



## Prevalence and factors associated with hepatitis B and D virus infections among migrant sex workers in Chiangmai, Thailand: A cross-sectional study in 2019



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### ARTICLE INFO

#### Article history:

Received 30 August 2020

Accepted 2 September 2020

#### Keywords:

Migrants  
Sex workers  
HBV  
HDV  
Prevalence  
Thailand

### ABSTRACT

**Objectives:** To determine the prevalence of hepatitis B surface antigen (HBsAg) and antibody to hepatitis delta virus (anti-HDV) and associated factors among migrant sex workers in Chiangmai, Thailand.

**Methods:** This cross-sectional study was conducted at various sexual entertainment venues in Chiangmai, Thailand, in 2019. Consenting participants were interviewed using a questionnaire, and plasma was tested for hepatitis B virus (HBV) markers (DiaSorin, Italy) and anti-HDV antibody (DIA.PRO Diagnostic Bioprobes, Italy), if HBsAg-positive. Associations between HBsAg positivity or HDV antibody and potential factors were examined using univariable and multivariable logistic regression analysis.

**Results:** A total of 396 migrant sex workers, half of them female, were recruited between February and September 2019. Their median age was 25 years (interquartile range 22–30 years) and 95% were Burmese. Overall, HBsAg prevalence was 11.4%; 8.1% in females and 14.7% in males (Chi-square,  $p = 0.040$ ). One-third were still susceptible to HBV. No HBsAg-positive participants had anti-HDV antibodies. HBsAg positivity was associated with being male (adjusted odds ratio (aOR) 3.01, 95% confidence interval (CI) 1.25–7.68,  $p = 0.014$ ), having attended school (aOR 4.50, 95% CI 1.26–15.98,  $p = 0.020$ ), being separated/divorced/widowed (aOR 5.77, 95% CI 1.48–22.52,  $p = 0.012$ ), and having unprotected sex (aOR 3.38, 95% CI 1.31–8.71,  $p = 0.012$ ).

**Conclusions:** In this young population, higher HBsAg prevalence in males may be related to sexual transmission, indicating the need for HBV screening programs linked with HBV prevention and care.

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### Introduction

Hepatitis B virus (HBV) is a major cause of chronic viral hepatitis, severe liver diseases, and liver cancer. Approximately 250 million people worldwide are chronically infected with HBV and it is estimated that one million people die annually, mostly from cirrhosis and hepatocellular carcinoma (WHO, 2019a). About 5% of chronic HBV carriers are co-infected with hepatitis delta virus (HDV) (WHO, 2019b), which is a defective RNA virus that requires

hepatitis B surface antigen (HBsAg) for its replication (Taylor, 2003). Individuals with chronic hepatitis B develops a more severe hepatitis disease when they are superinfected with HDV (Gupta et al., 2005). The main routes of transmission of these two viruses include perinatal transmission and parenteral or sexual contact with infected blood or body fluids.

Sex workers are considered as a high-risk group for the acquisition and transmission of HIV, as well as other sexually transmitted infections (STIs), due to the nature of their work and their sexual practices, e.g. high number of sexual partners, high frequency of unprotected sex. Furthermore, migrant sex workers are a more vulnerable population due to their legal status and have been shown to be at a greater risk of STIs and blood-borne infections than non-migrant sex workers, in both low-income and high-income countries (Platt et al., 2013).

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**Table 1**  
Socio-demographic, behavioral, and medical history characteristics of migrant sex workers in Chiangmai, Thailand, 2019.

