Impact of Testing on Sexually Transmitted Infections among Female Brothel Sex Workers in Bangladesh: A Randomized Controlled Trial

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Abstract. Past studies that have designed interventions to reduce the prevalence of sexually transmitted infections (STIs) have typically provided onsite treatment to sex workers who tested positive, which were expensive and difficult to implement. The purpose of this study was to examine the effect of an intervention which tested for STIs and provided information on the closest treatment facility on reducing the prevalence of STIs among female brothel-based sex workers (BSWs) in Bangladesh. The study adopted a pre–post interventional design as well as a randomized controlled study design. A baseline sample and follow-up urine sample were collected to evaluate the prevalence of STIs among participants in the treatment, but not control group. A baseline survey and interviews were also conducted for both the groups. The study found a nonsignificant reduction from baseline to follow-up in STI prevalence among intervention participants (adjusted odds ratio [aOR]: 0.74; 95% CI: 0.38, 1.45). However, the participants in the intervention group were significantly more likely to have a repeat client (aOR: 1.60; 95% CI: 1.12, 2.29) and nonsignificantly less likely to engage with a client suspected of having an STI (aOR: 0.62; 95% CI: 0.39, 1.00) than participants in the control group. The intervention testing of STIs and providing information to the positive cases about nearest treatment facilities were not effective in reducing the prevalence of STIs among BSWs. Further study of the clinical and behavioral impacts of such efforts to reduce STIs among BSWs is warranted.

INTRODUCTION

Female sex workers (FSWs) are at high risk of acquiring sexually transmitted infections (STIs) and HIV infection.[1–4] Female sex workers have increased vulnerability to HIV and STIs because of a combination of behavioral and structural factors, including gender power dynamics, gender-based violence, multiple sexual partnerships, stigma, and criminalization, as well as barriers to healthcare access.[5–7] There are estimated to be 200,000 FSWs in Bangladesh.[8] These FSWs are distributed across a range of urban and rural communities, working in either a brothel setting or as independent sex workers.[9] Sexually transmitted infections are considered one of the major public health concerns in many low-income countries, such as Bangladesh, and sex workers have been identified as one of the most important risk factors for community transmission of STIs in Bangladesh.[10] Some cross-sectional studies and serological surveys have reported a high prevalence of STIs, ranging from 8% to 64%, among FSWs in Bangladesh.[11] Therefore, it is important to design an appropriate intervention that will reduce the prevalence of STIs among FSWs and curtail their risk-taking behaviors.

Interventions have been designed to reduce the burden of STIs/HIV among FSWs in several developing countries.[12] Those interventions have included increasing the use of condoms among clients[13–18] and encouraging FSWs to practice protected sex alongside regular STI/HIV testing.[19–26] Some of these studies have measured the prevalence of STIs/HIV among FSWs at baseline and follow-up, to examine the effectiveness of the interventions. These studies have typically provided onsite treatment to FSWs in the event that they tested positive for STIs/HIV at baseline. For example, FSWs in India who tested positive for *Chlamydia trachomatis* (CT) or

Neisseria gonorrhoeae (NG) were treated with azithromycin and cefixime, respectively, in a study conducted by Ramesh and others.[27] However, those interventions may not be feasible because of the high cost associated in dispatching mobile teams of medical personnel to reach what is a dispersed target group, especially for resource-limited countries.[28] In addition, studies that have provided onsite STIs/HIV treatment at baseline may have overestimated the impact of the intervention. As a lack of access to health care among FSWs is a common problem, especially in developing countries such as Bangladesh, reflecting financial constraints and embarrassment felt when visiting healthcare providers, FSWs may not actually seek treatment for STIs/HIV.[5] Viable alternatives for FSWs to obtain treatment should be identified and systematically evaluated so that limited resources can be allocated for maximum impact. However, no such interventions have so far been tested in Bangladesh. Therefore, this study evaluated the effect of a simple intervention which included testing for the presence of STIs in urine samples, providing FSWs with the result of the urine test and, finally, informing STI-infected FSWs of the closest medical facility at which they could seek treatment.

The primary aim of our study was to examine the change in STI prevalence among female brothel-based sex workers (BSWs) in Bangladesh, located at Mymensingh and Tangail, before and after an STI testing intervention to test BSWs for STIs while providing those STI-infected BSWs with information on the closest clinics at which they could seek STI treatment. Given the risk factors that FSWs pose for community transmission, we also examined the impact of STI testing on the sex work behaviors of BSWs in our study. These results can be used to inform future research to formulate appropriate initiatives to complement the effects that arise from STI/HIV testing among FSWs.

MATERIALS AND METHODS

Design. We conducted a randomized controlled trial of CT and NG testing (also referred to as a STI test) at two brothels

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located in two cities—Mymensingh and Tangail—in Bangladesh. Between February 21, 2016 and March 5, 2016, 467 BSWs from the brothels located in these cities were recruited at baseline (Figure 1). We used the CT PCR kit and NG PCR kit (GeneProof, Brno, Czech Republic) to detect the presence of CT and NG, respectively, in urine samples of the BSWs. The randomized controlled trial (RCT) is registered: ACTRN12617001250325. Ethical and institutional approval were obtained from the respective institutions (CF 13/3517–2013001769).

Participants. Baseline surveys at the brothels in Mymensingh and Tangail were administered to participants between February and March 2016 (Supplemental Table 1). The survey included questions on demographic profile, occupational information, and the health awareness of participants with respect to STIs. Participants were interviewed on details about their last 3 days' commercial sex transactions and their last three commercial sex transactions, which included questions about condom use and characteristics of their clients. To minimize recall bias, surveyors provided sufficient time to all respondents to allow them to correctly recall past clients and their characteristics. All of our interviewers were well trained in

working with such a challenging community and vulnerable population as well as collecting long recall data from respondents. The survey also covered questions on whether the participant had been trafficked into the sex work industry and the risk tolerance of the participant in general and with respect to their health, for which they were asked to answer on a scale of 0–10 ("0" means risk averse and "10" means risk prone). The health anxiety of participants was derived from participants' responses on questions obtained from the 18-item Health Anxiety Inventory.[29]

Enumerators commenced the sampling process at the entrance of each brothel before spreading across the entire brothel. As brothels in Bangladesh consist of groups of small rented rooms, we grouped rooms in a brothel that were close to one another together (Supplemental Figures 1 and 2) and labeled them a "building" for the purpose of data analysis. This yielded a total of 54 buildings, consisting of seven buildings in the Mymensingh brothel and 47 buildings in the Tangail brothel.

Enumerators were instructed to sample BSWs who met the following criteria: 1) aged between 17 and 36 years, 2) must
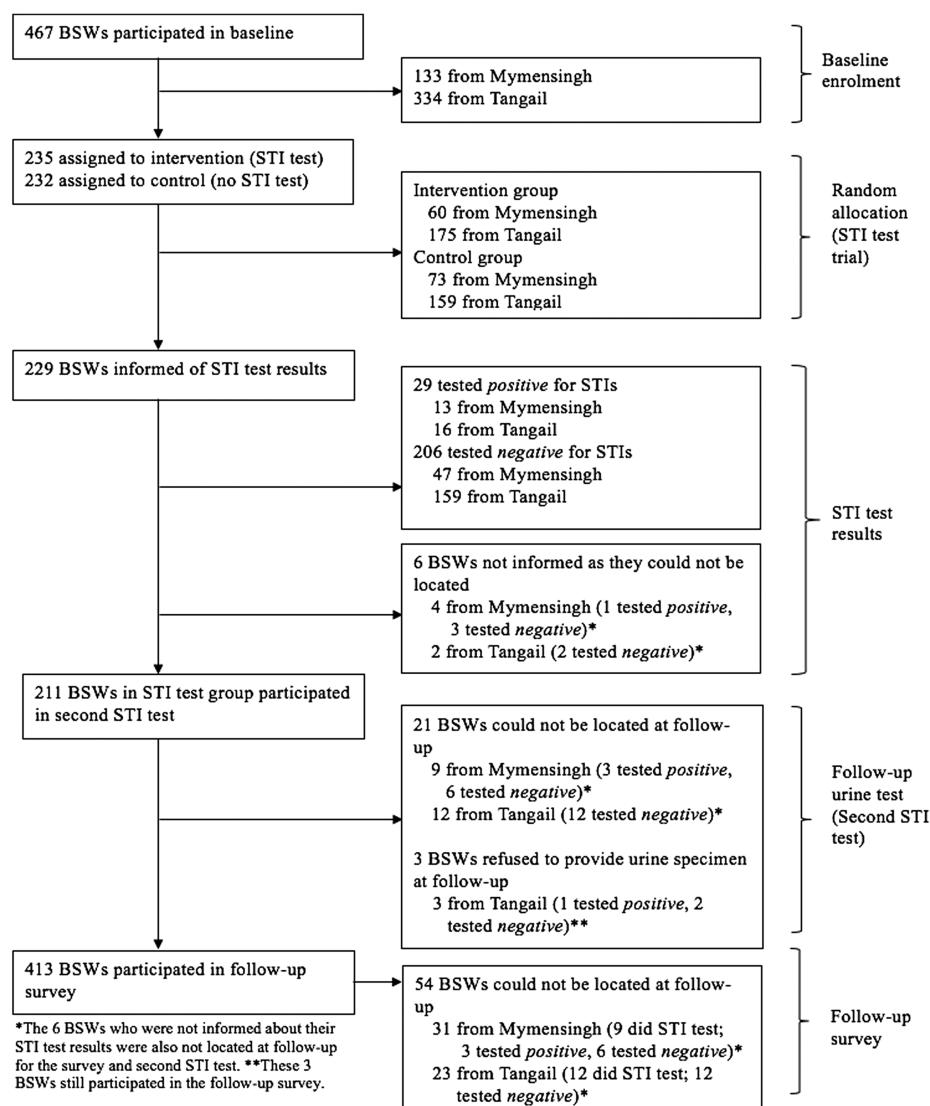

FIGURE 1.   Study profile of female brothel sex workers, Mymensingh and Tangail, Bangladesh.

have engaged in a commercial sexual transaction in the past 3 days, and 3) not be pregnant. The age restriction was introduced to ensure that the average age of our baseline sample aligns with the average age of BSWs (approximately 24 years old) reported in the literature.[30] The no-pregnancy criterion was used to avoid the possibility that pregnant BSWs may refrain from engaging in sexual transactions, thus affecting the collection of information on transactions at follow-up. This recruitment procedure returned a baseline sample of 467 BSWs. All participants in our study provided verbal consent.

