



ORIGINAL ARTICLE

Prevalence, correlates, and risk perception of HIV infection among heroin users in Central Taiwan



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Abstract We investigated the prevalence and correlated factors of human immunodeficiency virus (HIV) among heroin users attending methadone maintenance treatment (MMT) programs in Central Taiwan, and explored the degree of risk perception of HIV infection among the participants. Our study participants were 781 heroin users seeking treatment at the MMT program at Tsaotun Psychiatric Center in Taiwan. The presence of HIV antibodies was identified by microparticle enzyme immunoassay and confirmed by western blot. Multivariate logistic regression was used to identify the independent correlates of HIV infection. The mean age of the sample was 36.1 years [standard deviation (SD) = 7.6]; of the patients, 710 (90.9%) were men. The prevalence of HIV infection among our study population was 20.7%. Multivariate logistic regression analysis revealed that HIV infection was independently associated with the age of the patients of initial heroin use, heroin injection use, nondrug-related criminal convictions, needle-sharing behaviors, and sharing injection paraphernalia. A strong agreement existed between self-reported HIV serostatus and the results of laboratory analyses, with 88.8% of patients reporting their condition correctly. We found a high rate of HIV infection among patients in the MMT program. Factors associated with HIV infection were mostly related

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to drug-use behaviors. These findings stress the importance of education regarding drug-risk behaviors.

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Introduction

Human immunodeficiency virus (HIV) infection is the most serious global health problem of the 20th century. The estimated number of adults and children newly infected with HIV in 2008 was 2.7 million. In the same year, 2 million AIDS-related deaths were reported [1]. Compared with European countries, certain Asian countries have significantly higher HIV seroprevalence rates [2]. Approximately 4.7 million people are estimated to have HIV infection in Asia [1], 75% of whom are from China, India, and Thailand [3].

Compared with the global adult HIV prevalence rate of 0.8% in 2008 [1], the prevalence rate is relatively low in Taiwan (0.082% in 2009) [4]. Most of the HIV-infected individuals in Taiwan are men, aged 20–49 years [4]. Prior to 2003, less than 2% of the newly diagnosed cases each year were injecting drug users (IDUs) [5]. However, in 2006, 60% ($n = 1778$) of the newly diagnosed patients contracted HIV through intravenous drug use [6]. Injection drug use has become the main risk factor of HIV infection in the country, with more than one-third (38%) of IDUs in Taiwan becoming HIV/AIDS patients [7].

Heroin is the most commonly injected illicit drug in Taiwan [7]. According to the National Bureau of Controlled Drugs, in 2008, 52,708 people were incarcerated because of drug-related crimes, 77% of them being heroin users [8]. Half of the drug users in Taiwan have injected heroin at least once [9].

Heroin injection is strongly associated with the rapidly developing HIV epidemic [10] and is specifically associated with the sharing of injection paraphernalia [7,11]. The prevalence of HIV is significantly higher among intravenous heroin users than among noninjection heroin users [12]. A study conducted in Spain found that approximately one-third of heroin injectors were HIV positive [13]. Although injecting drug use is strongly associated with the HIV epidemic in most Asian countries, including China, Indonesia, Thailand, and Hong Kong [1], each country has a different set of independent risk factors. In Hong Kong, older men were more likely to be involved in HIV-related risk behaviors [14]. Indonesia, where more than half of IDUs (52%) had contracted HIV, was the only country in Asia that females had a higher HIV prevalence rate than male injectors [1].

Other studies have shown that the main risk factors for HIV infection also include young age [11], male sex [15], lower education [16], sex behaviors [17], criminal convictions [18], incarceration [19], depression [20], social support [20], impulsivity, and severity of dependence [21].

Understanding risk perceptions is important for designing appropriate strategies for HIV/AIDS prevention because people's behavior is guided more by the perceived

risk of infection than by their actual, but unknown, HIV status [22]. In Taiwan, the degree of risk perception concerning HIV infection among heroin users is rarely reported or remains unreported, although the scale of HIV infection is low in this population.

