

Cross-sectional study on risk factors of HIV among female commercial sex workers in Cambodia

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(Accepted 1 September 1999)

SUMMARY

To describe epidemiological features on HIV prevalence among female commercial sex workers (CSWs), a cross-sectional study on sexual behaviour and serological prevalence was carried out in Cambodia. The CSWs were interviewed on their demographic characters and behaviour and their blood samples were taken for testing on sexually transmitted diseases, including HIV, *Chlamydia trachomatis*, syphilis, and hepatitis B. Associations between risk factors and HIV seropositivity were analysed. High seroprevalence of HIV and *Chlamydia trachomatis* IgG antibody (CT-IgG-Ab) was shown among the CSWs (54 and 81·7%, respectively).

Univariate logistic regression analyses showed an association between HIV seropositivity and age, duration of prostitution, the number of clients per day and CT-IgG-Ab. Especially, high-titre chlamydial seropositivity showed a strong significant association with HIV prevalence. In multiple logistic regression analyses, CT-IgG-Ab with higher titre was significantly independently related to HIV infection. These suggest that existence of *Chlamydia trachomatis* is highly related to HIV prevalence.

INTRODUCTION

Geography and population of Cambodia

Cambodia is located in Southeast Asia, bordered by Thailand, Laos and Vietnam. The climate is tropical, its population is 9 898 900 (July 1993), with approx. 1 million living in the capital, Phnom Penh. About 90% of the population is of Khmer origin. The others are a diversity of ethnic groups including Chinese, Vietnamese, Cham (Muslim) and Hilltribes [1].

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Modern historical background of Cambodia

Cambodia gained independence from France as the Kingdom of Cambodia in 1953. During the Cold War between East and West, the kingdom took a neutral line in order to keep their independence. However, the stability of the government did not last for long. In 1970, in the background of the Vietnam War, Lon Nol, the Defence Minister, succeeded in a coup and established a pro-American regime, which was the start of the social dislocation of Cambodia. In 1975, after the end of the Vietnam War, Lon Nol's government was overthrown by Pol Pot's forces. The liquidation started from the execution of politicians,

