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Article

Knowledge and Preventive Practices Toward COVID-19 Among Sex Workers in Chiang Mai, Thailand

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Abstract

The COVID-19 pandemic disproportionately affected marginalized groups, including sex workers, who faced heightened risks due to precarious work environments. This cross-sectional study, conducted from March to October 2022 in Chiang Mai, Thailand, assessed COVID-19 knowledge and preventive measures among 264 sex workers to guide public health strategies and reduce transmission. Structured questionnaires were used, and knowledge and practice scores were classified as good or poor on the basis of an 80% threshold. The data were analysed via descriptive and inferential statistics. The median knowledge score was 10 (IQR = 9–10), with 89% (n = 235) demonstrating strong awareness. However, preventive practices were weaker (median = 5, IQR = 3–5), with only 32.2% (n = 85) exhibiting good adherence. Females outperformed males ($p < 0.001$), whereas older individuals followed preventive measures more consistently ($p < 0.001$). The heterosexual participants scored highest ($p < 0.001$), and those with 5.1–10 years of experience showed better compliance ($p = 0.033$). A weak but significant correlation was observed between knowledge and practice ($\rho = 0.218$, $p < 0.001$). Despite strong awareness, preventive behaviors remain inadequate, emphasizing the need for targeted interventions to enhance disease prevention and pandemic preparedness.

Keywords: COVID-19; knowledge; health behaviors; sex workers; Chiang Mai; Thailand

1. Introduction

The coronavirus disease 2019 (COVID-19) rapidly spread worldwide and escalated into a global pandemic after the initial cases were reported in Wuhan, China, in December 2019. The World Health Organization (WHO) declared COVID-19 a global health pandemic on March 11, 2020, and called for collaborative efforts from all countries to prevent the rapid spread of COVID-19 [1]. On January 14, 2020, Thailand detected its first laboratory-confirmed case of COVID-19 [2], becoming the first country outside of China to report such an occurrence. This initial case was the precursor to a series of sporadic imported cases and subsequent local transmissions. In response to emerging clusters, the Thai authorities shut down entertainment venues, pubs, and sporting arenas by mid-March. The situation intensified by early April when the government declared a state of emergency, instituted a curfew and imposed stringent travel restrictions, including halting all commercial international flights. These measures, which varied in intensity and scope, were part of a broader strategy to effectively mitigate the spread of COVID-19 across the nation.

Among the most vulnerable groups affected by these measures are sex workers [3–8]. The most recent estimate of the number of sex workers in Thailand is 144,000, although this is widely regarded as a significant underestimate, as sex work is illegal in the country [9,10]. The nationwide closure of

the estimated more than 23,000 entertainment venues where sex workers work meant that most lost the ability to earn an income overnight [11]. A small number of sex workers who continued to work despite the lockdown did so with weak negotiating powers, increasing their risk of exposure to COVID-19 and other infectious diseases [12].

An online survey conducted in April and May 2020 gathered responses from over 20,000 lesbian, gay, bisexual, transgender, and intersex (LGBTI) individuals in 138 countries and revealed that 1% of respondents began doing sex work and that 2% continued selling sex during the COVID-19 pandemic, putting themselves at risk of exposure to the virus [13]. A global survey [14] across 55 countries revealed that during the COVID-19 pandemic, sex workers struggled to access social protection and economic support available to the general population, including income and housing relief. Given their work in informal settings with limited access to essential services, this lack of support heightened their economic difficulties and vulnerability. This vulnerability is not limited to COVID-19 but might extend to other infectious diseases, accentuating the need for inclusive health policies that address the needs of all societal groups. Therefore, it is crucial for governments to implement inclusive responses that encompass all citizens, especially vulnerable groups such as sex workers, to ensure comprehensive public safety [15,16].

The health and well-being of sex workers are closely tied to those of their clients and the wider community [17]. Understanding epidemiological dynamics and transmission pathways is essential, as they significantly influence sex workers' practices in disease transmission. Consequently, it is crucial to equip sex workers with accurate information and education to prevent the spread of diseases, including COVID-19.

