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Risk factors associated with Chlamydia and gonorrhea infection among female sex workers in two Mexico-U.S. border cities

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Abstract

Female sex workers (FSWs) aged ≥ 18 years without known HIV infection living in Tijuana and Ciudad Juarez who had recent unprotected sex with clients underwent interviews and testing for Chlamydia and gonorrhea using nucleic acid amplification. Correlates of each infection were identified with logistic regression. Among 798 FSWs, prevalence of Chlamydia and gonorrhea was 13.0% and 6.4%. Factors independently associated with Chlamydia were being younger, working in Tijuana versus Ciudad Juarez, and recent methamphetamine injection. Factors independently associated with gonorrhea were working in Tijuana versus Ciudad Juarez, using illegal drugs before or during sex, and having a recent male partner who injects drugs. Chlamydia and gonorrhea infection were more closely associated with FSWs' drug use behaviors and that of their sexual partners than with sexual behaviors. Prevention should focus on subgroups of FSWs and their partners who use methamphetamine and who inject drugs.

Keywords

Chlamydia; gonorrhea; female sex workers; Mexico-U.S. border; women

INTRODUCTION

Tijuana, Baja California and Ciudad Juarez, Chihuahua lie on Mexico's border with the U.S. and are characterized by large populations of migrants and female sex workers (FSWs). Both cities have "zones of tolerance" where sex work is quasi-legal. Clients include men from both sides of the U.S.-Mexico border and from other countries, ranging in age from 18 to 80 years.^{1, 2} In 2006, it was reported that 4,850 Tijuana FSWs were registered with the

Municipal Health Service, while thousands of others are thought to work without a permit.³ Approximately 4,000 FSWs work in zones of tolerance of Ciudad Juárez, where sex work is not regulated by the Health Department.³

Prevalence estimates for Chlamydia and gonorrhea among FSWs in Mexico have been reported in a few studies.^{4, 5} However, data are sparse among FSWs who reside near the Mexico-U.S. border. Among 354 registered FSWs in three northern non-border Mexican cities (Durango, Durango; Zacatecas, Zacatecas; and Torreón, Coahuila), the prevalence of cervical Chlamydia trachomatis infection was 12.4%.³² In a 1993 study among 826 sex workers in Mexico City, 3.7% tested positive for gonorrhea.⁴

Chlamydia and gonorrhea share some risk factors, such as female gender, younger age at sexual debut, low contraceptive use, greater number of sexual partners, engaging in commercial sex work, and drug use.^{6–11} Recent studies have also identified partner-level risk factors; for example, in a sample of 15- to 24-year-olds, partners who had an STI in the past year and partnerships with an age difference of five years or more were more predictive of STIs than were the individual's own sexual behaviors.¹² STI risks may also differ by sexual partner type. Among 553 high-risk heterosexual women in Houston, Texas, condom use was higher with casual partners than with steady partners; however, this advantage was reversed when alcohol, drugs, or both were used.¹³

Although the number of studies has been fewer, there has been some research on partner-level characteristics that may influence STI acquisition in countries or communities that are specifically low- or middle-income. For example, a study of 4,000 married or cohabiting men living in Mexico City found that those having extra-relational sex in the last year were more likely to use condoms with their secondary partners (e.g., FSWs) than with their primary partners.¹⁴

In Mexico, certain population subgroups show high prevalence of Chlamydia and gonorrhea varying by region.^{15, 16} Of particular interest for our study was that women in communities along the border between Arizona and the Mexican state of Sonora were at significantly increased risk for Chlamydia infection compared to women attending clinics in non-border locations (9.0% versus 5.4%). Testing positive for Chlamydia was associated with younger age, a history of new sexual partner(s) in the previous three months, and proximity to the international border.¹⁷

Major drug trafficking routes for heroin, cocaine, and methamphetamine pass through both Tijuana and Ciudad Juárez. We previously reported that FSWs in these cities who injected drugs had higher overall STI prevalence and engaged in more unsafe sex with clients compared to FSWs who did not inject drugs.¹⁸ In addition, FSWs with U.S. clients were significantly more likely to inject drugs, have unprotected sex for more money, and to have recently tested positive for one of four STIs (gonorrhea, Chlamydia, HIV, active syphilis) compared to other FSWs.¹⁹ However, in that study we did not examine individual or partner-level risk factors for STI acquisition, nor did we examine risk factors for gonorrhea and Chlamydia separately. In the present analysis, we examine whether FSWs testing positive for gonorrhea and Chlamydia report higher rates of drug use before or during sex and whether partner-level characteristics are closely associated with these incident STIs. In a resource-limited setting such as Mexico, identifying correlates of STIs is important for targeting funding for STI screening and treatment.