Randomization and masking. The 467 participants at baseline were randomly assigned to the intervention group (STI testing; $n = 235$) or the control group (no STI testing; $n = 232$) of the STI test trial (Figure 1) after the baseline survey was completed. Randomization was conducted at the individual sex worker level. A list of random numbers was generated with Stata software (version 14, College Station, TX) to assign the participants to trial groups.

Participants were masked to each other's trial assignment. Intervention participants were informed of their assignment individually in private in their respective rooms at the time of the trial. Enumerators, International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b), and data analysts were not masked to the assignment of participants.

Experimental procedure. Before the baseline survey was conducted, all enumerators employed in our study were given training on techniques to interview BSWs.

The night before the STI test trial was scheduled, two urine collectors handed out urine bottles to participants in the intervention group in private in each of their respective rooms and instructed them to use the bottles to collect their first morning urine. The urine collectors visited the brothels the following morning to collect the urine specimens. The urine specimens were promptly deposited into coolers and transported to the icddr,b by the urine collectors. The urine specimens were stored at 4°C at icddr,b until they were tested for the presence of CT and NG. The urine collectors were trained by icddr,b on the collection and safe-keeping of the urine specimens. The urine for the baseline test was collected between May and June 2016 (Supplemental Table 1).

Urine test results were released to us by icddr,b on August 19, 2016 (Mymensingh sample) and August 29, 2016 (Tangail sample) (Supplemental Table 1). There was a significant time period between the collection of urine samples and the release of the STI results due to a shortage of the CT and NG PCR kits at icddr,b. A participant who had her urine tested was classified as positive if the test results were positive for either CT or NG and negative if all results were negative. A certified clinician visited Mymensingh and Tangail on August 24, 2016 and September 2, 2016, respectively, to inform participants of their test results in private in each of their rooms. The urine collectors assisted the clinician in locating the participants. The clinician was also responsible for advising STI-positive participants on where to seek treatment by providing them both written and verbally with the names and addresses of the closest clinics, with at least one of the clinics located within 1 km from the brothel in which the BSW was working. The research team did not follow-up with the BSWs regarding their visits to clinics. All tested participants were informed about their test results, but only the positive cases were provided with information about the location of the nearest clinic and advised to seek treatment at that clinic.

Both the follow-up survey and the second STI test were conducted with participants in November 2016, approximately 2–3 months after results were delivered to participants. The second urine collection followed the same procedure carried out in the first urine collection and was conducted only among those in the intervention group. The follow-up survey was conducted by the enumerators with all participants after the urine specimens had been collected by the urine collectors. We refer to the STI results from the first and second urine tests as the baseline and follow-up STI results, respectively.

Statistical justification for sample size. Prior studies found a 51% reduction in STI prevalence among FSWs in Bangladesh when onsite STI treatment was provided.[31] As our study provided participants in the intervention group who tested STI-positive with information on where to seek STI treatment in lieu of onsite STI treatment, we considered a more conservative 25% reduction in STI prevalence among participants at follow-up to be an appropriate target.

We used the Optimal Design software[32] (William T Grant Foundation, New York, NY) to calculate the minimum number of participants needed to detect a 25% reduction in STI prevalence between intervention and control participants with 90% confidence and 80% power. We estimated that the minimum number of participants required was 365. With our sample size of more than 400 sex workers after accounting for attrition, we have sufficient power to detect the group assignment effects.

Statistical analysis. The primary outcome of our STI test trial focused on the change in STI prevalence of participants in the intervention group only. The key secondary outcomes focused on the sex work behavior of participants in the intervention and control groups as reported in their last 3 days' commercial sexual transactions and last three transactions at follow-up. A description of the sex work behaviors of sex workers can be found in the Supplementary Material (Supplemental Table 2).

Primary outcome (STI prevalence). We estimated the following logistic regression model:

$$F(\text{STI\_Positive}_i) = \frac{1}{1 + e^{-\text{STI\_Positive}_i}} \, ,$$

$$\text{where} \; \text{STI\_Positive}_i = \; \beta_0 + \beta_1 \text{Follow\_Up}_i + \beta_2 X_i + \varepsilon_i,$$

where $F(.)$ refers to the cumulative standard logistic distribution function. The outcome variable, STI_Positive_i, is a dummy variable that takes the value one if participant i tested positive for STIs (CT and/or NG), and 0 if she tested negative for STIs. The explanatory variable, Follow_Up_i, is a dummy variable that takes the value one if the STI result of participant i is measured at follow-up, and 0 if the STI result is measured at baseline. X_i is a set of control variables of the characteristics of participant i. ε_i is the error term.

Secondary outcomes (sex work behavior). We measured the impact of the STI test trial by estimating the following ordinary least squares (OLS)/logistic regression model:

$$Y_i = \; \alpha_0 + \alpha_1 \text{Intervention}_i + \alpha_2 X_i + \varepsilon_i,$$

or

$$F(Y_i) = \frac{1}{1 + e^{-Y_i}} \, ,$$

$$\text{where} \; Y_i = \alpha_0 + \alpha_1 \text{Intervention}_i + \alpha_2 X_i + \varepsilon_i,$$

where Y_i refers to the key secondary outcome. Intervention$_i$ is a dummy variable that takes the value one if participant i is assigned to the intervention group, and 0 if the participant is assigned to the control group. X_i is a set of control variables of the characteristics of participant i. ε_i is the error term. Information related to the last three transactions, for example, number of clients, proportion of repeat clients, and clients using condoms; information related to client characteristics, for example, wealthy client, educated client, and attractive client; and overall risk attitude, heath risk attitude, and anxiety scores were considered as secondary outcome variables. The logistic regression model is only used for secondary outcomes with dichotomous values.

Spillover effects. Participants located in rooms that are close to one another (e.g., in the same building) may share similar (unobserved) characteristics that may differ from those of participants in rooms that are far apart. To account for this possibility, we clustered the standard errors of the estimates at the building level. There was natural variation in the percentage/intensity of participants assigned to the intervention across the buildings (Supplemental Figure 3), between 0% and 100%, during randomization. We measured the spillover effects of our STI test trial on the sex work behavior of participants by first creating the following variable for each building:

Intensity_Intervention

$$= \frac{\text{Number of participants assigned to intervention}}{\text{Total number of participants}}.$$

We then measured the spillover effects on subsamples (i.e., control participants only and intervention participants only) in our study by estimating the following OLS regression model:

$$Y_i = \emptyset_0 + \emptyset_1 \text{Intensity\_Intervention}_i + \emptyset_2 X_i + \varepsilon_i$$

or

$$F(Y_i) = \frac{1}{1 + e^{-Y_i}},$$

where $Y_i = \emptyset_0 + \emptyset_1 \text{Intensity\_Intervention}_i + \emptyset_2 X_i + \varepsilon_i,$

where Y_i refers to the key secondary outcome. X_i is a set of control variables of the characteristics of participant i. ε_i is the error term. The logistic regression model is only used for secondary outcomes with dichotomous values.

RESULTS

Sample and trial progression. Analyses of the primary outcome were conducted for the 211 participants in the intervention group that completed follow-up, whereas analyses of the *secondary* outcomes were conducted for the 413 participants in the control and intervention groups that completed follow-up.

Table 1 shows the baseline characteristics of the intervention and control groups. The mean age of participants was 25.0 years (SD = 5.1), and participants had 2.5 years of education (SD = 3.1). More than half (n = 263, 56%) of the participants were trafficked into the sex work industry and had an average of 7 years of sex work experience (SD = 5.5). Participants believed that, on average, around 30% (SD = 25.5) of their clients were STI-positive and that, on average,

the likelihood that they themselves were STI-positive was two (SD = 2.6) on a scale of 0–10 ("0" means sure that she does not have an STI and "10" means sure that she does have an STI). Participants earned an average of 330 Taka (US$4.14) per client (SD = 124.8 Taka [US$1.56]) (based on the exchange rate on March 5, 2016, using OANDA Currency Converter, Oanda Corporation, New York, NY). Less than half of the participants' clients were repeat clients, and 90% of clients used condoms. Baseline characteristics of the intervention and control groups of the trial were generally similar and balanced at randomization. The baseline characteristics between the two groups were also balanced at randomization by brothel (Supplemental Table 3) and when we excluded clustering at the building level (Supplemental Table 4).

A total of 24 participants (10%) in the intervention group did not undergo STI testing at follow-up (Figure 1). A total of 54 participants (12%) from both the intervention and control groups did not participate in the follow-up survey as they could not be located. A higher number of participants from the control group (n = 33) were lost to the follow-up than those in the intervention group (n = 24). The baseline characteristics of participants who dropped out between the intervention and control groups were generally similar (Supplemental Table 5).

Outcome results. Table 2 shows the prevalence of STIs among participants in the intervention group, both at baseline and at follow-up. The result shows a nonsignificant 26% reduction in STI prevalence among intervention participants (adjusted odds ratio [aOR]: 0.74; 95% CI: 0.38, 1.45) compared with the control participants.

Table 3 shows the impact of the trial on the sex work behavior (reported at follow-up) of participants. Participants in the intervention group had a statistically significant higher odds of having a repeat client (aOR: 1.60; 95% CI: 1.12, 2.29) and a nonsignificant lower odds of engaging with a client suspected of having an STI (aOR: 0.62; 95% CI: 0.39, 1.00) than participants in the control group. Participants in the intervention group were also more risk tolerant, both in general (adjusted difference: 0.46; 95% CI: 0.05, 0.86) and specifically with respect to their health (adjusted difference: 0.39; 95% CI: 0.08, 0.70).

