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Estimating misreporting in condom use and its determinants among sex workers: Evidence from the list randomisation method

Carole Treibich*and Aurélia Lépine†

Abstract

Social desirability bias, which is the tendency to under-report socially undesirable health behaviours, significantly distorts information on sensitive behaviours gained from self-reports. We designed a list randomisation method to indirectly elicit condom use among female sex workers and tested it among 651 female sex workers in Senegal, a country where sex workers face high social stigma and where the AIDS epidemic is mainly concentrated among this population. Based on our list randomisation, we found that the condom use rate in the last sexual intercourse with a client was 78%, which is significantly lower than the 97% obtained when asked directly in the survey. When estimating condom use among the subgroups, we found that female sex workers who are at a higher risk of infection are less likely to use condoms.

Key words: list randomisation, condom use, female sex workers, Senegal.

1 Introduction

Condom use is the main preventive tool available to limit the spread of sexually transmitted diseases (STIs) and human immunodeficiency virus infection/acquired immune deficiency

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syndrome (HIV/AIDS). Given that the consistent use of condoms is known as the most cost-effective way to prevent HIV transmission (Cohen et al., 2004; Creese et al., 2002), condom use is the pillar of any HIV prevention strategy in most countries. The promotion of condom use is often based on multiple interventions such as awareness campaigns and the free provision of condoms. However, the evaluation of the effects of such policies as well as their value for money is difficult to determine due to the impossibility to directly observe sexual behaviours adopted by targeted groups. Researchers and policy makers have no other choice than relying on individuals' declarations. As a matter of fact, in a systematic review looking at the effect of interventions involving condom promotion, Foss et al. (2007) found that most of the evidence published on the effect of such interventions is based on self-reported condom use, despite the inherent bias of such a measure. Indeed, one may wonder whether direct elicitation of condom use would provide an accurate estimate and could be used to measure the impact and monetary value of condom-based interventions. This may be even more of a concern when considering stigmatised groups highly targeted by preventive services, such as female sex workers (FSWs).

Our paper aims to measure misreporting in condom use among FSWs in Senegal, a country particularly interesting for the study of FSWs. First, while HIV prevalence is 0.7% in the general population, FSWs in Senegal are up to 9 times more likely to be infected, with HIV/AIDS with an HIV/AIDS prevalence of 6.6% in 2015 (APAPS and IRESSEF, 2015). Second, Senegal is the only African country where prostitution is legal and regulated by a public health policy. In 1969, the Government of Senegal legalised prostitution and introduced a compulsory registration programme for FSWs to monitor the prevalence of STIs, and later on, the spread of the HIV/AIDS epidemic. As a consequence of the close monitoring of this population, registered FSWs are aware of the benefits provided by the use of condoms and receive condoms for free at their monthly routine health visits. Third, Senegal is a Muslim-dominated country where a

woman's status is very low. As a result, despite having a legal status, FSWs face very high social stigma. In this context, we anticipate that condom use self-reported in face-to-face surveys is likely to be over-reported.

To estimate the amount of over-reporting and the determinants of condom use and of its over-reporting, we used list randomisation. The list randomisation method or item count technique provides privacy to respondents and thus limits dishonest answers caused by social desirability bias in face-to-face interviews (Holbrook and Krosnick, 2010). It has been applied to elicit vote preferences (Corstange, 2009; Gonzalez-Ocantos et al., 2012; Holbrook and Krosnick, 2010), illegal migration (McKenzie and Siegel, 2013), the use of micro finance loans (Karlan and Zinman, 2012) as well as opinions on topics such as same sex marriage (Lax et al., 2016) and racism (Blair and Kosuke, 2012; Kuklinski et al., 1997).

However, there are only a few studies that have applied the method in health research (Chong et al., 2013; Jamison et al., 2013; LaBrie and Earleywine, 2000; Walsh and Braithwaite, 2008), and the method has never been used to measure over-reporting in condom use among a low educated stigmatised group. We believe that it is important to assess whether list randomisation could be introduced into national surveys to obtain a less biased estimation of condom use among high-risk groups in low-income countries. In addition to providing a better estimate of condom use, list randomisation allows the identification of subgroups for which condom use rates are lower. We used the parameters from the model by Geoffard and Philipson (1996) to identify the main drivers of condom use. Finally, we compared the proportion of FSWs who openly declared using a condom with their last client with the proportion obtained through the indirect elicitation method to quantify the propensity to over-report condom use among subgroups. By doing so, we are able to test whether registered FSWs, who are by definition more exposed to HIV prevention services, are more likely to over-report condom use than their

non-registered counterparts.

We found that 22% of FSWs did not use a condom in their last sexual intercourse with a client, which is significantly greater than the 3% obtained when asked directly. Hence, our results confirm that list randomisation could be a promising indirect method to elicit condom use in low-income countries. When estimating condom use among subgroups, we found that FSWs at a higher risk of HIV are significantly less likely to have used a condom with their last client. The results also show that increasing the knowledge of FSWs regarding HIV and the consequences of STIs as well as increasing the links with health facilities would be useful policies to increase condom use. Finally, we did not find that FSWs receiving more HIV prevention services are more likely to over-report condom use.

2 Methodology

2.1 List randomisation method and underlying hypotheses

The principle of list randomisation is to allocate respondents randomly into the following two different groups: a “control” and a “treatment” group. Individuals allocated into the “control” group are presented with a number of non-sensitive statements. They are not asked to say whether they agree with each of the statements but only with how many of them they agree with. The same statements are presented to the “treated” group; the difference is that a sensitive statement is added to the series of non-sensitive statements. Assuming that the two groups agree on average with the same number of non-sensitive statements, one can deduce the share of individuals in the “treated” group who agreed with the sensitive item by comparing the average number of agreed statements in each group (see Glynn, 2013; Holbrook and Krosnick, 2010; Kuklinski et al., 1997).

The effectiveness of this methodology is based on the following three assumptions: (i) randomisation of the treatment, (ii) absence of any design effect, and (iii) honest answers. More precisely, individuals allocated to each group must be similar to ensure that they agree with the same number of non-sensitive items on average. Second, the addition of the sensitive item must not change the sum of the affirmative answers to the control items. Finally, as pointed out by Kuklinski et al. (1997), the choice of the non-key items needs to be such that individuals are not urged to provide false answers. There are two different types of dishonest answers: those who honestly would answer “yes” to all the non-sensitive items and hence would no longer benefit from any privacy if they agree with the sensitive item (ceiling effects) and those who honestly would answer “no” to all non-sensitive items and hence would no longer benefit from any privacy if they disagree with the sensitive item (floor effects).

2.2 List randomisation implemented among FSWs in the Dakar region

In 2015, we interviewed 651 FSWs in the Dakar suburbs, which represents 15% of the total estimated number of FSWs in the Dakar region (APAPS, 2011-2012). Ethical clearance was obtained from the London School of Hygiene & Tropical Medicine and from the national ethics committee in Senegal (reference number SEN15/15). Data were captured using electronic devices and all respondents were asked whether they used a condom with their last client. Then, we randomised the allocation of the participants into the “treatment” and “control” groups based on their identifying number to determine their elicited condom use.

