Effects of Sex Work on the Prevalence of Syphilis Among Injection Drug Users in 3 Russian Cities

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Objectives. We examined risk factors for syphilis infection among injection drug users in 3 Russian Federation cities, focusing particular attention on the potential roles of gender and sex work.

Methods. We conducted a cross-sectional survey of injection drug users in Moscow, Volgograd, and Barnaul, collecting behavioral data and testing for antibodies to *Treponema pallidum*. Associations between presence of antibodies to *T pallidum* and covariates were explored.

Results. Overall, the prevalence of antibodies to *T pallidum* was 11% (95% confidence interval = 9.7%, 13.1%). Syphilis was associated with involvement in sex work and with gender in Moscow and Barnaul but not in Volgograd. Female injection drug users not involved in sex work were more likely than men to be younger and to have recently begun to inject; female injection drug users involved in sex work were more likely than those not involved in sex work to inject daily.

Conclusions. Syphilis transmission dynamics varied by region. Sex work can increase syphilis risk among injection drug users, potentially feeding the momentum of sexually transmitted HIV and syphilis among noninjectors. Targeted interventions are needed to reduce both sexual and injection risk behaviors among injection drug users. (*Am J Public Health.* 2007;97:478–485. doi:10.2105/AJPH.2005.069732)

Since the collapse of the Soviet Union, commercial sex work has become more widespread in the Russian Federation, largely because of adverse effects resulting from the country's economic transition and high unemployment rates.[1] In addition to explicit sex-for-money exchanges, there has been an increase in the number of sexual relationships in which the partners have implicit financial motivations. These changes in the dynamics associated with sexual relationships, which reflect an increasing concentration on and differentials in wealth in Russian society in general and between men and women in particular, have been facilitated by the liberalization of attitudes toward sex in the wider society.[2–4]

There is no legislation governing sex work in the Russian Federation, and it operates in the context of considerable economic uncertainty, with elements of police and other forms of corruption (e.g., on the part of members of other official services). Local police are often involved in its management. It is controlled through prosecuting those involved for other offenses, such as possessing drugs, causing a public nuisance, or lacking an official residency permit. By law, all residents of the Russian Federation must have a residency permit, and residents must present this document to obtain free health care and social services at facilities offering such services.[5,6]

In addition, HIV associated with injection drug use has spread rapidly in Russia.[7–9] If sufficient sexual mixing occurs between injection drug users and their sexual partners, Russia's current HIV epidemic could become less concentrated and more generalized.[10] There is already substantial evidence in Russia indicating a close link between sex work and injection drug use.[11,12] Studies conducted in Moscow and Vilnius suggest that approximately 25% to 30% of female sex workers are also injecting drugs.[13–15] Similarly, 2 studies conducted in St. Petersburg indicate high rates of sex work involvement, between 37% and 50%, among female injection drug users.[16,17] Also, there is some evidence of sexual transmission between injection drug users and their noninjecting sexual partners.[11,16,18,19]

A high population prevalence of sexually transmitted infections (STIs), combined with inadequate treatment of these infections, can facilitate sexual transmission of HIV.[20] Syphilis epidemics have been reported in Russia since the early 1990s[2]; treatment is available through a network of state-provided dermatovenerology clinics, but a lack of confidentiality deters use of these clinics, and there is growing reliance on private clinics among those with the financial means.[2,21]

Data from national surveillance systems involving mandatory notification of new cases suggest that the syphilis incidence rate peaked in 1997 at 275.4 cases per 100 000 population, although it remained high in 2002 at 120.7 per 100 000.[2] There is some evidence to suggest that this decrease in observed incidence rates is more an artifact of changes in treatment-seeking behaviors (i.e., more use of private clinics and self-treatment options) and decreases in active case finding than a true decline in prevalence.[22]

Few cross-sectional studies of STI prevalence rates have been conducted in the Russian Federation as a means of corroborating surveillance data within the general population or within higher risk subpopulations such as injection drug users or sex workers. The limited evidence available indicates that STI prevalences among injection drug users recruited at needle and syringe exchange services range from 12% to 30%.[17,19]

In the absence of reliable estimates, we undertook a multicity cross-sectional survey designed to assess the prevalence of antibodies to *Treponema pallidum,* HIV, and hepatitis C virus (HCV) among injection drug users. Results on the overall prevalences revealed in the survey have been reported elsewhere.[23] The findings described here were derived from additional analyses that explored syphilis and associated risk factors, with a particular

focus on the potential roles of gender and sex work among injection drug users residing in the 3 cities studied.

