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Fearon, Elizabeth; Phillips, Andrew; Mtetwa, Sibongile; Chabata, Sungai; Mushati, Phillis; Cambiano, Valentina; Busza, Joanna; Napierala, Sue; Hensen, Bernadette; Baral, Stefan; +4 more... Weir, Sharon; Rice, Brian; Cowan, Frances; Hargreaves, James; (2019) How can programmes better support female sex workers to avoid HIV infection in Zimbabwe? A prevention cascade analysis. *Journal of Acquired Immune Deficiency Syndromes*. ISSN 1525-4135 DOI: <https://doi.org/10.1097/QAI.0000000000001980>

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Title: How can programmes better support female sex workers to avoid HIV infection in Zimbabwe? A prevention cascade analysis

Running Head: A prevention cascade for condoms and PrEP

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Presented at IAS AIDS 2018 conference in Amsterdam, July 2018, not otherwise published.

Conflicts of Interest and Source of Funding

We have no conflicts of interest to report. These analyses were funded by the Bill and Melinda Gates Foundation via the Measurement and Surveillance of HIV Epidemics Consortium, OPP1120138. The original trial from which data was collected was funded by DFID, Swedish SIDA and Irish Aid via Zimbabwe's Integrated Support Programme, and UNFPA.

Abstract

Background

'HIV prevention cascades' have been proposed to support programmes by identifying gaps in demand for, access to and capability to adhere to HIV prevention tools, but there are few empirical examples to guide development. We apply a prevention cascade framework to examine prevention coverage and factors associated with condoms and/or PrEP adherence among female sex workers (FSW).

Setting

Seven sites across Zimbabwe.

Methods

Seven respondent-driven sampling (RDS) surveys from the intervention sites of a pragmatic cluster-randomised trial in Zimbabwe in 2016 were analysed, and 611/1439 women testing HIV-negative included. We operationalised key components of an HIV prevention cascade including demand, supply and capability to adhere to two tools for HIV prevention: condoms and Pre-Exposure Prophylaxis (PrEP). We used adjusted logistic regression to identify determinants of adherence to condoms and PrEP in turn, examining the effect of adherence to one tool on adherence to the other.

Results

There were 343/611, 54.7%, women reporting adherence to condoms and/or PrEP, leaving almost half uncovered. While women were aware that condoms prevented HIV and reported good access to them, only 45.5% reported full adherence to condom use. For PrEP,

a new technology, there were gaps along all three domains of demand, supply and adherence. Alcohol use decreased adherence to PrEP and condoms. Younger and newer entrants to sex work were less likely to take PrEP every day.

Conclusion

HIV prevention programming among FSW in Zimbabwe could consider increasing awareness of PrEP alongside supply, alcohol use interventions, and approaches to engaging younger women.

Key words

HIV prevention; Condoms; Pre-exposure Prophylaxis; Sex workers; sub-Saharan Africa; Zimbabwe

Introduction

UNAIDS has set ambitious goals for reducing global HIV incidence through its HIV Prevention 2020 framework¹. Meeting these targets requires increasing coverage of populations at risk of HIV acquisition, including female sex workers (FSW). Programmes will need to ensure that demand for primary HIV prevention is high, evidence-based and rights-affirming HIV prevention tools are available and accessible, and adherence to prevention tools over time is monitored and supported.

In Zimbabwe, sex work is illegal and stigmatised, and FSW are at high risk of HIV. Incidence has been estimated at 10% per year² and site HIV prevalence estimates range between 40-80%^{3,4}. Regionally, HIV prevalence is 13.5 times higher among FSW than among all women aged 15-49 years⁵. Structural factors including poverty and economic shocks, criminalisation, and stigma interact to raise the risk of HIV acquisition among FSW via causal pathways affecting their vulnerability to violence, ability to negotiate with clients, access, carry and use condoms, and receive services and sensitive healthcare⁶⁻¹⁰.

Two tools that HIV-negative FSW could use to reduce their risk of acquiring HIV are 1) consistently taking Pre-Exposure Prophylaxis (PrEP) and 2) using condoms consistently. To increase the proportion of FSW effectively using these prevention tools, programmes will need to achieve three aims. First, they must ensure that there is high 'demand' for these tools among FSW by supporting them to perceive their risk of HIV, providing information and education about their effectiveness, and working towards a normative environment that supports their use. Second, programmes will need to ensure that FSW have geographic, financial and stigma-free access to these tools ('supply'). Third, programmes will need to

work to ensure FSW are capable of using the tools consistently over the period when they are at risk of acquiring HIV, which may require addressing both individual and structural factors that could inhibit adherence. These three 'steps' - demand, supply and capability to adhere - have been proposed as an 'HIV prevention cascade' analogous to the HIV treatment cascade, to help programmes identify gaps in HIV prevention programmes, target their efforts and select among possible interventions.

While templates for HIV prevention cascades have been suggested for individual prevention tools¹¹⁻¹⁵, programmes need to understand how use of different prevention tools might interact with each other, for instance in terms of risk compensation or with respect to how experience with one tool might affect demand for another, as well as how individual FSW characteristics might influence coverage. In this study, we apply a novel 'dual' prevention cascade framework to measure the extent to which HIV-negative FSW from seven sites in Zimbabwe had demand for, were supplied with, and reported adherence to two prevention tools: either condoms and/or PrEP. Previous studies have found that lower levels of condom use among FSW are associated with alcohol consumption¹⁶, unsupportive relationships with other FSW¹⁷, experience of violence, and police harassment¹⁸. Condom use can differ by partner type, (spouse or steady partner versus a commercial client), and strength of relationship with clients^{19,20}. Once introduced to PrEP conceptually, FSW have expressed high interest in using it²¹, though as yet, there is limited evidence on factors influencing PrEP adherence among FSW specifically. Among men who have sex with men (MSM) and transgender women, adherence to PrEP has varied by structural factors including race, education and economic security²²⁻²⁴. Across demonstration trials, being under 30 years was found in meta-analysis to be associated with lower PrEP adherence²⁵.

Here, we examine where there are gaps in support for prevention, and which FSW characteristics and experiences are associated with adherence to condoms and to PrEP. We identify a number of limitations to our approach based on secondary data and discuss these in detail, hoping that we will inspire others to continue to strengthen the data available for prevention cascades. Nevertheless, based on our findings, we make recommendations for strengthening HIV prevention in Zimbabwe's national sex worker HIV programme.

Methods

Setting and population

This study is a secondary analysis including HIV-negative FSW from seven sites, which formed the intervention arm of the Sisters Antiretroviral Programme for Prevention of HIV: an Integrated Response (SAPPH-IRe) trial. This was a cluster (site)-randomised trial of an enhanced HIV care and prevention package for FSW in fourteen sites reflecting different sex work location types, including towns, growth points, collieries and army bases. In all sites, the national sex work 'Sisters with a Voice' programme (Sisters) provided free condoms and contraception, HIV testing and counselling, syndromic management of STI's, health education, community mobilization, and legal advice. In the seven intervention sites, community mobilisation was enhanced, clinical services to initiate ART and PrEP were available on-site and community-based support for ART and PrEP adherence was provided. PrEP was offered to all women testing HIV-negative from July 2014 (November 2014 in one site) until endline in May 2016, along with a peer-based support programme and active follow-up. At this time in Zimbabwe, the SAPPH-IRe trial was the only way FSW could access PrEP.

Cross-sectional respondent driven sampling surveys (RDS) of approximately 200 women per site were conducted at study endline, with sample size determined by the primary trial outcome²⁶. Women were eligible if they had sold sex for money in the past 30 days, were aged 18 or older, and had been living/working in the site for six months. Because SAPPH-IRe was a pragmatic trial, we used RDS to obtain population-representative estimates amongst FSW at each site to assess the impact of the intervention on the FSW population as a whole, not only those who had had some contact with the enhanced Sisters intervention. We

describe detailed procedures elsewhere²⁷. Following mapping at each site, we purposefully selected initial ‘seeds’ of six or eight women, issued two coupons for recruitment and reached five sample waves. Interviewers administered the questionnaire and entered data onto tablet computers, uploaded to a master database daily. A capillary blood sample was collected on dried blood spot for HIV antibody testing and, if reactive, HIV viral load measured.

Measures

HIV status was assessed using the AniLabsystems EIA kit (AniLabsystems Ltd, OyToilette 3, FIN-01720, Finland) and confirmed by detectable viral load using NucliSENS EasyQ HIV-1 v2.0, or a second confirmatory ELISA (Enzygnost Anti-HIV 1/2 Plus ELISA, Germany) if no viral load was detected but the antibody test was positive.

Participants self-reported sociodemographic characteristics, FSW social network size, and sex work characteristics. For the prevention cascade analysis, we defined measures of adherent condom use or adherent PrEP use, denoting ‘coverage’ by reporting the use of one or both prevention tools. We asked women to recall condom use with steady partners and clients over different periods (last sex and previous month), and used prompting questions for women reporting “always” using them to confirm this. For the primary analyses, we denoted women as ‘adherent to condoms’ if they reported no instance of condomless sex: at last vaginal sex, last anal sex, last sex with a client, nor in describing frequency of condom use with clients in the past month, at last sex with a steady partner not reported to be known as HIV-negative, and not in describing frequency of condom use in the last month with a steady partner not known as HIV-negative. For PrEP, we considered FSW as adherent

if they self-reported that they were currently taking PrEP and that they were taking it every day.

Next, we identified variables related to the concepts of 'demand' and supply'. In relation to demand for PrEP, we used self-reported data on whether women had heard of PrEP (recognising this is only one dimension of demand). For condoms, we identified women who reported that condoms can prevent them from getting HIV, again recognising that knowledge is a component of demand²⁸ available in our data, but does not describe it entirely. In relation to PrEP supply, we identified women who reported ever having been offered PrEP in the RDS survey. In relation to condoms supply, we measured whether women reported that condoms were "easily available" to them whenever needed. We recognise and discuss a number of limitations with these variables in Discussion and make recommendations for improvements in future efforts.

We identified variables that may be associated with demand, supply and adherence to condoms and/or PrEP. We examined sociodemographic and sex work characteristics; frequency of alcohol consumption and binge drinking (six or more alcoholic drinks in one night) in the previous 12 months; whether FSW reported 'good' or 'very good' relations with other FSW (concepts investigated in previous studies²⁹), whether they discussed health with other FSW and were encouraged by them; recent experience of being stopped by the police (further Zimbabwe context³⁰); violence; and stigma related to being a sex worker (investigated in a previous study³¹). In assessing condom adherence, we also considered source of condoms (Sisters clinic, peer educator, clients) whether women were stopped by

the police for carrying condoms, had refused a client who was drunk or violent, or had not used a condom because they were drunk, or because a client was drunk.

Analytic Approaches

We have reported RDS diagnostics elsewhere²⁷. For these analyses, we further assessed whether site-specific estimates of condom and PrEP adherence appeared to converge over the recruitment waves (Appendix 1, Supplemental Digital Content 1).