In our survey, the “control” group was presented with the following question:

I [the interviewer] will read three statements. I will then ask you how many of these statements you agree with. You should not tell me which specific statement you agree with but the

number of statements you agree with. I will give you three marbles, and you have to hold them in your right hand. Keep both of your hands on your back side. For each of the statements, if you agree with it, please transfer one marble from your right hand to your left hand behind you. If you do not agree with it, please do not transfer any marble. At the end, I would like to know the total number of statements you agreed with. This number should correspond to the number of marbles you have in your left hand. I will now read the statements.

- 1. It is safer to bring a client home than going to a hotel.*
- 2. I prefer that the client pays me before intercourse.*
- 3. Monday is the day I have the greatest number of clients.*

FSWs from the “treatment” group received an additional marble and were presented the same statements plus the sensitive item that relates to condom use. Note that this sensitive item was presented in the second position in the treatment group list:

- 4. I used a condom during my last sexual intercourse with a client.*

3 Theoretical framework

In this section, we present a theoretical framework for the potential mechanisms at play in the decision to engage or not engage in unprotected sex. To do so, we adapted the model by Geoffard and Philipson (1996), which is a two-period model where individuals (in our case FSWs) decide whether to engage or not engage in an unprotected sex act in the period t and face the costs of being infected in the period $t + 1$. We added interdependence to the utility functions of FSWs and their clients (Bergstrom, 1999) so that the utility function of (infected) FSWs u depends on their sexual partner’s utility level v .

As it is commonly done in the literature for the compensating differential for unprotected sex (Arunachalam and Shah, 2012; Gertler and Shah, 2011; Rao et al., 2003), it is assumed that clients bear disutility from using condom. FSWs choose their behaviours to maximise their utility given their health state. The health status h of FSWs can take the following two values: susceptible ($h = s$) or infected with HIV ($h = i$). FSWs decide to adopt a behaviour b that can also take the following two values: protection against risk ($b = p$) or exposure to risk ($b = e$). The utility derived by FSWs $u(h, b)$ is a function of one's health and behaviour.

Ceteris paribus, protective activity (p) and infection (i) are both assumed to be costly as follows:

$$u(h, e) > u(h, p) \text{ and } u(s, b) > u(i, b)$$

FSWs discount future utility at a discount rate $\delta(h)$, which is a function of their future health state, with $\delta(s) < \delta(i)$.

The transition rate from state s to state i , which is conditional on exposure, is denoted as $\lambda = \pi \times P$ where P is the probability that a susceptible FSW matches with an infected client and π is the probability that an exposed activity between the FSW and her client will result in a new infection.

The underlying assumptions in the model are as follows:

$$P[h(t+1) = i | (h(t), b) = (s, e)] = \lambda \tag{1}$$

$$P[h(t+1) = i | (h(t), b) = (s, p)] = 0 \tag{2}$$

$$P[h(t+1) = i | (h(t), b) = i] = 1 \tag{3}$$

In other words, (1) the probability of getting infected if exposed for a susceptible FSW is λ ; (2) the probability of being infected under protection is zero and (3) the probability of

remaining infected if already infected is one, whichever behaviour is adopted by the FSW.

FSWs engage in safe sex if and only if the cost of protection (the loss of current utility from protection) is below the expected future utility loss due to infection.

$$u(s, e) - u(s, p) \leq \pi \cdot P \left[\frac{u(s)}{\delta(s)} - \frac{u(i)}{\delta(i)} \right]$$

While in this model, infected FSWs have no reason to engage in safe sex as $u(i, p) < u(i, e)$; thus, we relax this assumption and assume interdependence in the utility functions of FSWs and their clients (Bergstrom, 1999) so that the utility function of (infected) FSWs u depends on their sexual partner's utility level v , where

$$u(i, e) - u(i, p) \leq \pi[u(i, v(s)) - u(i, v(i))] \text{ with } v(s) > v(i)$$

4 Empirical strategy

Equation (4) shows that condom use estimated by list randomisation was estimated by regressing the number of statements the respondent agreed with (Y_i) on the allocation to the treatment group (T_i). The average condom use rate in the sample using list randomisation is then given by β and corresponds to the average difference in the number of statements between the control and the treatment group in the sample. All estimations compute robust standard errors to account for the difference in the variance of error term ε_i between the treatment and control groups.

$$Y_i = \beta T_i + \varepsilon_i \tag{4}$$

We use list randomisation to further investigate the characteristics of FSWs who did not use a condom during their last sexual intercourse.¹ Following Imai (2011), we investigated the relation between condom use and respondents' characteristics using a simple linear regression with the following interaction terms:

$$Y_i = \beta T_i + \gamma S_i + \alpha S_i \times T_i + \varepsilon_i \quad (5)$$

where S_i is a characteristic of individual i that may be correlated with condom use. β precisely reports the condom use rate among the subgroup for which $S_i = 0$, while α is the difference in the condom use rate between the two subgroups ($S_i = 1$ and $S_i = 0$). The p-value of α indicates if the condom use rate is different between the subgroups.

To improve the statistical power, we added some variables that are assumed to be correlated with the non-sensitive statements:

$$Y_i = \beta T_i + \gamma S_i + \alpha S_i \times T_i + X_i + \varepsilon_i \quad (6)$$

where X_i is a set of sex worker characteristics potentially influencing the answer to the non-sensitive items (i.e., FSW preferences regarding the place where the sex act occurred or the proportion of the last four sexual intercourses for which payment was made after the sex act). X_i also includes age, whether the FSW is divorced, whether the FSW lives with or next to her parents, the type of client (regular versus occasional) and whether clients are usually approached in a night club.

¹The advantage of the list randomisation methodology lies in the possibility of conducting subgroup analysis (see [Appendix 1](#) for a comparison of different techniques eliciting sensitive items).

5 Data

Data were collected from 651 FSWs living in Dakar suburbs in June and July 2015, which represents 15% of the estimated total FSWs in the Dakar region (APAPS, 2011-2012). Our sample contains an equal share of registered and non-registered FSWs. Given that sexual health services are integrated with reproductive health in Senegal, registered FSWs were recruited by the midwife in charge of their medical follow-up. All active registered FSWs from four (Pikine, Rufisque, Mbao and Sebikotane) out of the five STI health centres located in Dakar were contacted to participate in our study. Unregistered FSWs were recruited by NGO staffs and by peer FSWs using snowball sampling. FSWs were asked to come to the health centre and were interviewed at the health facility in private dedicated rooms. Survey participants received a CFAF 3,000 show-up fee that aimed to cover transport cost and the time spent at the health facility.

As part of the questionnaire, information on socio-economic and intrinsic characteristics, preferences (time preferences, risk aversion and altruism) and sex work activity (revenue, type of clients and type of sex acts) was collected from the respondents. Table 1 shows the different parameters from the model with their measurements from the data set and presents descriptive statistics of these variables.

6 Validation of list randomisation

6.1 Verification of the randomisation

We noted that randomisation ensured balance between the two groups with respect to their observable characteristics (Table A2, Appendix 2). The only significant difference observed was in the type of the sex worker's last client ($p=0.06$). However, given that we tested approximately 60 different treatment-control differences in this table, this unique significant difference is no

Table 1: Determinants of condom use.