METHODS

The survey was conducted between September and November 2003 in 3 Russian Federation cities: Moscow (n=455), Volgograd (n=517), and Barnaul (n=501).[23] All of the respondents reported that they had injected drugs in the previous 4 weeks, and all provided oral fluid samples for use in unlinked anonymous HIV, HCV, and syphilis testing.

A team of approximately 12 indigenous field workers recruited participants from nontreatment settings in each city. Field workers made contact with networks of injection drug users known to them and conducted face-to-face individual interviews in community settings; interviews were approximately 40 minutes in duration. Interviews were conducted at street locations, in respondents' homes, and at cafés but not at drug treatment centers or STI clinics. Field workers were current or former drug users, or had worked in the field of drug treatment or harm reduction, and had access to networks of users.

Structured questionnaires involving closed-ended items were developed from existing questionnaires that have been used extensively in multicenter studies conducted in both resource-constrained and developed countries; these questionnaires were pilot tested in Russia before initiation of the survey.[24–26] Participants who had injected within the preceding 4 weeks were categorized as injection drug users, and women who had exchanged anal, vaginal, or oral sex for money or goods within the previous 4 weeks were categorized as having engaged in sex work.

The OraSure device (OraSure Technologies Inc, Bethlehem, Pa) was used to collect oral fluid samples. The Murex ICE syphilis assay (Abbott/Murex, Dartford, England; modified for use with oral fluids by England's Health Protection Agency) was used to test for antibodies to *T pallidum*. Validation work with this assay, which detects primary, secondary, and latent-stage syphilis and past infections, has revealed sensitivity and specificity rates of 86% and 98.6%, respectively (J.V. Parry, written communication, February 2005).

The Oral Fluid Vironostika HIV-1 Microelisa System (bioMérieux Inc, Durham, NC) was used to screen for antibody to HIV (anti-HIV). Specimens reactive after initial testing were subjected to confirmatory testing with modifications of the Adaltis Detect HIV EIA (Biostat Diagnostics, Stockport, Cheshire, England) and HIV Blot 2.2 Western Blot (Abbott-Murex, Abbott Park, Ill) assays. Studies have shown that the Vironostika test's sensitivity and specificity are 99.9% and 99.2%, respectively.[27,28]

We compared gender-specific and sex work–specific risk behaviors using Pearson χ^2 tests (categorical variables) and *t* tests with equal variances (continuous variables). We assessed associations between antibodies to *T pallidum* infection and covariates for the entire sample across the 3 cities combined in both univariate and multiple logistic regression analyses. We determined statistical significance using the likelihood ratio test statistic.

We examined interaction terms between city and variables included in the final model to assess whether predictors of syphilis differed by city. If the *P* value from the likelihood ratio test for the interaction term was less than .01, we explored separate models for each city. Stata version 7 (Stata Corp, College Station, Tex) was used in conducting all of the analyses. In an overall multivariate model, duration of injection and the gender and sex work variables were independently associated with antibodies to *T pallidum* and also interacted with city ($P<.001$), suggesting that predictors of syphilis differed according to city. Therefore, we present univariate and multivariate results separately by city.

We followed a conceptual framework approach in conducting the multivariate analysis.[29] This approach involved classifying variables into 5 groups (sociodemographic indicators, history of drug use, injection risk behaviors, sexual risk behaviors, and environmental risk behaviors), with the analysis conducted in 3 stages. First, separate univariate models were used to explore each of the variables alone. Second, individual variables associated with the outcome variable in the univariate analysis at $P\leq.2$ were included in separate multivariate models for each group. Finally, variables significant at $P\leq.2$ in each of the 5 multivariate models were included in an overall multivariate model.

In addition, variables excluded at the first stage were added in the second- and third-stage models to assess their association with the outcome variable in the presence of other variables. We considered associations with *P* values between .05 and .01 as weak and focused our analyses on associations with *P* values of less than .01.

RESULTS

Sample Characteristics by Gender and Sex Work

Overall, 1473 injection drug users were recruited, of whom 29.5% (n=433) were women. Twenty-four percent (n=104) of female participants had engaged in sex work in the previous 4 weeks. Only 7 men reported having ever exchanged sex for money or goods, and they were excluded from the analyses. Across the sites, a total of 18 injection drug users refused to take part in the study.

