

Estimating misreporting in sensitive health behaviours: Evidence from condom use of female sex workers in Senegal

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Abstract

Self-reported condom use is high among female sex workers in most low and middle-income countries. Because the known benefit of using condoms is high, there is a desirability bias in under-reporting socially undesirable health behaviours such as unprotected sex. We use a list randomisation to measure misreporting in condom use in Senegal, a country where sex workers face high social stigma and where AIDS epidemic is mainly concentrated among this population. Using this indirect elicitation method, we find that 22% of female sex workers did not use a condom in their last sexual intercourse with a client, which is significantly greater than the 3% obtained when asked directly. When estimating condom use among sub-groups, we find that female sex workers who are at higher risk of infection are less likely to use condoms. Our study confirms that the list randomisation is an effective method to elicit sensitive health behaviours in low-income countries.

JEL Classification: C42; I12; I18; O55.

Key words: Senegal, measurement error, list randomisation, HIV/AIDS.

1 Introduction

Condom use is the main preventive tool available to limit the spread of sexually transmitted diseases (STI) and human immunodeficiency virus infection/acquired immune deficiency syndrome (HIV/AIDS). Given that the consistent use of condoms is known as the most cost-effective way to prevent HIV transmission, 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 due to the impossibility to directly observe sexual behaviours adopted by targeted groups. Researchers and policymakers have then 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) find 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 measure. Indeed, one may wonder whether direct elicitation of condom use will provide an accurate estimate and could be used to measure the impact and value for money of condom-based interventions. This may be even more of a concern when considering stigmatised group highly targeted by preventive services, such as female sex workers (FSW).

Our paper aims to measure misreporting in condom use among FSWs in Senegal, a country particularly interesting for the study of FSWs. Firstly, while HIV prevalence is less than 1% in the general population (UNAIDS, 2013), FSWs in Senegal are up to 30 times more likely to be infected with HIV/AIDS with an HIV/AIDS prevalence ranging from 10 to 27% that has increased over time and a STI prevalence that exceeds 60% (Laurent et al., 2003; Sow et al., 2011; Wang et al., 2007). Secondly, Senegal is the only African country where prostitution is legal and

regulated. In fact, in 1970, the Government of Senegal legalised prostitution and introduced a compulsory registration programme for FSWs in order 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. Hence, it is not surprising that previous studies documented a very high rate of condom use among this population in Senegal. In fact, Wang et al. (2007) reported that 95% of FSWs in Senegal declare always using condoms with clients. However, despite the fact that registering with authorities allows FSWs to work and receive preventive health services, the majority (60%) of FSWs in Dakar are clandestine (DLSI, 2013). This is explained by the high stigma attached to commercial sex work in Senegal and the fear of FSWs that their family relatives and friends discover their activity once they are registered and in possession of a FSW identity document.

In order to estimate the size of over-reporting in condom use, we use a list randomisation as an indirect way to elicit condom use. The list randomisation method provides privacy to respondents and enable not to misrepresent themselves in a face-to-face interview (Holbrook and Krosnick, 2010). In addition to estimate condom use in our sample, the list randomisation allows to identify sub-groups for which condom use rates are lower. Finally, we compare the proportion of FSWs who openly declared using a condom with their last client with the proportion obtained through the indirect elicitation method. This allows us to quantify the propensity to lie among sub-groups, and in particular to test whether registered FSWs who are more exposed to HIV prevention campaigns are more likely to lie than their clandestine counterparts.

We find 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. When estimat-

ing condom use among sub-groups, we find that high-risk FSWs (HIV positive, STI positive, FSWs who have a lot of clients and FSWs who consume alcohol or drugs before sex act) are significantly less likely to have used a condom with their last client. This result confirms the role of FSWs in the spread of the AIDS epidemic in Senegal. The results also show that increasing the knowledge of FSWs regarding HIV and the consequence of STI as well as increasing the links with health facilities would be useful policies to increase condom use. Finally, when estimating the propensity to lie among sub-groups, we do not find that FSWs receiving intensive HIV prevention services are more likely to lie regarding their condom use, challenging the idea of a higher social desirability bias in the context of widespread HIV prevention.

