



# Survey measures versus incentivized measures of risk preferences: Evidence from sex workers' risky sexual transactions



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## ABSTRACT

Survey measures of risk attitudes are primarily used in the health literature, although incentivized measures of risk preferences are being increasingly used in other fields. We exploit the unique setting of commercial female sex workers in Bangladesh to investigate whether incentivized measures of risk preferences, or non-incentivized survey measures of risk preferences, best identify the risky commercial sex decisions that they make. The study uses survey data collected during February–April 2016, and October–November 2016 from eight brothels in Bangladesh. Wave 1 includes 1,332 female sex workers, Wave 2 includes 1,185 female sex workers. Our findings suggest that researchers can reliably use survey measures to elicit risk preferences on health.

## 1. Introduction

The risk preferences of individuals affect a range of economic behavior, including a range of health-related behavior. For instance, one's risk preference likely influences whether one takes out health insurance, how often one consults a doctor and whether one engages in behaviors that either increase the risk of ill-health and mortality, such as smoking cigarettes or using illegal drugs, or reduce the risk of ill-health and mortality, such as eating well and exercise. Given the importance of risk preferences for how people behave and, in particular, how they invest in their health, it is important to get a proper handle on how we best measure them and, consequently, best control for how they affect an individual's health behavior.

Various methods have been developed by economists to elicit the risk preferences of individuals (See [Charness et al., 2013](#)). A central issue relating to the elicitation of risk preferences is whether non-incentivized instruments are able to provide reliable estimates of true risk attitudes. Studies such as [Holt and Laury \(2002\)](#) find that individuals are more likely to reveal their true risk preferences under incentivized conditions than when posed with hypothetical situations when making financial decisions under uncertainty. [Dohmen et al. \(2011\)](#) and [Hardeweg et al. \(2013\)](#), though, in field experiments, find that self-reported risk attitudes are capable of predicting actual decisions under uncertainty. In the specific context of health behaviors, [Anderson and Mellor \(2008\)](#) demonstrate that incentivized measures of risk preferences are good predictors of survey measures of risky health behaviors. One important issue, on which we know very little, however, is

the relative performance of various measures of risk preferences in estimating the risky decisions that individuals make when carrying out their jobs, particularly when those decisions can literally mean the difference between life and death.

Survey based measures are widely used in the health literature to gauge risk preferences ([Weil, 1999](#)), although incentivized measures of risk preferences are being increasingly used in other fields ([Charness et al., 2013](#)). Should economists be making greater use of incentivized measures, rather than survey measures, to gauge risk preferences in the health and labor context? We exploit the unique setting of commercial female sex workers in Bangladesh to examine whether incentivized measures of risk preferences, or non-incentivized survey measures of risk preferences, are better at identifying individuals' risky health and labor decisions.

To do that, we utilize data collected from two waves of surveys conducted with 1332 female sex workers at eight different brothels in Bangladesh. The theory of compensating wage differentials predicts that a person who is more risk loving will be more likely to select a risky option at a given price. Good measures of risk preferences should permit the identification of this particular prediction. Sex workers face a higher than average probability of contracting sexually transmitted infections (STIs), compared to the general population, and are more frequently confronted with risky situations that involve compensating wage differentials (see e.g., [Cooper et al., 2017](#); [Davey et al., 2018](#); [Packel et al., 2018](#)). If a sex worker contracts a STI from a client, this may not only impair her ability to earn an income, but may have serious health consequences, including death. Thus, the risks associated with

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engaging in unprotected sex, particularly if the sex worker suspects the client to have a STI, are very high. We take advantage of these characteristics of the labor market for sex workers, together with the availability of transactional data, to test the quality of incentivized measures, and non-incentivized survey measures, of risk preferences in the health context.

We find that the financial risk attitudes of sex workers elicited from an incentivized lottery game, as well as survey measures, do not predict that sex workers who are risk loving are more likely to engage in unprotected sexual transactions with clients. However, sex workers with higher self-reported health risk attitudes are more likely to have unprotected sex with clients, which is consistent with the theoretical prediction. While positive sorting might contribute to the effect of risk preferences on the likelihood of engaging in unprotected sex, we find that the relative performance of the risk preference measures and, in particular, the findings for self-reported health risk attitudes, are robust to addressing the effects of sorting.

Our findings contribute to a growing body of work in economic epidemiology, much of which is focused on the commercial sex market (see e.g. Cooper et al., 2017; Islam and Smyth, 2012, 2016; Packel et al., 2018; Rao et al., 2003; Robinson and Yeh, 2011). Economists have been interested in the extent to which market forces explain the persistence of unprotected sex, given that this has implications for the efficacy of public health campaigns designed to increase the use of condoms in the commercial sex sector. Studies consider how sexual risk-taking responds to economic incentives (Cooper et al., 2017; Luke, 2006, 2008; Packel et al., 2018; Robinson and Yeh, 2011). Related studies have considered behavioral responses to public health campaigns and public testing designed to prevent the spread of STIs (see e.g. Auld, 2003; Kremer, 1996; Philipson and Posner, 1995).

