PREVALENCE OF SEXUALLY TRANSMITTED INFECTIONS AND SEXUAL RISK BEHAVIOR AMONG FEMALE SEX WORKERS IN NINE PROVINCES IN INDONESIA, 2005

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Abstract. The objective of this study was to assess the sexually transmitted infection (STI) prevalence and sexual risk behavior among female sex workers (FSWs) in Indonesia. This cross-sectional 2005 study involved 2,500 FSWs in nine provinces in Indonesia. Informed consent was obtained; behavioral and clinical data were collected. Specimens were collected for STI testing, endocervical swabs were tested for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* (PCR), vaginal smears were cultured to detect *Trichomonas vaginalis* and sera were tested for syphilis (RPR and TPHA). The prevalence of chlamydial infection was 43.5%, gonorrhea 28.6%, trichomoniasis 15.1%, and syphilis 8.7%; the prevalence of any STI was 64.0%. Inconsistent condom use, younger age, and higher number of clients were independent risk factors for the presence of gonorrhea/chlamydia. Inconsistent condom use was common (73.2%); starting sex work at younger age, and higher number of clients were independent risk factors. Vaginal douching was reported by 89.6% of FSWs; no association with gonorrhea/chlamydial infection was found. This study identified a high STI prevalence and low consistent condom use among FSWs in Indonesia. This will need to be addressed to prevent further spread of infections, including HIV.

Key words: sexually transmitted infection, female sex worker, condom, vaginal douching, Indonesia

INTRODUCTION

Control of sexually transmitted infections (STIs) is important for prevention of STI sequelae, such as pelvic inflammatory disease, ectopic pregnancy, infertility and chronic abdominal pain (Donovan, 2004). In addition, STIs fuel the HIV epidemic by increasing the risk of HIV acquisition (Røttingen *et al*, 2001; Donovan, 2004) and by increasing HIV infectiousness among those already infected with HIV (Cohen

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et al, 1997; Rothenberg *et al*, 2000). Successful STI prevention programs in Thailand have had a major impact on reducing the spread of HIV infection (Hanenberg *et al*, 1994).

Several studies since the 1990s have shown a high prevalence of gonorrhea and chlamydia among female sex workers (FSWs), using different detection methods, in East Java (Joesoef *et al*, 1997), West Timor (Davies *et al*, 2003) and Bali (Ford *et al*, 2002). Conference papers from early 2000 reported gonorrhea/chlamydia prevalences (amplification assay) among FSWs ranging between 35% and 68% in Jayapura, Papua (Donegan *et al*, 2003), Surabaya, East Java (Donegan *et al*, 2003), and Denpasar, Bali (Schachter *et al*, 2005). The gonorrhea prevalence among FSWs visiting the same STI clinic in Denpasar decreased from 61% in 1997 (Ford *et al*, 2002) to 35% in 2004 after strengthening STI services (Schachter *et al*, 2005).

In addition, condom use in commercial sex remains low in Indonesia. Only 3% of the 200 sex workers surveyed in 2000 in Jakarta reported consistent condom use and 30% reported never using condoms (Sugihantono *et al*, 2003). A national behavioral survey in 2004 among seven thousand FSWs from sixteen cities in Indonesia showed only one third used condoms with their clients during the previous week (Ministry of Health, 2005).

Although the situation in Bali has been well documented (Ford *et al*, 2002; Ford and Wirawan, 2005; Schachter *et al*, 2005), only limited information about STI prevalence and risk behavior among female sex workers from other parts of Indonesia is available. We assessed the STI prevalence and risk behavior among FSWs in ten major cities of nine provinces in Indonesia. In addition, we studied factors associated with gonorrhea/chlamydia and inconsistent condom use. These findings will inform policy and contribute to the design of interventions to control the spread of STIs, including HIV.