The remainder of the paper is organized as follows. In section 2, we present the list randomisation methodology as well as the specific version implemented in our study. In section 3, we adapt a theoretical framework to understand the determinants of condom use among FSWs. Section 4 details the empirical strategy used to analyse the data. Section 5 introduces the data and verifies that the hypotheses required to use the list randomisation method are fulfilled. Section 6 presents the main results of the list randomisation and test the determinants of condom use modelled in Section 3. Section 7 summarises and discusses the implications of the results and section 8 concludes.

2 Methodology

2.1 List randomisation method and underlying hypotheses

The list randomisation or item count technique is an indirect questioning method implemented in order to limit the dishonest answers caused by a social desirability bias. 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), use of microfinance 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). The method has also been applied in order to elicit condom use under the influence of alcohol (LaBrie and Earleywine, 2000; Walsh and Braithwaite, 2008) and to elicit condom use in the context of the evaluation of the effects of health information interventions: an online sexual health education course in Columbia (Chong et al., 2013) and sexual information texting in Uganda (Jamison et al., 2013).

The principle of the list randomisation is to allocate respondents randomly to two different groups: a “control” and a “treatment” group. Individuals allocated to the “control” group are presented with a number of non-sensitive statements. They are not asked to say whether they agree on each of the statements but only with how many of them they agree on. 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. Therefore, respondents allocated to the “treated” group face an additional statement than those of the “control” group. Assuming that the two groups have a similar opinion of the 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). Therefore, this method yields an estimate of the proportion of individuals in the population interviewed who agree on the sensitive item.

The effectiveness of this methodology is based on three assumptions: (i) the randomisation of the treatment, (ii) the absence of any design effect, and (iii) the absence of liars. More precisely, individuals allocated to each group must be similar in order 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 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 lie. There are two different types of liars: those who honestly would answer yes to all the non-sensitive items and hence do no longer benefit from any privacy if they agree on the sensitive item (ceiling effects) and those who honestly would answer “no” to all non-sensitive items (floor effects). Glynn (2013) advised that some control items should be paired to be negatively correlated in order to minimise this problem.

Other techniques aiming at ensuring confidentiality and thus eliciting less biased prevalence of sensitive behaviours or opinions exist in the literature (see Anglewicz et al., 2013; Blattman et al., 2015; Krumpal, 2013; Roth et al., 2014). Table 1 presents several of these techniques 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 item count technique was the most appropriate method to estimate misreporting in condom use.

Table 1: 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 the respondent agree - 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 methods
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 a sub-group analysis
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 respondents 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 are ignorant about whom the incriminated information is being provided 	<ul style="list-style-type: none"> - Response accuracy for the second question is questionable

2.2 List randomisation implemented among FSWs in the region of Dakar

In June and July 2015, we interviewed 651 FSWs in Dakar suburbs, which represents 15% of the total estimated number of FSWs in the region of Dakar (DLSI, 2013). Our sample contains an equal share of registered and clandestine FSWs. Given that sexual health services are integrated to reproductive health in Senegal, registered FSWs were recruited by midwives while clandestine FSWs were recruited by NGOs staffs and by peer FSWs. FSWs were asked to come to the health centre and were interviewed at the health facility in private dedicated rooms. In order to implement the list randomisation technique, we randomised the allocation of participants to the “treatment” or “control” group based on their identifying number so that participants with an odd number were allocated to the “control” group and would be asked if they agree with three non-sensitive sentences, while those with an even number were allocated

to the “treated” group and they would be asked if they agree with four sentences, including the sensitive item (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 with how many of these statements you agree on. You should not tell me which specific statement you agree on but the number of statements you agree on. 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 on it, please transfer one marble from your right hand to your left hand behind you. If you do not agree on it, please do not transfer any marble. I will not see it, and you should not tell me. At the end, I would like to know the total number of statements you agreed on. 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 in a hotel.*
- 2. I prefer that the client pays me before the intercourse.*
- 3. Monday is the day I have the greatest number of clients.*

FSWs of 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 of the treatment group list:

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

Unlike other articles that investigated misreporting in unsafe sexual behaviours (Chong et al., 2013; LaBrie and Earleywine, 2000), the sensitive item used in this list randomisation

corresponds to the adoption of the safe conduct (as in Jamison et al., 2013). We decided to present the sensitive item in this way for two main reasons. Firstly, this allows us to keep the exact same wording than the one of the direct condom use question. Hence, we can compare the results obtained via the direct question and the list randomisation. Secondly, we believe that this formulation has a lower stigmatising effect on respondents. The share of FSWs who did not use a condom with their last client is then easily derived by deducing the estimated proportion that used a condom via the list randomisation to one.

