
Bridging Populations—Sexual Risk Behaviors and HIV Prevalence in Clients and Partners of Female Sex Workers, Bangkok, Thailand 2007

Neha S. Shah, Ray W. Shiraishi, Wonchart Subhachaturas, Abhijeet Anand, Sara J. Whitehead, Suvimon Tanpradech, Chomnad Manopai boon, Keith M. Sabin, Kimberley K. Fox, and Andrea Y. Kim

ABSTRACT *The aim of this study is to estimate HIV prevalence and assess sexual behaviors in a high-risk and difficult-to-reach population of clients of female sex workers (FSWs). A modified variation of respondent-driven sampling was conducted among FSWs in Bangkok, where FSWs recruited 3 FSW peers, 1 client, and 1 nonpaying partner. After informed consent was obtained, participants completed a questionnaire, were HIV-tested, and were asked to return for results. Analyses were weighted to control for the design of the survey. Among 540 FSWs, 188 (35%) recruited 1 client, and 88 (16%) recruited 1 nonpaying partner. Clients' median age was 38 years. HIV prevalence was 20% and was associated with younger age at first sexual experience [relative risk (RR)=3.10, 95% confidence interval (CI) 1.16–8.24] and condom use during last sexual encounter with regular partner (RR=3.97, 95% CI 1.09–14.61). Median age of nonpaying partners was 34 years, and HIV prevalence was 15.1%. There were 56 discordant FSW–client pairs and 14 discordant FSW–nonpaying partner pairs. Condom use was relatively high among discordant FSW–client pairs (90.1%) compared to discordant FSW–nonpaying partner pairs (18.7%). Results suggest that sexual partners of FSWs have a high HIV prevalence and can be a bridge for HIV transmission to other populations. Findings also highlight the importance of initiating surveillance and targeted programs for FSW partners, and demonstrate a recruitment method for hard-to-reach populations.*

KEYWORDS *Female sex workers, Thailand, Bridge population, Male clients, HIV*

INTRODUCTION

The first case of HIV in Thailand was reported in 1984. Over the next decade, the HIV epidemic became widespread among female sex workers (FSWs) and injection drug users (IDUs).^{1–3} In 1991, Thailand responded to the HIV epidemic in part by introducing the 100% Condom Program, which was a multifactorial prevention effort focusing on condom use and sexually transmitted infections (STI) and HIV prevention that targeted the sex work industry. Under this initiative, there was a

Shah, Shiraishi, Anand, Whitehead, Sabin, Fox, and Kim are with the Global AIDS Program, National Center for HIV, Viral Hepatitis, STD and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA; Subhachaturas is with the Bangkok Metropolitan Administration, Bangkok, Thailand; Whitehead, Tanpradech, and Fox are with the Thailand MOPH – U.S. Centers for Disease Control and Prevention Collaboration, Bangkok, Thailand.

Correspondence: Neha S. Shah, Global AIDS Program, National Center for HIV, Viral Hepatitis, STD and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA. (E-mail: Nshah6@cdc.gov)

decline in STI cases by more than 90%, and there was an increase in condom use in commercial sex to over 90%.^{1, 4-7} HIV prevalence subsequently declined in brothel-based FSWs following a peak prevalence of 31% in 1994.¹ Since the late 1990s, the 100% Condom Program has been scaled back due in part to overall cuts in HIV prevention funding, leading to a decrease in the number of STI clinics, outreach activities, and availability of condoms.^{4, 8}

Potential subpopulations affected by the scaling back of the 100% Condom Program are FSWs, their steady, nonpaying sex partners, and their clients. Although an estimated 10–20% of men in Thailand have visited a sex worker in the last 12 months, there are no data on HIV status or risk behaviors of clients of FSWs in the country. Data among proxy populations such as military recruits have shown that approximately 25% of Thailand's military recruits visited an FSW in the last year.^{6, 9-11} Clients of FSWs are likely to have additional nonpaid sexual partners and therefore serve as a potential bridge for transmission of HIV from a high-prevalence population—FSWs—to the general population. Because of clients' potential role in the HIV epidemic, understanding their risk behaviors and current HIV status is crucial for future HIV prevention programming and policy development.

However, because clients are not a readily identifiable group, targeting surveillance and prevention programs for this population is challenging. To date, only a few HIV prevalence surveys have been conducted in this population, and all have relied on investigator-recruited samples which have a potential misclassification bias.¹²⁻¹⁹ Snowball sampling and respondent-driven sampling (RDS) with sexually active males have limited ability to ensure that the participants recruited are clients of FSW.^{18, 20} Time location, venue-based, and institutional sampling capture individuals who are visible but may miss higher risk individuals who do not visit venues or institutions.^{12-17, 19} Additionally, routine sentinel surveillance of FSWs in Thailand is venue-based, which may miss potentially higher risk nonvenue-based or undocumented FSWs and their clients.²¹ In Thailand, venue-based FSWs are defined as FSWs working in venues such as in brothels or entertainment establishments, including massage parlors, karaoke bars, and beer bars, whereas nonvenue-based FSWs are those who make agreements with their clients in nonvenue-based settings such as streets, parks, parking lots, shopping malls, phones, and on the internet. As an increasing number of studies in multiple countries seek to understand the role of clients in the HIV epidemic, a new and less biased method for recruiting is needed.