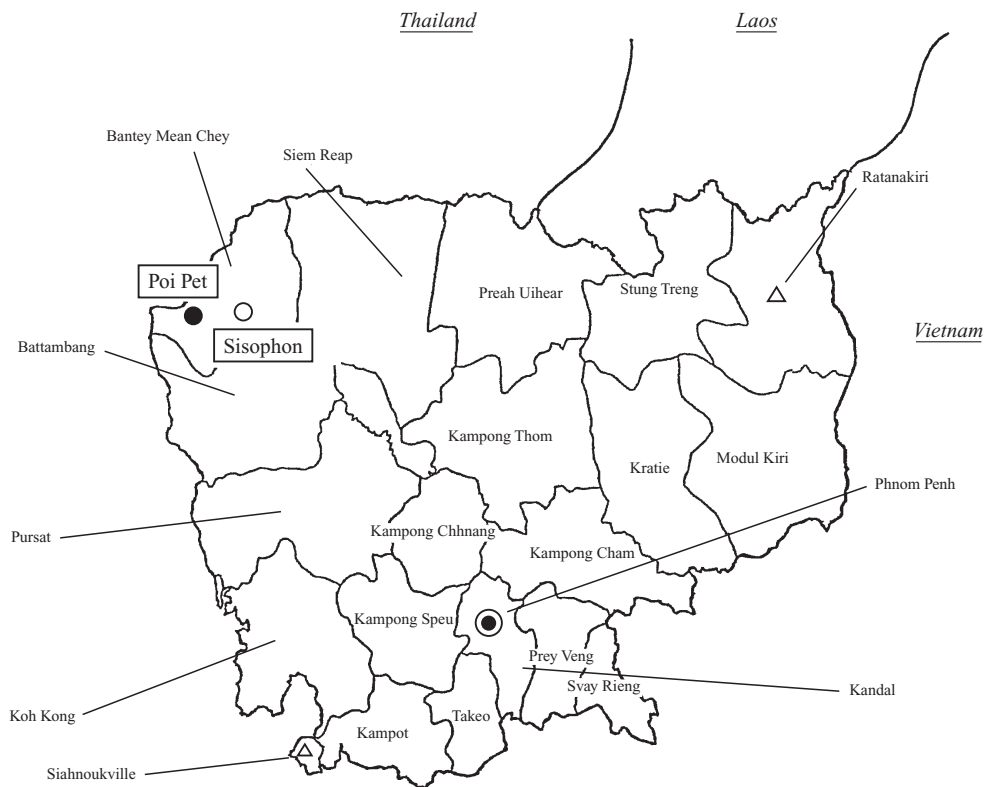


Fig. 1. Location of the study area, Sisophon (○) and Poi Pet (●), Banteay Mean Chey province, Cambodia.

and was expanded to intellectuals and skilled workers. In 1979, Pol Pot's regime was brought down by Heng Samrin's forces, which formed a pro-Vietnam government. However, the civil war continued and remained heated during the 1980s. A peace keeping operation by the United Nations (UN) started in 1992 and a general election was held under the supervision of the UN. Since then, the political situation has gradually stabilized and domestic conditions have been reconstructed with financial support from international organizations and foreign countries [1, 2].

After this long-term social dislocation, social reconstruction is now in progress. However, another problem has arisen, the HIV epidemic. Since 1991, when the first HIV-infected person was reported in Cambodia, the number of HIV-infected people has rapidly increased year by year. According to a report by the Ministry of Health, Cambodia, there were 11 807 diagnosed HIV-infected people and 987 AIDS patients by the end of December 1997 (Official HIV and AIDS case reports: Cambodia. World Health Organization regional office for the Western Pacific 1997). The Joint United Nations Program on AIDS (UNAIDS) and the World Health Organization (WHO) estimated the number of HIV-infected people at 130 000 at the end of 1997 (Report on the global

HIV/AIDS epidemic, June 1998. UNAIDS and WHO, Geneva, 1998). The spread of HIV in Cambodia is mainly caused by sexual transmission and the high-risk group in this country is female commercial sex workers, in whom a high prevalence of HIV and other STDs was reported [3]. A seroprevalence survey in 1997 showed the HIV seropositive rate among brothel-based commercial sex workers (CSWs) was about 39% (445 out of 1132) which was much higher than those among pregnant women (3%, 160 out of 5003) and blood donors (4%, 649 out of 18 222) (Report on HIV Seroprevalence Survey: Cambodia. World Health Organization regional office for the Western Pacific, 1998). In Cambodia, prostitution is prohibited by law, but it is hard to eliminate because it is a simple way for poor women to get money. Additionally, having sexual intercourse with CSWs is commonly accepted among young males [4]. A previous study in Cambodia showed that many young males frequently have sexual contact with CSWs [5]. Considering the risk of transmission to the general public from CSWs, effective preventive strategies against the HIV epidemic among CSWs need to be established urgently.

From December 1997 to January 1998, a cross-sectional epidemiologic study consisting of a ques-

tionnaire and serological study was carried out among CSWs in Sisophon and Poi Pet, Bantey Mean Chey province, Cambodia (Fig. 1) by a Japanese and Cambodian cooperative research group. The two cities are located near the border with Thailand, and are recognized as an epidemic area of HIV because of the flourishing commercial sex industry for soldiers, policemen and travellers. This study was conducted to analyse the risk factors of HIV among CSWs in this area in order to establish efficient preventive measures against the HIV epidemic. This study was approved by the Ministry of Health, Cambodia and the Ministry of Education, Science, Sports and Culture, Japan.