	Total (n = 396) n (%) or value	Female (n = 198) n (%) or value	Male (n = 198) n (%) or value
<b>Socio-demographic information</b>			
Age (years), median (IQR)	25 (22–30)	27 (23–31)	24 (22–28)
Age (years)			
≤20	40 (10.0)	14 (7.1)	26 (13.1)
21–30	277 (70.0)	129 (65.1)	148 (74.8)
>30	79 (20.0)	55 (27.8)	24 (12.1)
Country of birth			
Myanmar	368 (92.9)	186 (94.0)	182 (91.9)
Laos	4 (1.0)	3 (1.5)	1 (0.5)
Thailand	24 (6.1)	9 (4.5)	15 (7.6)
Race/ethnicity, n = 372			
Shan/Tai-Yai	341 (91.7)	171 (90.5)	170 (93.0)
Burmese	12 (3.2)	3 (1.6)	9 (4.9)
Laotian	4 (1.1)	3 (1.6)	1 (0.5)
Other	15 (4.0)	12 (6.3)	3 (1.6)
Education	278 (70.2)	130 (65.7)	148 (74.7)
Median duration, years (IQR)	6 (4–10)	6 (3–10)	6 (5–10)
Education duration (years)			
0–3 years (non-primary)	62 (22.3)	36 (27.7)	26 (17.5)
4–9 years (primary)	143 (51.4)	59 (45.4)	84 (56.8)
>9 years (secondary or higher)	73 (26.3)	35 (26.9)	38 (25.7)
Religion: Buddhism	375 (94.7)	185 (93.4)	190 (96.0)
Current workplace (>1 answer can be chosen)			
Karaoke	208 (52.5)	167 (84.3)	41 (20.7)
Traditional massage	52 (13.1)	17 (8.6)	35 (17.7)
Spa and sauna	2 (0.5)	0	2 (1.0)
Restaurants	23 (5.8)	2 (1.0)	21 (10.6)
Rural roadside bar	25 (6.3)	1 (0.5)	24 (12.1)
Pub/bar	80 (20.2)	2 (1.0)	78 (39.4)
Massage parlor	21 (5.3)	18 (9.1)	3 (1.5)
Other <sup>a</sup>	26 (6.6)	6 (3.0)	20 (10.1)
Median duration of stay in Thailand, years (IQR)	9 (4–16)	12 (4–20)	8 (5–12)
Marital status			
Single	221 (55.8)	94 (47.5)	127 (64.1)
Has a partner	135 (34.1)	70 (35.4)	65 (32.8)
Separated/divorced/widowed	40 (10.1)	34 (17.1)	6 (3.0)
Has children	131 (33.1)	99 (50.0)	32 (16.2)
Median monthly income, Baht (IQR)	10 000 (9000–17 000)	15 000 (10 000–20 000)	10 000 (9000–12 000)
Health behavior information			
Smoking (past 3 months)	135 (34.1)	27 (13.6)	108 (54.5)
Drinking alcohol (past 3 months)	358 (90.4)	180 (90.9)	178 (89.9)
Drugs use (past 3 months)	18 (4.5)	5 (2.5)	13 (6.6)
Drug injection	3 (0.8)	0	3 (1.5)
Medical history <sup>b</sup>			
Ever had a surgery or blood transfusion	74/393 (18.8)	62/197 (31.5)	12/196 (6.1)
Ever had HB vaccination	31/344 (9.0)	27/160 (16.9)	4/184 (2.2)
Ever been diagnosed with STIs <sup>c</sup>	106/240 (44.2)	42/145 (29.0)	64/95 (67.4)
Risk behavior <sup>b</sup>			
Ever had needle-stick injury	16/391 (4.1)	8/197 (4.1)	8/194 (4.1)
Ever shared sharp personal care items with others	195/396 (49.2)	137/198 (69.2)	58/198 (29.3)
Ever had tattoo or piercing on any part of body	357/396 (90.2)	188/198 (95.0)	169/198 (85.4)
Ever visited a community barber for shaving (males)	78/198 (39.4)	–	78/198 (39.4)
Ever had circumcision (males)	11/198 (5.6)	–	11/198 (5.6)
Sexual behavior			
Sexual identity			
Heterosexual	208 (52.5)	188 (95.0)	20 (10.1)
Homosexual	7 (1.8)	1 (0.5)	6 (3.0)
Bisexual	181 (45.7)	9 (4.5)	172 (86.9)
Median age at first sexual activity, years (IQR)	17 (16–18)	17 (16–18)	17 (16–18)
Total number of sexual partners (lifetime)			
<10 persons	66 (16.7)	37 (18.7)	29 (14.7)
10–49 persons	125 (31.6)	56 (28.3)	69 (34.8)
50–99 persons	106 (26.8)	39 (19.7)	67 (33.8)
100–149 persons	44 (11.1)	31 (15.7)	13 (6.6)
150–199 persons	9 (2.2)	7 (3.5)	2 (1.0)

**Table 1** (Continued)

	Total (n = 396) n (%) or value	Female (n = 198) n (%) or value	Male (n = 198) n (%) or value
≥200 persons	46 (11.6)	28 (14.1)	18 (9.1)
Number of sexual partners per day (past 3 months)			
<1 person	64 (16.2)	20 (10.1)	44 (22.2)
1–2 persons	217 (54.8)	129 (65.1)	88 (44.4)
3–4 persons	93 (23.5)	36 (18.2)	57 (28.8)
≥5 persons	22 (5.5)	13 (6.6)	9 (4.5)
Vaginal sex	383 (96.7)	197 (99.5)	186 (93.9)
Anal sex	177 (44.7)	1 (0.5)	176 (88.9)
Ever been forced to have sexual intercourse	25 (6.3)	13 (6.6)	12 (6.1)
In the past months, have had sex with husband/wife/lover	265 (66.9)	126 (63.6)	139 (70.2)
Always used condoms	45 (17.0)	25 (19.8)	20 (14.4)
Occasionally used condoms	65 (24.5)	18 (14.3)	47 (33.8)
Never used condoms	155 (58.5)	83 (65.9)	72 (51.8)
In the past months, have had sex with casual partners (including sex workers)	321 (81.1)	152 (76.8)	169 (85.4)
Always used condoms	282 (87.9)	143 (94.0)	139 (82.2)
Occasionally used condoms	37 (11.5)	8 (5.3)	29 (17.2)
Never used condoms	2 (0.6)	1 (0.7)	1 (0.6)

HB, hepatitis B; IQR, interquartile range; STI, sexually transmitted infection.

<sup>a</sup> Other: labor, housemaid, officer, handicraft maker, factory worker, online business, salesman.

<sup>b</sup> The answer “I don’t know” was considered as missing data.

<sup>c</sup> Sexually transmitted infections (STIs): gonorrhea, non-gonorrhea, syphilis, HIV, HBV, HCV, or genital herpes.