Table 4 shows the spillover effects of the STI test trial. The behavioral coefficients are large. For instance, participants in the control group had fewer repeat clients as the intensity of participants assigned to intervention increases (adjusted difference: –22.1%; 95% CI: –54.00, +9.77). Our results also suggest that, on average, as the intensity of participants assigned to intervention increases, intervention participants had fewer clients (adjusted difference: –2.88; 95% CI: –6.07, +0.32).

DISCUSSION

We have reported the effect of a simple intervention (testing STIs among BSWs and providing information about the nearest treatment facilities to the positive cases) in reducing the prevalence of STIs and risky sex behaviors among BSWs. This is the first study to combine both testing for STIs and providing information about treatment facilities as a potential cost-effective approach to improve the health outcomes, and risky sex behaviors, of BSWs in a developing country context. The intervention did not show any statistically significant effect in reducing the prevalence of STIs among BSWs.

	Mymensingh & tangail		
Baseline characteristics of BSWs (N = 467)	Control (n = 232)	Intervention (n = 235)	P-value (intervention vs. control)
Beauty (on a scale of 1–4)	3.3 (0.7)	3.2 (0.7)	0.15
Age (years)	24.6 (5.1)	25.1 (5.1)	0.23
Education (years)	2.7 (3.3)	2.3 (3.0)	0.19
Ever married, n (%)	144 (62)	142 (60)	0.69
Ever had children, n (%)	107 (46)	93 (40)	0.14
Father alive, n (%)	126 (54)	124 (53)	0.58
Mother alive, n (%)	156 (67)	168 (71)	0.40
Mother is/was a sex worker, n (%)	25 (11)	34 (14)	0.17
Trafficked into sex work industry, n (%)	127 (55)	136 (58)	0.49
Managed by a sardarnis/brothel madam, n (%)	20 (8.6)	17 (7.2)	0.47
Time in sex work (years)	7.1 (5.7)	7.6 (5.3)	0.32
Regular test for STIs, n (%)	173 (75)	165 (70)	0.36
STI likelihood (on a scale of 0–10)	1.7 (2.5)	1.7 (2.8)	0.81
STI anxious (on a scale of 0–10)	7.0 (3.3)	7.3 (3.1)	0.19
STI belief (on a scale of 0–100)	30.2 (25.9)	28.2 (25.1)	0.36
Ever watched video on STIs or HIV/AIDS, n (%)	101 (44)	110 (47)	0.48
Ever smoked, n (%)	125 (54)	114 (49)	0.19
Ever consumed alcohol, n (%)	100 (43)	102 (43)	0.94
Ever used drugs	90 (39)	72 (31%)	0.087
Health test score	8.4 (3.8)	8.5 (4.0)	0.72
Satisfied with life (on a scale of 0–10)	5.3 (3.3)	5.3 (3.2)	0.95
Esteem (on a scale of 1–5)	3.4 (1.0)	3.4 (1.0)	0.99
Extraversion	0.3 (1.9)	0.3 (1.8)	0.72
Agreeableness	1.6 (1.2)	1.6 (1.2)	0.90
Conscientiousness	1.2 (1.4)	1.1 (1.3)	0.42
Neuroticism	−0.1 (1.7)	−0.1 (1.5)	0.82
Openness	0.1 (1.5)	0.1 (1.5)	0.79
Friendly (on a scale of 1–5)	4.1 (0.8)	4.1 (0.8)	0.98
Communicates well (on a scale of 1–5)	4.0 (0.8)	4.0 (0.9)	0.59
Overall risk attitude (on a scale of 0–10)	4.5 (3.1)	4.4 (3.2)	0.81
Health risk attitude (on a scale of 0–10)	3.4 (3.1)	3.2 (3.2)	0.56
Last 3 days' transactional information			
Total income (Taka)*	3044.4 (2,485.2)	3075.2 (2,475.9)	0.88
Total clients	9.8 (8.0)	9.5 (7.0)	0.64
Total condoms used	9.0 (7.8)	8.6 (6.3)	0.63
Price per client (Taka)*	324.7 (124.2)	331.4 (125.6)	0.57
Percentage of regular clients	34.2 (34.4)	33.8 (35.7)	0.90
Percentage of clients suspected of having STIs	7.9 (22.9)	7.3 (20.9)	0.73
Percentage of clients using condom	91.3 (20.1)	93.1 (18.2)	0.31

STI = sexually transmitted infection. Data are n, n (%), or mean (SD). Beauty ("1"" means very unattractive and "5" means very attractive). Sexually transmitted infection likelihood measures the likelihood that BSW thinks she may have an STI ("0" means not at all and "10" means have it for sure). Sexually transmitted infection anxious measures how anxious BSW will be if she finds out she has an STI ("0" means not all and "10" means extremely anxious). Sexually transmitted infection belief measures the number of clients in a total of 100 that the BSW believes have an STI. Satisfied with life ("0" means not satisfied at all and "10" means completely satisfied). The health test score was derived from a twenty-item health test. Esteem measures whether BSW believes she has high self-esteem ("1" means strongly disagree and "5" means strongly agree). Friendly ("1" means strongly disagree and "5" means strongly agree). Communicates well ("1" means strongly disagree and "5" means strongly agree). Overall risk attitude ("0" means risk averse and "10" means risk prone). Health risk attitude ("0" means risk averse and "10" means risk prone).
* At the time of the baseline survey in early 2016, US$1 was approximately 78 Taka.

However, the intervention showed statistically significant effects in changing the risk-taking behaviors of BSWs, such as engaging repeat clients and avoiding clients suspected of having STIs.

Several studies have provided onsite STI treatment to FSWs who test positive for STIs at baseline. In this study, we assessed the effectiveness of an alternative approach, which entailed providing information on the closest clinic at which BSWs, who tested positive for STIs at baseline, could seek treatment. Although we find that providing such treatment information to STI-positive BSWs resulted in a nonsignificant reduction in STI prevalence among BSWs in the intervention group at follow-up, our finding of a reduction in STI prevalence is consistent with interventions that have provided onsite treatment to STI-positive FSWs.[14,15] The magnitude of the reduction in STI prevalence in our study, however, is not statistically significant and generally smaller than that reported in studies that provided onsite treatment. One study[31] reported a 51% drop in STI prevalence among FSWs in Bangladesh. The smaller reduction in our study likely reflects the fact that some BSWs might be reluctant to seek treatment. Several causes might be responsible for this reluctance of BSWs to seek medical treatment as described in the previously published literature,[5,33] including fear of being discriminated, not wanting to take time off work for fear of losing clients, and the lack of money to pay for treatment. The finding reported in this study might also be due to STI reinfection in BSWs who had already sought STI treatment. Future interventions should also target clients and other sex partners of BSWs for identification and treatment of STIs.

One of the limitations of the design is that we did not measure the STI prevalence of participants in the control group at follow-up due to shortage of funds. We were, therefore, unable to estimate the full impact of providing BSWs with information on where to seek treatment on STI prevalence. We were also not able to add an intervention to provide onsite treatment for STIs to gage the difference between the effectiveness of onsite treatment and giving BSWs information on the nearest

TABLE 2
Sexually transmitted infection prevalence of female brothel sex workers who were assigned to STI testing (primary outcome), Mymensingh and Tangail, Bangladesh

Intervention (urine test)

Primary outcome	Baseline (n = 235), n (%)	Follow-up (n = 211), n (%)	Follow-up STI result vs baseline STI result (adjusted odds ratio [95% CI])*	Adjusted P-value*
STI prevalence†	29 (12)	20 (9)	0.74 (0.38–1.45)	0.38
Chlamydia prevalence†	17 (7)	16 (8)	1.05 (0.52–2.11)	0.90
Gonorrhoea prevalence†	17 (7)	4 (2)	0.25 (0.08–0.76)	0.014

	Within those who tested positive for STIs at baseline and did not attrite at follow-up (n = 25)		Within those who tested negative for STIs at baseline and did not attrite at follow-up (n = 186)	
	Follow-up STI result vs. baseline STI result (aOR [95% CI])*	Adjusted P-value*	Follow-up STI result vs baseline STI result (aOR [95% CI])*	Adjusted P-value*
STI prevalence†	0.01 (0–0.54)	< 0.001	25.24 (4.23–25.53)	< 0.001
Chlamydia prevalence†	0.1 (0.02–0.45)	< 0.001	21.44 (3.54–21.71)	< 0.001
Gonorrhoea prevalence†	0.06 (0.01–0.34)	< 0.001	2.67 (0.21–2.784)	0.45

	Within those who tested positive for STIs at baseline and did not attrite at follow-up‡		Within those who tested negative for STIs at baseline, regardless of attrition status at follow-up§		Within those who tested negative for STIs at baseline and did not attrite at follow-up§	
	Baseline (n = 29), n (%)	Follow-up (n = 25), n (%)	Baseline (n = 206), n (%)	Follow-up (n = 25), n (%)	Baseline (n = 186), n (%)	Follow-up (n = 186), n (%)
STI prevalence†	29 (100)	25 (100)	0 (0)	5 (20)	0 (0)	15 (8)
Chlamydia prevalence†	17 (59)	15 (60)	0 (0)	3 (12)	0 (0)	13 (7)
Gonorrhoea prevalence†	17 (59)	14 (56)	0 (0)	2 (8)	0 (0)	2 (1)

aOR = adjusted odds ratio; BSWs = brothel-based sex worker; STI -FF sexually transmitted infection. Data are n or n (%).
* Adjusted odds ratios are calculated through a logistic regression of the selected primary outcome variable (STI prevalence, chlamydia prevalence, and gonorrhea prevalence) on the follow-up dummy variable and clustering at the building level (non-aOR is reported in Supplemental Table 6). Models were adjusted for types of STIs.
† Brothel-based sex worker is considered STI positive if she tested positive for chlamydia, and/or gonorrhea. Only BSWs who were allocated to the STI test group were tested for STIs.
‡ Four BSWs who tested positive for STIs at baseline dropped out at follow-up (three BSWs could not be located at follow-up for a second STI test, and one BSW refused to provide urine specimen at follow-up).
§ Twenty BSWs who tested negative for STIs at baseline dropped out at follow-up (18 BSWs could not be located at follow-up for the second STI test, and two BSWs refused to provide a urine specimen at follow-up).