We also contribute to the literature that has considered the relationship between incentivized measures of risk preferences and risky health behaviors (Anderson and Mellor, 2008) and the stability of risk preference within subjects by comparing measures obtained from an economics experiment with real monetary rewards and a survey with questions on hypothetical gambles (Anderson and Mellor, 2009). Other studies have considered incentivized and questionnaire measures of risk attitudes in the context of risk-taking in the lab (Lönnqvist et al., 2015); however, a limitation of the applicability of such studies is evidence that risk-taking behavior in the lab often is not reflective of risk-taking in real life (Verschoor et al., 2016). There are no studies in the economic epidemiology literature on sex workers, or in other fields, which consider the relative performance of incentivized measures and survey-based measures of risk preferences in estimating the risky decisions that individuals make in their jobs. Our findings are the first to demonstrate that survey measures of health risk attitudes are better at identifying the risky decisions that individuals make in their jobs than either incentivized measures or survey measures of financial risk preferences.

Our findings suggest that a simple survey measure can yield a meaningful measure of individual specific attitudes to risk, which map into actual labor market choices that individuals make in jobs with high stakes for their health. Our findings are important because they indicate that behaviorally valid attitudes to risk can be collected using surveys that are relatively cheap to administer and easy to analyze. This result is consistent with the findings in Dohmen et al. (2011), who also find that surveys can accurately measure risk preferences. However, it also extends the result in that study to show this is valid both for self-reported health risk behavior and self-reported illicit drug use and that survey measures of risk preferences map to how people behave on-the-job in occupations that involve high-risks to their health.

## 2. Method

### 2.1. Survey

Female sex workers are legally allowed to engage in commercial sex

work in licensed brothels regulated by local authorities in a few areas in Bangladesh. Brothels are typically made up of groups of buildings, consisting of a large number of small rented rooms. Some of these brothels are estimated to house thousands of active sex workers. We use data from two waves of a survey, which we administered jointly with two local NGOs, PIACT Bangladesh and GDRI. The first wave includes 1332 female sex workers randomly selected from eight brothels across six districts in Bangladesh. The second wave includes 1185 female sex workers, from among those who participated in the first wave. The first wave survey was conducted between February and April 2016, while the second wave survey was conducted between October and November 2016. The study was approved by the Human Research Ethics Committee at Monash University (Australia) (MUHREC Human Ethics Certificate of Approval # CF13/3517 - 2013001769).

The second wave survey was administered to the same group of female sex workers who participated in the first wave survey. A total of 147 female sex workers could not be located for the second wave. There is generally a high turnover of sex workers in brothels. Additionally, sex workers tend to relocate among brothels frequently. The attrition rate of 11 percent is considered low given the circumstances in the sex work industry in Bangladesh. Note, however, that our results are not influenced by such attrition. The survey collects information related to sex workers' demographic characteristics, education, physical attractiveness, business hours and income, experience with abuse and violence, borrowing and lending networks, last three business transactions, expenditure, drug use and health behavior, life satisfaction and well-being, personality traits, risk attitudes, cognitive skills and health knowledge.

We use survey questions related to self-reported risk attitudes and their past three business transactions. Sex workers reported their risk tolerance in general, in financial matters and in health. The survey questions and response categories for risk tolerance are framed similar to the German Socio-Economic Panel and Dohmen et al. (2011), in which respondents are asked to answer on a scale from 0 to 10, where the value 0 means: 'not at all willing to take risks' (risk-averse) and the value 10 means: 'very willing to take risks' (risk-prone). We divide these variables by 10 to code measures of overall risk tolerance, financial risk tolerance and health risk tolerance. For each of their past three transactions, sex workers reported the nature of the sexual act (e.g. anal sex, hand relief, oral sex, vaginal sex, kissing or companionship/talking), total amount of money received before, and after, the sexual act, whether a condom was used, if so who initiated the condom use and information about the client, including whether he was suspected to be STI-positive, whether he was a regular, his age, educational attainment, wealth, cleanliness, attractiveness and personality. Note that the types of sexual act sex workers perform in each transaction are not mutually exclusive. Thus, the one transaction, might, for example, involve both kissing and penetration sex. Overall, 99.8 percent of the transactions involve penetration sex (i.e., vaginal, anal, or oral).

The survey also collects information related to three out of the five risky health behaviors (cigarette smoking, alcohol consumption and being obese), examined in Anderson and Mellor (2008). The other two risky health behaviors; namely, seat belt non-use and driving over the speed limit, which Anderson and Mellor (2008) consider, do not apply to most Bangladeshi women. Seat belts are often not available in the passenger seat and women generally do not drive in Bangladesh. Information about illicit drug use (cannabis, heroin, oradexon, phensidyl and yaba) is also collected. For each of these risky health behaviors, we create a dummy variable set equal to 1, if, respectively, the sex worker is smoking cigarettes, consuming alcohol, taking illicit drugs or is obese (i.e., BMI > 30) at the time of the survey. Following studies such as Anderson and Mellor (2008), we use these risky health behaviors as proxies for risk attitudes in the supplementary analysis reported in Section 3.3 below.

