

Supplementary tables and figures for “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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## The Global AIDS Strategy

| Prioritisation strata | Criterion  |
|-----------------------|--|
| Low                   | 0.3-1.0% incidence and low-risk behaviour, or <0.3% incidence and high-risk behaviour    |
| Moderate              | 1.0-3.0% incidence and low-risk behaviour, or 0.3-1.0% incidence and high-risk behaviour |
| High                  | 1.0-3.0% incidence and high-risk behaviour   |
| Very high             | >3.0% incidence  |

Table A: Prioritisation strata according to HIV incidence in the general population and behavioural risk.

| Intervention  | Low | Moderate | High | Very High |
|---|-----|----------|------|-----------|
| Condoms and lube for those with non-regular partners(s) with unknown STI status and not on PrEP | 50% | 70%      | 95%  | 95%       |
| STI screening and treatment   | 10% | 10%      | 80%  | 80%       |
| Access to PEP   | -   | -        | 50%  | 90%       |
| PrEP use  | -   | 5%       | 50%  | 50%       |
| Economic empowerment  | -   | -        | 20%  | 20%       |

Table B: Commitments to be met for each intervention in terms of proportion of the prioritisation strata reached, where "-" represents no commitment.

## Household survey data

### Included surveys

| Type              | Year | Transactional sex question | Sample size |       |       |       |
|-------------------|------|----------------------------|-------------|-------|-------|-------|
|                   |      |                            | 15-19       | 20-24 | 25-29 | Total |
| <b>Botswana</b>   |      |                            |             |       |       |       |
| BAIS              | 2013 | ✓                          | 557         | 588   | 649   | 1794  |
| Total             |      |                            | 557         | 588   | 649   | 1794  |
| <b>Cameroon</b>   |      |                            |             |       |       |       |
| DHS               | 2004 | ✗                          | 2675        | 2207  | 1732  | 6614  |
| DHS               | 2011 | ✗                          | 3588        | 3115  | 2655  | 9358  |
| PHIA              | 2017 | ✗                          | 2620        | 2339  | 2259  | 7218  |
| DHS               | 2018 | ✓                          | 3349        | 2463  | 2345  | 8157  |
| Total             |      |                            | 12232       | 10124 | 8991  | 31347 |
| <b>Kenya</b>      |      |                            |             |       |       |       |
| DHS               | 2003 | ✗                          | 1819        | 1709  | 1391  | 4919  |
| DHS               | 2008 | ✗                          | 1767        | 1743  | 1419  | 4929  |
| DHS               | 2014 | ✗                          | 2861        | 2534  | 2858  | 8253  |
| Total             |      |                            | 6447        | 5986  | 5668  | 18101 |
| <b>Lesotho</b>    |      |                            |             |       |       |       |
| DHS               | 2004 | ✗                          | 1761        | 1455  | 1026  | 4242  |
| DHS               | 2009 | ✗                          | 1833        | 1543  | 1194  | 4570  |
| DHS               | 2014 | ✗                          | 1537        | 1292  | 1067  | 3896  |
| PHIA              | 2017 | ✓                          | 1156        | 1202  | 1054  | 3412  |
| Total             |      |                            | 6287        | 5492  | 4341  | 16120 |
| <b>Mozambique</b> |      |                            |             |       |       |       |
| AIS               | 2009 | ✗                          | 1031        | 1106  | 987   | 3124  |
| DHS               | 2011 | ✗                          | 2932        | 2299  | 2206  | 7437  |
| AIS               | 2015 | ✗                          | 1552        | 1389  | 1080  | 4021  |
| Total             |      |                            | 5515        | 4794  | 4273  | 14582 |
| <b>Malawi</b>     |      |                            |             |       |       |       |
| DHS               | 2000 | ✗                          | 2914        | 2998  | 2358  | 8270  |
| DHS               | 2004 | ✗                          | 2407        | 2823  | 2135  | 7365  |
| DHS               | 2010 | ✗                          | 5031        | 4387  | 4309  | 13727 |
| DHS               | 2015 | ✓                          | 5273        | 5094  | 3976  | 14343 |
| PHIA              | 2016 | ✓                          | 1646        | 1934  | 1511  | 5091  |
| Total             |      |                            | 17271       | 17236 | 14289 | 48796 |
| <b>Namibia</b>    |      |                            |             |       |       |       |
| DHS               | 2000 | ✗                          | 1427        | 1313  | 1098  | 3838  |
| DHS               | 2006 | ✗                          | 2203        | 1869  | 1544  | 5616  |
| DHS               | 2013 | ✗                          | 1852        | 1709  | 1481  | 5042  |
| PHIA              | 2017 | ✓                          | 1491        | 1525  | 1370  | 4386  |
| Total             |      |                            | 6973        | 6416  | 5493  | 18882 |
| <b>Eswatini</b>   |      |                            |             |       |       |       |
| DHS               | 2006 | ✗                          | 1265        | 1027  | 731   | 3023  |
| PHIA              | 2017 | ✗                          | 1031        | 895   | 811   | 2737  |

|                     |      | Total |  | 2296   | 1922  | 1542  | 5760   |
|---------------------|------|-------|--|--------|-------|-------|--------|
| <b>Tanzania</b>     |      |       |  |        |       |       |        |
| AIS                 | 2003 | x     |  | 1466   | 1377  | 1270  | 4113   |
| AIS                 | 2007 | x     |  | 2137   | 1676  | 1509  | 5322   |
| DHS                 | 2010 | x     |  | 2221   | 1860  | 1613  | 5694   |
| AIS                 | 2012 | x     |  | 2474   | 1923  | 1815  | 6212   |
| PHIA                | 2016 | ✓     |  | 2999   | 2845  | 2521  | 8365   |
| Total               |      |       |  | 11297  | 9681  | 8728  | 29706  |
| <b>Uganda</b>       |      |       |  |        |       |       |        |
| DHS                 | 2000 | x     |  | 1687   | 1541  | 1326  | 4554   |
| DHS                 | 2006 | x     |  | 1948   | 1660  | 1404  | 5012   |
| AIS                 | 2011 | x     |  | 2451   | 2164  | 1921  | 6536   |
| DHS                 | 2011 | x     |  | 2025   | 1664  | 1614  | 5303   |
| DHS                 | 2016 | ✓     |  | 4276   | 3782  | 3014  | 11072  |
| PHIA                | 2016 | x     |  | 3289   | 3059  | 2574  | 8922   |
| Total               |      |       |  | 15676  | 13870 | 11853 | 41399  |
| <b>South Africa</b> |      |       |  |        |       |       |        |
| DHS                 | 2016 | ✓     |  | 1505   | 1408  | 1397  | 4310   |
| Total               |      |       |  | 1505   | 1408  | 1397  | 4310   |
| <b>Zambia</b>       |      |       |  |        |       |       |        |
| DHS                 | 2007 | x     |  | 1598   | 1405  | 1373  | 4376   |
| DHS                 | 2013 | x     |  | 3685   | 3036  | 2789  | 9510   |
| PHIA                | 2016 | ✓     |  | 2120   | 2045  | 1619  | 5784   |
| DHS                 | 2018 | ✓     |  | 3112   | 2687  | 2166  | 7965   |
| Total               |      |       |  | 10515  | 9173  | 7947  | 27635  |
| <b>Zimbabwe</b>     |      |       |  |        |       |       |        |
| DHS                 | 1999 | x     |  | 1467   | 1230  | 1011  | 3708   |
| DHS                 | 2005 | x     |  | 2128   | 1943  | 1438  | 5509   |
| DHS                 | 2010 | x     |  | 1963   | 1796  | 1679  | 5438   |
| DHS                 | 2015 | ✓     |  | 2154   | 1777  | 1646  | 5577   |
| PHIA                | 2016 | ✓     |  | 2114   | 1817  | 1573  | 5504   |
| Total               |      |       |  | 9826   | 8563  | 7347  | 25736  |
| Total               |      |       |  | 106397 | 95253 | 82518 | 284168 |

Table C: All of the surveys that we used in our analysis and their sample sizes, disaggregated by respondent age.

| Survey     | Exclusion reason  |
|------------|---|
| MOZ2003DHS | No GPS coordinates available to place survey clusters within districts. |
| TZA2015DHS | Insufficient sexual behaviour questions.                                |
| UGA2004AIS | Unable to download region boundaries.                                   |
| ZMB2002DHS | No GPS coordinates available to place survey clusters within districts. |

Table D: All of that surveys that were excluded from our analysis.

## Spatial analysis levels

| Country      | Number of areas | Analysis level |
|--------------|-----------------|----------------|
| Botswana     | 27              | 3              |
| Cameroon     | 58              | 2              |
| Kenya        | 47              | 2              |
| Lesotho      | 10              | 1              |
| Mozambique   | 161             | 3              |
| Malawi       | 33              | 5              |
| Namibia      | 38              | 2              |
| Eswatini     | 4               | 1              |
| Tanzania     | 195             | 4              |
| Uganda       | 136             | 3              |
| South Africa | 52              | 2              |
| Zambia       | 116             | 2              |
| Zimbabwe     | 63              | 2              |

Table E: The number of areas and analysis levels for each country that were used in our analysis.

## Survey questions and risk group allocation

| Variable(s)   | Description  |
|---------------|--|
| v501          | Current marital status of the respondent.  |
| v529          | Computed time since last sexual intercourse.   |
| v531          | Age at first sexual intercourse-imputed.   |
| v766b         | Number of sexual partners during the last 12 months (including husband).   |
| v767[a, b, c] | Relationship with last three sexual partners. Options are: spouse, boyfriend not living with respondent, other friend, casual acquaintance, relative, commercial sex worker, live-in partner, other. |
| v791a         | Had sex in return for gifts, cash or anything else in the past 12 months. Asked only to women 15-24 who are not in a union.  |

Table F: AIS, BAIS and DHS survey questions.

| Variable(s)           | Description  |
|-----------------------|--|
| part12monum           | Number of sexual partners during the last 12 months (including husband).   |
| part12modkr           | Reason for leaving part12monum blank.  |
| partlivew[1, 2, 3]    | Does the person you had sex with live in this household?   |
| partrelation[1, 2, 3] | Relationship with last three sexual partners. Options are: husband, live-in partner, partner (not living with), ex-spouse/partner, friend/acquaintance, sex worker, sex worker client, stranger, other, don't know, refused. |
| sellsx12mo            | Had sex for money and/or gifts in the last 12 months.  |
| buysx12mo             | Paid money or given gifts for sex in the last 12 months.   |

Table G: PHIA survey questions.

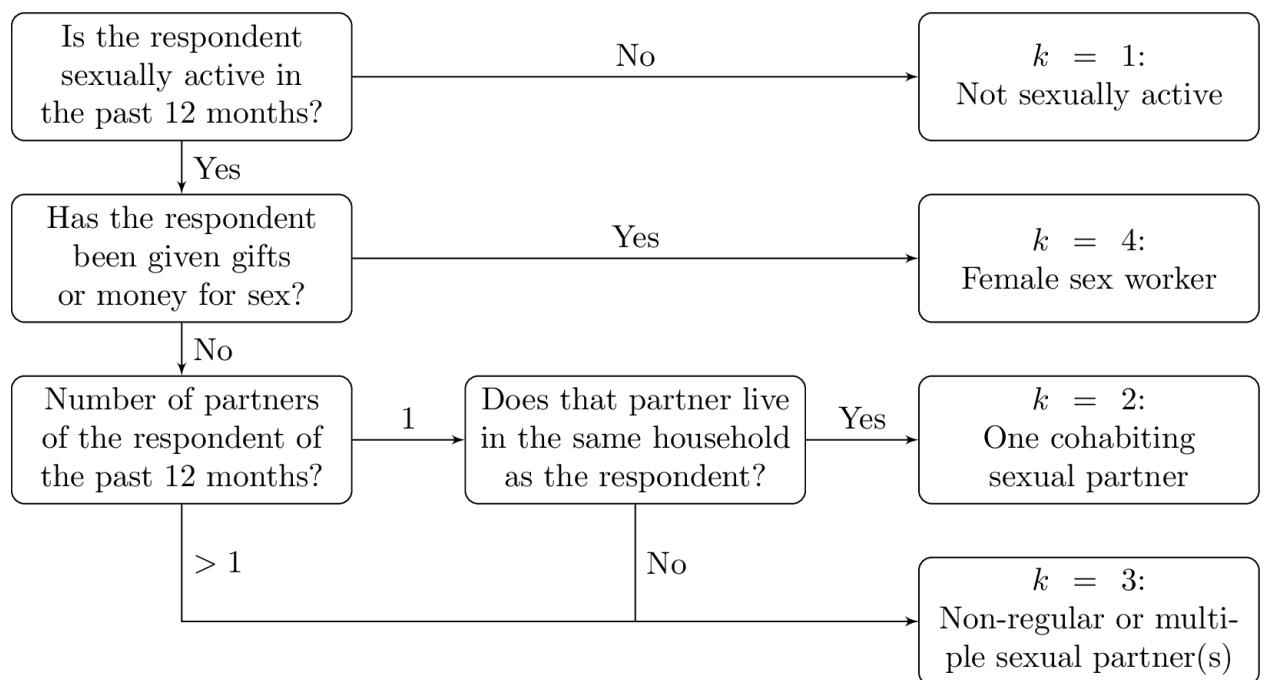


Figure A: Flowchart describing allocation of respondents to risk groups.

## Miscellaneous figures

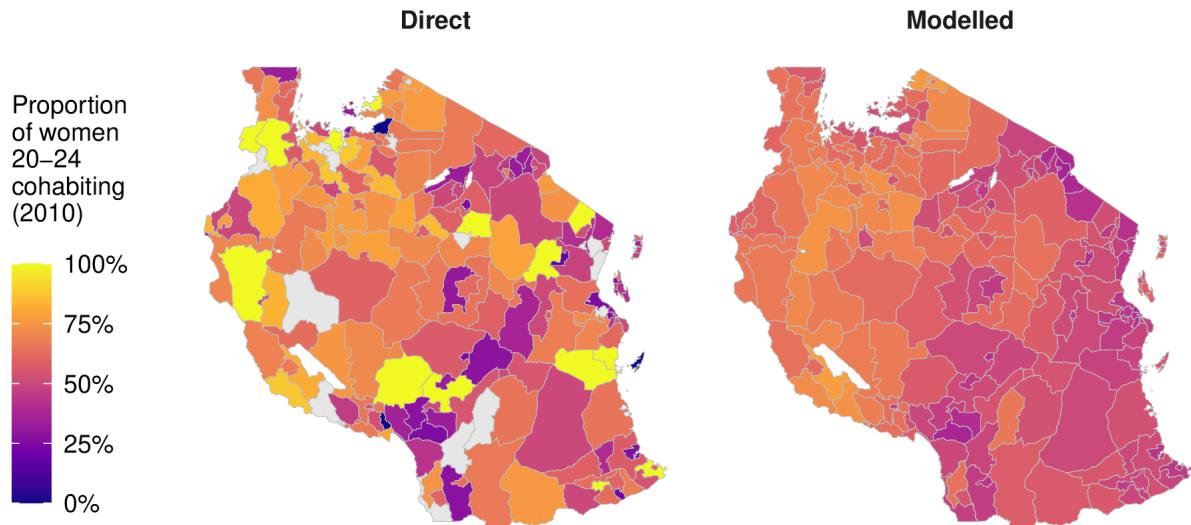


Figure B: Illustration our model results for AGYW 20-24 in Tanzania in 2010 in the cohabiting risk group. Compared to the direct survey results, our spatio-temporally smoothed estimates more plausibly represent district-level heterogeneity, as well as imputing any districts with missing data.

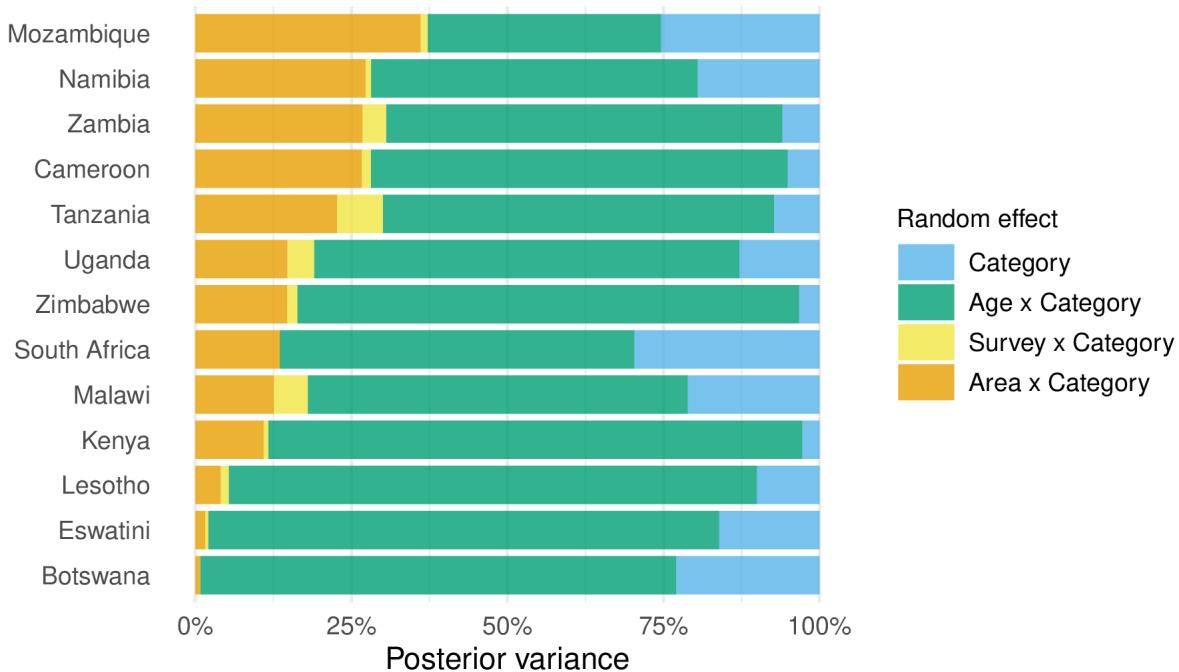


Figure C: Proportion of variance explained by each random effect (Sobol' indices) when the multinomial regression model is fit to each country individually. In this setting, country-category random effects are not included in the model and year-category random effects are replaced by survey-category random effects (for countries with surveys in multiple years). Countries are ordered by the proportion of their variance which is explained by the area-category random effects.

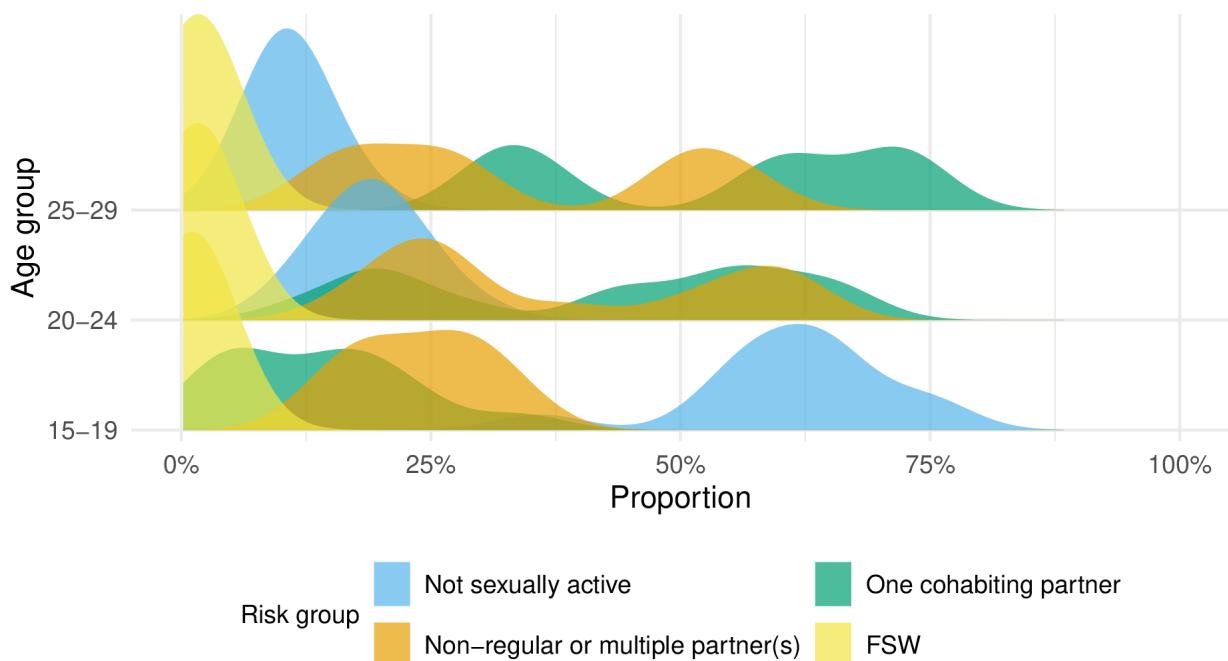


Figure D: The posterior density of national-level risk group proportions by age, illustrating the bi-modality of the cohabiting partner and non-regular and multiple partner(s) risk groups.