METHODS

Study sample

There is no registration system for prostitution in Cambodia; however, the government knows roughly the number of brothels. At the time of the study, there were 20 brothels in Sisophon and 35 brothels in Poi Pet. The populations of CSWs in Sisophon and Poi Pet were estimated by the Ministry of Health, Cambodia at approx. 150 and 290, respectively. The participants were recruited by the brothel owners from all 20 brothels in Sisophon and 10 brothels, randomly selected from the 35 brothels, in Poi Pet. Out of 150 CSWs in Sisophon, 148 came to hear our explanation of the study, while 62 out of 65 CSWs who belonged to the 10 brothels in Poi Pet attended our explanation of the study. Eventually, verbal informed consent was obtained from 143 CSWs in Sisophon (a response rate of approx. 95%) and 59 CSWs in Poi Pet (approx. 91%) after careful detailed explanation of the purpose and the procedure of this study and a guarantee of their anonymity.

Questionnaire

A questionnaire on sexual behaviour of CSWs was developed by this Japan–Cambodia research group, which included questions about their demographic characteristics and risk factors which were suggested in previous studies [6–11]; past history of STDs, sexual intercourse without condoms, lack of genital hygiene, commencement of commercial sex work at a young age, a lower charge for sexual services and ignorance of HIV infection. The questionnaire was written in English and translated into Khmer. The

Khmer questionnaire was then back-translated into English in order to check the accuracy of translation. Any inconsistencies between the English and Khmer versions were rectified.

Procedure

All eligible subjects were numbered in order to maintain anonymity and to link individual questionnaires with serological tests. They were interviewed according to the questionnaire by trained female interviewers who belonged to the provincial health department. After the interview, 5 ml blood samples were taken from all participants for serological tests.

Each subject received a ticket printed with an individual number after their blood samples had been taken. They could receive the results of their blood tests in return for the numbered ticket at the provincial office. Appropriate medical care for the subjects whose serological tests proved positive would be provided by the Ministry of Health in Cambodia.

Laboratory analyses

Blood samples were tested for syphilis and genital chlamydial infection, which seem to have an enhancing effect on HIV transmission. Hepatitis B was also surveyed as a sexually transmitted disease. The serum was separated from blood at the provincial laboratory, and then the serum samples were immediately transported to Sianouk Hospital in Phnom-Penh, preserved at 4 °C. The samples were tested for HIV antibody (HIV-Ab) with enzyme immunoassay (EIA, Generavia-mixt, Pasteur, Paris, France), *Treponema pallidum* haemagglutination assay (TPHA; Fujirebio, Tokyo, Japan), hepatitis B surface antigen (HBs-Ag; Serodia, Fujirebio, Tokyo, Japan) and hepatitis B surface antibody (HBs-Ab; Serodia, Fujirebio, Tokyo, Japan) by trained technicians at the hospital laboratory. Then the remaining serum samples were frozen and transported to Japan by air. All the samples were examined for *Chlamydia trachomatis* IgG antibody (CT-IgG-Ab; ELISA, SRL Inc., Tokyo, Japan) and positive samples with EIA were confirmed by Western Blot (Diagnostics Pasteur, Paris, France) at the laboratory of Yokohama City Institute of Health, Japan. Quality control, which included retesting of randomly chosen serum samples for TPHA, hepatitis B surface antigen, hepatitis B

surface antibody and HIV, was carried out at the Department of Public Health, Yokohama City University, School of Medicine, Japan, by trained laboratory technicians.

Statistical analyses

Relationships between HIV seropositivity and risk factors were analysed univariately by calculating unadjusted odds ratios (OR, 95% confidence intervals; 95% CI). The statistical significance of differences in prevalence was analysed using χ^2 test and χ^2 test for trend. Multiple logistic regression analysis was used to determine the adjusted OR associated with HIV infection using a model that included statistically significant factors as independent variables in univariate analyses. These analyses were conducted using SPSS (Windows, version 7.51J).