Chiangmai province is in the North of Thailand and is the second-largest province of the country. It shares a border with Myanmar. Chiangmai city is the economic and tourist hub of the northern region and one of the most important tourist destinations in Thailand. In 2015, the Foreign Workers Administration Office of Thailand estimated that about 102,000 migrants were legal workers in Chiangmai; most of them were Tai-Yai, Shan, and Karen. The number of illegal migrant workers is unknown, and due to legal or language barriers, they are often employed in the informal sectors such as childcare and sex work (Barmania, 2013). Moreover, most migrant sex workers do not have an identification card, leading to problems in accessing health services. Many migrant sex workers come from neighboring countries where universal hepatitis B vaccine policies were implemented in the early 2000s and are still highly endemic for chronic hepatitis B. Most have limited knowledge of HBV infection and its clinical consequences, and are unaware of their hepatitis B status. Moreover, most investigations in sex workers in Thailand have focused on the prevalence of and factors associated with HIV infection and other STIs such as syphilis, chlamydia, gonorrhea (Celentano et al., 1994; Chemnasiri et al., 2010; Kilmarx et al., 1999; Kunawarak et al., 1995; Limpakarnjanarat et al., 1999; Manopaiboon et al., 2013; van Griensven et al., 1995). Data on HBV and HDV prevalence are more limited.

This study was performed to analyze the prevalence of and factors associated with HBV and HDV infections among a population of migrant sex workers in Chiangmai, Thailand.

## Materials and methods

### Study population and inclusion criteria

This cross-sectional survey was conducted among migrant sex workers in Chiangmai, Thailand, between February and September 2019. Eligible participants were individuals of both sexes (male and female), who were non-Thai citizens, aged 18 years or more, and who had traded sex for money in the past year. Participants were recruited from various sexual entertainment venues (e.g., karaoke, bars, clubs, massage parlors, and restaurants).

The study was approved by the Human Experimentation Committee of the Research Institute for Health Sciences, Chiang Mai University (Number 19/61). Potential participants were

informed about the study and signed a consent form. Their participation in the study was kept confidential. Participants were identified with a code (no names) that was used to link each participant with the questionnaire, blood samples, and test results.

### Data collection methods

Participants were administered a face-to-face standard questionnaire by trained interviewers speaking the same language. The interviews were conducted in their workplaces, where participants felt comfortable and safe. Data were collected using a structured questionnaire with seven sections covering socio-demographic characteristics, health behavior, sexual behavior, quality of life, rating scale for depression, HIV knowledge, and HBV and hepatitis C virus (HCV) knowledge. For this sub-study, only socio-demographic information, medical history, health behaviors, risk behaviors, and sexual behaviors data were included.

### Blood processing and laboratory testing for HBV markers and anti-HDV

After the interview, 6 ml of peripheral blood was collected from each participant and transferred to the laboratory for processing. Plasma was separated and kept frozen at  $-70^{\circ}\text{C}$  until testing for HBV markers and anti-HDV antibody. Plasma samples were first tested for HBsAg using MUREX<sup>®</sup> HBsAg version 3 (DiaSorin, Saluggia-Vercelli, Italy) (97% sensitivity and 98% specificity). Samples negative for HBsAg were then tested for antibody to hepatitis B surface antigen (anti-HBs) levels using ETI-AB-AUK-3 anti-HBs (99.1% sensitivity and 98.2% specificity) and antibody to hepatitis B core antigen (anti-HBc) using MUREX<sup>®</sup> anti-HBc total (100% sensitivity and 99.7% specificity), according to the manufacturer's protocols (DiaSorin, Saluggia-Vercelli, Italy). Participants with an anti-HBs antibody level  $>10$  IU/mL were considered as having protective immunity against HBV.

HBsAg-negative participants were categorized into four groups according to their anti-HBs and anti-HBc serology results: (1) resolved HBV infection if anti-HBc and anti-HBs were positive; (2) exposed to HBV if only anti-HBc was positive; (3) HB vaccinated if only anti-HBs was positive; (4) susceptible to HBV infection if both anti-HBc and anti-HBs were negative.

Participants testing HBsAg-positive were tested for anti-HDV antibody using the HDV antibody test (98% sensitivity and 98% specificity) according to the manufacturer's protocol (DIA.PRO; Diagnostic Bioprobes, Milan, Italy).

The results of laboratory tests were delivered to participants on presentation of their card number in private places. Participants who tested positive for HBsAg received information about the prevention and management of HBV and HDV infection and were encouraged to attend the health center of their choice for clinical care.

#### Data analysis

Categorical variables are presented as frequencies and percentages and continuous variables are described using the median with interquartile range (IQR). Continuous variables were dichotomized using common cutoff values. The prevalence of HBV markers and anti-HDV are reported with the 95% confidence interval (95% CI).

The variables analyzed for association with HBsAg positivity were socio-demographic data (i.e., sex, age, race, education, workplace, marital status), health behaviors (i.e., smoking, alcohol consumption, drug use), medical history (i.e., surgery or blood transfusion, STIs), risk behaviors (i.e., sharing sharp personal equipment, piercing/tattoos, visiting a barber, circumcision), and sexual behaviors (i.e., sexual identity, age at first sexual activity, number of sexual partners, sexual behavior, and condom use).