Studies on HIV infection among heroin users in Taiwan included incarcerated injection heroin users [7,23]; however, studies investigating the prevalence of HIV infection and its related factors among opiate-dependent patients in methadone maintenance treatment (MMT) programs are rare. Our study investigates the prevalence and correlates of HIV infection among heroin users seeking treatment in the Taiwanese MMT program and explores the degree of participant risk perception.

Materials and methods

Participants and procedure

Participants in our study were heroin-dependent patients, aged ≥ 18 years, recruited from 2006 to 2010 at an MMT program at Tsaotun Psychiatric Center in Nantou County, Central Taiwan. Nantou City comprises approximately 540,000 inhabitants. All attendees were interviewed by a senior psychiatrist to confirm the heroin-dependence diagnosis according to the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (DSM-IV) criteria. They also completed a set of self-reported questionnaires administered by a trained psychiatric nurse on the first day of the MMT program. Exclusion criteria included illiteracy and a diagnosis of mental retardation. The assessment included demographic data, history of heroin substance abuse and other substance use, criminal history, and psychosocial information prior to MMT.

Measurements

The heroin-related behaviors of patients were assessed prior to MMT. Questions included participant ages for initial substance use and first heroin use, frequency of heroin detoxification for more than 2 weeks (lifetime), number of criminal convictions (substance related and nonsubstance related), main method of heroin administration (injection or smoking, lifetime), sharing needles with others (yes/no, lifetime), and sharing paraphernalia, with the exception of needles (yes/no, lifetime). The method of heroin use was determined from the answers of the following question: "What has been your main method for using heroin in the past 6 months?" Heroin in Taiwan is sold using the traditional measuring unit of a half qian (1 qian = 3.75 g). Patients were asked the amount of heroin (in half qian/d) they used in the 2 weeks prior to the interview.

Blood samples were taken from the patients on entry to treatment. The presence of HIV antibodies was tested by a microparticle enzyme immunoassay (AxSYM HIV 1/2 gO; Abbott Laboratories, Diagnostics Division, Abbott Park, IL) and confirmed by western blot (NEW LAV BLOT 1; Bio-Rad, France). The application of chemiluminescent immunoassays with the ARCHITECT i2000 system was used to detect anti-hepatitis C virus (anti-HCV) and hepatitis B surface antigen (HBsAg). These tests were performed at the Department of Laboratory Medicine, Department of Health, Tai-Chung Hospital, Taiwan.

We used the following self-administered questionnaires for this study: the Chinese version of the Centre for Epidemiologic Studies Depression Scale (CESD) [24,25] and the Chinese version of the Severity of Dependence Scale (SDS[Ch]) [26]. A positive correlation was found between SDS[Ch] scores and DSM-IV criteria for heroin dependence [27]; the family adaptation, partnership, growth, affection, resolve scale (APGAR[Ch]) [28,29]; and the Chinese version of the Barratt Impulsiveness Scale (BIS-11-CH) [30,31]. All scales were validated in Taiwan, and total scores were used for statistical analysis. Higher scores indicated more severe conditions for all instruments. Risk perception regarding HIV infection was assessed by the question "Do you have HIV?" (the answer options: "yes", "no", or "not sure").

Statistical analysis

We conducted a descriptive analysis to describe the socio-demographic characteristics, heroin-related problems, and HIV prevalence in the sample. Descriptive statistics, such as means, standard deviations (SDs), and proportions, were used when appropriate. The Chi-square test and *t* test were used to assess the association of all variables, and all significant factors were entered into a multivariate logistic regression model (backward elimination) to identify significant variables related to HIV infection after adjusting for the potential effects of other variables. Kappa was used to represent the agreement between self-reported HIV and laboratory findings. A similar statistical procedure was performed to establish significant variables related to needle sharing. The variance inflation factor (VIF) was used to detect multicollinearity in the regression model. Explanatory variables with a VIF of ≥ 5 indicates a multicollinearity problem [32]. Differences were considered significant if $p < 0.05$. An analysis was conducted using SPSS version 15.0 (SPSS Inc., Chicago, IL, USA).