RESULTS

Demographic characteristics

Age, nationality and marital status of the participants are summarized in Table 1. The mean age of the 202 CSWs was 20.3 years old (standard deviation: 3.0, youngest: 15, oldest: 33). Twenty-two (10.9%) were under 18 years. There were 196 Cambodians and 5 Vietnamese. With regard to their marital status, 132 (65.3%) were single, 4 (2.0%) were married and 66 (32.7%) were separated from their spouses.

Serological prevalence

The HIV seroprevalence rate was 54.0% (109 out of 202). The seropositive rate of TPHA, HBs-Ag, HBs-Ab and CT-IgG-Ab was 7.9, 9.4, 34.7 and 81.7%, respectively. Forty-four percent of the 202 subjects had either HBs-Ag or HBs-Ab (Table 1). There were no significant differences in these seroprevalence rates between Sisophon and Poi Pet ($P > 0.1$). We classified the subjects into three age-groups; less than 18 years old, from 18 to 20, and over 20 (Table 2). A gradient in the prevalence of HIV was noted between the three age groups (χ^2 test; $P = 0.0108$, χ^2 test for trend; $P = 0.0029$). Meanwhile, there was a high seroprevalence of CT-IgG-Ab even among the younger CSWs, and there was little difference in CT-IgG-Ab prevalence between the three age groups (χ^2 test; $P = 0.2329$, χ^2 test for trend; $P = 0.2778$).

Univariate analyses

Results of univariate logistic regression analyses are presented in Table 3. Because of the little difference in demographic characteristics and serological status between CSWs living in Sisophon and those in Poi Pet, the analyses were carried out for both CSWs combined. A significant association was seen between HIV seropositivity and current age, age on commencement of commercial sex work, duration of commercial sex work and the number of clients per day. Subjects who were not able to answer the question on the routes of HIV infection correctly had lower HIV seroprevalence. There was no association between HIV seroprevalence and frequency of condom use or past history of STDs. CSWs with lower charge per client tended to be more frequently HIV positive, but the difference was not statistically significant. Most of them answered that they had practiced genital hygiene 'every time' after sexual intercourse, and no association of the method of cleansing with HIV seropositivity was found. Regarding the results of serological tests, TPFA seropositivity had a positive association with HIV infection; however, it was not statistically significant. On the other hand, CT-IgG-Ab seropositivity was significantly related to HIV infection ($P = 0.0016$). The result of CT-IgG-Ab with ELISA was determined based on a diagnostic criterion (SRL, Inc., cut-off index of 0.9, index of 1.1 or more for seropositivity) [12]. The subjects were classified into three groups according to the index. The first group was the negative or borderline group (index < 1.1). The second was the positive but low titre group (index ≥ 1.1 , < 4). The third was the positive with high titre group (index ≥ 4). The HIV-positivity rate of the high CT-IgG-Ab titre group was significantly higher than that of the negative or borderline group (OR 4.46, 95% CI 1.97–10.07). The positive but low titre group also had a higher prevalence of HIV than the negative or borderline group (OR; 2.36, 95% CI: 1.00–5.58) (Table 3).

Multivariate analyses

The result of multivariate logistic regression analysis between HIV-Ab seropositivity and related risk factors that were statistically significant in the univariate analyses is presented in Table 4. CT-IgG-Ab seropositivity with higher titre was significantly independently related to HIV infection (adjusted OR

Table 1. Demographic characteristics and serological data of commercial sex workers in Sisophon and Poi Pet, Cambodia