Focusing on the knowledge and preventive practices of sex workers is essential for understanding their role in managing infection risk, particularly in the context of infectious disease outbreaks such as COVID-19. Notably, there is a significant lack of information regarding their perceptions of and preventive practices against COVID-19. This lack of data hampers the ability to comprehend fully how the pandemic affects sex workers. As such, a study is needed to address these gaps by evaluating the knowledge and preventive practices of sex workers in relation to COVID-19.

This study was carried out during the epidemic of COVID-19 in Chiang Mai, Thailand, a region known for its tourism and sex industry. This research aims to dissect the knowledge and preventive practices related to COVID-19 and identify critical gaps that hinder effective disease management within this community. The results could help formulate policies that enhance health protection for this at-risk group during the upcoming epidemic. The findings of this study are especially relevant given the ongoing global health situation, where the emergence of new virus strains, along with fluctuating case numbers, highlights the necessity for ongoing vigilance and flexible strategies, ensuring that marginalized communities such as sex workers are not only included but also adequately protected in the global pandemic response [18].

2. Methods

2.1. Study Setting and Study Population

This cross-sectional study was conducted in Chiang Mai city, Northern Thailand, from March to October 2022. This study was part of a larger investigation into the health and health behaviors of sex workers in cities. The research team accessed potential participants through established networks of local government and nongovernmental organizations (NGOs) that were already familiar with and trusted by sex worker communities. More detailed information about the study's methodology has been included in a recent publication on human papillomavirus infection among sex workers [19]. The eligibility criteria included individuals who identified themselves as sex workers, were 18 years of age or older, and had engaged in sexual activity within the past 12 months.

2.2. Measures

The questionnaire consisted of 3 sections: sociodemographic (11 items covering age, gender, education, income, and living conditions), knowledge of COVID-19 (10 items), and preventive practices (10 items). These sections were designed to capture comprehensive data relevant to the sex worker population in Chiang Mai.

A set of questions assessing COVID-19 knowledge was adapted from established research tools [20,21] to evaluate multiple key areas. These areas include risk factors, susceptibility, symptoms, the incubation period, disease severity and asymptomatic transmission, treatment options, isolation and quarantine practices, preventive measures, and modes of transmission. The participants earned 1 point for each correct response, whereas incorrect or 'do not know' answers were given 0 points. The maximum achievable score was 10 points.

A set of questions assessing COVID-19 preventive practices was also adapted from existing research tools [20,21]. Preventive practices were evaluated through questions addressing mask wearing, hand hygiene, physical distancing, respiratory hygiene, limiting social interactions, seeking medical advice, disinfecting the home environment, and avoiding close contact. Responses were scored on a frequency scale, with 'always' receiving 1 point and 'never' or 'sometimes' receiving 0 points. The maximum possible score for preventive practices was 10 points.

2.3. Data Collection

This study recruited participants over 18 years of age who had engaged in sex work in the past year. NGO staff contacted them at workplaces or the NGO clinic to schedule appointments. A pre-interview screening ensured eligibility, followed by informed consent. To maintain confidentiality, interviews were conducted in private rooms with only research staff present, and participants from the same venue were grouped together.

The one-on-one interviews were conducted by trained interviewers. The training emphasized the use of interview tools and the administration of questionnaires. Each interview lasted approximately 15–20 minutes, with data being collected via a computer-assisted questionnaire using portable tablets. All the data were securely recorded via the Research Electronic Data Capture (REDCap) platform.

2.4. Statistical Analysis

The data were summarized via descriptive statistics. The knowledge and practice scores were compared via the Mann-Whitney U test for two independent groups and the Kruskal-Wallis test for comparisons involving more than two independent groups. Factors influencing knowledge and practice were identified through univariable and multivariable linear regression. A cut-off value of $\geq 80\%$ was set to define good knowledge and sufficient practice on the basis of a review of similar studies. Statistical significance was set at $P < 0.05$. Spearman's rank correlation was used to examine the relationship between knowledge and preventive practices. All the statistical analyses were performed via SPSS version 26.0 (IBM Corp., Armonk, NY).

2.5. Ethical Considerations

This study was approved by the Human Experimentation Committee of the Research Institute for Health Sciences, Chiang Mai University. All methods were performed in accordance with relevant guidelines and regulations, including the Declaration of Helsinki. The participants were informed about the study's objectives, and their anonymity and confidentiality were safeguarded. All the participants provided informed consent and received 300 Baht for their participation in the interviews.