TABLE 3
Sex work behavior of female brothel sex workers, Mymensingh and Tangail, Bangladesh

Secondary outcome	Intervention (n = 214) vs control (n = 199) (adjusted mean difference/aaOR [95% CI])*	Adjusted P-value*
Last 3 days' transactional information (results are in mean difference)†		
Total number of clients	−0.10 (−1.24-1.03)	0.86
Proportion of repeat clients (%)	6.30 (−1.07-13.66)	0.09
Proportion of clients suspected of having STIs (%)	−0.60 (−3.58-2.38)	0.69
Proportion of clients using condom (%)	−1.14 (−5.35-3.06)	0.59
Last three transactions (results are in OR)†,‡		
Used a condom	0.90 (0.41–1.98)	0.79
Used a condom with all three clients	0.91 (0.46–1.79)	0.79
Used a condom with at least two clients	0.68 (0.17–2.77)	0.59
Used a condom with at least one client	1.77 (0.20–15.6)	0.61
Had a repeat client	1.60 (1.12–2.29)	0.01
Had a client suspected of having STIs	0.62 (0.39–1.00)	0.05
Inspected client for STIs	0.81 (0.50–1.30)	0.38
Had a wealthy client	1.08 (0.83–1.39)	0.57
Had an educated client	0.93 (0.68–1.26)	0.63
Had an attractive client	1.02 (0.78–1.32)	0.91
Had a clean client	0.81 (0.43–1.55)	0.53
Liked the client	1.07 (0.82–1.39)	0.63
Others (results are in mean difference)		
Overall risk attitude (on a scale of 0–10)	0.46 (0.05–0.86)	0.03
Health risk attitude (on a scale of 0–10)	0.39 (0.08–0.70)	0.02
Anxiety score§	1.76 (0.84–2.68)	0.00

aOR = adjusted odds ratio.
* Adjusted mean difference (calculated for *last 3 days' transaction information* and *Others*)/aOR (calculated for *last three transactions*) calculated via a linear/logistic regression of the selected secondary outcome variable on the treatment status and pre-intervention level outcomes, and clustered at the building level (non-adjusted mean difference is reported in Supplemental Table 7). Models were adjusted for educational level, previous personal history, having children or not and history of using drugs and smoking.
† Fifteen brothel-based sex workers reported no transactions in the last 3 days (eight from intervention and seven from control).
‡ Listed secondary outcomes are binary outcomes.
§ Anxiety score is derived from the Health Anxiety Inventory, the higher the score the higher the anxiety. No adjustment for baseline measure because data were not collected at baseline. Overall risk attitude ("0" means risk averse and "10" means risk prone). Health risk attitude ("0" means risk averse and "10" means risk prone).

clinics to seek treatment. The reduction in the prevalence of STIs among those in the intervention group in our study, however, suggests that providing BSWs with information on where to seek STI treatment may be a promising alternative, but it requires more extensive and larger scale evaluation to confirm its effectiveness. Moreover, we chose to conduct the STI test with BSWs only as they are easier to locate, to conduct a follow-up interview, than street sex workers who are more prone to site relocation. Therefore, our results may not be generalizable to other FSWs that are not brothel based. Future

TABLE 4
Spillover effects of STI testing on the sex work behaviors of female brothel sex workers, Mymensingh and Tangail, Bangladesh

Secondary outcome	Intensity of BSWs assigned to intervention on control group (n = 199) (adjusted mean difference/adjusted odds ratio [95% CI])*	Adjusted P-value*	Intensity of BSWs assigned to intervention on intervention group (n = 214) (adjusted mean difference/adjusted odds ratio [95% CI])*	Adjusted P-value*
Last 3 days' transactional information (results are in mean difference)†				
Total number of clients	−1.77 (−5.87-2.33)	0.39	−2.88 (−6.07-0.32)	0.08
Proportion of repeat clients (%)	−22.11 (−54.00-9.77)	0.17	6.00 (−38.27-50.28)	0.79
Proportion of clients suspected of having STIs (%)	6.82 (−10.20-23.85)	0.42	−7.44 (−26.85-11.98)	0.45
Proportion of clients using condom (%)	4.71 (−8.85-18.28)	0.49	−7.41 (−28.20-13.38)	0.48
Last three transactions (results are in OR)†,‡				
Used a condom	5.21 (0.38–72.3)	0.22	0.36 (0.04–3.50)	0.38
Had a repeat client	0.47 (0.07–3.05)	0.43	2.07 (0.31–13.78)	0.45
Had a client suspected of having STIs	1.26 (0.09–17.4)	0.86	0.50 (0.02–11.85)	0.67
Inspected client for STIs	0.28 (0.06–1.37)	0.12	0.99 (0.13–7.76)	1.00
Had a wealthy client	0.90 (0.28–2.94)	0.86	2.20 (0.75–6.49)	0.15
Had an educated client	1.56 (0.32–7.50)	0.58	0.70 (0.28–1.73)	0.44
Had an attractive client	0.81 (0.22–2.98)	0.75	1.52 (0.51–4.51)	0.45
Had a clean client	0.25 (0.01–9.10)	0.45	2.26 (0.25–20.38)	0.47
Liked the client	0.58 (0.22–1.54)	0.28	1.33 (0.50–3.57)	0.57
Others (results are in mean difference)				
Overall risk attitude (on a scale of 0–10)	−0.94 (−3.57-1.69)	0.48	0.27 (−1.88-2.42)	0.80
Health risk attitude (on a scale of 0–10)	0.51 (−1.66-2.68)	0.64	0.56 (−0.97-2.09)	0.46
Anxiety score§	−0.25 (−5.35-4.86)	0.92	−2.15 (−6.70-2.40)	0.35

BSW = brothel-based sex worker.
* Adjusted mean difference (calculated for *Last 3 days' transaction information* and *Others*)/adjusted odds ratio (calculated for *Last three transactions*) calculated via a linear/logistic regression of selected secondary outcome variable on the proportion of BSWs assigned to the intervention group, pre-intervention–level outcomes, and clustered at the building level (non-adjusted mean difference is reported in Supplemental Table 8).
† Seven BSWs reported no transactions in the last 3 days.
‡ Listed secondary outcomes are binary outcomes.
§ Anxiety score is derived from the Health Anxiety Inventory, the higher the score the higher the anxiety. No adjustment for baseline measure because data were not collected at baseline. Overall risk attitude ("0" means risk averse and "10" means risk prone). Health risk attitude ("0" means risk averse and "10" means risk prone).

studies could include an STI test for the control group at follow-up to more accurately measure the impact of providing such treatment information to BSWs, and also extending the trial to non–brothel-based FSWs.

Our results also showed that testing for STIs may have had the positive effect of encouraging BSWs to engage repeat clients and avoid clients suspected of having STIs. Engaging more with repeat clients reduces BSWs' exposure to new clients, which could lower the risk of BSWs being infected with STIs.[34] However, our analyses showed that BSWs in the intervention group became more risk tolerant toward their health. This result is inconsistent with them exhibiting safer sexual behaviors. The increase in self-perceived risk tolerance may be due to the possibility that STI testing made the risks associated with sex work more salient to BSWs.[35] As such, BSWs may have realized that their behavior was riskier than how they originally perceived it to be and, thus, subsequently revised their perception of their risk tolerance upward.

Finally, for the primary outcome of interest (the prevalence of STIs), only the pre–post intervention evaluation was conducted, given that we did not have a control group available for comparison. The results about the clients' characteristics could be subject to recall bias despite our best efforts to minimize such. Therefore, the results of this intervention should be interpreted with caution. Although there was a randomly assigned control group for drawing causal inferences about the effects of the intervention on risky sex behaviors, the relatively short duration of the intervention (2–3 months) means that the intervention may not be sufficiently strong for behavioral changes to take place. This may explain why the effect on reducing STIs is not particularly strong, even when there is suggestive evidence that BSWs take less risk with respect to the clients with whom they engage. A final limitation is the potential for contamination between the intervention and control groups because participants in both the intervention and control groups reside in the same location. Therefore, a further large-scale well-designed study such as a clustered RCT with repeated interventions that runs for a longer period of time may help to identify a more effective, generalizable, and sustainable solution.

CONCLUSION

The results reported here highlight that once-off testing of BSWs for STIs and providing positive cases with information about nearby medical facilities at which they can seek treatment is unlikely to result in significant changes in the prevalence of STIs. Despite the intervention having a nonsignificant effect on the primary outcome of the study, it suggests that BSWs respond to the intervention by taking less risk with respect to the clients with whom they engage. The key contribution of this study is shedding light on the broad limitations of such a simple intervention in reducing the prevalence of STIs in a developing country context. More importantly, the research points out potential areas in which future interventions can focus to effect behavioral changes. A systematic, and in-depth, qualitative and quantitative evaluation of already implemented interventions is warranted to help develop a more effective and generalizable intervention to reduce STIs in marginalized populations in the future.

