



Background

Circumcision reduces the risk of female-to-male HIV transmission by ~60%

- WHO recommends circumcision as an important additional HIV prevention strategy
- Circumcision prevalence is on the rise in rural KwaZulu-Natal, South Africa as a result of recent circumcision interventions
- The benefits of circumcision, however, may be negated by risk compensation (i.e. increases in risky sexual behaviors because of the biological HIV risk reduction following circumcision)
- To date, measurements of risk compensation in sub-Saharan African have been largely limited to RCTs

Using a population-based longitudinal dataset, we test the risk compensation hypothesis for the first time in a “real world” sub-Saharan African setting

Methods

Data

Longitudinal demographic surveillance data from a site in KZN, South Africa monitored by the Africa Health Research Institute

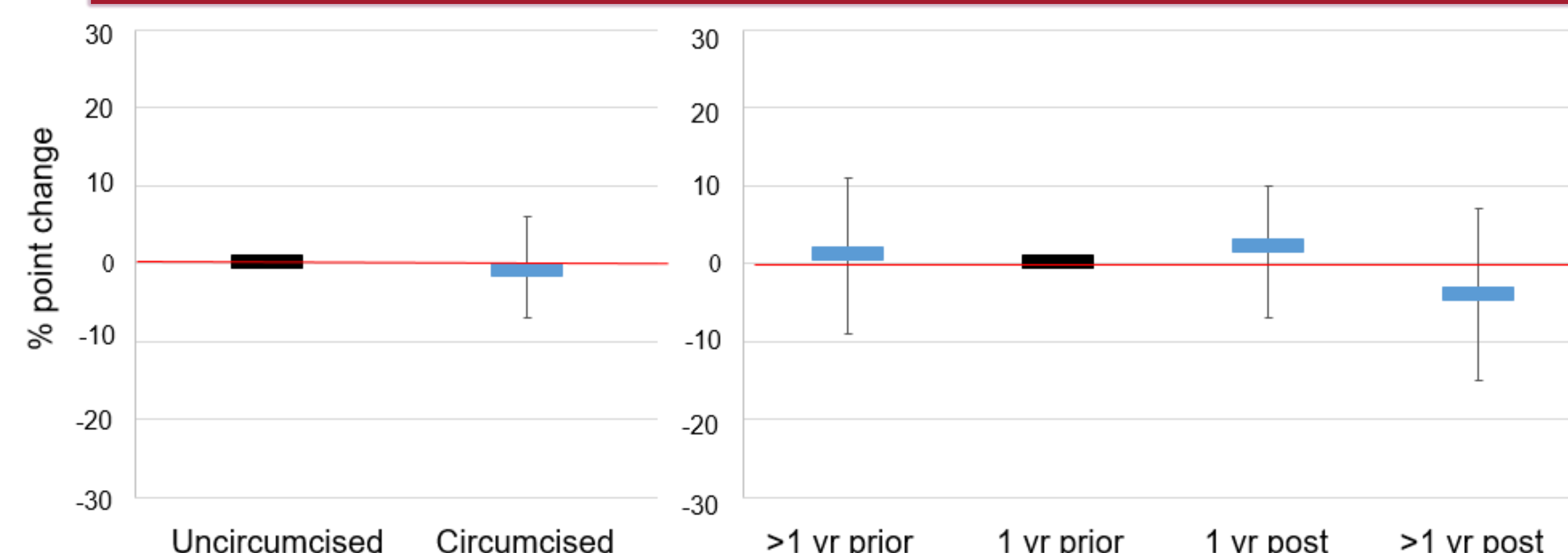
- Annual surveillance since 2003, self-reported circumcision status collected in 2003 then 2009 to 2014
- **Risk compensation:** used four distinct variables: (1) self-reported condom no use at last sex, (2) regular condom use = “never”, (3) current relationship count, and (4) number of sexual partners in the last 12 months. Among all years of observation with self-reported circumcision status, 76%, 64%, 63% and 64% of these respective variables were missing; missing data was dropped from the analyses.
- **Circumcision:** measured this using two different measurements: (1) a binary circumcision indicator and (2) a categorical circumcision indicator that accounted for time preceding and following circumcision (>1yr pre, 1yr pre, 1yr post, >1yr post). We assumed individuals remained circumcised after their first report and that the date of circumcision occurred midway between the last non-circumcised and first circumcised self-report
- **Covariates:** included calendar year and age (linear and quadratic transformation).

