

Successful targeting of HIV prevention using risk behaviour would greatly increase expected new infections preemptively reached.

Spatio-temporal estimates of HIV risk group proportions for adolescent girls and young women across 13 priority countries in sub-Saharan Africa

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Introduction

- Adolescent girls and young women (AGYW) 15-29 face disproportionately high risk of HIV infection, and have been identified as a **priority population** for prevention efforts
- The UNAIDS Global AIDS Strategy 2021-2026 recommends **differentiating services** for AGYW geographically based both on individual risk behaviour and epidemic indicators
- We used a spatio-temporal model to estimate the proportion of AGYW in four behavioural risk categories $k = 1 : 4$ in 13 priority countries at a district level in the years 1999-2018

k	Category	Risk ratio
1	Not sexually active	0
2	One cohabiting partner	1
3	Non-regular partner(s)	1.72
4	Female sex workers (FSW)	13

Methods

- We analyzed 47 national household surveys (AIS, BAIS, DHS, PHIA)
- For the categories $k \in \{1, 2, 3^+\}$ we fit a survey-weighted multinomial logistic regression via the multinomial-Poisson transformation

$$y_{itak}^* \sim \text{Poisson}(\kappa_{itak}),$$

$$\log(\kappa_{itak}) = \underbrace{\theta_{ita}}_{\text{Observation (IID)}} + \underbrace{\beta_k}_{\text{Category (IID)}} + \underbrace{\alpha_{ak}}_{\text{Age (IID)}}$$

$$+ \underbrace{\zeta_{ck}}_{\text{Country (IID)}} + \underbrace{\phi_{ik}}_{\text{Spatial (Besag)}} + \underbrace{\gamma_{tk}}_{\text{Temporal (AR1)}}$$

where $p_{itak} = \text{softmax}(\kappa_{itak})_k$

- Using the Poisson formulation facilitated inference using integrated nested Laplace approximation (Rue, Martino, and Chopin 2009) via [R-INLA](#)
- To estimate the FSW proportion we used the 13 surveys with a transactional sex question to fit a survey-weighted logistic regression

$$y_{ia4}^* \sim \text{Binomial}(y_{ia3} + y_{ia4}, p_{ia4}/(p_{ia3} + p_{ia4})),$$

$$\text{logit}(p_{ia4}/(p_{ia3} + p_{ia4})) = \beta_0 + \beta_{\text{cfswever}} x_c$$

$$+ \underbrace{\alpha_a}_{\text{Age (IID)}} + \underbrace{\zeta_c}_{\text{Country (IID)}} + \underbrace{\phi_i}_{\text{Spatial (Besag)}}$$

where x_c is the proportion of men in each country who are clients of FSW (Hodgins et al. 2021)

- We aligned our FSW estimates to the national-level UNAIDS Key Populations Atlas (Johnston et al. 2022)
- We estimated incidence and number of expected new infections by risk group using the risk ratios to disaggregate Naomi model (Eaton et al. 2021) general population incidence estimates