The objective of this study was to obtain a sample of male clients of FSWs participating in an RDS study, using FSW-initiated recruitment of their male sexual partners. The goal was to gain an understanding of sociodemographic characteristics, estimate HIV prevalence, and assess HIV risk behaviors of partners—both clients and nonpaying partners—of FSWs in Bangkok, Thailand in order to target future prevention programs for this population.

METHODS

This study of male sexual partners of FSWs was embedded in an RDS study targeting both venue and nonvenue FSWs in Bangkok. The details of RDS methodology are beyond the scope of this paper and have been described previously.^{22, 23} In brief, RDS is a chain-referral, probability-based sampling method designed to reach hidden populations. Using the standard RDS design, initial FSW

participants (termed “seeds”) were selected to initiate coupon-based recruitment. Seeds were recruited by trained survey staff consisting of nongovernment organizations who work with FSWs and sex establishment owners based on pre-existing contacts and FSW willingness to participate. Seeds then recruit their fellow peers whom comprise wave 1. Wave 1 respondents recruit wave 2 respondents, and the process continues until the desired sample size is achieved. RDS has been used successfully for sampling FSWs, men who have sex with men (MSM), and IDUs.^{24–29} In addition to recruiting their FSW peers, according to standard RDS methodology, in this study, FSWs were also asked to recruit 1 paying male client and 1 nonpaying male sex partner such as a spouse or boyfriend (Figure 1). Though the focus of this analysis is on paying male clients of FSWs, nonpaying partners were also allowed to enroll in the study to minimize the likelihood of nonpaying clients falsely claiming to be a paying client due to the recruiter and recruit compensation, resulting in misclassification bias. Neither clients nor partners were requested to recruit other clients or partners of FSWs. The protocol was approved by the Institutional Review Boards at the Centers for Disease Control and Prevention and the Thailand Ministry of Health.

The study was conducted from August to November 2007 in 3 survey sites in Bangkok, chosen for their convenience and accessibility to nonvenue-based FSWs. Eligible males were aged 18 years or older who had bought sex from a female with money or gifts within the past month. A condom use rate of 60% among military conscripts,¹¹ considered a proxy group for clients of FSWs, was used to calculate a sample size of 350 (175 each for clients and nonpaying partners) and provided a power of at least 75% to detect an 18% (30% of 60%) change in condom use rate with an α of 0.05 and design effect of 1.5. Recruitment began with 15 FSWs,

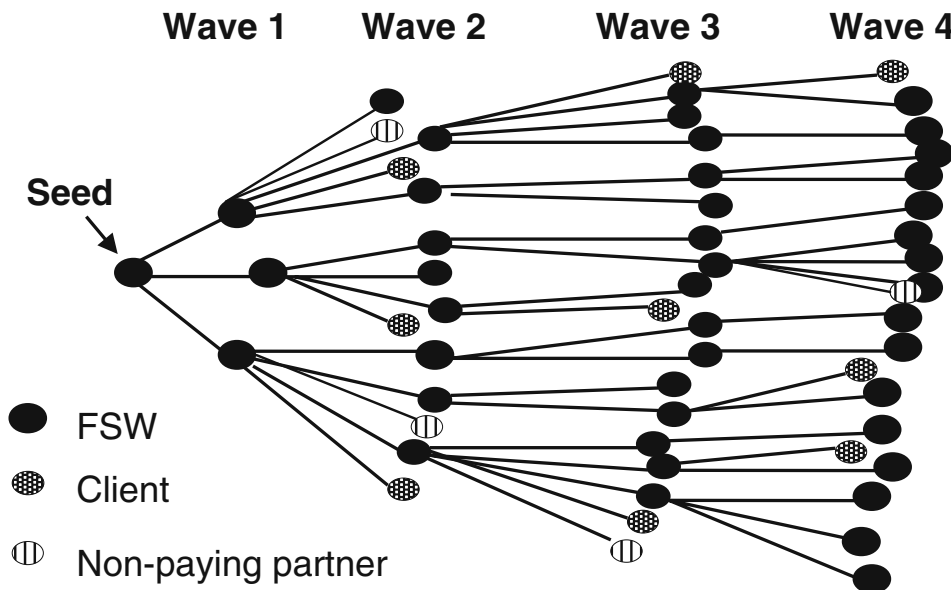


FIGURE 1. Schematic representation of RDS recruitment waves where FSW-initiated recruitment was used to obtain a sample of FSWs but also male clients and their nonpaying sexual partners. *Seed* was defined as a preselected FSW identified from the community by study staff. Seeds were then asked to recruit their FSW peers. Those FSWs recruited comprise *Wave 1*. Wave 1 participants were then asked to recruit participants who comprise *Wave 2*. Recruitment continues in successive waves until sample size is reached. Each recruited FSW was invited to recruit 1 client and 1 nonpaying partner. These partners did not recruit additional participants.