Table 1 shows sample characteristics by gender and sex work. First, we compared female injection drug users who were not sex workers ("non–sex workers") with male injection drug users. Non–sex workers were younger than male injection drug users (mean ages of 24.3 and 26.2 years, respectively; $P<.001$), and slightly more had attended college ($P=.02$). Non–sex workers were more likely to be recent initiates into drug injection, having injected for a mean of 5.7 years in comparison with 7.4 years among male injection drug users ($P<.001$). More non–sex workers than male injection drug users reported injecting vint, a "homemade" liquid methamphetamine ($P<.001$). There were no gender-specific differences in injection risk behaviors, with similar proportions of male and female participants reporting that they had injected with used needles or syringes in the previous 4 weeks and that they injected daily.

Male injection drug users were more likely than non–sex workers to report having had 2 or more sexual partners in the previous 12 months ($P<.001$). Non–sex workers were more likely than male injection drug users to report that their sexual partners were also

TABLE 1—Characteristics of Injection Drug Users in 3 Russian Cities, 2003

	Men				Female Non–Sex Workers				Female Sex Workers	
	No.	% or Mean (SD)	χ^2 or *t* Value	*P*[a]	No.	% or Mean (SD)	χ^2 or *t* Value	*P*[a]	No.	% or Mean (SD)
Overall	1037	100			329	100			104	100
Demographic characteristics										
Age, y	1036	26.2 (6.4)		<.001	329	24.3 (5.7)		<.001	104	21.5 (4.3)
No residence permit	48	5.0	0.12	.74	17	5.4	78.1	<.001	41	40.6
Attended college	255	24.8	5.2	.02	102	31.2	15.7	<.001	12	11.5
History of drug use										
Injection drug use duration, y	1035	7.4 (5.6)		<.001	328	5.7 (4.8)		<.001	104	3.7 (3.3)
Drug injected in previous 4 weeks										
Heroin	718	73.6			203	68.4			59	66.3
Vint[b]	165	16.9			76	25.6			27	30.0
Mak[c]	92	9.4	21.4	<.001	18	6.1	1.5	.47	3	3.3
Injection risk behaviors										
Injected with used needles/syringes in previous 4 weeks	135	13.2	1.5	.23	52	15.9	0.01	.92	16	16.3
Injected daily	181	17.6	0.18	.67	54	16.6	12.3	<.001	33	32.4
Sexual risk behaviors										
More than 2 nonpaying sex partners in previous 12 months (all types)	727	71.1	51.0	<.001	158	49.4	7.4	.006	62	65.3
Injection-drug-using sex partner in previous 12 months	465	46.9	61.8	<.001	229	72.2	30.1	<.001	38	41.3
Inconsistent (not every time) use of condom for vaginal sex in past 4 weeks	472	57.0	9.6	.002	177	67.8	15.5	<.001	30	41.7
History of sexually transmitted infection	397	39.0	2.7	.1	109	33.9	13.8	<.001	56	54.4
Environmental risk behaviors										
Treatment for drug use	397	38.5	5.3	.02	103	31.4	0.46	.497	29	27.8
Arrested in past 12 months	561	55.0	56.8	<.001	101	31.0	23.9	<.001	58	58.0
HIV	76	7.8	0.83	.363	29	9.4	0.45	.50	7	7.2
Treponema pallidum	105	10.8	0.33	.57	37	12.0	1.22	.27	16	16.3

Note. χ^2 and *t* tests compared (1) men with women who were sex workers and (2) women who were non–sex workers with women who were sex workers. Numbers do not always correspond with the total sample size because not all participants responded to every question.
[a]Derived from Pearson χ^2 or *t* test with equal variance for continuous variables.
[b]A "homemade" liquid methamphetamine.
[c]A "homemade" liquid derivative of opium poppy straw.

injection drug users (*P*<.001). Male injection drug users were more likely than non–sex workers to report having paid for sex in the past 12 months (*P*<.001) but were less likely to report having engaged in inconsistent (i.e., not 100%) condom use during vaginal sex in the past 4 weeks (*P*=.002). Similar proportions of men and non–sex workers reported STI histories (*P*=.1). More men reported a history of drug treatment (*P*=.02), and more had been arrested in the previous 12 months (*P*<.001). There were no gender-specific differences in anti-HIV (*P*=.36) or *T pallidum* (*P*=.57) prevalences between male injection drug users and non–sex workers.