Parameter	Description	Factors influencing the parameters	Expected effect	Obs	Mean
$u(s, e) - u(s, p)$	Cost of protection	Revenue loss:	-		
		Earned more than 12,500 CFAF for the last intercourse		643	0.499
		Beauty (≥ 5 out of 10)		651	0.776
		Condom price:	+		
		Received free condoms		641	0.671
		Reduction in sexual pleasure:	+		
FSWs who declare having no reduction in sexual pleasure with condoms		640	0.195		
Violence:	-				
The last client negotiated the price		605	0.534		
Violence from a client in the past year		648	0.255		
P	Probability that a susceptible individual matched with an infected one	Client at risk of HIV: Last client was at risk of HIV	+	593	0.73
π	Probability that an exposed activity between them will result in a new infection	Risk taking:	-		
		More than 3 clients a week		648	0.684
		Subjective risk taking in health domain (≥ 8 out of 10)		651	0.054
		Last client was an occasional client		645	0.440
		Performed anal sex during last intercourse		645	0.023
		HIV and STI knowledge:	+		
		High HIV knowledge (≥ 6 out of 8)		651	0.796
		Poor trust towards the efficacy of condoms:	-		
Perceived condoms inefficacious to prevent HIV		606	0.254		
Agrees with 'One cannot avoid HIV by always using condoms'		643	0.171		
$u(i, e)$	Utility in the case of infection	Social exclusion:	+		
		Was introduced to the sex business by another SW		651	0.267
		Thinks that all girls in the same location use condoms		364	0.522
		Would be ashamed if a neighbour learns about her sex work activity		648	0.844
		Fears that a neighbour who learns about her sex activity will repeat it to others		647	0.856
		Medical and opportunity cost:	+		
		Thinks that will lose more than 14 days of work if has an STI		648	0.486
		Expects to pay more than 15,000 CFAF in the case of a genital ulcer		634	0.364
Quality of life if infected:	-				
Knows ART		647	0.504		
$u(s)$	Preference for health	Legal status:	+		
		Registered with authorities		650	0.500
		Demand for prevention:	+		
		Is affiliated with a health centre		648	0.731
		Does her monthly routine visit		269	0.729
		Visited a health centre in the last 6 months		651	0.750
Had an HIV screening in the past year		651	0.806		
δ	Discount rate	Preference for present:	-		
		Agrees with 'Instead of saving, I prefer to spend my money today'		651	0.788
		Alcohol or drug consumption during last intercourse		640	0.077
$u(i, p) < u(i, e)$	Disutility in using condoms once infected	HIV and STI status:	-		
		HIV positive according to medical records (biological test)		219	0.059
		Subjective expectations about being HIV positive		582	0.065
Subjective expectations about being STI positive		583	0.398		
$u(v(s))$	Interdependent utilities	Altruism: Gave more than 40% of the amount received in a dictator game	+	651	0.289

Notes: All listed variables are binary variables.

more than what would be expected by chance. This was confirmed by the joint significance tests for a large share of the set of variables presented in Table A2.²

6.2 Absence of ceiling, floor and design effects

We also needed to ensure that the list of non-sensitive items provided enough privacy to respondents in the treated group (hypothesis 2) and that the addition of the sensitive item did not modify the answers regarding the non-sensitive statements (hypothesis 3). In Table A3 (Appendix 2), we estimated the proportion of FSWs in the control group who did not agree with any statement and answered “0” to the item count list question. If this proportion was high, it would encourage respondents in the treated group to report a positive value since answering “0” would reveal that they had unprotected sex. Since the proportion of individuals answering “0” in the control group was less than 3%, we did not face this issue. We also avoided the issue of ceiling effects because the proportion of respondents in the control group who answered “3” to the non-sensitive items was also very low (9%). This absence of ceiling and floor effects has been ensured thanks to the negative correlation between items 2 and 3. Some protection for the respondents is therefore built-in to allow them to honestly report their true behaviours towards condom use. Finally, the difference (Row 5) between the proportion of individuals in the treated group (Row 2) and in the control group (Row 4) who agree with at least j statements ($j = 1, 2, 3, \text{ and } 4$) is always positive, which provides evidence of the absence of design effects.

²More precisely, two tests of joint significance were performed and provided similar results. While the first one aimed to maximise the size of the sample considered (645 observations and 32 variables), the second one increased the number of variables included in the model (621 observations and 39 variables).

7 Results

7.1 Measuring misreporting in condom use

Using self-reported information, we found that 97.2% of FSWs declared to have used a condom with their last client. Table 2 presents the results from the list randomisation exercise. It appears that based on list randomisation, the condom use rate is equal to 79.7% when considering all female sex workers (Panel A) and 77.7% versus 97.2% when self-reported if we consider the sample of FSWs who answered to the self-declared question (Panel B). As a result, the self-reported condom use is overestimated by 19.5% points (95% CI [7.5; 31.6]).

The difference between self-reported condom use and the condom use elicited by list randomisation is statistically significant ($p < 0.01$). For the entire sample, i.e., when including the 10.6% who did not answer the direct question, the elicited condom use rate using list randomisation is 2 percentage points higher. This is an interesting result because it means that respondents who did not answer the self-reported question report slightly higher condom use (see Panel C).

Table 2: Condom use with the last client estimated with the list experiment.

	Average number of agreed statements		Estimated condom use	CI 95%
	Control	Treatment		
<i>Panel A: All female sex workers (n=651)</i>	1.700	2.497	0.797	[68.52, 90.93]
<i>Panel B: Restricted to individuals who answered the self-declared question (n=582)</i>	1.685	2.462	0.777	[65.67, 89.75]
<i>Panel C: Restricted to individuals who did not answered the self-declared question (n=69)</i>	1.839	2.763	0.924	[64.10, 120.78]

Notes: The proportion who used a condom is obtained by taking the difference between the “control” and “treated” means.

7.2 Measuring misreporting in condom use for subgroups

Table 3 displays the results obtained when performing the subgroup analysis based on the variables presented in Table 1.

Factors affecting the costs of protection We found that having high earnings³ is negatively correlated with the likelihood of using a condom (68.4% vs. 89.4%, p-value=0.07). Nevertheless, FSWs who received free condoms are not more likely to use condoms than those who have to pay for condoms. In addition to these financial costs, FSWs were asked to compare their sexual pleasure with and without condoms. Those who declared that the use of condom does not decrease their sexual pleasure showed greater condom use, although the difference is not statistically significant (94.7% vs. 76.2%, p-value=0.17). No information regarding the type of violence experienced during the last sexual intercourse was collected. We attempted to overcome this issue (i) by comparing FSWs who suffered from violence by an occasional client in the last twelve months with those who did not and (ii) by looking at whether the last client negotiated the price of intercourse as a proxy for a FSW's low bargaining power. However, we did not find any significant differences in condom use between these subgroups.

Factors affecting the probability that a susceptible FSW matches with an infected client FSWs were asked about their last client characteristics. We found that FSWs are more likely to use a condom with clients perceived to be at high risk of HIV (90.4% vs. 77.4%), though this difference was not statistically significant.