MATERIALS AND METHODS

Sampling and study procedures

This cross-sectional study was conducted in ten major cities of nine provinces in Indonesia (Medan - North Sumatera, Tanjung Pinang - Riau Island, Palembang - South Sumatra, West Jakarta, Bandung - West Java, Semarang - Central Java, Surabaya and Banyuwangi - East Java, Manado - North Sulawesi, and Jayapura - Papua) between February and July 2005.

Individual FSWs were selected through three-stage, time-location sampling. First, a sample of census blocks was chosen via systematic-random sampling with a probability proportional to the estimated number of FSWs working at venues located within the block. Separate sampling frames for street, brothel and entertainment-based sex workers, were developed on sample census blocks from mappings of sex-work venues (produced jointly by non-governmental organizations providing services to FSW); systematic-random samples of venues were chosen from each group via systematic-random sampling with probability proportional to venue size. Finally, systematic-random samples were chosen from the women appearing at each site on a randomly chosen day and time period.

All FSWs received an invitation card to attend the STI clinic, only 350 cards per city were marked for study participation. Study participation invitation cards were distributed randomly proportional to venue size. FSWs received the same benefits at the clinic regardless of their type of invitation card and their participation status.

Study teams visited selected clusters of sex work venues and briefly explained the project to FSWs. They provided invitation cards, including the study clinic address and contact details, and invited the FSWs to visit the clinic for STI services and study participation. Data were collected from FSWs age 15-50 years old who visited the clinic with a study participation card; 250 participants were randomly selected per city from this sample.

Female interviewers received a 3-day training, including an overview of the study, ethical issues related to human subjects, interview techniques, and they received an explanation of the questionnaire. Interviewers explained the study objectives, procedures, benefits and risks to potential participants. The form was read in Bahasa Indonesian and verbal informed consent was provided by the participant. The consent form, containing the participant study code, was signed by a witness.

Behavioral data were collected during face-to-face interviews and included information on demographics, duration of sex work, number of partners during the previous week, condom use, visits to STI clinics and practice of vaginal douching. Vaginal douching was differentiated into self-douching and douching provided by a nurse at the establishment (a common practice in Indonesia and provided by a private nurse upon request by the sex worker or establishment owner). Midwives collected information regarding history of STIs, performed genital examinations and collected endocervical swabs.

This project was approved by the ethics committees and review boards of the National Institute for Health Research and Development from the Indonesian Ministry of Health and the Family Health International Protection of Human Subjects Committee. Participants with a minimum age of 15 years were considered appropriate for this study since youth receive reproductive health services in Indonesia without parental consent. In addition, information about this vulnerable group of young sex workers was considered important.

Laboratory analysis

Serum was tested for syphilis in local laboratories using the Rapid Plasma Reagin (RPR) test (BD Diagnostics, Maryland, MD) as a screening test and the *Treponema pallidum* hemagglutination assay (TPHA; Fuji-rebio, Tokyo, Japan) as a confirmatory test. Specimens with both positive RPR and TPHA results were tittered until 1:128 dilution.

Endocervical swabs were placed in transport media and sent to the laboratory of the National Institute of Health Research and Development for detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* by polymerase chain reaction analysis (Roche Amplicor Diagnostic System, Basel, Switzerland). Smears were collected from the posterior fornix and cultured in local laboratories for detection of *Trichomonas vaginalis* (InPouch, Biomed Diagnostics, White City, OR).

Endocervical swabs and cervicovaginal smears were examined by light microscopy and treatment was provided free of charge on the same day, based on patient evaluation per national STI treatment guidelines (*eg*, treatment of cervicitis presumptively due to gonorrhea/chlamydia with 400 mg cefixime and 1 g azithromycin).

Statistical analysis

Double data entry was performed using Microsoft Excel. Data were analyzed and statistical tests performed using Stata 7.0 (Stata Corporation, Texas City, TX). The category "any STI" included positive test

results for gonorrhea, chlamydia, trichomoniasis or syphilis. Active syphilis was defined by a positive TPHA with a RPR titer $\geq$1:8. Risk factors for gonorrhea and/or chlamydial infection were assessed to identify possibilities for targeted intervention.