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Supplementary material

	Start	End
Baseline survey and randomisation - Mymensingh	February 21, 2016	February 25, 2016
Baseline survey and randomisation - Tangail	February 29, 2016	March 5, 2016
First urine collection	May 22, 2016	June 5, 2016
Release of urine test results - Mymensingh	August 19, 2016	August 19, 2016
Release of urine test results -Tangail	August 29, 2016	August 29, 2016
Doctor informed participants of their urine test results – Mymensingh	August 24, 2016	August 24, 2016
Doctor informed participants of their urine test results – Tangail	September 1, 2016	September 2, 2016
Follow-up survey and second urine collection	November, 2016	November, 2016

Supplementary Table 1: Study timeline of STI testing intervention and baseline and follow-up surveys with female brothels sex workers, Mymensingh and Tangail, Bangladesh
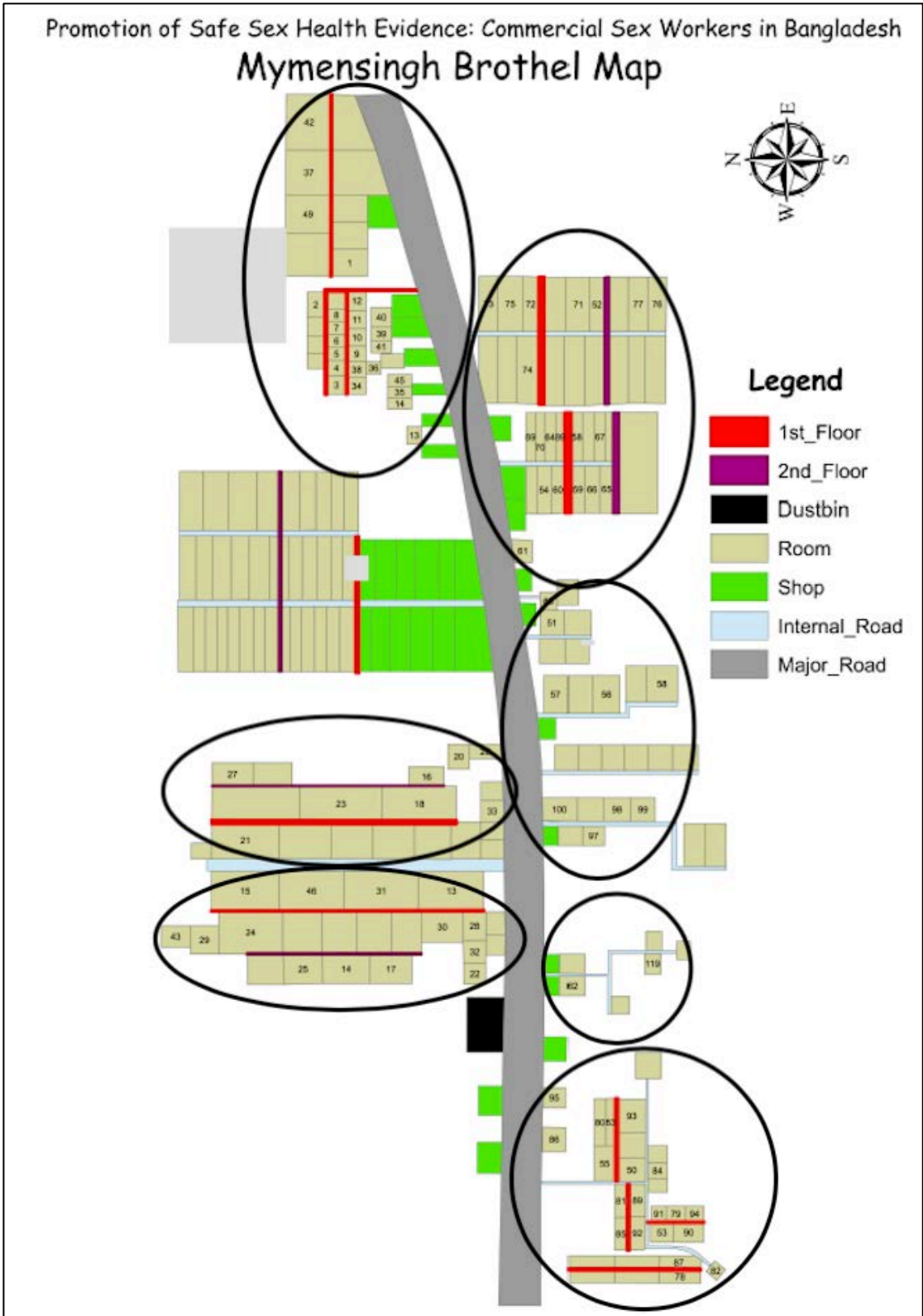
Notes: The number signifies the BSWs in our study. The black ovals/circles show the rooms that were grouped together to form a building.

Supplementary Figure 1: Mymensingh map, Bangladesh
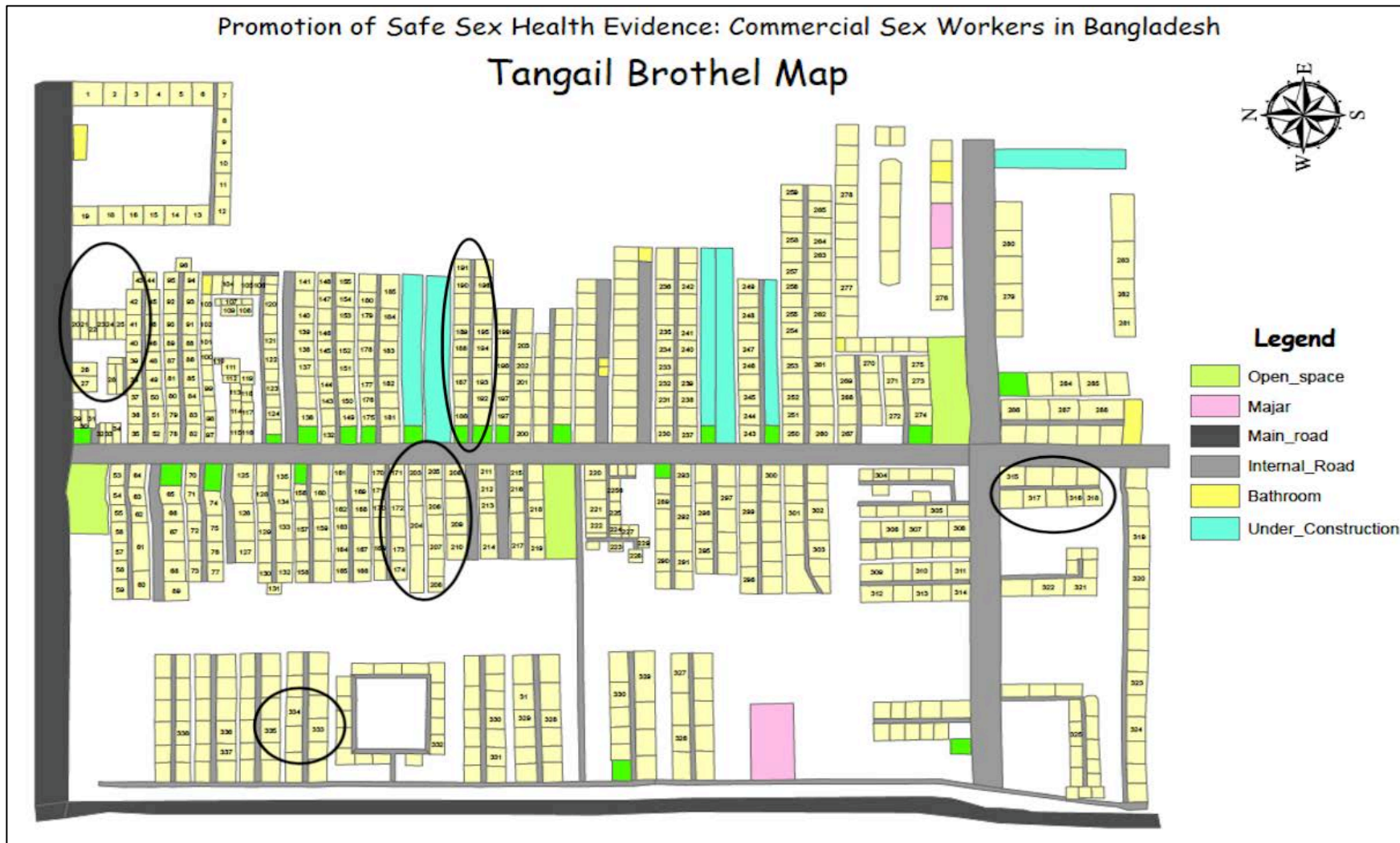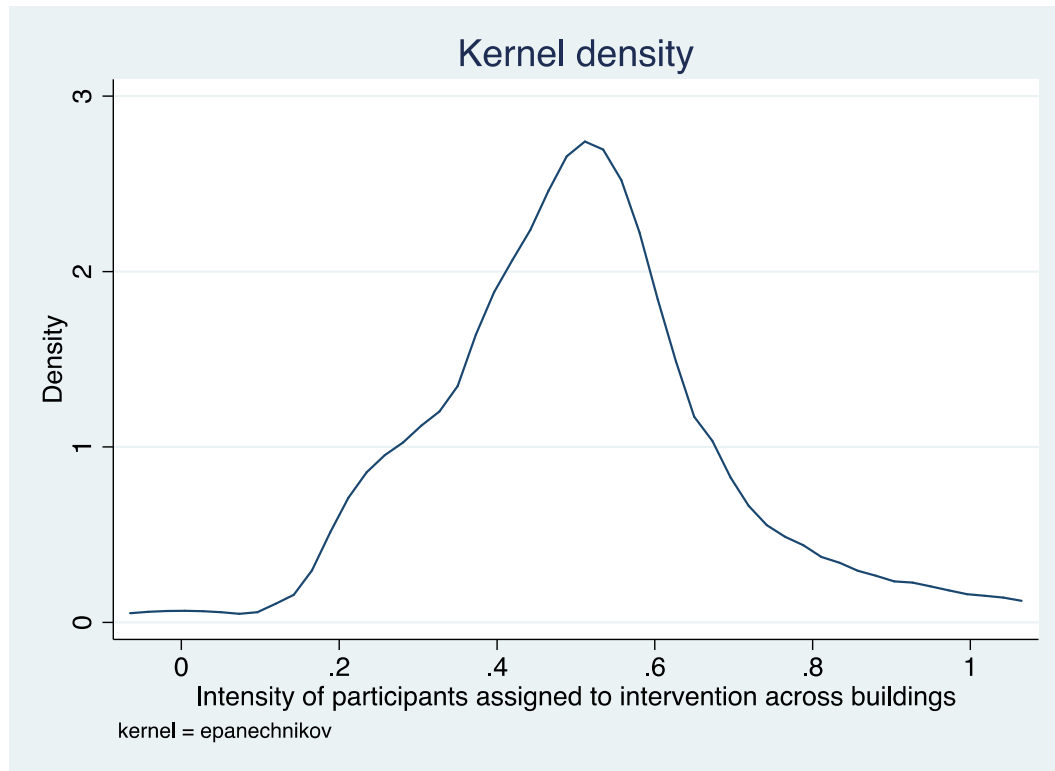
Notes: The number signifies the BSWs in our study. The black ovals/circles the rooms that were grouped together to form a building.