Second, we compared characteristics of female injection drug users by whether they had engaged in sex work in the previous 4 weeks (Table 1). On average, sex workers were younger than non–sex workers (mean ages of 21.5 and 24.3, respectively; *P*<.001), and they were less likely to have city residency permits (*P*<.001) or to have attended college (*P*<.001). Sex workers were more likely to be recent injection initiates, having injected for a mean of 3.3 years in comparison with 4.8 years among non–sex workers (*P*<.001). There were no differences in primary drug injected in the past 4 weeks (*P*=.47). Similar proportions of sex workers and non–sex workers reported having injected with used needles or syringes in the preceding 4 weeks, but sex workers were more likely to report having injected daily (*P*<.001).

Proportionally more sex workers than non–sex workers reported having had 2 or more nonpaying sexual partners in the previous 12 months (*P*<.01); however, sex workers were less likely than non–sex workers to report having had sexual partners who were injection drug users (*P*<.001), and they were more likely to report always having used a condom with nonpaying sexual partners (*P*<.001). More than half of

sex workers reported having had an STI, compared with approximately one third of non–sex workers ($P<.001$). Similar proportions of sex workers and non–sex workers reported a history of drug treatment ($P=.5$), but sex workers were far more likely to report having been arrested by the police in the previous 12 months ($P<.001$). There were no differences in HIV ($P<.5$) or *T pallidum* ($P=.27$) prevalences between sex workers and non–sex workers.

Characteristics of Sex Workers

Sex workers reported high client turnover rates in the preceding 4 weeks (data not shown). The median number of different clients with whom sex workers had engaged in vaginal sex during this period was 23 (range: 0–200), and the median number of new clients was 20 (range: 0–200). The median number of clients who were also injection drug users was 0 (range: 0–8). All sex workers reported having engaged in vaginal sex with a client, and almost all (95%) reported having used a condom on the most recent occasion.

Sample Characteristics by City

Table 2 presents the characteristics of the sample by city. Across the 3 cities, more than two thirds of the respondents were male, a quarter were female non–sex workers, and fewer than 10% were female sex workers. Similar proportions of respondents in the 3 cities reported injecting daily, injecting with used needles or syringes, ever having had an STI, and having a history of drug treatment. However, higher proportions of the Volgograd and Barnaul participants had been injecting for 2 years or less. Injectors in Moscow and Barnaul (25% and 27%, respectively) were more likely than those in Volgograd (8%) to inject vint, whereas injectors in Barnaul were more likely to inject mak, a "homemade" liquid derivative of opium poppy straw (17%).

Approximately 60% to 70% of respondents in each city reported having had 2 or more sexual partners in the previous 12 months; the percentage of respondents who reported having sexual partners who were also injection drug users varied from 38% in Volgograd to 70% in Moscow. More participants in Volgograd (54%) than in Moscow (27%) or Barnaul (41%) reported always having used condoms during vaginal sex with their nonpaying sexual partners in the preceding 4 weeks. Similarly, a higher percentage of injection drug users in Volgograd (20%) than in the other 2 cities (Moscow, 10%; Barnaul, 13%) reported having paid for sex in the past 12 months. More injection drug users in Moscow (62%) and Volgograd (53%) than in Barnaul (36%) reported having been stopped by the police, but more in Barnaul (34%) than in Moscow (26%) or Volgograd (22%) reported ever having been imprisoned.

Risk Factors for Antibodies to *Treponema pallidum*

Univariate analyses. In the Moscow sample, increased odds of infection with antibodies to *T pallidum* were associated with several factors in the univariate analyses: sex work (odds ratio [OR]=4.4; 95% confidence interval [CI]=1.6, 12.3), injecting vint (OR=2.6; 95% CI=1.2, 5.6), reported STI history (OR=2.0; 95% CI=1.0, 4.0), and ever having been imprisoned (OR=2.2; 95% CI=1.0, 4.5; Table 2). In Volgograd, odds ratios for antibodies to *T pallidum* increased with increasing injection drug use durations. In addition, relative to injection drug users with no history of drug treatment, those with a history of treatment were at twice the odds (OR=2.2; 95% CI=1.4, 3.4) of having antibodies to *T pallidum*.