We described the sociodemographic and sex work characteristics of women testing HIV-negative at time of interview. In describing the prevention cascade, we pooled data from across the seven sites but also reported the range of site specific estimates. We used RDS-II weighting when calculating proportions and in regression analyses, dropping seed participants and weighting each woman in each site by the inverse of her 'degree', which we normalised by site when pooling data. We developed a 'dual' HIV prevention cascade, including both condoms and PrEP. We estimated the proportion of HIV-negative women who 'demanded', were 'supplied' and who were able to 'adhere' to condoms and/or PrEP, and therefore the proportion of all HIV-negative women who were 'covered' by either or both HIV prevention method.

To guide the Sisters programme in improving HIV prevention coverage, we examined associations between FSW characteristics and experiences and their reported adherence to condoms and to PrEP. We included factors found in previous research among FSW to determine condom use or those hypothesised to affect adherence to PrEP, and included adherence to PrEP in the model for adherence to condoms and vice versa. We used logistic

regression, dropping seed participants, weighting by site-normalised inverse degree and including a fixed term for site. We present crude associations and associations adjusted for age, education, marital status, food insecurity, age started sex work and number of clients in the previous week.

We examined whether associations differed for adherence to condoms with clients or with steady partners, among those reporting steady partners. We also conducted our analyses without weighting for normalised inverse degree (see Appendix 2, Supplemental Digital Content 1).

All analyses were conducted using R version 3.3.2.

Ethics

The SAPPH-IRe trial, including these analyses, received approval from the Medical Research Council Zimbabwe, University College London, the London School of Hygiene and Tropical Medicine, and RTI International.

Role of the Funding Source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Recruitment

There were 611 HIV-negative FSW among 1439 women recruited to the seven intervention sites in 2016. RDS recruitment worked well and convergence of adherence and HIV measures was achieved in most sites (see Appendix 1, Supplemental Digital Content 1 and trial report)²⁷.

Description of participants and experience of sex work

Mean age among the women was 30.4 years. The majority of women had completed no or primary education only (68.2%) and were divorced/separated (63.1%), Table 1. Most women began sex work after age 20 (67.6%) and had 1-5 clients per week (60.3%). The majority reported 'good' or 'very good' relations with other FSW (71.8%) and almost all agreed or strongly agreed that they felt comfortable discussing health issues with other FSW (96.8%). Similar proportions reported that they experienced physical violence from intimate partners or clients in the past one month: 13.3% and 12.8%, respectively. There were 63.4% who reported that "they had been talked badly about" for being a sex worker and 29.2% said they had felt "ashamed" of being a sex worker. Three-percent reported being denied health services because they were sex workers. Almost half reported no alcohol consumption in the previous year, though 16.5% reported drinking four or more nights per week and 25.7% reported drinking more than 6 drinks in one night at least once in the past 12 months. There were 9.7% and 10.3% respectively who reported that their own or client drinking had prevented them from using a condom at least once in the previous year.

Coverage of HIV prevention: demand, supply and adherence to condoms and/or PrEP

An estimated 54.7% of HIV-negative FSW (site range 33.6-61.8%) were either adherent to condom condoms and/or PrEP, Table 1 and Figure 1. Most (39.1% of all HIV-negative women) were using condoms consistently, but not taking and adherent to PrEP. There were 9.2% who were taking PrEP every day but not adherent to condoms, while 6.4% were adherent to both condoms and PrEP.

Some 94.0% of women reported that they knew that condoms could prevent HIV infection and that they could access condoms, Figure 1. The proportion of women reporting that they were always adherent to condoms across all condom use questions was 45.5% (site range 30.0-57.5%).

Some 60.9% of HIV-negative women had ever heard of PrEP, while 28.8% of HIV-negative women had ever been offered it. There were 15.6% of all HIV-negative women who reported currently taking PrEP and taking it every day.

Measures of condom adherence

Levels of condom adherence varied depending on the measure chosen, Figure 2. Use at 'last sex' measures were higher than measures asking about use over the previous month, which had an additional prompt for those initially answering that they had 'always' used a condom. While 96.3% of women said they had used a condom at last sex with a client, only 50.4% said that they had "always" used condoms with clients over the last month, confirmed by a prompt question. Adherence with steady partners not known to be HIV-negative was 85.1%, of the 418 women who reported steady partners. Across partner types

and ways of asking about condom use, the weighted percentage of women who reported no instance of condomless sex, except with a steady partner known to be HIV-negative, was 45.5%.

Factors associated with condom adherence

Before adjustment, each additional year of age was associated with higher odds of condom adherence (crude OR=1.04, 95% CI 1.02-1.07), as was starting sex work at an older age,

Table 2. After adjustment, some evidence remained that starting sex work at an older age increased the likelihood of condom adherence (aOR=1.05, 95% CI 1.00-1.11). We did not find strong evidence for an association between condom adherence and education, marital status, food insecurity, relationships with other sex workers or experience of stigma.

Unadjusted, there was an association between being stopped or harassed by the police in the past month and reporting non-adherence to condoms (OR=0.40, 95% CI 0.17-0.94), but the evidence for this association reduced once adjusted (aOR=0.50, 95% CI 0.21-1.20). FSW who had experienced client violence in the past month were also less likely to report condom adherence (crude OR=0.46, 95% CI 0.23-0.92) but after adjustment, the evidence for this association also reduced (aOR=0.51, 95% CI 0.25-1.23).

Frequency of alcohol consumption, though not binge drinking, was associated with decreased condom adherence. After adjustment, women who reported that a client's drinking had prevented condom use had 0.22 times the odds of adherence compared to those who did not report this (95% CI 0.07-0.64). Women who reported drinking alcohol two to three times or four or more times per week were also less likely to be adherent, (aOR 0.34, 95% CI 0.16-0.69 for four or more times, compared to no drinking).

Women who had received condoms from a peer educator were more likely to be adherent than those who had not (aOR=1.64, 95% CI 1.01-2.65). Women who reported using condoms brought by clients were less likely to adhere to them than those who did not, (aOR=0.48, 95% CI 0.30-0.78).

Factors associated with adherence to PrEP

Women reporting adherent use of PrEP were more likely to be older, aOR=1.05 for each additional year of age (95% CI 1.01-1.10), but to have begun sex work at a younger age, aOR=0.94 (95% CI 0.89-0.99) for each year; indicating they had a longer duration of sex work than those non-adherent to PrEP, Table 3.

Women who had alcohol two to three times per week were less likely to adhere to PrEP than those who never drank (aOR=0.38, 95% CI 0.15-0.96), though there was not a clear dose response relationship and there was no evidence for decreased adherence among those reporting binge drinking compared to those who drank alcohol but who did not report binge drinking. Adherence to condoms with all partners or with clients only was not associated with PrEP adherence. However, among those women who had steady partners, reported adherence to condoms with those partners was associated with increased likelihood of also being adherent to PrEP (aOR=6.86, 95%CI 1.90-24.74), Appendix 2, Supplemental Digital Content 1, Table 4.

Sensitivity analyses

There were 47 women missing responses to frequency of condom use with clients in the past month, which appeared to be differential by PrEP adherence. We repeated our analyses 1) without weighting participant respondents by normalised inverse degree; 2) with a different treatment for a missing condom use variable; 3) examining condom adherence with clients and steady partners separately. These results are reported in full in Appendix 2, Supplemental Digital Content 1, but did not alter the overall conclusions from the primary analysis.

Discussion

We used an HIV prevention cascade framework¹¹ to investigate levels of prevention coverage among HIV-negative FSW at seven sites in Zimbabwe in 2016. Approximately half of HIV-negative FSW were currently adherent to condoms and/or to PrEP; almost half of HIV-negative FSW are in need of additional strategies to prevent them from acquiring HIV.

Nearly all FSW were aware that condoms could prevent HIV, an aspect of demand, and were able to access condoms when needed, supply. However, there were gaps in adherence: condom use at all occasions, except with a steady partner believed to be HIV-negative, was reported by less than half of women (45.5%). A minority of women reported high alcohol consumption, but this was associated with non-adherence to condoms and some sex workers reported that own or client alcohol use had caused them to have sex without a condom in the past year. Among Kenyan FSW, an adaptation of WHO's Brief Intervention for Hazardous and Harmful Drinking reduced alcohol use³² and experience of client violence, which could be applicable for FSW in Zimbabwe³³. Programming could consider how to support women to use condoms even in situations where they and/or their clients are drinking. While our study found weak statistical evidence for an association between condom adherence and experience of violence and police harassment, alcohol consumption and experiencing violence and harassment have been found to be related in other FSW populations³⁴, and should be explored further.

Women whose clients provided condoms were less likely to be adherent than those who did not, while women who received condoms from a peer educator were more likely to be adherent. FSW depending more on clients could have had a less reliable and trustworthy

supply in practice. Women who meet peer educators are given condom negotiation training and education, which could additionally benefit their condom adherence.

Our measurement of condom adherence confirms the recommendation to use multiple questions in measuring coverage of condom use³⁵. The UNAIDS Global AIDS Monitoring indicator of condom use among FSW - condom use at last sex with a client³⁶- measured adherence at 96%, whereas this dropped to 48% when asking whether women had always used condoms in the previous month. Our findings point to the need for caution when applying this indicator to constructing prevention cascades for FSW, which could give a false impression of high condom adherence.

For PrEP, as expected for a new tool (and in this case available only as part of a trial), there were gaps across demand, supply and adherence. Programmes might need to support younger and newer entrants to sex work to take-up and adhere to PrEP, as well as those women with a higher alcohol consumption, the latter also a concern identified by FSW in Kenya³⁷. PrEP is more likely than condoms to be taken at a time other than when alcohol is being consumed, which might be an advantage. However, our data uses a cross-sectional measure of adherence, and while other studies of FSW have found strong interest in PrEP once FSW are made aware of it, they highlight the need for long-term support to take it^{38,39}.

Our findings point to the importance of considering prevention tools together in a dual prevention cascade. It is important to understand whether women who are not able to use condoms consistently are able to use PrEP. There are also fears of 'risk compensation' in relation to PrEP usage, whereby those on PrEP increase their frequency of condomless sex,

though the evidence for changes in sexual risk behaviours, reported condom use, and STIs among men who have sex with men and transgender women starting PrEP has been mixed^{23,40-42}. Overall, we did not find a statistically significant relationship between condom and PrEP adherence except among women with steady partners in our study, where condom adherence with partners not known to be HIV-negative was associated with a higher likelihood of PrEP adherence than condom non-adherence. These women might have been more capable of adhering to prevention in general. However, there was possible differential condom use reporting bias by PrEP adherence status, making conclusions about how PrEP and condom use interact difficult. We need longitudinal cohort studies and ongoing monitoring to better determine how women use condoms and PrEP, why they choose one or the other, and whether this varies by partner type and other circumstances.