2.2. Summary statistics

Tables A1 and A2, in the online appendix, provides summary statistics and definitions of the key variables. The mean age of sex workers in our sample is 25.5 years old. A sex worker has, on average, 2.3 years of education. The average BMI is about 25, and 14 percent are obese. On average, sex workers' self-reported risk tolerance is low; they rated their health risk tolerance to be 3.4 and their financial risk tolerance to be 4.2 on a scale of 0–10. A sizable number of sex workers have had some experience with risky health behaviors. For example, 41 percent have smoked cigarettes, 26 percent have consumed alcohol and 17 percent have used illicit drugs. On average, sex workers answered correctly two out of three questions regarding the transmission and prevention of STIs. They estimated that 27 out of 100 clients in the brothel are STI-positive and rated their own likelihood of being STI-positive to be 1.7 out of 10. The bottom panel of Table A1 reports variables related to sex workers' past three transactions. Roughly 11 percent of these transactions involve unprotected sex. The average transaction price is roughly 357 Taka (US\$4.6). The average price of protected sex is roughly 347 Taka (US\$4.5), while the average price of unprotected sex is roughly 436 Taka (US\$5.6). The premium associated with unprotected sex is, thus, approximately 22 percent, while 34 percent of these transactions involve a regular client (someone who had visited at least twice before). Less than 1 percent of these transactions involve anal sex. Interestingly, the client is suspected to be STI-positive in 27 percent of these transactions, which coincides with the average (beliefs) estimated STI rates of brothel clients (27 percent).

2.3. Experiment to elicit risk preferences

In addition to responding to survey questions, sex workers also participated in a simple incentivized lottery game designed to elicit their financial risk preferences. All respondents who participated in the lottery choice game were paid in cash according to the realized payoffs and the cash payments were made immediately following the conclusion of the lottery game. The average payment was 232 Taka and approximately 42 percent of sex workers received 350 Taka or more.

In the lottery game, sex workers were asked to choose the option that they favored among six options, similar to the game proposed by Eckel and Grossman (2002) and that used in Dave et al. (2010) and Eckel and Grossman (2008). Option 1 guarantees a payment of 100 Taka, while options 2 to 6 involved a coin toss giving an outcome of heads or tails with 50-50 chance. The degree of riskiness of each lottery option increased in ascending order, with option 6 being the riskiest. Sex workers were shown pictures of the total amount of money involved in each option (see Appendix 2). As discussed in Charness et al. (2013), various experimental methods exist to elicit risk preferences, ranging from the simple to the complex. While one method is not necessarily 'better' than any other method, the method that is preferable in the circumstances often turns on the characteristics of the sample. Charness et al. (2013) and Dave et al. (2010) suggest that a simple method is preferable in circumstances in which participants may find it difficult to understand a more complex game. We utilize this particular lottery game, as opposed to a more complex game, such as that used in Holt and Laury (2002), because it is a relatively simple lottery game, making it easy for sex workers to comprehend.

We use two different methods to derive incentivized measures of financial risk preferences from the lottery game. First, we label a sex worker as risk loving (=1) if she selected the riskiest lottery option (option 6), and zero otherwise. The advantage of this approach is that we make no assumption about the sex worker's utility function. We also calculate the coefficient of relative risk aversion (CRRA) parameters for each sex worker by assuming that she has a constant relative risk aversion utility function:

**Table 1**  
Payoffs and constant relative risk aversion (CRRA) coefficient of lottery game.

Lottery game option	Frequency	Share (%)	Low payoff	High payoff	CRRA coefficient
1	91	6.83	100	100	$3.75 \leq \rho \leq \infty$
2	168	12.61	80	200	$1.47 \leq \rho \leq 3.75$
3	118	8.86	70	250	$1.12 \leq \rho \leq 1.47$
4	162	12.16	60	300	$1.00 \leq \rho \leq 1.12$
5	314	23.57	50	350	$0 \leq \rho \leq 1.00$
6	479	35.96	0	400	$-\infty \leq \rho \leq 0$

Notes: We use the log of the lower bound CRRA coefficient to code a measure of risk preference. As the CRRA lower bound coefficient values for option 5 and option 6 are 0 and  $-\infty$ , we set the lower bound value to 0.1 for option 5 and 0.00001 for option 6. We also code a lottery risk loving dummy variable using option 6.

$$U(Y) = \frac{Y^{1-\rho}}{1-\rho}$$

where  $\rho$  is the CRRA coefficient and  $Y$  is the lottery payoff. We use the log of the lower bound CRRA coefficient as a measure of risk preference. As the CRRA lower bound coefficient values for option 5 and option 6 are 0 and  $-\infty$ , we set the lower bound value to 0.1 for option 5 and 0.00001 for option 6.

Table 1 shows the corresponding payoffs for all six lottery game options, the proportion of sex workers selecting each lottery option and the range of CRRA coefficient values for each lottery option. Almost half of our sample selected either option 5 or 6, which contrasts with the lower risk behavior observed among subjects in similar risk games conducted in other studies (e.g. Barr and Genicot, 2008).