## Country-specific figures

### Comparison of direct and modelled risk group estimates

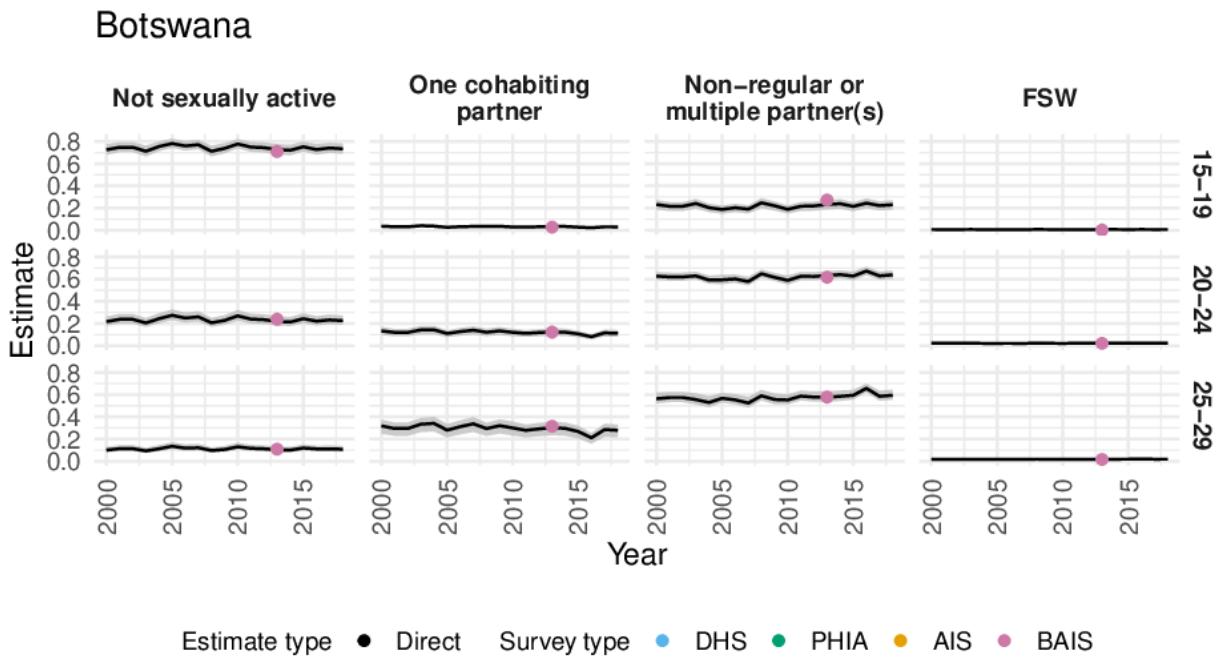


Figure E: Comparison of modelled and direct national-level estimates in 1999-2018 in Botswana. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Cameroon

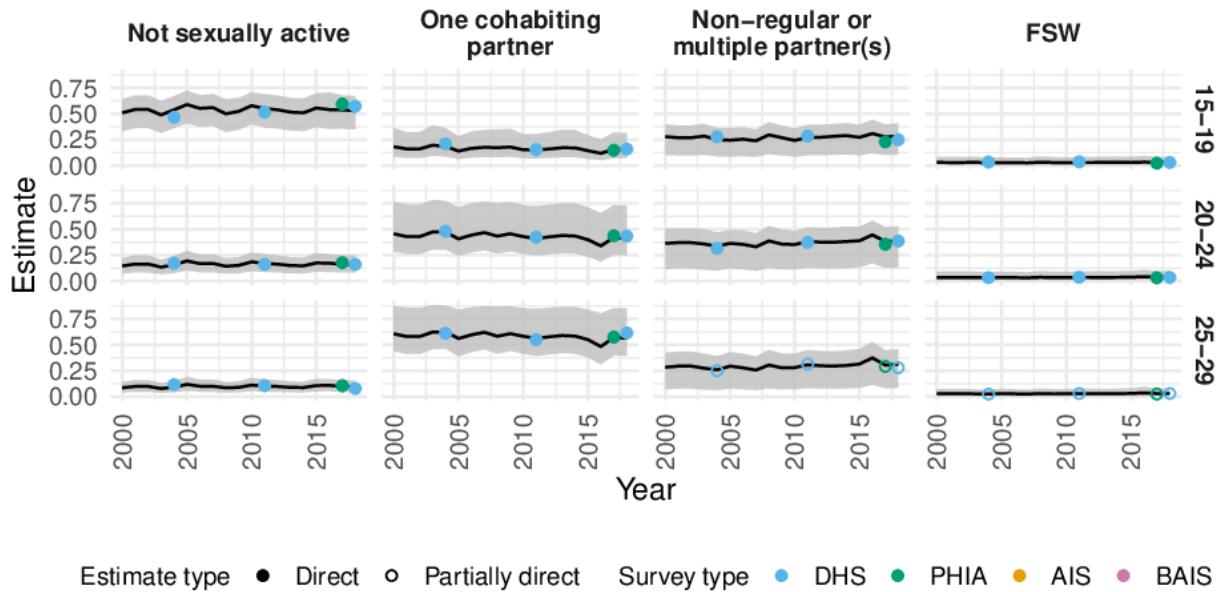


Figure F: Comparison of modelled and direct national-level estimates in 1999-2018 in Cameroon. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Kenya

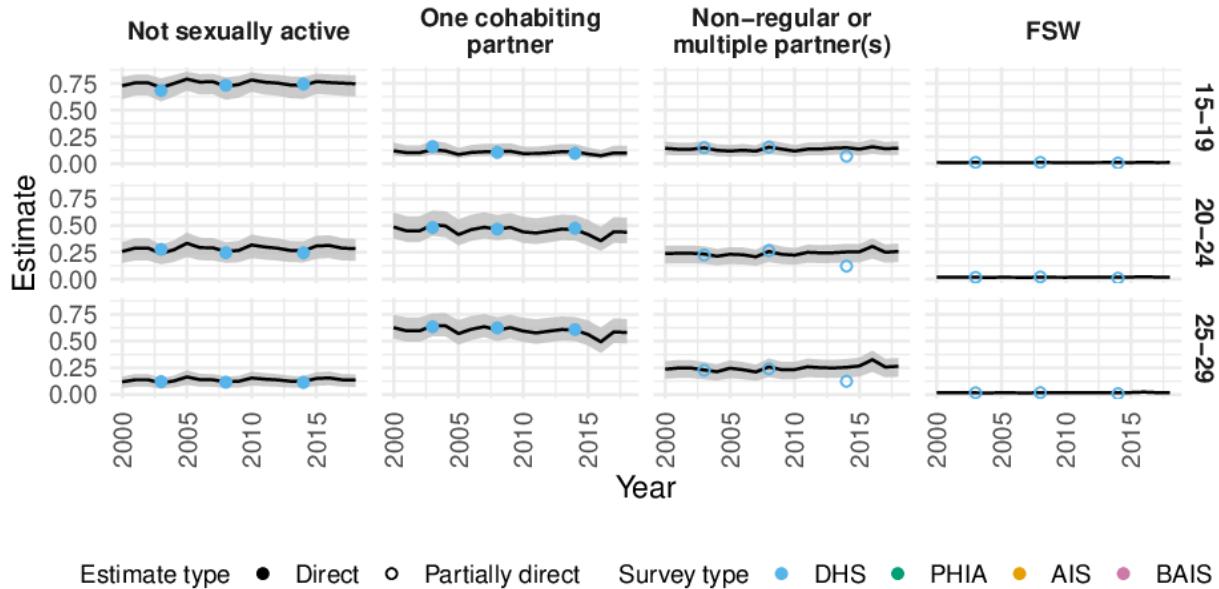


Figure G: Comparison of modelled and direct national-level estimates in 1999-2018 in Kenya. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Lesotho

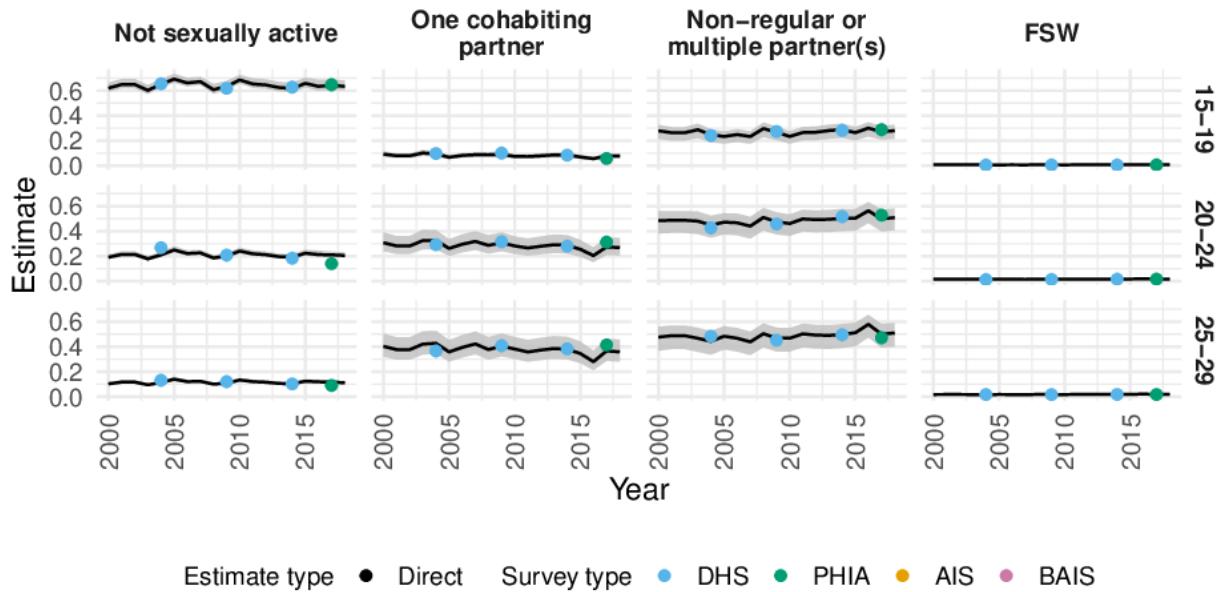


Figure H: Comparison of modelled and direct national-level estimates in 1999-2018 in Lesotho. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Mozambique

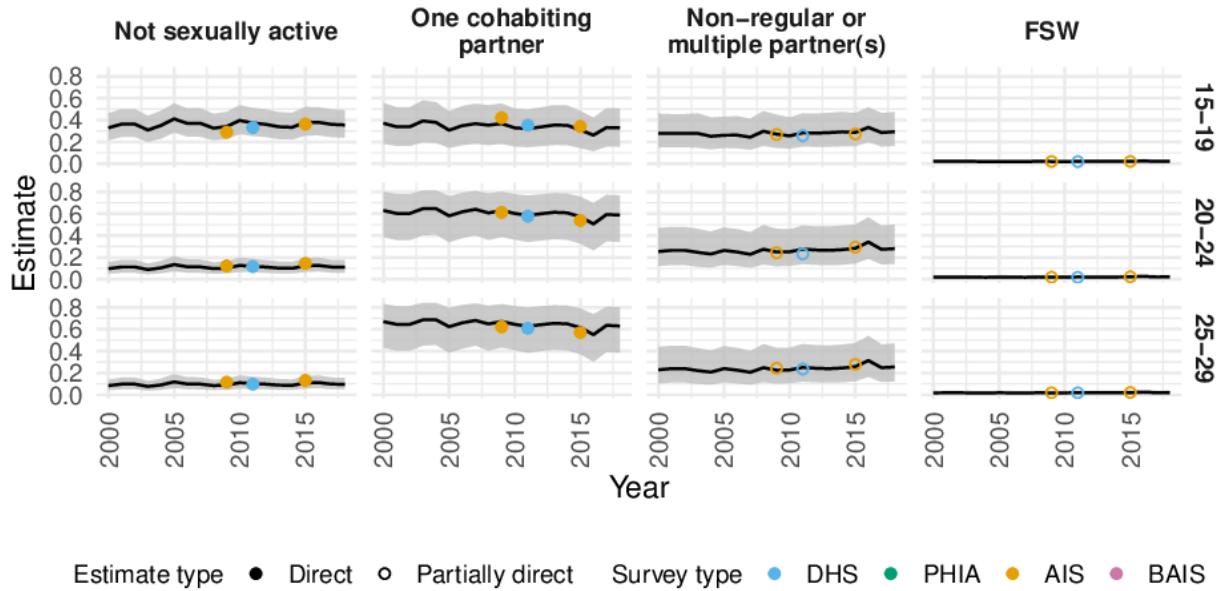


Figure I: Comparison of modelled and direct national-level estimates in 1999-2018 in Mozambique. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Malawi

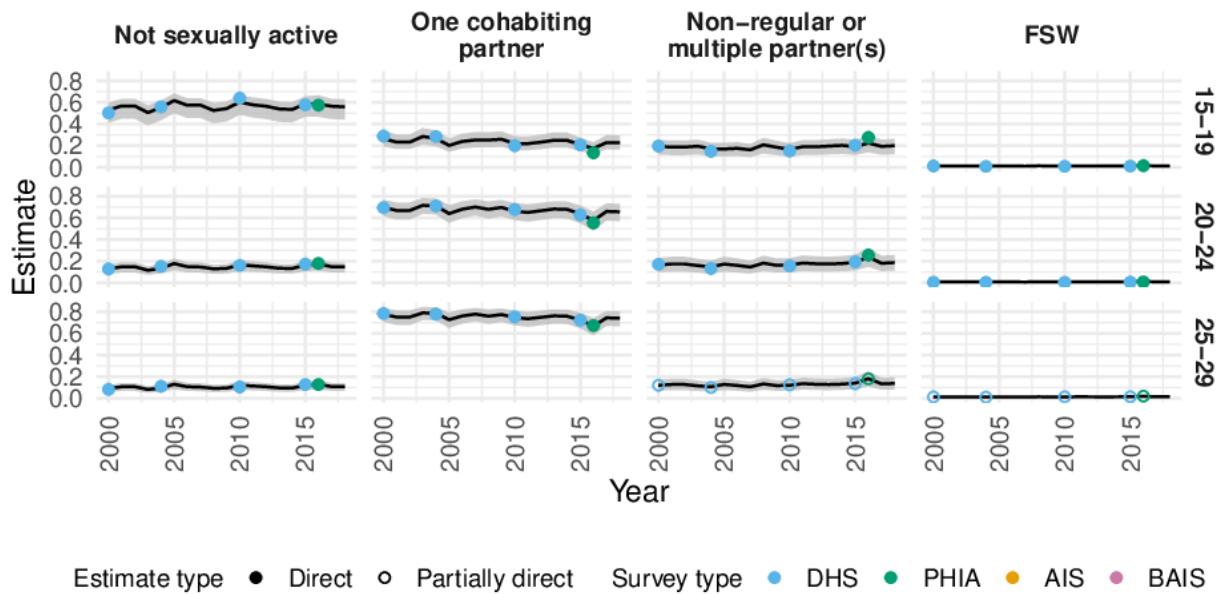


Figure J: Comparison of modelled and direct national-level estimates in 1999-2018 in Malawi. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Namibia

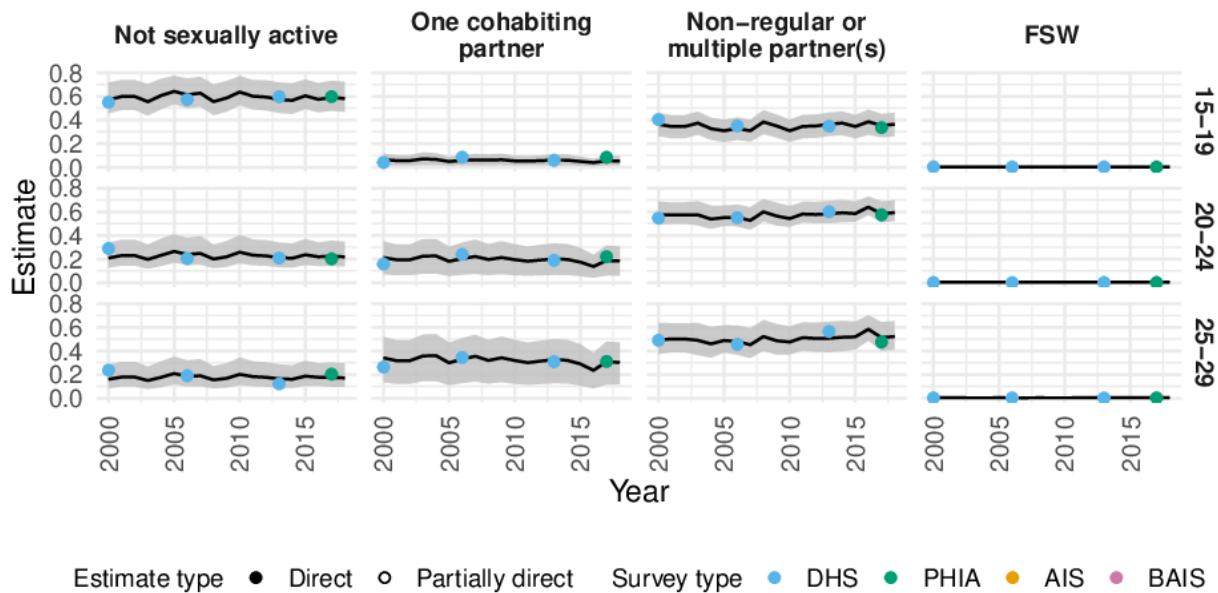


Figure K: Comparison of modelled and direct national-level estimates in 1999-2018 in Namibia. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Eswatini

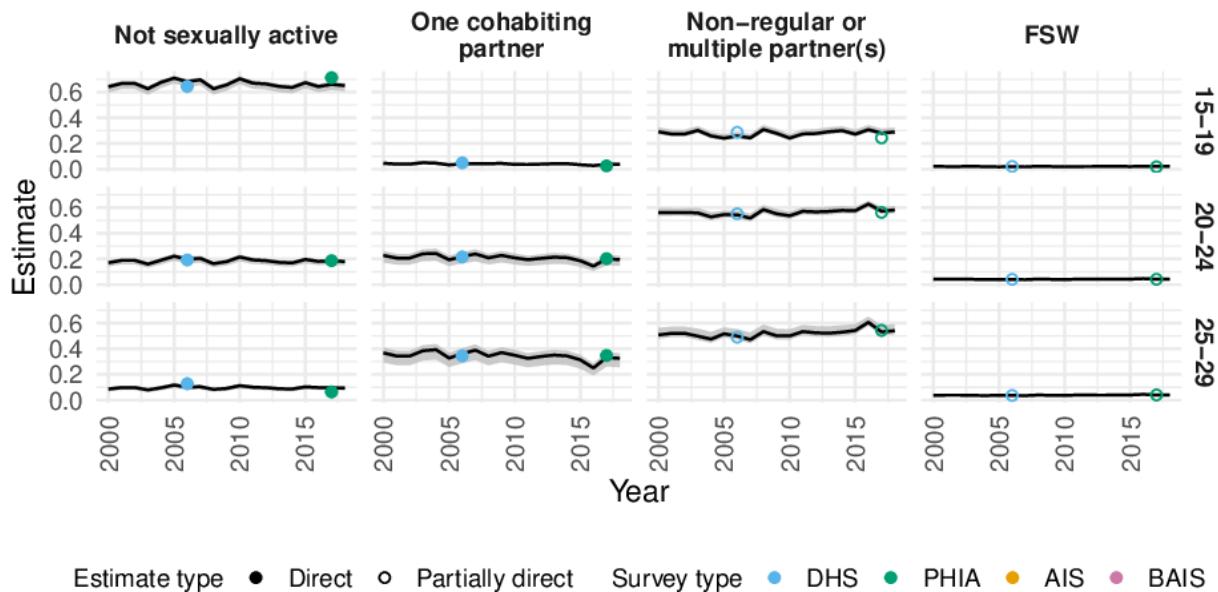


Figure L: Comparison of modelled and direct national-level estimates in 1999-2018 in Eswatini. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Tanzania

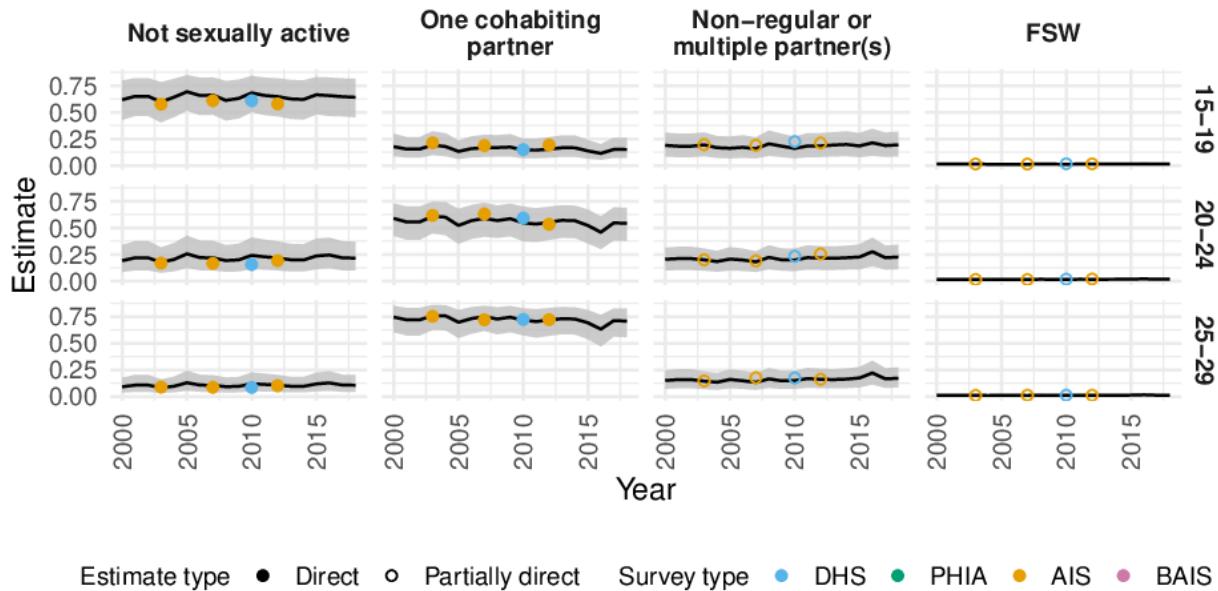


Figure M: Comparison of modelled and direct national-level estimates in 1999-2018 in Tanzania. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Uganda

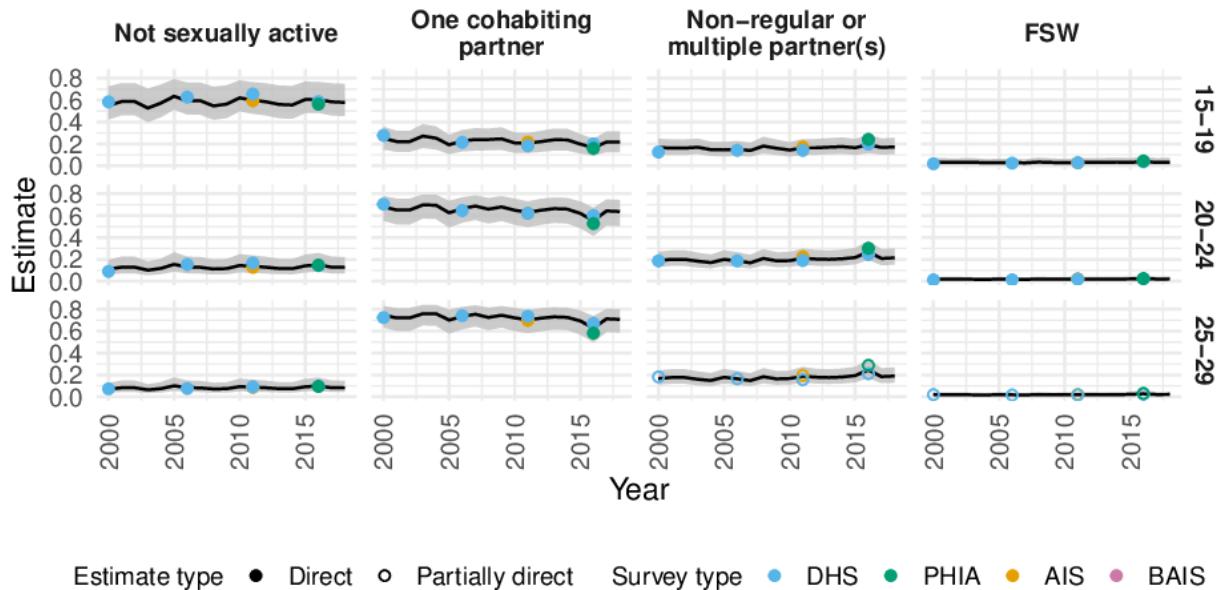


Figure N: Comparison of modelled and direct national-level estimates in 1999-2018 in Uganda. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## South Africa