This is a secondary analysis and there are limitations with the application of a prevention cascades framework to these data. A core aim of our work was to try to operationalise the prevention cascade framework, and to reflect on limitations and suggest improvements for future applications. Concepts of demand and supply are multidimensional and are not fully described by the variables available here. We used having heard of PrEP and awareness of condoms as preventing HIV infection as necessary, but not sufficient, measures of demand. Other factors hypothesised to affect demand such as encouragement to take PrEP by other sex workers, are included in our risk factor analyses, but we did not measure individual risk perception or make more detailed assessment of norms. We considered supply measures from the perspective of individual sex workers rather than examining programme outputs for example. In future applications, it could be beneficial to consider programme and user perspectives in tandem¹³ to assess whether they align. We did find some variation in

cascade components across sites, particularly for PrEP. Our data are from intervention sites of a cluster-randomised trial, and might not be generalisable to a later roll-out of PrEP in this population, though the trial was pragmatic and thus closer to routine delivery than an efficacy trial.

As strengths, our data were collected from a diverse group of sites using identical protocols and RDS, designed to be representative of the population of sex workers, unlike data from small, non-population-based demonstration projects. While our outcomes were self-reported and subject to reporting biases, we were able to biologically determine which women were HIV-negative.

In future applications of the prevention cascade, more nuanced data describing concepts of demand (knowledge, attitudes, perceived risk, normative environment) and supply could be developed. Measuring demand in the context of multipurpose products like condoms should also be considered. It might not be the case that these concepts are best measured using a single quantitative survey, and methods such as discrete choice experiments⁴³ and participatory ranking⁴⁴ might be informative, as well as combining data from programme records and surveys. Future applications might also consider these intermediate cascade steps as outcomes in order to understand what factors are particularly associated with demand for or supply of HIV-prevention tools. Zimbabwe has a PrEP implementation plan for which roll-out has begun⁴⁵, and as PrEP usage expands, analyses of the differences between sub-groups of those covered by no prevention tools, covered by both PrEP and condoms or covered by either PrEP or condoms could help to further understand which sub-groups might adopt which prevention strategy and in what circumstances.

We have shown a dual cascade HIV prevention framework of demand, supply and adherence to be informative in determining levels of prevention coverage among FSW at high risk of HIV acquisition, and in identifying programmatic gaps and possible strategies. In line with a combination prevention approach, we recommend that prevention cascades consider demand, supply and capability to adhere to different prevention tools together, and investigate the role of structural, community and individual level factors in determining coverage.

Acknowledgements

We thank the participants of the SAPPH-IRe trial. These secondary analyses were supported by the Bill and Melinda Gates Foundation via the Measurement and Surveillance of HIV Epidemics Consortium, and the SAPPH-IRe trial by DFID, Swedish SIDA and Irish Aid via Zimbabwe's Integrated Support Programme and UNFPA.

EF and JRH conceived and designed the study. EF conducted analyses and wrote the manuscript draft. FMC, JRH, SM, PM, SN, SC, JB, JRH, AP, and VC provided guidance to original study design (FMC was the Principle Investigator), the data collection tools and/or management, and reviewed and provided comments on early drafts of this study. BR, BH, SSW, and SB commented on the application of the HIV prevention cascades framework used in the study. All of the authors reviewed and commented on draft manuscripts, and approved the final manuscript.

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Figures and Tables

Figure 1: Demand, Supply, Adherence and Coverage by Condoms and/or PrEP amongst 611 HIV-negative FSW from seven sites

Figure 2: A comparison of measures of condom adherence amongst 611 HIV-negative FSW from seven sites

Table 1: Characteristics of FSW across seven sites testing HIV-negative (n=611)

Table 2: Factors associated with adherence to condoms among 611 HIV-negative FSW from seven sites

Table 3: Factors associated with adherence to PrEP among 611 HIV-negative FSW from seven site

Table 1: Characteristics of FSW across seven sites testing HIV-negative (n=611)

Characteristics of HIV negative FSW from 7 sites, n=611	n	Unweighted %	Weighted %*
Age (mean years)	30.4		
Education			
None	182	29.8	36.4
Primary	194	31.8	31.8
Secondary	235	38.5	31.8
Marital status			
Married	10	1.6	2.2
Divorced/separated	398	65.1	63.1
Widowed	78	12.8	14.5
Never married	125	20.5	20.2
Experienced food insecurity in the past 4 weeks	242	39.6	46.2
Number of clients per week			
0	31	5.1	5.7
1-5	339	55.5	60.3
6-9	158	25.9	23.5
10-15	39	6.4	4.7
16+	44	7.2	5.8
Age started sex work			
<18	88	14.4	18.4
18-19	90	14.7	13.9
20-24	187	30.6	28.4
25-29	138	22.6	21.3
30+	108	17.7	17.9
Alcohol consumption over the past 12 months			
Never	262	42.9	45.0
Once a month or less	44	7.2	5.4
2-4 times a month	77	12.6	14.6
2-3 times a week	112	18.3	18.4
4 or more times a week	115	18.8	16.5
Had more than 6 alcoholic drinks in one night during last 12 months			
Never- have not had alcohol in last 12 months	262	42.9	45.0
Never- drank alcohol but no occasions of more than 6 drinks	169	27.7	28.9
Yes, at least one occasion	178	29.1	25.7
Relationships with other sex workers			
Reports good or very good relations with other sex workers	450	73.6	71.8
Discusses health with other sex workers	593	97.1	96.8
Recent experience of violence			
Stopped or harassed by the police in the last month	43	7.0	6.4
Experienced intimate partner violence in the past month	77	12.6	13.3
Experienced violence from a client in the past month	80	13.1	12.8
Stigma ever experienced as a result of being a FSW			
Reports lost respect or social standing	267	43.7	40.0
Reported feeling ashamed	153	25.0	29.2
Reports that she is talked badly about by other	407	66.6	63.4
Ever denied health services	24	3.9	3.0
Ever verbally assaulted	163	26.7	22.4
Factors affecting supply of condoms			
Supply: Received condoms from Sisters Programme in past year	367	60.1	58.0
Supply: Ever received condoms from a peer educator	380	62.2	59.3
Clients bring their own condoms	296	48.4	48.5
Use condoms brought by clients	218	35.7	38.6

Table 1 (continued)**Factors affecting adherence to condoms**

In past year, ever stopped carry condoms because afraid of police	29	4.7	4.6
In past year, failed to use condom with a client due to own drinking	59	9.7	10.7
In past year, failed to use condom with a client due to his drinking	63	10.3	12.8
Ever refuse a client because he was drunk or violent	314	51.4	50.3

Coverage by Condoms and/or PrEP

Adherent to neither condoms nor PrEP	268	43.9	45.3
Adherent to PrEP, not condoms	50	8.2	9.2
Adherent to condoms, not PrEP	245	40.1	39.1
Adherent to PrEP and Condoms	48	7.9	6.4

**Data pooled across 7 sites, seed participants dropped and weighted by inverse degree normalised by site.*

Table 2: Factors associated with adherence to condoms among 611 HIV-negative FSW from seven sites

Characteristics of HIV negative sex workers, n=611	n condom adherent	Weighted % condom adherent	Crude Odds Ratio	95% CI		Adjusted Odds Ratio	95% CI	
Adherence to condoms among all HIV negative FSW	293/611	45.5						
Age in years	mean 31.8 adherent	mean 29.3 non-adherent	1.04	1.02	1.07	1.01	0.96	1.06
Education								
None	91/182	47.1	1.00			1.00		
Primary	91/194	43.2	0.78	0.43	1.41	0.88	0.48	1.62
Secondary	111/235	45.9	0.80	0.44	1.42	0.88	0.49	1.58
Marital status								
Currently married	5/10	61.1	2.15	0.43	10.89	1.72	0.33	8.89
Divorced/separated	185/398	44.0	1.37	0.78	2.40	1.10	0.60	2.02
Widowed	47/78	53.9	2.48	1.06	5.84	1.12	0.41	3.04
Never married	56/125	42.5	1.00			1.00		
Experienced food insecurity in the past month	105/242	41.6	0.78	0.49	1.22	0.71	0.45	1.13
Number of clients in the last week	mean 5.5 adherent	mean 6.5 non-adherent	0.98	0.95	1.02	0.99	0.96	1.02
Age in years that started sex work	mean 25.8 adherent	mean 22.8 non-adherent	1.06	1.03	1.09	1.05	1.00	1.11
Relationships with other sex workers								
Good or very good relations with other sex workers	214/450	44.7	1.15	0.67	1.99	1.06	0.60	1.87
Don't talk about health with other sex workers	13/18	76.5	2.87	0.80	10.33	4.00	1.01	15.87
Stigma ever experienced as a result of being a FSW								
Reports lost respect or social standing	122/267	43.2	0.95	0.61	1.49	1.02	0.65	1.61
Reported feeling ashamed	74/153	49.0	1.30	0.76	2.20	1.17	0.68	2.00
Reports that she is talked badly about by others	183/407	41.6	0.68	0.42	1.09	0.71	0.44	1.17
Ever denied health services	8/24	37.9	0.64	0.19	2.24	0.84	0.23	3.09
Ever verbally assaulted	72/163	43.3	0.72	0.42	1.27	0.76	0.44	1.31
Recent experience of harassment or violence								
Stopped or harassed by the police in the last month	15/43	24.7	0.40	0.17	0.94	0.50	0.21	1.20
In past year, stopped carry condoms because afraid of police	10/29	43.0	0.84	0.28	2.56	0.90	0.27	2.95
Experienced intimate partner violence in the past month	29/77	30.5	0.54	0.27	1.07	0.59	0.29	1.19
Experienced violence from a client in the past month	30/80	28.4	0.46	0.23	0.92	0.51	0.25	1.03
Ever refuse a client because he was drunk or violent	135/314	44.5	0.88	0.56	1.38	1.02	0.65	1.61
Frequency of alcohol consumption								
Never	139/262	50.9	1.00			1.00		
Once a month or less	26/44	61.7	1.61	0.66	3.93	1.43	0.61	3.33
2-4 times a month	39/77	49.2	0.91	0.44	1.86	0.89	0.42	1.86
2-3 times a week	50/112	38.8	0.49	0.26	0.92	0.50	0.26	0.94
4 or more times a week	38/115	28.9	0.34	0.17	0.69	0.34	0.16	0.69
Had more than 6 alcoholic drinks in one night during last 12 months								
Never- have not had alcohol in last 12 months	139/262	50.9	1.54	0.89	2.67	1.59	0.93	2.73
Never- drank alcohol but no occasions of more than 6 drinks	81/169	40.9	1.00			1.00		
Yes, at least one occasion	71/178	40.2	0.84	0.45	1.57	0.84	0.44	1.58
Supply of condoms								
Received condoms from Sisters Programme in past year	189/367	48.1	1.43	0.89	2.32	1.48	0.89	2.44
Ever received condoms from a peer educator	187/380	48.6	1.54	0.97	2.44	1.64	1.01	2.65
Clients bring their own condoms	148/296	48.9	1.15	0.73	1.82	1.16	0.73	1.86
Use condoms brought by clients	99/218	39.0	0.52	0.32	0.85	0.48	0.30	0.78
Adherent to PrEP	48/98	40.8	0.92	0.50	1.69	0.90	0.47	1.71