Factors affecting the probability that an exposed activity between a FSW and a client will result in a new infection Having an occasional client reduces the probability of engaging in safe sex even if this difference is not statistically significant. FSWs who have more than three clients per week are significantly less likely to have used a condom (73.3% vs. 95.0%, p-value=0.08). FSWs who declare to be willing to take risks with their health tend to be less likely to use condoms, though the sample size of this subgroup does not enable us to detect a statistically significant difference. FSWs who have a better knowledge regarding

³More than 12,500 CFAF for the sexual act, which corresponds to the median in our sample

HIV transmission modes are more likely to have used a condom with their last client (85.2% vs. 58.5%, p-value=0.06). For FSWs who think that condoms will not prevent against HIV infection, they have a lower condom use, but this difference is not statistically significant (62.0% vs. 82.9%, p-value=0.14).

Factors affecting the utility in the case of an infection We found that peer effects and social norms play a role in condom use. FSWs who declare that all the girls working in their area use condoms are more likely to have used a condom with their last client (98.8% vs. 63.2%, p-value=0.02). This is also the case for FSWs who entered sex work thanks to another sex worker (97.4% vs. 73.9%, p-value=0.06). Furthermore, we investigated the impact of fear of social stigma on condom use by looking at the following two different variables: those who would be ashamed if a neighbour learns about their sex work activity and those who fear the neighbour would repeat this to others. Both subgroups are more likely to use condoms (85.2% vs. 47.2%, p-value=0.02 and 84.6% vs. 42.7%, p-value=0.02 respectively).

As expected, perceived high STI consequences are positively associated with the decision to engage in safe sex. On one hand, FSWs who think they will lose more than 14 days of work in the case of an STI are more likely to have used a condom during their last paid intercourse (92.9% vs. 66.6%, p-value=0.02). Likewise, FSWs who expect to pay more than 15,000 CFAF in medical expenses in the case of a genital ulcer are more likely to have used a condom with their last client (85.2% vs. 65.7%, p-value=0.10). FSWs who are aware of the existence of antiretroviral treatment (ART) also displayed lower rate of condom use than FSWs who had never heard about ART, but this difference was not statistically significant (71.5% vs. 88.9%, p-value=0.13).

Factors reflecting the preference for health FSWs who visited a health centre in the past six months are more likely to have used a condom (86.0% vs. 60.9%, p-value=0.07). However,

being a registered FSW and adhering to medical visits is not correlated with condom use.

Factors affecting the discount rate FSWs who declared that they have consumed alcohol or drugs before their last paid sexual intercourse are significantly less likely to have used a condom (40.7% vs. 81.4%, p-value=0.06).

Testing the disutility in using condoms once infected HIV positive FSWs (estimated via biological markers) are less likely to have used a condom than HIV negative FSWs (5.0% vs 80.0%, p-value=0.05). This negative relationship between HIV status and condom use was somehow confirmed for the entire sample when considering subjective expectations regarding HIV status. Additionally, FSWs who believe that they have another STI than HIV (also estimated via subjective expectations) are significantly less likely to have used a condom with their last client (57.1% vs 89.4%, p-value=0.01).

Interdependent utilities We found that altruistic FSWs are more likely to have used a condom (97.2% vs. 72.6%, p-value=0.05).

Table [A4 \(Appendix 3\)](#) shows that very similar results were found when introducing the set of covariates aiming at controlling for any sex worker's characteristics, which could influence the answers to the non-sensitive items or when restricting the sample to FSWs who answered the self-declared condom use question.

Table 3: Condom use by subgroups.

		Self-declared condom use					List randomisation ‡						
		<i>Obs if</i>		Yes	No	Difference	SE	<i>Obs if</i>		Yes	No	Difference	SE
<i>Obs</i>	<i>Yes</i>	<i>Yes</i>	<i>No</i>					<i>Obs</i>	<i>Yes</i>				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$u(s, e) - u(s, p)$	Revenue loss:												
	Earned more than 12,500 CFAF in the last intercourse	582	293	0.956	0.990	-0.034**	0.013	643	321	0.684	0.894	-0.210*	0.114
	Beauty (≥ 5 out of 10)	582	461	0.972	0.975	-0.003	0.016	651	505	0.745	0.974	-0.230*	0.131
	Condom price:												
	Received free condoms	573	371	0.987	0.970	0.016	0.013	641	430	0.791	0.849	-0.058	0.124
	Reduction in sexual pleasure:												
	FSWs who declare having no reduction in sexual pleasure with condoms	572	111	0.982	0.980	0.002	0.014	640	125	0.947	0.762	0.186	0.135
	Violence:												
	The client negotiated the price	576	309	0.981	0.966	0.014	0.014	605	323	0.780	0.821	-0.041	0.120
	Violence from a client in the past year	581	150	0.980	0.970	0.010	0.014	648	165	0.843	0.782	0.061	0.122
P	Client at risk of HIV:												
	Last client was at risk of HIV	543	39	0.923	0.974	-0.051	0.043	593	43	0.904	0.774	0.129	0.213
π	Risk taking:												
	More than 3 clients a week	581	397	0.970	0.978	-0.008	0.014	648	443	0.733	0.950	-0.217	0.122
	Subjective risk taking in health domain (≥ 8 out of 10)	582	33	0.939	0.974	-0.035	0.042	651	35	0.500	0.812	-0.312	0.230
	Last client was an occasional client	582	266	0.981	0.965	0.016	0.013	645	284	0.711	0.860	-0.148	0.115
	HIV and STI knowledge:												
	High HIV knowledge (≥ 6 out of 8)	582	460	0.980	0.943	0.038*	0.022	651	518	0.852	0.585	0.266*	0.144
	Poor trust towards the efficacy of condoms:												
	Perceived condoms inefficacious to prevent HIV †	543	125	0.992	0.967	0.025**	0.012	606	154	0.620	0.829	-0.209	0.142
	Agrees with ‘One cannot avoid HIV by always using condoms’	576	101	0.960	0.979	-0.019	0.021	640	110	0.618	0.830	-0.212	0.150
	$u(i, e)$	Social exclusion:											
Was introduced to the sex business by another sex worker		582	165	0.982	0.969	0.013	0.013	651	174	0.974	0.739	0.234*	0.122
Thinks that all girls in the same location use condoms		322	163	1.000	0.975	0.025**	0.012	364	190	0.988	0.632	0.356**	0.151
Would be ashamed if a neighbour learns about her sex work activity		579	485	0.975	0.957	0.018	0.022	648	547	0.852	0.472	0.380**	0.160
Fears that a neighbour who learns about her sex activity will repeat it to others		578	493	0.976	0.953	0.023	0.024	647	554	0.846	0.427	0.419**	0.181
Medical and opportunity cost:													
Thinks that will lose more than 14 days of work if has an STI		581	283	0.968	0.977	-0.008	0.014	648	315	0.929	0.666	0.263**	0.114
Expects to pay more than 15,000 CFAF in the case of a genital ulcer		568	368	0.965	0.985	-0.020	0.013	634	403	0.852	0.657	0.195	0.119
Quality of life if infected:													
Know ART		581	290	0.983	0.962	0.021	0.014	647	326	0.715	0.889	-0.173	0.114

Table 3: Condom use by subgroups (continued).