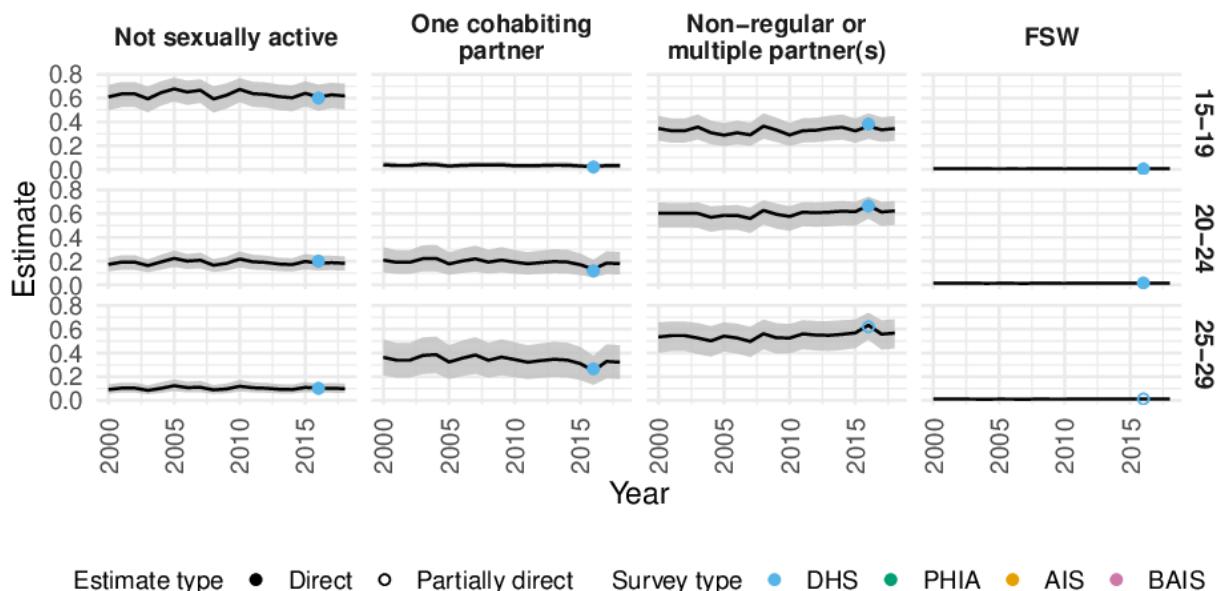


Figure O: Comparison of modelled and direct national-level estimates in 1999-2018 in South Africa. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Zambia

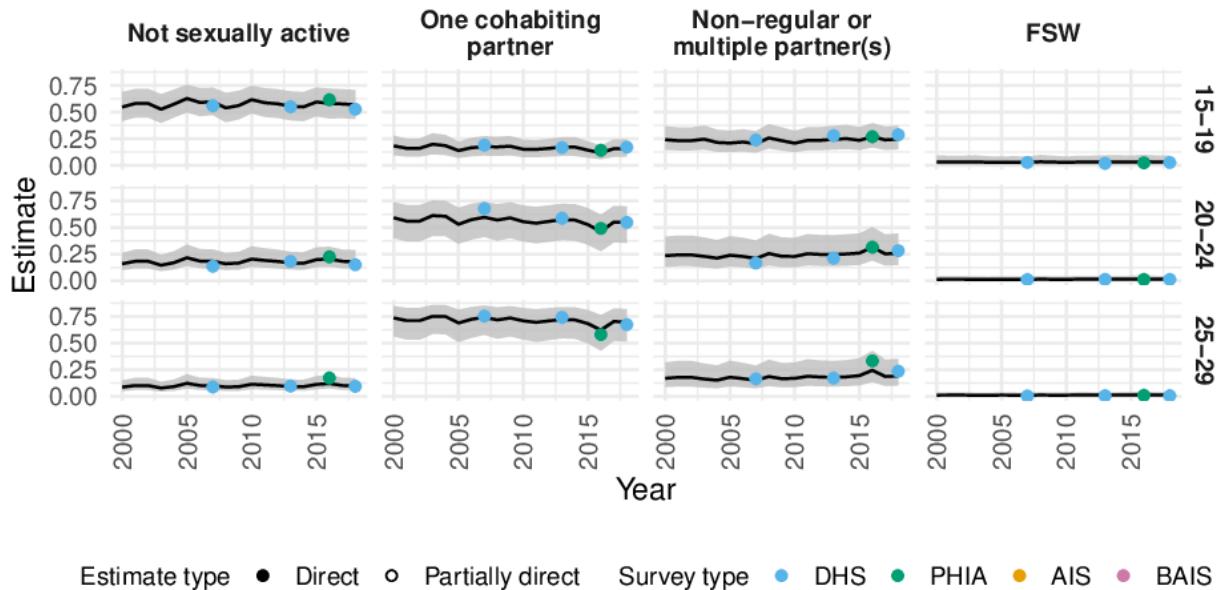


Figure P: Comparison of modelled and direct national-level estimates in 1999-2018 in Zambia. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## Zimbabwe

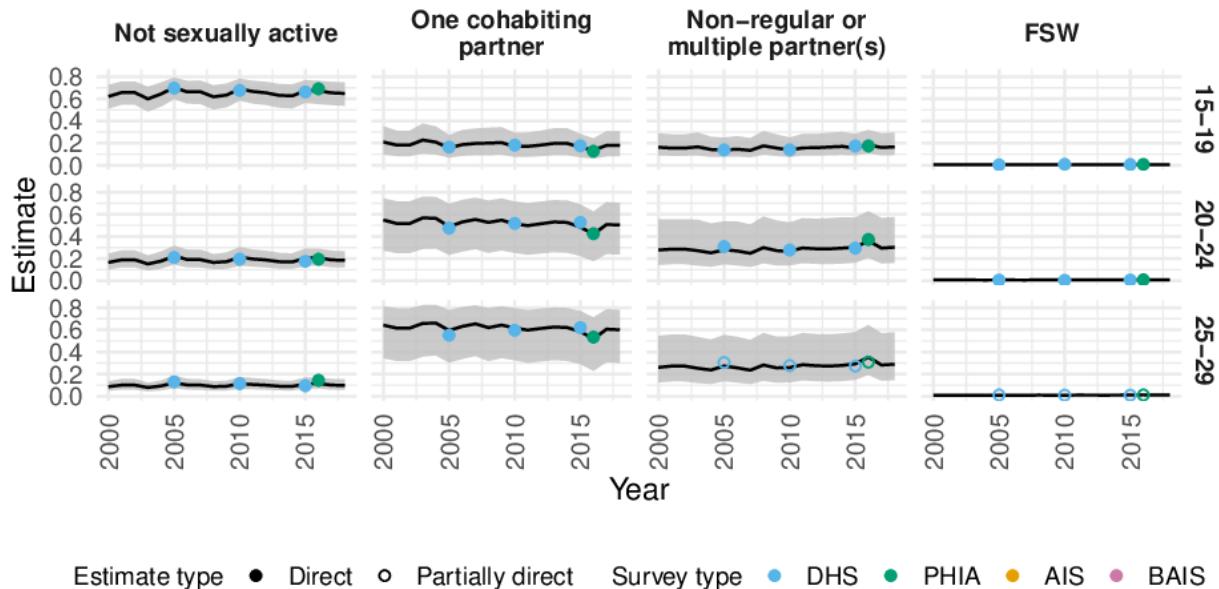


Figure Q: Comparison of modelled and direct national-level estimates in 1999-2018 in Zimbabwe. Estimates are described as "partially direct" when there are no surveys containing a transactional sex question in a country-age-group and we instead used modelled logistic regression estimates to differentiate the direct estimates.

## HIV prevalence

## Botswana

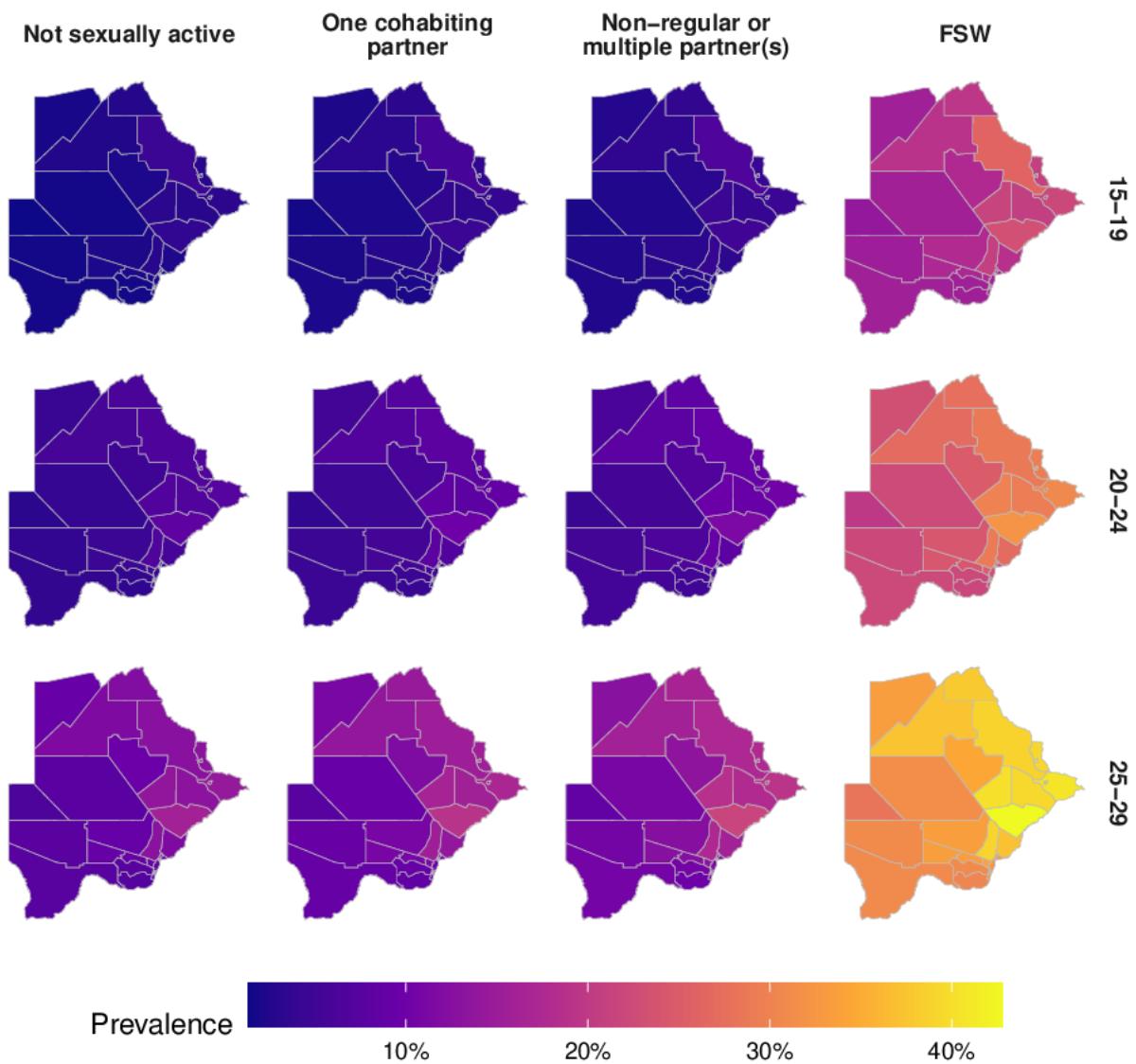


Figure R: District-level HIV prevalence for each of the risk groups in 2018 in Botswana.

## Cameroon

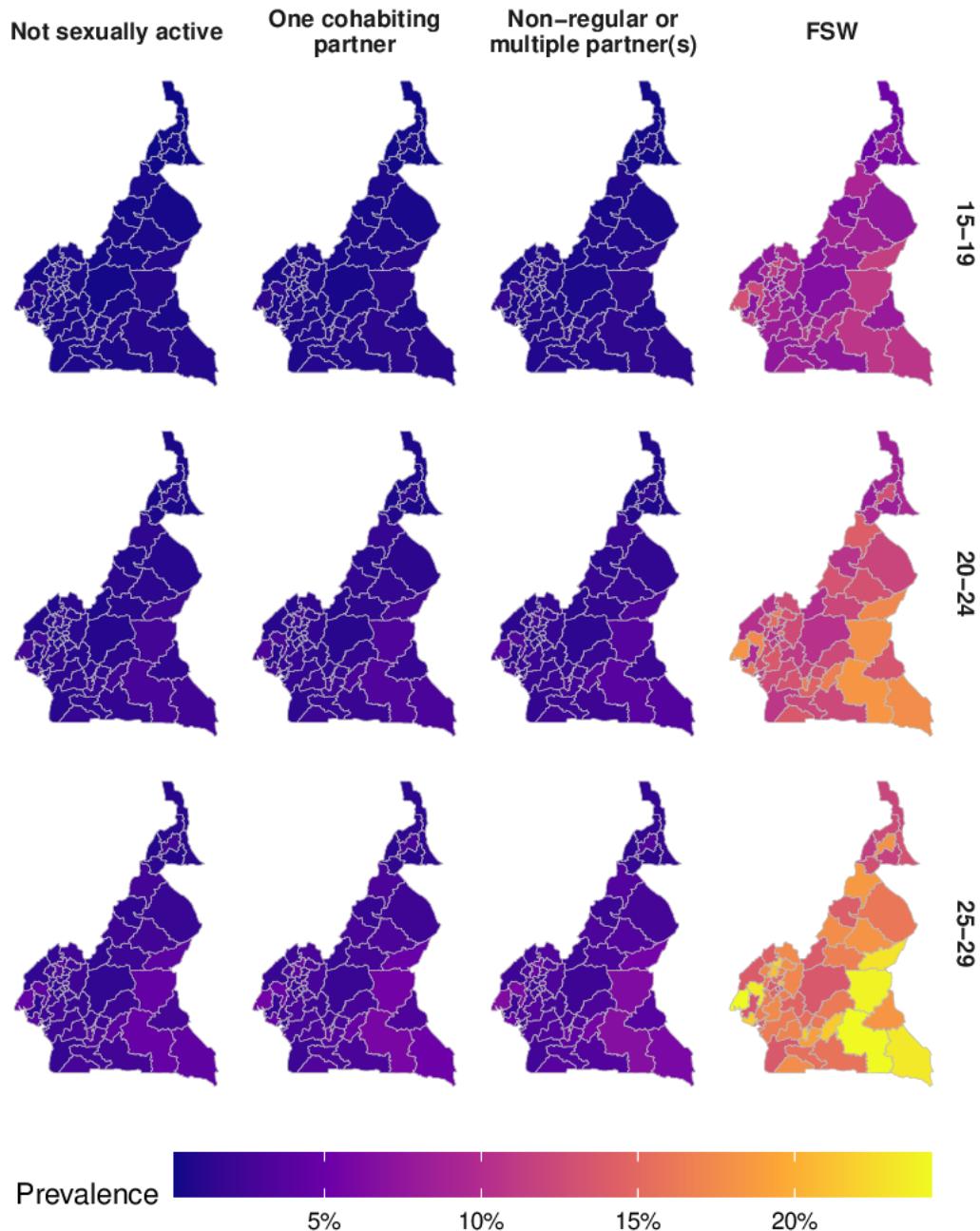


Figure S: District-level HIV prevalence for each of the risk groups in 2018 in Cameroon.

Kenya

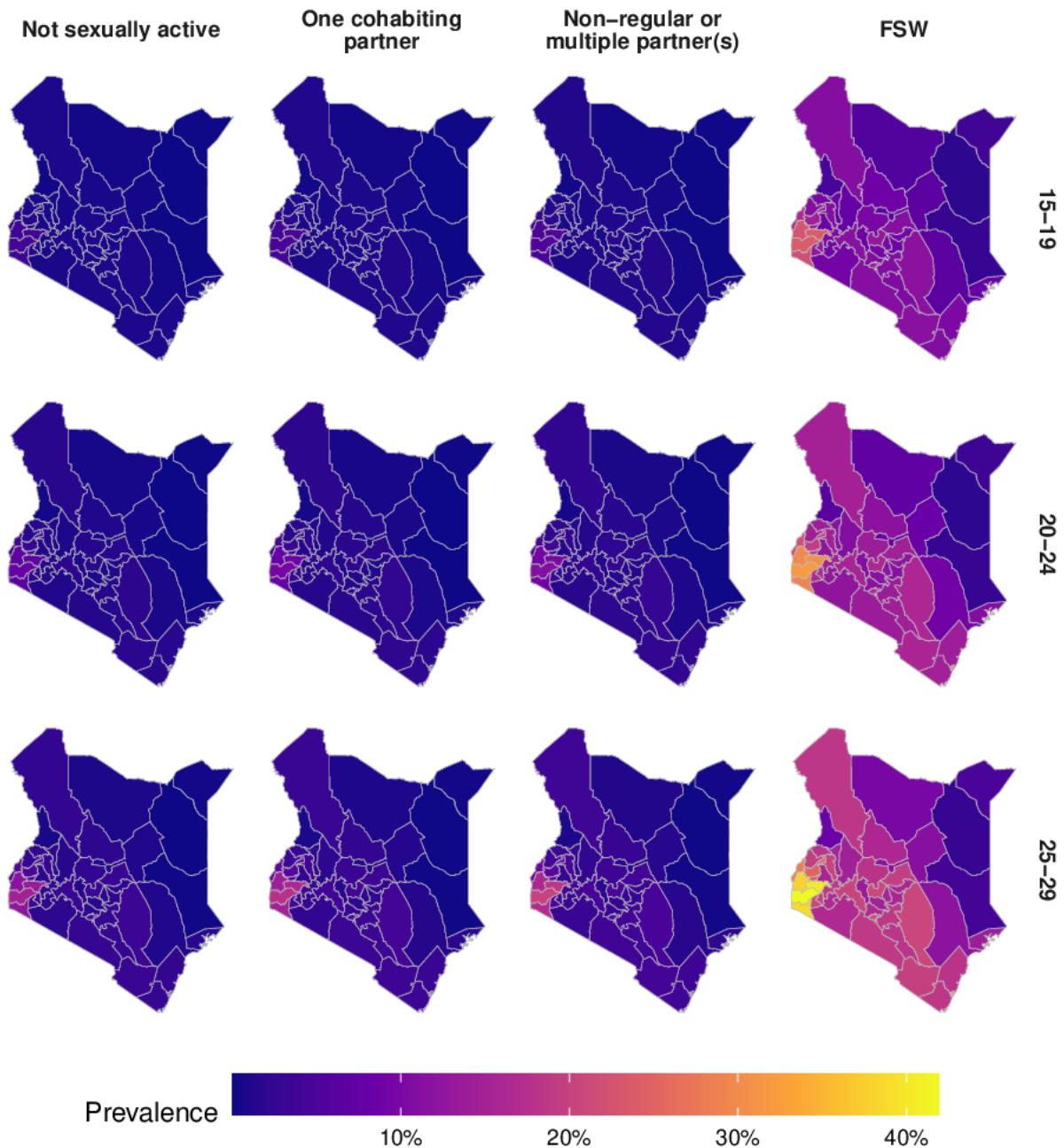


Figure T: District-level HIV prevalence for each of the risk groups in 2018 in Kenya.

## Lesotho

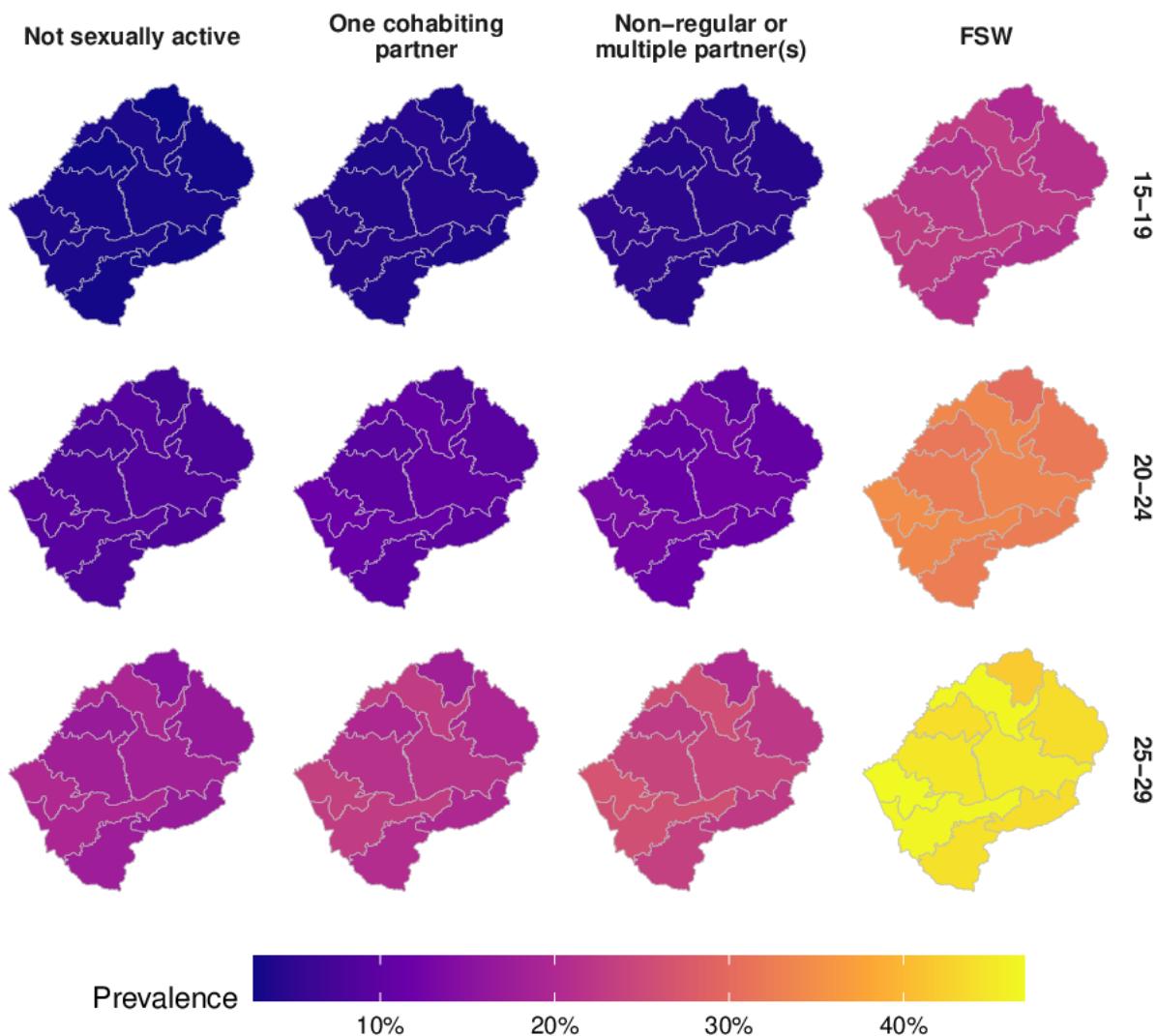


Figure U: District-level HIV prevalence for each of the risk groups in 2018 in Lesotho.