3 Theoretical framework

In this section, we present a theoretical framework of the potential mechanisms at play in the decision to engage or not in safe sex. To do so, we adapt the model of Geoffard and Philipson (1996) to a two-period model where FSWs decide whether to engage or not in safe sex in period t and face the costs of being infected in period $t + 1$. As it is commonly done in the literature on the compensating differential for unprotected sex (Arunachalam and Manisha, 2012; Gertler and Shah, 2011; Rao et al., 2003), it is assumed that clients bear disutility from protected sex. FSWs choose their behaviour to maximise their utility given their health state. The health status h of FSWs can take two values: susceptible ($h = s$) or infected with HIV ($h = i$). FSWs decide to adopt a behaviour that also can take two values: protection against risk ($\alpha = p$) or exposure to risk ($\alpha = e$). The utility derived by FSWs $u(h, \alpha)$ is a function of one's health and behaviour.

Ceteris paribus, protective activity and infection are both assumed to be costly:

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

FSWs discount future utility at a discount rate $\delta(h)$, which is a function of the future health

state, with $\delta(s) < \delta(i)$.

The transition rate from state s to state i , conditional on exposure, is denoted $\lambda = \beta \times P$ where P is the probability that a susceptible FSW matches with an infected client and β 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 that:

$$P[h(t+1) = i | (h(t), \alpha) = (s, e) = \lambda] \quad (1)$$

$$P[h(t+1) = i | (h(t), \alpha) = (s, p) = 0] \quad (2)$$

$$P[h(t+1) = i | h(t) = i = 1] \quad (3)$$

In other words, (1) the probability to get infected if exposed for a susceptible FSW is λ ; (2) the probability to be infected under protection is zero and (3) the probability to remain infected if already infected is one.

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.

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

While in this model, infected FSWs have no reason to engage in safe sex: $u(i, p) < u(i, e)$, 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 utility level v :

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

Based on the theoretical model, Table 2 summarises the main parameters of the model as well as their measure in the data set.

4 Empirical strategy

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

$$Y_i = \beta T_i + \gamma S_i + \alpha S_i \times T_i + \varepsilon_i \quad (4)$$

where Y_i is the number of statements the respondent agreed on, T_i indicates whether or not the respondent was allocated to the treated group, S_i is a characteristics of individual i that may be correlated with condom use. β reports the condom use rate among the subgroups for which $S_i = 0$. $(\beta + \alpha)$ indicates the condom use rate among the subgroups for which $S_i = 1$. Hence, α indicates if the condom use rate is different among subgroups. Robust standard errors are computed to account for the difference in the variance of error term between the treatment and control groups.

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

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

where X_i is a set of sex worker characteristics potentially influencing the answer to the non-sensitive items (i.e. on FSWs preferences regarding the place where sex act occurred, whether payment is made before or after sex act and sex acts distribution over the week). X_i also include age, whether the FSW is divorced, whether the FSW lives with or next to their parents,

the type of client (regular versus occasional), whether clients are usually approached in a night club and the proportion of the last four sexual intercours for which payment was made after the sex act. In fact, while younger FSWs and FSWs who live with their parents may prefer going to a hotel for discretion purpose, FSWs who are divorced or who only have regular clients may prefer having sexual intercours at home. Furthermore, it is likely that sex workers who usually approach clients in night clubs or bars are much more likely to have more clients over the weekends. Finally, the observed proportion of the time when payment took place before sexual act over the last four sexual intercours reflects to some extent FSW preferences regarding this element.

5 Validation of the list randomisation

The effectiveness of the list randomisation methodology is based on three assumptions: (i) the randomisation of the treatment, (ii) the absence of ceiling or floor effects which would prevent respondents from answering honestly, and (iii) the absence of any design effect, in other words, the fact that adding the sensitive item does not modify the answers regarding the non-sensitive statements. In the next paragraph, we review these hypotheses and check whether they are fulfilled.