Univariable analyses were performed using logistic regression to identify factors potentially associated with HBV infection. Variables with a *p*-value lower than 0.250 in the univariable analysis were entered into a multivariable analysis, and a backward elimination procedure was used to identify factors independently associated with HBsAg positivity. All data analyses were performed using Stata version 14.0 software (StataCorp, College Station, TX, USA). Differences were considered statistically significant if the *p*-value was  $\leq 0.05$ .

## Results

#### Study population characteristics

A total of 396 sex workers were recruited. Their characteristics are described in Table 1. Fifty percent of participants were female. The median age of the participants was 25 years (IQR 22–30 years). Almost all were Shan/Tai-Yai (91.7%) and had been born in Myanmar (92.9%). A large majority (70.2%) had received an education either in their country of origin or in Thailand. The median duration of living in Thailand was 9 years (IQR 4–16 years). More than half were single and one-third had children. The median monthly income was 10,000 Baht (\$320).

During the past 3 months, most participants (90.4%) reported having consumed alcohol, 34.1% reported smoking, and 4.5% reported experiencing drug abuse. Three participants (0.8%) reported a history of injecting drugs. In the past 12 months, 44.2% of them had been diagnosed with STIs. Almost all had tattoos or ear–nose–body piercings (90.2%). The median age at first sexual activity was 17 years (IQR 16–18 years). Half (54.8%) had one to two sexual partners per day. The majority always used condoms while having sex with casual partners other than their husband or wife.

#### Prevalence of HBsAg positivity and serological status

Of the 396 participating migrant sex workers, 56.1% (111 of 198) of females and 61.6% (122 of 198) of males presented markers of current or past HBV infection (Table 2). Of the 351 who were HBsAg-negative, 138 (39.3%) were considered as having resolved their HBV infection, 50 (14.2%) as having been previously exposed to HBV, 15 (4.3%) as vaccinated, and 148 (42.2%) as susceptible to HBV infection.

The overall prevalence of HBsAg positivity was 11.4% (95% CI 8.6–14.9%) (Table 3); the prevalence was 8.1% (95% CI 5.0–12.8%) in females and 14.7% (95% CI 10.3–20.3%) in males (Chi-square, *p* = 0.040). The prevalence of HBsAg positivity tended to increase with age. Among migrant sex workers aged 21–30 years, the overall prevalence of HBsAg positivity was 11.2%, and it was higher in males than in females (16.2% vs 5.4%; Chi-square, *p* = 0.004). The prevalence of HBsAg positivity according to sex and other variables is described in Table 3.

#### Prevalence of anti-HDV positivity

None of the 45 participants who were positive for HBsAg were found to be positive for anti-HDV (0%, 95% CI 0–7.9%).

#### Factors associated with HBsAg positivity

Univariable analysis showed that HBsAg positivity was associated with being male, having separated/divorced/widowed, having visited a community barber for shaving, having anal sex, and having unprotected sex (*p* < 0.05) (Table 4).

Multivariable analysis (Table 4) showed that HBsAg positivity was independently associated with having attended school (adjusted odds ratio (aOR) 4.80, 95% CI 1.34–17.22, *p* = 0.016), having separated/divorced/widowed (aOR 5.40, 95% CI 1.42–20.61, *p* = 0.013), having anal sex (aOR 3.63, 95% CI 1.51–8.75, *p* = 0.004), and having unprotected sex (aOR 3.68, 95% CI 1.40–9.65, *p* = 0.008). The other factors are described in Supplementary Material Table S1.

After adjusting for sex (anal sex, closely associated with sex, was omitted from this analysis) (Table 4), HBsAg positivity was associated with being male (aOR 3.10, 95% CI 1.25–7.68, *p* = 0.014),

**Table 2**  
HBV serological status of migrant sex workers in Chiangmai, Thailand.

HBV serological status <sup>a</sup>	Total			Females			Males		
	N	n	% (95% CI)	N	n	% (95% CI)	N	n	% (95% CI)
HBV-infected	396	45	11.4 (8.6–14.9)	198	16	8.1 (5.0–12.8)	198	29	14.7 (10.3–20.3)
Resolved HBV infection	351	138	39.3 (34.3–44.6)	182	64	35.2 (28.5–42.4)	169	74	43.8 (36.5–51.4)
Exposure to HBV	351	50	14.2 (10.9–18.3)	182	31	17.0 (12.2–23.2)	169	19	11.2 (7.3–17.0)
HB vaccinated	351	15	4.3 (2.6–7.0)	182	11	6.0 (3.4–10.6)	169	4	2.4 (0.9–6.2)
Susceptible to HBV infection	351	148	42.2 (37.1–47.4)	182	76	41.8 (34.8–49.1)	169	72	42.6 (35.3–50.2)

Anti-HBc, antibody to hepatitis B core antigen; anti-HBs, antibody to hepatitis B surface antigen; CI, confidence interval; HB, hepatitis B; HBsAg, hepatitis B surface antigen; HBV, hepatitis B virus.