Results

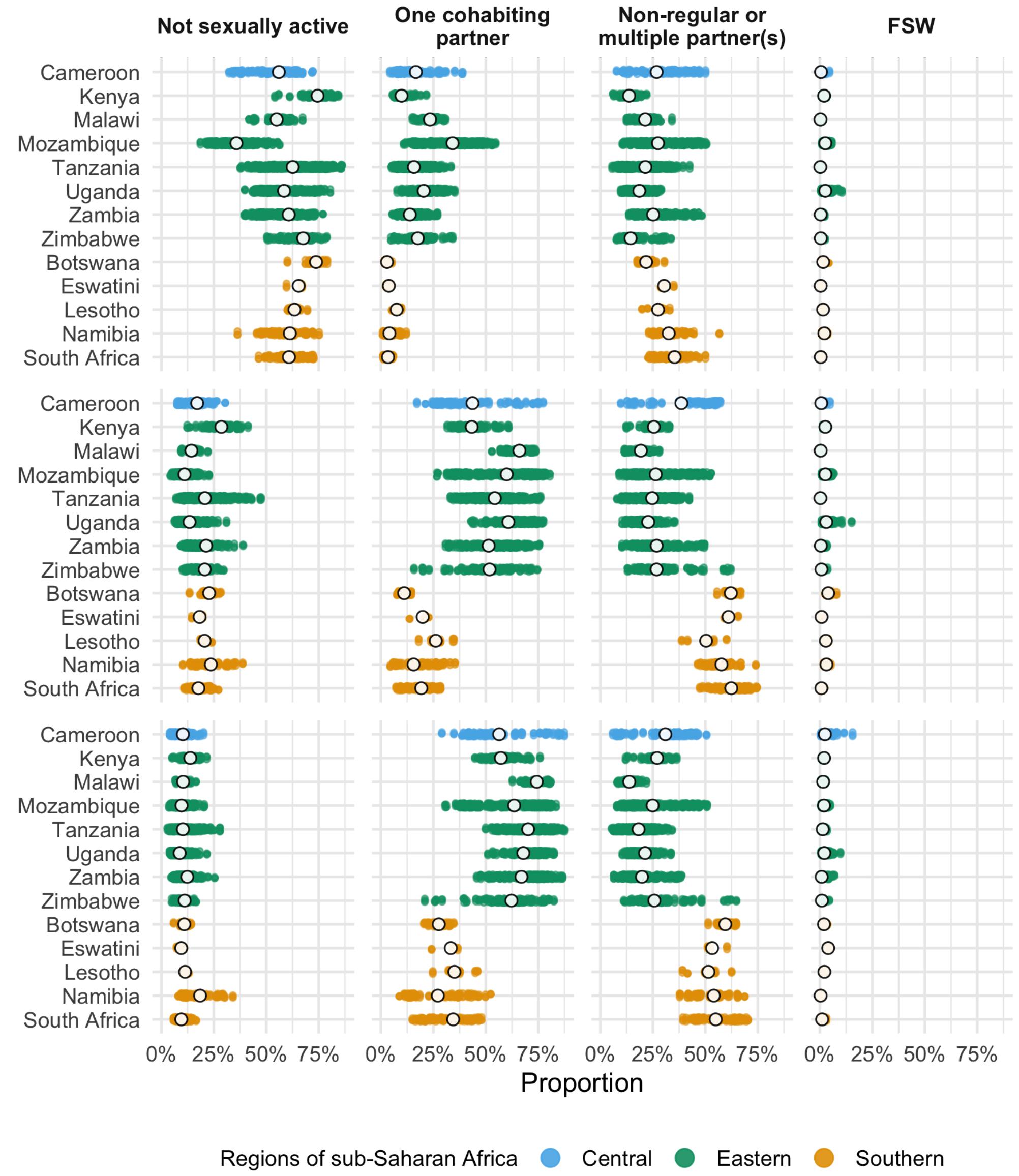


Figure 1: Dotplots showing the posterior mean of our district level estimates (in colour) and national estimates (in white) in 2018.

- We found a geographic delineation, with cohabiting more common in the east and non-regular partner(s) more common in the south
- Large numbers of 15-19 in Mozambique have early sexual debut and are already cohabiting