Sex workers appear to have a high level of financial risk tolerance in the sample. As such, one may be concerned that they did not take the task seriously. However, the payoffs in option 5 and option 6 are quite significant in the Bangladeshi context. For example, the payoff in options 5 and 6 is roughly the average transaction price of protected sex. Given that an average sex worker sees roughly three clients per day and spends approximately 30 min with each client, what she can earn from participation in the quick lottery game is fairly sizable. If we compare the payoffs to the average daily wage in Bangladesh, which was about 200 Taka at the time of the survey, then the stakes involved with options 5 and 6 are large. In this light, the sex workers had every reason to take the lottery game very seriously.

2.4. Issues concerning risk preferences using survey

There are three potential shortcomings with our survey data. First, one potential concern with eliciting many of these risky health behaviors, especially about unprotected sex, through surveying is that respondents might underreport them because of social desirability concern. While we cannot completely rule out such possibility, we believe that concern with social desirability is not likely to be significant in the Bangladeshi sex worker context. If sex workers are concerned about admitting having unprotected sex, then we would expect that their self-reported belief about own STI positive status to be much lower than the actual rate of STI positive status. This is not the case. We collected the urine sample of approximately 200 sex workers, who were randomly selected at two brothel sites, several weeks after each round of the survey to test for Chlamydia and Gonorrhoeae. In this subsample, approximately 17.5 percent of sex workers believed that they were STI positive at baseline, while the actual rate of STI was just 12 percent in the first round and 9 percent in the second round of the STI test.

The second potential concern is that we do not focus on more objective measures of risky sex behaviors, such as actual STI status. As we have data on STI status and also unprotected sex transactions for approximately 200 sex workers, we were, however, able to examine the correlation between these two indicators for this subsample. The

correlation between being STI positive and the unprotected sex transaction indicator for this small sample of sex workers was only 0.04 ( $p < 0.15$ ). Several reasons may explain this weak positive correlation. One consideration is that the sample is quite small, so we have low statistical power to detect any significant relationship if it exists. Another factor is that not all unprotected sex will necessarily lead to STIs when the actual rate of STIs is low. A third consideration is that sex workers might receive medical treatment between the survey and biomarker collection. Finally, the reliability of any urine test will never be 100% accurate.

A third potential limitation is that because sex workers answered questions about unprotected sex and a range of other risky health behaviors and conditions before they responded to the risk tolerance questions, it is possible that the subjects may have unintentionally been primed to associate sex behaviors with health risk. Although we are interested in the relative performance of the various measures of risks and any potential priming effect that exists may apply to both financial and health risk measures, we cannot test for its presence and rule it out because we did not randomize the order in which we asked the various questions and implemented the incentivized lottery game.

### 3. Empirical specifications and results

#### 3.1. Pair-wise correlations of measures of risk preferences

We report the pairwise correlations between health risk tolerance, financial risk tolerance and various measures of risk preferences in Table A3 in the online appendix. Based on previous findings by Anderson and Mellor (2008), we expect both incentivized measures, and survey-based measures, to be significantly positively correlated. Table A3 shows that health risk tolerance is correlated with financial risk tolerance and that both health risk tolerance and financial risk tolerance are positively correlated with cigarette smoking, alcohol use and drug use, but not obesity. Mirroring the findings in Anderson and Mellor (2008), the measures derived from the incentivized lottery game are significantly correlated with cigarette smoking, alcohol consumption, obesity, and financial risk tolerance.

Overall, most of our measures of risk preferences, whether incentivized, or survey-based, are significantly correlated in the expected directions. This result indicates that they accurately capture aspects of risk preferences and are not just noise.

#### 3.2. Risk preferences, and risky transactions

Although our measures capture aspects of risk preferences and are correlated in the expected direction, some may better reflect individuals' actual risk preferences when performing their jobs. Thus, we estimate the following OLS specification to further examine the effectiveness of various measures of risk preferences in predicting risk taking decisions:

$$Unsafe_{ijt} = \beta_0 + \beta_1 Risk_i + \beta_2 STI_{jt} + \delta' X_{ijt} + Wave_t + \varepsilon_{ijt} \quad (1)$$

The outcome variable,  $Unsafe_{ijt}$ , indicates whether sex worker  $i$  engaged in an unprotected sexual transaction or not with client  $j$  in survey wave  $t$ . Note that because we use two waves of surveys, and each survey collects information about the last three transactions, there are six transactions per sex worker. The explanatory variables of interest are  $Risk_i$  and  $STI_{jt}$ . The variable  $Risk_i$  is a measure of sex worker  $i$ 's risk tolerance. With the exception of the CRRRA coefficient, all measures of risk preferences considered are increasing in the level of tolerance.  $STI_{jt}$  is a dummy variable indicating whether sex worker  $i$  suspected client  $j$  in transaction  $t$  to be STI-positive.  $Wave_t$  is a dummy variable to capture the survey wave effect.  $X_{ijt}$  is a set of control variables that capture characteristics of the sex worker, the client and the transaction. The error term is  $\varepsilon_{ijt}$ . We basically pool the last three transactions of all sex

workers from the two survey waves and treat each transaction of each sex worker as a separate observation. The standard errors are clustered at the sex worker level.