<sup>a</sup> HBV-infected: HBsAg-positive. Resolved HBV infection: HBsAg-negative, anti-HBc-positive, anti-HBs-positive. Exposure to HBV: HBsAg-negative, anti-HBc-positive, anti-HBs-negative. HB vaccinated: HBsAg-negative, anti-HBc-negative, anti-HBs-positive. Susceptible to HBV infection: HBsAg-negative, anti-HBc-negative, anti-HBs-negative.

**Table 3**  
Prevalence of HBsAg positivity among migrant sex workers in Chiangmai, Thailand, 2019.

		Total			Female			Male		
		N	n	% (95% CI)	N	n	% (95% CI)	N	n	% (95% CI)
HBsAg positivity		396	45	11.4 (8.6–14.9)	198	16	8.1 (5.0–12.8)	198	29	14.7 (10.3–20.3)
Socio-demographic information										
Age (years)										
	≤20	40	3	7.5 (2.4–21.1)	14	2	14.3 (3.4–44.3)	26	1	3.8 (0.5–23.7)
	21–30	277	31	11.2 (8.0–15.5)	129	7	5.4 (2.6–11.0)	148	24	16.2 (11.1–23.1)
	>30	79	11	14.0 (7.8–23.5)	55	7	12.7 (6.1–24.6)	24	4	16.7 (6.2–37.6)
Country of birth										
	Myanmar	368	40	10.9 (8.1–14.5)	186	13	7.0 (4.1–11.7)	182	27	14.8 (10.3–20.8)
	Laos	4	1	25.0 (2.4–82.1)	3	1	33.3 (2.5–90.6)	1	0	0 (N/A)
	Thailand	24	4	16.7 (6.2–37.5)	9	2	22.2 (5.1–60.5)	15	2	13.3 (3.2–42.0)
Race/ethnicity										
	Shan/Tai-Yai	341	37	10.9 (8.0–14.6)	171	11	6.4 (3.6–11.3)	170	26	15.3 (10.6–21.6)
	Burmese	12	1	8.3 (1.1–43.7)	3	0	0 (N/A)	9	1	11.1 (1.3–53.5)
	Laotian	4	1	25.0 (2.4–82.1)	3	1	33.3 (2.5–90.6)	1	0	0 (N/A)
	Other	15	2	13.3 (3.2–41.9)	12	2	16.7 (3.9–49.7)	3	0	0 (N/A)
School attending										
	No	118	10	8.5 (4.6–15.1)	68	3	4.4 (1.4–13.0)	50	7	14.0 (6.7–26.8)
	Yes	278	35	12.6 (9.2–17.1)	130	13	10.0 (5.9–16.5)	148	22	14.9 (10.0–21.6)
Current workplace										
	Karaoke	208	20	9.6 (6.3–14.5)	167	14	8.4 (5.0–13.7)	41	6	14.6 (6.6–29.3)
	Traditional massage	52	8	15.4 (7.8–28.1)	17	3	17.6 (5.6–43.9)	35	5	14.3 (6.0–30.5)
	Spa and sauna	2	0	0 (N/A)	0	0	0	2	0	0 (N/A)
	Restaurants	23	4	17.4 (6.5–38.9)	2	1	50.0 (1.9–98.1)	21	3	14.3 (4.5–37.0)
	Rural roadside bar	25	3	12.0 (3.8–31.9)	1	1	100	24	2	8.3 (2.0–28.7)
	Pub/bar	80	12	15.0 (8.7–24.7)	2	0	0 (N/A)	78	12	15.4 (8.9–25.3)
	Massage parlor	21	0	0 (N/A)	18	0	0 (N/A)	3	0	0 (N/A)
	Other <sup>a</sup>	26	3	11.5 (3.7–30.9)	6	1	16.7 (1.8–68.1)	20	2	10.0 (2.4–33.4)
Marital status										
	Single	221	18	8.1 (5.2–12.6)	94	4	4.3 (1.6–10.9)	127	14	11.0 (6.6–17.8)
	Has a partner	135	19	14.1 (9.1–21.1)	70	5	7.1 (3.0–16.2)	65	14	21.5 (13.1–33.3)
	Separated/divorced/ widowed	40	8	20.0 (10.2–35.5)	34	7	20.6 (10.0–37.7)	6	1	16.7 (1.8–68.1)
Has children										
	No	265	29	10.9 (7.7–15.3)	99	7	7.1 (3.4–14.2)	166	22	13.3 (8.9–19.4)
	Yes	131	16	12.2 (7.6–19.1)	99	9	9.1 (4.8–16.7)	32	7	21.9 (10.6–39.7)
Health behavior										
Smoking (past 3 months)										
	No	261	27	10.3 (7.2–14.7)	171	14	8.2 (4.9–13.4)	90	13	14.4 (8.5–23.4)
	Yes	135	18	13.3 (8.5–20.2)	27	2	7.4 (1.8–25.9)	108	16	14.8 (9.2–22.9)
Drinking alcohol (past 3 months)										
	No	38	8	21.1 (10.8–37.1)	18	3	16.7 (5.3–41.9)	20	5	25.0 (10.5–48.7)
	Yes	358	37	10.3 (7.6–14.0)	180	13	7.2 (4.2–12.1)	178	24	13.5 (9.2–19.4)