identified through community organizations, nonrandomly selected by survey staff. FSWs received compensation for completing the interview (approximately 11 USD) and for recruiting their partners (approximately 1 USD) to participate in the survey. Partners received the same compensation for completing the survey. Recruitment of clients and nonpaying partners stopped when the target sample size was reached for clients.

After informed consent was obtained, all participants completed a self-administered questionnaire addressing demographic background, sexual behaviors, HIV knowledge, STI history, and service utilization. Sexual behaviors included questions regarding condom use during last sexual encounter and consistency of condom use over the last month. Condom use during last sexual encounter was used for analysis to minimize recall bias. Questionnaires were administered using a handheld computer, supplemented with an optional audio component. If the participant was uncomfortable using the handheld computer, a face-to-face interview was conducted by trained staff. Following the interview and pretest counseling for HIV testing, oral fluid was collected from consenting participants using Orasure™ kits. Specimens were sent to the national STI laboratory and tested using Oral Fluid Vironostika™ HIV-1 Microelisa System (BioMerieux, Inc., Durham, NC). HIV test results were anonymous and linked to participants by their unique study identification number. Participants were encouraged to return to the study site 2 weeks after the initial visit to receive HIV post-test counseling and HIV test results. Those with a positive HIV test result were referred to local public health facilities for free confirmatory HIV testing.

ANALYSIS

Data were analyzed using RDS Analysis Tool (RDSAT) version 6.0.1³⁰ and SAS Callable SUDAAN version 9.0.3.³¹ RDSAT is a statistical software package specifically designed for RDS data analysis and has been described in detail previously.³² Briefly, RDSAT adjusts the population estimates by accounting for differences in participants' recruitment pattern, network size, and homophily.^{23, 33} A weighting approach incorporating RDSAT and compensating for any differential undersampling of partners was used for data analyses.³⁴⁻³⁶ Bivariate analysis with relative risks (RR) and corresponding 95% confidence intervals (CI) was weighted, but serodiscordant and recruitment frequencies were unweighted. Statistical significance was assessed using the chi-square test. Multivariate analysis was not conducted, as the study was not powered for such analysis. Bivariate analysis for nonpaying partners was not conducted because sample size was small and not powered for such analyses. Results from the FSW study have been previously presented³⁷ and will not be presented here.

RESULTS

Of 540 FSWs asked to recruit 1 paying male client and 1 nonpaying partner, 188 (35%) recruited a client and 88 (16%) a nonpaying partner. Four clients and 2 nonpaying partners were excluded because they did not meet the inclusion criteria. Six clients and 7 nonpaying partners were further excluded as they were recruited by seeds and RDSAT weights cannot be generated for partners recruited by seeds. The final analysis included 178 clients and 79 nonpaying partners. Forty-five FSWs recruited both a client and nonpaying partner. Over 70% of participants chose to have a face-to-face interview instead of answering questions on a handheld computer.

Sociodemographic characteristics for clients and nonpaying partners are summarized in Table 1. Among clients, the median age was 38.5 years (unweighted, interquartile range (IQR) 30–50), and 41.2% were currently married. In total, 75.6%, 82.3%, and 90.5% of clients reported condom use during the last sexual encounter with their regular partners (wife or live-in sexual partner), casual partners, and FSW partners, respectively. Among nonpaying partners, the median age was 34 years (unweighted, IQR 27–43), and 56.4% were currently married. Nonpaying partners reported a similar frequency of condom use with FSW and casual partners but only 37.7% with regular partners. The majority of nonpaying partners (81.7%) had some secondary or university education, while the majority of clients (72.9%) had none or primary education. A few clients (4.2%) and nonpaying partners (8.3%) reported injection drug use, though most drank alcohol in the last month (60.6% and 70.1% among clients and nonpaying partners, respectively). The majority of clients (93.5%) and nonpaying partners (58.1%) reported >1 sexual partner in the last month, and 10.1% and 16.2% of clients and nonpaying partners respectively reported ever having had anal sex with a male.