Descriptive statistics were used to describe variables in terms of frequency, mean, median and range. The prevalence of infection was assessed with 95% exact binomial confidence intervals (CIs). Frequency data were analyzed by chi-square test, a *p*-value <0.05 was considered significant. Factors thought to be associated with gonorrhea/chlamydia or inconsistent condom use were analysed with bivariate and multivariate models; continuous variables were compared using median levels. Logistic regression analysis was used to calculate odds ratios (OR) with 95% CIs. Multivariate analysis was carried out using factors with $p<0.2$ on bivariate analysis and following backward stepwise elimination; significant risk factors with $p<0.05$ were retained in the model.

RESULTS

An average of 330 invitation cards (range 278-332) were distributed to FSWs at selected blocks in each city; of those invited, 87% to 100% visited the clinics. Samples from 250 FSWs were obtained in each city providing a total sample size of 2,500 FSWs. No street-based FSWs were identified in Jayapura - Papua, Tanjung Pinang - Riau Island or West Jakarta. No brothels were found in Bitung - North Sulawesi, Medan - North Sumatra or West Jakarta and no entertainment-based FSWs were identified in Banyuwangi - East Java.

The demographics and sexual behaviors of the 2,500 FSWs are presented in Table 1. The study population consisted of brothel-based (42.6%), street-based (17.1%) and entertainment-based FSWs (40.3%). The median age was 25 years (range 15-49 years). About half the FSWs reported having a steady partner (44.6%) (Table 1). The median age when women sold sex for the first time was 24 years old; the median duration of selling sex was one year. A high proportion of FSWs (89.6%) reported vaginal douching during the previous week and some (9.9%) reported having douching performed by a nurse (Table 1). Only 26.8% of FSWs reported consistent condom use with clients during the previous week and 23.5% acknowledged never using condoms.

The overall STI prevalence among FSWs in the ten cities of nine provinces in Indonesia was 64.0% (95% CI 62.1-65.8); 55.6% (95% CI 53.7-57.6) of FSWs had chlamydia, gonorrhea or both. The prevalence of chlamydia infection was 43.5% (95% CI 41.6-45.5), gonorrhea 28.6% (95% CI 26.9-30.5), and trichomoniasis 15.1% (95% CI 13.7-16.5). The seroprevalence of syphilis was 8.7% (95% CI 7.6-9.9) and the prevalence of active syphilis was 3.5% (95% CI 2.8-4.3). The prevalence was high across provinces, especially chlamydia (56.4%) in Central Java, gonorrhea (44.0%) in South Sumatra, trichomoniasis (23.6%) in Papua and syphilis (22.4%) in North Sumatra (Fig 1).

Brothel-based and street-based sex workers were at higher risk for gonorrhea/chlamydia compared to entertainment-based sex workers; this remained statistically significant on multivariate analysis [Adjusted OR (AOR)] 1.6 and 1.4, respectively) (Table 2). Independent risk factors for STI detection included age younger than 25 years (AOR 2.0), primary education or less (AOR 1.2), selling sex for less than one year (AOR 1.4), and inconsistent condom use in the previous week (AOR 1.3) (Table 2).

Table 1
Demographics, behavioral characteristics and sexually transmitted infections (STIs) among 2,500 female sex workers in nine provinces in Indonesia, 2005.