In equation (1), we expect  $\beta_1 > 0$  and  $\beta_2 < 0$ . The first relationship informs us whether the likelihood of engaging in unprotected sex is higher for a more risk-loving sex worker than a less risk-loving sex worker. Good measures of risk preferences should produce estimates consistent with this relationship. The second relationship informs us whether the likelihood of engaging in unprotected sex decreases when the risk of being infected with STI increases.

In addition to having appropriate measures of risk preferences, a major empirical challenge in identifying these relationships is whether the riskiness of a particular client is exogenous to the risk preference of the sex worker. When clients and sex workers sort by risk preferences, this condition is likely to be violated and, in the presence of positive sorting, the OLS estimator is likely to overestimate the positive relationship between risk preferences and unprotected sex. Specifically, risk tolerant sex workers are more willing to have unprotected sex for a given price, while risk seeking clients are probably more likely to request unprotected sex. As a result, the risk preferences of clients are potentially captured by the risk preferences of the sex workers due to sorting. For our purposes, however, it is arguable that this is less of a concern as we are interested in the relative performance of various measures of risk preferences. As long as the extent of bias due to sorting is similar across the different measures of risk preferences under examination, our conclusion regarding the relative performance of various measures of risk preferences should be robust to this type of bias.

The control variables included should help mitigate the bias in coefficient estimates due to sorting. For example, we include the sex worker's self-belief as to her own likelihood of being STI-positive as an additional control variable. We expect the inclusion of this variable to reduce the bias due to positive sorting. Given that STI positive sex workers are more likely to be the risk tolerant type and are also more likely to engage in unprotected sex, the inclusion of this control variable reduces the positive correlation between the risk preference measure and the error term. Furthermore, we also include characteristics of clients and sex workers that are likely to be correlated with their risk preferences and STI status, such as the sex worker's knowledge of the STI transmission mechanism and prevention strategies, the client's education level, the client's wealth, the client's physical attractiveness, the client's personality, the client's cleanliness and the nature of sexual services involved in the transaction.

An alternative approach is to exploit the repeated observations per person across the two survey waves to extract information about sex workers' choices about risky sexual transactions, rather than assuming the individual-specific effect as a random variable as in the OLS specification. However, each sex worker played the incentivized lottery game only once, which was at the time of the first wave of the survey. Hence, our measures of risk preferences do not vary from one survey wave to another. Therefore, we adopt a fixed effect approach similar to that employed by Hirsch and Schumacher (2005) and Epstein and Nicholson (2009), using a two-stage estimation strategy. In the first stage, we run the following regression separately for each survey wave  $t$ :

$$Unsafe_{ij} = \alpha_i + \lambda' C_j + u_{ij} \quad (2)$$

We include a set of individual (sex worker) fixed effects  $\alpha_i$  in equation (2), as well as a set of client and transaction characteristics,  $C$ , as control variables, because unprotected sexual transactions and client characteristics vary from transaction to transaction. After estimating equation (2) separately for each survey wave, we obtain a set of estimated fixed effect parameters,  $\hat{\alpha}_{it}$  for the two survey waves and estimate the following second stage regression:

$$\hat{\alpha}_{it} = \beta_0 + \beta_1 Risk_i + \delta' Z_{it} + Wave_t + \varepsilon_{it} \quad (3)$$

As in the case of OLS, we also expect  $\beta_1 > 0$  here. Because the fixed

**Table 2**  
The relationship between risk preferences and unprotected sexual transactions.

	(1) Health risk tolerance	(2) Financial risk tolerance	(3) Lottery risk loving	(4) CRRA (risk aversion)
<i>A. OLS estimates</i>				
Risk preference (β <sub>1</sub> )	0.101*** (0.020)	-0.006 (0.018)	-0.011 (0.010)	0.001 (0.001)
STI-positive client (β <sub>2</sub> )	-0.050*** (0.010)	-0.046*** (0.010)	-0.046*** (0.010)	-0.046*** (0.010)
Belief of own STI status	0.040* (0.023)	0.058*** (0.022)	0.058*** (0.022)	0.058*** (0.022)
STI knowledge score	-0.007 (0.006)	-0.011* (0.006)	-0.011* (0.006)	-0.010 (0.006)
Client is well educated	-0.030*** (0.009)	-0.027*** (0.009)	-0.027*** (0.009)	-0.027*** (0.009)
Client is wealthy	0.020* (0.010)	0.020* (0.010)	0.020** (0.010)	0.021** (0.010)
Client is clean	0.038*** (0.014)	0.033** (0.014)	0.033** (0.014)	0.033** (0.014)
Client has likeable personality	0.013 (0.009)	0.014 (0.009)	0.014 (0.009)	0.014 (0.009)
Client is attractive	-0.009 (0.010)	-0.012 (0.010)	-0.013 (0.010)	-0.013 (0.010)
Client is regular	0.042*** (0.010)	0.041*** (0.010)	0.041*** (0.010)	0.040*** (0.010)
Anal sex is involved	0.197** (0.099)	0.209** (0.099)	0.208** (0.099)	0.207** (0.099)
R-squared	0.022	0.015	0.015	0.015
<i>B. Fixed effect estimates</i>				
Risk preference (β <sub>1</sub> )	0.122*** (0.020)	-0.001 (0.019)	-0.017* (0.010)	0.002** (0.001)
Belief of own STI status	0.027 (0.022)	0.044** (0.022)	0.044** (0.022)	0.044** (0.022)
STI knowledge score	-0.019*** (0.006)	-0.025*** (0.006)	-0.024*** (0.006)	-0.024*** (0.006)
R-squared	0.036	0.019	0.020	0.021