TABLE 1 Sociodemographic characteristics and risk behaviors of partners of FSWs—Bangkok, Thailand, 2007

Characteristic	Clients		Nonpaying partners	
	<i>n</i> = 178		<i>n</i> = 79	
	<i>n</i> /total ^{a, b}	% (95% CI) ^c	<i>n</i> /total ^{a, b}	% (95% CI) ^c
Age in years				
<40	94/178	51.3 (39.2–63.3)	50/79	75.0 (62.9–84.1)
≥40	84/178	48.7 (36.7–60.8)	29/79	25.0 (15.9–37.1)
Education				
None/primary	121/172	72.9 (60.4–82.3)	17/76	18.3 (10.6–29.7)
Secondary/university	51/172	27.2 (17.7–39.3)	59/76	81.7 (70.3–89.4)
Age at first intercourse in years				
<20	121/178	67.3 (54.6–77.9)	61/79	80.3 (65.8–89.7)
≥20	57/178	32.7 (22.1–45.4)	18/79	19.7 (10.3–34.2)
Currently married	60/178	41.2 (29.8–53.7)	51/79	56.4 (40.6–71.0)
Number of sexual partners in last month				
0–1	17/155	6.5 (2.8–14.4)	25/61	41.9 (26.3–59.4)
2 or more	138/155	93.5 (85.6–97.2)	36/61	58.1 (40.6–73.7)
Ever had sex with a man	19/178	10.1 (4.7–20.4)	6/79	16.2 (6.4–35.5)
Condom use during last sexual encounter				
Regular partner	70/105	75.6 (59.7–86.6)	32/66	37.7 (23.8–54.0)
Casual partner	100/119	82.3 (66.9–91.4)	30/36	87.1 (71.2–94.8)
FSW	136/160	90.5 (80.8–95.6)	31/36	88.2 (71.8–95.7)
Injected drugs last 12 months	8/178	4.2 (1.0–15.6)	4/79	8.3 (2.9–21.7)
Drank alcohol in last month	115/177	60.6 (48.2–71.8)	48/79	70.1 (56.9–80.6)
Self-reported STI symptoms in the last month	48/178	27.5 (17.9–39.7)	57/79	39.1 (25.2–55.2)

^aUnweighted

^bDifferences in counts of individuals by characteristics are due to missing values for that characteristic

^cPercentages and confidence intervals were weighted

HIV Results

Of the 178 clients who were HIV-tested, 39 (23.0%) returned for HIV results. Of the 177 clients who provided information on previous HIV testing, 57 (26.4%) reported having ever been HIV-tested, and 1 reported having tested HIV-positive in the past. The HIV prevalence for clients was 20.0% (95% CI 12.1–31.2%). Of those clients who tested positive for HIV ($n=39$), 23.5% (unweighted) were married, and 87.3% (unweighted) reported more than 1 sexual partner in the last month. Condom use among HIV-positive clients was high: 92.6%, 77.7%, and 88.2% with regular, casual, and FSW partners, respectively (unweighted).

All nonpaying partners accepted HIV testing, and 9 (6.9%) returned for HIV results; 32 (38.3%) reported having previously had an HIV test, and none reported ever having tested HIV-positive in the past. The HIV prevalence for nonpaying partners was 15.1% (95% CI 3.2–30.9%). In the data reported from Thailand, the adjusted HIV prevalence for the FSW in this study was 20% (95% CI 16–25%).³⁷ Among all FSWs recruited, 67% reported having previously had a HIV test, but data regarding knowledge of previous HIV test result were not available as few women completed this questions in the FSW survey.³⁷

Bivariate analyses of factors associated with HIV infection in clients are summarized in Table 2. Clients whose first sexual experience was at age <20 years had a higher relative risk of being HIV-positive (RR=3.10, 95% CI 1.16–8.24) compared to clients whose first sexual experience was ≥ 20 years. Clients who used a condom during last sexual encounter with regular partner had a higher relative risk of being HIV-positive (RR=3.97, 95% CI 1.09–14.61).

HIV-Discordant Partner Pairs

Among 178 FSWs who recruited a client, 56 (31.4%) FSW–client pairs were HIV-discordant (Figure 2). Among the FSW–client-discordant pairs, the FSW was HIV-positive, and the client was HIV-negative in 26 cases (46.4%). Among the 79 FSWs who recruited a nonpaying partner, 14 (17.7%) FSW–nonpaying partner pairs were HIV-discordant. Among the 45 FSWs who recruited both a client and nonpaying partner, all 45 FSWs were HIV-negative; however, 11 (24.4%) had a client who was HIV-positive while her nonpaying partner was HIV-negative, and 4 (8.9%) had a nonpaying partner who was HIV-positive while her client was HIV-negative.

Among HIV-discordant FSW–client pairs, 90.1% of clients reported condom use during the last sexual encounter with an FSW and 73.4% during the last sexual encounter with their regular partner. Among HIV-discordant FSW–nonpaying partner pairs, 18.7% of nonpaying partners reported condom use during the last sexual encounter with their regular partner.