Supplementary Figure 2: Tangail map, Bangladesh

Supplementary Figure 3: Variation in percentage/intensity of female brothel sex workers assigned to STI testing (intervention group) across buildings in brothels, Mymensingh and Tangail, Bangladesh

Commercial safe sex behaviours of BSWs	Description
Last three days' transactional information:	
Proportion of repeat clients (%)	Total number of repeat clients divided by the total number of clients as reported in the last three days transactions by sex worker
Proportion of clients suspected of having STIs	Total number of clients suspected of having STIs divided by the total number of clients as reported in the last three days transactions by sex worker
Proportion of clients using condom (%)	Total number of clients who used a condom with the sex worker divided by the total number of clients as reported in the last three days transactions by sex worker
Last three transactions:	
Used a condom	Equals 1 if sex worker engaged in protected sex in this transaction; 0 otherwise
Used a condom with all three clients	Equals 1 if sex worker used a condom with all three clients; 0 otherwise
Used a condom with at least two clients	Equals 1 if sex worker used a condom with at least two clients; 0 otherwise
Used a condom with at least one client	Equals 1 if sex worker used a condom with at least one client; 0 otherwise
Had a repeat client	Equals 1 if the client in this transaction had engaged in the services of the sex worker more than twice in the past; 0 otherwise
Had a client suspected of having STIs	Equals 1 if sex worker suspected that the client in this transaction may have STIs; 0 otherwise
Had a wealthy client	Equals 1 if sex worker considered the client in this transaction to be wealth or very wealthy; 0 if sex worker considered the client to be of average wealth or poor
Had an educated client	Equals 1 if sex worker considered the client in this transaction to be moderately educated or highly educated; 0 if sex worker considered the client to be lowly educated or not educated
Had an attractive client	Equals 1 if sex worker rated the appearance of the client in this transaction to be attractive; 0 if sex worker rated the appearance of the client to be average or unattractive
Had a clean client	Equals 1 if sex worker considered the client in this transaction to be clean or very clean; 0 if sex worker considered the client to be dirty
Liked the client	Equals 1 if sex worker liked the client in this transaction somewhat or very much; 0 if sex worker liked the client not very much or not at all
Others:	
Overall risk attitude	Self-reported risk measure towards general matters is measured on a scale of 0-10 ("0" means risk-averse; "10" means risk-prone)
Health risk tolerance	Self-reported risk measure towards health is measured on a scale of 0-10 ("0" means risk-averse; "10" means risk-prone)

Anxiety score	Score is derived from the eighteen-item Health Anxiety Inventory (HAI); the higher the score, the higher the anxiety of the sex worker

Supplementary Table 2: Description of commercial sex work behaviours of female brothel sex workers, Mymensingh and Tangail, Bangladesh

Statistical analysis plan

The *primary* outcome of our STI test trial focused on the change in STI prevalence of participants in the intervention group only. The key *secondary* outcomes focused on the commercial safe sex behaviour of participants in the intervention and control groups as reported in their last three days' commercial sexual transactions and last three transactions at follow-up. We also analysed whether the STI test trial had any spill over effects on the safe sex behaviour of participants in the intervention and control groups.

Primary outcome (STI prevalence)

We estimated the following logistic regression model:

$$F(STI\_Positive_i) = \frac{1}{1 + e^{-STI\_Positive_i}}$$

$$where: STI\_Positive_i = \beta_0 + \beta_1 Follow\_Up_i + \beta_2 X_i + \varepsilon_i$$

where *F(.)* refers to the cumulative standard logistic distribution function. The outcome variable, *STI_Positive$_i$*, is a dummy variable that takes the value 1 if participant *i* tested positive for STIs (CT and/or NG), and 0 if she tested negative for STIs. The explanatory variable, *Follow_Up$_i$*, is a dummy variable that takes the value 1 if the STI result of participant *i* is measured at follow-up, and 0 if the STI result is measured at baseline. *X$_i$* is a set of control variables of the characteristics of participant *i*. ε_i is the error term.

Secondary outcomes (Safe sex behaviour)

We measured the impact of the STI test trial by estimating the following OLS/logistic regression model:

$$Y_i = \alpha_0 + \alpha_1 Intervention_i + \alpha_2 X_i + \varepsilon_i$$

or

$$F(Y_i) = \frac{1}{1 + e^{-Y_i}}$$

$$where: Y_i = \alpha_0 + \alpha_1 Intervention_i + \alpha_2 X_i + \varepsilon_i$$

where Y_i refers to the key secondary outcome. *Intervention$_i$* is a dummy variable that takes the value 1 if participant i is assigned to the intervention group, and 0 if assigned to the control group. X_i is a set of control variables of the characteristics of participant i. ε_i is the error term. The logistic regression model is only used for secondary outcomes with dichotomous values.

Spill over effects
We measured the spill over effects of our STI test trial on the safe sex behaviour of participants by first creating the following variable for each building:

$$Intensity\_Intervention = \frac{Number\ of\ participants\ assigned\ to\ intervention}{Total\ number\ of\ participants}$$

We then measured the spill over effects on sub-samples (i.e. control participants only, intervention participants only) in our study by estimating the following OLS/logistic regression model:

$$Y_i = \emptyset_0 + \emptyset_1 Intensity\_Intervention_i + \emptyset_2 X_i + \varepsilon_i$$

or

$$F(Y_i) = \frac{1}{1 + e^{-Y_i}}$$

$$where: Y_i = \emptyset_0 + \emptyset_1 Intensity\_Intervention_i + \emptyset_2 X_i + \varepsilon_i$$

where Y_i refers to the key secondary outcome. X_i is a set of control variables of the characteristics of participant i. ε_i is the error term. The logistic regression model is only used for secondary outcomes with dichotomous values.

	Mymensingh			Tangail		
Baseline characteristics of BSWs:	Control (n=73)	Intervention (n=60)	p-value (Intervention *vs* control)	Control (n=159)	Intervention (n=175)	p-value (Intervention *vs* control)
Beauty (on a scale of 1-4)	3.2 (0.7)	3.1 (0.8)	0.19	3.3 (0.6)	3.2 (0.7)	0.42
Age (years)	23.2 (5.0)	23.6 (5.3)	0.63	25.3 (5.1)	25.6 (4.9)	0.47
Education (years)	2.5 (3.2)	2.2 (3.2)	0.58	2.8 (3.3)	2.3 (2.9)	0.21
Ever married	38 (52%)	28 (47%)	0.52	106 (67%)	114 (65%)	0.77
Ever had children	31 (42%)	25 (42%)	0.94	76 (48%)	68 (39%)	0.053
Father alive	43 (59%)	33 (55%)	0.72	83 (52%)	91 (52%)	0.76
Mother alive	43 (59%)	40 (67%)	0.27	113 (71%)	128 (73%)	0.71
Mother is/was a sex worker	2 (3%)	3 (5%)	0.82	23 (14%)	31 (18%)	0.13
Trafficked into sex work industry	37 (51%)	31 (52%)	0.93	90 (57%)	105 (60%)	0.50
Managed by a *sardarnis*/brothel madam	18 (24.7%)	13 (21.7%)	0.61	2 (1.3%)	4 (2.3%)	0.49
Time in sex work (years)	5.5 (4.8)	5.1 (4.0)	0.62	7.8 (6.0)	8.4 (5.5)	0.36
Regular test for STIs	46 (63%)	38 (63%)	0.97	127 (80%)	127 (73%)	0.18
STI likelihood (on a scale of 0-10)	1.9 (2.5)	2.2 (3.3)	0.35	1.6 (2.4)	1.6 (2.6)	0.95
STI anxious (on a scale of 0-10)	6.2 (3.7)	6.8 (3.4)	0.25	7.3 (3.1)	7.4 (3.0)	0.59
STI belief (on a scale of 0-100)	29.9 (27.6)	30.1 (28.9)	0.96	30.3 (25.2)	27.6 (23.6)	0.32
Ever watched video on STIs or HIV/AIDs	24 (33%)	25 (42%)	0.25	77 (48%)	85 (49%)	0.98
Ever smoked	35 (48%)	21 (35%)	0.31	90 (57%)	93 (53%)	0.64
Ever consumed alcohol	20 (27%)	14 (23%)	0.69	80 (50%)	88 (50%)	0.42
Ever used drugs	24 (33%)	10 (17%)	0.093	66 (42%)	65 (35%)	1.00
Health test score	7.0 (4.0)	6.5 (3.6)	0.47	9.0 (3.6)	9.2 (3.9)	0.31
Satisfied with life (on a scale of 0-10)	5.4 (3.3)	5.4 (2.9)	0.94	5.2 (3.3)	5.2 (3.3)	0.98
Esteem (on a scale of 1-5)	3.4 (1.0)	3.4 (1.0)	0.87	3.5 (1.0)	3.5 (1.0)	0.89
Extraversion	0.5 (2.1)	0.1 (1.8)	0.35	0.3 (1.8)	0.3 (1.8)	0.76
Agreeableness	1.5 (1.4)	1.5 (1.5)	0.90	1.7 (1.2)	1.7 (1.2)	0.87