	n (%)
General	
Median age, years (IQR)	25 (15-49)
Marital status	
Single	543 (21.7%)
Married	352 (14.1%)
Separated	1,441 (57.7%)
Widow	163 (6.5%)
Steady partner	1,114 (44.6%)
None or primary education completed	1,124 (45.0%)
No contraception	832 (33.3%)
Venue	
Entertainment (karaoke, massage, bar, restaurant)	1,008 (40.3%)
Brothel	1,065 (42.6%)
Street	427 (17.1%)
Behavioral	
Median age at first selling sex, years (IQR)	24 (13-48)
Median duration of sex work, months (IQR)	12 (0.1-240)
Douching during previous week	2,224 (89.6%)
Douching performed by nurse during previous week	247 (9.9%)
Number of clients previous week (IQR)	4 (2-9)
Brothel	7 (4-12)
Street	3 (1-5)
Entertainment (karaoke, massage, bar, restaurant)	3 (1-7)
Condom use with clients during previous week	
Always	668 (26.8%)
Sometimes	1,238 (49.7%)
Never	586 (23.5%)
Used condom at last sex with client	1,264 (50.7%)
Number of visits to STI clinic in previous 3 months	
Never	1,406 (56.2%)
Once	408 (16.3%)
More than once	686 (27.4%)
Source of treatment at last episode of STI among those reporting STI symptoms during the previous year	
Doctor	349 (33.2%)
Self-treatment at drugstore	383 (36.4%)
Traditional treatment	128 (12.2%)
No treatment	192 (18.3%)
Number of contacts by outreach worker during previous 3 months	
Never	997 (39.9%)
Once	409 (16.4%)
More than once	1,067 (42.7%)

IQR, Inter quartile range (25%-75%); Numbers may vary due to missing data.

Table 2
Factors associated with gonorrhea and/or chlamydial infection among 2,500 female sex workers in nine provinces in Indonesia, 2005.

Factor	Gonorrhea and/or chlamydia infection			
	Unadjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
Province				
North Sulawesi	1		1	
North Sumatra	1.0 (0.8 - 1.3)	0.9	1.8 (1.2 - 2.7)	0.002
Riau	1.8 (1.4 - 2.3)	<0.001	1.5 (0.98 - 2.2)	0.06
South Sumatra	1.9 (1.5 - 2.5)	<0.001	1.9 (1.3 - 2.9)	0.002
Jakarta	1.2 (0.9 - 1.7)	0.2	1.5 (0.96 - 2.2)	0.07
West Java	2.5 (1.8 - 3.4)	<0.001	1.9 (1.2 - 2.8)	0.003
East Java	1.8 (1.4 - 2.3)	<0.001	2.7 (1.8 - 4.0)	<0.001
Central Java	2.0 (1.6 - 2.6)	<0.001	2.2 (1.5 - 3.2)	<0.001
Papua	1.3 (1.0 - 1.7)	0.04	2.2 (1.5 - 3.3)	<0.001
Sex work venue				
Entertainment	1		1	
Brothel	1.6 (1.4 - 1.8)	<0.001	1.6 (1.3 - 2.0)	<0.001
Street	1.3 (1.1 - 1.6)	0.004	1.4 (1.1 - 1.9)	0.02
Age				
≥ 25 years old	1		1	
< 25 years old	2.1 (1.9 - 2.4)	<0.001	2.0 (1.7 - 2.4)	<0.001
Completed education				
More than primary	1		1	
None or primary	1.2 (1.0 - 1.4)	0.05	1.2 (1.04 - 1.5)	0.02
Median age start selling sex				
≥ 24 years old	1		-	-
< 24 years old	1.8 (1.6 - 2.1)	<0.001		
Duration of sex work				
≥ 1 year	1		1	
< 1 year	1.8 (1.6 - 2.1)	<0.001	1.4 (1.2 - 1.7)	<0.001
Number of partners previous week				
< 4 clients	1		-	-
≥ 4 clients	1.5 (1.3 - 1.7)	<0.001		
Condom use with clients previous week				
Consistent	1		1	
Inconsistent	1.6 (1.4 - 2.9)	<0.001	1.3 (1.1 - 1.6)	0.005
Self douching previous week				
No	1		-	-
Yes	0.9 (0.7 - 1.1)	0.3		
Douching performed by nurse previous week				
No	1		-	-
Yes	0.6 (0.5 - 0.8)	<0.001		
STI clinic visits during previous 3 months				
≥ 2 times	1		-	-
Once	0.9 (0.7 - 1.1)	0.2		
Never	1.0 (0.8 - 1.2)	0.7		
Last STI treatment				
Clinic	1		-	-
Traditional/self or none	1.1 (0.9 - 1.5)	0.4		

CI, Confidence interval; OR, Odds ratio

Table 3
Factors associated with inconsistent[a] condom use during the previous week with a client among 2,500 female sex workers in nine provinces in Indonesia, 2005.