## Mozambique

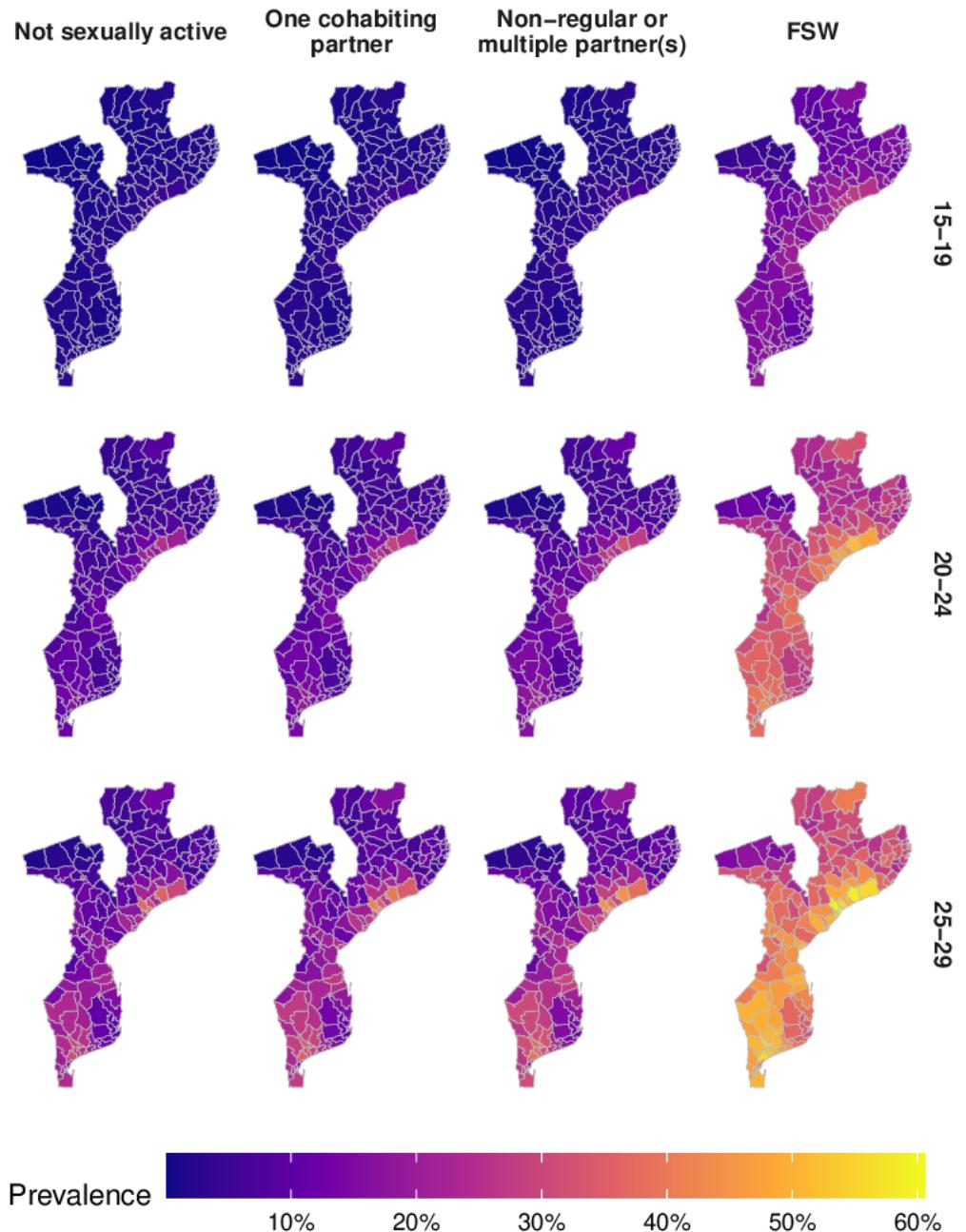


Figure V: District-level HIV prevalence for each of the risk groups in 2018 in Mozambique.

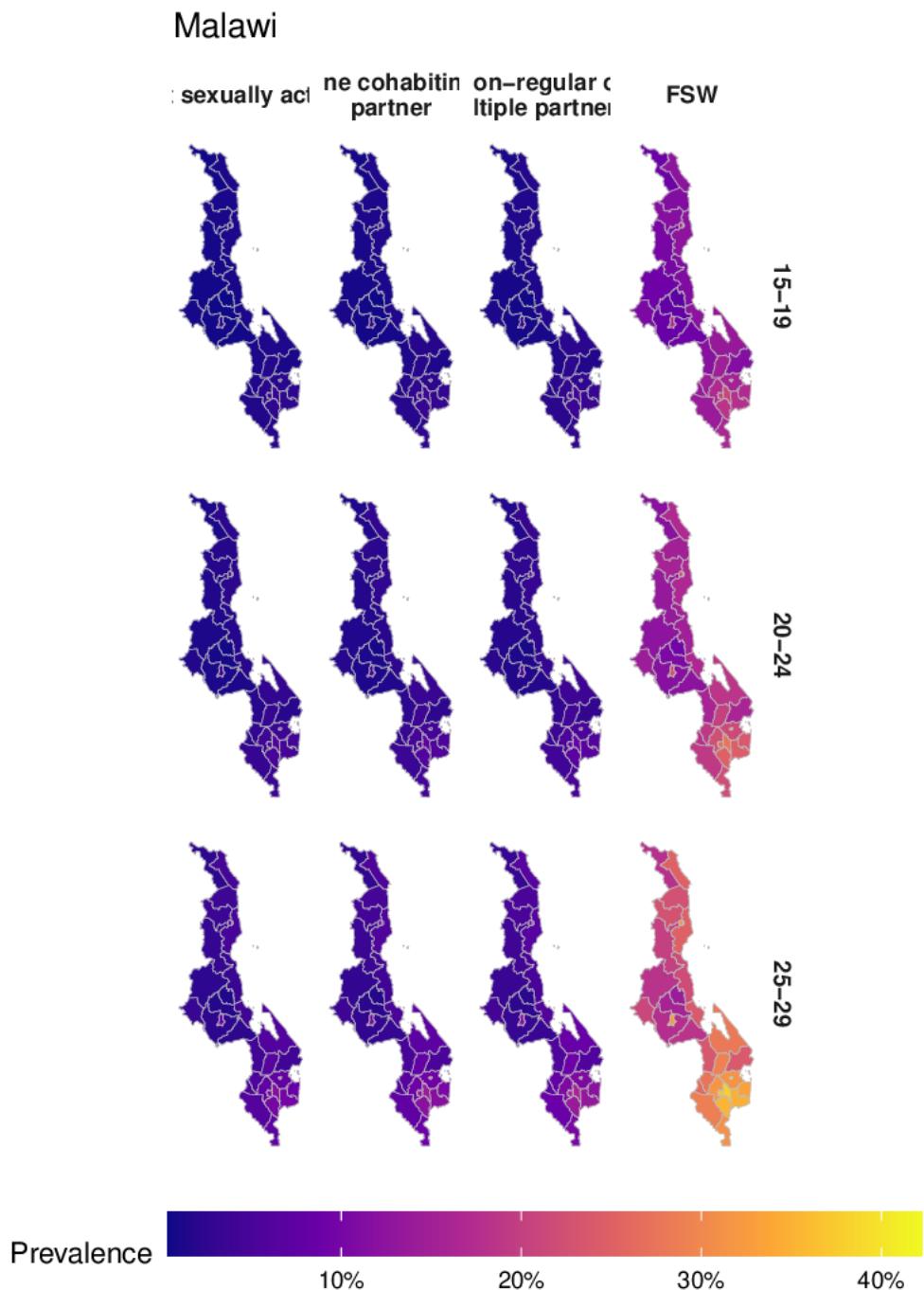


Figure W: District-level HIV prevalence for each of the risk groups in 2018 in Malawi.

## Namibia

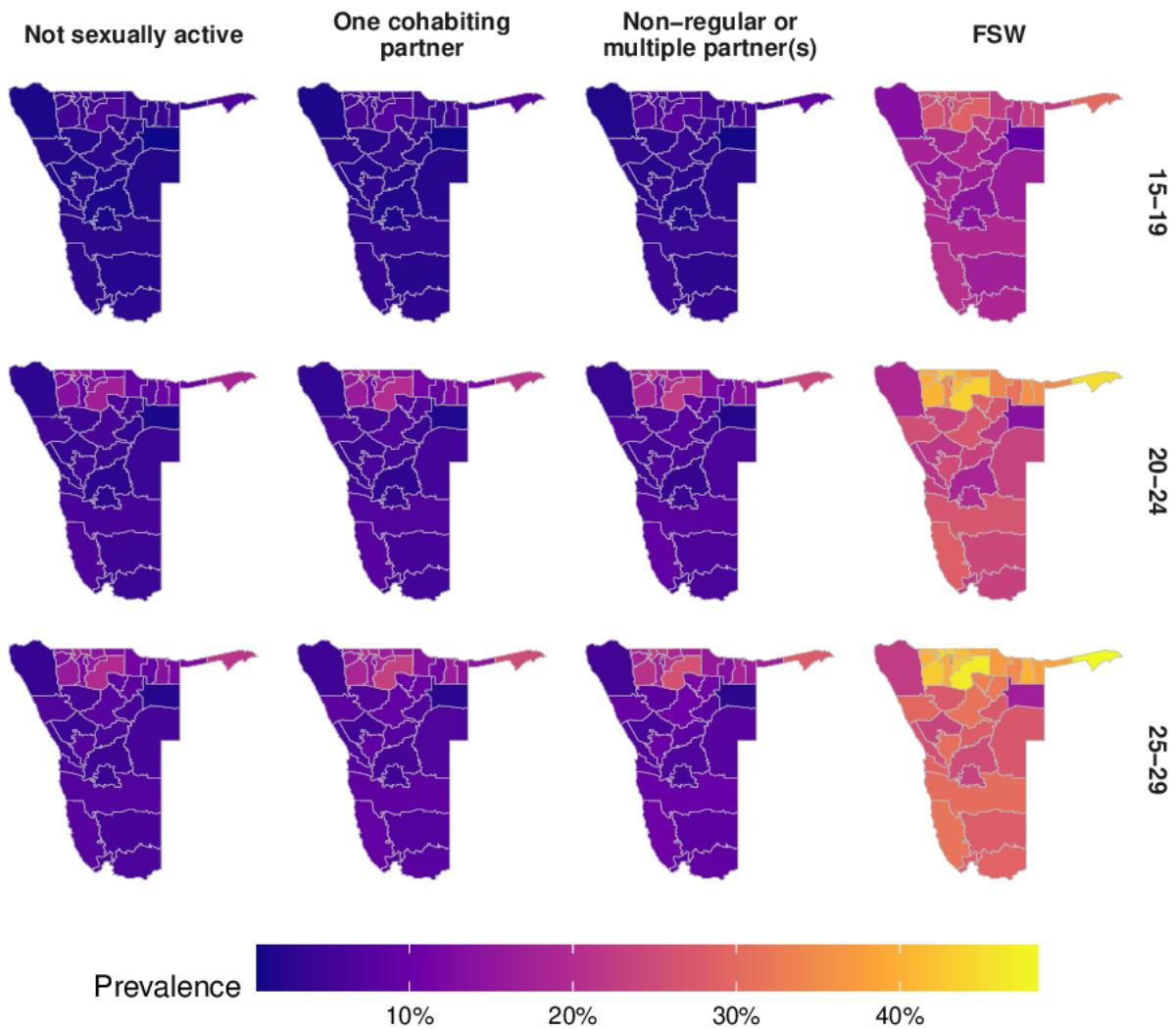


Figure X: District-level HIV prevalence for each of the risk groups in 2018 in Namibia.

## Eswatini

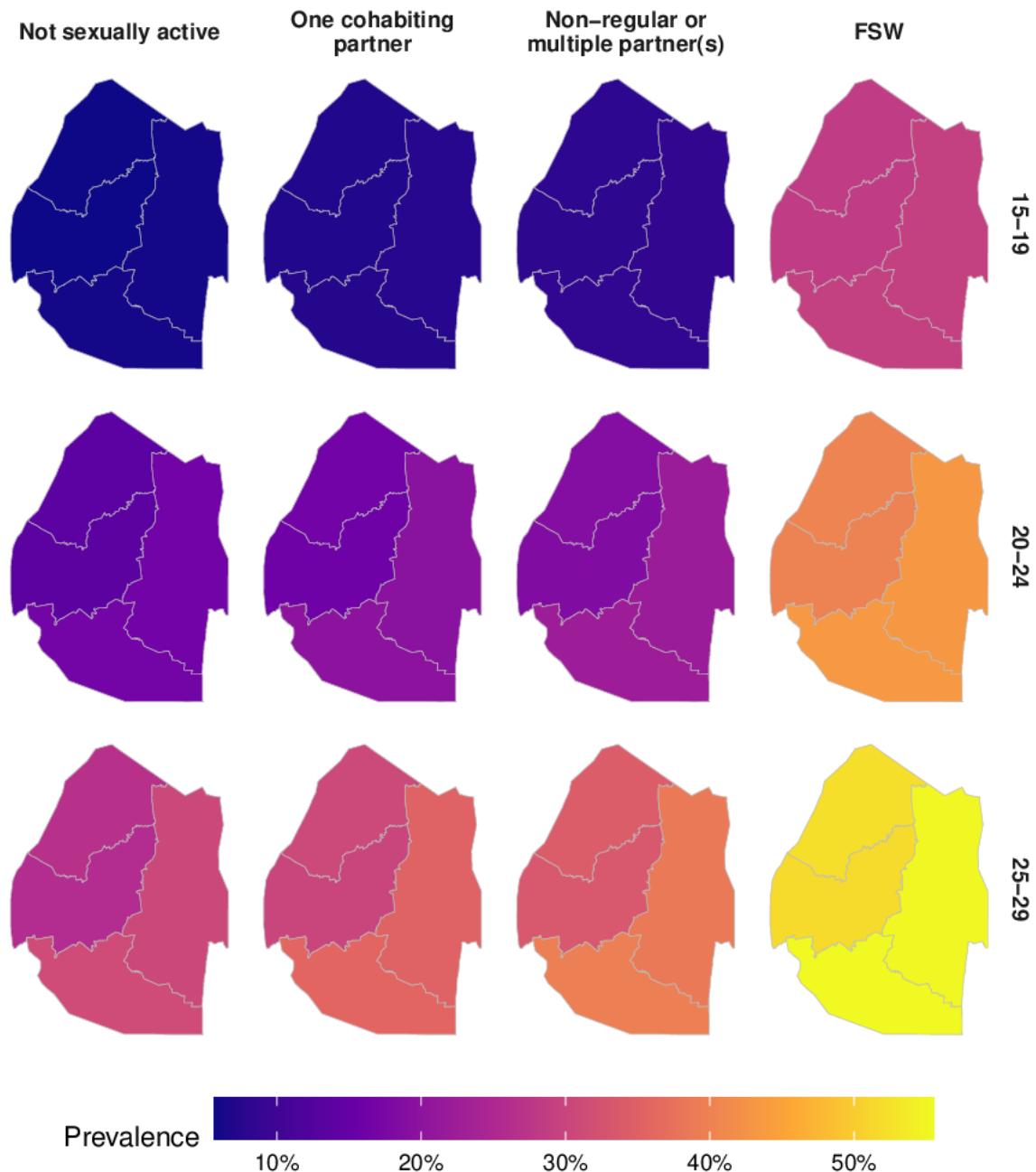


Figure Y: District-level HIV prevalence for each of the risk groups in 2018 in Eswatini.

## Tanzania

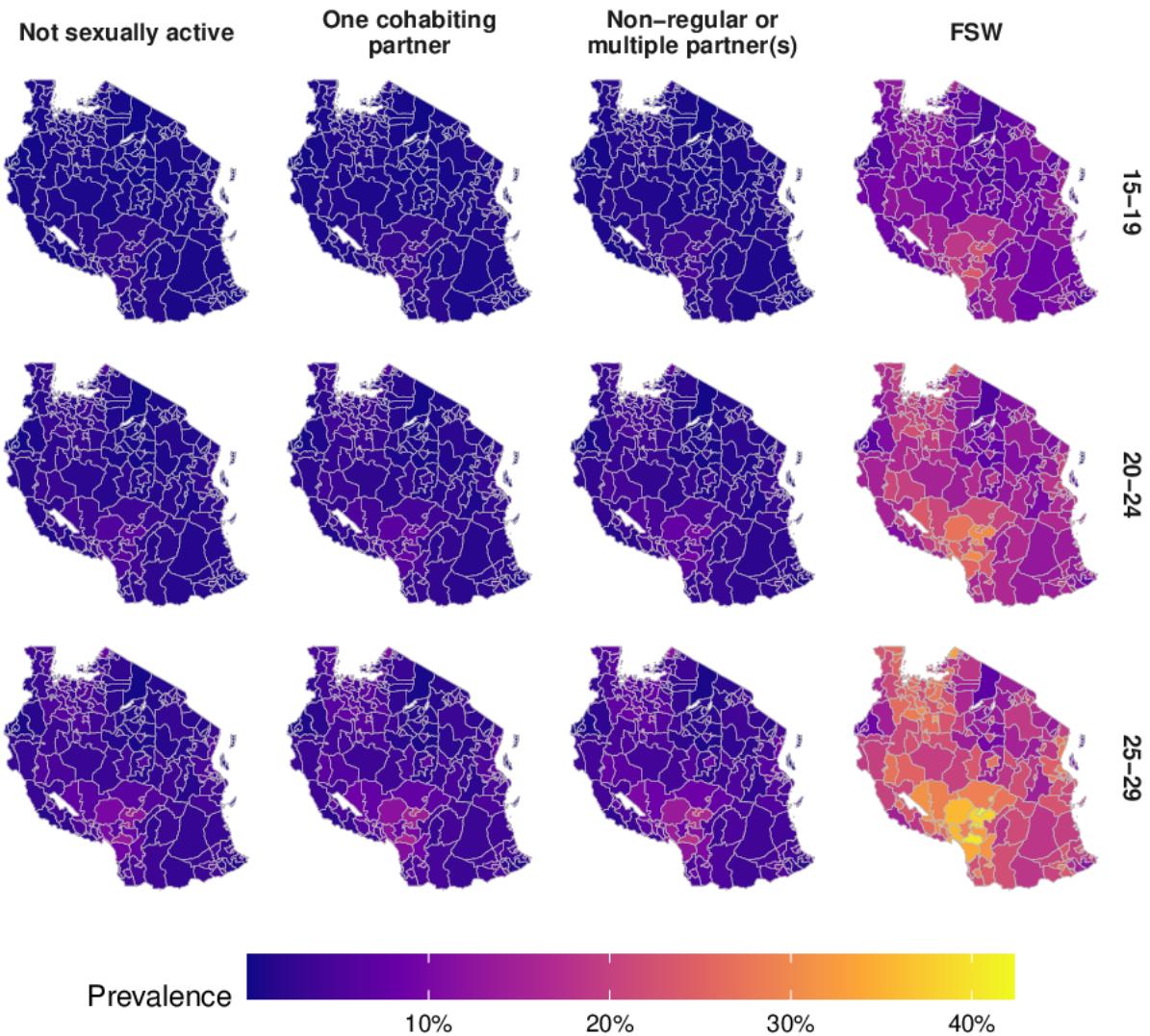


Figure Z: District-level HIV prevalence for each of the risk groups in 2018 in Tanzania.

## Uganda

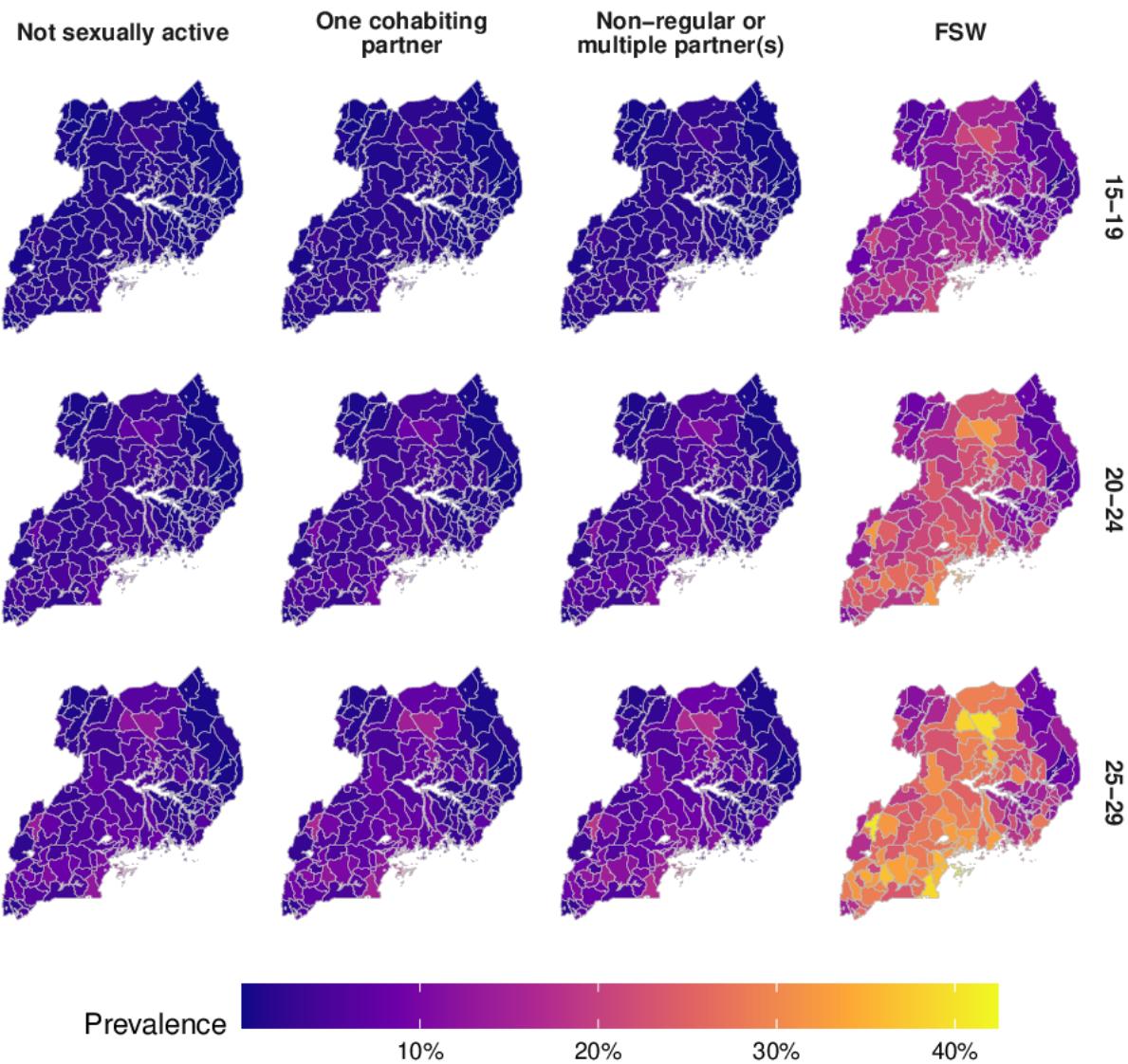


Figure AA: District-level HIV prevalence for each of the risk groups in 2018 in Uganda.