DISCUSSION

The high HIV prevalence for both clients and nonpaying partners in this survey makes these among the highest HIV risk subpopulations in Bangkok, Thailand. In comparison, Bangkok's HIV prevalence in persons who injected drugs was 28% in 2007,³⁸ 31% among MSM in 2007,^{39, 40} and 2.5% in among FSWs surveyed during sentinel surveillance in 2007.⁴¹ Though almost all partners were tested for HIV, there was a poor rate of return for test results, suggesting that most partners of FSWs are aware of their HIV status. Our study was unable to determine why using condoms with a regular partner was associated with HIV positivity. Future studies

TABLE 2 Behavioral characteristics associated with HIV infection in clients of FSWs—Bangkok, Thailand, 2007

Characteristic	<i>n</i> (unweighted) ^a		Weighted		
	HIV+	HIV−	% HIV+	RR	95% CI
Age					
<40	17	74	19.8	0.97	0.37–2.53
≥40	22	62	20.3	Referent	Referent
Education					
None/primary	25	94	20.9	1.15	0.42–3.17
Secondary/university	13	38	18.1	Referent	Referent
Age at first intercourse in years					
<20	27	91	25.8	3.10	1.16–8.24 ^b
≥20	12	45	8.3	Referent	Referent
Currently married					
Yes	11	49	11.3	0.43	0.15–1.24
No	28	87	26.2	Referent	Referent
Number of sexual partners in last month					
0–1	5	12	47.3	2.09	0.74–5.86
2 or more	32	103	22.8	Referent	Referent
Ever had sex with a male					
Yes	4	15	15.0	0.73	0.20–2.61
No	35	121	20.6	Referent	Referent
Condom use during last sexual encounter with regular partner					
Yes	15	55	24.6	3.97	1.09–14.61
No	7	27	6.2	Referent	Referent
Condom use during last sexual encounter with casual partner					
Yes	19	78	19.9	0.76	0.22–2.64
No	6	13	26.1	Referent	Referent
Condom use during last sexual encounter with FSW partner					
Yes	27	107	18.5	0.79	0.25–2.45
No	8	16	23.5	Referent	Referent
Used injection drugs in last 12 months					
Yes	1	7	2.6	0.13	0.01–1.45
No	38	129	20.8	Referent	Referent
Drank alcohol in last month					
Yes	25	87	23.9	1.65	0.63–4.31
No	14	48	14.5	Referent	Referent
Had any STI symptoms in last month					
Yes	12	35	19.8	0.98	0.36–2.68
No	27	101	20.1	Referent	Referent

^aDifferences in counts of individuals by characteristics are due to missing values for that characteristic

^b*p* value<0.05

should consider including more questions regarding knowledge of the partner's HIV status or a willingness to protect one's regular partner as potential associations.

This is the first reported study of partners of FSWs where FSWs initiated the recruitment of their male partners. Results from this study indicate that FSW-initiated recruitment of their partners is a feasible method of sampling hard-to-reach partner populations. In previous surveys of partners, recruitment has been investigator-driven; therefore, verification of client status was challenging and often not possible. With an FSW-initiated client recruitment method, because FSWs recruit

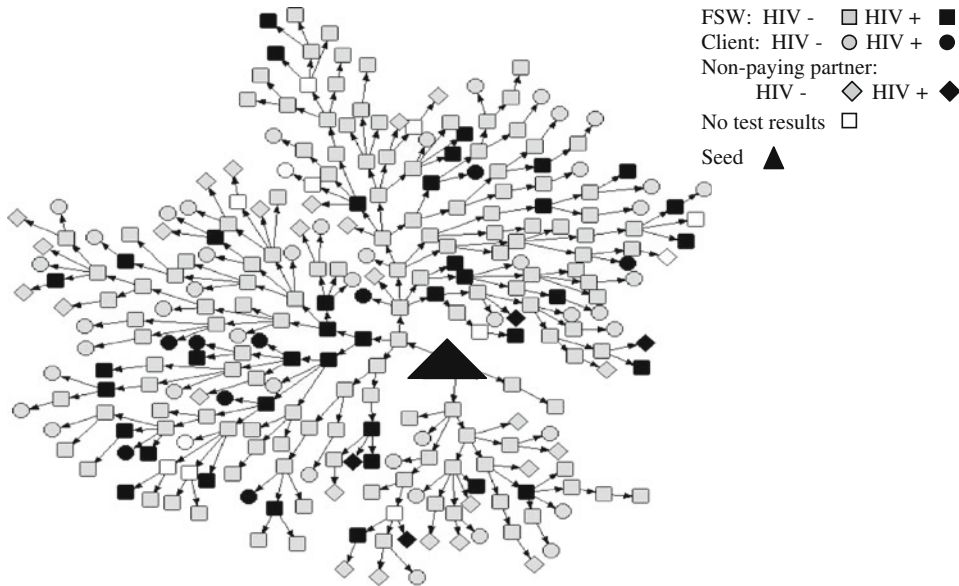


FIGURE 2. HIV status among recruited FSWs and partners, Bangkok, Thailand, 2007. Recruitment pattern is based on 1 of 7 seeds.

known clients, survey participants may be more likely to be clients of FSWs, reducing misclassification bias. Building client recruitment on a systematic method of FSW recruitment may also produce a more representative sample than obtained with convenience sampling. The successful enrollment of the targeted client sample size by their FSW suggests that clients are willing to participate in survey activities.