Ethics

Our study was approved by the institutional review board of the Tsaotun Psychiatric Center. All patients provided written informed consent prior to participation.

Results

The total study sample comprised 781 heroin users with a mean age of 36.1 years (SD = 7.6); 710 (90.9%) were men and 59.4% of all participants had received < 9 years of education (mean 9.9, SD = 2.0). Six patients were excluded because of illiteracy or mental retardation. The mean age

for first heroin use was 26.2 years (SD = 12.0). The most frequently reported method of heroin administration (used by 81.4% of the patients) was injection. Of the patients, 92.0% had criminal convictions related to substance-use offences (possession/selling; $n = 2.3$, SD = 1.5) and 66.3% related to nonsubstance use ($n = 1.2$, SD = 1.3).

Table 1 shows the sample characteristics related to HIV serostatus. The prevalence of HIV infection among the study population was 20.7%. The prevalence of HCV and hepatitis B virus (HBV) was 90.1% and 66.2%, respectively. In total, 154 men and eight women were diagnosed as HIV seropositive. In the univariate analysis, HIV-positive patients were younger in age (34.2 ± 6.9 years vs. 36.5 ± 7.9 years; $p = 0.001$) and younger in age for their first illegal drug (22.1 ± 6.2 years vs. 24.3 ± 7.6 years; $p < 0.001$), had more drug-related (2.7 ± 1.6 vs. 2.2 ± 1.5 ; $p < 0.001$) and nondrug-related (1.6 ± 1.5 vs. 1.1 ± 1.2 ; $p < 0.001$) criminal convictions, and were more likely to initiate heroin use at a younger age (23.9 ± 5.7 years vs. 26.8 ± 13.1 years; $p = 0.006$) than HIV-negative patients. HIV-infected patients also tended to be more depressed ($p = 0.009$). The prevalence of HIV-positive users among the injecting heroin users in this study group was 23.1%. Those who injected heroin were more likely to be HIV positive ($p = 0.001$). HIV-positive patients were also more likely to test positive for HCV infection ($p < 0.001$). Compared to HIV-negative heroin users, HIV-positive heroin users were more likely to be men ($p = 0.039$). HIV-positive patients reported more sharing of needles ($p < 0.001$) and injection paraphernalia ($p < 0.001$). The HIV subgroups did not differ significantly regarding HBV. Factors such as family support, impulsivity, education, detoxification frequency, and severity of dependence were not significant in our study.

With respect to the degree of risk perception, 779 heroin users responded regarding the risk perception of their HIV status. Among them, 150 (19.3%) reported HIV infection, 553 (71.0%) reported HIV noninfection, and 76 (9.7%) were unsure of their HIV status. A strong agreement existed between self-reported HIV serostatus and the results of the laboratory analyses, with 88.8% of responders reporting their condition correctly. Among the 150 HIV-infected heroin users identified by blood test, 91.9% reported their condition correctly. We categorized the first answer as infection (self-report) and the last two answers as no infection (self-report) to calculate the kappa value with laboratory results. The kappa was 0.94 [95% confidence interval (CI), 0.91–0.97; $p = 0.005$], showing a high level of agreement [33]. We treated HIV serostatus as the gold standard; the positive and negative predictive values were 0.987 and 0.979, respectively, in this study. The sensitivity and specificity were 0.919 and 0.997, respectively. These measurements also showed high levels of agreement between the self-reports and the HIV serostatus.

We performed a multivariate logistic regression analysis with backward elimination to identify factors related to HIV infection among heroin users. HIV infection was independently associated with the age of initial heroin use [odds ratio (OR), 0.95; 95% CI, 0.91–0.98; $p = 0.001$], heroin injection use (OR, 1.95; 95% CI, 1.01–3.49; $p = 0.025$), nondrug-related criminal convictions (OR, 1.95; 95% CI, 1.09–3.49; $p = 0.005$), needle-sharing behaviors (OR, 2.11; 95% CI, 1.17–3.80; $p = 0.013$), and sharing of injection

Table 1 Patient demographics and clinic characteristics of heroin users in Central Taiwan, 2006–2010.