In Barnaul, the odds ratio for antibodies to *T pallidum* was 3 times higher (95% CI=1.0, 10.4) among sex workers than among men, and the odds ratio was twice as high (95% CI=1.0, 5.4) among non–sex workers as among men. Increased prevalence of antibodies to *T pallidum* was associated with increasing injection drug use durations and age, as well as with daily injection (OR=4.9; 95% CI=2.3, 10.6) and reported STI history (OR=2.2; 95% CI=1.0, 4.8).

Multivariate analyses. Table 3 presents results of the multivariate analyses for the 3 cities separately. In Moscow, the analyses indicated that non–sex workers had more than twice the odds of men of being positive for antibodies to *T pallidum* (OR=2.7; 95% CI=1.2, 6.0), and sex workers were at 5 times the risk (OR=4.9; 95% CI=1.7, 14.2). Injection drug users who had been imprisoned were at an almost 3-times greater risk of having antibodies to syphilis relative to injection drug users who had not been imprisoned (OR=2.6; 95% CI=1.2, 5.6).

In Volgograd, only 1 risk factor remained significantly associated with antibodies to *T pallidum* in the multivariate analyses. Injection drug users with a history of drug treatment had twice the odds of those without such a history of having antibodies to *T pallidum* (OR=2.1; 95% CI=1.3, 3.4). In Barnaul, sex workers had almost 10 times the odds of having antibodies to *T pallidum* as men (95% CI=2.2, 43.6), and non–sex workers had 5 times the odds (95% CI=1.9, 14.2). Odds of antibodies to *T pallidum* also increased with age. Finally, increased odds were associated with injecting daily (OR=3.9; 95% CI=1.7, 8.9) and having been arrested by the police in the previous 12 months (OR=2.5; 95% CI=1.0, 6.4).

DISCUSSION

Our findings suggest that the prevalence of antibodies to *T pallidum* varies among injection drug users in Moscow, Volgograd, and Barnaul and that sex work and gender are independent predictors of prevalences in Moscow and Barnaul. This latter result indicates that, in Moscow and Barnaul, female injection drug users who are both involved and not involved in sex work are at greater risk than male injection drug users of sexual acquisition and transmission of syphilis. This pattern was not repeated in Volgograd, suggesting that syphilis transmission dynamics are also regionally contingent. In addition, our findings showed that female injection drug users were more vulnerable than male users to injection and sexual risk behaviors, primarily because they were younger, more recent injectors; they were less likely to use condoms; and they were more likely to have sexual partners who were injection drug users themselves.

Vulnerability Among Sex Workers

Other studies of injection drug users in Russia have suggested increased STI risks associated with involvement in sex work.[16,17,30] In St. Petersburg, for example,

TABLE 2—Sample Characteristics, by City, and Risk Factors for Antibodies to *Treponema pallidum*: Results of Univariate Analyses