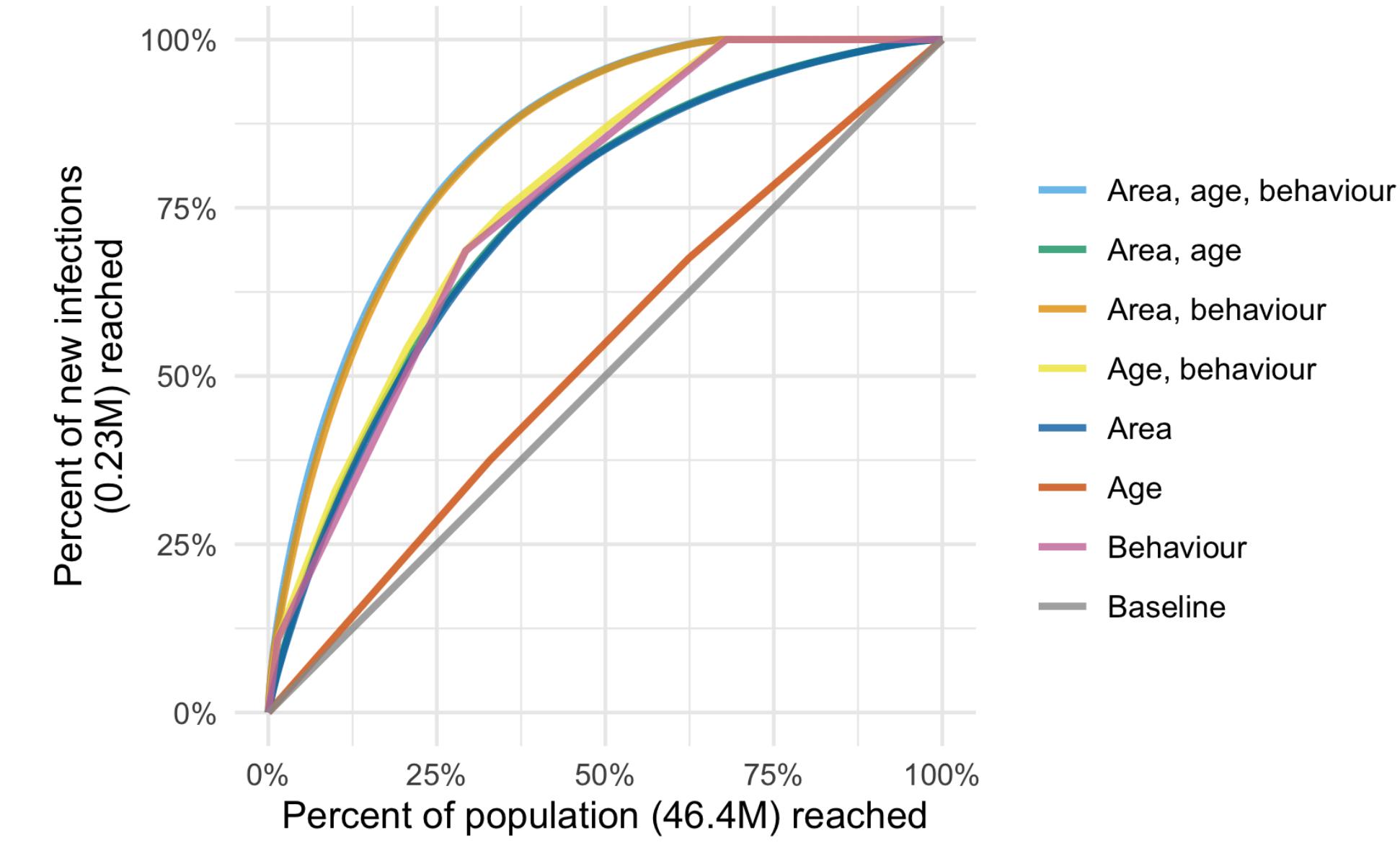


Figure 3: Comparison of targeting strategies

- Using location, age and behavioral risk stratification, 25% of expected new infections can be found by reaching 3% of the population, compared with 8% of the population when behaviour is excluded
- Majority of this benefit comes from reaching FSW, who are 3.5% of the at risk population but 21.0% of all expected new infections

Discussion

- Using a **modular approach** allowed us to integrate all data from non-conformable surveys
- Spatio-temporal smoothing** can be used to overcome high variance from the small sample sizes that result when further stratifying districts
- Individual behaviour is a **key determinant** of risk and providing prevention services on the basis of behavior would allow many more expected new infections to be reached, especially among FSW

Limitations

- No assessment of **practicalities** or **costs** of risk stratification approaches, or efficacy of available interventions
- No adjustment for **reporting bias**
- Risk category definitions** could be disputed
 - What constitutes sex work?
 - Is within-group risk heterogeneity small enough?