Factor	Inconsistent condom use			
	Unadjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
Province				
North Sulawesi	1		1	
North Sumatra	0.3 (0.2 - 0.4)	<0.001	0.3 (0.2 - 0.5)	<0.001
Riau	0.9 (0.6 - 1.3)	0.5	0.8 (0.5 - 1.4)	0.5
South Sumatra	1.4 (0.9 - 2.1)	0.2	1.1 (0.7 - 1.8)	0.7
Jakarta	0.6 (0.4 - 0.9)	0.2	0.7 (0.5 - 1.2)	0.2
West Java	1.0 (0.7 - 1.6)	0.9	0.6 (0.4 - 0.9)	0.02
East Java	1.4 (0.9 - 2.0)	0.1	0.9 (0.6 - 1.4)	0.7
Central Java	1.2 (0.8 - 1.8)	0.5	0.9 (0.5 - 1.4)	0.6
Papua	0.5 (0.3 - 0.7)	<0.001	0.6 (0.4 - 0.9)	0.02
Sex work venue				
Entertainment	1		1	
Brothel	3.4 (2.8 - 4.2)	<0.001	2.3 (1.8 - 3.0)	<0.001
Street	2.6 (2.0 - 3.5)	<0.001	2.8 (2.0 - 3.8)	<0.001
Age				
≥ 25 years old	1		-	
< 25 years old	1.9 (1.6 - 2.3)	<0.001		
Completed education				
None or primary	1		-	
More than primary	0.9 (0.7 - 1.1)	0.2		
Median age started selling sex				
≥ 24 years old	1		1	
< 24 years old	2.0 (1.7- 2.5)	<0.001	1.7 (1.7 - 2.0)	<0.001
Duration of sex work				
≥ 1 year	1		1	
< 1 year	1.2 (1.0 - 1.4)	0.08	-	
Number of partners previous week				
< 4 clients	1		1	
≥ 4 clients	2.5 (2.5 - 3.3)	<0.001	2.5 (2.0 - 2.5)	<0.001
Self douching previous week				
No	1		-	
Yes	1.1 (0.9 - 1.5)	0.4		
Douching performed by nurse previous week				
No	1		1	
Yes	0.3 (0.2 - 0.4)	<0.001	0.4 (0.3 - 0.6)	<0.001
STI clinic visits during previous 3 months				
≥ 2 times	1		-	
Once	1.2 (0.9 - 1.6)	0.3		
Never	1.0 (0.8 - 0.3)	0.9		
Outreach worker contacts during previous 3 months				
≥ 2 times	1		-	
Once	1.4 (1.4 - 2.0)	<0.01		
Never	1.3 (1.0 - 1.4)	0.09		

[a]Inconsistent condom use was defined as using condoms sometimes or never.
CI, Confidence interval; OR, Odds ratio

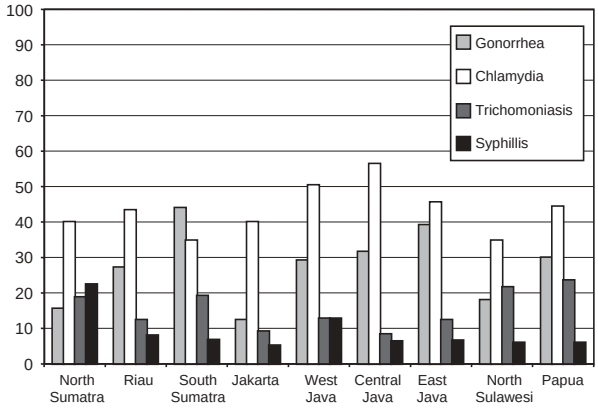

Fig 1–Prevalence of gonorrhea, chlamydia, trichomoniasis and syphilis among female sex workers in nine provinces in Indonesia, 2005.