MATERIALS AND METHODS

Study population

From March 2004 through January 2006, FSWs in Tijuana (N=474) and Ciudad Juarez (N=450) were recruited into a behavioral intervention study described previously.²⁰ Participants were women at least 18 years old who had traded sex for drugs, money, or other material benefit and reported having had unprotected vaginal or anal sex with a client at least once during the previous four weeks.

Measures

Data were collected during a private interview. Measures included demographics, sexual behaviors, substance use, male client characteristics, and test results for Chlamydia, gonorrhea, syphilis antibodies, and HIV antibodies. Data were restricted to the baseline visit.

Demographic characteristics—Sociodemographics included age, age at initiation into sex work, marital status, having children, city of residence, place of birth, and type of sex work (street worker, dance hostess, barmaid, other).

Sexual behaviors—Condom use was assessed by the following: whether participants had condoms with them at the interview; total number of sex acts and of unprotected sex acts in the past six months, broken down according to partner type (spouse or steady; any client; non-regular clients; regular clients); average amount (USD) paid by clients for protected and unprotected sex; and frequency of condom use for vaginal sex with male clients (never or sometimes versus often or always). The ratio of the total number of sex acts to unprotected sex acts in the past six months were used to calculate the percent of unprotected vaginal sex for each partner type.

Substance use—Each participant was asked whether had she used alcohol or an illegal drug before or during sex during the past month; had ever injected cocaine, heroin, methamphetamine, speedball, or any illicit drug; the number of her sex partners in the past month who were IDU; the number of her male clients in the last six months who (to the FSW's knowledge) had ever injected drugs; and whether the participant had ever shared needles or injection equipment with anyone.

Male client characteristics—We assessed number, type (regular and non-regular), and perceived origin (U.S. or Mexico) of male clients, as well as the number of vaginal sex acts with clients of each type.

Chlamydia, gonorrhea, syphilis, and HIV—Cervical swabs were prepared and tested with nucleic acid amplification using the Aptima[®] Combo-2 assay collection device (Genprobe, San Diego, CA) to detect *Neisseria gonorrhea* and *Chlamydia trachomatis*. From a blood sample, HIV antibody was detected on site using the Determine[®] rapid HIV antibody test (Abbott Pharmaceuticals, Boston, MA); reactive samples were confirmed by enzyme immunoassay (EIA) and Western blot. The rapid plasma reagin (RPR) test was used to detect syphilis antibody (Macro-Vue, Becton Dickinson, Cockeysville, MD, USA); reactive samples were confirmed by *Treponema pallidum* hemagglutinin assay (TPHA) (Fujirebio, Wilmington, DE, USA). RPR titers >1:8 were considered consistent with active infection.²¹

Statistical analysis

Bivariate associations by Chlamydia and gonorrhea infection were performed with nonparametric Fisher's Exact Test and Wilcoxon's Two Sample Test, as appropriate.

Logistic regression was performed to identify factors associated with Chlamydia and gonorrhea infections. In multivariate regressions, all variables attaining a significance of $p < 0.10$ in bivariate analysis were considered for inclusion; models were reduced manually using stepwise regression and the Likelihood Ratio test ($p < 0.05$). Factors with medium-to-high Spearman correlation ($r > 0.6$) were not included in the same model. A tolerance test was performed on the final model to assess multicollinearity.

RESULTS

Of 924 participants, 126 had samples that were spoiled due to extreme heat and border crossing delays; their Chlamydia and gonorrhea test results were thus excluded. Women who were excluded for this reason were significantly older, more likely to be from Ciudad Juarez and to be street workers, were less likely to be migrants, reported significantly less unprotected vaginal sex with any type of client, and earned less for sex with and without a condom. Of the 798 remaining, 466 (58.4%) worked in Tijuana and 332 (41.6%) in Ciudad Juarez. Median age was 32 years (IQR: 26, 39); 17.8% had ever injected drugs; and the median number of clients in the past six months was 240 (IQR: 72, 480). Overall, 104 (13.0%) tested positive for Chlamydia, and 51 (6.4%) tested positive for gonorrhea.