## South Africa

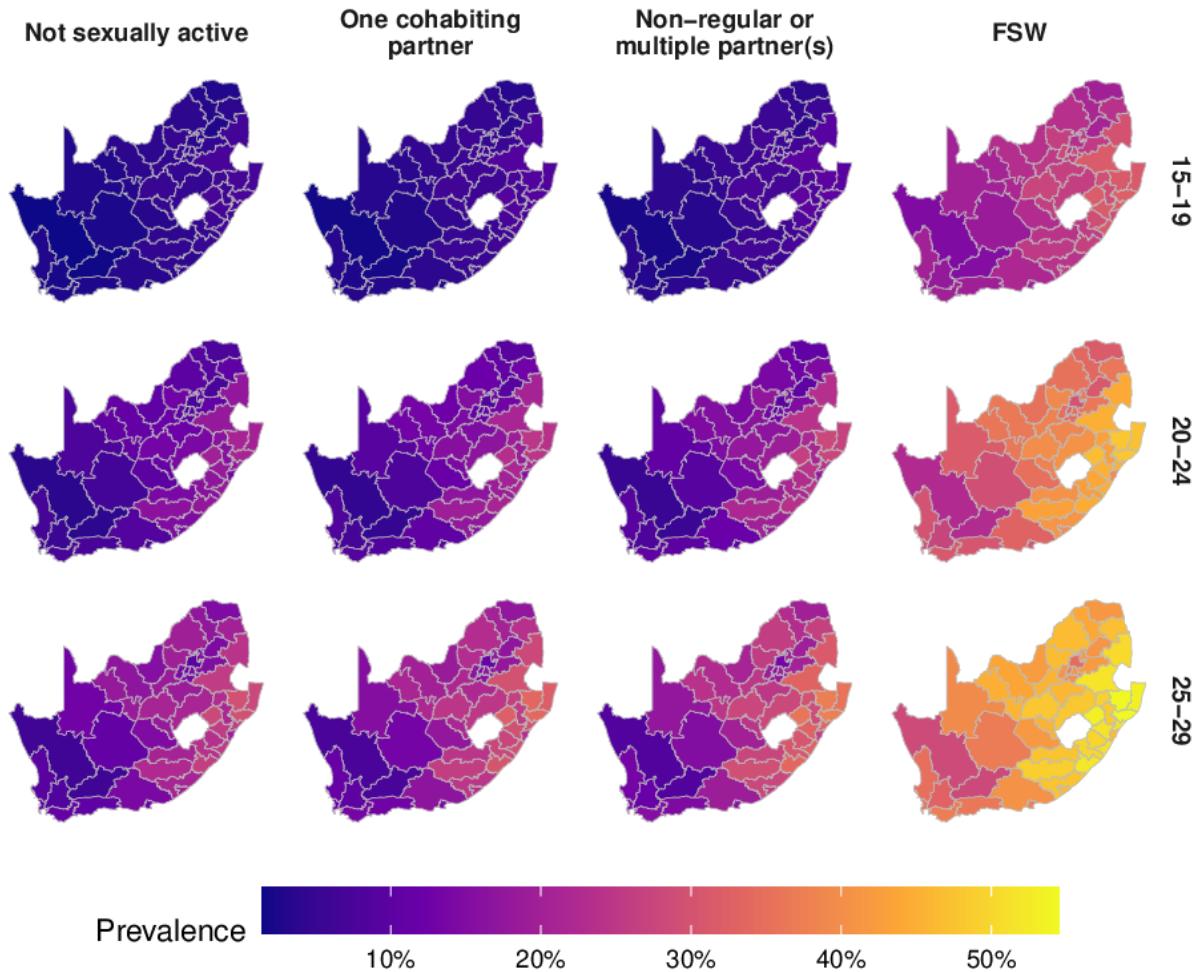


Figure AB: District-level HIV prevalence for each of the risk groups in 2018 in South Africa.

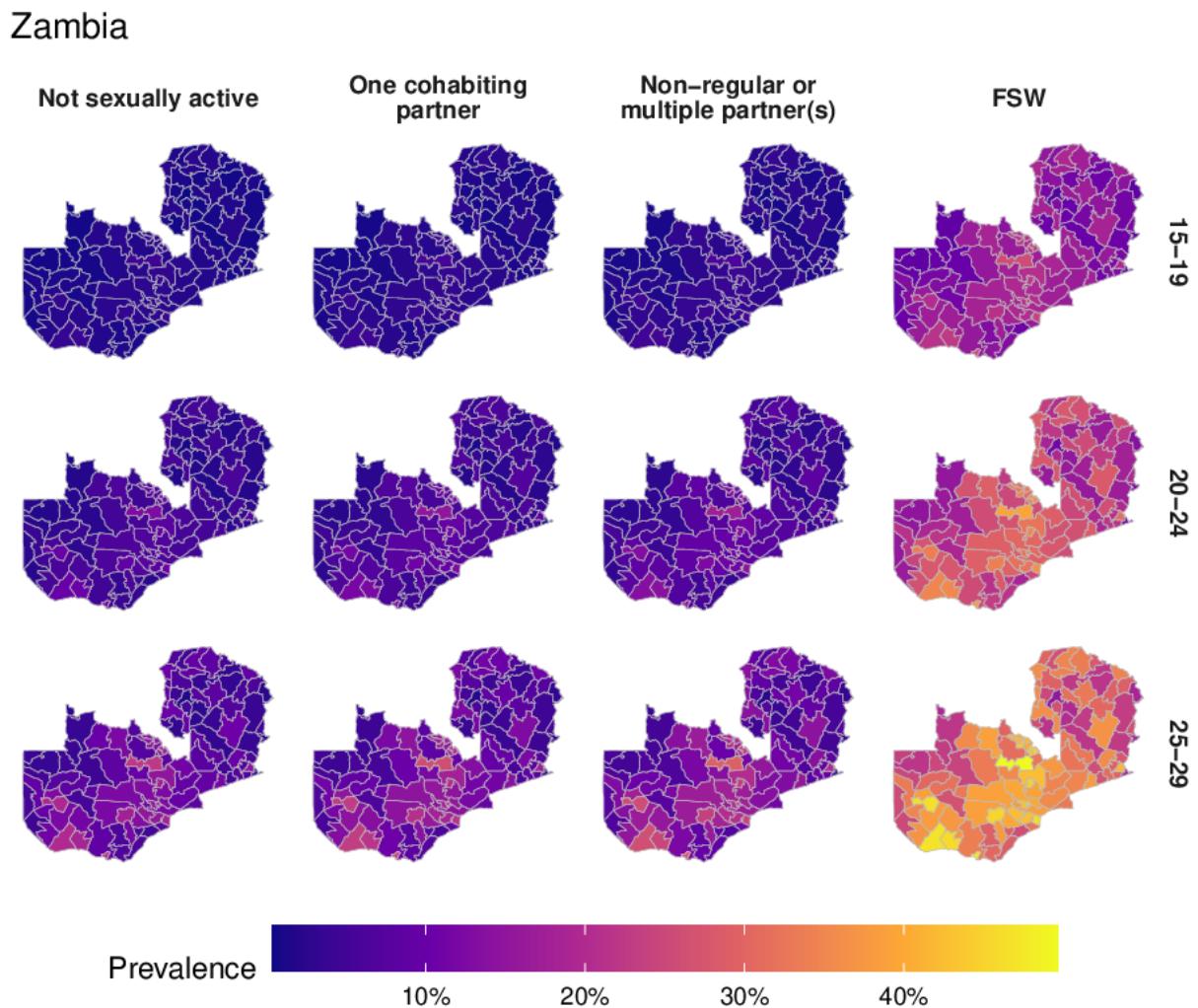


Figure AC: District-level HIV prevalence for each of the risk groups in 2018 in Zambia.

## Zimbabwe

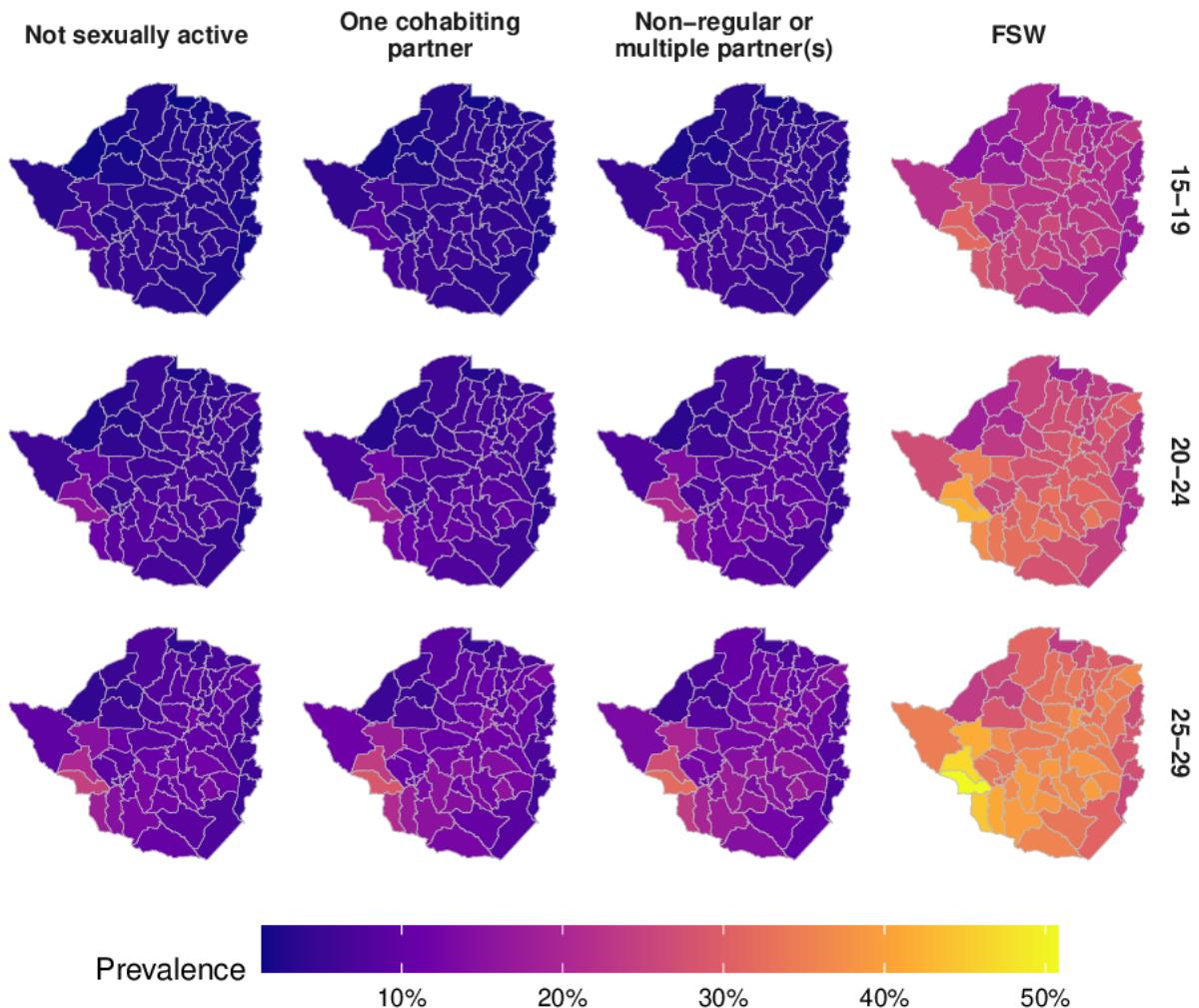


Figure AD: District-level HIV prevalence for each of the risk groups in 2018 in Zimbabwe.

## HIV incidence

## Botswana

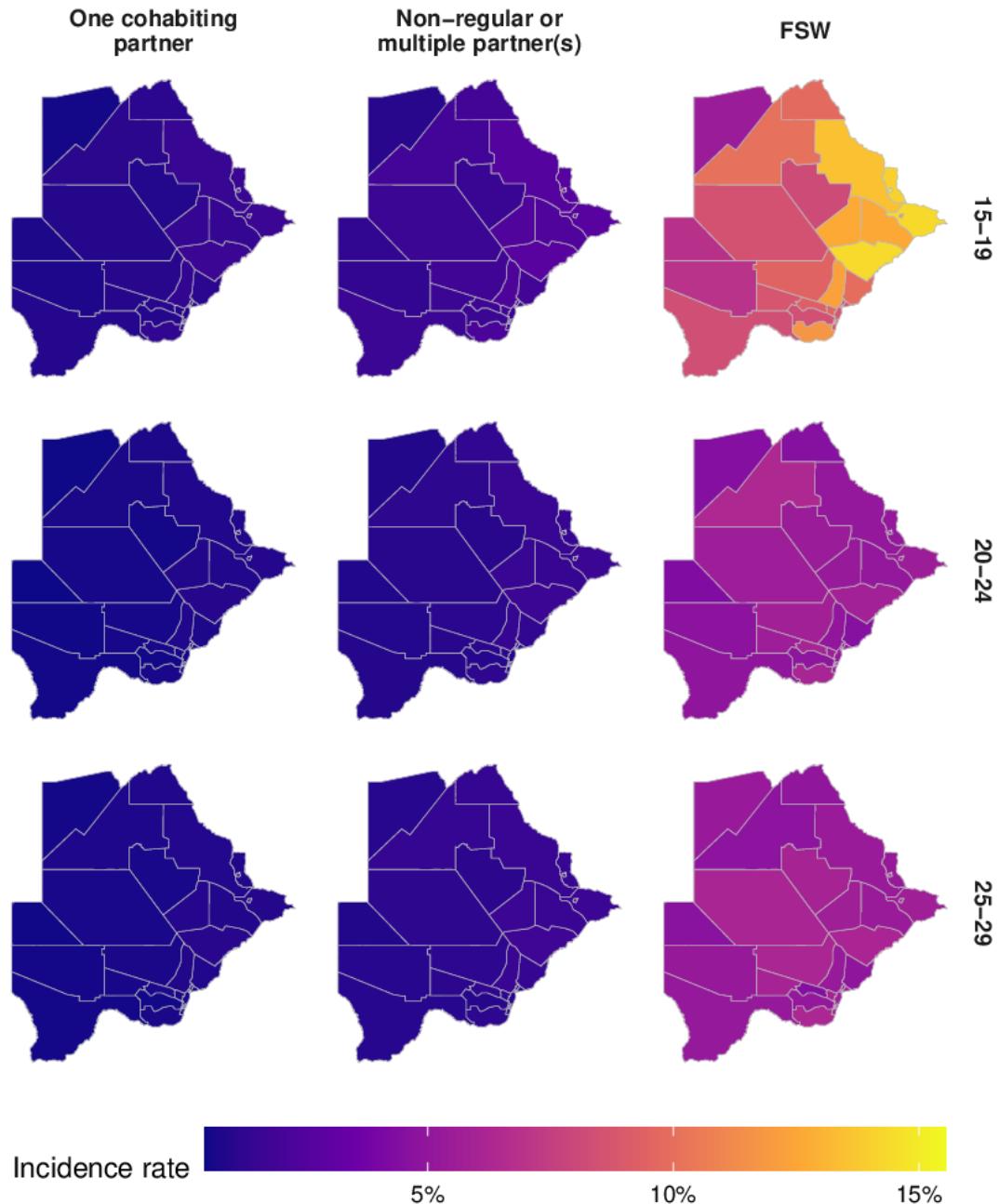


Figure AE: District-level HIV incidence for each of the risk groups in 2018 in Botswana.

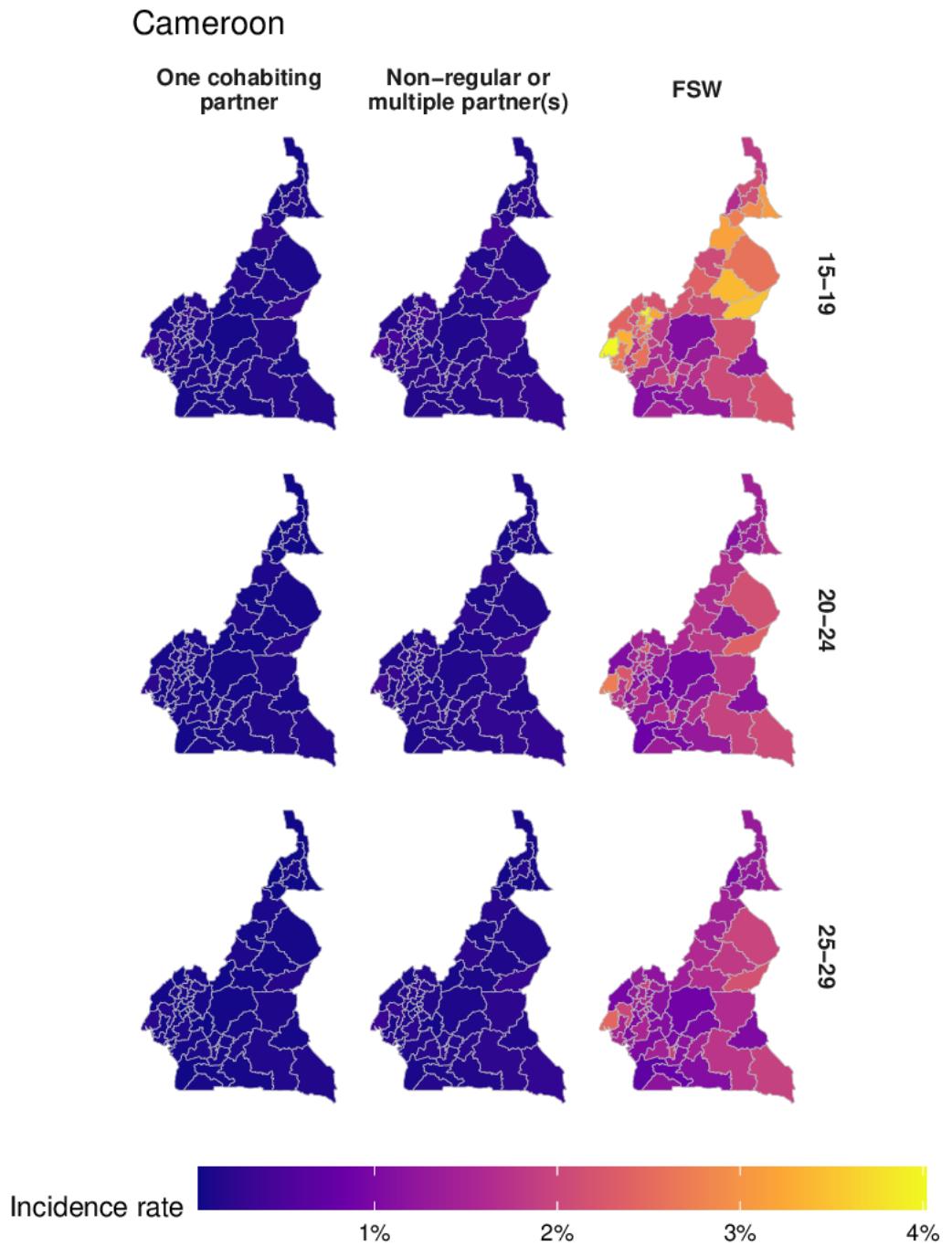


Figure AF: District-level HIV incidence for each of the risk groups in 2018 in Cameroon.

Kenya

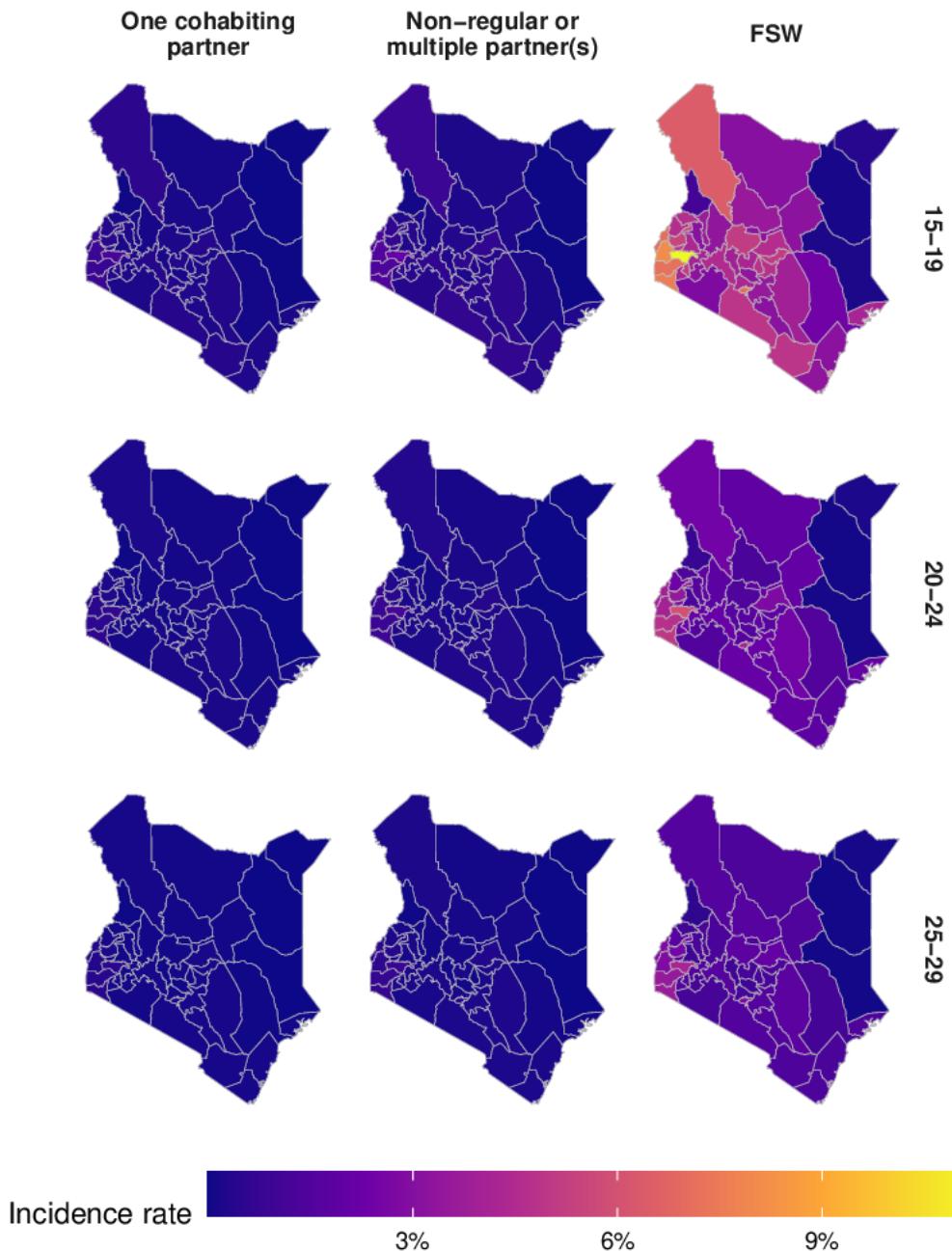


Figure AG: District-level HIV incidence for each of the risk groups in 2018 in Kenya.