Brothel-based and street-based sex workers were at higher risk for inconsistent condom use with clients, compared to entertainment-based sex workers (AOR 2.3 and 2.8, respectively) (Table 3). Independent risk factors for inconsistent condoms use with clients included starting sex work at younger age (AOR 1.7) and having had more than four clients in the previous week (AOR 2.5). Women who reported vaginal douching performed by paramedics in the previous week were less likely to use condoms inconsistently with clients compared to those who did not report this behavior (AOR 0.4).

DISCUSSION

The prevalence of chlamydia infection, gonorrhea, syphilis and trichomoniasis was high among sex workers in nine provinces in Indonesia. According to reports from 2000 and earlier, using a variety of detection assays, STI prevalence among sex workers in Indonesia has remained high over the past fifteen years (Joesoef *et al*, 1997; Ford *et al*, 2002; Davies *et al*, 2003; Donegan *et al*, 2003; Schachter *et al*, 2005). This shows action is needed to control STIs, to prevent sequelae and to prevent transmission of infections, including HIV.

The finding that 55.6% of FSWs had either chlamydia or gonorrhea in our study justifies the use of periodic presumptive treatment for chlamydia infection and gonorrhea as an STI control strategy (WHO, 2008). Studies of gonococcal isolates from East Java (Sutrisna *et al*, 2006), Papua (Sutrisna *et al*, 2006) and Bali (Donegan *et al*, 2006) show 40-60% resistance to quinolones. Alternative adequate treatment, such as cefixime, needs to be provided for the approximately 50% of 193,000 to 273,000 female sex workers in Indonesia who are infected (Ministry of Health, 2002). Although cost-effectiveness studies (Vickerman *et al*, 2006) are not available for Indonesia, presumptive treatment with effective drugs could rapidly reduce the prevalence of STI and save expenses related to laboratory and clinical examinations (Vickerman *et al*, 2006; WHO, 2008;). Brothel-based and young FSWs could especially benefit from this strategy as they were the group at highest risk for chlamydia and gonorrhea in our study. Based on these data, periodic presumptive treatment and a condom promotion program were developed for brothel-based FSWs at two sites in Indonesia; this pilot showed significant reductions in chlamydia and gonorrhea prevalence (Bollen *et al*, 2009).

Most sex workers reported inconsistent condom use during the previous week and one third reported never using condoms. This proportion might be even higher, as desired answers may have been provided to please the interviewer. This phenomenon was observed in a survey among FSWs in Jakarta (Sedyaningsih-Mamahit and Gortmaker, 2003) and was

also described in a randomized trial among Thai youth showing a lower prevalence of risk behavior among those who were interviewed than those who completed a self-administered questionnaire (van Griensven *et al*, 2006). Others have shown an increase in consistent condom use from 19% in 1992-1993 to 78% in 1999 among brothel-based sex workers in Bali who had regular clinic visits and education (Ford *et al*, 2005). These services need to be scaled up, although it might be challenging to achieve similar successful results in a programmatic setting.

Most FSWs reported vaginal douching during the previous week and about 10% had vaginal douching performed by a nurse during the previous week. This finding is alarming as vaginal douching has been associated with increased risk of bacterial vaginosis, gonorrhea, chlamydia and HIV infection (Zhang *et al*, 1997; Fonck *et al*, 2001). We did not find an increased risk for STIs among women who reported vaginal douching. Others report frequent use of vaginal douching among FSWs in Bali and a lack of association with STI detection (Reed *et al*, 2001). However, no differentiation was made between the various products used for douching in Indonesia (including povidone-iodine solution, toothpaste, leaf extracts and traditional herbs); these products have not been evaluated for antiseptic effects or for mucosal safety. More studies of the effects of vaginal use of these products are needed.

Interestingly, consistent condom use was more frequently reported by sex workers who reported vaginal douching by a nurse during the previous week. This may be explained by a possible counseling effect of the paramedic who provided the douching. Alternatively, and more likely, women who used services from a paramedic might also be more concerned about their health and more likely to use condoms with their clients.