Despite the very successful targeted condom prevention messages in the sex industry in the 1990s, there is no 100% condom use among FSWs and their clients and other partners.^{11, 21} The current study confirms these findings and specifically identifies inconsistent condom use among serodiscordant FSW pairs, both with clients and nonpaying partners. Such high-risk behaviors increase the risk of HIV transmission, not only between FSWs and clients but also to their other sexual partners. Additionally, many partners (both clients and nonpaying) who tested positive for HIV were married or had other sexual partners who are also at increased risk for HIV acquisition due to inconsistent condom use. Through these high-risk behaviors, sexual partners of FSWs can serve as a bridge for introducing HIV into other populations. Further research and prevention programs should focus on sexual behaviors among discordant partners, and on increasing HIV testing for partners of clients and nonpaying partners of FSW.

This study is subject to the following limitations. First, a selection bias may have been introduced, as only a consecutive subsample of FSW recruits were asked to recruit a partner and the FSW may not have randomly selected a partner to refer from among her network of partners. Second, since data were not collected from partners who refused a coupon from FSWs, assessing if there were differences between the clients recruited and those who refused was not possible. Third, though we tried to minimize the inclusion of nonpaying partners into the client population by allowing them to be recruited separately, there may have been participants who were not true clients but were included in the clients sample due to incentives and remuneration. Fourth, most participants requested a face-to-face interview, which may have introduced a response bias on sensitive questions such as condom use,

HIV status, prior HIV testing, or drug use. Fifth, since a majority of FSWs recruited were nonvenue-based, clients and nonpaying partners may not be representative of all FSW partners. Sixth, since the study was not powered for multivariate analysis, assessing characteristics that were independently associated with HIV was limited. Additionally, since the study was not powered for analysis of the nonpaying partners, analyses of this population were limited. Seventh, social desirability bias may have led to overreporting of condom use—especially with the interviewer-administered questionnaires—which could have obscured the protective effect of condom use and created a spurious association between condom use and HIV infection.^{42, 43} Furthermore, since clients and nonpaying partners were permitted to come to the study sites to complete the questionnaire at their convenience, we were unable to confirm or correlate condom use during last sexual encounter with the FSW who recruited them. Lastly, all data analyses were based on FSWs' self-reported peer network size and number of clients, which cannot be validated for accuracy.

In 2001, the HIV prevalence in Thai military recruits, who have been used as a proxy population for FSW clients, was estimated to be <1%.^{44, 45} In addition to a higher prevalence of HIV, rates of IDU and sex with a male partner in this study population were higher than in the general population (IDU 1.0% and sex with male 2.7%).^{46, 47} These findings observed within both the client and nonpaying partner populations suggest that instead of using proxy estimates or estimated from the general population for partners of FSWs, improved surveillance or inclusion of FSW partners into annual sentinel surveillance should be considered to provide a better understanding of the HIV trends to inform targeted interventions and prevention programs for this population. Additionally, a more concentrated effort should be directed to returning results including alternative methods for HIV testing such as sequential rapid testing or additional incentives for participants who return for results. Since this study was successful at FSW-initiated client recruitment and participation, future studies can consider having clients recruit their client peers or their other partners into HIV studies. Lastly, to improve the accuracy of risk behavior reporting in future studies and because audio-assisted handheld computers were not the preferred method for survey participation, other methods for data collection should be considered, such as surveys administered using an audio recording of questions with paper-based questionnaires.¹² Results from this study highlight the potentially significant role clients and all sexual partners of FSWs play in the HIV epidemic in Thailand and that consideration should be given to the development of HIV prevention programs specifically targeted for these high-risk populations.

ACKNOWLEDGMENTS

The authors thank all those who participated in the study, the local organizations that assisted with the study enrollment and data collection, and the Thailand Ministry of Health. The authors are also thankful to Douglas Heckathorn and Matt Salganik who provided guidance for data analysis, Lisa Johnston who conducted the RDS training, and Dana Dolan who helped with editing the manuscript. Support for this analysis was provided by the Epidemic Intelligence Service Program in Atlanta, United States, the President's Emergency Plan for AIDS Relief in Atlanta, USA, the Bangkok Metropolitan Administration, Bangkok, Thailand, and the Thailand Ministry of Public Health—US Centers for Disease Control and Prevention Collaboration, Bangkok.