3. Results

Among the 264 participants, 52.3% were male, with a significant majority aged between 20 and 40 years (79.6%). Most were native Thais (73.9%) or Buddhists (91.7%) and had received formal

education (86%). The most common marital status was single (68.2%). Nearly half of the participants identified as bisexual (49%), followed by heterosexual (45.1%) and homosexual (6.1%). On average, the participants had been working as sex workers for 4 years. The most common working venue was pubs and bars (26.5%). Just under half (48.1%) had biological children, 52.5% lived in rented rooms, and the median income was 15,000 Baht (Table 1).

Table 1. Demographic characteristics of the sex workers (n=264).

Characteristics	n (%)
Gender	
Male	138(52.3)
Female	126(47.7)
Age (Median=31 year, IQR= 25–28)	
< 20 years	13(4.9)
20–30 years	114(43.2)
31–40 years	96(36.4)
41–50 years	41(15.5)
Education	
Primary	55(20.8)
Secondary	75(28.4)
High school	65(24.6)
College/university	24(9.1)
Other ^a	8(3)
Marital status	
Single	180(68.2)
Have a partner	53(20.1)
Separated/Divorced/Widowed	31(11.7)
Sexual Identity	
Heterosexual	119(45.1)
Homosexual	16(6.1)
Bisexual	129(48.9)
Career duration (Median= 4 year, IQR= 2–8)	
0–2 years	78(29.5)
2.1–5 years	81(30.7)
5.1–10 years	63(23.9)
>10 years	42(15.9)
Workplace	
Karaoke	37(14)
Traditional Massage	66(25)
Spa & Sauna	13(4.9)
Restaurants	4(1.5)
Café	2(0.8)
Rural road–side bar)	4(1.5)
Pub/Bar	70(26.5)
Massage Parlor	44(16.7)
Other ^b	91(34.5)

Biological kids	
Yes	127(48.1)
No	137(51.9)
Family members	
1 person (living alone)	106(40.2)
2–3 persons	89(33.7)
4–5 persons	60(22.7)
≥ 6 persons	9(3.4)
Accommodation	
House	71(26.9)
Dormitory	46(17.4)
Rent a room	139(52.7)
Other ^δ	8(3)
Monthly income	
(Median=15000 Baht, IQR=10000–25000)	
≤ 5,000	9(3.4)
5,001–10,000	91(34.5)
10,001–15,000	51(19.3)
15,001–20,000	41(15.5)
>20,000	72(27.3)

*p<0.05, IQR= interquartile range, ^aDiploma, vocational certificates, ^bSex worker networking app, ^δWorkplace or friend/relative house,.

The participants’ overall understanding of COVID–19 was reflected in a median knowledge score of 10 (IQR = 9–10), with 89% correctly answering at least 8 questions and 55.7% achieving a perfect score of 10. The median score for COVID–19 preventive practices was 5 (IQR = 3–5), with only 32.2% demonstrating sufficient preventive measures (≥ 8). A weak positive correlation (q=0.218, p < 0.001) was found between knowledge and practice scores.

Females scored higher in knowledge (median = 10, IQR = 9.0–10.0) than males did (median = 10, IQR = 8.0–10.0; p = 0.036). Knowledge increased with age, peaking among those aged 31–50 (median = 10, IQR = 9.0–10.0), although this trend was not statistically significant (p = 0.140). Career duration showed a similar trend, with participants having 2.1–10 years of experience scoring highest (median = 10, IQR = 9.0–10.0; p = 0.495). No significant differences were observed across education level, marital status, sexual identity, workplace, or accommodation type. Participants from smaller households (1–5 members) tended to score slightly higher (median = 10, IQR = 9.0–10.0) than those in larger households (≥6 members: median = 9.0, IQR = 7.0–9.5; p = 0.057).

Compared with their male counterparts, female sex workers adhered more to preventive measures (p < 0.001). Age significantly impacted preventive practice scores (p < 0.001), with older participants scoring higher, particularly those aged 41–50 years (median = 5.5, IQR = 4.0–10.0), than those under 20 years (median = 3.0, IQR = 1.5–6.0).