Conscientiousness	1.1 (1.5)	1.3 (1.2)	0.64	1.3 (1.3)	1.1 (1.4)	0.22
Neuroticism	-0.4 (1.8)	-0.2 (1.3)	0.63	0.03 (1.7)	-0.1 (1.6)	0.46
Openness	0.1 (1.5)	0.2 (1.6)	0.59	0.04 (1.5)	0.05 (1.5)	0.99
Friendly (on a scale of 1-5)	3.8 (0.9)	3.8 (1.0)	0.89	4.3 (0.7)	4.3 (0.6)	0.65
Communicates well (on a scale of 1-5)	3.7 (0.9)	3.5 (1.0)	0.12	4.1 (0.7)	4.1 (0.8)	0.87
Overall risk attitude (on a scale of 0-10)	4.4 (3.1)	4.7 (3.1)	0.65	4.5 (3.2)	4.3 (3.2)	0.57
Health risk attitude (on a scale of 0-10)	3.5 (3.3)	3.5 (3.6)	0.95	3.3 (3.0)	3.1 (3.1)	0.52
Last three days' transactional information						
Total income (Taka)	3597.7 (2734.1)	3836. 3 (2865.2)	0.42	2790.3 (2327.4)	2814.3 (2278.8)	0.91
Total clients	12.5 (7.8)	13.5 (9.3)	0.14	8.5 (7.7)	8.1 (5.4)	0.57
Total condoms used	11.3 (7.9)	12.5 (8.0)	0.19	8.0 (7.5)	7.4 (5.0)	0.41
Price per client (Taka)	279.9 (105.5)	289.4 (102.0)	0.72	345.2 (127.0)	345.8 (129.9)	0.97
Proportion of regular clients (%)	33.0 (30.6)	25.5 (32.4)	0.073	34.8 (36.1)	36.7 (36.5)	0.65
Proportion of clients suspected of having STIs (%)	15.8 (29.6)	9.9 (20.4)	0.087	4.3 (18.0)	6.4 (21.1)	0.33
Proportion of clients using condom (%)	88.5 (21.6)	94.3 (13.3)	0.076	92.6 (19.2)	92.7 (19.6)	0.94

Data are n, n (%), or mean (SD). Beauty ("1" very unattractive "5" very attractive). STI likelihood measures the likelihood that BSW thinks she may have an STI ("0" not at all; "10" have it for sure). STI anxious measures how anxious BSW will be if she finds out she has an STI ("0" not all; "10" extremely anxious). STI belief measures the number of clients out of 100 that the BSW believes have an STI. Satisfied with life ("0" not satisfied at all; "10" completely satisfied). Health test score was derived from a twenty-item health test. Esteem measures whether BSW believes she has high self-esteem ("1" strongly disagree; "5" strongly agree). Friendly ("1" strongly disagree; "5" strongly agree). Communicates well ("1" strongly disagree; "5" strongly agree). Overall risk attitude ('0" risk averse; "10" risk prone). Health risk attitude ('0" risk averse; "10" risk prone). *At the time of the baseline survey in early 2016, US$1 was approximately 78 Taka.

Supplementary Table 3: Baseline characteristics of female brothel sex workers, Mymensingh and Tangail, Bangladesh (broken down by brothels)

	Mymensingh & Tangail		
Baseline characteristics of BSWs:	Control (n=232)	Intervention (n=235)	p-value (Intervention *vs* control)
Beauty (on a scale of 1-4)	3.3 (0.7)	3.2 (0.7)	0.29
Age (years)	24.6 (5.1)	25. 1 (5.1)	0.27
Education (years)	2.7 (3.3)	2.3 (3.0)	0.15
Ever married	144 (62%)	142 (60%)	0.72
Ever had children	107 (46%)	93 (40%)	0.15
Father alive	126 (54%)	124 (53%)	0.62
Mother alive	156 (67%)	168 (71%)	0.45
Mother is/was a sex worker	25 (11%)	34 (14%)	0.21
Trafficked into sex work industry	127 (55%)	136 (58%)	0.50
Managed by a *sardarnis*/brothel madam	20 (8.6%)	17 (7.2%)	0.58
Time in sex work (years)	7.1 (5.7)	7.6 (5.3)	0.34
Regular test for STIs	173 (75%)	165 (70%)	0.29
STI likelihood (on a scale of 0-10)	1.7 (2.5)	1.7 (2.8)	0.84
STI anxious (on a scale of 0-10)	7.0 (3.3)	7.3 (3.1)	0.26
STI belief (on a scale of 0-100)	30.2 (25.9)	28.2 (25.1)	0.42
Ever watched video on STIs or HIV/AIDs	101 (44%)	110 (47%)	0.48
Ever smoked	125 (54%)	114 (49%)	0.25
Ever consumed alcohol	100 (43%)	102 (43%)	0.95
Ever used drugs	90 (39%)	72 (31%)	0.064
Health test score	8.4 (3.8)	8.5 (4.0)	0.75
Satisfied with life (on a scale of 0-10)	5.3 (3.3)	5.3 (3.2)	0.96
Esteem (on a scale of 1-5)	3.4 (1.0)	3.4 (1.0)	0.99
Extraversion	0.3 (1.9)	0.3 (1.8)	0.69
Agreeableness	1.6 (1.2)	1.6 (1.2)	0.91
Conscientiousness	1.2 (1.4)	1.1 (1.3)	0.38

Neuroticism	-0.1 (1.7)	-0.1 (1.5)	0.83
Openness	0.1 (1.5)	0.1 (1.5)	0.79
Friendly (on a scale of 1-5)	4.1 (0.8)	4.1 (0.8)	0.98
Communicates well (on a scale of 1-5)	4.0(0.8)	4.0 (0.9)	0.62
Overall risk attitude (on a scale of 0-10)	4.5 (3.1)	4.4 (3.2)	0.80
Health risk attitude (on a scale of 0-10)	3.4 (3.1)	3.2 (3.2)	0.50
Last three days' transactional information			
Total income (Taka)	3044.4 (2485.2)	3075.2 (2475.9)	0.89
Total clients	9.8 (8.0)	9.5 (7.0)	0.67
Total condoms used	9.0 (7.8)	8.6 (6.3)	0.64
Price per client (Taka)	324.7 (124.2)	331.4 (125.6)	0.56
Proportion of regular clients (%)	34.2 (34.4)	33.8 (35.7)	0.90
Proportion of clients suspected of having STIs (%)	7.9 (22.9)	7.3 (20.9)	0.75
Proportion of clients using condom (%)	91.3 (20.1)	93.1 (18.2)	0.30

Data are n, n (%), or mean (SD). Beauty ("1" very unattractive "5" very attractive). STI likelihood measures the likelihood that BSW thinks she may have an STI ("0" not at all; "10" have it for sure). STI anxious measures how anxious BSW will be if she finds out she has an STI ("0" not all; "10" extremely anxious). STI belief measures the number of clients out of 100 that the BSW believes have an STI. Satisfied with life ("0" not satisfied at all; "10" completely satisfied). Health test score was derived from a twenty-item health test. Esteem measures whether BSW believes she has high self-esteem ("1" strongly disagree; "5" strongly agree). Friendly ("1" strongly disagree; "5" strongly agree). Communicates well ("1" strongly disagree; "5" strongly agree). Overall risk attitude ('0" risk averse; "10" risk prone). Health risk attitude ('0" risk averse; "10" risk prone). *At the time of the baseline survey in early 2016, US$1 was approximately 78 Taka.

Supplementary Table 4: Baseline characteristics of female brothel sex workers, Mymensingh and Tangail, Bangladesh (not clustered at building level)

Baseline characteristics of BSWs:	Participants lost to follow-up (n=57)			Remaining participants (n=410)		
	Intervention (n=24)	Control (n=33)	p value (Intervention vs control)	Intervention (n=211)	Control (n=199)	p value (Intervention vs control)
Beauty (on a scale of 1-4)	3.1 (0.7)	3.3 (0.7)	0.26	3.2 (0.7)	3.2 (0.6)	0.33
Age (years)	23.9 (5.1)	22.3 (4.5)	0.17	25.3 (5.1)	25.0 (5.2)	0.54
Education (years)	3.4 (3.7)	3.0 (3.2)	0.69	2.2 (2.8)	2.7 (3.3)	0.14
Ever married	16 (67%)	17 (52%)	0.16	126 (60%)	127 (64%)	0.39
Ever had children	9 (38%)	11 (33%)	0.76	84 (40%)	96 (48%)	0.057
Father alive	13 (54%)	20 (61%)	0.71	111 (53%)	106 (53%)	0.71
Mother alive	17 (71%)	22 (67%)	0.91	151 (72%)	134 (67%)	0.31
Mother is/was a sex worker	6 (25%)	3 (9%)	0.37	28 (13%)	22 (11%)	0.25
Trafficked into sex work industry	10 (42%)	21 (64%)	0.10	126 (60%)	106 (53%)	0.16
Managed by *sardarnis*/brothel madam	2 (8%)	3 (9%)	0.87	15 (7%)	17 (9%)	0.51
Time in sex work (years)	6.3 (5.5)	5.7 (4.3)	0.63	7.7 (5.3)	7.3 (5.9)	0.46
Regular test for STIs	16 (67%)	18 (55%)	0.39	149 (71%)	155 (78%)	0.13
STI likelihood (on a scale of 0-10)	2.7 (3.6)	2.4 (2.6)	0.75	1.6 (2.7)	1.6 (2.4)	0.81
STI anxious (on a scale of 0-10)	8.0 (2.6)	7.3 (3.6)	0.31	7.2 (3.2)	6.9 (3.3)	0.28
STI belief (on a scale of 0-100)	28.4 (28.4)	32.5 (31.6)	0.53	28.2 (24.7)	29.8 (24.9)	0.54
Ever watched video on STIs or HIV/AIDs	11 (46%)	12 (36%)	0.47	99 (47%)	89 (45%)	0.70
Ever smoked	9 (38%)	21 (64%)	0.051	105 (50%)	104 (52%)	0.52
Ever consumed alcohol	10 (42%)	12 (36%)	0.64	92 (44%)	88 (44%)	0.89
Ever used drugs	10 (42%)	16 (48%)	0.58	62 (29%)	74 (37%)	0.088
Health test score	8.0 (4.0)	7.5 (3.9)	0.50	8.6 (4.0)	8.5 (3.8)	0.93
Satisfied with life (on a scale of 0-10)	6.0 (3.4)	5.3 (3.7)	0.34	5.2 (3.2)	5.3 (3.2)	0.75
Esteem (on a scale of 1-5)	3.3 (1.0)	3.5 (1.1)	0.50	3.5 (1.0)	3.4 (1.0)	0.78
Extraversion	0.3 (1.6)	0.2 (1.8)	0.90	0.3 (1.8)	0.3 (1.9)	0.61
Agreeableness	1.9 (1.2)	1.9 (1.1)	0.72	1.6 (1.2)	1.6 (1.2)	0.94