Factors associated with Chlamydia infection

FSWs who tested positive for Chlamydia were significantly younger and more likely to be living in Tijuana than in Ciudad Juarez. We did not find differences by Chlamydia infection with respect to their age of initiation into sex work, marital or migration status, sex worker type, condom use practices, or male client characteristics (Table 1).

FSWs who tested positive for Chlamydia had higher lifetime prevalence of injecting drugs (29% versus 16%), and were more likely to have ever shared needles or injection equipment (23% versus 12%) or injected heroin (26% versus 14%) or methamphetamine (10% versus 3%) in the last month. We did not find significant differences with respect to alcohol or illegal drug use before or during sex, injecting cocaine or speedball in the previous month, or number of IDU sex partners in the past month. Not surprisingly, FSWs with Chlamydia infection also had significantly higher prevalence of HIV (15% versus 4%), active syphilis (titer $> 1:8$) (18% versus 9%), and gonorrhea (19% versus 4%).

Factors independently associated with Chlamydia were being younger (AOR: 0.63; 95% CI: 0.48, 0.82 per 10 years), working in Tijuana versus Ciudad Juarez (AOR: 2.34; 95% CI: 1.43, 3.83), and having injected methamphetamine in the past month (AOR: 2.68; 95% CI: 1.18, 6.05) (Table 2).

Factors associated with gonorrhea infection

Factors associated with gonorrhea infection among FSWs in Tijuana and Ciudad Juarez included substance use, certain client characteristics, and having other STIs. FSWs with gonorrhea infection were over four times more likely to work in Tijuana than in Ciudad Juarez. We detected no associations between gonorrhea infection and age, age of initiation into sex work, marital status, having children, migration, sex worker type, or condom use practices (Table 3).

FSWs with gonorrhea infection were more likely to have often or always used illegal drugs before or during sex, to have ever injected drugs, and to have ever shared needles or injection equipment. Those testing positive had significantly higher lifetime prevalence of drug injection (43% vs 16%) as well as injection in the past month of cocaine (15% versus 6%), heroin (37% versus 14%), methamphetamine (16% versus 3%), and speedball (14%

versus 6%) (Table 3). We did not find associations with alcohol use before or during sex, or number of IDU sex partners.

FSWs with gonorrhea had significantly fewer non-regular clients in the past month but had significantly more vaginal sex with these clients. They were also more likely to report having a male client who had ever injected drugs or a U.S. client. We found no association between gonorrhea and numbers of male clients, vaginal sex with regular male clients, or sharing needles with clients. FSWs with gonorrhea had significantly higher prevalence of HIV (22% versus 4%), active syphilis (titer >1:8) (36% versus 8%), and Chlamydia (39% versus 11%).

Factors independently associated with gonorrhea infection were working in Tijuana versus Ciudad Juarez (AOR: 4.75; 95% CI: 1.80, 12.52), use of illegal drugs before or during sex (AOR: 5.96; 95% CI: 3.01, 11.80) and having a male IDU partner in the last 6 months (AOR: 2.32; 95% CI: 1.16, 4.63) (Table 2).

DISCUSSION

In this study of high-risk FSWs residing in two Mexico-U.S. border cities, Chlamydia and gonorrhea were more closely associated with drug use among FSWs and their sexual partners than it was with FSWs' sexual behaviors. Specifically, use of illegal drugs before or during sex and having male IDU clients were independently associated with gonorrhea infection, and recent methamphetamine injection was independently associated with Chlamydia infection. Odds of Chlamydia and gonorrhea infection were two to four times higher in Tijuana than in Ciudad Juarez. These findings have implications for targeting STI prevention and treatment to subgroups of FSWs who use illicit drugs in these resource-limited settings, especially in Tijuana.

We found that methamphetamine injection was an independent predictor of Chlamydia infection. Use of methamphetamine has been associated with increased libido and numbers of sexual partners as well as with high-risk sexual behavior.^{22–25} Although methamphetamine use is becoming more common among heterosexual women in countries such as the U.S., the high prevalence of methamphetamine injection in our sample (21%) is unusual.