Drug user (past 3 months)										
	No	378	42	11.1 (8.3–14.7)	193	16	8.3 (5.1–13.2)	185	26	14.1 (9.7–20.0)
	Yes	18	3	16.7 (5.3–41.8)	5	0	0 (N/A)	13	3	23.1 (7.2–53.7)
Drug injection										
	No	393	45	11.5 (8.7–15.0)	198	16	8.1 (5.0–12.8)	195	29	14.9 (10.5–20.6)
	Yes	3	0	0 (N/A)	0	0	0	3	0	0 (N/A)
Medical history										
Ever had a surgery or blood transfusion										
	No	319	38	11.9 (8.8–16.0)	135	12	8.9 (5.1–15.1)	184	26	14.1 (9.8–20.0)
	Yes	74	7	9.4 (4.5–18.6)	62	4	6.4 (2.4–16.2)	12	3	25.0 (7.8–56.8)
Ever had an HBV vaccination										
	No	313	37	11.8 (8.7–15.9)	133	10	7.5 (4.1–13.5)	180	27	15.0 (10.5–21.1)
	Yes	31	5	16.1 (6.8–33.8)	27	4	14.8 (5.5–34.1)	4	1	25.0 (2.3–82.2)
Ever been diagnosed with STI <sup>b</sup>										
	No	134	12	9.0 (5.1–15.2)	103	6	5.8 (2.6–12.5)	31	6	19.4 (8.8–37.5)
	Yes	106	14	13.2 (7.9–21.2)	42	6	14.3 (6.5–28.7)	64	8	12.5 (6.3–23.2)
Risk behavior										
Ever shared sharp personal care items with others										
	No	201	22	11.0 (6.9–22.1)	61	2	3.3 (0.8–12.4)	140	20	14.3 (9.4–21.2)
	Yes	195	23	11.8 (8.0–15.0)	137	14	10.2 (6.1–16.6)	58	9	15.5 (8.2–27.4)
Ever had tattoo or piercing on any part of body										
	No	39	7	18.0 (8.7–33.4)	10	0	0 (N/A)	29	7	24.1 (11.8–43.2)
	Yes	357	38	10.6 (7.8–14.3)	188	16	8.5 (5.2–13.5)	169	22	13.0 (8.7–19.0)
Ever visited a community barber for shaving (males)										
	No	120	11	9.2 (5.1–15.9)	120	11	9.2 (5.1–15.9)	120	11	9.2 (5.1–15.9)
	Yes	78	18	23.1 (15.0–33.8)	78	18	23.1 (15.0–33.8)	78	18	23.1 (15.0–33.8)
Ever had a circumcision (males)										
	No	187	26	13.9 (9.6–19.7)	187	26	13.9 (9.6–19.7)	187	26	13.9 (9.6–19.7)
	Yes	11	3	27.3 (8.5–60.3)	11	3	27.3 (8.5–60.3)	11	3	27.3 (8.5–60.3)
Sexual behavior										
Sexual identity										
	Heterosexual	208	18	8.7 (5.5–13.4)	188	16	8.5 (5.3–13.5)	20	2	10.0 (2.4–33.4)
	Homosexual	7	0	0 (N/A)	1	0	0 (N/A)	6	0	0 (N/A)
	Bisexual	181	27	14.9 (10.4–20.9)	9	0	0 (N/A)	172	27	15.7 (11.0–22.0)
Age at first sexual activity (years)										
	<15	44	6	13.6 (6.2–27.4)	14	2	14.3 (3.4–44.3)	30	4	13.3 (5.0–31.1)
	15–19	296	35	11.8 (8.6–16.1)	153	13	8.5 (5.0–14.1)	143	22	15.4 (10.3–22.3)
	20–24	51	3	5.9 (1.9–16.9)	27	1	3.7 (0.5–23.0)	24	2	8.3 (2.0–28.7)
	≥25	5	1	20.0 (2.1–74.5)	4	0	0 (N/A)	1	1	100.0
Total number of sexual partners, lifetime (persons)										
	<10	66	7	10.6 (5.1–20.8)	37	4	10.8 (4.0–25.9)	29	3	10.3 (3.3–28.2)
	10–49	125	12	9.6 (5.5–16.2)	56	4	7.1 (2.7–17.8)	69	8	11.6 (5.9–21.7)
	50–99	106	17	16.0 (10.2–24.4)	39	5	12.8 (5.3–27.7)	67	12	17.9 (10.4–29.1)
	100–149	44	5	11.4 (4.8–24.8)	31	2	6.5 (1.6–23.0)	13	3	23.1 (7.2–53.7)
	150–199	9	0	0 (N/A)	7	0	0 (N/A)	2	0	0 (N/A)
	≥200	46	4	8.7 (3.3–21.2)	28	1	3.6 (0.5–22.3)	18	3	16.7 (5.3–41.9)
Number of sexual partners per day, past 3 months (persons)										
	<1	64	10	15.6 (8.6–26.8)	20	4	20.0 (7.5–43.7)	44	6	13.6 (6.2–27.5)
	1–2	217	22	10.1 (6.8–15.0)	129	8	6.2 (3.1–12.0)	88	14	15.9 (9.6–25.2)
	3–4	93	12	12.9 (7.4–21.5)	36	3	8.3 (2.6–23.3)	57	9	15.8 (8.3–27.9)