Sexual identity also influenced preventive practice scores (p < 0.001), with heterosexual participants scoring significantly higher (median = 6.5, IQR = 4.0–9.0) than homosexual (median = 3.5, IQR = 2.2–5.0) and bisexual participants (median = 4.0, IQR = 2.0–7.0). Career duration was another significant factor (p = 0.033), with longer career durations being associated with higher scores, as those with over 10 years of experience had a median score of 6.0 (IQR = 3.0–10.0) compared with 5.0 (IQR = 2.0–8.0) for those with less than 2 years of experience.

The type of workplace significantly impacted preventive practice scores, with participants working in pubs and bars (median = 3.5, IQR = 2.0–7.0) and massage parlors (median = 7.0, IQR = 4.0–10.0) showing notable differences (p = 0.008 and p = 0.009, respectively). Parenthood also played a

role, with participants who were parents scoring higher (median = 6.0, IQR = 3.0–9.0) than nonparents did (median = 5.0, IQR = 2.0–8.0, $p = 0.032$).

No significant differences in preventive practice scores were observed across education level, marital status, family size, accommodation type, or income level. (Table 2)

Table 2. Knowledge and preventive practice scores of sex workers toward COVID-19.

Characteristics	Knowledge score			Practice Score		
	Median	IQR	p	Median	IQR	p
Gender			0.036*			<0.001*
Male	10.0	8.0–10.0		4.0	1.0–6.0	
Female	10.0	9.0–10.0		7.0	4.0–10.0	
Age			0.140			<0.001*
< 20 years	9.0	8.5–10.0		3.0	1.5–6.0	
20–30 years	10.0	8.0–10.0		4.0	2.0–7.0	
31–40 years	10.0	9.0–10.0		6.0	3.0–9.0	
41–50 years	10.0	9.0–10.0		5.5	4.0–10.0	
Education			0.282			0.888
Primary	10.0	9.0–10.0		5.0	2.0–5.0	
Secondary	10.0	9.0–10.0		5.0	2.0–5.0	
High school	10.0	9.0–10.0		5.0	3.0–5.0	
College/university	9.0	8.0–10.0		4.5	3.0–4.0	
Other ^α	10.0	7.7–10.0		4.5	3.0–4.0	
Marital status			0.291			0.060
Single	10.0	9.0–10.0		5.0	2.0–8.0	
Have a partner	10.0	9.0–10.0		6.0	3.0–9.0	
Separated/Divorced/Widowed	10.0	9.0–10.0		6.0	3.0–9.0	
Sexual Identity			0.483			<0.001*
Heterosexual	10.0	9.0–10.0		6.5	4.0–9.0	
Homosexual	10.0	8.2–10.0		3.5	2.2–5.0	
Bisexual	10.0	8.0–10.0		4.0	2.0–7.0	
Career duration			0.495			0.033*
0–2 years	9.0	8.0–10.0		5.0	2.0–8.0	
2.1–5 years	10.0	9.0–10.0		5.0	2.5–7.0	
5.1–10 years	10.0	9.0–10.0		6.0	3.0–9.0	
>10 years	10.0	9.0–10.0		6.0	3.0–10.0	
Workplace						
Karaoke (n)	10.0	9.0–10.0	0.239	6.5	3.2–10.0	0.134
Traditional Massage	10.0	9.0–10.0	0.707	5.0	3.0–9.0	0.730
Spa & Sauna	9.5	8.0–10.0	0.811	7.0	2.0–10.0	0.261
Restaurants	10.0	9.2–10.0	0.340	6.5	4.2–8.7	0.445
Café	9.5	9.0–10.0	0.889	5.0	8.0–3.0	0.963
Rural road–side bar)	9.5	7.5–10.0	0.778	5.5	2.5–8.5	0.929
Pub/Bar	9.5	9.0–10.0	0.640	3.5	2.0–7.0	0.008*
Massage Parlor	10.0	9.0–10.0	0.213	7.0	4.0–10.0	0.009*
Other ^β	10.0	9.0–10.0	0.995	5.0	3.0–8.0	0.993
Biological kids			0.127			0.032*
Yes	10.0	9.0–10.0		6.0	3.0–9.0	
No	10.0	8.0–10.0		5.0	2.0–8.0	
Family members			0.057			0.638