Models

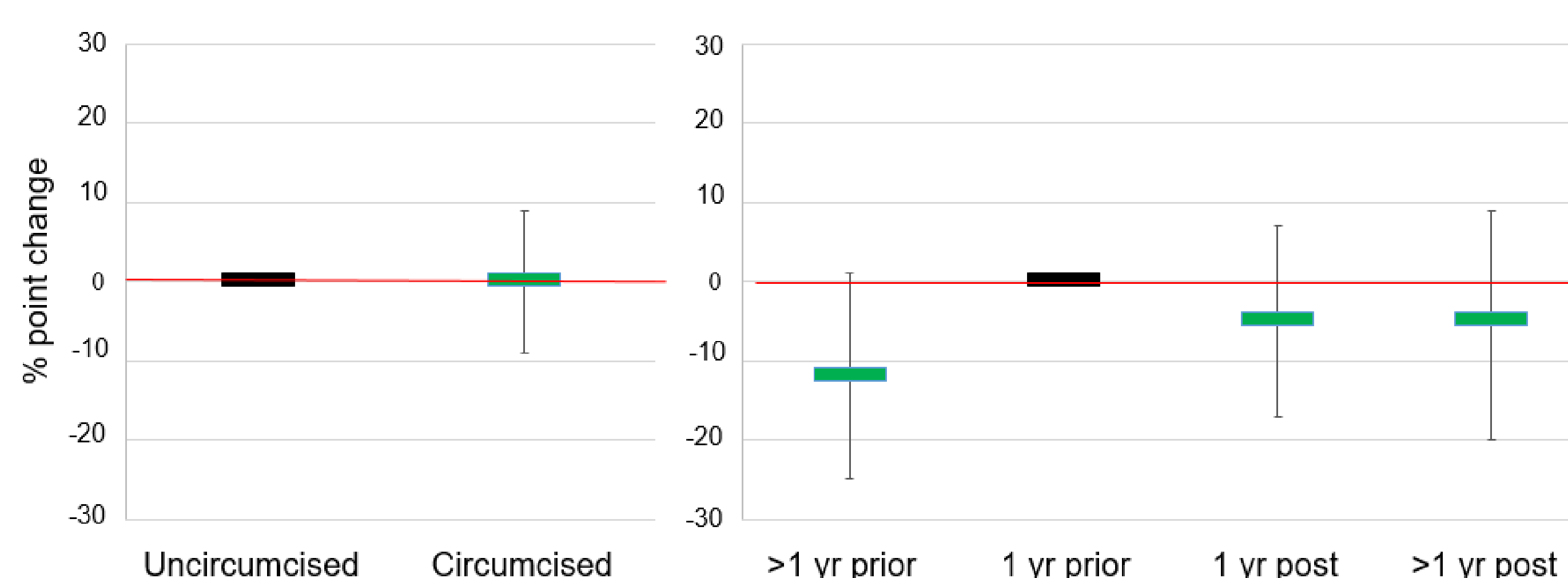
Multivariable models with individual fixed effects were used to determine the impact of circumcision on risk compensation

- **Eight different models were run;** two models for each of the four risk compensation variables. The first of each of these models included (a) binary circumcision status as an explanatory variable and the second included (b) categorical circumcision status as an explanatory variable.
- **Fixed effects** absorbed all non time varying confounders at the individual level
- **Linear fixed effects models** were used to measure all risk compensation outcomes. Positive coefficients suggest increase risk taking behaviors, while negative coefficients suggest decreased risk taking behaviors, Figures 1-4.