Notes: The dependent variable is unprotected sexual transactions. Each column reports a different measure of risk preference used as the key explanatory variable. The sample includes 1332 sex workers in the first wave survey and 1185 sex workers in the second wave survey, each of whom reported the past three transactions for a total of 7470 observations (27 sex workers in the second wave reported zero past transactions). All OLS specifications include a constant term and a survey wave dummy. STI-positive client is a dummy variable indicating whether the client is suspected to be STI-positive. The fixed effect estimates are based on a two-stage approach as described in the text; the second stage includes a constant term but the constant estimates are omitted here. The second stage is estimated using generalized least squares, where the weight for each sex-worker-wave observation is based on the standard error of the estimated fixed effect in the first stage. With the exception of column (4), in which the coefficient of constant relative risk aversion is used to measure the degree of risk aversion, the variable risk preference is increasing in the sex worker's preference for risk. Robust standard errors reported in parentheses are clustered at the sex worker level. \*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1.

effect parameter is capturing the individual-specific component of the tendency to engage in unprotected sexual transactions, we expect more risk tolerant sex workers to have a greater tendency to engage in unprotected sex. In addition to the risk measure, we include other characteristics of sex workers, Z, which may vary across survey waves, and also a survey wave dummy. To account for heteroskedasticity arising from the fixed effect coefficients estimated in the first stage, we estimate equation (3) using generalized least squares, where the weight for each sex-worker-wave observation increases with the precision of the coefficient from equation (2).

Panel A of Table 2 reports the estimates based on the OLS specification (equation (1)) that includes control variables to address potential positive sorting between sex workers and clients. The results suggest that the perceived health risk of a client has a stronger negative effect on the likelihood of a sex worker engaging in unprotected sex. The likelihood of engaging in unprotected sex decreases by approximately 5

percentage points when a client is suspected to be STI-positive and all estimates are significant at the 1 percent level. The estimated effect of risk preference on the likelihood of engaging in unprotected sex, and its statistical significance, are fairly sensitive to the measures of risk preference used. Health risk tolerance is the only measure that is positively correlated with unprotected sex and statistically significant at the 1 percent level. The financial risk tolerance measure has the opposite sign, but is not statistically significant. The measures of risk preferences derived from the incentivized lottery game have the opposite sign. In particular, the lottery risk taking indicator has a negative coefficient and the CRRA parameter has a positive coefficient, but neither is statistically significant at the 10 percent level. These estimates signify the possibility that the risk attitudes derived from the lottery game are not a good measure of health risk preferences, and are therefore unable to produce estimates consistent with theoretical predictions.

Panel A of Table 2 also reveals some other interesting correlations. Sex workers who have a stronger belief about their own STI status being positive are significantly more likely to engage in unprotected sex. Better educated clients are somewhat less likely to engage in unprotected sex. Sex workers are more likely to engage in unprotected sex when anal sex is involved. These results suggest the importance of knowledge and education in risky health behaviors. Sex workers are significantly more likely to engage in unprotected sex when they consider the clients to be wealthy or clean, or when the client visits them regularly. These results indicate that whether sex workers engage in risky sex with clients can be influenced by characteristics of their clients that have nothing to do with the actual health risk that they pose to the sex workers.

How important is the influence of a sex worker's health risk tolerance on her likelihood of engaging in unprotected sex, relative to the influence of other factors that are also significant in predicting her likelihood of engaging in unprotected sex? For every one standard deviation (i.e., 0.26 according to Table A1) increase in her health risk tolerance, the model predicts that the likelihood of a sex worker engaging in unprotected sex increases by 2.6 percentage points. Among other factors, those with the strongest association with a sex worker's likelihood of engaging in unprotected sex are whether a client is suspected to be STI-positive and whether a client is a regular or not. For every one standard deviation (i.e., 0.45 according to Table A1) increase in the probability that a client is suspected to be STI-positive, the model predicts that the likelihood that a sex worker engages in unprotected sex decreases by 2.2 percentage points. For every one standard deviation (i.e., 0.47 according to Table A1) increase in the probability that a client is a regular, the model predicts that the likelihood of a sex worker engaging in unprotected sex increases by 2 percentage points. In sum, the association between the sex worker's own health risk preference and the likelihood that she engages in unprotected sex is stronger than either the association between her client's traits, whether the client is a regular and her belief about her own STI status and the likelihood that she engages in unprotected sex.