	Sisophon (n = 143)	Poi Pet (n = 59)	Total (n = 202)
Age			
Average (yrs)	20.3	20.1	20.3
Standard deviation	3.1	2.8	3.0
Range	15–33	17–28	15–33
< 18	16 (11.2)†	6 (10.2)	22 (10.9)
18–20	79 (55.2)	34 (57.6)	113 (55.9)
> 20	48 (33.6)	19 (32.2)	67 (33.2)
Nationality			
Cambodian	140 (97.9)	56 (94.9)	196 (97.0)
Vietnamese	3 (2.1)	2 (3.4)	5 (2.5)
Unknown	—	1 (1.7)	1 (0.5)
Marital status			
Single	89 (62.2)	43 (72.9)	132 (65.3)
Married	4 (2.8)	—	4 (2.0)
Separated	50 (35.0)	16 (27.1)	66 (32.7)
HIV-Ab			
(+)	75 (52.4)	34 (57.6)	109 (54.0)
(–)	68 (47.6)	25 (42.4)	93 (46.0)
(±)	—	—	—
TPHA			
(+)	14 (9.8)	2 (3.4)	16 (7.9)
(–)	128 (89.5)	55 (93.2)	183 (90.6)
(±)	1 (0.7)	2 (3.4)	3 (1.5)
HBs-Ag			
(+)	13 (9.1)	6 (10.2)	19 (9.4)
(–)	130 (90.9)	53 (89.8)	183 (90.6)
(±)	—	—	—
HBs-Ab			
(+)	47 (32.9)	23 (39.0)	70 (34.7)
(–)	95 (66.4)	36 (61.0)	131 (64.8)
(±)	1 (0.7)	—	1 (0.5)
CT-Ab*			
(+)	119 (83.2)	46 (80.0)	165 (81.7)
(–)	22 (15.4)	9 (15.2)	31 (15.3)
(±)	2 (1.4)	4 (6.8)	6 (3.0)

* CT-Ab, *Chlamydia trachomatis* IgG antibody.

† Values in parentheses are percentages.

Table 2. Seroprevalence of HIV antibody and *Chlamydia trachomatis* IgG antibody among commercial sex workers by age groups

Age	n	HIV (+)	CT-Ab* (+)
< 18	22	6 (27.3)†	18 (81.8)
18–20	113	59 (52.2)	88 (77.9)
> 20	67	44 (65.7)	59 (88.1)
Total	202	109 (54.0)	165 (84.2)
χ^2 -test		$P = 0.0108$	$P = 0.2329$
χ^2 test for trend		$P = 0.0029$	$P = 0.2778$

* CT-Ab, *Chlamydia trachomatis* IgG antibody.

† Values in parentheses are percentages.

3.69, 95% CI 1.54–8.84), but the other factors were not. Another multivariate logistic regression analysis model of HIV and the other serological tests for sexually transmitted diseases also showed a significant independent relation between HIV seroprevalence and CT-IgG-Ab seropositivity (adjusted OR 2.71, 95% CI 1.13–6.46) (Table 5).

DISCUSSION

There are some limitations of studies targeting commercial sex workers. First, it is not easy to recruit study samples randomly, as a complete list of CSWs in

Table 3. Univariate logistic regression analyses between HIV antibody (HIV-Ab) seropositivity and risk factors among commercial sex workers