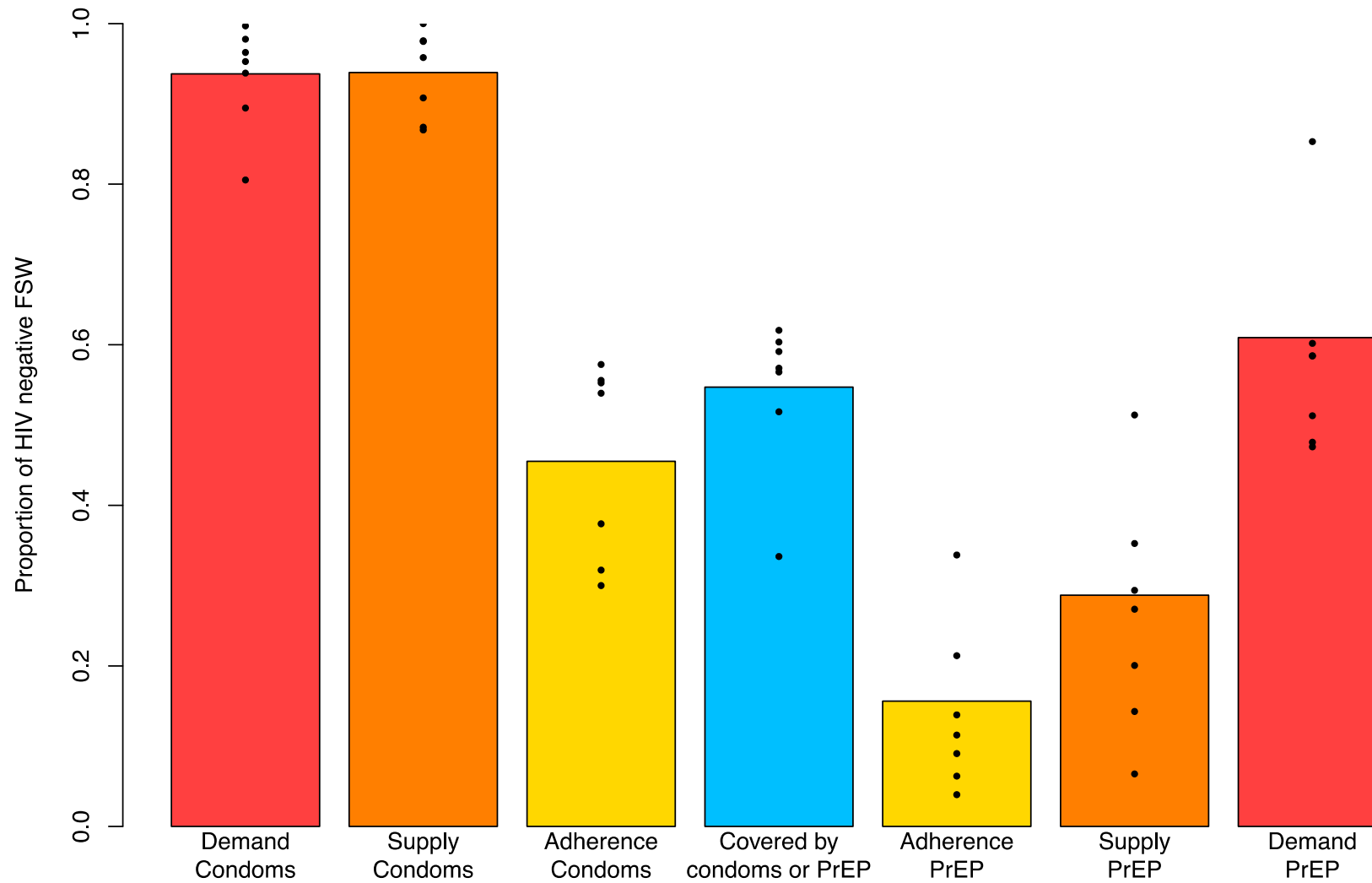
RDS-II weighted %, all models drop seeds weight by inverse site-normalised degree and include a fixed term for site. Adjusted models are adjusted for age, education, marital status, food insecurity, number of clients and age started sex work. Where not shown, reference groups are those who have not experienced or reported the given factor.

Table 3: Factors associated with adherence to PrEP among 611 HIV-negative FSW from seven sites

Characteristics of HIV negative sex workers, n=611	n PrEP adherent	Weighted % PrEP adherent	Crude Odds Ratio	95% CI		Adjusted Odds Ratio	95% CI	
Adherence to PrEP amongst all HIV negative sex workers	98/611	15.6						
Age in years	mean 34.2	mean 29.8 non-adherent	1.02	0.99	1.05	1.05	1.01	1.10
Education								
None	31/182	18.6	1.00			1.00		
Primary	31/194	15.5	1.06	0.46	2.47	1.28	0.56	2.95
Secondary	31/235	12.3	0.81	0.39	1.68	1.03	0.46	2.33
Marital status								
Currently married	2/10	9.9	1.08	0.16	7.30	1.14	0.16	8.30
Divorced/separated	58/398	14.5	1.32	0.61	2.83	1.45	0.66	3.20
Widowed	20/78	28.3	2.23	0.89	5.62	2.39	0.82	6.96
Never married	18/125	10.7	1.00			1.00		
Experienced food insecurity in the past month	40/242	15.5	0.85	0.45	1.63	0.69	0.37	1.30
Number of clients in the last week	mean 5.3 adherent	mean 6.2 non-adherent	0.98	0.93	1.03	0.98	0.94	1.03
Age started sex work	mean 24.7 adherent	mean 24.0 non-adherent	0.99	0.96	1.03	0.94	0.89	0.99
Relations with other sex workers								
Good or very good relations with other sex workers	78/450	17.5	1.19	0.48	2.90	1.19	0.52	2.73
Don't about health with other sex workers	3/18	7.6	0.70	0.14	3.56	0.85	0.16	4.49
Recent experience of violence								
Stopped or harassed by the police in the last month	4/43	15.5	0.63	0.15	2.61	0.58	0.16	2.12
Experienced intimate partner violence in the past month	12/77	14.7	0.78	0.25	2.41	0.79	0.28	2.23
Experienced violence from a client in the past month	12/80	14.2	0.75	0.18	3.03	0.78	0.21	2.87
Stigma ever experienced as a result of being a FSW								
Reports lost respect or social standing	34/267	13.9	0.76	0.38	1.52	0.90	0.43	1.87
Reported feeling ashamed	19/153	14.7	1.09	0.49	2.42	1.09	0.47	2.50
Reports that she is talked badly about by others	56/407	12.5	0.49	0.25	0.96	0.56	0.28	1.10
Ever denied health services	7/24	40.2	3.76	1.06	13.27	2.88	0.73	11.37
Ever verbally assaulted	18/163	7.4	0.47	0.21	1.05	0.49	0.22	1.06
Frequency of alcohol consumption								
Never	40/262	18.9	1.00			1.00		
Once a month or less	5/44	9.3	0.37	0.04	0.48	0.37	0.10	1.31
2-4 times a month	21/77	20.9	1.07	0.06	1.41	1.09	0.44	2.73
2-3 times a week	16/112	7.4	0.36	0.45	5.75	0.38	0.15	0.96
4 or more times a week	16/115	13.3	0.70	0.07	1.25	0.74	0.28	1.97
Had more than 6 alcoholic drinks in one night during last 12 months								
Never- have not had alcohol in last 12 months	40/262	18.9	1.80	0.72	4.51	1.57	0.64	3.84
Never- drank alcohol but no occasions of more than 6 drinks	34/169	15.8	1.00			1.00		
Yes, at least one occasion	24/178	10.0	0.80	0.27	2.34	1.00	0.33	3.08
Adherent to condoms	48/293	14.0	0.92	0.50	1.69	0.91	0.47	1.75
Adherent to condoms with clients	54/329	15.0	1.18	0.62	2.22	1.12	0.57	2.19
Adherent to condoms with steady partners, amongst those with a partner, n=418	62/364	17.5	7.67	2.08	28.37	6.86	1.90	24.74

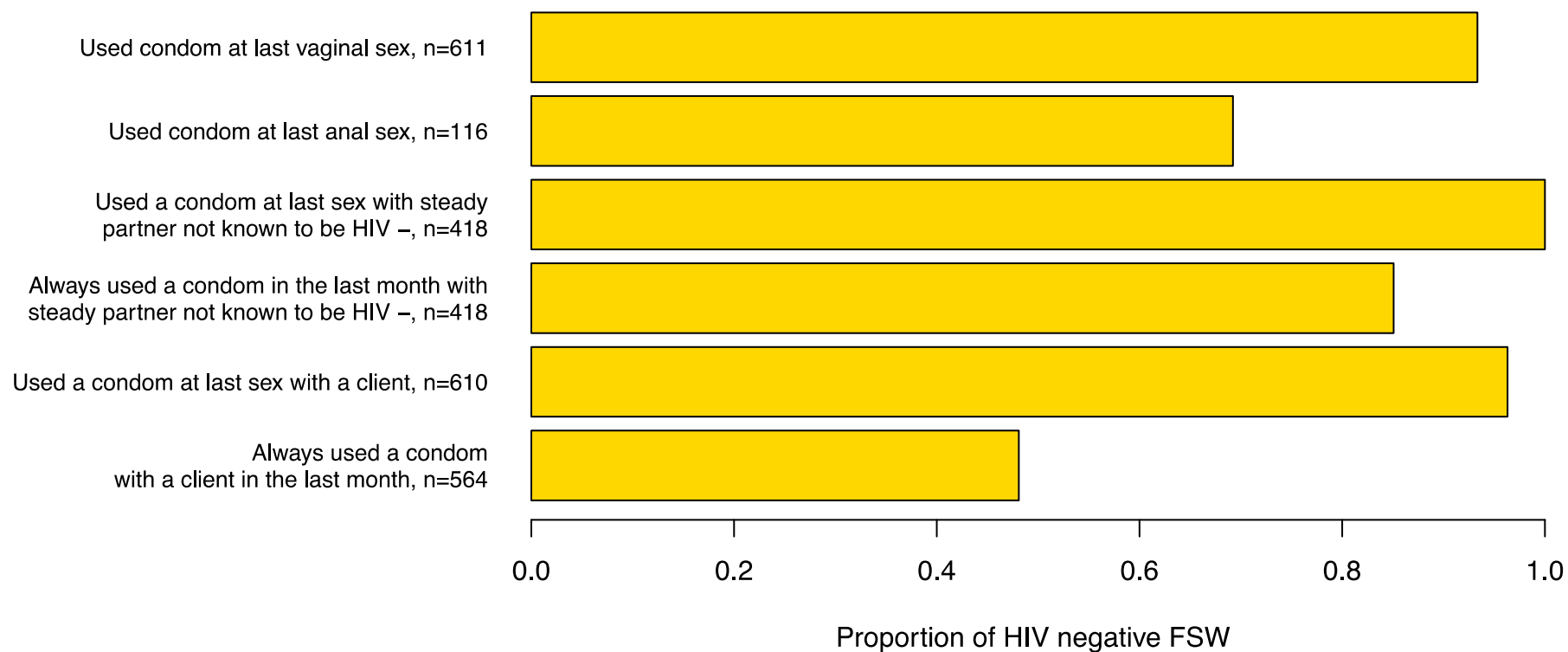
RDS-II weighted %. All models drop seeds and weight by inverse site-normalised degree and include a fixed term for site. Adjusted models are adjusted for age, education, marital status, food insecurity, number of clients and age started sex work. Where not shown, reference groups are those who have not experienced or reported the given factor.