## Lesotho

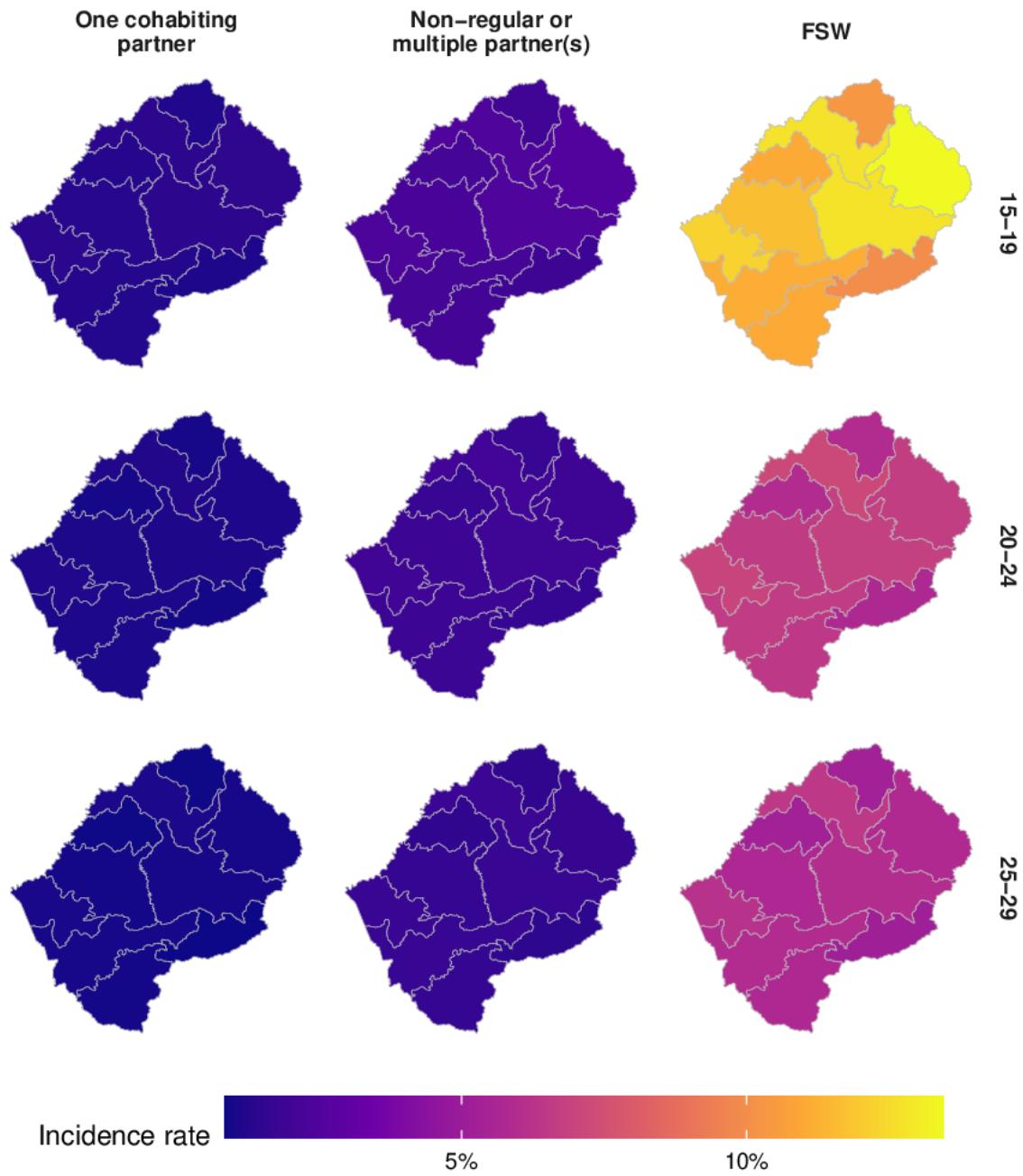


Figure AH: District-level HIV incidence for each of the risk groups in 2018 in Lesotho.

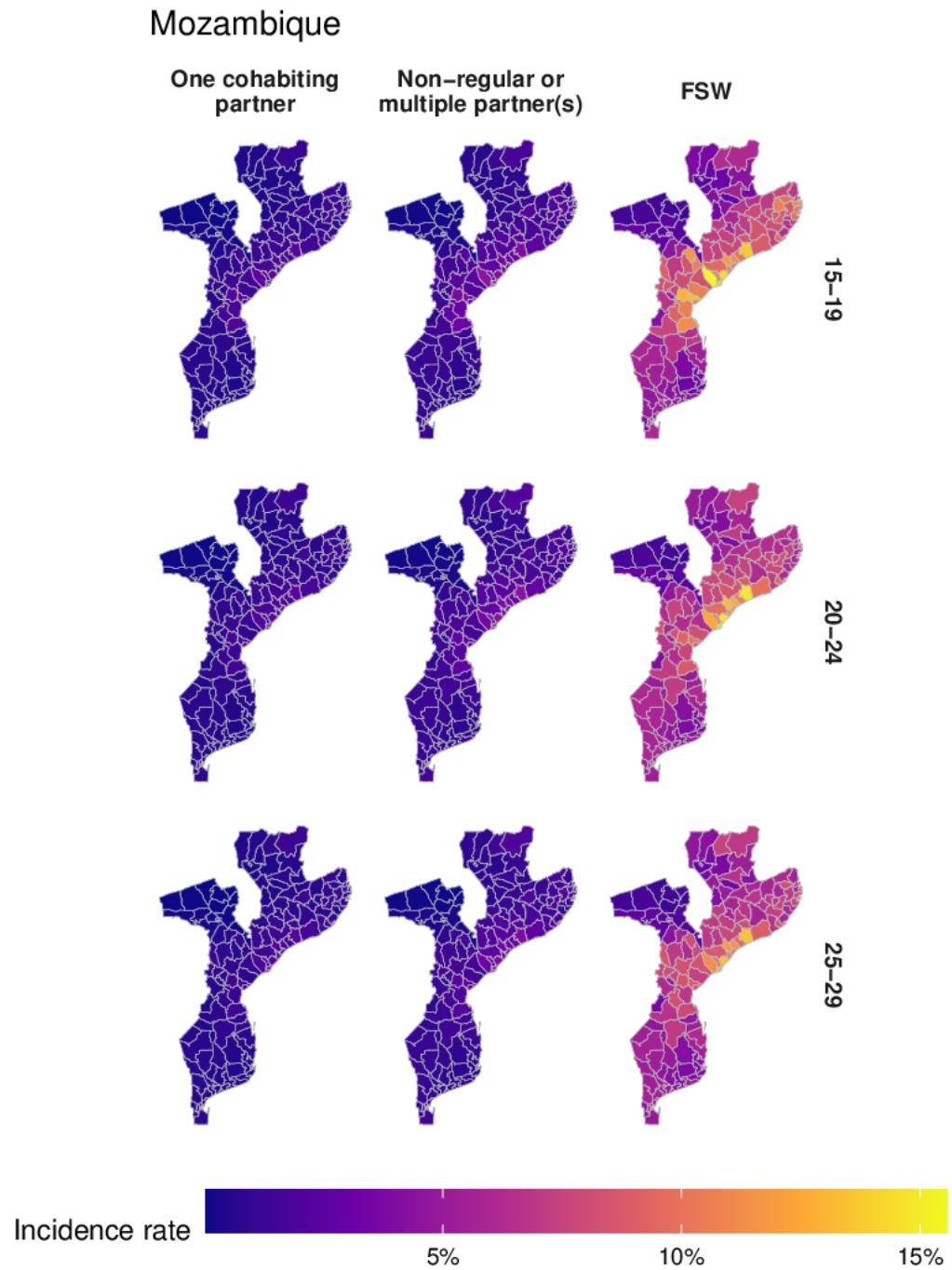


Figure AI: District-level HIV incidence for each of the risk groups in 2018 in Mozambique.

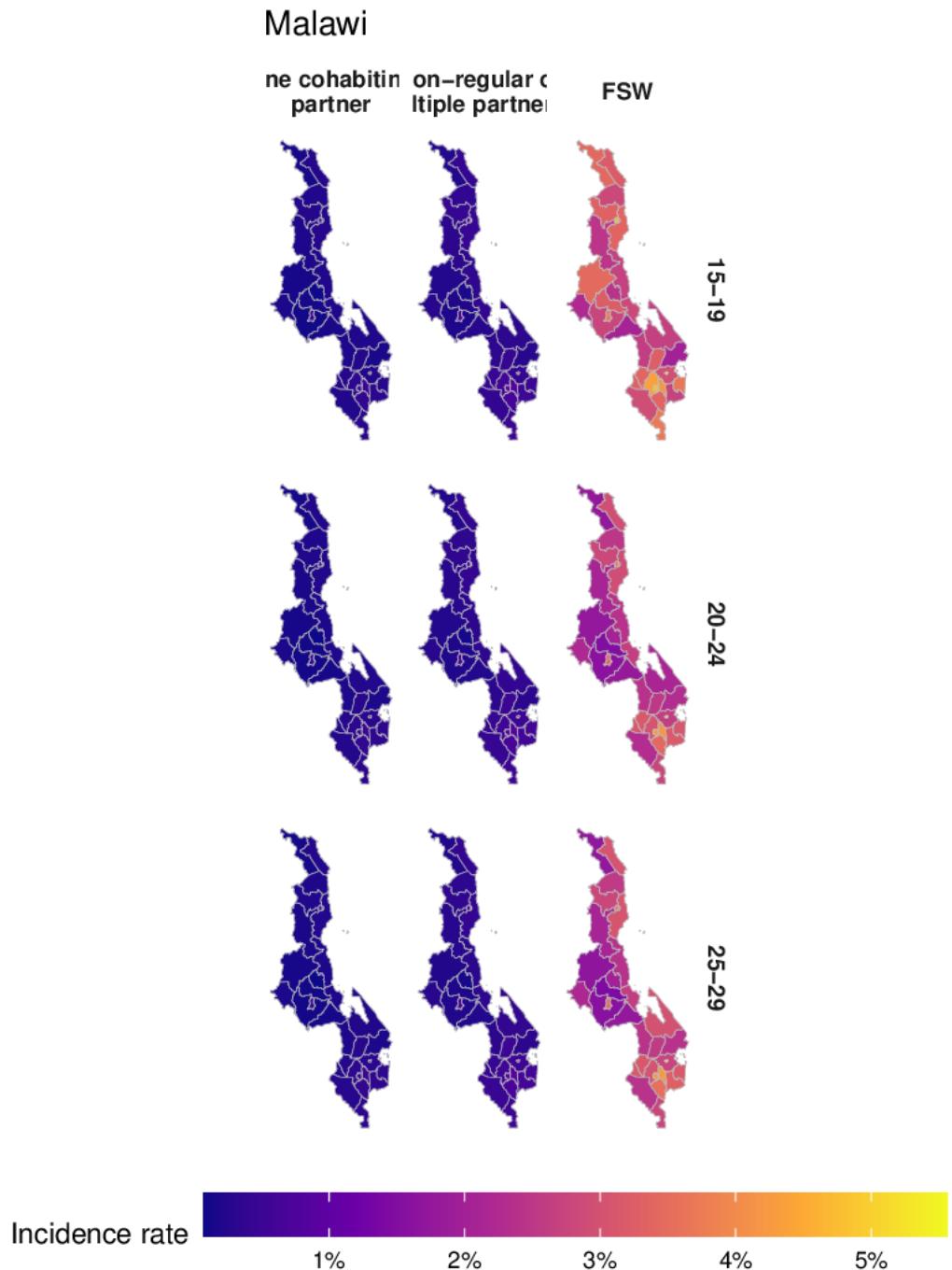


Figure AJ: District-level HIV incidence for each of the risk groups in 2018 in Malawi.

## Namibia

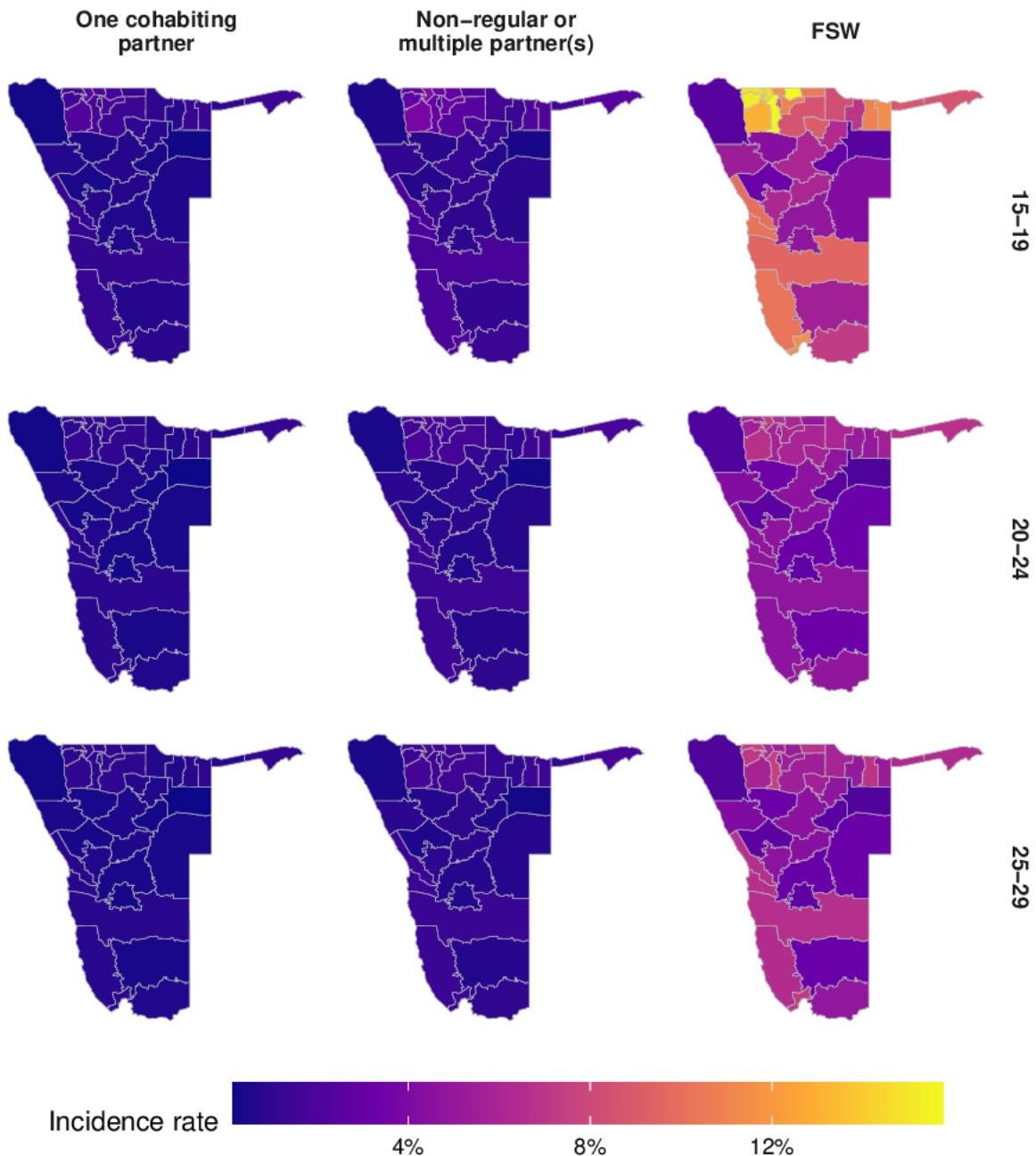


Figure AK: District-level HIV incidence for each of the risk groups in 2018 in Namibia.

## Eswatini

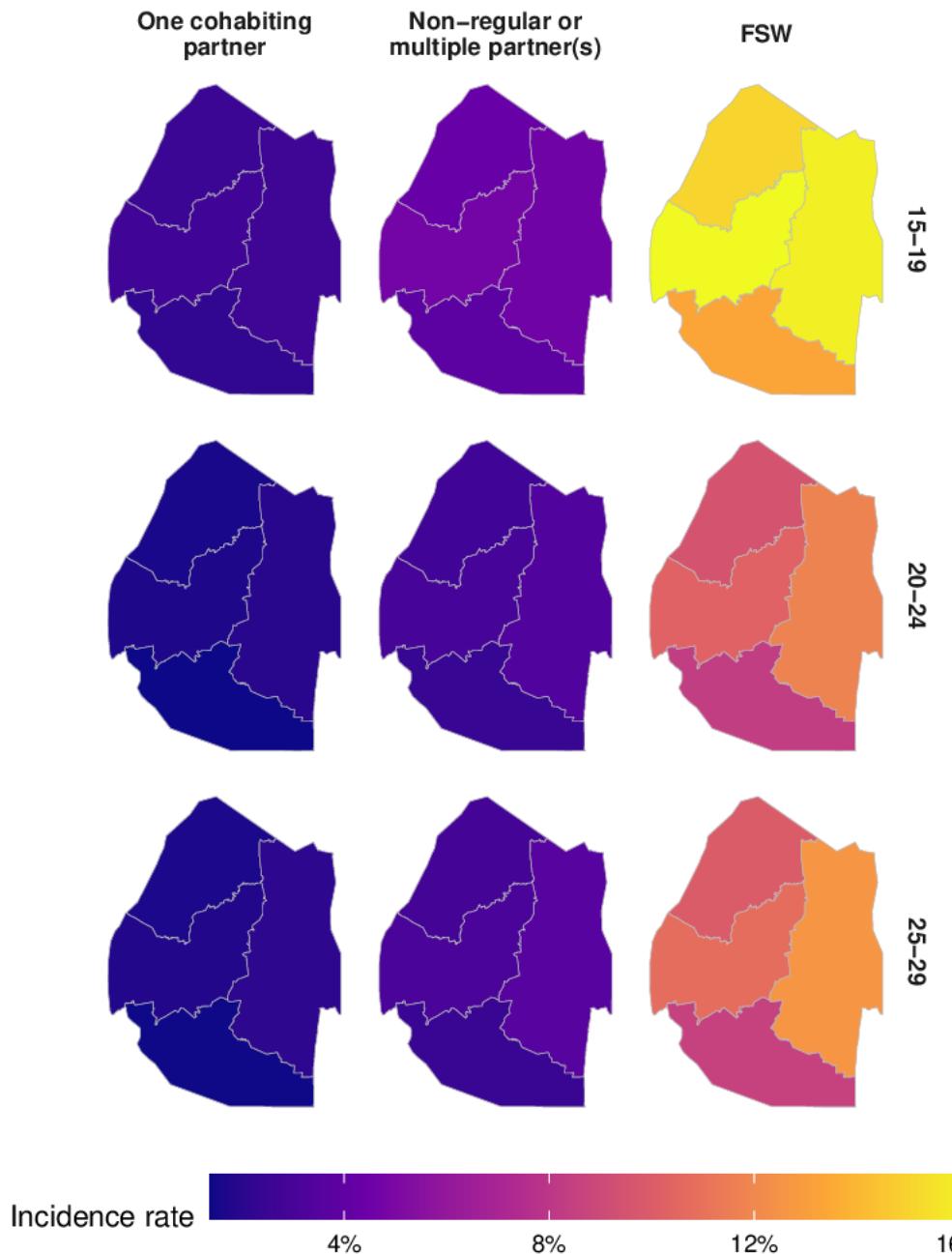


Figure AL: District-level HIV incidence for each of the risk groups in 2018 in Eswatini.

## Tanzania

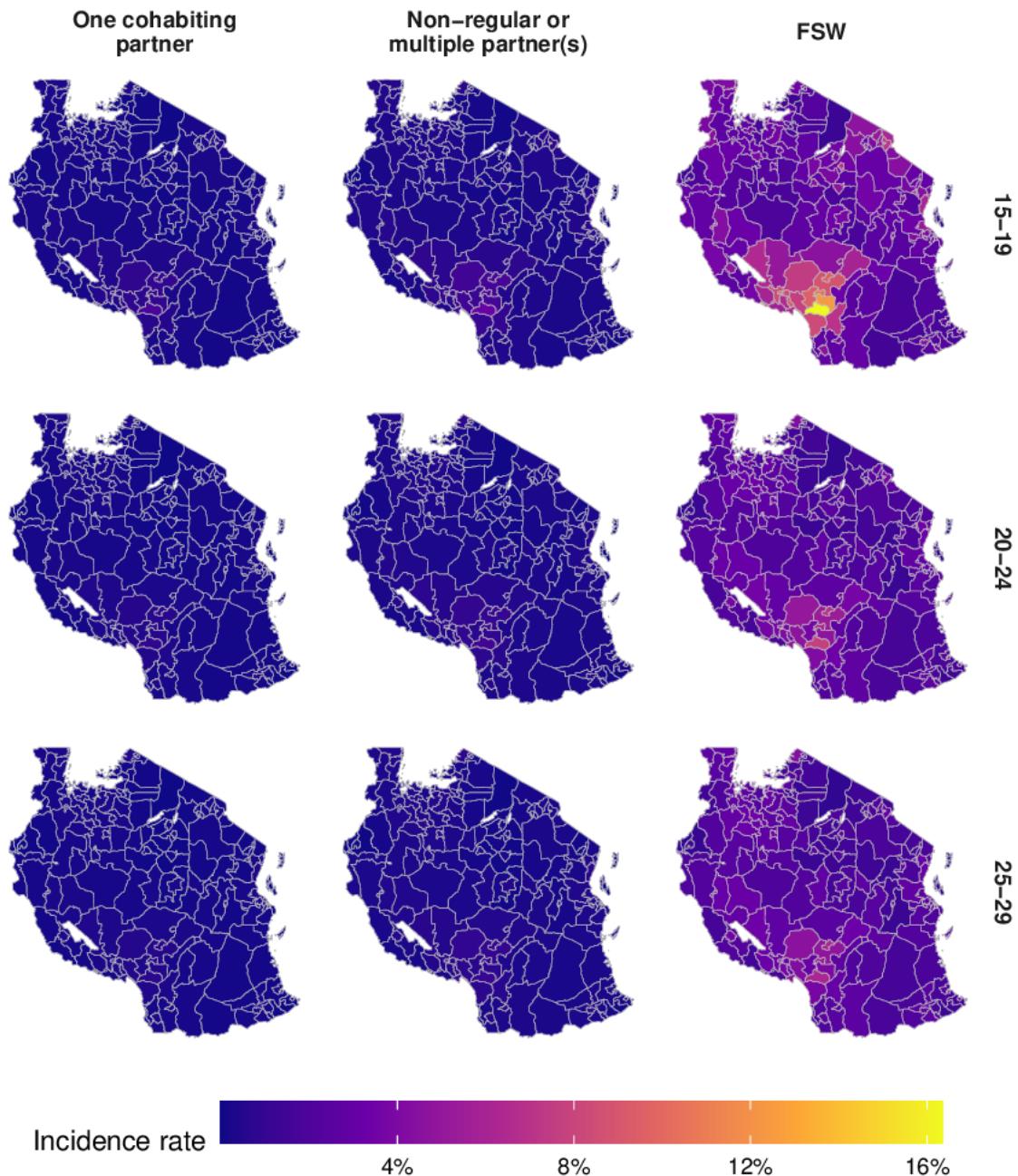


Figure AM: District-level HIV incidence for each of the risk groups in 2018 in Tanzania.