Variables	<i>n</i>	HIV-Ab (+)	HIV-Ab (-)	OR*	95% CI†	<i>P</i> value
Current age						
< 18	22	6	16	1		
18–20	113	59	54	2.91	(1.06–7.99)	0.0376
> 20	67	44	23	5.10	(1.75–14.80)	0.0027
Age on commencement of commercial sex work						
< 18	46	20	26	1		
18–20	102	53	49	1.41	(0.70–2.83)	0.3403
> 20	54	36	18	2.60	(1.15–5.86)	0.0212
Duration of commercial sex work						
< 1	125	57	68	1		
≥ 1 < 2	48	33	15	2.62	(1.30–5.31)	0.0073
≥ 2	29	19	10	2.27	(0.98–5.26)	0.0570
Number of clients per day						
≤ 1	17	5	12	1		
2–3	88	48	40	2.88	(0.94–8.86)	0.0653
≥ 4	97	56	41	3.28	(1.07–10.02)	0.0375
Condom use						
Every time	71	37	34	1		
Sometimes	130	72	58	1.14	(0.64–2.04)	0.6564
Response to request for sexual intercourse without condom						
Accept	125	68	57	1.07	(0.60–1.91)	0.8165
Refuse	74	39	35	1		
Past history of STDs						
Yes	96	52	44	1.02	(0.58–1.77)	0.955
No	106	57	49	1		
Knowledge on routes of HIV infection						
Correct answer						
Zero	72	32	40	0.47	(0.24–0.94)	0.0339
One	68	38	30	0.75	(0.37–1.51)	0.4163
Two	62	39	23	1		
Earnings per client						
< 5000 Riel‡	113	59	54	1.64	(0.67–3.96)	0.2719
5000–10000 Riel	62	39	23	2.54	(0.98–6.59)	0.0545
> 10000 Riel	25	10	15	1		
Post-coital genital hygiene						
Every time	197	106	91	unable to calculate		
Sometimes	4	3	1	unable to calculate		
Method of genital hygiene						
Soap & water	56	34	22	1		
Water only	85	42	43	0.63	(0.32–1.25)	0.1888
Others	61	33	28	0.76	(0.37–1.59)	0.4703
TPHA						
+	16	12	4	2.75	(0.86–8.85)	0.0892
– and ±	186	97	89	1		
(a) CT-Ab						
+	165	98	67	3.45	(1.60–7.47)	0.0016
– and ±	37	11	26	1		
(b) CT-Ab with index §						
< 1.1	37	11	26	1		
≥ 1.1 < 4.0	64	32	32	2.36	(1.00–5.58)	0.0496
4.0 ≥	101	66	35	4.46	(1.97–10.07)	0.0003

* OR, odds ratio.

† CI, confidence interval.

‡ US\$1 = 3590 Riel (1998).

§ Based on a criterion of SRL Inc. Tokyo, Japan.

|| CT-Ab, *Chlamydia trachomatis* IgG antibody.

Table 4. Multiple logistic regression analysis between HIV antibody seropositivity and related risk factors among commercial sex workers

Variables	Adjusted OR	95% CI	P value
Current age			
< 18	1		
18–20	2.19	(0.45–10.73)	0.3333
< 20	1.56	(0.15–16.26)	0.7098
Age on commencement of commercial sex work			
< 18	1		
18–20	1.44	(0.40–5.18)	0.5728
< 20	3.62	(0.43–30.56)	0.2376
Duration of commercial sex work			
< 1	1		
≥ 1 < 2	2.03	(0.87–4.73)	0.0992
≥ 2	2.15	(0.61–9.37)	0.2785
Number of clients per day			
≤ 1	1		
2–3	2.64	(0.75–9.28)	0.1307
≥ 4	3.31	(0.92–11.87)	0.0658
Knowledge on routes of HIV infection			
Correct answer			
zero	0.74	(0.34–1.64)	0.4609
one	1.04	(0.47–2.26)	0.9279
two	1		
CT-Ab* with index			
< 1.1	1		
≥ 1.1 < 4.0	1.87	(0.75–4.68)	0.1814
≥ 4.0	3.69	(1.54–8.84)	0.0034

* CT-Ab, *Chlamydia trachomatis* IgG antibody.

Table 5. Multiple logistic regression analysis of seropositivity of TPHA, HBs antigen or antibody, and *Chlamydia trachomatis* IgG antibody with HIV seroprevalence among commercial sex workers

	n	HIV(+)	HIV(–)	Adjusted OR	95% CI	P value
TPHA(+)	16	12 (75.0)†	4 (25.0)	2.75	(0.83–9.12)	0.0988
HBs; Ag(+) or Ab(+)	89	56 (62.9)	33 (37.1)	1.76	(0.95–3.24)	0.0701
CT-Ab*(+)	165	98 (59.4)	67 (40.6)	2.71	(1.13–6.46)	0.0251

* CT-Ab, *Chlamydia trachomatis* IgG antibody.