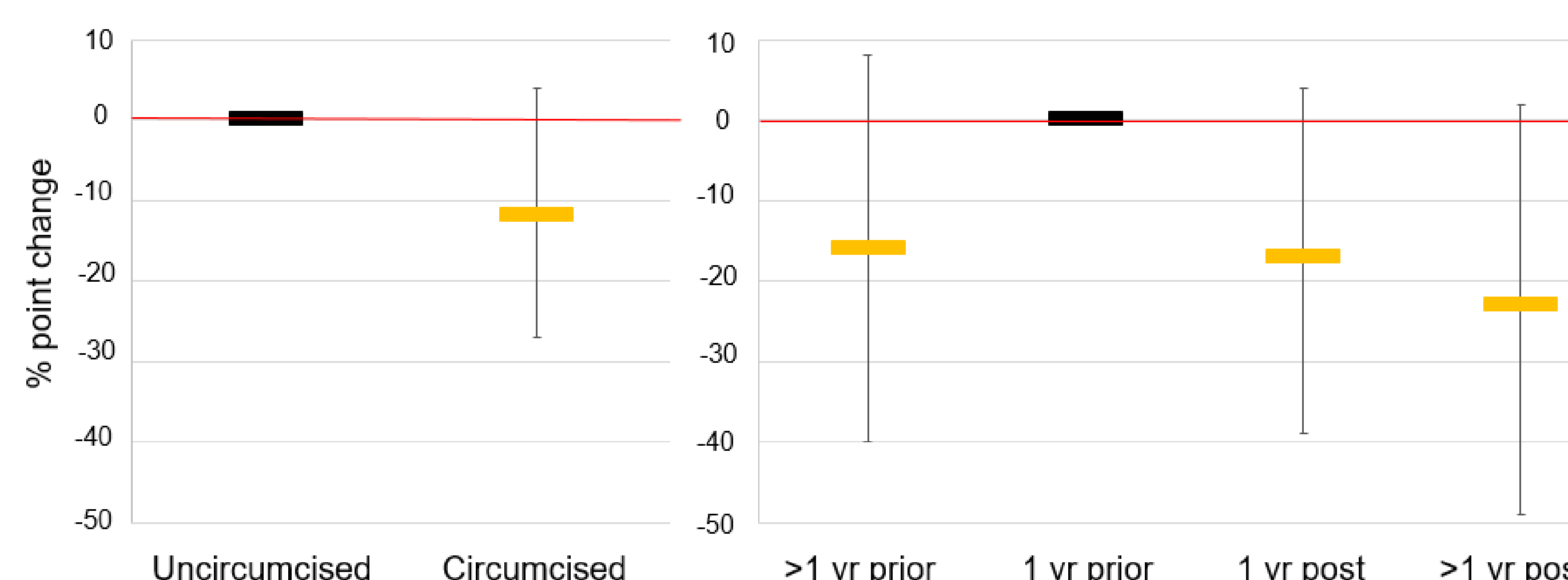
Results



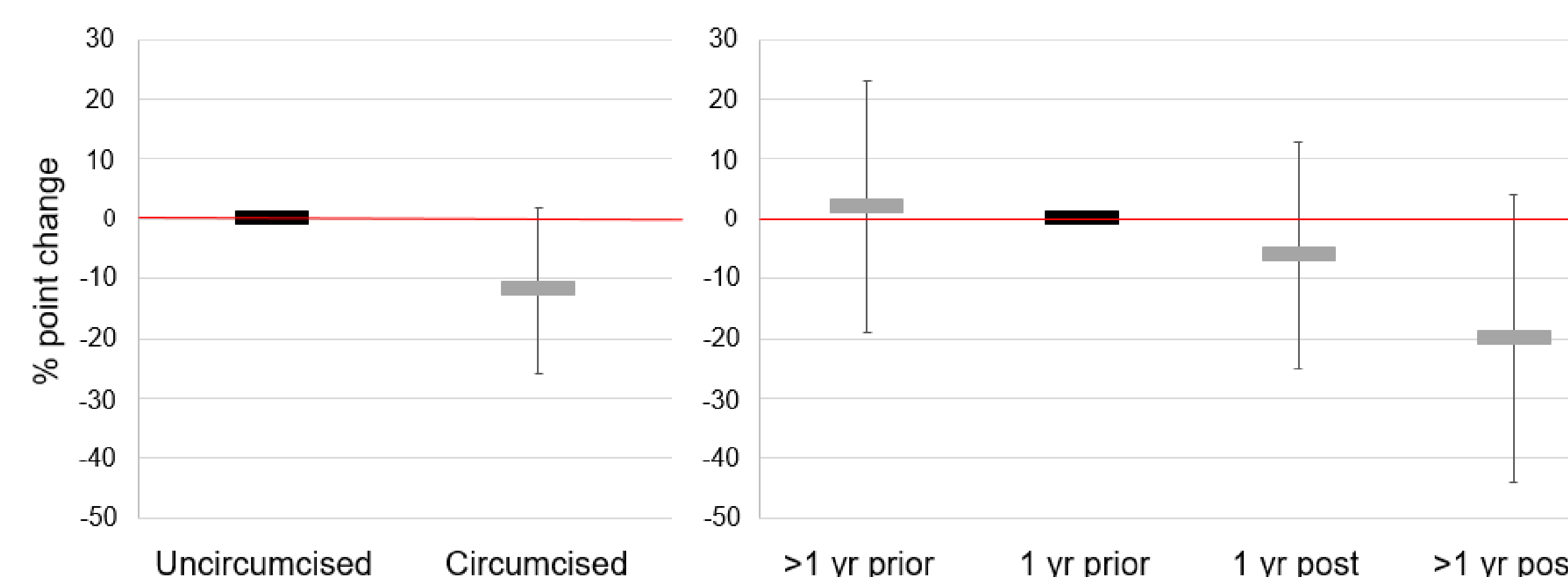
Figures 1a & 1b. Self-reported circumcision and condom use at last-sex* (N=5,294; PY=6,829)