		Self-declared condom use						List randomisation ‡					
		<i>Obs if</i>		Yes	No	Difference	SE	<i>Obs if</i>		Yes	No	Difference	SE
		<i>Obs</i>	<i>Yes</i>					<i>Obs</i>	<i>Yes</i>				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$u(s)$	Legal status:												
	Registered with authorities	582	271	0.985	0.961	0.024*	0.013	650	325	0.848	0.749	0.100	0.115
	Demand for prevention:												
	Is affiliated with health centre	580	416	0.978	0.957	0.021	0.017	648	474	0.843	0.680	0.163	0.133
	Does her monthly routine visit	224	156	0.993	1.000	-0.006	0.006	269	196	0.841	0.711	0.130	0.190
	Visited a health centre in the last 6 months	582	427	0.981	0.948	0.033*	0.019	651	488	0.860	0.609	0.251*	0.137
	Had an HIV screening in the past year	582	464	0.983	0.932	0.051**	0.024	651	525	0.803	0.774	0.029	0.153
δ	Preference for present:												
	Agrees with ‘Instead of saving I prefer spending my money today’	582	472	0.972	0.973	-0.001	0.017	651	513	0.791	0.809	-0.018	0.138
	Alcohol or drug consumption during last intercourse	579	41	1.000	0.970	0.030***	0.007	640	49	0.407	0.814	-0.407*	0.218
$u(i,p)$ < $u(i,e)$	HIV and STI status:												
	HIV positive according to medical records (biological test)	185	10	1.000	0.994	0.006	0.006	219	13	0.050	0.800	-0.750*	0.384
	Subjective expectations about being HIV positive \diamond	521	32	0.969	0.973	-0.005	0.032	582	38	0.421	0.787	-0.366	0.278
	Subjective expectations about being STI positive \diamond	521	207	0.966	0.978	-0.012	0.015	583	232	0.571	0.894	-0.323***	0.124
$u(v(s))$	Altruism:												
Gave more than 40% of the amount received in the dictator game	582	170	0.976	0.971	0.006	0.014	651	188	0.972	0.726	0.245**	0.125	

Notes: † Condom inefficacy refers to a subjective probability higher than 80% of being infected after 100 protected intercourses. \diamond Sample is restricted to individuals who understood the subjective probabilities. “Obs” reports the total number of respondents for whom we have information on the variable. “Obs if Yes” presents the number of respondents who answered “Yes” to the related question. Columns (3) and (9) [Columns (4) and (10), respectively] display the proportion of FSWs who answered “Yes” [“No”] and who used a condom in their last sexual act.

Reading note: For the variable ‘Registered with authorities’, columns (7) to (10) can be read as follows : Among the 650 respondents, 325 of them are registered, 84.8% of legal sex workers used a condom with their last client, and 74.9% of illegal sex workers used a condom with their last client.

Columns (5) and (11) correspond to the difference between (3) and (4) and between (9) and (10), respectively. Columns (6) and (12) give the robust standard errors of the estimated difference.

‡ List randomisation - estimation: equation (5): $Y_i = \beta T_i + \gamma S_i + \alpha S_i \times T_i + \varepsilon_i$. Reported levels of significance are * $p < 0.1$, ** $p < 0.05$ and *** $p < 0.01$.

7.3 The role of prevention on condom use over-reporting

An important concern is whether high-risk populations who are more exposed to intensive HIV prevention services tend to over-report more condom use. To measure the role of prevention on condom use over-reporting, we perform the following procedure. First, we computed the proportion of FSWs who declared using a condom with their last client depending on their registration status, assuming that registered FSWs are more exposed to HIV prevention than non-registered FSWs. Then, we estimated condom use for those groups using the list randomisation results presented in Table 3. Finally, we computed the difference in condom use obtained with the two methods as well as its associated standard error. Table 4 reports the propensity to over-report condom use depending on HIV prevention exposure. Overall, there is no evidence that FSWs receiving intensive HIV prevention services are more likely to over-report condom use. Conversely, we found that FSWs who have not visited a health centre in the last six months tend to be more likely to over-report their condom use when compared to FSWs who recently attended a health centre, though this result is not statistically significant.

Table 4: Social desirability bias.

	<i>Obs</i>	<i>Obs if Yes</i>	Over-reporting estimation		Difference (3)	SE (4)
			Yes (1)	No (2)		
<i>Legal status</i>						
Registered with authorities	650	325	0.137	0.213	-0.076	0.122
Is affiliated with a health centre	648	474	0.135	0.277	-0.142	0.129
<i>Access to HIV prevention and linked to the health system</i>						
Visited a health centre in the past 6 months	651	488	0.121	0.339	-0.218	0.144
Visited a health centre less than a month ago	651	368	0.122	0.246	-0.124	0.112
Does her monthly visits	269	196	0.152	0.289	-0.136	0.185
Received free condoms	641	430	0.196	0.122	0.074	0.125
Had an HIV screening in the past year	651	525	0.179	0.158	0.021	0.161

Notes: (1) and (2) correspond to the difference in condom use with the direct and indirect measures for the control group and the treated group, respectively. (3) is the difference between (1) and (2). (4) is the standard error of (3) and is equal to the square root of the sum of the squared standard errors of (1) and (2) (not reported in this table). The p-value indicates whether the difference is significantly different from zero and has been computed as follows: $p\text{-value} = 2 \times \text{normal}(-\text{abs}((3)/(4)))$. None of the differences are statistically significant at the 10% level or lower. “*Obs*” reports the total number of respondents for whom we have information, i.e., 650 respondents. “*Obs if Yes*” presents the number of respondents who answered “Yes” to the question, i.e., 325 respondents are registered.

8 Discussion

Using list randomisation, we found that FSWs in Dakar over-report condom use by 19.5 points. The misreporting in condom use is higher than previously reported in the literature. Previous studies concluded that condom use was overestimated by 11 points among college students in the United States (LaBrie and Earleywine, 2000) and by 14 points among young men in Uganda, but condom use was neither overestimated among young women (Jamison et al., 2013) nor among teenagers in Colombia (Chong et al., 2013). The high misreporting in our study is likely to be explained by the characteristics of the targeted population; given that sex work is morally condemned by the Senegalese society, FSWs fear to be looked down upon when disclosing socially unacceptable behaviours in a face-to-face survey. Hence, by guaranteeing anonymity, the list randomisation method seems particularly suited to this population. Nonetheless, we acknowledge that condom use may still be overestimated. While list randomisation guarantees privacy in response to survey participants, it cannot help with participants who do not want to reveal their true behaviours. For example, we found that among the respondents who did not answer the self-declared condom use question, only 8% did not use condoms with their last client according to list randomisation, which may indicate that condom use is still overestimated in this sub-sample (see Table 2, Panel C).