Future work

- Inclusion of **more surveys** e.g. VACS
- Extension to **general population**: men and women 15-49

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References

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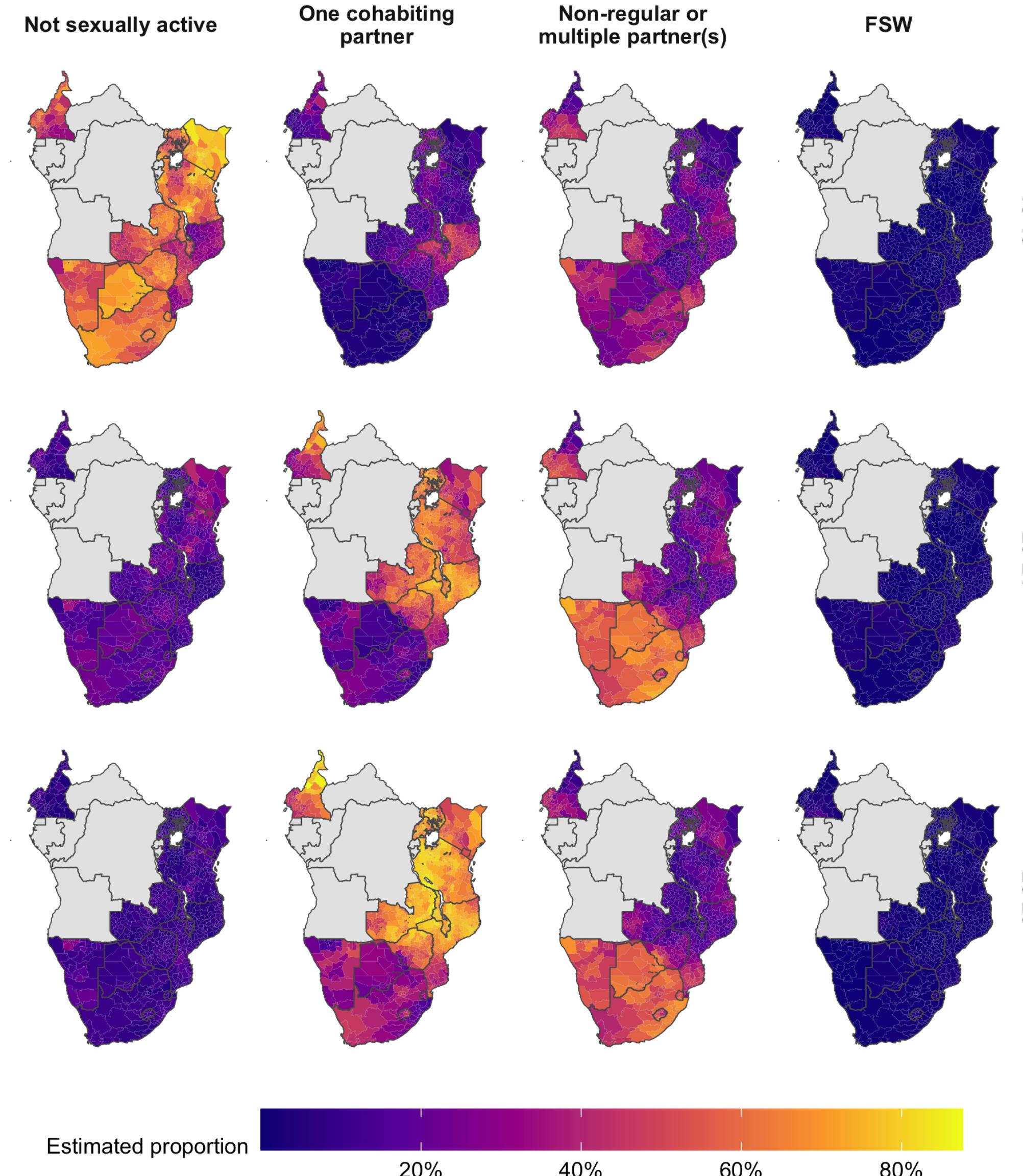


Figure 2: Chloropleths showing the posterior mean of our district level estimates in 2018.

- There is **significant variation** in risk group proportions **within** and **between countries**, as well as **between age groups** (but close to no change over time)