Table 3 (Continued)

		Total			Female			Male		
		N	n	% (95% CI)	N	n	% (95% CI)	N	n	% (95% CI)
Vaginal sex	≥5	22	1	4.6 (0.6–27.2)	13	1	7.7 (1.0–41.4)	9	0	0 (N/A)
	No	13	0	0 (N/A)	1	0	0 (N/A)	12	0	0 (N/A)
	Yes	383	45	11.8 (8.9–15.4)	197	16	8.1 (5.0–12.9)	186	29	15.6 (11.0–21.6)
Anal sex	No	219	18	8.2 (5.2–12.7)	197	16	8.1 (5.0–12.9)	22	2	9.1 (2.2–30.9)
	Yes	177	27	15.3 (10.7–21.4)	1	0	0 (N/A)	176	27	15.3 (10.7–21.5)
Frequency of condom use while having sex with husband/wife/lover	All the time	45	3	6.7 (2.1–19.0)	25	1	4.0 (0.5–24.7)	20	2	10.0 (2.4–33.5)
	Occasionally	65	4	6.2 (2.3–15.4)	18	0	0 (N/A)	47	4	8.5 (3.2–20.9)
	Never	155	23	14.8 (10.0–21.4)	83	9	10.8 (5.7–19.7)	72	14	19.4 (11.8–30.4)
Frequency of condom use while having sex with casual sexual partner (including sex worker)	All the time	282	35	12.4 (9.0–16.8)	143	13	9.1 (5.3–15.1)	139	22	15.8 (10.6–23.0)
	Occasionally	37	4	10.8 (4.1–25.8)	8	0	0 (N/A)	29	4	13.8 (5.1–32.1)
	Never	2	0	0 (N/A)	1	0	0 (N/A)	1	0	0 (N/A)

CI, confidence interval; HBsAg, hepatitis B surface antigen; HBV, hepatitis B virus; N/A, not applicable; STI, sexually transmitted infection.

<sup>a</sup> Other: labor, housemaid, officer, handicraft maker, factory worker, online business, salesman.

<sup>b</sup> Sexually transmitted infections (STIs): gonorrhea, non-gonorrhea, syphilis, HIV, HBV, HCV, or genital herpes.

Table 4

Factors associated with HBV infection among migrant sex workers in Chiangmai, Thailand, 2019.

Characteristics		Univariable		Multivariable		Multivariable <sup>a</sup>	
		OR (95% CI)	p-Value	aOR (95% CI)	p-Value	aOR (95% CI)	p-Value
Socio-demographic information							
Sex	Female	1.00					
	Male	1.95 (1.02–3.72)	0.042			3.10 (1.25–7.68)	0.014
School attendance	No	1.00					
	Yes	1.56 (0.74–3.26)	0.241	4.80 (1.34–17.22)	0.016	4.50 (1.26–15.98)	0.020
Marital status	Single	1.00					
	Has a partner	1.85 (0.93–3.66)	0.079	1.80 (0.70–4.61)	0.219	1.90 (0.75–4.82)	0.178
	Separated/divorced/ widowed	2.82 (1.13–7.02)	0.026	5.40 (1.42–20.61)	0.013	5.77 (1.48–22.52)	0.012
Health behavior							
Drinking alcohol (past 3 months)	No	1.00					
	Yes	0.43 (0.18–1.01)	0.053				
Risk behavior							
Ever had tattoo or piercing on any part of body	No	1.00					
	Yes	0.54 (0.22–1.32)	0.178				
Ever visited a community barber for shaving (males)	No	1.00					
	Yes	2.97 (1.32–6.71)	0.009				
Ever had a circumcision (males)	No	1.00					
	Yes	2.32 (0.58–9.32)	0.235				
Sexual behavior							
Sexual identity	Heterosexual	1.00					
	Bisexual	1.85 (0.98–3.49)	0.057				
Number of sexual partners per day, past 3 months (persons)	<1	1.00					
	1–2	0.61 (0.27–1.36)	0.228				
	3–4	0.8 (0.32–1.98)	0.63				
	≥5	0.26 (0.31–2.13)	0.209				
Anal sex	No	1.00					
	Yes	2.01 (1.07–3.78)	0.031	3.63 (1.51–8.75)	0.004		
Frequency of condom use while having sex with husband/wife/lover	All the time or occasionally	1.00					
	Never	2.58 (1.07–6.26)	0.035	3.68 (1.40–9.65)	0.008	3.38 (1.31–8.71)	0.012

aOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

<sup>a</sup> This analysis was adjusted for sex (anal sex was omitted from this analysis).

having attended school (aOR 4.50, 95% CI 1.26–15.98,  $p = 0.020$ ), having separated/divorced/widowed (aOR 5.77, 95% CI 1.48–22.52,  $p = 0.012$ ), and having unprotected sex (aOR 3.38, 95% CI 1.31–8.71,  $p = 0.012$ ).