5.1 Verification of the randomisation

Tables 3 and 4 display the means of the outcomes of interest and their potential determinants for the control and treatment groups. We note that randomisation ensured balance between the two groups with respect of their observable characteristics. The only significant difference observed is in the type of the sex worker last client ($p=0.06$). However, given that we test around 60 different treatment-control differences in this table, this unique significant difference is no more than what would be expected by chance. Furthermore, the joint significance tests of a large

share of the set of variables, presented in Table 4, confirm the success of the randomisation.¹

Based on these results, it seems that any differences in responses to the list randomisation between the two groups should reflect the condom use proportion.

¹More precisely, two tests of joint significance were performed and provide similar results. While the first one try 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).

Table 3: Tests of randomisation

Variables	Observations	Control	Treated	p-value
	651	323	328	
<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 4: Tests of randomisation (continued)

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

5.2 Absence of ceiling, floor and design effects

We also need to ensure that the list of non-sensitive items provides enough privacy to respondents in the treated group (hypothesis 2) and that the addition of the sensitive item does not modify the answers regarding the non-sensitive statements (hypothesis 3). In Table 5, we estimate the proportion in the control group who did not agree with any statement and answered “0” to the item count list question. It would be an issue if this proportion was high given that it would encourage respondents in the treated group to report a positive value since answering

“0” would mean that they had unprotected sex. Since the proportion of individuals answering “0” in the control group is less than 3% we do not face such issue. We also avoid the issue of ceiling effect given that the proportion of respondents in the control group who answered “3” to the non-sensitive items is also very low (9%). This absence of ceiling and floor effects has been ensured thanks to the negative correlation between items 2 and 3. Indeed, it is likely that many individuals will answer “yes” to item 2 - “*I prefer that the client pay me before the intercourse*”,² while they are likely to rather answer “no” to item 3 - “*Monday is the day where I have the greatest number of clients*”.³ Some protection for the respondents is therefore built to allow them to honestly report their true behaviour towards condom use (Glynn, 2013). Finally, the difference (Row 5) between the proportions of individuals in the treated group (Row 2) and in the control group (Row 4) who agree with at least j statements ($j = 1, 2, 3, 4$) is always positive, which provides evidence of an absence of design effect (Glynn, 2013).

Table 5: 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.

²As a matter of fact, in our sample, 67% of the respondents declare that their last client paid before sex act.

³25% of the 1,994 paid sexual acts in our dataset, for which we have the date information, occurred on Saturday.

6 Results

6.1 Declared condom use

FSWs were asked whether they have used a condom for each of their four last paid sexual intercourses, the two last sexual intercourses occurring with an occasional client and a regular client respectively. Since the data set contains the date of those sexual intercourses, we can identify the last paid sexual intercourse. From Table 6, we note that a very high proportion of FSWs declared using condoms with their last client (97%). This proportion is high for sexual intercourses with both occasional (98%) and regular (96%) clients. Note that 10.6% of FSWs did not answer this question, which confirms the sensitivity of such question.

Table 6: Declared condom use

	<i>Observations</i>	Mean	Std. dev.
In the last sexual intercourse with a client	582	97.25	16.37
In the last sexual intercourse with an occasional client	408	98.28	13.00
In the last sexual intercourse with a regular client	478	96.44	18.54
In the two last intercourses with occasional clients	408	97.79	14.71
In the two last intercourses with regular clients	469	94.88	22.06

6.2 Measuring misreporting in condom use

Table 7 presents the result of the list randomisation exercise. It appears that 77.7% of FSWs agreed with the sensitive item “*I used a condom during my last intercourse with a client*”. By simply taking the opposite event, we obtain that 22.3% did not use any protection in their last paid sexual intercourse (see Panel A). The difference between the self-reported condom use and the condom use elicited by the list randomisation is statistically significant ($p < 0.01$). For the entire sample i.e. when including the 10.6% who did not answer to the direct question, the elicited condom use rate using the list randomisation was 79.7%. This is an interesting result because it means that respondents who did not answer to the self-reported question report a

slightly higher condom use (see Panel B). In order to investigate this further, Panel C shows the elicited condom use for the 10.6% who did not answer the direct question. We found that, among this sub-sample, estimated condom use rate is 92.4%.