While gonorrhea infection was not associated with use of methamphetamine or other drug types, it was independently associated with using an illegal drug before or during sex. A critical review of 16 epidemiologic studies associated drug use with increasing rates of STIs, including gonorrhea.²⁶ Other studies have documented an association between substance use and lower rates of condom use or impaired ability to use condoms.^{13, 27} Some of the authors have initiated a new intervention study that aims to promote skills in negotiating condom use among FSWs in Tijuana and Ciudad Juarez who inject drugs, and we hope this will lead to a significant reduction in HIV/STI incidence.

Having an IDU sex partner in the past six months was the only partner-level variable to be associated with incident STIs in our study, and this relationship was observed only for gonorrhea. The lack of independent association of Chlamydia and gonorrhea with other partner characteristics may be due to limited study power, and the fact that women were asked to report their partner characteristics. Future studies should consider obtaining such data directly from FSWs' clients and intimate partners, since FSWs' reports of their partners may not be a suitable proxy.

Our results support the existing literature linking younger age with Chlamydia infection. In a systematic review of risk factors for Chlamydia among females in the United Kingdom and

Ireland, younger age was one of the most important determinants.²⁸ Our findings reinforce the need for increased screening for Chlamydia among young FSWs, especially those who inject methamphetamine.

Interpretation of these findings should consider a number of limitations. First, we relied on the accuracy of self-report, which could result in underreporting, especially for variables relating to partner characteristics. Further, given that data were gathered as part of an intervention study to reduce sexual risk, only women reporting recent unsafe sex were included, which may have biased associations with condom use towards the null. Specimen spoilage led us to exclude samples from 126 FSWs, some of whom appear to have been higher risk. This may have caused some selection bias that influenced our results in unanticipated ways; however, this would tend to affect external validity and not the internal validity of our findings. Finally, since this analysis was cross-sectional, no causal inferences can be drawn; however, since nucleic acid amplification detected active infection, the variables we found to be associated with Chlamydia and gonorrhea may be true risk factors.

Given that both Chlamydia and gonorrhea are cofactors of HIV transmission,²⁹ there is a need to scale up interventions to increase testing, diagnosis, and treatment for STIs, especially among drug using FSWs and their partners in these cities. Since Tijuana and Ciudad Juárez are experiencing rising rates of HIV infection among FSWs,^{30, 31} identifying and intervening on risk factors for Chlamydia and gonorrhea have implications not only for STI control, but also for containing the burgeoning HIV epidemic.

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Table 1
Factors associated with Chlamydia infection among female sex workers in Tijuana and Ciudad Juarez (N=798)

Demographic Characteristics	Overall N	Negative (n=694)	Positive (n=104)	p-value	OR (95% CI)
Age in years, <i>mean (SD)</i>	798	34 (9)	30 (8)	<0.001	0.64 (0.49, 0.82)*
Age at initiation into sex work	790			0.72	
Less than 18 years, <i>n (%)</i>		66 (10)	11 (11)		1.00
18 years or older, <i>n (%)</i>		623 (90)	90 (89)		0.87 (0.44, 1.70)
Marital status	794			0.33	
Married or cohabiting, <i>n (%)</i>		164 (24)	19 (18)		1.00
Single, <i>n (%)</i>		343 (50)	59 (57)		1.48 (0.86, 2.57)
Other, <i>n (%)</i>		184 (27)	25 (24)		1.17 (0.62, 2.21)
Has children, <i>n (%)</i>	794	647 (94)	96 (93)	0.83	0.93 (0.41, 2.13)
City of residence	798			<0.001	
Tijuana, <i>n (%)</i>		386 (56)	80 (77)		2.63 (1.64, 4.35)
Ciudad Juarez, <i>n (%)</i>		308 (44)	24 (23)		1.00
Migrated into this state, <i>n (%)</i>	794	428 (62)	70 (68)	0.27	1.30 (0.84, 2.03)
Sex worker type	798			0.75	
Street worker, <i>n (%)</i>		365 (53)	54 (52)		1.00
Dance hostess, <i>n (%)</i>		155 (22)	27 (26)		1.18 (0.72, 1.94)
Barmaid, <i>n (%)</i>		117 (17)	14 (14)		0.81 (0.43, 1.51)
Other, <i>n (%)</i>		57 (8)	9 (9)		1.07 (0.50, 2.28)
Condom Use					
% unprotected vaginal sex with spouse or steady partners, <i>mean (SD)</i>	235	90 (26)	82 (38)	0.22	0.91 (0.81, 1.02)*
% unprotected vaginal sex with any type of client, <i>mean (SD)</i>	782	44 (31)	48 (34)	0.45	1.03 (0.97, 1.1)*
% unprotected vaginal sex with non-regular clients, <i>mean (SD)</i>	686	36 (34)	37 (37)	0.68	1.00 (0.94, 1.07)*
% unprotected vaginal sex with regular clients, <i>mean (SD)</i>	720	52 (35)	53 (37)	0.77	1.01 (0.95, 1.07)*
Average USD amount earned for sex with a condom, <i>mean (SD)</i>	783	29 (23)	37 (47)	0.55	1.08 (1.01, 1.15)*
Average USD amount earned for sex without a condom, <i>mean (SD)</i>	792	47 (73)	59 (97)	0.48	1.01 (0.99, 1.03)*