## Uganda

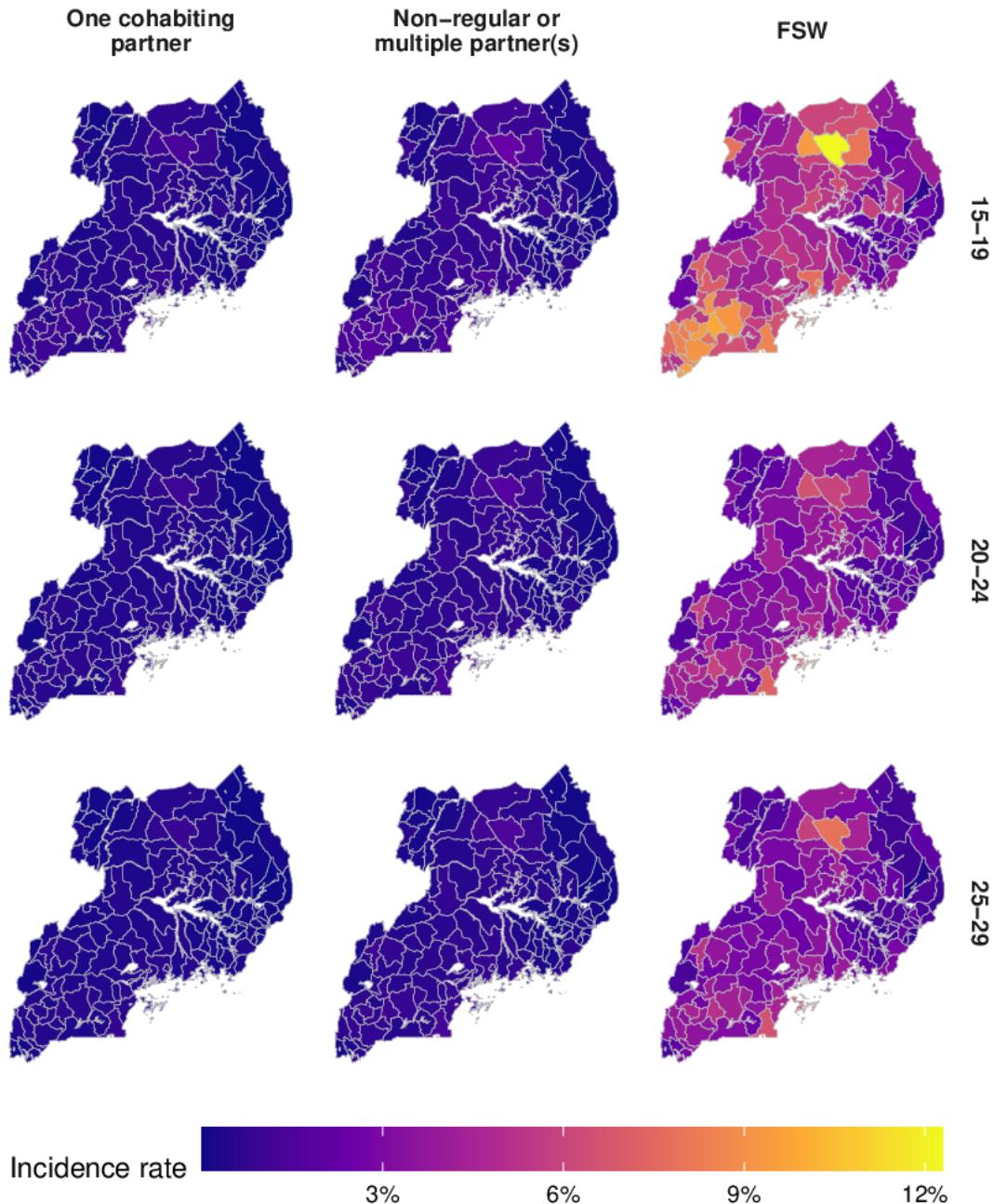


Figure AN: District-level HIV incidence for each of the risk groups in 2018 in Uganda.

## South Africa

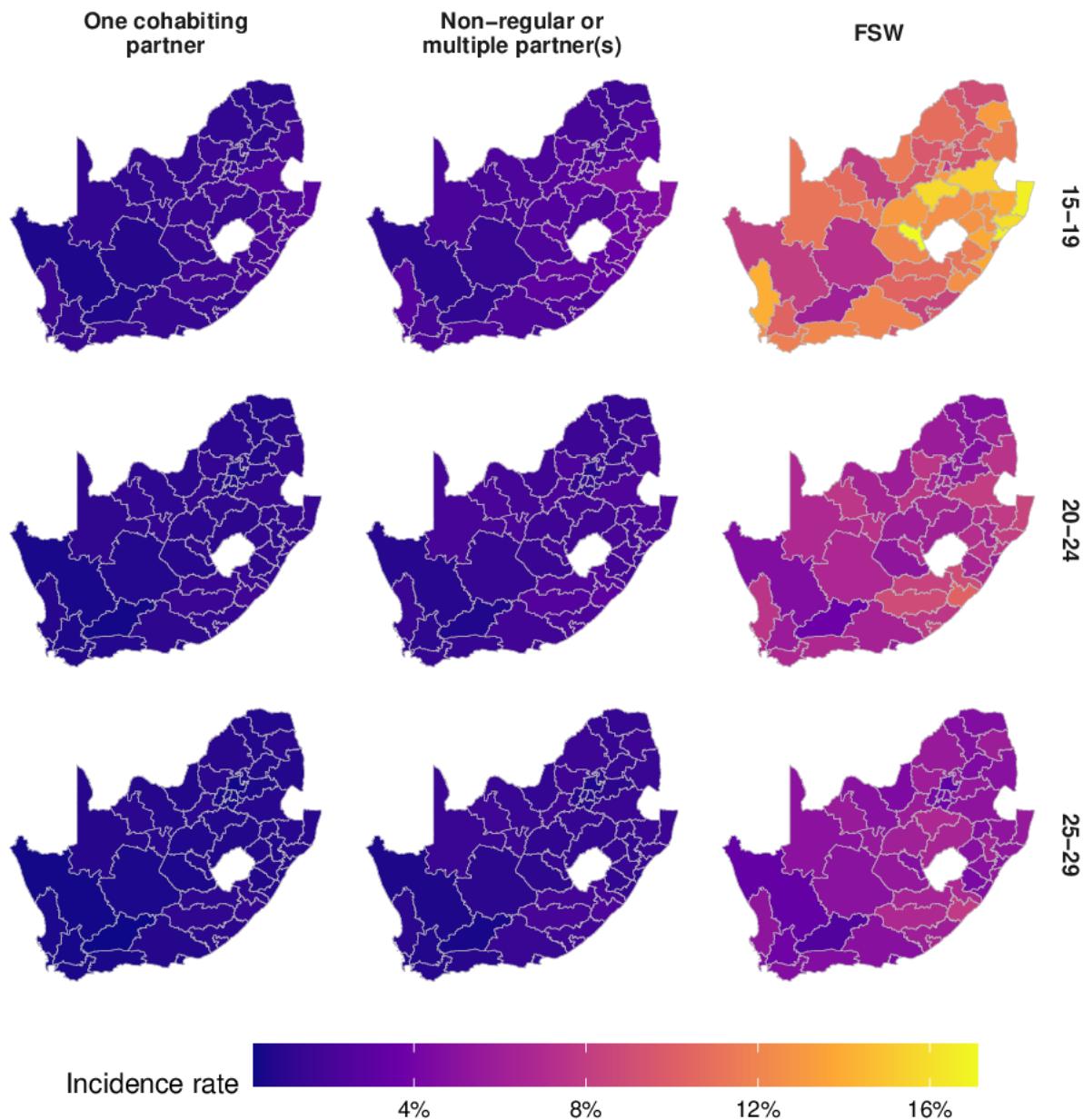


Figure AO: District-level HIV incidence for each of the risk groups in 2018 in South Africa.

## Zambia

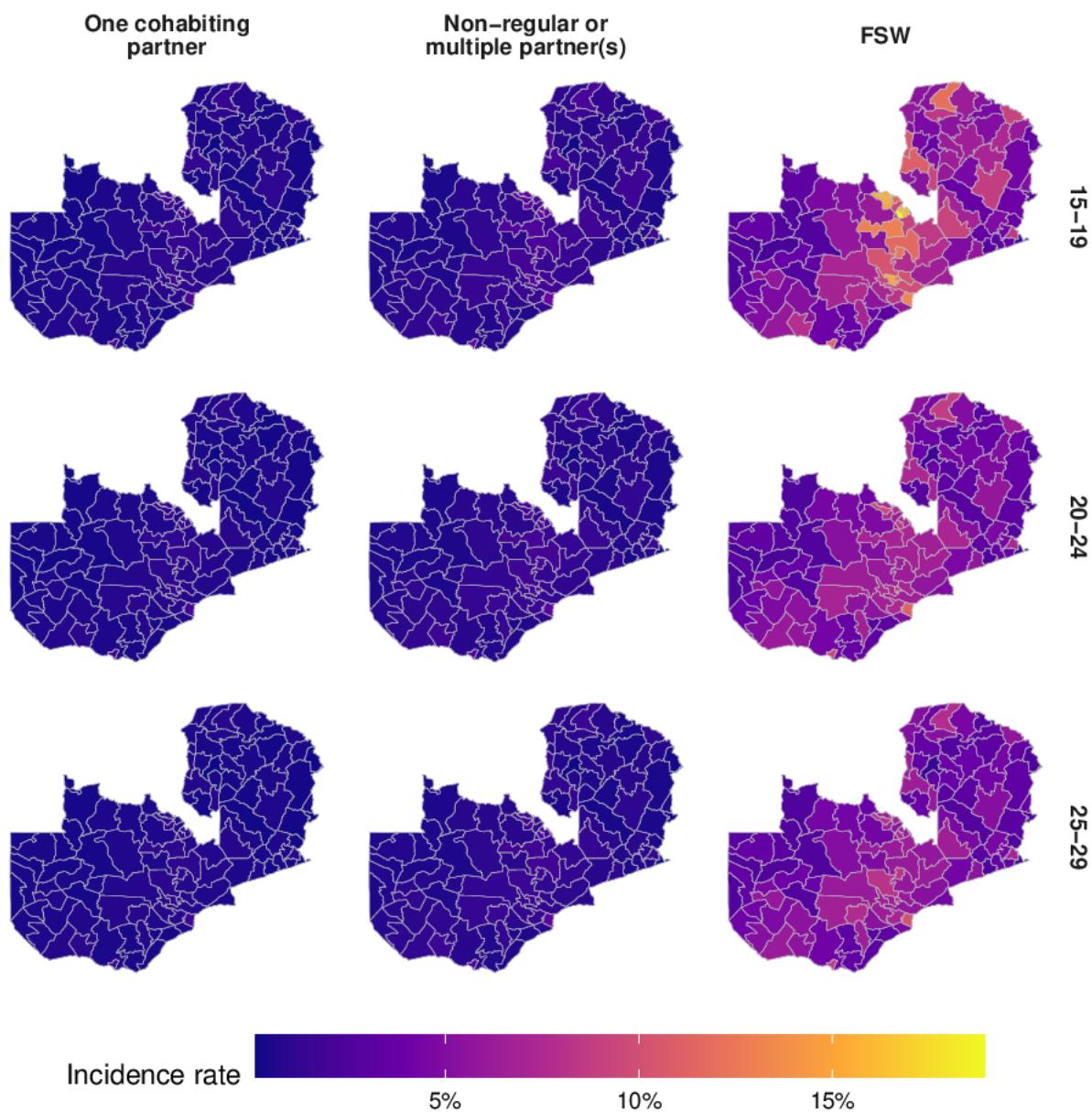


Figure AP: District-level HIV incidence for each of the risk groups in 2018 in Zambia.

## Zimbabwe

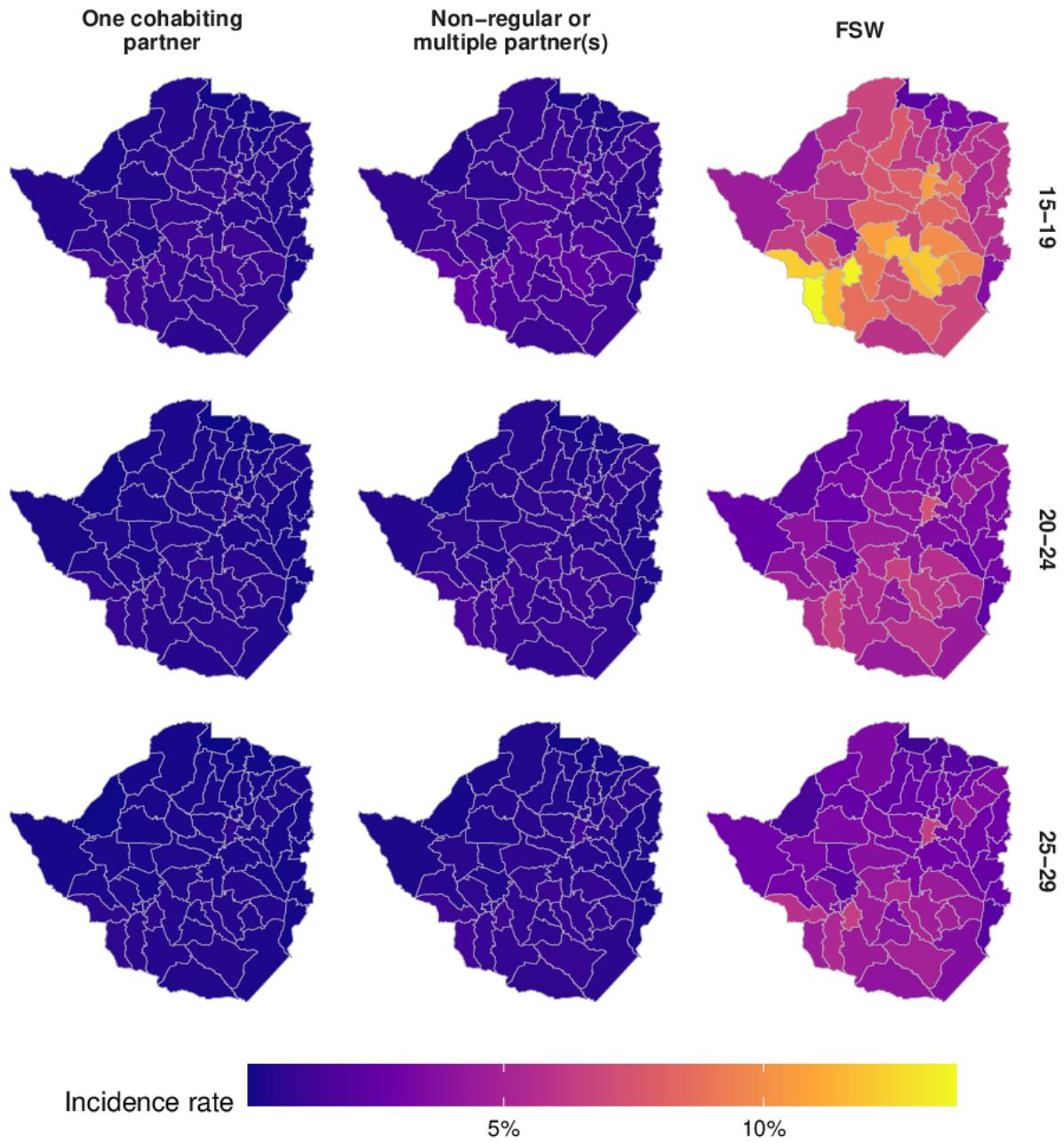


Figure AQ: District-level HIV incidence for each of the risk groups in 2018 in Zimbabwe.

## Expected new infections reached

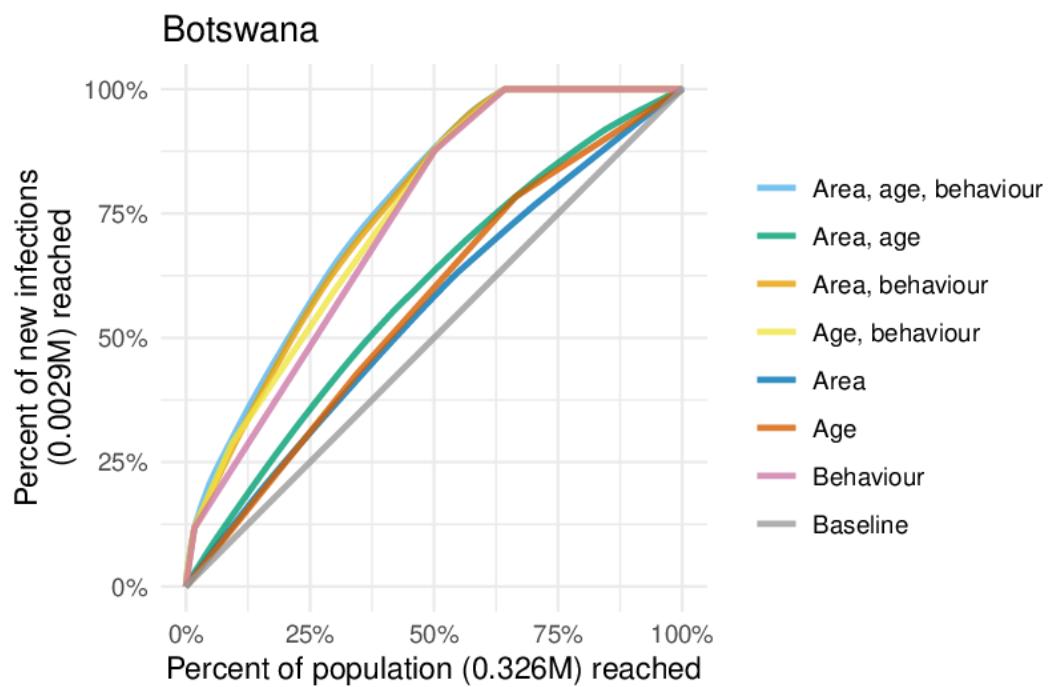


Figure AR: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Botswana.

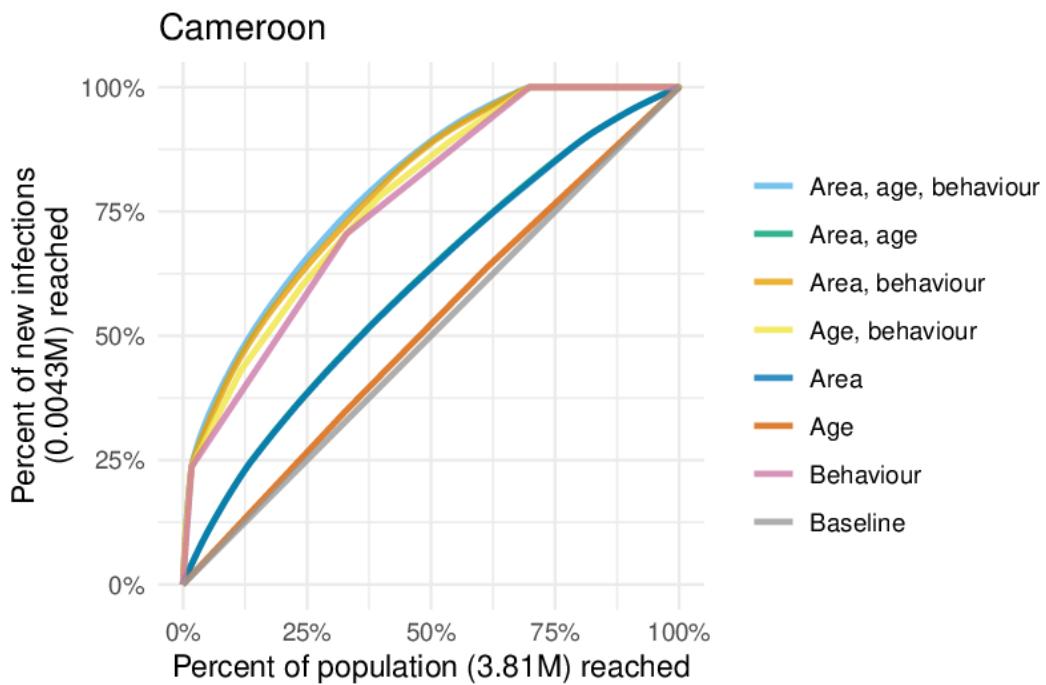


Figure AS: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Cameroon.

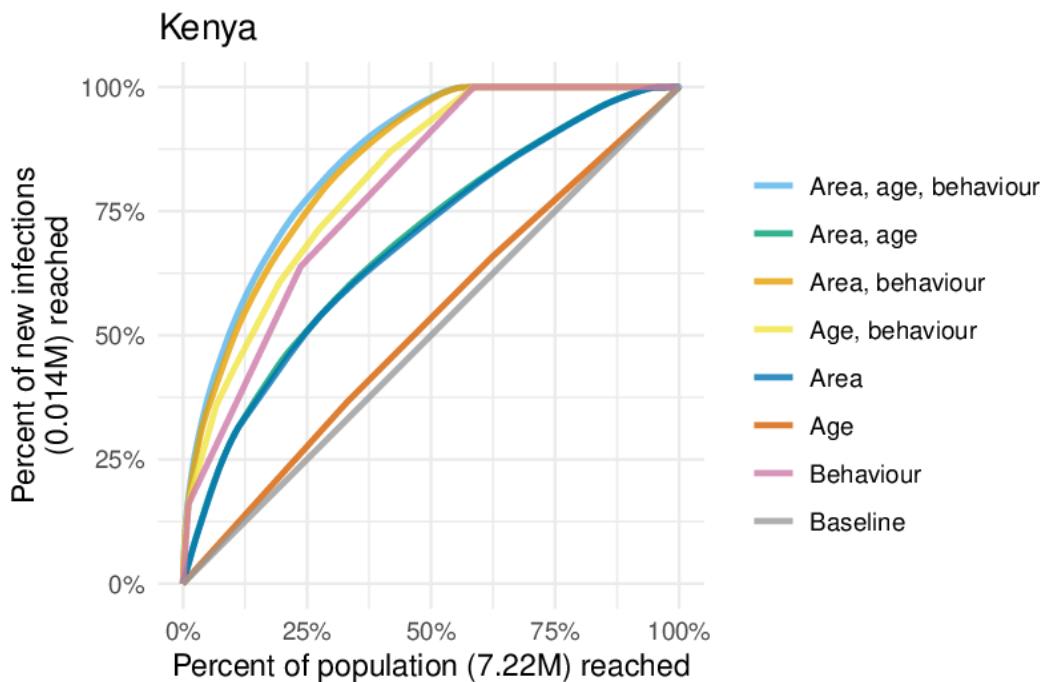


Figure AT: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Kenya.

