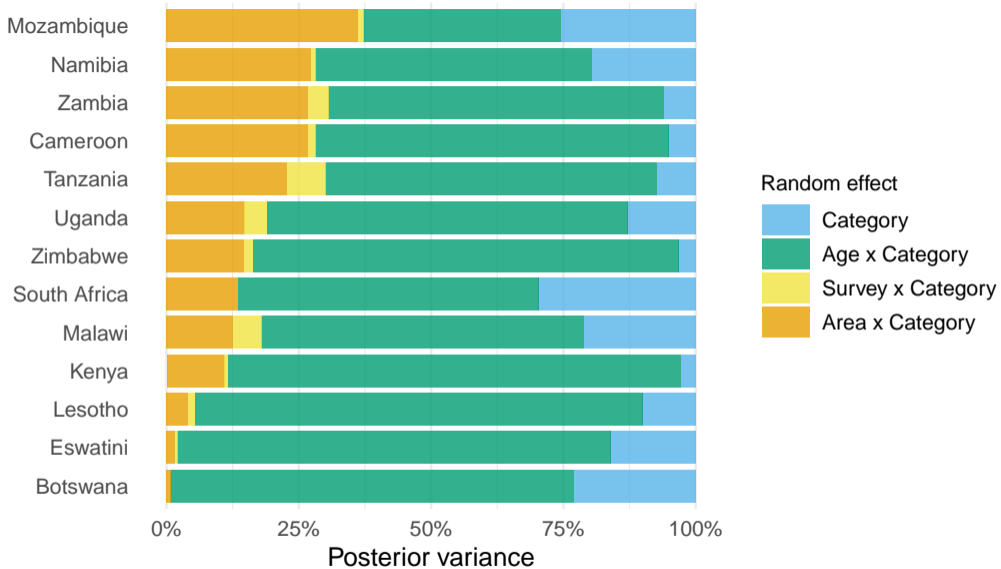


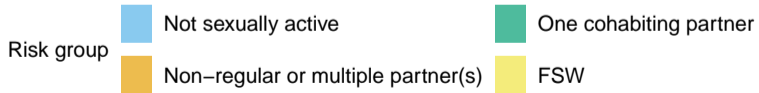
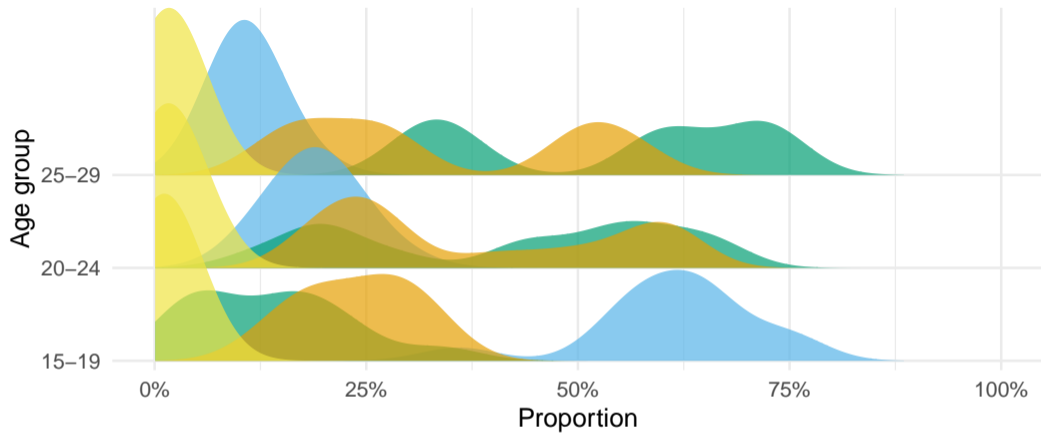
20-24



25-29







Next steps

- Have sent to Elona in Cape Town to get feedback
- Connecting more to policy, recently produced “new infections by risk group”
- Adding logistic regression model for proportion of non-regular partner(s) who are KP