Figure 1: Demand, Supply, Adherence and Coverage by Condoms and/or PrEP amongst 611 HIV-negative FSW from seven sites



Data from seven sites is pooled, weighted by inverse degree normalised by site with seed participants dropped. Points indicate site specific estimates.

Figure 2: A comparison of measures of condom adherence amongst 611 HIV-negative FSW from seven sites



Bar values indicate estimates from seven sites that are pooled, weighted by inverse degree normalised by site with seed participants dropped. Not all measures applied to all women, (eg. depending on whether the woman reported having a steady partner or declined to answer the question). The summary condom adherence measure is based on no reporting of non-condom use for any of the above measures. There were no participants for whom all variables were missing and the only measure with significant missingness was 'Always used a condom with a client in the last month', which 47 participants declined to answer.

Supplemental Digital Content

Appendix 1: Respondent Driven Sampling Diagnostics

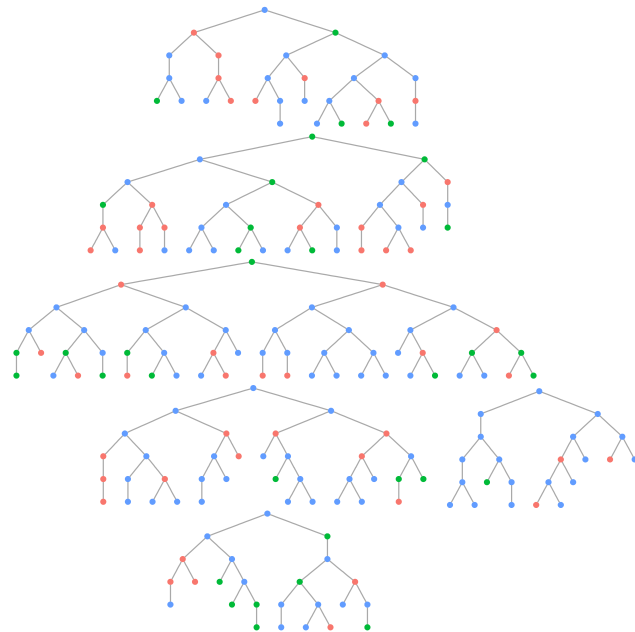
We have reported in detail on the RDS diagnostics for these surveys in relation to the main SAPPH-IRe trial finding¹. Here, we considered recruitment dynamics as they related to the prevention cascade framework, examining recruitment trees by adherence to condoms and to PrEP, and the extent to which estimates of adherence to condoms and PrEP had converged as the sample accumulated. As recruitment included both HIV-positive and negative FSW, we include all in our diagnostics report (n=1439).

PrEP and condom adherence did not appear to concentrate in any particular recruitment chains (example tree, Figure 1). RDS-weighted estimates for adherence to PrEP appeared to converge well in each site (Figure 3), and adherence to condoms well in four sites (Figure 2). In three sites, it is possible the adherence to condoms estimate might have risen further with additional recruitment, and therefore we might have underestimated condom adherence when pooling the data.

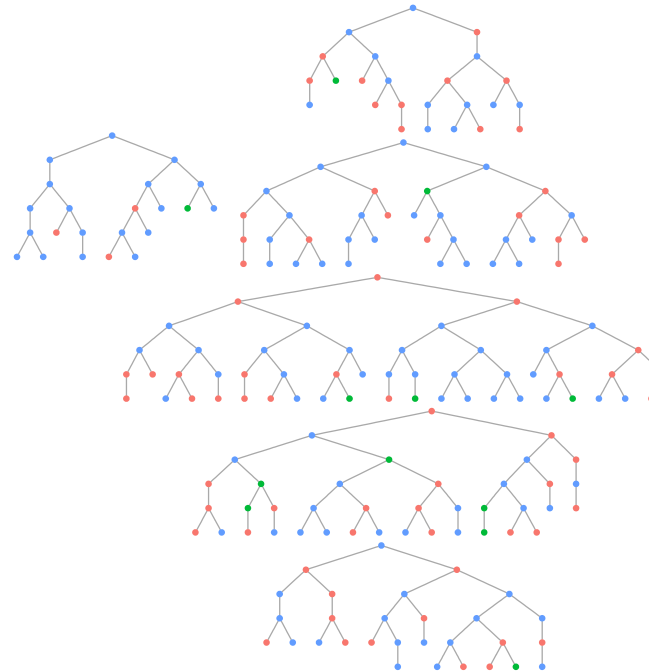
Appendix 1 Figure 1 : One example site’s recruitment trees by HIV status and A) adherence to condoms; and B) adherence to PrEP among all FSW at the seven sites (n=1439)

Circles are participants and lines are recruitment ties. The top of each chain is the seed participant, with her recruits below and so on.

A



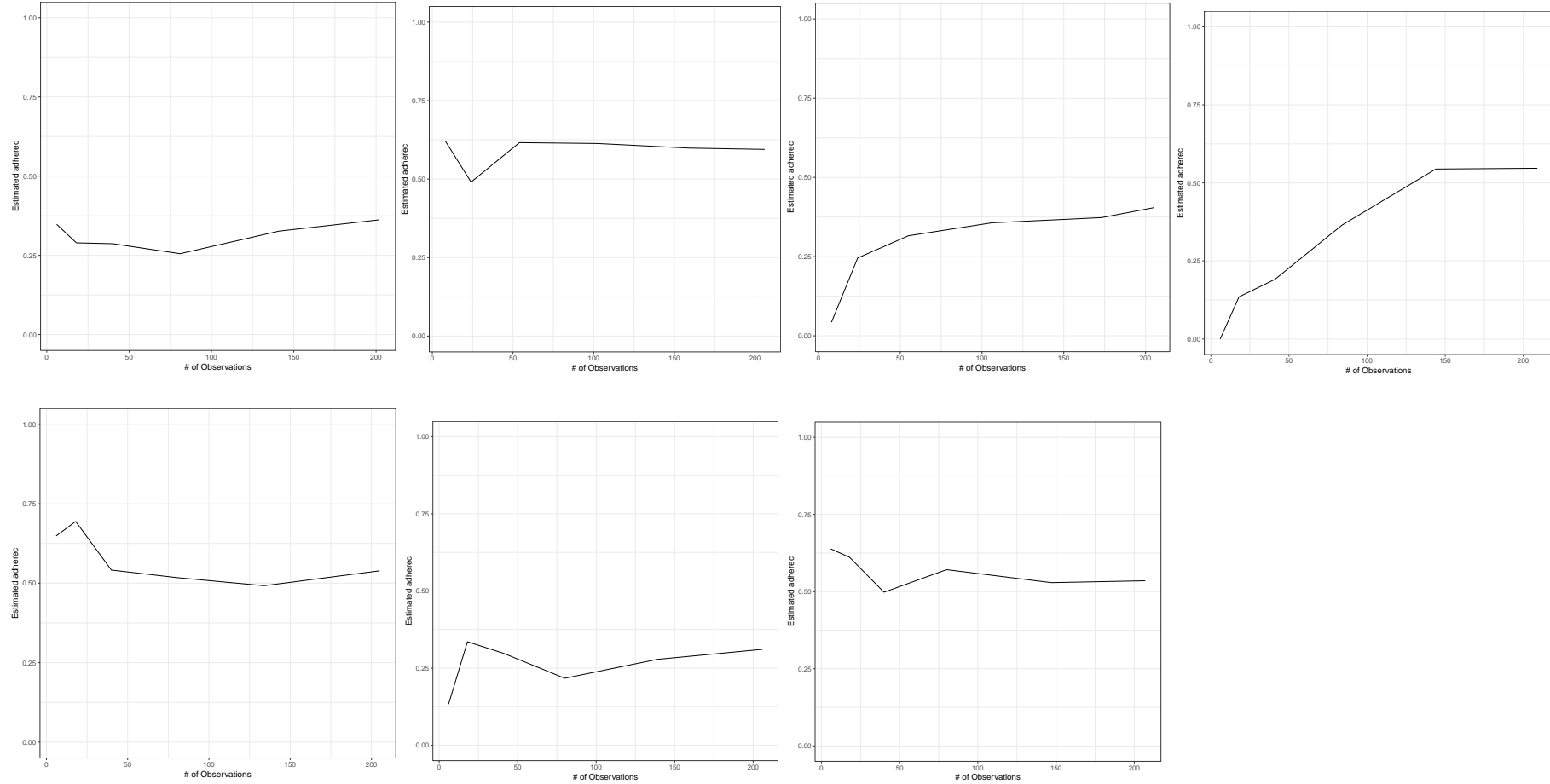
B



● Not adherent to condoms
 ● Adherent to condoms
 ● HIV positive
 ● Not adherent to PrEP
 ● Adherent to PrEP
 ● HIV positive