	Moscow			Volgograd			Barnaul		
	No. (%)	*T pallidum* Prevalence, No. (%)	OR (95% CI)	No. (%)	*T pallidum* Prevalence, No. (%)	OR (95% CI)	No. (%)	*T pallidum* Prevalence, No. (%)	OR (95% CI)
Overall	455 (100)	33 8	NA	517 (100)	96 (20)	NA	501 (100)	29 (6)	NA
Demographic characteristics									
Group									
Male	301 (66)	15 (5)	1.0	389 (76)	75 (21)	1.0	347 (69)	14 (4)	1.0
Female non–sex workers	119 (26)	12 (11)	2.0 (0.9, 4.6)	90 (17)	13 (16)	0.7 (0.4, 1.3)	121 (24)	11 (9)	2.4 (1.0, 5.4)
Female sex workers	34 (8)	6 (20)	4.4 (1.6, 12.3)	36 (7)	5 (15)	0.6 (0.2, 1.7)	34 (7)	4 (12)	3.2 (1.0, 10.4)
Age, y									
≤20	62 (14)	5 (9)	1.0	71 (14)	15 (21)	1.0	148 (30)	2 (1)	1.0
21–24	129 (28)	11 (10)	1.1 (0.4, 3.2)	198 (38)	26 (14)	0.6 (0.3, 1.2)	123 (25)	8 (7)	5.1 (1.1, 24.7)
25–29	168 (37)	9 (6)	0.6 (0.2, 1.9)	204 (39)	41 (23)	1.1 (0.6, 2.1)	114 (23)	8 (7)	5.5 (1.2, 26.6)
≥30	96 (21)	8 (9)	1.0 (0.3, 3.2)	44 (9)	14 (35)	2.0 (0.8, 4.7)	116 (23)	11 (10)	7.8 (1.7, 35.8)
Official residency permit									
Yes	363 (87)	7 (15)	1.0	455 (96)	85 (20)	1.0	34 (7)	1 (3)	1.0
No	53 (13)	24 (7)	0.5 (0.2, 1.1)	19 (4)	1 (6)	4.1 (0.5, 31.5)	458 (93)	28 (6)	2.1 (0.3, 16.1)
Attended college									
No	286 (64)	25 (10)	1.0	372 (73)	72 (21)	1.0	434 (87)	28 (7)	1.0
Yes	162 (36)	7 (5)	0.5 (0.2, 1.2)	140 (27)	24 (21)	1.0 (0.6, 1.7)	67 (13)	1 (1)	0.2 (0.0, 1.6)
History of drug use									
Duration of injection, y									
≤2	45 (10)	5 (13)	1.0	101 (20)	9 (10)	1.0	261 (52)	3 (1)	1.0
3–5	104 (23)	7 (7)	0.6 (0.2, 1.9)	186 (36)	33 (19)	2.3 (1.0, 4.9)	240 (48)	26 (11)	10.4 (3.1, 34.8)
6–9	185 (41)	13 (8)	0.6 (0.2, 1.7)	168 (32)	38 (26)	3.3 (1.5, 7.1)	NA	NA	NA
≥10	118 (26)	8 (7)	0.6 (0.2, 1.8)	59 (11)	15 (28)	3.7 (1.5, 9.3)	NA	NA	NA
Primary drug used in past 4 weeks									
Heroin	279 (73)	16 (6)	1.0	424 (87)	85 (22)	1.0	277 (56)	13 (3)	1.0
Vint[a]	96 (25)	13 (15)	2.6 (1.2, 5.6)	37 (8)	6 (18)	0.8 (0.3, 1.9)	135 (27)	7 (5)	1.1 (0.4, 2.8)
Mak[b]	8 (2)	1 (13)	2.1 (0.3, 18.3)	21 (4)	4 (21)	1.0 (0.3, 3.0)	84 (17)	9 (11)	2.5 (1.0, 6.2)
Injection risk behaviors									
Injected with used needles/syringes in past 4 weeks									
No	373 (85)	27 (8)	1.0	449 (88)	80 (20)	1.0	423 (85)	25 (6)	1.0
Yes	65 (15)	5 (8)	1.0 (0.4, 2.8)	54 (11)	15 (25)	1.4 (0.7, 2.6)	74 (15)	4 (6)	0.9 (0.3, 2.8)
Frequency of injection									
Less than daily	365 (82)	29 (9)	1.0	428 (83)	74 (19)	1.0	398 (80)	14 (4)	1.0
Daily	82 (18)	4 (5)	0.6 (0.2, 1.7)	87 (17)	22 (27)	1.5 (0.9, 2.6)	99 (20)	15 (15)	4.9 (2.3, 10.6)
Sexual risk behaviors									
History of sexually transmitted infection									
No	254 (57)	14 (6)	1.0	332 (66)	60 (20)	1.0	298 (60)	12 (4)	1.0
Yes	189 (43)	19 (11)	2.0 (1.0, 4.0)	174 (34)	35 (23)	1.2 (0.8, 1.9)	200 (40)	17 (9)	2.2 (1.0, 4.8)
Total no. of sexual partners in past 12 months (all types)									
≥2	293 (66)	19 (7)	1.0	308 (61)	55 (19)	1.1 (0.7, 1.7)	348 (70)	16 (5)	1.0
1	148 (34)	12 (9)	1.2 (0.6, 2.6)	198 (39)	39 (21)	1.0	146 (30)	11 (8)	1.7 (0.8, 3.7)
Injection-drug-using sexual partners									
No	127 (30)	13 (11)	1.0	314 (62)	60 (21)	1.0	228 (48)	60 (21)	1.0
Yes	296 (70)	18 (7)	0.6 (0.3, 1.2)	190 (38)	31 (17)	0.1 (0.5, 1.3)	248 (52)	31 (17)	3.2 (1.3, 8.1)