Conscientiousness	0.9 (1.2)	1.3 (1.4)	0.10	1.2 (1.4)	1.2 (1.4)	0.66
Neuroticism	-0.1 (1.4)	-0.1 (1.8)	0.98	-0.1 (1.5)	-0.1 (1.7)	0.82
Openness	-0.2 (1.1)	-0.1 (1.3)	0.93	0.1 (1.6)	0.1 (1.5)	0.79
Friendly (on a scale of 1-5)	4.2 (0.6)	3.9 (0.9)	0.39	4.1 (0.8)	4.2 (0.8)	0.59
Communicates well (on a scale of 1-5)	4.0 (0.8)	3.8 (0.9)	0.50	3.9 (0.9)	4.0 (0.8)	0.41
Overall risk attitude (on a scale of 0-10)	5.0 (2.8)	4.4 (3.1)	0.47	4.3 (3.2)	4.5 (3.2)	0.66
Health risk attitude (on a scale of 0-10)	3.3 (3.5)	3.6 (3.4)	0.67	3.2 (3.2)	3.4 (3.1)	0.64
Last three days' transactional information:						
Total income (Taka)	3633.8 (2935.1)	4576.5 (3525.7)	0.27	3011.7 (2418.3)	2790.3 (2177.3)	0.21
Total clients	12.1 (10.1)	15.4 (10.0)	0.12	9.2 (6.5)	8.8 (7.2)	0.58
Total condoms used	10.9 (8.1)	14.6 (9.6)	0.12	8.5 (6.1)	8.1 (7.0)	0.54
Price per client (Taka)	305.1 (138.3)	293.9 (73.8)	0.70	334.4 (124.1)	329.8 (130.1)	0.73
Percentage of regular clients (%)	32.6 (32.2)	41.0 (35.8)	0.31	34.0 (36.2)	33.1 (34.1)	0.80
Percentage of clients suspected of having STIs (%)	9.2 (22.7)	10.4 (24.6)	0.85	7.1 (20.7)	7.5 (22.7)	0.82
Percentage of clients using condom (%)	92.4 (16.5)	94.6 (14.0)	0.54	93.2 (18.4)	90.7 (20.9)	0.21

Data are n, n (%), or mean (SD). Beauty ("1" very unattractive "5" very attractive). STI likelihood measures the likelihood that BSW thinks she may have an STI ("0" not at all; "10" have it for sure). STI anxious measures how anxious the BSW will be if she finds out she has an STI ("0" not all; "10" extremely anxious). STI belief measures the number of clients out of 100 that the BSW believes have an STI. Satisfied with life ("0" not satisfied at all; "10" completely satisfied). Health test score was derived from a twenty-item health test. Esteem measures whether BSW believes she has high self-esteem ("1" strongly disagree; "5" strongly agree). Friendly ("1" strongly disagree; "5" strongly agree). Communicates well ("1" strongly disagree; "5" strongly agree). Overall risk attitude ('0" risk averse; "10" risk prone). Health risk attitude ('0" risk averse; "10" risk prone).

Supplementary table 5: Baseline characteristics of female brothel sex workers who attrited and did not attrite at follow-up, Tangail and Mymensingh, Bangladesh

Unadjusted results

| Primary outcome | Intervention (Urine test) | | | |
	Baseline (n=235)	Follow-up (n=211)	Follow-up *vs* baseline [Odds ratio (95% CI)]	p value
STI prevalence[+]	29 (12%)	20 (9%)	0.74 (0.41-1.36)	0.34
Chlamydia prevalence	17 (7%)	16 (8%)	1.05 (0.52-2.13)	0.90
Gonorrhoea prevalence	17 (7%)	4 (2%)	0.25 (0.08-0.75)	0.013

Data are n, n (%). [+]BSW is considered STI-*positive* if she tested positive for chlamydia, and/or gonorrhoea. Only BSWs who were allocated to the urine test group were tested for STIs. Odds ratios are calculated through a logistic regression of the selected primary outcome variable (STI prevalence, chlamydia prevalence, gonorrhoea prevalence) on the follow-up dummy variable.

Supplementary table 6: STI prevalence of female brothel sex workers who were assigned to urine testing (primary outcome), Mymensingh and Tangail, Bangladesh

Secondary outcome	Intervention (n=214) *vs* control (n=199) [Mean difference/Odds ratio (95% CI)]	p value
Last three days' transactional information (results are in mean difference)+:		
Total number of clients	0.08 (-0.52-0.68)	0.78
Proportion of repeat clients (%)	5.73 (1.68-9.79)	0.01
Proportion of clients suspected of having STIs (%)	-0.10 (-2.38-2.18)	0.93
Proportion of clients using condom (%)	-1.00 (-3.24-1.25)	0.38
Last three transactions (results are in mean OR)+♦:		
Used a condom	0.86 (0.48-1.55)	0.62
Used a condom with all three clients	0.87 (0.57-1.34)	0.54
Used a condom with at least two clients	0.60 (0.29-1.24)	0.17
Used a condom with at least one client	1.62 (0.57-4.58)	0.36
Had a repeat client	1.52 (1.18-1.96)	0.00
Had a client suspected of having STIs	0.64 (0.48-0.85)	0.00
Inspected client for STIs	0.74 (0.57-0.96)	0.02
Had a wealthy client	1.08 (0.86-1.36)	0.51
Had an educated client	0.94 (0.74-1.19)	0.63
Had an attractive client	1.05 (0.81-1.36)	0.74
Had a clean client	0.75 (0.40-1.42)	0.38
Liked the client	1.07 (0.85-1.35)	0.57
Others (results are in mean difference):		
Overall risk attitude (on a scale of 0-10)	0.45 (0.22-0.68)	0.00
Health risk attitude (on a scale of 0-10)	0.38 (0.19-0.57)	0.00
Anxiety score+	1.71 (1.01-2.40)	0.00

Mean difference (calculated for *last three days transactional information* and *Others*)/Odds ratio (calculated for *last three transactions*) calculated via a linear/logistic regression of the selected secondary outcome variable on the treatment status. +15 BSWs reported no transactions in last three days (8 from intervention, 7 from control). ♦Listed secondary outcomes are binary outcomes. +Anxiety score is derived from Health Anxiety Inventory (HAI-18), the higher the score the higher the anxiety. Overall risk attitude ('0" risk averse; "10" risk prone). Health risk attitude ('0" risk averse; "10" risk prone).

Supplementary table 7: Sex work behaviour of female brothel sex workers, Mymensingh and Tangail, Bangladesh

Secondary outcome	Intensity of BSWs assigned to intervention on control group (n=199) [Mean difference/Odds ratio (95% CI)]	p value	Intensity of BSWs assigned to intervention on intervention group (n=214) [Mean difference/Odds ratio (95% CI)]	p value
Last three days' transactional information (results are in mean difference)+				
Total number of clients	-2.19 (-4.39-0.00)	0.05	-6.62 (-9.26--3.97)	0.00
Proportion of repeat clients (%)	-25.60 (-43.99- -7.21)	0.01	10.51 (-5.57-26.59)	0.20
Proportion of clients suspected of having STIs (%)	5.16 (-5.78-16.10)	0.35	-8.42 (-17.03-0.19)	0.06
Proportion of clients using condom (%)	2.63 (-7.50-12.76)	0.61	-0.53 (-9.52-8.46)	0.91
Last three transactions (results are in OR)+♦:				
Used a condom	2.90 (0.19-45.54)	0.45	1.15 (0.13-10.19)	0.90
Had a repeat client	0.47(0.14-1.62)	0.23	1.85 (0.74-4.64)	0.19
Had a client suspected of having STIs	1.68 (0.46-6.17)	0.44	0.38 (0.11-1.34)	0.13
Inspected client for STIs	0.46 (0.13-1.67)	0.24	0.74 (0.29-1.90)	0.53
Had a wealthy client	0.83 (0.28-2.49)	0.74	2.86 (1.18-6.94)	0.02
Had an educated client	1.54 (0.51-4.65)	0.44	0.74 (0.30-1.83)	0.52
Had an attractive client	0.80 (0.23-2.77)	0.73	1.68 (0.63-4.47)	0.30
Had a clean client	0.33 (0.01-8.80)	0.51	3.05 (0.27-34.02)	0.37
Liked client's personality	0.56 (0.19-1.66)	0.29	1.94 (0.81-4.69)	0.14
Others (results are in mean difference):				
Overall risk attitude (on a scale of 0-10)	-0.96 (-2.04-0.13)	0.08	0.08 (-0.82-0.98)	0.87
Health risk attitude (on a scale of 0-10)	0.50 (-0.42-1.41)	0.29	0.32 (-0.40-1.05)	0.38
Anxiety score+	0.03 (-3.04-3.10)	0.99	-1.80 (-4.63-1.04)	0.21

Mean difference (calculated for *last three days transaction information* and *Others*)/Odds ratio (calculated for *last three transactions*) calculated via a linear/logistic regression of outcome variable on the proportion of BSWs assigned to intervention group/tested STI-*positive*/tested STI-*negative*. +7 BSWs reported no transactions in last three days. ♦Listed secondary outcomes are binary outcomes. +Anxiety score is derived from the Health Anxiety Inventory (HAI-18), the higher the score the higher the anxiety. Overall risk attitude ('0" risk averse; "10" risk prone). Health risk attitude ('0" risk averse; "10" risk prone).

Supplementary table 8: Spill over effects of STI testing on the sex work behaviours of female brothel sex workers, Mymensingh and Tangail, Bangladesh