† Values in parentheses are percentages.

an area does not exist. In the present study, we tried to recruit CSWs with the brothel owners' cooperation. While participants were recruited from all brothels in Sisophon, they were recruited from only 10 brothels, randomly selected from 35 brothels, in Poi Pet due to the limited budget of this study. Additionally, although there were some Vietnamese CSWs in this area, the language barrier have led to most of the participants being Cambodian CSWs (97%). Secondly, in a questionnaire study, many interviewees are

apt to select favourable answers, possibly resulting in interview bias.

In answer to the questionnaire study, current age, age on commencement of commercial sex work, duration of commercial sex work, number of clients per day and correct knowledge of the routes of HIV transmission showed a significant association with HIV-Ab seropositivity in univariate analyses (Table 3). Theoretically, long-term commercial sex work or frequent sexual intercourse with many clients raises

the risk of HIV infection due to the increased exposure to HIV. In these analyses, the odds ratios of HIV seropositivity among the subjects who had worked longer or more frequently tended to be higher. Griensven and colleagues reported in a study in Thailand [9] that a younger age on commencement of commercial sex work, especially 12–15 years old, was significantly related to HIV infection independent of the duration of commercial sex work. In the present study, such a tendency was not observed. The reasons might be that current age confounded the relationship between the age on commencement of commercial sex work and HIV-Ab seropositivity, because our subjects commenced sex work at an older age compared with the subjects of the above study and that the age range was relatively narrow and the duration of commercial sex work was short.

The odds ratio of HIV seropositivity among the subjects who were able to give two correct answers on routes of HIV transmission was twice as high as that among the subjects who were not. The reason might be that older CSWs, among whom the HIV seropositive rate was high, tended to answer correctly. Providing information on HIV, including routes of transmission, is an important strategy to prevent HIV prevalence. Several educational programmes on HIV prevention by official or semi-official sectors, such as non-governmental organizations (NGOs), have been carried out in Cambodia. Such educational programmes are expected to contribute toward the acquisition of correct knowledge on HIV infection for CSWs. In this questionnaire survey, more than half of the subjects answered that they had been taught about preventive methods against HIV by public health nurses, physicians and staff of NGOs, so they tended to have correct knowledge on the routes of HIV transmission. However, it was clear that the knowledge on HIV infection did not relate to frequency of condom use or prevalence of HIV. Thus, education and information does not necessarily change behaviour. Condom use is an effective method of protecting against HIV infection; however, there was no difference in the HIV seroprevalence between 'every time use' and 'sometimes use'. It might be supposed that the subjects over-reported the frequency of their condom use or that they were infected with HIV before they began to use condoms.

A large number of studies have found an association between HIV infection and STDs [8, 10, 13–17]. In our study, univariate analysis between HIV-Ab and CT-IgG-Ab showed a significant relationship (OR

3.45, 95% CI 1.60–7.47). Multiple logistic regression analysis of risk factors for HIV-Ab showed a strong independent relationship between HIV-Ab and CT-IgG-Ab with higher titre (index ≥ 4.0). The association between HIV and *Chlamydia trachomatis* (*C. trachomatis*) has been demonstrated in several previous studies [10, 14, 16, 18–22]. In this study, syphilis and *C. trachomatis* were chosen as common STD pathogens which seem to have an enhancing effect on HIV infection. The prevalence of CT-IgG-Ab among the subjects was extremely high (81.7%) in comparison to that of TPHA (7.9%). We examined *C. trachomatis* IgG antibody with ELISA to identify current and previous infection with *C. trachomatis*. The feasibility of the ELISA technique for *C. trachomatis* serological detection has been shown previously [12, 23–26]. The IgG antibody indicates past infection and the appearance of very high titre, or a more than fourfold increase in pre-existing titre, can also signify acute infection [27–30]. As indicated in Table 3, this study showed a strong relationship between HIV-Ab and higher titre of CT-IgG-Ab. This strongly suggests that active *C. trachomatis* infection is likely to increase the risk of HIV infection.