Continued

TABLE 2—*Continued*

Paid for sex in past 12 months									
No	408 (90)	32 (9)	1.0	413 (80)	78 (21)	1.0	435 (87)	27 (6)	1.0
Yes	47 (10)	1 (2)	0.2 (0.0, 1.8)	104 (20)	18 (19)	0.9 (0.5, 1.6)	66 (13)	2 (3)	0.5 (0.1, 2.0)
Used condoms during vaginal sex with nonpaying partners in past 4 weeks									
Always	90 (27)	5 (7)	1.0	213 (54)	49 (26)	1.0	178 (41)	8 (5)	1.0
Not always	244 (73)	22 (10)	1.6 (0.6, 4.2)	178 (46)	35 (22)	0.8 (0.5, 1.3)	259 (59)	19 (8)	1.7 (0.7, 4.0)
Environmental risk behaviors									
Ever in drug treatment									
No	296 (65)	21 (8)	1.0	286 (56)	39 (15)	1.0	355 (71)	18 (5)	1.0
Yes	157 (35)	12 (8)	1.1 (0.5, 2.3)	227 (44)	56 (27)	2.2 (1.4, 3.4)	146 (29)	11 (8)	1.5 (0.7, 3.3)
Stopped by police in past 12 months									
No	168 (38)	16 (10)	1.0	243 (47)	44 (21)	1.0	317 (64)	15 (5)	1.0
Yes	275 (62)	16 (6)	0.6 (0.3, 1.2)	269 (53)	51 (20)	1.0 (0.6, 1.5)	178 (36)	14 (8)	1.7 (0.8, 3.7)
Ever imprisoned									
No	337 (74)	19 (6)	1.0	398 (78)	69 (19)	1.0	328 (66)	15 (5)	1.0
Yes	117 (26)	14 (13)	2.2 (1.0, 4.5)	115 (22)	26 (24)	1.4 (0.8, 2.3)	171 (34)	14 (8)	1.9 (0.9, 4.1)

Note. OR = odds ratio; CI = confidence interval; NA = not applicable. Numbers do not always correspond with the total sample size because a small proportion (n = 96) of oral fluid samples did not produce a valid antibody result.
[a]A "homemade" liquid methamphetamine.
[b]A "homemade" liquid derivative of opium poppy straw.

a survey showed that 28% of female injection drug users taking part in a syringe exchange program tested positive for antibodies to *T pallidum* and that sex workers were 9 times more likely to have syphilis than non–sex workers.[16] Our findings indicate that sex workers are a highly vulnerable and marginalized group; in comparison with non–sex workers, they were less likely to have attended college or to have official city residency permits, they were younger, and they were more likely to inject daily and to have been arrested in the previous 12 months. A history of arrest in the past year was associated with increased likelihood of syphilis in Barnaul. It is likely that sex workers without residency permits were temporary residents, highlighting the potential for transmission of syphilis by this group across different cities.

Sexual Risk Behaviors

Our findings point to considerable sexual mixing between populations of injection drug users and nonusers, as well as substantial frequencies of sexual risk behaviors among these populations. The majority of respondents reported having had 2 or more sexual partners in the previous 12 months, among whom a large proportion were not injection drug users. Levels of sexual mixing differed between men, female non–sex workers, and female sex workers, highlighting the importance of gender- and sex–work-specific interventions designed to reduce sexual risk behaviors.

Our results indicate that condom use was low and that many male injection drug users had sexual partners who were not users, suggesting a potential role for these men in transmitting STIs to their nonusing partners. The majority of non–sex workers reported that their sexual partners were also injection drug users, suggesting less sexual mixing between populations but indicating an increased risk of both injection drug use and sexual acquisition and transmission of STIs, including HIV.

Sex workers reported that only a minority of both their paying and nonpaying partners were injection drug users and reported a high turnover of clients, again pointing to the potential for sexual transmission to populations of noninjection users. Sex workers reported more consistent condom use with both clients and nonpaying partners than did non–sex workers; however, these reports were not supported by the higher syphilis prevalences found in this group. Furthermore, frequencies of reported STI histories were high in all groups but highest among sex workers, most likely as a result of the higher number of sex acts engaged in by this group.

Injection Drug Use and Exposure to Syphilis

Our findings suggest limited associations between injection risk behaviors and syphilis. The multivariate analyses of the Barnaul data showed that injection frequency was associated with increased odds of antibodies to *T pallidum*. Related evidence from Moscow and Volgograd indicated that sex workers in those cities had reduced odds of being anti-HCV positive, suggesting that they engaged in less risky injection behaviors.[23] Our findings show that HIV prevalences were no lower among sex workers than among the other groups in any of the 3 cities and that syphilis prevalences in this group were higher in Moscow and Barnaul, further highlighting the possibility of sexual transmission of STIs (including HIV) among sex workers and outward to the general population.