Our study showed younger FSWs were at higher risk compared to older FSWs, perhaps because younger women are biologically more susceptible to mucosal infections (Lee *et al*, 2006). Those who reported unprotected sex with clients during the past week were more likely to have gonorrhea/chlamydia compared to those who reported consistent condom use, which emphasizes the effectiveness of condom use and the importance of condom promotion programs.

A limitation of this study was HIV testing not being included to save resources; national HIV surveillance data were referenced instead. Surveillance in 2005 showed a 1-8% HIV prevalence among FSWs across multiple provinces, except for Papua which had a 23% HIV prevalence (Ministry of Health, 2008).

The gonorrhea/chlamydia prevalence was higher among brothel-based sex workers than other sex workers, independent of age and number of partners. Condom use was lowest among brothel-based sex workers. We cannot explain the high gonorrhea/chlamydia prevalence and low condom use in brothels, and hypothesize client or venue specific factors are at play. However, these findings are surprising, since this population of sex workers is the easiest to reach for STI treatment and by condom promotion programs. Policies are more easily carried out in brothels than in entertainment places; this has been shown to be successful in reducing STI prevalence in Thailand (Hanenberg *et al*, 1994). Presumptive STI treatment and condom distribution programs are currently being implemented and evaluated for brothel-based sex workers.

In conclusion, we found a high STI prevalence along with low condom use

among sex workers across Indonesia. In addition to providing presumptive treatment for chlamydia and gonorrhea, STI services and behavior change communication are being strengthened to decrease the STI burden and to prevent an increase in HIV transmissions.

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REFERENCES

Bollen LJM, Anartati AS, Morineau G, *et al*. Addressing the high prevalence of gonococcal and chlamydial infections among female sex workers in Indonesia: early results of an enhanced, comprehensive intervention. *Sex Transm Infect* 2010; 86: 61-5.

Cohen MS, Hoffman IF, Royce RA, *et al*. Reduction of concentration of HIV-1 in semen after treatment of urethritis: implications for prevention of sexual transmission of HIV-1. AIDSCAP Malawi Research Group. *Lancet* 1997; 349: 1868-73.

Davies SC, Otto B, Partohudoyo S, *et al*. Sexually transmitted infections among female sex workers in Kupang, Indonesia: searching for a screening algorithm to detect cervical gonococcal and chlamydial infections. *Sex Transm Dis* 2003; 30: 671 -9.

Donegan E, Padmidewi MM, Brooks DG, *et al*. Prevalence of cervical *Neisseria gonorrhoeae* and *Chlamydia trachomatis* in Indonesian female sex workers using amplified and non-amplified nucleic acid tests [Abstract 0622]. Ottwa: International Society for Sexually Transmitted Diseases Research (ISSTDR), July 27, 2003. [Cited 2009 Jan 6]. Available from: URL: http://www.med.uottawa.ca/isstdr/2003_ISSTDR/welcome.htm

Donegan EA, Wirawan DN, Muliawan P, *et al*. Fluoroquinolone-resistant *Neisseria gonorrhoeae* in Bali, Indonesia: 2004. *Sex Transm Dis* 2006; 33: 625-9.

Donovan B. Sexually transmissible infections other than HIV. *Lancet* 2004; 363: 545-50.

Fonck K, Kaul R, Keli F, *et al*. Sexually transmitted infections and vaginal douching in a population of female sex workers in Nairobi, Kenya. *Sex Transm Infect* 2001; 77: 271-5.

Ford K, Wirawan DN, Reed BD, *et al*. The Bali STD/AIDS study: evaluation of an intervention for sex workers. *Sex Transm Dis* 2002; 29: 50-8.

Ford K, Wirawan DN. Condom use among brothel-based sex workers and clients in Bali, Indonesia. *Sex Health* 2005; 2: 89-96.