We empirically tested the role of the main parameters from Geoffard and Philipson (1996)'s model. We found that one of the main reasons for not using condom comes from the existence of a premium for unprotected sex (Gertler et al., 2005; Rao et al., 2003). By showing that more expensive sex acts were more likely to be unprotected, our results confirm the important role of clients in the AIDS epidemic. Policies that would aim to reduce the strong preference of clients for unprotected sex could be effective in limiting HIV transmission. While a main barrier to

condom use is the fact that condom use is under the client's control (Wojcicki and Malala, 2001), our data show that only 7% of the 1,629 protected sexual intercourses contained in our data set were protected using a female condom. This suggests that the low bargaining power of FSWs may not be the main reason for not using condoms and justifies why FSWs with a lower bargaining power or FSWs exposed to physical violence from a client are not less likely to use condoms in our data set.

Our results provide some evidence on the role of factors affecting the utility in the case of infection upon condom use. First, we showed that FSWs who fear social stigma are more likely to use condoms. This indicates that while stigma reduction policies will certainly reduce social exclusion of FSWs, the absence of social sanctions could lead to greater risk-taking. Second, we found that condom use is significantly higher for FSWs who anticipate that infection will lead to important direct and indirect costs and a lower quality of life. For example, we found that women who have heard about ART are less likely to use condoms. There is some evidence in the literature that ART roll out is associated with greater risk taking (Geoffard and Méchoulan, 2004; Gray et al., 2003). However, the negative relationship between ART knowledge and condom use could also come from the fact that FSWs on ART have a lower incentive to use protection, *ceteris paribus*. To test this, we excluded FSWs who believed that they were infected with HIV from our sample, which reinforced the negative relationship between ART knowledge and condom use. FSWs who knew about ART had a lower condom use by 25 points and this difference was statistically significant at 5%.

The model by Geoffard and Philipson (1996) predicts that once infected, FSWs should stop using condoms because the benefits provided from protection is nil; this was confirmed empirically. This result is particularly alarming because it shows that the riskiest sexual intercourses

are more likely to be unprotected compared with safer ones. In fact, we estimate that among the 4,225 sexual intercourses that occur weekly in our sample, 8% involved HIV positive FSWs. This is because HIV positive FSWs have on average 7 weekly clients (compared to 6.5 for HIV negative ones). Among those 329 sexual intercourses that are particularly at risk of infection, only 16 were protected according to the list randomisation results. However, the increased likelihood of adopting risky sexual behaviours once infected can be mitigated if we assume interdependent utilities. When testing this empirically, we find that altruistic HIV positive FSWs have a condom use rate that is 85 points greater than non-altruistic HIV positive FSWs, although the difference was not statistically significant given the small sample (p -value=0.12).

While our results are novel and in line with economic theory predictions, our study has several limitations. First, the small size of our sample prevents us from detecting moderate differences in condom use for a few subgroups. In addition to the issue of low statistical power, the small sample size also leads to higher uncertainty in the estimated proportion of condom use for several subgroups. For instance, while we estimate that the condom use by HIV positive FSWs (according to biological markers) is only 5%; this result may be attributable to the small HIV prevalence in our sample. In the treated group of HIV positive FSWs, the average number of true statements was 2.2, while it was 1.7 in the total sample, leading to an underestimation of condom use for this subgroup. When considering the number of true statements in the total sample, list randomisation concludes that condom use is 20 points lower for HIV positive FSWs. Despite the impossibility to investigate the causal effect of HIV status on condom use, our findings confirm that FSWs are an important vector of HIV transmission in Senegal. An important limitation however is that while we assume that clients bear disutility from using condoms, the data did not allow us to investigate the role of client preferences on condom use.

Future research on the use of the list randomisation method to elicit sexual behaviours could be conducted along three axes. First, additional methodological research that would provide guidance regarding the optimal design of list randomisation is required. While the number and choices of non-key items should not affect the results in theory, there is some empirical evidence that the choice of non-key items does matter (Droitcour et al., 1991). Unlike previous papers using list randomisation to elicit condom use (Chong et al., 2013; Jamison et al., 2013; LaBrie and Earleywine, 2000; Walsh and Braithwaite, 2008) and building on the agreement in the recent literature that it is better to select non-key items that relate to the topic of interest (see Imai et al., 2015; Karlan and Zinman, 2012; Wolter and Laier, 2014), our non-key items are related to sex work activity. Second, we showed that results obtained from list randomisation are to some extent imprecise, and, given the implementation challenges when performing a list randomisation, the method is often applied to small samples. When the length of the survey allows it, a double list randomisation where each group serves once as the control group and once as the treated group can increase precision (Glynn, 2013). Finally, future research on condom use measurements should aim to test the validity of the results obtained with list randomisation. This could be performed by asking condom use question to clients in addition to FSWs since clients are less likely to over-report condom use (Wilson et al., 1989) or to compare the results obtained with the list randomisation to results obtained with another indirect elicitation method.

9 Conclusion

We implemented list randomisation on FSWs to test if condom use was over-reported. Our results are consistent with the fact that self-reported condom use leads to a large overestimation of condom use, which has direct implications when this measure is used to assess the impact

and the value for money of condom-based interventions. When analysing the determinants of condom use, we provide some alarming evidence on the fact that sexual intercourses most at risk of infection are more likely to be unprotected than safer ones. We also highlight some important factors that affect the decision to engage in unprotected sex. While many of those factors have something to do with a FSW's personality and social norms, and hence are hardly changeable, our results also suggest that a mix of policies that consist of both educating FSWs and clients on the benefits of protected sex and reducing the costs associated with protected sex could be effective to increase condom use.

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Appendices

Appendix 1 Techniques eliciting sensitive items

Table A1 presents several techniques aiming at ensuring confidentiality and summarizes the strengths and weaknesses of each of them. We believe that given the low-literacy level of FSWs and the policy relevance of performing a sub-group analysis, the list randomisation methodology was the most appropriate method to estimate misreporting in condom use.

Table A1: Strengths and weaknesses of measurement techniques eliciting sensitive items.

Methodology	Description	Strengths	Weaknesses
List randomisation	Respondents are allocated randomly to two different groups. They are asked on how many of j non-sensitive items (plus one sensitive item) they agree on if they belong to the control group (to the treated group).	<ul style="list-style-type: none"> - Enumerators do not know with which items respondents agree on - Can be implemented in low-literacy settings - Allows sub-group analysis 	<ul style="list-style-type: none"> - Imprecise results, hence requires large sample - Success depends on the design and on enumerators understanding of the method
Ballot box	Respondents fill in a form with no identifier which is then put in a sealed envelope	<ul style="list-style-type: none"> - Enumerators never ask directly the sensitive question 	<ul style="list-style-type: none"> - Population under study must be literate - Impossibility to perform sub-group analyses
Randomised response technique	Respondents use a participant-controlled randomised device not seen by the interviewer. Depending on the outcome of the device, the respondent provides an automatic response or a truthful response	<ul style="list-style-type: none"> - Enumerators do not know if the response is true or automatic 	<ul style="list-style-type: none"> - Population under study must be literate
Diaries	Respondents complete digital diaries on a daily basis about their daily activities including potentially the sensitive behaviour	<ul style="list-style-type: none"> - No recall bias issue - No face-to-face interview - Insights into event level factors impacting the adoption of the sensitive behaviour 	<ul style="list-style-type: none"> - Population under study must be literate - Need a safe place to hide the diary
Qualitative approach	Enumerators spend time with respondents and report the respondent's admission of adopting the sensitive behaviour	<ul style="list-style-type: none"> - Trust building and time invested by validators should reduce the under-reporting of the sensitive behaviour 	<ul style="list-style-type: none"> - Need to recruit enumerators who can approach respondents and spend time with them without modifying their habits
Nominative technique	Respondents are asked to report (i) how many of their close friends adopt the sensitive behaviour of interest, (ii) how many of other close friends of each reported individual who adopt the sensitive behaviour also know about it. This allows calculation of weights that correct for multiple reports of one particular individual.	<ul style="list-style-type: none"> - Enumerators do not know about whom the incriminated information is being provided 	<ul style="list-style-type: none"> - Response accuracy for the second question is questionable

Appendix 2 Verification of the list randomisation hypothesis

Table A2: Tests of randomisation.