TABLE 3—Risk Factors for Antibodies to *Treponema pallidum*: Results of Multivariate Analyses

	Adjusted Odds Ratio (95% Confidence Interval)	*P*
Moscow[a]		
Group		.01
Men	1.0	
Female non–sex workers	2.7 (1.2, 6.0)	
Female sex workers	4.9 (1.7, 14.2)	
Ever imprisoned		<.01
No	1.0	
Yes	2.6 (1.2, 5.6)	
Volgograd[b]		
Ever in drug treatment		<.01
No	1.0	
Yes	2.1 (1.3, 3.4)	
Barnaul[c]		
Group		<.001
Men	1.0	
Female non–sex workers	5.2 (1.9, 14.2)	
Female sex workers	9.8 (2.2, 43.6)	
Age, y (continuous)		.01
≤20	1.0	
21–24	4.7 (0.9, 24.3)	
25–29	6.8 (1.3, 36.4)	
≥30	10.7 (2.0, 57.0)	
Frequency of injection		<.01
Less than daily	1.0	
Daily	3.9 (1.7, 8.9)	
Arrested in past 12 months		.05
No	1.0	
Yes	2.5 (1.0, 6.4)	

[a]Final model adjusted for group and ever having been imprisoned.
[b]Final model adjusted for ever having been in drug treatment.
[c]Final model adjusted for group, age, frequency of injection, and having been arrested in the past 12 months.

Limitations

As a result of the lower sensitivity of the oral fluid assay in detecting antibodies to *T pallidum* relative to a serum assay, the true prevalence of syphilis in our sample was probably slightly higher than our findings suggest, and this misclassification may have led to weakened odds ratios. In addition, given that our data were drawn from a cross-sectional survey and that behavioral findings were based on self-reported information, any inferences about causality between the risk factors assessed and syphilis infection are limited. We used peer interviewers to limit the potential bias associated with socially desirable responses,[31,32] but the ability to establish causality was further weakened by the fact that the syphilis test used here not only measured antibodies to *T pallidum* but also detected past infections. Further research including serological samples and involving prospective study designs is needed to better establish causality.

Furthermore, because the respondents were recruited from community settings, no established sampling frame is available from which a measure of representativeness can be obtained. However, we attempted to minimize potential geographic and network bias by ensuring multisite and multinetwork recruitment. Finally, it was not possible to ascertain significant differences in risk factors between female non–sex workers and female sex workers in the multivariate analyses because of insufficient power to detect such differences.

Conclusions

In line with limited evidence suggesting that HIV prevalence is associated with sex work among Russian injection drug users,[23] our findings indicate that syphilis prevalence is associated with sex work in this population. A high proportion of male injection drug users in our sample reported having paid for sex in the preceding 12 months, particularly in Volgograd, where the prevalence of syphilis was highest. Although paying for sex was not associated with syphilis infection in Volgograd, this behavior reinforces evidence indicating the potential role of sex work in increasing syphilis risk among injection drug users and potentially feeding the momentum of sexual transmission of HIV and syphilis among noninjectors.

Targeted interventions sensitive to gender differences are urgently needed as a means of aiding efforts to reduce both sexual and injection risk behaviors among injection drug users, particularly those who are involved in sex work. Such interventions will help prevent ongoing syphilis transmission and simultaneously limit the outward spread of HIV between injection drug users and their sexual partners. ■

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Contributors

L. Platt and T. Rhodes designed the study and supervised all aspects of its implementation. L. Platt conducted the analyses and led the writing. A. Judd assisted with the study and contributed to the analyses. E. Koshkina, S. Maksimova, and N. Latishevskaya supervised the implementation of the study at each site and contributed to the writing of the article. A. Renton oversaw regulatory issues in relation to test kits and provided comments on the analyses. T. McDonald and J.V. Parry conducted laboratory testing of oral fluid samples and developed the modified *Treponema pallidum* assay for use with oral fluid samples.

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Human Participant Protection

This study was approved by the Riverside Research Ethics Committee (Chelsea and Westminster Hospitals, London). All participants provided informed consent.

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