Hanenberg RS, Rojanaphithayakorn W, Kunasol P, Sokal DC. Impact of Thailand's HIV-control programme as indicated by the decline of sexually transmitted diseases. *Lancet* 1994; 344: 243-5.

Joesoef MR, Linnan M, Barakbah Y, *et al*. Patterns of sexually transmitted diseases in

female sex workers in Surabaya, Indonesia. *Int J STD AIDS* 1997; 8: 576-80.

Katz MH. Multivariable analysis: a practical guide for clinicians. Chapter 7: Setting up a multivariable analysis: subjects. 1st ed. Cambridge: Cambridge University Press, 2002.

Lee V, Tobin JM, Foley E. Relationship of cervical ectopy to chlamydia infection in young women. *J Fam Plann Reprod Health Care* 2006; 32: 104-6.

Ministry of Health, Republic of Indonesia. Directorate General of Communicable Disease Control and Environmental Health. National estimates of adult HIV infection, Indonesia, 2002. [Cited 2009 Jan 6]. Available from: URL: http//www.fhi.org/en/HIVAIDS/pub/survreports/indonesia 2002.htm

Ministry of Health, Republic of Indonesia. Behavioral Surveillance Survey (BSS) result in Indonesia 2004-2005. Jakarta: Ministry of Health, 2005.

Ministry of Health, Republic of Indonesia, Directorate General of Disease Control and Environmental Health. Laporan Triwulan IV Kasus AIDS. Jakarta: Ministry of Health, 2008.

Reed BD, Ford K, Wirawan DN. The Bali STD/AIDS study: association between vaginal hygiene practices and STDs among sex workers. *Sex Transm Infect* 2001; 77: 46-52.

Rothenberg RB, Wasserheit JN, St Louis ME, Douglas JM. The effect of treating sexually transmitted diseases on the transmission of HIV in dually infected persons: a clinic-based estimate. *Sex Transm Dis* 2000; 27: 411-6.

Røttingen JA, Cameron DW, Garnett GP. A systematic review of the epidemiologic interactions between classic sexually transmitted diseases and HIV: how much really is known? *Sex Transm Dis* 2001; 28: 579-97.

Schachter J, Donegan EA, Wirawan DN, *et al*. Prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* in Indonesian female sex workers using gen-probe's APTIMA COMBO 2 Test. Washington DC: Interscience Conference on Antimicrobal Agents and Chemotherapy (ICAAC), December 16-19, 2005.

Sedyaningsih-Mamahit E, Gortmaker S. Reproducibility and validity of self-reported condom use in Jakarta. *Southeast Asian J Trop Med Public Health* 2003; 34: 136-46.

Sugihantono A, Slidell M, Syaifudin A, *et al*. Syphilis and HIV prevalence among commercial sex workers in Central Java, Indonesia: risk-taking behavior and attitudes that may potentiate a wider epidemic. *AIDS Patient Care STDS* 2003; 11: 595-600.

Sutrisna A, Soebjakto O, Wignall FS, *et al*. Increasing resistance to ciprofloxacin and other antibiotics in *Neisseria gonorrhoeae* from East Java and Papua, Indonesia, in 2004 - implications for treatment. *Int J STD AIDS* 2006; 17: 810-2.

van Griensven F, Naorat S, Kilmarx PH, *et al*. Palmtop-assisted self-interviewing for the collection of sensitive behavioral data: randomized trial with drug use urine testing. *Am J Epidemiol* 2006; 163: 271-8.

Vickerman P, Terris-Prestholt F, Delany S, *et al*. Are targeted HIV prevention activities cost-effective in high prevalence settings? Results from a sexually transmitted infection treatment project for sex workers in Johannesburg, South Africa. *Sex Transm Dis* 2006; 33: S122-32.

World Health Organization (WHO), Population Council. Periodic presumptive treatment for sexually transmitted infections – experience from the field and recommendations for research. Geneva: WHO, 2008.

Zhang J, Thomas A, Leybovich E. Vaginal douching and adverse health effect: A meta-analysis. *Am J Public Health* 1997; 87: 1207-11.