Panel B of Table 2 reports the estimates based on the two-stage fixed effect approach (equation (3)). The patterns shown in panel B of Table 2 are similar to those shown in panel A of Table 2. Health risk tolerance is the only measure that is positively correlated with unprotected sex, which is statistically significant at the 1 percent level. The fixed effect estimate for the coefficient of health risk tolerance is slightly larger in magnitude than the OLS estimate reported in panel A of Table 2. For every one standard deviation (i.e., 0.26 according to Table A1) increase in her health risk tolerance, the model predicts that the likelihood of a sex worker engaging in unprotected sex increases by 3.2 percentage points. In comparison, changes in a sex worker's knowledge about STI do not predict her likelihood of engaging in unprotected sex as well. For every one standard deviation (i.e., 0.8 according to Table A1) increase in her STI knowledge score, the model predicts that the likelihood of a sex worker engaging in unprotected sex decreases by 1.5 percentage points. Financial risk tolerance is not statistically significant.

The measures of risk preferences derived from the incentivized lottery game have an unexpected sign and are statistically significant at the 5%–10% level. We speculate that the reason why the sign is opposite to what is expected is that sex workers who take greater health risks at work through engaging in a higher number of unprotected sexual transactions have, on average, a lower income target. In our sample, the income target decreases by roughly 140 Taka ( $p < 0.000$ ), on average, for sex workers with one more unprotected sexual transaction taken at baseline. Differences in income targets across sex workers with varying degrees of health risk tolerance may help explain why a sex worker's financial risk-taking behavior in the incentivized game is negatively related with her unprotected sexual transactions, while her self-reported health risk tolerance is positively correlated with her unprotected sexual transactions. Specifically, sex workers who are more health risk tolerant could reach their income target relatively easily by taking the safe lottery option of guaranteed 100 Taka. In contrast, sex workers who are less health risk tolerant were confronted with the uncertainty associated with waiting for one more safe sex transaction to make an extra 347 Taka or taking the risky lottery option immediately with a 50 percent chance of making 400 Taka to realize their much higher income target. Overall, our findings indicate that health risk tolerance is a better measure of sex workers' occupational health risk taking behavior than measures of their financial risk attitudes in a wage-compensating setting.

### 3.3. Other risky health behaviors as proxies for risk attitudes

Since past studies also consider other non-work-related risky health behaviors as proxy measures of risk attitudes, we also examine how well cigarette smoking, alcohol consumption, being obese and illicit drug use measure sex workers' occupational health risk taking behaviors, relative to the health risk tolerance measure.

Analyzing the relationship between unprotected sexual transactions and these risky health behaviors also serve as an additional check on the extent of bias due to misreporting in the data, even though we have argued that concern about social desirability is less likely to be a significant problem in the Bangladeshi sex worker context. Unlike the 0–10 scale health risk tolerance measure, these risky health behavior measures are more likely to be misreported (underreported) if social desirability is a concern. Because unprotected sex is our outcome measure of interest, the extent of underreporting is essentially a regression error term. When the key explanatory variable of interest is another risky health behavior, then the same type of social desirability concern that might influence the underreporting of unprotected sexual transactions might also influence the underreporting of this risky health behavior.

We expect the issue of social desirability to be more acute with respect to behavior that is socially sanctioned. A good example of such socially sanctioned behavior is alcohol consumption, which the Muslim faith prohibits. If we see unprotected sexual transactions to be more strongly correlated with alcohol use than with cigarette smoking, illicit drug use or general health risk tolerance, then it is more likely that misreporting bias is present.

Columns 1 to 4 in Table 3 present the relationship between unprotected sexual transactions and each of the four risky health behaviors. Panel A reports estimates based on the OLS specification while panel B reports estimates based on the two-stage fixed effect approach. Only illicit drug use shows a positive and statistically significant relationship with unprotected sexual transactions. Cigarette smoking, alcohol consumption, and obesity are not statistically related with the likelihood of engaging in unprotected sex at conventional levels of statistical significance. Given that alcohol use is not significantly correlated with unprotected sexual transactions, while illicit drug use and health risk tolerance are, misreporting bias due to social desirability concern is likely to be negligible in this context.

Our findings indicate that both general health risk tolerance and

**Table 3**

The relationship between unprotected sexual transactions and other risky health behaviors.

	(1) Cigarette smoking	(2) Alcohol Use	(3) Drug use	(4) Obese	(5) Health risk tolerance
<i>A. OLS estimates</i>					
Risk behavior ( $\beta_1$ )	−0.003 (0.010)	0.005 (0.010)	0.031*** (0.011)	0.007 (0.015)	0.057*** (0.021)
R-squared	0.015	0.015	0.017	0.015	0.019
Observations	7470	7470	7470	7470	4818
Sample	Full	Full	Full	Full	Non-drug use
<i>B. Fixed effect estimates</i>					
Risk behavior ( $\beta_1$ )	−0.001 (0.011)	0.009 (0.011)	0.034*** (0.011)	0.007 (0.016)	0.070*** (0.022)
R-squared	0.019	0.019	0.024	0.019	0.014
Observations	2488	2488	2488	2488	1604
Sample	Full	Full	Full	Full	Non-drug use

Notes: See notes to Table 2.

drug use predict greater likelihood of unprotected sex. It is plausible to think that drug users are more likely to acknowledge that they have a high tolerance for risk in the health domain. If this is the case, this potentially qualifies our conclusions: drug users, probably because they need money to satisfy their addiction or because their drug use attenuates their perceptions of the risks or diminishes their will power or agency, are more willing to engage in risky sexual transactions. Given the plausibility of this argument, we further restrict the sample to non-drug users to re-estimate the relationship between unprotected sexual transactions and health risk tolerance and report the results in column 5 in Table 3. The coefficient on health risk tolerance diminishes relative to that in column 1 Table 2, but it remains statistically significant and positive at the 1 percent level. Thus, our findings that general health risk tolerance predicts greater likelihood of unprotected sex also apply to non-drug users.