1 person (living alone)	10.0	9.0–10.0	5.0	3.0–9.0
2–3 persons	10.0	9.0–10.0	5.0	3.0–8.0
4–5 persons	10.0	9.0–10.0	5.0	3.0–8.0
≥ 6 persons	9.0	7.0–9.5	4.0	2.0–5.0
Accommodation		0.440		0.221
House	10.0	9.0–10.0	5.0	3.0–8.0
Dormitory	10.0	9.0–10.0	7.0	3.0–9.5
Rent a room	10.0	9.0–10.0	4.0	2.5–9.0
Other ^δ	10.0	6.2–10.0	3.0	1.2–7.2
Monthly income (Baht)		0.112		0.057
≤ 5,000	9.5	9.0–10.0	4.5	3.0–6.5
5,001–10,000	10.0	8.0–10.0	5.0	2.2–9.0
10,001–15,000	10.0	9.0–10.0	4.0	2.0–7.2
15,001–20,000	10.0	9.0–10.0	5.5	3.0–8.0
>20,000	10.0	9.0–10.0	6.0	3.0–9.0

*p<0.05,^aDiploma, vocational certificates, ^βsex worker networking app, ^δworkplace or friend/relative house.

Over 80% of the participants correctly answered all but one of the COVID–19 knowledge questions. The exception was question K10, where 26.1% mistakenly believed there was an effective cure for COVID–19, resulting in fewer than 80% correct responses. In contrast, the highest percentage of correct answers (97.3%) was for question K1, which addressed susceptibility to infection. More detailed results can be found in Table 3.

Table 3. The number and percentage of sex workers who answered each COVID–19 knowledge question correctly (N = 264).

Knowledge Questions	Correct n (%)
K1: All population is generally susceptible to infection. (true)	257 (97.3%)
K2: The main clinical symptoms of COVID–19 are fever, fatigue, dry cough. (true)	255 (96.6%)
K3: The COVID–19 virus spreads via respiratory droplets of infected individuals. (true)	251 (95.1%)
K4: COVID–19 disease is highly infectious and spreads quickly. (true)	246 (93.2%)
K5: Hand washing, mask wearing, and social distancing effectively prevent COVID–19. (true)	246 (93.2%)
K6: The incubation time of the disease is 14 days, typically 7 days. (true)	242 (91.7%)
K7: Not all with COVID–19 get severe. Elderly, chronically ill, obese at higher risk. (true)	240 (90.9%)
K8: Asymptomatic patients can transfer the virus to others. (true)	236 (89.4%)
K9: Isolate and treat confirmed patients; quarantine suspected cases for 14 days. (true)	224 (84.8%)
K10: There is currently no effective cure for COVID–19. (true)	195 (73.9%)

With respect to COVID–19 preventive practices, the most common practice was always wearing a mask when going out (P1), with 79.9% adherence, followed by respiratory hygiene (P2), with 76.5%

adherence. In contrast, avoiding contact with contaminated surfaces (P10) was the least common practice, with only 33.3% adherence (see Table 4 for details).

Table 4. The number and percentage of sex worker participants who responded that they practiced preventive measures during the COVID-19 epidemic (N = 264).

Practice Questions	Yes n (%)
P1: Always wear a mask when going out.	211 (79.9%)
P2: Cover mouth/nose when coughing/sneezing & avoid touching face, nose, or mouth with hands.	202 (76.5%)
P3: Wash hands with water, soap, or alcohol-based hand sanitizer.	145 (54.9%)
P4: Appropriate exercise and rest properly.	143 (54.2%)
P5: Seek medical advice when symptoms such as fever and cough appear.	142 (53.8%)
P6: Always disinfect home environment.	138 (52.3%)
P7: Reduce visit your friends, or relatives.	114 (43.2%)
P8: Reduce visits to crowded places.	107 (40.5%)
P9: Keep distances from others at least 2 meters.	104 (39.4%)
P10: Avoid contact with contaminated public surfaces like elevator buttons and stair railings.	88 (33.3%)

The regression analysis revealed that male sex and single marital status were significant predictors of lower rates of COVID-19 preventive practices in both the univariate and multivariate analyses ($p < 0.05$). Younger age groups (<20 years and 20–30 years), shorter career durations (0–2 years and 2.1–5 years) and non-heterosexual identities, and having biological kids were associated with lower preventive practices in the univariable analysis ($p < 0.05$) but were not significant in the multivariable model. Further details are presented in Table 5.