## Discussion

In this study, 58.8% (233 of 396) of migrant sex workers had markers of exposure to HBV, of whom 45 individuals were positive for HBsAg, giving a prevalence of 11.4% in the total population studied. This prevalence is higher than that in the general

population of Thailand (4%) and Myanmar (6.5%) (Chongrisawat et al., 2006; Ministry of Health and Sports of Myanmar, 2017). Most of the migrant sex workers came from Myanmar and had been born before the hepatitis B vaccine was integrated into the Expanded Program on Immunization in 2003 and before the birth dose vaccination initiated in 2010 (Ministry of Health and Sports of Myanmar, 2017). The high prevalence of HBsAg positivity among the population studied may reflect the situation of chronic HBV infection in Myanmar before 2003 and may have resulted mainly from perinatal transmission of HBV, a common route of infection in these settings. However, sexual transmission, in particular among

the male population, may also have contributed to this high prevalence. Indeed, the risk of HBsAg positivity was more than three times higher among participants having unprotected sex (aOR 3.38, 95% CI 1.31–8.71,  $p = 0.012$ ). In a study conducted among female commercial sex workers in Chiangmai, the prevalence of HBsAg positivity was 11% and factors associated with HBV infection were blood transfusion and sexually transmitted diseases, indicating that HBV can be transmitted readily by either blood or sexual contact (Taketa et al., 2003).

In the present study, the prevalence of HBsAg positivity was higher among male migrant sex workers than among females (14.7% vs 8.1%,  $p = 0.040$ ), with a risk of HBsAg positivity triple the risk in females (aOR 3.10, 95% CI 1.25–7.68,  $p = 0.014$ ). The reason for this increased risk in males is unclear. Most of the participants had not been vaccinated, so this difference in risk was not related to the response to hepatitis B (HB) vaccine. Also, it is still unclear whether this difference could have been due to a higher risk of perinatal transmission of HBV in males. Some studies have reported that the male sex was associated with a higher risk of perinatal transmission of HBV (Li et al., 2014; Siakwa et al., 2016), while other studies have found no difference in HBV transmission between the sexes in infants (Agbede et al., 2007; Chen et al., 2018a; Zhang et al., 2014). Sexual HBV transmission is a plausible explanation for the higher risk of HBsAg among males, since most of the male participants reported practicing anal sex, which has also been associated with HBsAg positivity (Lange et al., 1990).

The risk of being HBsAg-positive was almost five times higher in participants who had attended school for education (aOR 4.50, 95% CI 1.26–15.98,  $p = 0.020$ ). A previous investigation suggested that the transmission from an HBV-infected student to a teacher in an elementary school setting can occur without a reported overt percutaneous or per mucosal exposure to blood or infectious body fluids (Williams et al., 1997). Also, when going to school, children are in contact with many other children who may be infected with HBV, so the risk of exposure to HBV may be higher in schools than in households.

The risk of HBsAg positivity in participants who were separated/divorced/widowed was five times higher when compared to those who were single (aOR 5.77, 95% CI 1.48–22.52,  $p = 0.012$ ). This is consistent with the study of Mutagoma et al., which demonstrated an increase in HBsAg prevalence among female sex workers with married status in Rwanda (Mutagoma et al., 2017). The explanation behind this higher HBsAg prevalence is unclear, since the population in the present study was sex workers, who may differ in their sexual behavior from a general population.

Among the HBsAg-positive individuals, none were found to be positive for anti-HDV, consistent with the very low prevalence among the general Thai population reported in a systematic review of HDV prevalence (0%, 95% CI 0–9.41%) (Chen et al., 2018b). However, a high seroprevalence of anti-HDV has been reported in some specific populations in Thailand: 21.8% in intravenous drug users (IVDUs) (Theamboonlers et al., 2002), 11.1% in chronic hepatitis patients, and 8.3% in cirrhotic patients (Louisirrotch-anakul et al., 1988).

This study has some limitations. All data were reported through an interview and answers could not be fully confirmed. For example, 31 participants reported a history of HB vaccination, but anti-HBs antibody was found in only 15 participants.

In conclusion, more than one-third of this young population of migrant sex workers were still susceptible to HBV infection and 11% were positive for HBsAg. These results indicate that HBV screening programs targeting migrant sex workers are needed to identify individuals with high-risk behaviors who will benefit from HB vaccine and to link those with chronic hepatitis B infection to care. These interventions will contribute to the control of HBV and reaching the sustainable development goals to combat hepatitis (SDG 3).

## Funding

This study was supported by Chiang Mai University, Chiangmai, Thailand.

## Ethical approval

The study was approved by the Human Experimentation Committee of the Research Institute for Health Sciences, Chiang Mai University (Number 19/61), Chiangmai, Thailand.

## Conflict of interest

The authors declare that they have no conflict of interest.

## CRediT authorship contribution statement

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## Acknowledgements

The authors would like to express their gratitude to all participants in this study and to the local teams that carried out the fieldwork. We are also grateful for the support of the Perfect Life Organization, M Plus Clinic, Office of Disease Prevention and Control 1 Chiangmai, and Chiangmai Provincial Public Health Office.

## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.ijid.2020.09.004>.

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