Table 7: Condom use with last client estimated with the list experiment

	Mean for list question for		Estimated proportion	CI 95%
	Control	Treatment		
<i>Panel A: Restricting to individuals who answered the self-declared question (n=582)</i>				
Condom use	1.685	2.462	0.777	[65.67 ; 89.75]
No condom use	1.685	1.462	0.223	[10.25 ; 34.33]
<i>Panel B: All female sex workers (n=651)</i>				
Condom use	1.700	2.497	0.797	[68.52 ; 90.93]
No condom use	1.700	1.497	0.203	[9.07 ; 31.48]
<i>Panel C: Restricting to individuals who did not answer the self-declared question (n=69)</i>				
Condom use	1.839	2.763	0.924	[64.10 ; 120.78]
No condom use	1.839	1.763	0.076	[-20.79 ; 35.90]

Notes: The proportion who did not use a condom is obtained by deducting 1 to the average number of agreed sentences in the “treated group” and then by taking the difference in “control” and “treated” means.

6.3 Measuring misreporting in condom use for sub-groups

Table 9 displays the results obtained when performing the sub-group analysis presented in Table 2.

Factors affecting the costs of protections We find that having high earnings (more than 12,500 CFAF for the sexual act, which corresponds to the median in our sample) is negatively correlated with the likelihood of using a condom (68% vs. 89%, p-value=0.07). At the very beginning of each interview the interviewers were asked to assess the beauty of the interviewees. FSWs who are considered to be more beautiful are less likely to have used a condom in their last paid intercourse (75% vs. 97%, p-value=0.08), reflecting potentially a higher condom price differential for more beautiful FSWs. Nevertheless, FSW who received free condoms are not more likely to use condoms than those who have to pay for condoms. Besides these financial costs, FSWs were asked to compare their sexual pleasure with and without condoms. Those

who declare that they have sexual pleasure despite the use of condoms tend to be more likely to have used a condom in their last intercourse with a client (95% vs. 76%, p-value=0.17). No information regarding the type of violence experienced during the last sexual intercourse has been collected. We attempt 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 the intercourse, taken as a proxy for a low bargaining power of the FSW. However, we do not find any significant differences in condom use between these sub-groups.

Factors affecting the probability that a susceptible FSW matches with an infected client FSWs were asked about their last client characteristics. We find that FSWs are more likely to use a condom with clients perceived to be at high risk of HIV (90% vs. 77%), yet this difference is not statistically significant.

Factors affecting the probability that an exposed activity between a FSW and a client will result in a new infection A series of information regarding the circumstances of the last intercourse has been collected. Anal sex and the fact that the last client was an occasional client seem to reduce the probability to engage in safe sex even if these differences are not statistically significant. FSWs who have more than three clients per week are significantly less likely to have used a condom (73% vs. 95%, p-value=0.08). FSWs who declare to be willing to take risks with their health tend to be less likely to use condoms, yet the sample size of this sub-group does not enable us to detect a statistically significant difference. FSWs who have a better knowledge regarding HIV transmission modes are more likely to have used a condom with their last client (85% vs. 59%, p-value=0.06). As for FSWs who think that condoms will not protect them from HIV infection, they have a lower condom use (62% vs. 83%, p-value=0.14).

Factors affecting the utility in case of infection We find that peer effect and social norms have a role to play 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 (99% vs. 63%, p-value=0.02). This is also the case for FSWs who entered prostitution thanks to another sex worker (97% vs. 74%, p-value=0.06). 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 are more likely to use condoms (85% vs. 47%, p-value=0.02 and 85% vs. 43%, p-value=0.02 respectively).

As expected perceived STI consequences is correlated with the decision to engage or not in safe sex. On the one hand, FSWs who think they will lose more than 14 days of work in case of STI infection are more likely to have used the condom during their last paid intercourse (93% vs. 67%, p-value=0.02). Likewise, FSWs who expect to pay more than 15,000 CFAF of medical expenses in case of genital ulcer seem to be more likely to have used a condom with their last client (85% vs. 66%, p-value=0.10). FSWs who are aware of the existence of antiretroviral treatment (ART) tend to use less condoms than FSWs who never heard about such HIV treatments (72% vs. 89%, 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% vs. 61%, p-value=0.07). However, registering with authorities and attending routine 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 (41% vs. 81%, 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% vs 80%, p-value=0.05). This negative relation between HIV status and condom use is somehow confirmed on the entire sample when considering subjective expectations regarding HIV status. In addition, 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% vs 89%, p-value=0.01).