Disclaimer. The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

REFERENCES

1. The World Bank. Thailand's response to AIDS: Building on success, confronting the future. *Thailand Social Monitor*. November 5, 2000.
2. Weiniger B, Limpakarnjanarat K, Ungchusak K, et al. The epidemiology of HIV infection and AIDS in Thailand. *AIDS*. 1991;5(Supplement):71-86.
3. Ungchusak K, Thanprasertsuk S, Sriprapandh S, Chokevivat V, Pinichpongse S, Kunasol P. The national sentinel seroprevalence survey for HIV-1 infection in Thailand. *Thai AIDS J*. 1990;2:45-56.
4. World Health Organization South-East Asia Regional Office and Ministry of Public Health Thailand. External Review of the Health Sector Response to HIV/AIDS in Thailand, 2005. http://www.searo.who.int/LinkFiles/News_and_Events_ThailandProgrammeReviewNEW.pdf Accessed 5 Aug 2008.
5. Kilmarx P, Palanuvej T, Limpakarnjanarat K, et al. Seroprevalence of HIV among female sex workers in Bangkok: Evidence of ongoing infection risk after the "100% Condom Program" was implemented. *J Acquir Immune Defic Syndr*. 1999;21(4):313-316.
6. Nelson K, Celentano D, Eiumtrakol S, et al. Changes in sexual behavior and a decline in HIV infection among young men in Thailand. *N Engl J Med*. 1996;335:297-303.
7. Celentano D, Nelson K, Lyles C, et al. Decreasing incidence of HIV and sexually transmitted diseases in young Thai men: Evidence for success of the HIV/AIDS control and prevention program. *AIDS*. 1998;12:F29-F36.
8. Pisani E, Brown T. *AIDS in Asia: Face the Facts*. Washington, DC: Monitoring the AIDS Pandemic; 2004.
9. Monitoring the AIDS Pandemic Network. *MAP Report 2005: Sex Work and HIV in Asia*. Washington, DC; 2005.
10. Brown T, Peerpatarapokin W. The Asian Epidemic Model: A process model for exploring HIV policy and programme alternatives in Asia. *Sex Transm Infect*. 2004;80:i19-i24.
11. Chamrathirong A, Kittisuksathit S, Podhisita C, Isarabhakdi P, Sabaiying M. National Sexual Behavior Survey of Thailand 2006. Nakhon Pathom: Institute for Population and Social Research, Mahidol University; 2007.
12. Nguyen NT. *Risk Factors and the HIV/AIDS Situation Among Female Sex Workers' Clients in Hai Phong City, Vietnam*. Los Angeles: Epidemiology, UCLA; 2007.
13. Wilson D, Chiroro P, Lavelle S, Mutero C. Sex worker, client sex behavior and condom use in Harare, Zimbabwe. *AIDS Care*. 1989;1(3):269-280.
14. Barnard M, McKeganey N, Leyland A. Risk behaviors among male clients of female prostitutes. *BMJ*. 1993;307(6900):361-362.
15. Lowndes C, Alary M, Gnintoungbé C, et al. Management of sexually transmitted diseases and HIV prevention in men at high risk: Targeting clients and non-paying sexual partners of female sex workers in Benin. *AIDS*. 2000;14:2523-2534.
16. Pickering H, Todd J, Dunn D, Pepin J, Wilkins A. Prostitutes and their clients: A Gambian survey. *Soc Sci Med*. 1992;34(1):75-88.
17. Ford K, Wirawan D. Condom use among brothel-based sex workers and clients in Bali, Indonesia. *Sex Health*. 2005;2:89-96.
18. Ford K, Chamrathirong A. Sexual partners and condom use of migrant workers in Thailand. *AIDS Behav*. 2007;11:905-914.
19. Day S, Ward H, Perrotta L. Prostitution and risk of HIV: Male partners of female prostitutes. *BMJ*. 1993;307(6900):359-361.
20. Chopra MM, Townsend LM, Johnston LP, et al. Estimating HIV prevalence and risk behaviors among high-risk heterosexual men with multiple sex partners: Use of respondent-driven sampling. *J Acquir Immune Defic Syndr*. 2009;51(1):72-77.