Table 5. Factors associated with COVID-19 prevention practices via regression analysis.

Characteristics	Univariable				Multivariable			
	95% CI				95% CI			
	B	Lower	Upper	p	B	lower	upper	p
Biological gender								
Male	-2.20	-2.94	-1.46	<0.001*	-1.87	-2.87	-0.88	<0.001*
Age (ref >40 years)								
<20 years	-2.77	-4.74	-0.80	0.006*	-1.37	-3.48	0.74	0.204
20–30 years	-1.90	-3.03	-0.78	0.001*	-0.55	-1.88	0.78	0.413
31–40 years	-0.62	-1.77	0.53	0.291	-0.23	-1.47	1.00	0.709
Having Biological kids								
	0.856	0.078	1.634	0.031*	-0.35	-1.36	0.66	0.494

No. of family members (ref>5 persons)								
1 person	1.49	-0.73	3.70	0.190	1.90	-0.50	4.30	0.120
2–3 persons	1.43	-0.81	3.66	0.210	1.57	-0.69	3.83	0.170
4–5 persons	1.38	-0.90	3.66	0.240	1.10	-1.18	3.37	0.340
Accommodation (ref house)								
Dormitory	0.12	-1.08	1.32	0.850	-0.27	-1.61	1.07	0.694
Rent a room	-0.58	-1.50	0.35	0.220	-1.18	-2.37	0.01	0.051
Other ^a	-1.87	-4.24	0.50	0.120	-1.78	-4.12	0.56	0.135
Marital status (ref having partner)								
Single	-1.06	-2.05	-0.07	0.036*	-1.15	-2.28	-0.02	0.046*
Separated/Divorced/Widowed	-0.15	-1.58	1.28	0.839	-0.43	-1.90	1.04	0.563
Income (baht)								
More than 10000	-2.41	-1049	0.567	0.558	-0.56	-1.45	0.32	0.494
Education (ref Basic)								
Advanced	-2.18	-1.43	1.00	0.724	-0.05	-1.24	1.13	0.929
Sexual identity (ref Heterosexual)								
Homosexual	-2.60	-4.23	-0.97	0.002*				
Bisexual	-1.74	-2.51	-0.96	0.000*				
Career Duration (ref >10 years)								
0–2 years	-1.60	-2.80	-0.40	0.009*				
2.1–5 years	-1.20	-2.40	-0.01	0.049*				
5.1–10 years	-0.39	-1.64	0.86	0.541				

*p<0.05, B = regression coefficient, CI = confidence interval, Basic (primary, secondary, high school), Advanced (university, diploma, vocational certificate), ^aworkplace or friend/relative house.

4. Discussion

This study investigated COVID–19 knowledge and preventive practices among sex workers in Chiang Mai, a marginalized population with limited access to healthcare and preventive resources. Employing a cross–sectional design, the data were collected through structured interviews conducted by trained staff in collaboration with trusted local NGOs. This approach facilitated access to a hard–to–reach population and yielded valuable insights into specific knowledge gaps and behavioral factors influencing health outcomes in vulnerable groups, contributing to the design of targeted public health interventions during pandemics.

The study included 264 participants, nearly evenly split between males and females, with a predominant age range of 20–40 years. Most participants had received formal education, but socioeconomic factors, work environments, gender, age, sexual identity, and career duration influenced both knowledge and practice scores. These findings highlight the interplay of demographic, social, and behavioral factors in shaping health behaviors and adherence to preventive measures.

The participants presented a generally high level of COVID–19 knowledge, with an accurate understanding of virus transmission and preventive measures. However, some misconceptions persist, particularly about the existence of an effective cure and isolation protocols, which could undermine preventive efforts. Females scored higher than males did, reflecting potential differences in access to health information or levels of engagement with educational resources. Workplace environments also played a role, as participants in structured settings such as massage parlors and karaoke establishments presented higher knowledge levels than did those in pubs or roadside bars. These findings emphasize the need for targeted educational campaigns to address misconceptions and ensure that accurate health messaging reaches all sectors, particularly those in informal or underserved settings.