Interdependent utilities We measured altruism with a real payment dictator game and we find that altruistic FSWs are more likely to have used a condom (97% vs. 73%, p-value=0.05).

Table 9 also shows that very similar results are found when introducing the set of covariates aiming at controlling for any sex worker characteristics which could influence the answers to the non-sensitive items.

Table 8: Condom use by sub-groups

		List randomisation estimations							
		Model without covariates: equation (4)				Model with covariates: equation (5)			
		Obs.	mean groupe = 0	mean group = 1	difference p-value	Obs.	mean groupe = 0	mean group = 1	difference p-value
$u(s, e) - u(s, p)$	Revenue loss:								
	Earned more than 12,500 CFAF in the last intercourse	643	0.894	0.684	0.065	642	0.908	0.678	0.043
	Beauty (≥ 5 out of 10)	651	0.974	0.745	0.080	645	0.999	0.739	0.055
	Condom price:								
	Received free condoms	641	0.849	0.791	0.639	635	0.837	0.794	0.728
	Reduction in sexual pleasure:								
	Top 20% FSWs who have the highest sexual pleasure with condoms	640	0.762	0.947	0.169	634	0.761	0.944	0.184
	Violence:								
	The client negotiated the price	605	0.821	0.780	0.730	605	0.819	0.777	0.728
	Violence from a client in the past year	445	0.765	0.738	0.851	443	0.740	0.754	0.921
P	Client at risk of HIV:								
	Last client was at risk of HIV	593	0.774	0.904	0.541	592	0.776	0.915	0.528
β	Risk taking:								
	More than 3 clients a week	648	0.950	0.733	0.076	643	0.946	0.740	0.091
	Self-reported risk taking in health (≥ 8 out of 10)	651	0.812	0.500	0.175	645	0.811	0.505	0.177
	Last client was an occasional client	645	0.860	0.711	0.196	643	0.863	0.715	0.203
	HIV and STI knowledge:								
	High HIV knowledge (≥ 6 out of 8)	651	0.585	0.852	0.063	645	0.598	0.848	0.077
	Condom inefficacy:								
	Perceived condom inefficacy ^{+◊}	606	0.829	0.620	0.138	600	0.828	0.610	0.126
	One cannot avoid HIV by always using condoms	640	0.830	0.618	0.157	634	0.833	0.602	0.118
	$u(i, e)$	Social exclusion:							
Was introduced to the sex business by another SW		651	0.739	0.974	0.055	645	0.736	0.985	0.046
All girls in the same location use condoms		364	0.632	0.988	0.017	361	0.652	0.958	0.044
Would be ashamed if a neighbour learns about her sex work activity		648	0.472	0.852	0.018	642	0.456	0.855	0.014
Fear that a neighbour who learns about her sex activity repeat this to others		647	0.427	0.846	0.020	641	0.429	0.847	0.023
Medical and opportunity cost:									
Thinks will lose more than 14 days of work if has a STI		648	0.666	0.929	0.020	642	0.663	0.932	0.019
Expect to pay more than 15 000 CFAF in case of genital ulcer		634	0.657	0.852	0.102	628	0.652	0.854	0.094
Quality of life if infected:									
Know ART		647	0.889	0.715	0.128	641	0.902	0.702	0.084

Table 9: Condom use by sub-groups (continued)

		List randomisation estimations							
		Model without covariates: equation (4)				Model with covariates: equation (5)			
		mean	mean	difference		mean	mean	difference	
		<i>Obs.</i>	groupe = 0	group = 1	p-value	<i>Obs.</i>	groupe = 0	group = 1	p-value
$u^{(s)}$	Legal status:								
	Registered with authorities	650	0.749	0.848	0.382	644	0.747	0.850	0.368
	Demand for prevention:								
	Is affiliated to a health centre	648	0.680	0.843	0.219	643	0.684	0.841	0.242
	Does her monthly routine visits	269	0.711	0.841	0.490	267	0.692	0.841	0.441
δ	Visited a health centre in the last 6 months	651	0.609	0.860	0.066	645	0.599	0.862	0.054
	Had a HIV screening in the past year	651	0.774	0.803	0.847	645	0.787	0.801	0.927
δ	Preference for present:								
	Instead of saving I prefer spending my money today	651	0.809	0.791	0.894	645	0.824	0.787	0.790
$u^{(i,p)}$	Alcohol or drug consumption in the last intercourse	640	0.814	0.407	0.061	639	0.815	0.429	0.073
	HIV and STI status:								
	HIV positive according to medical record	219	0.800	0.050	0.049	217	0.797	0.071	0.041
$u^{(i,e)}$	Subjective expectations about being HIV positive \diamond	582	0.787	0.421	0.188	576	0.783	0.446	0.220
	Has a non-negative probability to have an STI other than HIV today	583	0.894	0.571	0.009	577	0.889	0.577	0.015
$u^{(v(s))}$	Altruism:								
	Gave more than 40% of the amount received in the dictator game	651	0.726	0.972	0.050	645	0.733	0.953	0.080