Figures 2a & 2b. Self-reported circumcision and “never” using condoms on a regular basis* (N=7,472; PY=10,102)



Figures 3a & 3b. Self-reported circumcision and current relationship count* (N=7,818; PY=10,671)



Figures 4a & 4b. Self-reported circumcision and the number of sexual partners in the last month* (N=7,440; PY=10,045)

**(a) binary circumcision status, (b) years to and from circumcision incidence; black bar indicates reference category; red line indicates zero value; % point change = change in the probability (expressed in %) of the outcome occurring*

Characteristic	N/PY (%)
Age (median, IQR)	23 (18 to 38)
Age at sexual debut (median, IQR)	17 (16 to 19)
Years in school (median, IQR)	10 (7 to 12)
Married (N, %)	1905 (12.7%)
Ever circumcised (N, %)	1944 (13.0%)
HIV-positive (N, %)	1831 (12.2%)
Employment (PY, %)	6,091 (32.3%)
Newly circumcised, from 2009-2014 (N, %)	954 (6.4%)
Condom use at last sex (PY, %)	
Used condom	5,200 (76.1%)
Didn't use condom	1,629 (23.9%)
Regular condom use (PY, %)	
Always	3,185 (31.5%)
Sometimes	3,487 (34.5%)
Never	3,430 (34.0%)
Current relationship count	
Median (IQR)	1 (1 to 1)
Number of partners in last 12 months	
Median (IQR)	1 (1 to 1)

Table 1. Demographic and socioeconomic characteristics of the study sample (N=14,997; 27,956 person-years observation)

Conclusion

We find no evidence for risk compensation in sexual behavior following circumcision in a high HIV prevalence population using population based surveys

- If anything, circumcision appears to be associated with slightly decreased risk taking behaviors, however, none of the coefficients across all eight models were significant.
- Limitations of this analysis include misreporting in sexual behaviors and high percentages of missing data for the four outcome variables, but it is not unreasonable to assume the outcome data to be missing at random by circumcision status
- Based on this analysis, the often-hypothesized risk compensation phenomenon is unlikely to reduce the impact of VMMC campaigns on HIV incidence in a “real-life” setting

Circumcision should continue to be scaled up as a key HIV prevention strategy and newly circumcised males should continue to be counseled on the importance of condom use.

Acknowledgements

All individuals in the uMkhanyakude district of KZN, South Africa who participated in the AHRI surveillance and the AHRI team that collected and catalogued this data. Research support: T32AI007535-16A1 (PI: George Seage).

Host Organization

1. Harvard T.H. Chan School of Public Health, Department of Global Health and Population, Boston, USA
2. University College London, United Kingdom
3. Africa Health Research Institute, Mtubatuba, South Africa
4. Institute of Public Health, Heidelberg University, Germany