However, in regard to the statistical relationship between HIV and *C. trachomatis*, confounding factors that may affect the relationship have to be considered, because sexually transmitted diseases including HIV and *C. trachomatis* have the same behavioural risk factors which work as confounding factors, for example, inconsistent condom use and frequency of sexual intercourse. In order to adjust the mutual risk factors for STDs, multivariate logistic regression analysis of HIV and other STDs, including syphilis, hepatitis B and *C. trachomatis*, was carried out. The analysis showed a significant independent relationship between HIV seroprevalence and CT-IgG-Ab seropositivity only (Table 5). This result indicates that HIV infection is associated with *C. trachomatis* infection independently of sexually transmissible risk factors.

There are two possible explanations for the direct relationship between HIV infection and *C. trachomatis* infection. First, immunologic changes due to HIV infection may induce *C. trachomatis* infection [31, 33]. Burunham and colleagues demonstrated that women infected with HIV had an increased prevalence of *C. trachomatis* infection and an increased incidence of reinfection [22]. This report suggests that the existence of HIV increases susceptibility of *C. trachomatis* infection. Second, *C. trachomatis* infection may

induce HIV infection, as a change of vaginal flora may increase the risk of HIV infection [31]. Histological change of the vaginal epithelium may also increase the risk of HIV infection. Kiviat and colleagues observed such histologic changes as local loss of the surface columnar epithelium with cervical *C. trachomatis* infection [33].

Although several cross-sectional studies have shown an association between the two infections, they do not give a clear explanation for the causation. The present epidemiologic study also produced evidence that CT-IgG-Ab seropositivity is significantly associated with HIV seroprevalence; however, the causal relationship is not clear. This study, however, suggested the important role of *C. trachomatis* infection relating to HIV prevalence. As presented in Table 2, the positivity rate of CT-IgG-Ab among the younger CSWs who were less than 18 years old was already extremely high (81.8%, 18 of 22). On the other hand, HIV-Ab seroprevalence among them remained relatively low (27.3%, 6 of 22) and increased with increasing age. From a time sequential point of view, there might be a high prevalence of *C. trachomatis* prior to infection with HIV, which might have induced the spread of HIV. Epidemiological study with follow up (a cohort study) would be needed to confirm this relationship.

More than 80% of the CSWs had CT-IgG-Ab in this study; however, half of the CT-IgG-Ab-positive women answered that they had not been infected with STDs previously and none of them confirmed that they had been infected with *C. trachomatis*. It is possible that they might not have been aware of *C. trachomatis* infection, because a large percentage of *C. trachomatis*-infected people are asymptomatic [34]. This indicates that not only the medical care system for *C. trachomatis* infection and other STDs, but also the screening system for these STDs is very important to prevent sexually transmitted infections.

In conclusion, the present study indicated a strong relationship between *C. trachomatis* infection and HIV among CSWs in Sisophon and Poi Pet, Cambodia. Epidemiological follow-up studies or intervention studies [35, 36] of *C. trachomatis* are needed to confirm this relationship.

ACKNOWLEDGEMENT

The present study was partly supported by the research grant from the Ministry of Education, Science, Sports and Culture, Japan on grant-in-aid for

scientific research. We acknowledge the staff of the Ministry of Health, Cambodia: Dr P. Mun, Ms S. Ek, Dr S. Chhuon, the staff of Bantey Mean Chey provincial office, Cambodia: Dr S. Ing, Dr S. Samrith, Mr S. H. Khoun, Mr S. A. Tin, Ms V. Kiev, Ms S. Khnoeum, Ms D. L. Chhay, Ms S. Kem, Mr E. Sin, Mr H. Chhay, for their cooperation and support on survey conduction and data collection, and the staff of Sihanouk Hospital: Dr E. Bou, Mr B. Tauch, Mr S. Man, Mr S. Heng for technical help. We are also grateful for the helpful advice of Dr G. Petersen of the WHO office in Phnom Penh, Miss K. Namiki of System Science Consultants Inc. Tokyo, Japan, Dr K. Toba of Yokohama City Institute of Health, Yokohama, Japan.

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