Notes: \diamond Sample is restricted to individuals who understood the subjective probabilities. + Condom inefficacy refers to a subjective probability higher than 80% to be infected after 100 protected intercourses.

6.4 The role of intensive prevention on the propensity to lie

An important concern is whether high-risk populations who are more exposed to intensive HIV prevention services tend to lie more about their condom use. The fact that half of our sample includes FSWs who are registered with authorities allows investigating if those FSWs are more likely to lie than their clandestine counterparts. To measure the role of prevention on the propensity to lie, we perform the following procedure. First, we compute the proportion of FSWs who declared using a condom with their last client depending on whether they are exposed to intensive HIV prevention. Then, we estimate condom use for those groups using the list randomisation results presented in Table 9. Finally, we compute the difference in condom use obtained with the two methods as well as its associated standard error. Table 10 reports the propensity to lie regarding condom use depending on the exposure to HIV prevention. Overall, there is no evidence that FSWs receiving intensive HIV prevention services are more likely to over-report condom use. Conversely, the only statistically significant result indicates the opposite since we find that FSWs who have not visited the 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. All other results are not statistically significant but show similar direction of the bias.

Table 10: Social desirability bias

	<i>Obs.</i>	Liars		Difference	SE	P-value
		Group = 0	Group = 1			
		(1)	(2)	(3)	(4)	(5)
<i>Legal status</i>						
Legal sex worker	650	0.213	0.137	0.076	0.114	0.506
Is affiliated to a health centre	648	0.277	0.135	0.142	0.156	0.361
<i>Access to HIV prevention and link with the health system</i>						
Did not visited the health centre in the last six months	652	0.121	0.339	-0.218	0.134	0.103
Visited the health centre less than a month ago	651	0.246	0.122	0.124	0.124	0.319
Does her monthly visits	269	0.289	0.152	0.136	0.198	0.491
Received free condoms	641	0.122	0.196	-0.074	0.129	0.564
Had a HIV screening in the past year	651	0.158	0.179	-0.021	0.154	0.891

Notes: (1) and (2) corresponds to the difference in condom use with the direct and indirect measures for 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).

(5) is the p-value indicating whether the difference is significantly different from zero and has been computed in the following way: $p\text{-value} = 2 * \text{normal}(-\text{abs}((3)/(4)))$.

7 Discussion

Using a list randomisation, we found that FSWs in Dakar over-report condom use by 19.5 points. The misreporting in condom use is higher than the one 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), 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. Indeed, anonymity is crucial when interviewing FSWs given that their close relatives are often unaware of their sex work activity. In addition, because they are stigmatised, FSWs fear to be looked down upon when disclosing socially unacceptable behaviours. Hence by guaranteeing anonymity, the list randomisation method seems particularly suited to this population. Nonetheless, we acknowledge that condom use may still be over-estimated. While the list randomisation guarantees privacy in response to survey participants, it cannot help with participants who do not want to reveal their true behaviour. This is highlighted by the fact that among the respondents who did not answer to the self-declared condom use question, only 8% did not use condom with their last

client according to the list randomisation.

The over-reporting in condom use suggests that the precautions we took during the survey to ensure anonymity and confidentiality were not sufficient to elicit true behaviours. We recruited female enumerators with previous experience with FSWs and HIV surveys and conducted every interview in separate rooms. An option to limit bias in response in future study could be to train FSWs as survey enumerators. This was done in a large FSW survey in Equator and was associated to lower self-reported condom use rate (82% of FSWs declared having used a condom in all their three last sexual intercourses) and to survey participants feeling open to disclose their STI status in focus group discussions (Arunachalam and Manisha, 2012). However, additional information collected as part of this survey through a game presenting hypothetical clients and asking about the willingness to engage in an unprotected intercourse confirms the high condom use rate obtained with the list randomisation. Indeed, 92% of the respondents refused to engage in unprotected sex even when they know that the client is HIV free.