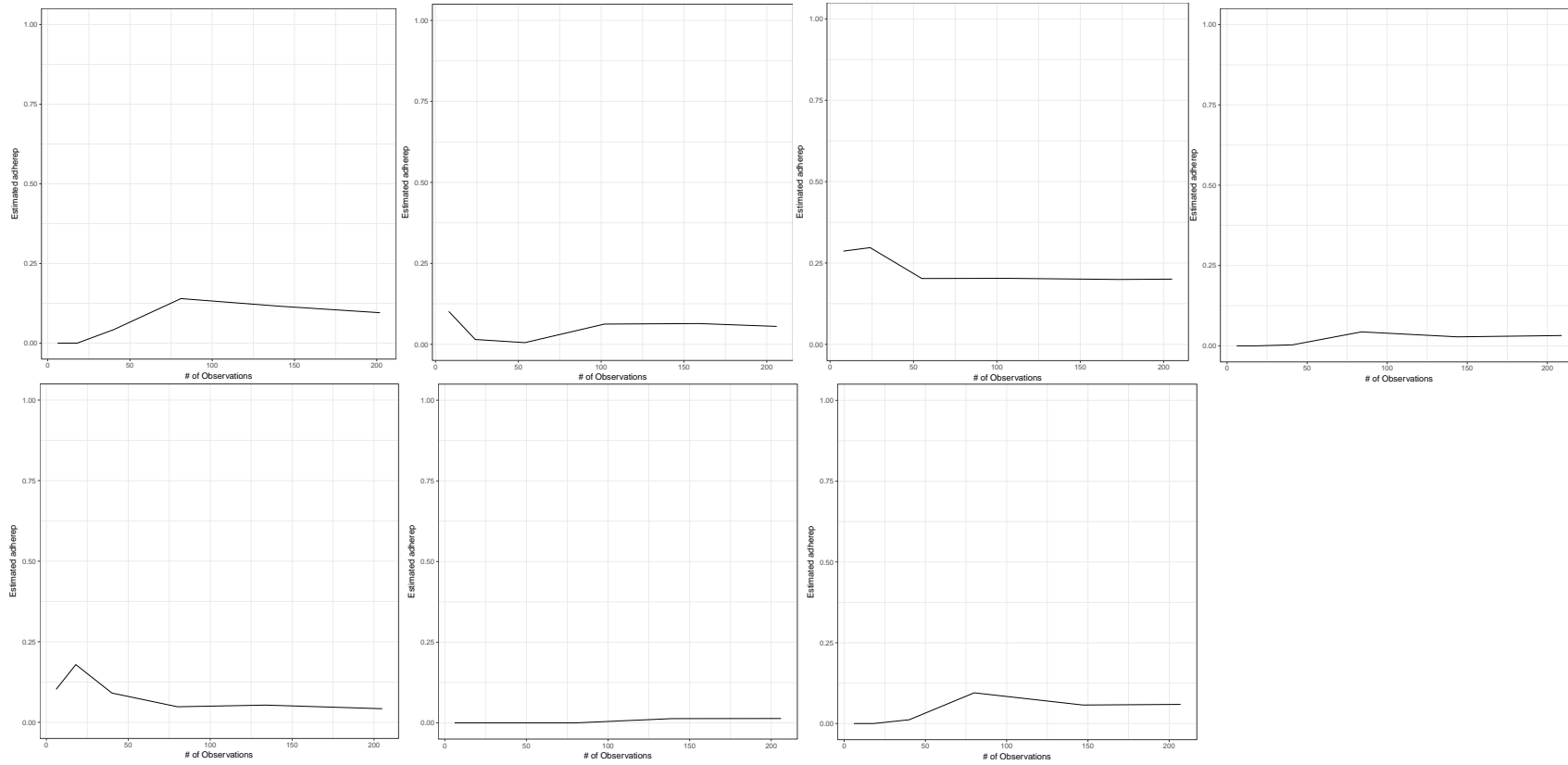
Appendix 1 Figure 2: Convergence of estimates of adherence to condoms in seven sites

For each plot, the solid line shows the cumulative RDS-II weighted estimate of adherence to condoms as the sample size increased. The dotted line shows the final estimate. Note that estimates are out of all women in these denominators ($n=1439$ total recruited), not only those 611 HIV-negative, as in the main analysis.



Appendix 1 Figure 3: Convergence of estimates of adherence to PrEP in seven sites

For each plot, the solid line shows the cumulative RDS-II weighted estimate of adherence to condoms as the sample size increased. The dotted line shows the final estimate. Note that estimates are out of all women in these denominators ($n=1439$ total recruited), not only those $n=611$ HIV-negative, as in the main analysis.



Appendix 2: Sensitivity Analysis Results

We examined how consistent our findings as to factors associated with condom and PrEP adherence were when 1) observations were unweighted (seed participants still dropped); 2) 47 women who declined to report condom use with clients over the last month were excluded from the analyses rather than coded according to their other condom use responses; and 3) adherence to condoms with clients and adherence to condoms with steady partners were treated separately.

Unweighted analyses

The unweighted analyses showed less evidence that using condoms provided by peer educators was associated with higher adherence (aOR=1.12, 95% CI 0.78-1.61 unweighted, compared to aOR=1.64 (95% CI 1.01-2.65) weighted. There was also not evidence that women who did not talk about health with other sex workers were more likely to be adherent to condoms, an association seen in the weighted model. Women who do not talk about health with other sex workers were rare (18/611) and had a lower network size than women who did. This would have weighted their responses upwards, which could account for the difference with the weighted model. Other associations with alcohol use, duration in sex work and condom supply were similar across the weighted and unweighted models.

The unweighted model for PrEP adherence was consistent with the weighted model in identifying a possible association with alcohol use, but showed reduced evidence for an association between prep adherence, current age, age began sex work or condom adherence with a partner, Table 3 main paper and Table 2 Appendix 2.

Condom adherence with steady partners not known to be HIV-negative compared to condom adherence with clients

Women with steady partners (n=418) reported higher condom adherence with partners who were not known to be HIV-negative, than with clients (85.1% compared to 50.4%), Figure 2 main paper.

Alcohol use was associated with reduced condom adherence both with partners and with clients, Tables 5 and 6 Appendix 2. Women who had experienced violence from a client in the last month were less likely to report condom adherence with partners (aOR=0.25, 95% CI 0.09-0.69), though there was less evidence for this association with clients (aOR=0.53, 95% CI 0.26-1.06). Using condoms brought by clients was associated with client condom adherence (aOR 0.48, 95% CI 0.29-0.78), but not condom use among partners (aOR=0.86, 95% CI 0.36-2.06). Women who reported that they were talked badly about on account of being a sex worker were also less likely to be adherent to condoms with partners, but there was little evidence for this association with condom adherence with clients.

There was evidence that women who were adherent to PrEP were more likely to adhere to condoms with a partner, 97% among those adhering to PrEP, (aOR=7.97, 95% 1.76-36.08), but there was not evidence for this association with clients (aOR 1.14, 95% CI 0.58-2.23), Table 5 and 6 Appendix 2. This finding was reflected in the corresponding analysis using

PrEP adherence as the outcome and condom adherence with partners as the exposure in the main paper, Table 3.

Excluding n=47 women who do not report frequency of condom use with clients in the last month

Women who were adherent to PrEP were more likely to have a missing response to this variable. In the primary study analysis, their condom adherence measure was coded according to their responses to the other condom use questions. However, because the question about frequency of use with clients in the past month was the most discriminatory, we repeated our risk factor analyses for condom adherence and PrEP adherence excluding these women. In so doing, there was a strong was effect of adhering to PrEP on adhering to condoms (aOR=0.57, 95% CI 0.29-1.13), Appendix 2 Table 5, than in the main analysis (aOR=0.90, 95% CI 0.47-1.71), Table 3 main paper, but the statistical evidence remained weak.

Appendix 2 Table 1: Unweighted findings of factors associated with adherence to condoms among 611 HIV-negative FSW

Characteristics of HIV-negative sex workers, n=611	n condom adherent	Unweighted % condom adherent	Crude Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Adherence to condoms among all HIV-negative sex workers	293/611	48.0				
Age in years	mean 29.3 non-adherent	mean 31.8 adherent	1.03	1.01 1.05	0.98	0.95 1.01
Education						
None	91/182	50.0	1.00	1.00 1.00	1.00	
Primary	91/194	46.9	0.78	0.50 1.19	0.79	0.50 1.25
Secondary	111/235	47.2	0.72	0.47 1.09	0.73	0.47 1.15
Marital status						
Currently married	5/10	50.0	1.17	0.29 4.69	1.02	0.25 4.18
Divorced/separated	185/398	46.5	1.36	0.87 2.12	1.13	0.71 1.82
Widowed	47/78	60.3	2.80	1.50 5.29	1.74	0.82 3.73
Never married	56/125	44.8	1.00		1.00	
Experienced food insecurity in the past month	105/242	43.4	0.82	0.58 1.15	0.74	0.52 1.05
Number of clients in the last week	mean 6.5 non-adherent	mean 5.5 adherent	0.99	0.97 1.02	1.00	0.97 1.02
Age in years that started sex work	mean 22.8 non-adherent	mean 25.8 adherent	1.06	1.03 1.08	1.06	1.02 1.11
Relationships with other sex workers						
Good or very good relations with other sex workers	214/450	53.6	1.09	0.74 1.62	0.98	0.66 1.48
Don't talk about health with other sex workers	13/18	72.2	2.13	0.76 6.94	2.47	0.87 8.20
Stigma ever experienced as a result of being a FSW						
Reports lost respect or social standing	122/267	45.7	0.91	0.65 1.27	0.69	0.49 0.97
Reported feeling ashamed	74/153	48.4	1.05	0.71 1.54	1.01	0.68 1.51
Reports that she is talked badly about by others	183/407	45.0	0.74	0.52 1.05	0.78	0.54 1.12
Ever denied health services	8/24	33.3	0.37	0.14 0.91	0.43	0.16 1.07
Ever verbally assaulted	72/163	44.2	0.73	0.50 1.07	0.79	0.53 1.17
Recent experience of harassment or violence						
Stopped or harassed by the police in the past month	15/43	34.9	0.57	0.28 1.11	0.60	0.29 1.20
In past year, stopped carry condoms because afraid of police	10/29	34.5	0.47	0.19 1.05	0.52	0.21 1.21
Experienced intimate partner violence in the past month	29/77	37.7	0.70	0.41 1.16	0.77	0.45 1.30
Experienced violence from a client in the past month	30/80	37.5	0.62	0.37 1.02	0.65	0.38 1.08
Ever refuse a client because he was drunk or violent	135/314	43.0	0.65	0.47 0.91	0.69	0.49 0.97
Frequency of alcohol consumption						
Never	139/262	53.1	1.00		1.00	
Once a month or less	26/44	59.1	1.31	0.66 2.64	1.32	0.65 2.71
2-4 times a month	39/77	50.6	0.86	0.50 1.48	0.93	0.53 1.64
2-3 times a week	50/112	44.6	0.62	0.38 0.99	0.64	0.39 1.04
4 or more times a week	38/115	33.0	0.39	0.24 0.64	0.40	0.24 0.66
Had more than 6 alcoholic drinks in one night during last 12 months						
Never - have not had alcohol in last 12 months			1.28	0.85 1.92	1.22	0.80 1.86
Never - drank alcohol but no occasions of more than 6 drinks			1.00		1.00	
Yes, at least one occasion			0.67	0.42 1.05	0.65	0.40 1.03
Supply of condoms						
Received condoms from Sisters Programme in past year	189/367	51.5	1.41	0.99 2.03	1.36	0.94 1.98
Ever received condoms from a peer educator	187/380	49.2	1.13	0.80 1.60	1.12	0.78 1.61
Clients bring their own condoms	148/296	50.3	1.06	0.75 1.49	1.02	0.71 1.45
Use condoms brought by clients	99/218	45.4	0.70	0.49 1.00	0.66	0.45 0.96
Adherent to PrEP	48/98	49.0	1.06	0.67 1.68	1.05	0.65 1.69

RDS-II weighted%, all models drop seeds weight by inverse site-normalised degree and include a fixed term for site.

Adjusted models are adjusted for all variables in the table.

Where not shown, reference groups are those who have not experienced or reported the given factor.