### 3.4. Robustness

We perform a set of robustness tests in this section. First, we check if main results are sensitive to excluding sex workers who dropped out of the survey in the second wave. Panel A of Table A4 in the online appendix, shows that the results are similar to those in Table 2. Second, we exclude the variable measuring whether the sex worker thinks that her client is STI-positive and re-estimate the relationship between unprotected sex and risk tolerance. Panel B of Table A4 shows that our results are robust to excluding from our regressions the variable relating to sex workers' perception about the riskiness of clients. The effect size and significance of our risk measures are generally similar to those in Table 2. Third, we also consider an alternative measure of risky sex by defining an indicator that takes the value of one if a sex worker engages in unprotected sex and the client is suspected as STI positive. We estimate the relationship between this definition of risky sex transaction and each of the risk measures and report the results in panel C of Table A4. Our main conclusion with respect to financial risk and health risk tolerance remains unchanged. The correlation between risky sex transaction and general health risk tolerance is positive and statistically significant at the 1 percent level, while financial risk tolerance and measures based on the incentivized lottery game have the wrong sign.

Lastly, we also estimated regressions in which price charge is used as the dependent variable for the sample of encounters involving unprotected sexual transactions (panel D of Table A4). If we use pooled OLS regression that includes all the control variables, we find a negative coefficient for health risk tolerance which is marginally statistically significant ( $p < 0.18$ ), while the coefficient for each of the financial risk measures is not statistically significant ( $p > 0.62$ ). However, if we use the fixed effect approach and restrict the sample to encounters

involving unprotected sex only, we also find a negative coefficient for health risk tolerance, but the  $p$  value is much higher ( $p=0.241$ ). The coefficient for the financial risk measures have the opposite sign to what is expected and none of them are statistically significant at the 10 percent level. One possible explanation for the lack of statistical significance is that the variation in prices across transactions is much smaller than the variation in unprotected sex encounters across transactions. The other possible explanation is that the market is highly competitive, meaning that demand is very price elastic. Overall, the signs and magnitudes of the coefficients of our main results are still comparable if the sample is restricted to only those encounters involving unprotected sex and the outcome is the price charged.

#### 4. Conclusion

We find that financial risk attitudes of sex workers, whether self-reported or elicited from an incentivized lottery game, are unable to predict the risky sexual transactions of sex workers. By contrast, self-reported health risk attitude and self-reported illicit drug use behaviors predict the risky sexual transactions of sex workers. Our findings imply that risk preferences are potentially domain specific and that financial and health risk preferences may not closely align. Another implication of our finding is that self-reported attitudes to risk with respect to health behavior and illicit drug use collected in surveys can be a behaviorally valid representation of attitudes to risk when mapped to how people behave in jobs with high risks to health.

One potential limitation of the study is that the dependent variable is a self-report of engaging in unprotected sexual transactions and self-reports in the sexual domain are known to be potentially unreliable and suffer from social desirability bias. This also affects many of the risk measures (with the exception of the incentivized lottery). Our analysis suggests that social desirability bias is likely to not be a significant issue in our context. A second limitation is that we asked respondents questions about their attitudes towards risk after they answered questions about unprotected sex, a range of other risky health behaviors, and financial decisions. The way in which we ordered the questions might have primed sex workers to think about their risk attitudes, leading to stronger estimated effects. A third limitation in terms of generalizing our results is that the sample is composed of female sex workers, individuals who have one way or another ended up working in a risky environment. Clearly, this is a very different sample than the general population and might, for example, explain the larger fraction choosing the two riskier lottery options 5 and 6 (close to 60 percent).

This said, sex work is an issue of major public health and safety concern in many countries. This is not only because of the risk that clients face in contracting STIs and then infecting other sexual partners, but, above all, because sex workers constitute a vulnerable population. As such, sex work represents an important market that is of special interest to policymakers (Evans et al., 2010). There are many individuals from low socio-economic backgrounds who may be similarly prone to engage in risky sex behaviors or other high-risk behaviors that pose the same public health concerns and equally require policy intervention.

Our primary interest in this study was to understand how measures of health risk differ from various measures of financial risk in informing us about the risky sex behaviors of sex workers. Because there are no incentivized measures of health risk in the literature, we thought it natural to include survey measures that many other studies have used. An alternative design that could be used in future research would be to incorporate the same lottery game, but with hypothetical payoffs among a random subset of participants to further allow an examination of the relative performance of the incentivized financial risk measure and non-incentivized financial risk measure that are identical with the exception of the hypothetical and real payoffs. Such a design would address the question of whether questions about hypothetical lotteries will measure financial risk attitudes as well as incentivized lotteries.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2019.112497>.

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