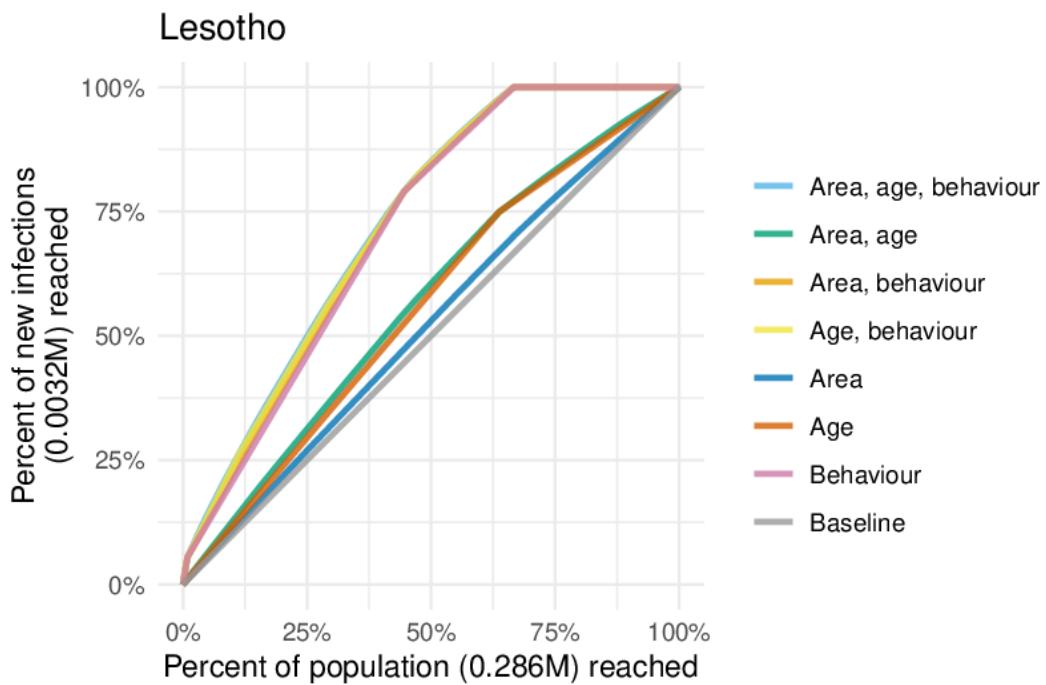


Figure AU: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Lesotho.

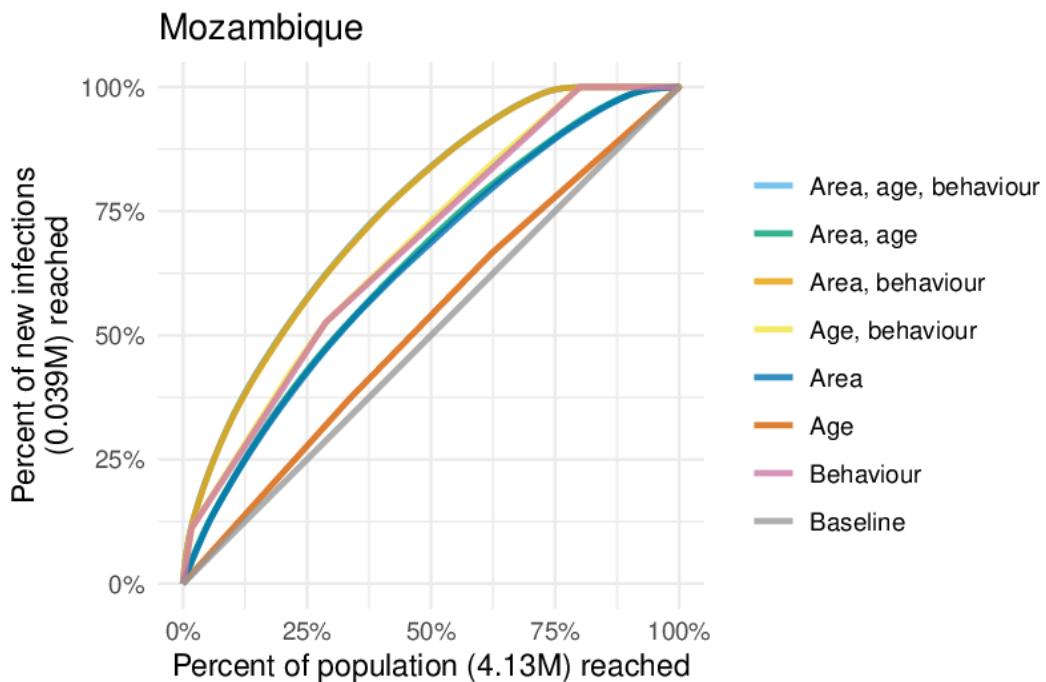


Figure AV: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Mozambique.

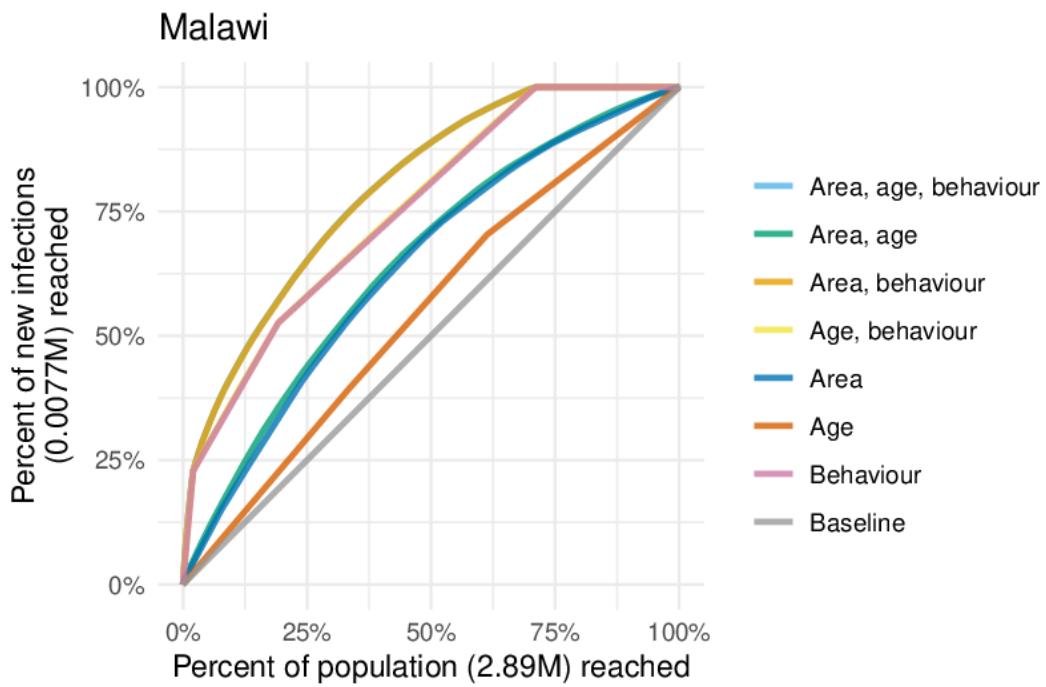


Figure AW: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Malawi.

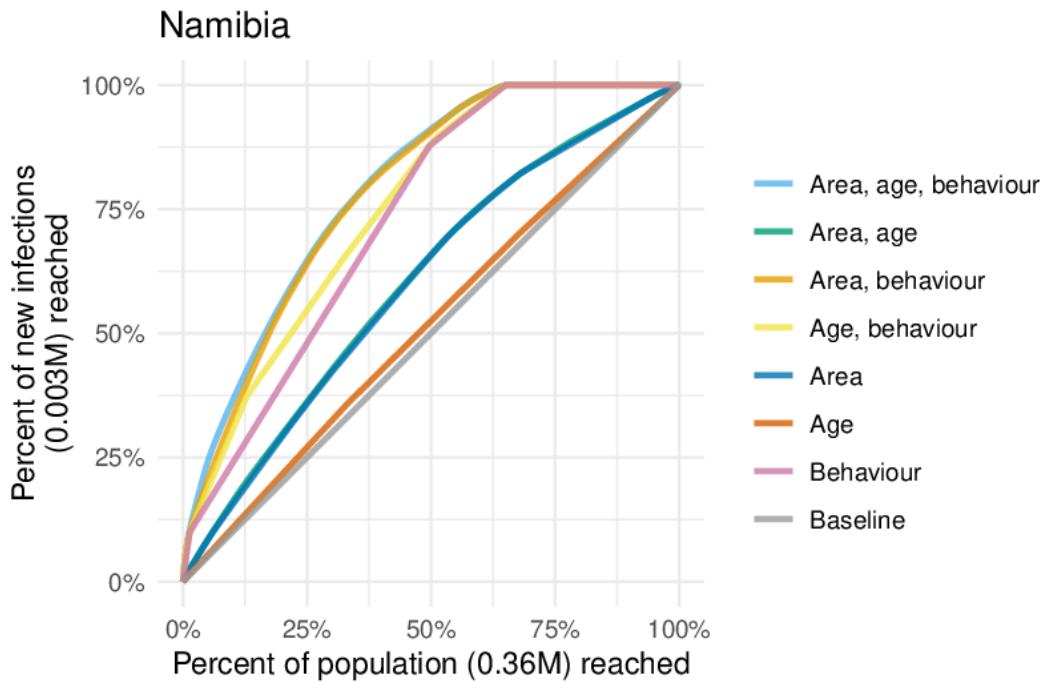


Figure AX: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Namibia.

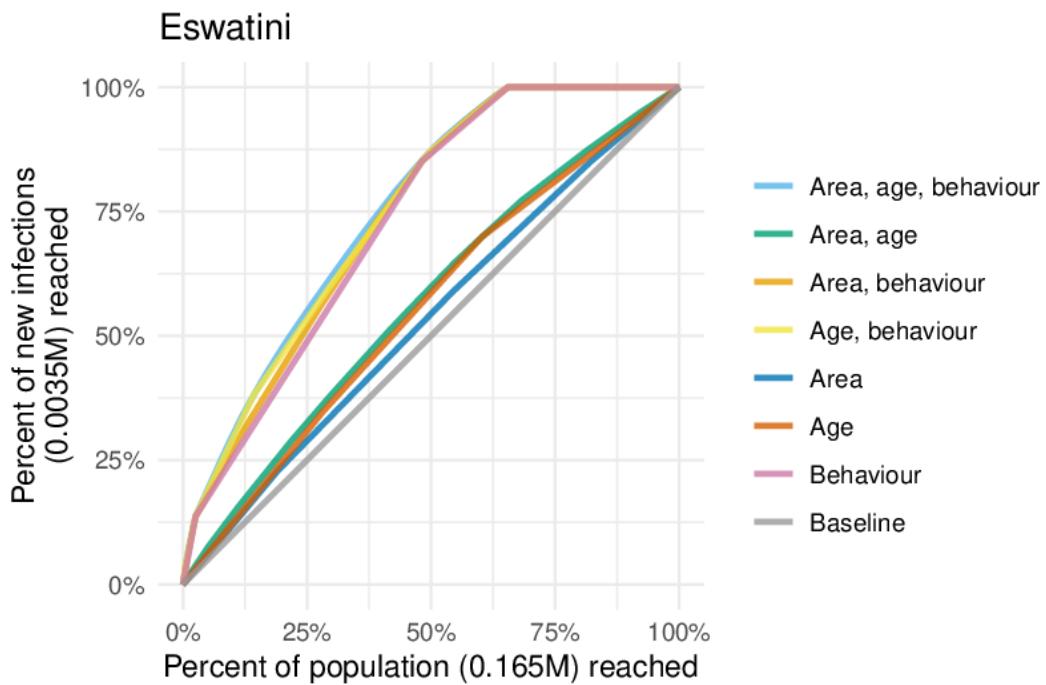


Figure AY: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Eswatini.

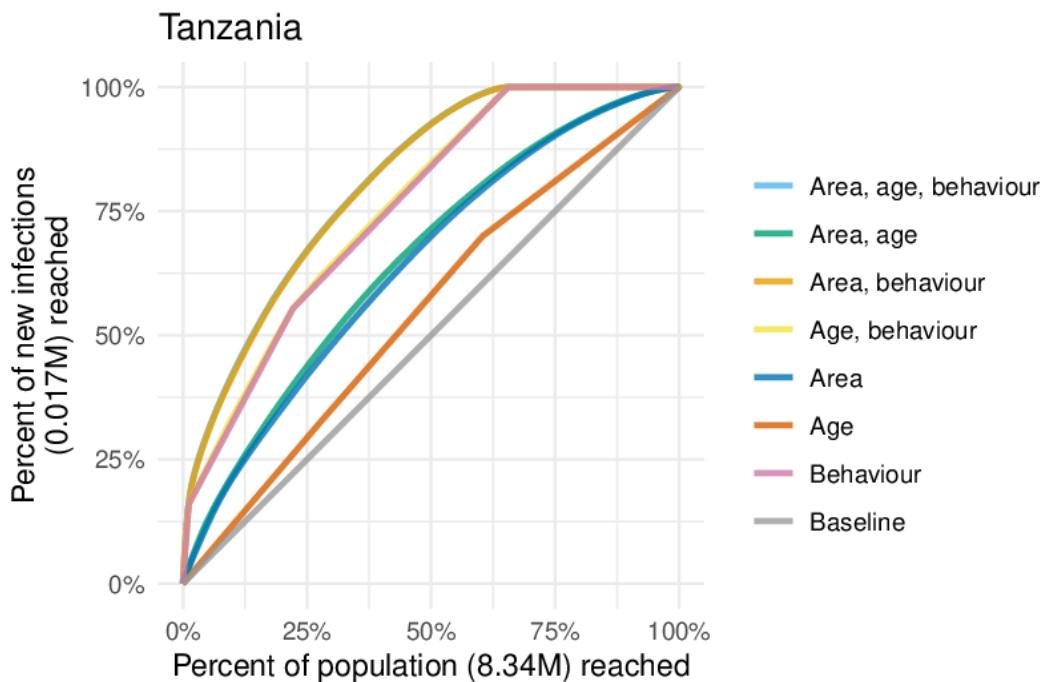


Figure AZ: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Tanzania.

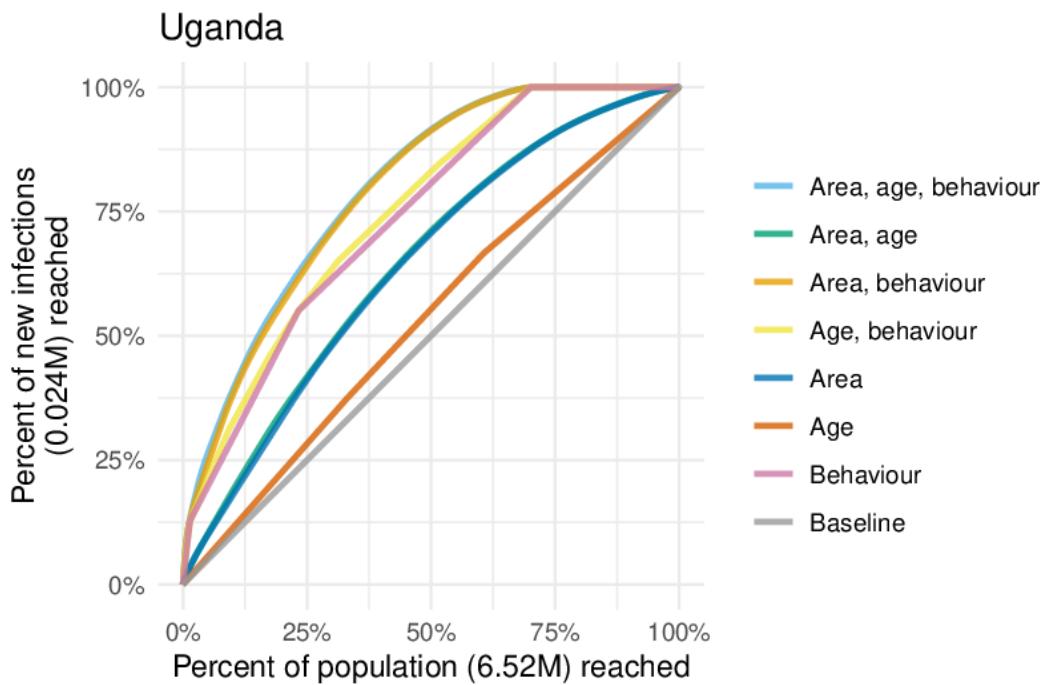


Figure BA: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Uganda.

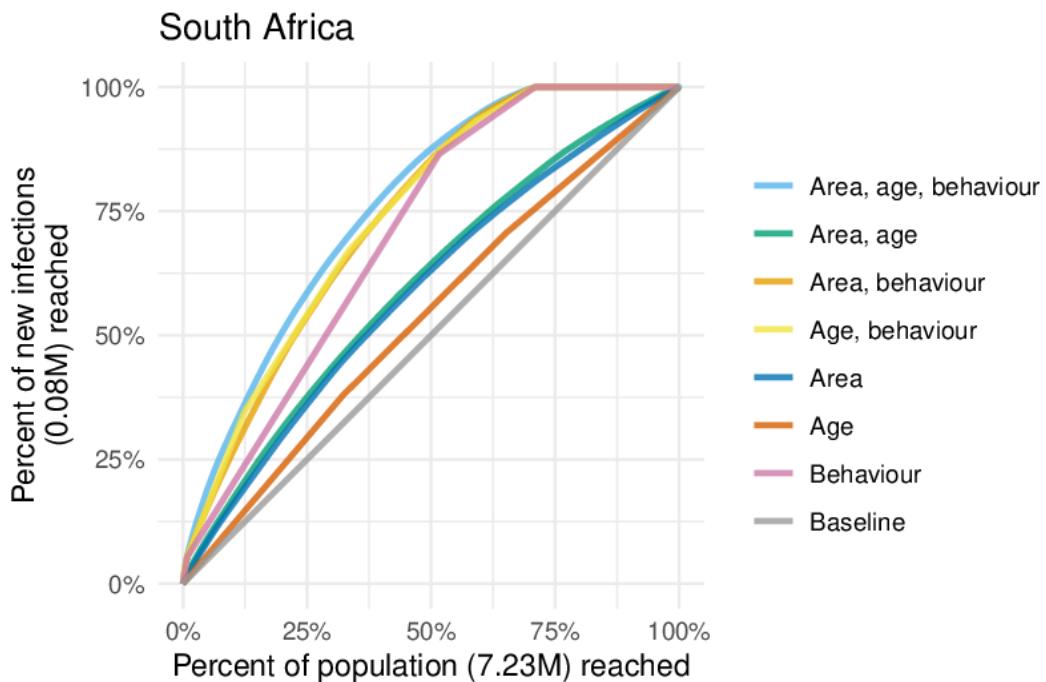


Figure BB: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in South Africa.

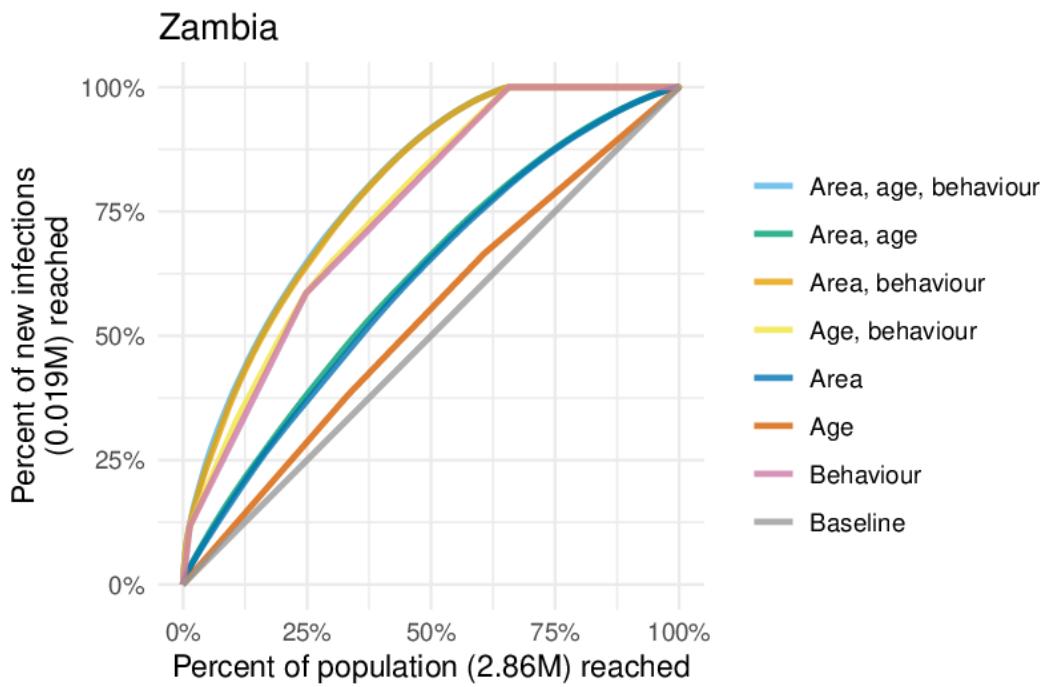


Figure BC: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Zambia.

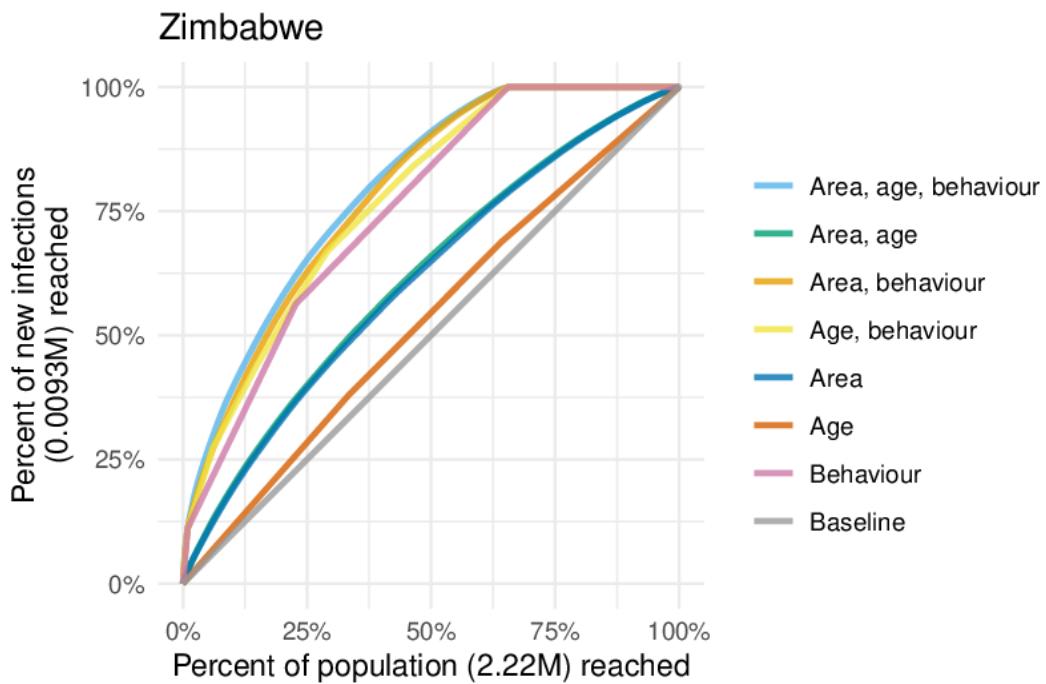


Figure BD: Percentage of expected new infections reached taking a variety of risk stratification approaches against the percentage of at risk population reached in Zimbabwe.