Variables	<i>Observations</i> 651	Control 323	Treated 328	p-value
<i>Socio-demographic characteristics</i>				
Age (in years) *	651	35.58	36.16	0.421
Has the legal age (above 21)	651	96.28	97.56	0.346
Is divorced *	651	67.80	70.73	0.419
Never married *	651	25.70	23.17	0.454
Has at least one child	651	86.38	89.63	0.201
Number of children *	651	2.53	2.50	0.813
Age of first child	573	19.16	19.12	0.905
Menopausal	642	21.70	25.62	0.244
Use contraceptive methods	495	86.96	86.78	0.953
Use condoms as contraceptive method	495	52.57	49.17	0.451
Went to koranic school	646	8.46	7.65	0.703
Highest level of education achieved *	650	1.07	1.01	0.446
Has a regular partner *	651	46.13	41.16	0.202
Lives alone	647	16.56	16.21	0.903
Household size *	651	6.26	6.24	0.957
Number of moving out in the past year *	651	0.235	0.332	0.392
Dead mother *	651	30.96	36.28	0.151
Dead father	649	65.84	65.14	0.851
Mother lives in Dakar *	651	52.01	49.70	0.555
Father lives in Dakar *	651	19.81	22.56	0.392
HH monthly expenditures *	651	358,017	349,909	0.757
Monthly sex revenues (CFAF)	649	134,498	132,299	0.821
Perceived wealth (1 to 10) *	651	3.82	3.90	0.675
HH members received transfers in the past year	649	27.73	25.00	0.431
HH members sent transfers in the past year	647	38.87	38.11	0.843
Altruism for talibe (CFAF) *	651	266	278	0.537
Altruism for sex worker (CFAF) *	651	140	131	0.601
Risk aversion in general (1 to 10) *	651	6.31	6.19	0.579
Risk aversion in sex (1 to 10) *	651	7.76	7.64	0.567
Preferences for future (1 to 10) *	651	6.69	6.88	0.457
Trust in others	648	82.19	81.10	0.721
Life satisfaction (1 to 4) *	650	2.20	2.25	0.470
Beauty (1 to 10) *	651	5.81	5.80	0.930
Health status (0 to 100) *	651	73.92	73.21	0.677
Feelings of helplessness (1 to 4) *	651	3.23	3.18	0.529
Fear of discrimination due to HIV	614	67.43	71.61	0.261
Fear of discrimination due to sex work	633	74.52	73.67	0.807
Family knows about sex work	641	28.39	26.85	0.664
Feel respected (1 to 10) *	651	7.63	7.37	0.148
HIV knowledge (score 0-8) *	651	6.32	6.45	0.186

Table A2: Tests of randomisation (continued).

Variables	<i>Observations</i> <i>651</i>	Control <i>323</i>	Treated <i>328</i>	p-value
<i>Sex work activity</i>				
Work mostly in bars or brothels *	<i>651</i>	23.84	26.83	0.381
Work mostly at home *	<i>651</i>	28.48	29.57	0.760
Experience in sex work ‡ (in years)	<i>650</i>	7.64	8.51	0.147
Age at first sexual intercourse *	<i>650</i>	17.24	17.28	0.891
Age at first paid sexual intercourse *	<i>650</i>	27.94	27.61	0.594
Has only occasional clients ◊	<i>645</i>	11.32	14.98	0.170
Has only regular clients ◊	<i>645</i>	33.02	32.42	0.871
Last client was occasional ◊	<i>645</i>	40.37	47.68	0.062
Declared use of condom with last client	<i>582</i>	97.60	96.90	0.603
Number of clients within a week ◊	<i>648</i>	6.49	6.56	0.893
<i>Link with the authorities and the health system</i>				
Legal sex worker (LSW) *	<i>650</i>	47.68	52.29	0.240
LSW since more than one year	<i>650</i>	37.46	38.53	0.779
Thinks sex work is legal	<i>610</i>	60.30	64.22	0.315
Police violence in the last 12 months *	<i>651</i>	6.81	7.93	0.587
LSW who go to her monthly visits	<i>269</i>	72.87	72.86	0.998
Has received free condoms ◊	<i>641</i>	65.41	68.73	0.372
Is affiliated with a STD centre ◊	<i>648</i>	72.36	74.01	0.637
Came to a STD centre in the last month *	<i>651</i>	56.97	56.10	0.824
Had an HIV screeng in the past year *	<i>651</i>	81.11	80.18	0.764
HIV positive according to medical records	<i>219</i>	4.90	6.84	0.548
Has got STI symptoms in the last month ◊	<i>646</i>	20.67	23.55	0.383
Test of joint significance (when considering the variables indicated by *): F(32,612) = 0.63, p-value = 0.947				
Test of joint significance (when considering the variables indicated by * and ◊): F(39,581) = 0.76, p-value = 0.855				

Notes: ‡ Experience in sex work = age - age at first paid sexual intercourse.

Table A3: Checking floor, ceiling and design effects.

Estimated Proportions	Source	Obs.	Number of reported items					Sum
			0	1	2	3	4	
Row 1	Treatment list	328	0.006	0.079	0.409	0.424	0.082	1.000
Row 2	Proportion at least		1	0.994	0.915	0.506	0.082	-
Row 3	Control list	323	0.028	0.334	0.548	0.090	0	1.000
Row 4	Proportion at least		1	0.972	0.638	0.090	0	-
Row 5	Row2 - Row 4		0	0.022	0.0277	0.416	0.082	0.796

Remark: The Row 5 = Row 2 - Row 4 gives estimates of the population proportion that would honestly say ‘yes’ to the sensitive item and ‘yes’ to exactly $(j - 1)$ non sensitive items. The sum of the difference between Row 2 and Row 4 gives the difference-in-means estimator.

Appendix 3 Robustness checks

Table A4: Robustness checks - Condom use by subgroups.