Substance Use

	Overall N	Negative (n=694)	Positive (n=104)	p-value	OR (95% CI)
Ever injected drugs, <i>n</i> (%)	798	112 (16)	30 (29)	<0.01	2.11 (1.32, 3.37)
Has ever shared needles or injection equipment, <i>n</i> (%)	798	86 (12)	24 (23)	0.01	2.12 (1.27, 3.53)
Injected cocaine in past month, <i>n</i> (%)	756	38 (6)	8 (8)	0.38	1.40 (0.63, 3.09)
Injected heroin in past month, <i>n</i> (%)	795	99 (14)	27 (26)	<0.01	2.10 (1.29, 3.41)
Injected methamphetamine in past month, <i>n</i> (%)	787	19 (3)	10 (10)	<0.01	3.76 (1.70, 8.34)
Injected speedball in past month, <i>n</i> (%)	785	42 (6)	9 (9)	0.28	1.50 (0.70, 3.17)
Number of IDU sex partners in past month, <i>mean</i> (SD)	786	1 (2)	1 (2)	0.74	0.83 (0.28, 2.48)*
STI Status					
HIV, <i>n</i> (%)	795	28 (4)	16 (15)	<0.001	4.31 (2.24, 8.27)
Active syphilis (titer >1:8), <i>n</i> (%)	793	63 (9)	18 (18)	0.01	2.11 (1.19, 3.73)
Gonorrhea, <i>n</i> (%)	798	31 (4)	20 (19)	<0.001	5.09 (2.78, 9.34)

Univariate statistics include Mean (SD) and Wilcoxon Test p-value for continuous variables, N (%) and Fisher Exact Test p-value for categorical variables.

IDU = injection drug user

* per 10 unit increase

OR (CI) values that are significant are shown in bold

Note: the following variables were entered into the analysis but were found not significant: under Condom Use: participant brought condoms to the interview (Y/N); used condoms for vaginal sex with male clients in past 6 months (never or sometimes vs. often or always). Under Substance Use: used alcohol before or during sex (never or sometimes vs. often or always); used illegal drug before or during sex (never or sometimes vs. often or always). None of the measured Male Client Characteristics (e.g., number of male clients in past 6 months) was found significant.

Table 2

Characteristics independently associated with Chlamydia and gonorrhea infection among female sex workers

Characteristic	AOR (95% CI)
<i>Chlamydia Infection (N=777)</i>	
City of residence (Tijuana vs. Ciudad Juarez)	2.34 (1.43, 3.83)
Age (per 10 years)	0.63 (0.48, 0.82)
Injected methamphetamine in past month	2.68 (1.18, 6.05)
<i>Gonorrhea Infection (N=610)</i>	
City of residence (Tijuana vs. Ciudad Juarez)	4.75 (1.80, 12.52)
Used illegal drug before or during sex	5.96 (3.01, 11.80)
Had male IDU clients in last 6 months	2.32 (1.16, 4.63)

Table 3
Factors associated with gonorrhea infection among female sex workers in Tijuana and Ciudad Juarez (N=798)