Appendix 2 Table 2: Unweighted findings of factors associated with adherence to PrEP among 611 HIV-negative FSW

Characteristics of HIV-negative Sexworkers, n=611	n PrEP adherent	Unweighted % PrEP adherent	Crude Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Adherence to PrEP amongst all HIV-negative Sexworkers	98/611	16.0				
Age in years	mean 34.2 adherent	mean 29.8 non-adherent	1.02	1.00 1.04	1.03	0.99 1.07
Education						
None	31/182	17.0	1.00		1.00	
Primary	31/194	16.0	1.29	0.71 2.35	1.56	0.83 2.98
Secondary	31/235	13.2	1.17	0.66 2.10	1.44	0.78 2.72
Marital status						
Currently married	2/10	20.0	1.74	0.23 8.45	1.61	0.21 7.99
Divorced/separated	58/398	14.6	1.08	0.59 2.06	1.04	0.55 2.03
Widowed	20/78	25.6	1.50	0.68 3.32	1.26	0.48 3.28
Never married	18/125	14.4	1.00		1.00	
Experienced food insecurity in the past month	40/242	16.5	1.02	0.64 1.63	0.99	0.61 1.60
Number of clients in the last week	mean 5.3 adherent	mean 5.2 non-adherent	0.99	0.95 1.02	0.99	0.95 1.02
Age started sex work	mean 24.7 adherent	mean 24.0 non-adherent	1.01	0.98 1.04	0.98	0.94 1.02
Relations with other sexworkers						
Good or very good relations with other sexworkers	78/450	17.3	1.06	0.61 1.92	1.02	0.58 1.87
Don't talk about health with other sexworkers	3/18	16.7	1.54	0.33 5.14	1.61	0.34 5.52
Recent experience of violence						
Stopped or harassed by the police in the last month	4/43	9.3	0.46	0.11 1.32	0.49	0.11 1.45
Experienced intimate partner violence in the past month	12/77	15.6	1.02	0.49 1.98	1.00	0.47 1.98
Experienced violence from a client in the past month	12/80	15.0	0.93	0.45 1.79	0.91	0.43 1.79
Stigma ever experienced as a result of being a FSW						
Reports lost respect or social standing	34/267	12.7	0.60	0.37 0.96	0.62	0.38 1.00
Reported feeling ashamed	19/153	12.4	0.82	0.46 1.42	0.77	0.42 1.36
Reports that she is talked badly about by others	56/407	13.8	0.63	0.39 1.01	0.66	0.41 1.07
Ever denied health services	7/24	29.2	2.25	0.78 6.07	2.14	0.70 6.03
Ever verbally assaulted	18/163	11.0	0.67	0.37 1.16	0.67	0.36 1.17
Frequency of alcohol consumption						
Never	40/262	15.3	1.00		1.00	
Once a month or less	5/44	11.4	0.64	0.20 1.66	0.62	0.19 1.63
2-4 times a month	21/77	27.3	1.93	1.00 3.69	1.96	1.00 3.78
2-3 times a week	16/112	14.3	0.99	0.49 1.91	1.03	0.51 2.02
4 or more times a week	16/115	13.9	0.91	0.45 1.77	0.99	0.48 1.96
Had more than 6 alcoholic drinks in one night during last 12 months						
Never - have not had alcohol in last 12 months	40/262	14.2	0.78	0.46 1.34	0.76	0.44 1.31
Never - drank alcohol but on no occasions more than 6 drinks	34/169	20.1	1.00		1.00	
Yes, at least one occasion	24/178	13.5	0.72	0.38 1.34	0.72	0.37 1.36
Adherent to condoms	48/293	16.4	1.06	0.67 1.68	1.05	0.64 1.69
Adherent to condoms with clients	54/329	16.4	1.18	0.74 1.90	1.15	0.71 1.89
Adherent to condoms with steady partners, amongst those with a partner, n=418	62/364	17.0	2.32	0.88 8.02	2.42	0.87 8.85

Models are unweighted and include a fixed term for site.

Adjusted models are adjusted for age, education, marital status, food insecurity, number of clients and age started sex work..

Where not shown, reference groups are those who have not experienced or reported the given factor.

Appendix 2 Table 3: Associations with adherence to condoms, excluding women who do not report frequency of condom use with clients in the past month, n=564

Characteristics of HIV-negative sex workers, n=564	n condom adherent	Weighted % condom adherent	Crude Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Adherence to condoms among all HIV-negative sex workers	256/564	42.3				
Age in years	32.1 (mean adherent)	29.3 (mean non-adherent)	1.05	1.02 1.08	1.00	0.94 1.06
Education						
None	77/165	43.2	1.00	1.00 1.00	1.00	
Primary	80/180	40.5	0.80	0.43 1.50	0.96	0.51 1.82
Secondary	99/219	43.2	0.82	0.44 1.53	0.96	0.52 1.77
Marital status						
Currently married	5/10	61.1	2.47	0.46 13.19	1.94	0.36 10.40
Divorced/separated	161/368	40.3	1.57	0.85 2.90	1.25	0.64 2.44
Widowed	44/73	53.8	3.79	1.43 10.07	1.60	0.51 4.98
Never married	46/113	37.6	1.00	1.00 1.00	1.00	
Experienced food insecurity in the past month	87/218	36.5	0.73	0.45 1.19	0.66	0.41 1.07
Number of clients in the last week	5.4 (mean adherent)	6.5 (mean non-adherent)	0.98	0.94 1.02	0.99	0.95 1.02
Age in years that started sex work	26.4 (mean adherent)	22.7 (mean non-adherent)	1.08	1.04 1.11	1.07	1.01 1.14
Relationships with other sex workers						
Good or very good relations with other sex workers	186/413	42.1	1.31	0.75 2.30	1.19	0.66 2.13
Don't talk about health with other sex workers	12/17	41.5	2.30	0.61 8.63	3.03	0.75 12.34
Stigma ever experienced as a result of being a FSW						
Reports most respect or social standing	104/243	40.4	0.94	0.59 1.51	0.90	0.56 1.45
Reported feeling ashamed	68/145	46.5	1.34	0.77 2.35	1.18	0.67 2.06
Reports that she is talked badly about by others	158/374	38.5	0.66	0.40 1.07	0.73	0.44 1.23
Ever denied health services	8/24	37.9	0.71	0.20 2.59	1.00	0.24 4.09
Ever verbally assaulted	70/159	43.2	0.81	0.45 1.44	0.89	0.50 1.58
Recent experience of harassment or violence						
Stopped or harassed by the police in the last month	14/42	24.3	0.46	0.19 1.08	0.62	0.26 1.51
In past year, stopped carry condoms because afraid of	7/26	39.2	0.73	0.21 2.51	0.77	0.19 3.14
Experienced intimate partner violence in the past month	28/74	30.4	0.61	0.30 1.22	0.71	0.34 1.49
Experienced violence from a client in the past month	27/76	26.9	0.48	0.23 0.99	0.54	0.25 1.14
Ever refuse a client because he was drunk or violent	117/290	40	0.78	0.49 1.25	0.90	0.56 1.45
Frequency of alcohol consumption						
Never	121/242	46.7	1.00	1.00 1.00	1.00	
Once a month or less	25/43	61	1.83	0.75 4.46	1.61	0.69 3.80
2-4 times a month	33/68	44.9	0.97	0.44 2.14	0.86	0.39 1.87
2-3 times a week	43/104	37	0.54	0.28 1.03	0.55	0.28 1.08
4 or more times a week	34/107	28.2	0.36	0.17 0.75	0.35	0.16 0.75
Supply of condoms						
Received condoms from Sisters Programme in past year	161/335	44.2	1.28	0.78 2.11	1.29	0.76 2.17
Ever received condoms from a peer educator	160/347	44.9	1.40	0.87 2.27	1.47	0.89 2.43
Clients bring their own condoms	135/278	47.9	1.27	0.79 2.05	1.29	0.79 2.10
Use condoms brought by clients	95/209	39.3	0.60	0.36 0.98	0.55	0.33 0.92
Adherent to PrEP	36/85	31.1	0.66	0.34 1.28	0.57	0.29 1.13

RDS-II weighted %, all models drop seeds weight by inverse site-normalised degree and include fixed term for site.

Adjusted models are adjusted for all variables in the table.

Where not shown, reference groups are those who have not experienced or reported the given factor.

Appendix 2 Table 4: Associations with adherence to PrEP, excluding women who do not report frequency of condom use with clients in the past month, n=564

Characteristics of HIV-negative sex workers, n=564	n PrEP adherent	Weighted % PrEP adherent	Crude Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Adherence to PrEP amongst all HIV-negative sex workers	85/564	14.4				
Age in years	34.8 (mean adherent)	29.7 (mean non-adherent)	1.03	0.99 1.06	1.06	1.02 1.11
Education						
None	26/165	17.4	1.00		1.00	
Primary	25/180	12.7	0.90	0.35 2.34	1.18	0.46 2.99
Secondary	34/219	12.8	0.93	0.42 2.03	1.31	0.56 3.10
Marital status						
Currently married	2/10	9.9	1.07	0.16 7.07	1.11	0.15 7.97
Divorced/separated	47/368	12.6	1.18	0.55 2.54	1.32	0.60 2.91
Widowed	19/73	28.3	2.54	1.02 6.35	2.54	0.84 7.66
Never married	17/113	10	1.00		1.00	
Experienced food insecurity in the past month	32/218	13.6	0.77	0.38 1.56	0.60	0.30 1.18
Number of clients in the last week	4.9 (mean adherent)	6.2 (mean non-adherent)	0.97	0.92 1.01	0.97	0.93 1.01
Age started sex work	25.3 (mean adherent)	24.1 (mean non-adherent)	1.00	0.97 1.03	0.93	0.89 0.98
Relations with other sex workers						
Good or very good relations with other sex workers	68/413	16.2	1.16	0.43 3.14	1.24	0.53 2.89
Don't talk about health with other sex workers	3/17	14.6	0.94	0.18 4.86	1.08	0.19 6.02
Recent experience of violence						
Stopped or harassed by the police in the past month	4/42	15.5	0.70	0.17 2.94	0.79	0.21 2.92
Experienced intimate partner violence in the past month	12/74	15.4	0.87	0.28 2.70	0.92	0.33 2.57
Experienced violence from client in the past month	11/76	14.5	0.85	0.21 3.55	1.00	0.26 3.89
Stigma ever experienced as a result of being a FSW						
Reports lost respect or social standing	30/243	13.6	0.83	0.39 1.74	1.06	0.47 2.38
Reported feeling ashamed	17/145	15	1.29	0.56 2.95	1.32	0.56 3.11
Reports that he is talked badly about by others	50/374	11.8	0.51	0.25 1.05	0.58	0.28 1.21
Ever denied health services	7/24	40.2	4.01	1.14 14.16	3.04	0.74 12.46
Ever verbally assaulted	18/159	7.5	0.52	0.23 1.19	0.56	0.25 1.27
Frequency of alcohol consumption						
Never	36/242	18.8	1.00		1.00	
Once a month or less	4/43	7.7	0.31	0.29 1.13	0.29	0.07 1.25
2-4 times a month	14/68	13.1	0.61	0.94 1.06	0.65	0.23 1.89
2-3 times a week	15/104	7.4	0.36	0.51 1.83	0.44	0.17 1.13
4 or more times a week	16/107	14.4	0.81	0.53 1.79	0.95	0.34 2.67
Had more than 6 alcoholic drinks in one night during last 12 months						
Never - have not had alcohol in last 12 months	36/242	18.8	1.57	0.73 3.35	1.39	0.67 2.88
Never - drank alcohol but no occasions of more than 6 drinks	28/156	13.5	1.00		1.00	
Yes, at least one occasion	31/165	8.2	0.60	0.24 1.52	0.54	0.19 1.50
Adherent to condoms	36/256	10.6	0.66	0.34 1.28	0.56	0.28 1.12
Adherent to condoms with clients	42/290	12.2	0.90	0.46 1.78	0.75	0.37 1.51
Adherent to condoms with steady partners, amongst those with a partner, n=418	62/361	17.6	7.62	2.06 28.22	6.79	1.88 24.47

RDS-II weighted %. All models drop seeds and weight by inverse site-normalised degree and include fixed term for site. Adjusted models are adjusted for age, education, marital status, food insecurity, number of clients and age started sex work. Where not shown, reference groups are those who have not experienced or reported the given factor.