We empirically test the role of the parameters of the theoretical model of (Geoffard and Philipson, 1996). We find that a main reason for not using condom comes from the existence of a premium for unprotected sex (Rao et al., 2003). Another direct cost associated with condom use reported in the literature is the fact that condom use is under the client's control (Wojcicki and Malala, 2001). Female condoms present the advantage of being user-initiated and are widely available in Senegal. However only 7% of the 1,629 protected sexual intercourses contained in our data set were protected using a female condom. This suggests that 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.

We also provide some evidence on how the factors affecting the utility in case of infection interact with condom use. First, we show that FSWs who fear social stigma are more likely to use condom. While stigma reduction policies will certainly reduce social exclusion of FSWs, they could also have a disinhibition effect. Second, we find 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 instance, we find that women who have heard about ART are less likely to use condoms. There is some evidence in the literature that ART roll out was 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*. In order to test this, we excluded from our sample FSWs who believed that they were infected with HIV and this 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 of Geoffard and Philipson (1996) predicts that once infected, FSWs should stop using condoms because the benefits provided from protection is nil and this was confirmed empirically. This result is particularly alarming because it shows that at risk sexual intercourses are more likely to be unprotected than 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 due to the fact that HIV positive FSWs have on average 7 weekly clients (compared to 6.5 for HIV negative ones). Among those 329 sexual intercourses 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 interdepen-

dent 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 (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 from detecting moderate differences in condom use for several sub-groups. In addition to the issue of low statistical power, small sample size also leads to higher uncertainty in the estimated proportion of condom use for several sub-groups. For instance, while we estimate that condom use of 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 under-estimation of condom use for this sub-group. When considering the number of true statements in the total sample, the list randomisation concludes that condom use is 20 points lower for HIV positive FSWs. Despite the impossibility to investigate a causal effect of HIV status on condom use, our findings confirm that FSWs are an important vector of HIV transmission in Senegal. In addition, the design could have been improved by randomising the order of the statements to prevent any framing effect and by giving four statements to both groups to avoid cognitive biases. Yet the latter would have implied to select a fourth statement in the control group for which we would have known the answer. We believe that this would come with additional bias and that the use of marbles has allowed participants to keep track of their answers. Furthermore, it was previously shown that the number of non-sensitive items do not seem to affect the results (Karlan and Zinman, 2012; Tsuchiya et al., 2007). An important limitation however is that while we make the assumption that clients bear disutility from using condoms, the data did not allow 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 some guidance regarding the optimal design of list randomisation is required. While in theory, the number and choices of non-key items should not affect the results, there are some empirical evidence that the choice of non-key items does matter. Droitcour et al. (1991) tested whether non-key items that are unrelated to sexual behaviours were better to elicit unbiased HIV related behaviours. They found that the use of non-key items that were unrelated to the key content make participants suspicious about the survey, and therefore reduces the success of the list randomisation method. Unlike previous papers using a 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 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), we decided to select non-key items that relate to sex work activity. Secondly, we show that results obtained from the list randomisation are to some extent imprecise, and given the implementation challenges when doing 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 measurement should aim to test the validity of the results obtained with the list randomisation. This could be done by asking condom use question to clients in addition to FSWs since clients are found to be less likely to over-report condom use (Wilson et al., 1989). Another option would be to implement a list randomisation to both FSWs and clients. This would imply to conduct the survey at the place of work of FSWs, which could be associated with additional challenges. A last option to test the validity of the list randomisation would be to confront the results of the list randomisation to the ones obtained using other methods aiming at reducing measurement error.

8 Conclusion

We implement a list randomisation on FSWs in order to test if condom use was over-reported. Our results are consistent with the fact that self-reported condom use leads to an overestimation in condom use, which has direct implications when this measure is used to assess 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 intervene in the decision to engage in unprotected sex. While many of those factors have something to do with FSWs personality and social norms and hence are hardly changeable, our results also suggest that a mix of policies that consist in both educating FSWs on the perceived benefits of protected sex and in reducing the costs associated with protected sex may be effective to increase condom use.

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