Demographic Characteristics	Overall N	Negative (n=747)	Positive (n=51)	p-value	OR (95% CI)
Age in years, mean (SD)	798	33 (9)	31 (7)	0.11	0.73 (0.53, 1.03) *
Age at initiation into sex work	790			0.31	
Less than 18 years, n (%)		70 (9)	7 (14)		1.00
18 years or older, n (%)		671 (91)	42 (86)		0.63 (0.27, 1.45)
Marital status	794			0.06	
Married or cohabiting, n (%)		172 (23)	11 (22)		1.00
Single, n (%)		369 (50)	33 (65)		1.40 (0.69, 2.83)
Other, n (%)		202 (27)	7 (14)		0.54 (0.21, 1.43)
Has children, n (%)	794	697 (94)	46 (90)	0.37	0.61 (0.23, 1.60)
City of residence	798			<0.001	
Tijuana, n (%)		423 (57)	43 (84)		4.17 (1.92, 9.09)
Ciudad Juarez, n (%)		324 (43)	8 (16)		1.00
Migrated into this state, n (%)	794	466 (63)	32 (63)	0.99	1.00 (0.56, 1.80)
Sex worker type	798			0.02	
Street worker, n (%)		383 (51)	36 (71)		1.00
Dance hostess, n (%)		178 (24)	4 (8)		0.24 (0.08, 0.68)
Barmaid, n (%)		124 (17)	7 (14)		0.60 (0.26, 1.38)
Other, n (%)		62 (8)	4 (8)		0.69 (0.24, 2.00)
Condom Use					
% unprotected vaginal sex with spouse or steady partners, mean (SD)	235	90 (27)	87 (35)	0.84	0.97 (0.81, 1.15) *
% unprotected vaginal sex with any type of client, mean (SD)	782	45 (32)	44 (31)	0.88	0.99 (0.90, 1.08) *
% unprotected vaginal sex with non-regular clients, mean (SD)	686	37 (35)	35 (35)	0.79	0.99 (0.90, 1.08) *
% unprotected vaginal sex with regular clients, mean (SD)	720	52.5 (35.3)	45 (36)	0.16	0.94 (0.87, 1.03) *
Average USD amount earned for sex with a condom, mean (SD)	783	30.1 (27.8)	30 (22)	0.34	0.99 (0.89, 1.11) *
Average USD amount earned for sex without a condom, mean (SD)	792	49 (78)	40 (28)	0.69	0.97 (0.90, 1.04) *
Substance Use					

	Overall N	Negative (n=747)	Positive (n=51)	p-value	OR (95% CI)
Ever injected drugs, <i>n</i> (%)	798	120 (16)	22 (43)	<0.001	3.96 (2.20, 7.13)
Has ever shared needles or injection equipment, <i>n</i> (%)	798	96 (13)	14 (28)	0.01	2.57 (1.34, 4.92)
Injected cocaine in past month, <i>n</i> (%)	756	39 (6)	7 (15)	0.02	2.93 (1.23, 6.95)
Injected heroin in past month, <i>n</i> (%)	795	107 (14)	19 (37)	<0.001	3.53 (1.93, 6.46)
Injected methamphetamine in past month, <i>n</i> (%)	787	21 (3)	8 (16)	<0.001	6.49 (2.72, 15.53)
Injected speedball in past month, <i>n</i> (%)	785	44 (6)	7 (14)	0.03	2.62 (1.11, 6.17)
Number of IDU sex partners in past month, <i>mean</i> (SD)	786	1 (2)	1 (2)	0.09	1.96 (0.72, 5.38) *
STI Status					
HIV, <i>n</i> (%)	795	33 (4)	11 (22)	<0.001	5.92 (2.79, 12.58)
Active syphilis (titer >1:8), <i>n</i> (%)	793	63 (8)	18 (36)	<0.001	6.07 (3.23, 11.43)
Gonorrhea, <i>n</i> (%)	798	84 (11)	20 (39)	<0.001	5.09 (2.78, 9.34)

Univariate statistics include Mean (SD) and Wilcoxon Test p-value for continuous variables, N (%) and Fisher Exact Test p-value for categorical variables.

IDU = injection drug user

* per 10 unit increase

OR (CI) values that are significant are shown in bold

Note: see Note to Table 1. The same variables were omitted from Table 3.