21. Guest P, Prohmo A, Bryant J, Janyam S, Phuengsamran D. Survey of sexual and reproductive health of sex workers in Thailand. Nakohn Pathom: Institute for Population and Social Research, Mahidol University; 2007.
22. Heckathorn D. Respondent-driven sampling: A new approach to the study of hidden populations. *Soc Probl.* 1997;44(2):174-199.
23. Heckathorn D. Respondent-driven sampling II: Deriving valid population estimates from chain-referral samples of hidden populations. *Soc Probl.* 2002;49(1):11-34.
24. Tun W, de Mello M, Pinho A, Chinaglia M, Diaz J. Sexual risk behaviours and HIV seroprevalence among male sex workers who have sex with men and non-sex workers in Campinas, Brazil. *Sex Transm Infect.* 2008;84(6):455-457.
25. Deiss R, Brouwer K, Loza O, et al. High-risk sexual and drug using behaviors among male injection drug users who have sex with men in 2 Mexico-US border cities. *Sex Transm Dis.* 2008;35(3):243-249.
26. Wattana W, van Griensven F, Rhucharoenpornpanich O, et al. Respondent-driven sampling to assess characteristics and estimate the number of injection drug users in Bangkok, Thailand. *Drug Alcohol Depend.* 2007;90(2-3):228-233.
27. Shahmanesh M, Cowan F, Wayal S, Copas A, Patel V, Mabey D. The burden and determinants of HIV and sexually transmitted infections in a population based sample of female sex workers in Goa, India. *Sex Transm Infect.* 2009;85(1):50-59.
28. Colby D, Minh T, Toan T. Down on the farm: Homosexual behaviour, HIV risk and HIV prevalence in rural communities in Khanh Hoa province, Vietnam. *Sex Transm Infect.* 2008;84(6):439-443.
29. Malekinejad M, Johnston L, Kendall C, Kerr LRFS, Rifkin MRR, Rutherford G. Using respondent-driven sampling methodology for HIV biological and behavioral surveillance in international settings: A systematic review. *AIDS Behav.* 2008;12:S105-S130.
30. *Respondent Driven Sampling Analysis Tool* [computer program]. Version 6.0.1. Ithaca, NY; 2004.
31. *SUDAAN* [computer program]. Version 9.0.3. Research Triangle Park, NC.
32. Salganik M, Heckathorn D. Sampling and estimation in hidden populations using respondent-driven sampling. *Sociol Methodol.* 2004;34:193-239.
33. Johnston L, Malekinejad M, Kendall C, Iuppa I, Rutherford G. Implementation challenges to using respondent-driven sampling methodology for HIV biological and behavioral surveillance: field experiences in international settings. *AIDS and Behavior.* 2008;12:131-141.
34. Heckathorn D. Note on Weighting Partners in RDS Studies. In: Shah N, ed. *Personal Communication*; 2007.
35. Goel S, Salganik M. Respondent-Driven Sampling as Markov Chain Monte Carlo. Paper presented at: Consultation on the Analysis of Data Collected Through Respondent Driven Sampling, Atlanta, GA; 2008.
36. Heckathorn D. Assumptions of RDS: Analytic vs. Functional Assumptions. Paper presented at: Consultation on the Analysis of Data Collected Through Respondent Driven Sampling; 2008; Atlanta, GA.
37. Manopaiboon C, Whitehead S, Subhachaturas W, et al. Unexpectedly high HIV prevalence among Thai sex workers in a respondent-driven sampling survey. Paper presented at: Australasian Society for HIV Medicine, Perth, Australia; 2008.
38. Bureau of Epidemiology. Reporting of HIV Infection Situation in Thailand, 2007. Department of Disease Control Bangkok: Thailand Ministry of Public Health; 2007.
39. Plipat T, Kratsawad K. HIV prevention among men who have sex with men. In: Bureau of Epidemiology, Department of Disease Control, Thailand: Ministry of Public Health; 2008.
40. Centers for Disease Control and Prevention. HIV prevalence among populations of men who have sex with men—Thailand, 2003 and 2005. *MMWR Morb Mortal Wkly Rep.* 2006;55(31):844-848.

41. Bureau of Epidemiology. Results of HIV sentinel-surveillance classified by population in Thailand, 2007. In: Department of Disease Control Bangkok: Thailand Ministry of Health; 2007.
42. Zenilman J, Weisman C, Rompalo A, et al. Condom use to prevent STDs: the validity of self-reported condom use. *Sex Transm Infect.* 1995;22:15-21.
43. Turner C, Miller H. Zenilman's anomaly reconsidered: fallible reports, ceteris paribus, and other hypotheses. *Sex Transm Infect.* 1997;24:522-527.
44. National AIDS Prevention and Alleviation Committee. UNGASS Country Progress report—Thailand. http://data.unaids.org/pub/Report/2008/thailand_2008_country_progress_report_en.pdf. Accessed 28 Jul 2008.
45. UNAIDS. Fact Sheet: HIV/AIDS and Uniformed Services. http://data.unaids.org/Topics/Security/fs_uniformedservices_en.pdf. Accessed 11 Aug 2008.
46. Bureau of Epidemiology. *Behavioral Surveillance System among General Population Age 15-49 Years in Regards to HIV, Thailand, 2004*. Bangkok: Department of Disease Control; 2006.
47. Cáceres C, Konda K, Pecheny M, Chatterjee A, Lyerla R. Estimating the number of men who have sex with men in low and middle income countries. *Sex Transm Infect.* 2006;82:iii3-iii9.