Appendix Table 5: Adherence to condoms with clients amongst HIV-negative FSW, n=611

Characteristics of HIV-negative Sex workers n=611	n condom adherent, clients	Weighted % condom adherent	Crude Odds Ratio	95%CI	Adjusted Odds Ratio	95%CI
Adherence to condoms with clients amongst all HIV-negative FSW	329/611	50.4				
Age in years	31.4 (mean) adherent	29.5 (mean) non-adherent	1.04	1.01 1.07	1.01	0.97 1.07
Education						
None	97/182	50.4	1.00		1.00	
Primary	102/194	48.2	0.81	0.44 1.47	0.92	0.49 1.73
Secondary	130/235	52.7	0.92	0.50 1.67	1.03	0.56 1.90
Marital status						
Currently married	7/10	71.2	2.49	0.44 14.21	2.04	0.35 11.92
Divorced/separated	208/398	48.4	1.37	0.78 2.38	1.16	0.63 2.12
Widowed	50/78	58.2	2.55	1.03 6.30	1.27	0.43 3.73
Never married	64/125	48.9	1.00		1.00	
Experienced food insecurity in the past month	115/242	44.6	0.69	0.44 1.10	0.64	0.40 1.01
Number of clients in the last week	mean 5.4 adherent	mean 5.5 non-adherent	0.98	0.95 1.02	0.99	0.96 1.02
Age in years that started sex work	mean 25.3 adherent	mean 22.9 non-adherent	1.05	1.02 1.08	1.03	0.98 1.09
Relationships with other sex workers						
Good or very good relations with other sex workers	236/450	48.1	0.95	0.55 1.65	0.87	0.49 1.56
Don't talk about health with other sex workers	16/18	48.9	20.61	4.45 95.41	30.35	5.86 157.07
Stigma ever experienced as a result of being a FSW						
Reports lost respect or social standing	136/167	46.8	0.87	0.56 1.36	1.16	0.73 1.83
Reported feeling ashamed	86/153	55.9	1.47	0.85 2.53	1.39	0.80 2.41
Reports that he is talked badly about by others	207/407	47	0.73	0.46 1.18	0.80	0.48 1.32
Ever denied health services	13/24	69	2.09	0.59 7.44	2.82	0.70 11.36
Ever verbally assaulted	86/163	50.1	0.74	0.42 1.31	0.79	0.45 1.37
Recent experience of harassment or violence						
Stopped or harassed by the police in the last month	20/43	33	0.51	0.23 1.14	0.68	0.29 1.58
In past year, stopped carry condoms because afraid to	12/29	47.9	0.77	0.27 2.22	0.83	0.26 2.66
Experienced intimate partner violence in the past month	36/77	39	0.64	0.32 1.25	0.69	0.34 1.40
Experienced violence from a client in the past month	36/80	33.3	0.48	0.24 0.95	0.53	0.26 1.06
Ever refuse client because he was drunk or violent	160/314	50.7	0.98	0.63 1.54	1.16	0.73 1.83
Frequency of alcohol consumption						
Never	148/262	53.8	1.00		1.00	
Once a month or less	28/44	65.8	1.70	0.68 4.23	1.46	0.61 3.48
2-4 times a month	46/77	56.4	1.11	0.54 2.29	1.10	0.53 2.30
2-3 times a week	61/112	45.9	0.54	0.29 1.02	0.54	0.29 1.01
4 or more times a week	45/115	35.2	0.37	0.18 0.75	0.36	0.17 0.74
Had more than 5 alcoholic drinks in one night during last 12 months						
Never - have not had alcohol in last 12 months	148/262	53.8	1.66	0.95 2.90	1.72	0.99 2.99
Never - drank alcohol but on occasions of more than 5 drinks	87/169	42.7	1.00		1.00	
Yes, at least one occasion	92/178	52.3	1.24	0.67 2.33	1.27	0.67 2.41
Supply of condoms						
Received condoms from Sisters Programme in past year	210/367	52.3	1.33	0.82 2.15	1.36	0.82 2.25
Ever received condoms from a peer educator	211/380	53.3	1.52	0.95 2.44	1.62	0.99 2.64
Clients bring their own condoms	165/296	53.8	1.04	0.65 1.64	1.03	0.64 1.66
Use condoms brought by clients	113/218	44.6	0.51	0.32 0.84	0.48	0.29 0.78
Adherent to PrEP	54/98	48.5	1.18	0.62 2.22	1.14	0.58 2.23

RDS-II weighted %, all models drop seeds weight by inverse site-normalised degree and include a fixed term for site.

Adjusted models are adjusted for age, education, marital status, food insecurity, number of clients and age started sex work..

Where not shown, reference groups are those who have not experienced or reported the given factor.

Appendix Table 6: Adherence to condoms with partners amongst HIV-negative FSW who have a steady partner, n=418

Characteristics of HIV-negative sex workers, of those reporting having a steady partner, n=418	n condom adherent, partners	Weighted % condom adherent	Crude Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Adherence to condoms with a steady partner	364/418	85.10%				
Age in years	31.3 (mean adherent)	30.1 (mean non-adherent)	1.03	0.98 1.08	1.00	0.93 1.08
Education						
None	100/115	83.7	1.00		1.00	
Primary	102/122	85.9	1.24	0.46 3.36	1.47	0.48 4.51
Secondary	162/181	85.6	1.15	0.34 3.93	1.42	0.38 5.30
Marital status						
Currently married	8/10	89.8	1.79	0.26 12.45	1.53	0.22 10.53
Divorced/separated	232/266	82.9	0.97	0.34 2.77	0.94	0.32 2.79
Widowed	48/53	92.1	3.34	0.72 15.58	2.46	0.47 12.81
Never married	76/89	85.8	1.00		1.00	
Experienced food insecurity in the past month	139/159	84.3	1.01	0.43 2.37	1.04	0.43 2.48
Number of clients in the last week	mean 5.4 adherent	mean 5.1 non-adherent	0.96	0.92 1.01	0.97	0.92 1.01
Age in years that started sex work	mean 25.1 adherent	mean 23.3 non-adherent	1.04	0.99 1.08	1.02	0.96 1.09
Relationships with other sex workers						
Good or very good relations with other sex workers	272/311	84.7	0.71	0.29 1.77	0.77	0.28 2.09
Don't talk about health with other sex workers	12/12	84.9	1.12	0.13 9.60	0.94	0.11 8.16
Stigma ever experienced as a result of being a FSW						
Reports lost respect or social standing	149/174	86.4	1.23	0.54 2.81	0.95	0.43 2.11
Reported feeling ashamed	96/108	88.7	1.59	0.52 4.91	1.73	0.57 5.27
Reports that she is talked badly about by others	243/286	80.7	0.25	0.09 0.70	0.28	0.11 0.73
Ever denied health services	13/18	82.9	0.87	0.20 3.81	0.74	0.15 3.63
Ever verbally assaulted	102/121	84.3	0.66	0.28 1.54	0.69	0.28 1.71
Recent experience of harassment or violence						
Stopped or harassed by the police in the last month	24/29	77.5	0.59	0.14 2.45	0.76	0.18 3.11
In past year, stopped carry condoms because afraid of	16/20	90.4	1.57	0.36 6.79	1.20	0.24 6.01
Experienced intimate partner violence in the past month	48/61	75.3	0.51	0.17 1.54	0.54	0.19 1.55
Experienced violence from a client in the past month	42/55	67.8	0.26	0.09 0.78	0.25	0.09 0.69
Ever refuse a client because he was drunk or violent	185/216	84	0.85	0.36 2.01	0.95	0.43 2.11
Frequency of alcohol consumption						
Never	166/181	93.2	1.00		1.00	
Once a month or less	29/30	96.5	1.71	0.20 14.72	1.78	0.18 17.56
2-4 times a month	46/52	89.9	0.93	0.21 4.03	0.92	0.23 3.73
2-3 times a week	63/78	71.5	0.11	0.03 0.40	0.11	0.03 0.39
4 or more times a week	60/77	69.9	0.14	0.04 0.45	0.14	0.04 0.46
Had more than 5 alcoholic drinks in one night during last 12 months						
Never have not had alcohol in last 12 months	166/181	93.2	5.95	1.95 18.95	5.79	1.96 17.04
Never drank alcohol but on occasions of more than 5 drink	90/106	73.3	1.00		1.00	
Yes, at least one occasion	107/130	83.6	1.80	0.77 4.18	1.94	0.76 4.95
Supply of condoms						
Received condoms from Sisters Programme in past year	214/245	83.1	0.64	0.28 1.44	0.59	0.26 1.34
Ever received condoms from a peer educator	219/252	81.9	0.57	0.24 1.32	0.56	0.24 1.26
Clients bring their own condoms	186/204	91	2.13	0.79 5.79	2.06	0.73 5.82
Use condoms brought by clients	136/154	87.3	0.92	0.36 2.35	0.86	0.36 2.06
Adherent to PrEP	62/66	97.1	7.67	2.07 28.39	7.97	1.76 36.08

RDS-II weighted %, all models drop seeds weight by inverse site-normalised degree and include a fixed term for site. Adjusted models are adjusted for age, education, marital status, food insecurity, number of clients and age started sex work.. Where not shown, reference groups are those who have not experienced or reported the given factor. Instances of condomless sex with a partner reported as known to be HIV negative not counted as 'non-adherent'

References

1. Cowan F, Davey C, Fearon E, et al. Randomised trial of a combination intervention to empower female sex workers in Zimbabwe to link and adhere to antiretrovirals for treatment and prevention. (*Submitted*). 2017.