		List randomisation (Panel B) ‡					List randomisation (Panel A) †						
		Obs if		Yes	No	Difference	SE	Obs if		Yes	No	Difference	SE
	Obs	Yes	Yes					Yes	Yes				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
$u(s, e) - u(s, p)$	Revenue loss:												
	Earned more than 12,500 CFAF for the last intercourse	582	293	0.668	0.890	-0.221*	0.122	642	321	0.635	0.952	-0.317***	0.110
	Beauty (≥ 5 out of 10)	582	461	0.726	0.970	-0.244*	0.147	644	500	0.737	0.977	-0.240*	0.129
	Condom price:												
	Received free condoms	573	371	0.785	0.801	-0.016	0.131	634	424	0.776	0.850	-0.074	0.119
	Reduction in sexual pleasure:												
	FSWs who declare having no reduction in sexual pleasure with condoms	572	111	0.981	0.729	0.251*	0.149	633	124	0.919	0.759	0.160	0.132
Violence:													
The client negotiated the price	576	309	0.768	0.815	-0.047	0.123	605	323	0.804	0.795	0.009	0.116	
Violence from a client in the past year	581	150	0.844	0.751	0.093	0.127	643	164	0.851	0.765	0.086	0.117	
P	Client at risk of HIV:												
	Last client was at risk of HIV	543	39	0.888	0.747	0.140	0.233	592	43	0.931	0.777	0.154	0.230
π	Risk taking:												
	More than 3 clients a week	581	397	0.712	0.945	-0.234*	0.131	642	440	0.733	0.944	-0.212*	0.117
	Subjective risk taking in health domain (≥ 8 out of 10)	582	33	0.474	0.792	-0.318	0.243	644	35	0.583	0.801	-0.218	0.210
	Last client was an occasional client	582	266	0.717	0.838	-0.121	0.123	644	284	0.717	0.849	-0.131	0.112
	HIV and STI knowledge:												
	High HIV knowledge (≥ 6 out of 8)	582	460	0.831	0.574	0.257*	0.151	644	512	0.841	0.602	0.239*	0.134
	Poor trust towards the efficacy of condoms:												
Perceived condoms inefficacious to prevent HIV †	543	125	0.495	0.829	-0.334**	0.162	599	152	0.611	0.819	-0.208	0.137	
Agrees with ‘One cannot avoid HIV by always using condoms’	576	101	0.591	0.811	-0.220	0.152	633	110	0.617	0.823	-0.206	0.146	
$u(i, e)$	Social exclusion:												
	Was introduced to the sex business by another SW	582	165	0.981	0.701	0.279**	0.129	644	172	0.959	0.735	0.224*	0.119
	Thinks that all girls in the same location use condoms	322	163	0.899	0.655	0.244	0.160	360	189	0.955	0.673	0.282*	0.148
	Would be ashamed if a neighbour learns about her sex work activity	579	485	0.836	0.440	0.396**	0.171	641	540	0.848	0.468	0.380**	0.153
	Fears that a neighbour who learns about her sex activity will repeat it to others	578	493	0.825	0.410	0.415**	0.194	640	547	0.837	0.469	0.367**	0.174
	Medical and opportunity cost:												
	Thinks that will lose more than 14 days of work if has an STI	581	283	0.911	0.639	0.272**	0.122	641	313	0.937	0.649	0.288***	0.110
Expects to pay more than 15,000 CFAF in the case of a genital ulcer	568	368	0.841	0.612	0.229*	0.129	627	401	0.840	0.656	0.184	0.117	
Quality of life if infected:													
Know ART	581	290	0.686	0.870	-0.184	0.123	640	325	0.702	0.890	-0.188*	0.110	

Table A4: Robustness checks - Condom use by subgroups (continued).

		List randomisation (Panel B) ‡					List randomisation (Panel A) †						
		<i>Obs if</i>		Yes	No	Difference	SE	<i>Obs if</i>		Yes	No	Difference	SE
<i>Obs</i>	<i>Yes</i>	<i>Obs</i>	<i>Yes</i>					<i>Obs</i>	<i>Yes</i>				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	((8)	(9)	(10)	(11)	(12)		
$u(s)$	Legal status:												
	Registered with authorities	582	271	0.846	0.723	0.123	0.122	643	322	0.821	0.762	0.059	0.111
	Demand for prevention:												
	Is affiliated with a health centre	580	416	0.830	0.649	0.181	0.141	641	470	0.834	0.686	0.148	0.128
	Does her monthly routine visit	224	156	0.871	0.705	0.166	0.204	266	193	0.826	0.693	0.133	0.186
Visited a health centre in the last 6 months	582	427	0.845	0.592	0.253*	0.143	644	484	0.842	0.638	0.204	0.129	
Had an HIV screening in the past year	582	464	0.786	0.745	0.041	0.161	644	521	0.794	0.776	0.019	0.147	
δ	Preference for present:												
	Agrees with ‘Instead of saving I prefer to spend my money today’	582	472	0.760	0.822	-0.062	0.159	644	507	0.789	0.782	0.007	0.134
	Alcohol or drug consumption during last intercourse	579	41	0.400	0.804	-0.405	0.248	639	49	0.348	0.822	-0.474**	0.208
$u(i,p)$ < $u(i,e)$	HIV and STI status:												
	HIV positive according to medical records (biological test)	185	10	0.167	0.808	-0.641	0.404	216	13	0.221	0.765	-0.543*	0.287
	Subjective expectations about being HIV positive \diamond	521	32	0.375	0.761	-0.386	0.291	575	38	0.479	0.769	-0.290	0.267
	Subjective expectations about being STI positive \diamond	521	207	0.525	0.877	-0.352***	0.132	576	231	0.621	0.843	-0.221*	0.122
$u(v(s))$	Altruism:												
Gave more than 40% of the amount received in the dictator game	582	170	0.927	0.715	0.213	0.133	644	187	0.954	0.723	0.231*	0.124	

Notes: Panel B corresponds to the restricted sample i.e. to respondents who answered to the self-declared condom use question (582 out of 650 FSWs) and Panel A to the full sample.

† Condom inefficacy refers to a subjective probability higher than 80% to be infected after 100 protected intercourses. \diamond Sample is restricted to individuals who understood the subjective probabilities. “Obs” reports the total number of respondents for whom we have information on the variable. “Obs if Yes” presents the number of respondents who answered “Yes” to the related question. Columns (3) and (9) [Columns (4) and (10)] display the proportion of FSWs who answered “Yes” [“No”] and who used a condom in their last sexual act.

Reading note: For the variable ‘Registered with authorities’, columns (7) to (10) can be read as follows: Among the 643 respondents, 322 of them are registered, 82.1% of legal sex workers used a condom with their last client, 76.2% of illegal sex workers did so.

Columns (5) and (11) correspond to the difference between (3) and (4) and between (9) and (10) respectively. Columns (6) and (12) give the robust standard errors of the estimated difference.

‡ Equation (5): $Y_i = \beta T_i + \gamma S_i + \alpha S_i \times T_i + \varepsilon_i$.

† Equation (6): $Y_i = \beta T_i + \gamma S_i + \alpha S_i \times T_i + X_i + \varepsilon_i$. X_i include age, whether the FSW is divorced, whether the FSW lives with or next to her parents,

whether last client was an occasional client, whether clients are usually approached in a night club, whether she had last paid sexual intercourse at home, proportion of the last four sexual intercourses for which payment was made after the sex act.

Reported levels of significance are * p<0.1, ** p<0.05 and *** p<0.01.