The findings concerning adherence to COVID-19 preventive practices among sex workers are inconsistent with findings from similar studies in other countries [22–27]. Mask wearing is the most widely adopted measure, likely because of its visibility and ease of enforcement [28–32]. However, other practices, such as hand hygiene and maintaining physical distance, were less consistently followed, indicating behavioral fatigue and diminished risk perception. These patterns highlight the need for sustained interventions that address both informational and structural barriers to compliance, including strategies to combat fatigue and enhance risk awareness.

Notably, gender and age significantly influenced preventive practices, which is consistent with broader health behavior studies. Compared with males, females presented higher adherence scores, which aligns with evidence suggesting that women are generally more likely to adopt preventive behaviors due to greater health consciousness and risk perception [33]. Similarly, older participants, particularly those above 40 years, displayed better compliance than younger individuals did. This is consistent with findings in other contexts, where younger adults often prioritize short-term benefits over long-term health, leading to lower adherence [33,34]. The younger participants in this study may have prioritized financial stability over health, underscoring the importance of tailored, peer-led programs that frame preventive behaviors in terms of long-term benefits to their health and livelihoods.

Workplace settings and living arrangements further influenced adherence levels. Compared with those in other establishments, participants in pubs and bars reported significantly lower compliance, reflecting challenges inherent to their work environments. However, contrary to initial assumptions, workers in massage parlors presented significantly higher preventive practice scores, indicating that such environments may have implemented stricter health protocols. Living with biological children was associated with higher practice scores, likely due to increased familial responsibilities, whereas income also showed marginal significance in determining adherence to preventive measures. These findings suggest that interventions must consider the specific social and environmental dynamics of participants to effectively address barriers to preventive behavior.

Although a positive association existed between knowledge and preventive practices, this correlation was weak, highlighting that knowledge alone is insufficient to drive behavioral change. Instead, factors such as gender, age, workplace, and income had a stronger influence on adherence levels. Interventions that integrate practical support with targeted education campaigns addressing these barriers are critical for improving health outcomes. Regression analysis revealed that male sex and single marital status were linked to lower adherence to COVID-19 preventive practices, reflecting the influence of gender norms and social factors. Although younger age, less work experience, non-heterosexual identity, and having children were significant in the initial analysis, these factors were less impactful when other variables were considered. Socioeconomic factors such as family size, income, and education had no significant effect on adherence. The findings highlight the need for targeted public health strategies for men and single individuals, with a focus on the psychological and social drivers behind preventive behaviors.

A key strength of this study is its focus on a marginalized, vulnerable, and hard-to-reach population often overlooked in public health research. The use of multivariate analysis allowed the identification of specific demographic and social factors influencing COVID-19 preventive practices, providing valuable insights for targeted interventions. Additionally, the study's cross-sectional design and robust sample size increase the generalizability of the findings to similar populations.

However, several limitations must be acknowledged. The cross-sectional nature of the study limits the ability to infer causality between knowledge and practice, as well as the hypothesized predictor and outcome variables. The reliance on self-reported data may introduce recall and reporting bias, particularly in sensitive areas such as sexual behavior and compliance with preventive measures. Moreover, the study was conducted several times after the peak of the epidemic, potentially limiting its relevance, as behaviors and knowledge evolved over time. Future research should prioritize longitudinal studies to monitor these changes and assess the long-term effectiveness of public health interventions.

In addition, intervention studies that measure the direct impact of targeted health promotion strategies are essential to enhance the practical application of knowledge and improve health outcomes among vulnerable groups.

5. Conclusions

This study revealed a significant gap between COVID–19 knowledge and the adoption of preventive practices among sex workers in Chiang Mai. While knowledge levels are generally high, the practical application of preventive measures has remained insufficient. Multivariate analysis revealed that sex and age were significant predictors of preventive practices, with females and older individuals demonstrating better adherence. These findings underscore the need for public health interventions that target broader behavioral factors beyond demographic characteristics. Tailored approaches addressing gender–specific needs, empowering younger individuals, and considering workplace settings are critical for improving the implementation of preventive measures.

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