Variable	Total valid sample			HIV						<i>p</i> (<i>t</i> test)
	<i>n</i> ^a	Mean	SD	Negative			Positive			
				<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	
Age (y)	781	36.1	7.6	619	36.5	7.9	162	34.2	6.9	0.001
Education (y)	781	9.9	2.0	619	9.9	2.1	162	9.7	1.9	0.193
Onset age of substance (y)	781	23.8	7.3	619	24.3	7.6	162	22.1	6.2	<0.001
Onset age of heroin use (y)	781	26.2	12.0	619	26.8	13.1	162	23.9	5.7	0.006
Dose of heroin (half qian/d ^b)	780	5.0	5.1	618	4.9	5.2	162	5.3	5.0	0.459
Detoxification for heroin more than 2 wk (lifetime)	778	2.8	2.8	616	2.8	2.7	162	2.7	3.1	0.632
Severity of heroin dependence (SDS, ^c total score)	781	7.4	2.7	619	7.4	2.7	162	7.4	2.5	0.962
No. of criminal convictions (illegal substances)	779	2.3	1.5	618	2.2	1.5	161	2.7	1.6	<0.001
No. of criminal convictions (nonsubstance causes)	777	1.2	1.3	617	1.1	1.2	160	1.6	1.5	<0.001
Impulsivity (Barrat Impulsivity Scale ^c)	725	72.5	8.7	569	72.2	7.8	156	73.5	11.3	0.104
Family support (APGAR ^c)	781	5.7	4.3	619	5.6	4.3	162	6.1	4.3	0.161
Depression (CESD Scale ^c)	781	23.05	9.8	619	22.6	9.8	162	24.8	9.6	0.009

Variable		Total valid sample size	HIV				<i>p</i> (Chi-square)
			Negative		Positive		
			<i>n</i>	%	<i>n</i>	%	
Sex	Male	710	556	89.8	154	95.1	0.039
	Female	71	63	10.2	8	4.9	
Injection	Yes	618	475	77.6	143	89.9	0.001
	No	153	137	22.2	16	10.1	
Needle sharing	Yes	86	38	6.2	48	29.6	<0.001
	No	693	579	93.8	114	70.4	
Paraphernalia sharing	Yes	148	70	11.3	78	48.1	<0.001
	No	632	548	88.7	84	51.9	
HCV	Yes	704	542	88.0	162	100.0	<0.001
	No	74	74	12.0	0	0.0	
HBV	Yes	517	411	66.2	106	65.4	0.777
	No	262	206	33.4	56	34.6	

APGAR = adaptation, partnership, growth, affection, resolve score; CESD = Centre for Epidemiologic Studies Depression; HCV = hepatitis C virus; HBV = hepatitis B virus; SD = standard deviation; SDS = Severity of Dependence Scale.

^a Total number of observations do not sum up to 781 for all variables due to missing values.

^b 1 qian = 3.75 g (number of half qians of heroin used per day).

^c Chinese versions.

Table 2 Multivariate logistic regression analysis for human immunodeficiency virus (HIV) infection among 781 heroin users in Central Taiwan, 2006–2010.

Variables	Odds ratio		<i>p</i>	Variance inflation factor
	Estimate	(95% CI)		
Onset age of heroin use (y)	0.95	0.91–0.98	0.001	1.04
Vessel or muscle injection of heroin	1.95	1.01–3.49	0.025	1.04
Criminal convictions (nonsubstance causes)	1.95	1.09–3.49	0.005	1.01
Needle sharing	2.11	1.17–3.80	0.013	1.45
Paraphernalia sharing	5.17	3.18–8.41	0.000	1.45

CI = confidence interval.

paraphernalia (OR, 5.17; 95% CI, 3.18–8.41; $p < 0.001$; Table 2). The VIFs of explanatory variables of <5 indicated limited multicollinearity in the previous final regression model (Table 2). All models in the model selection process also included variables with VIFs of <5 .

We performed a similar analysis to identify factors related to needle sharing among heroin users. Needle sharing was independently associated with the severity of heroin dependence (OR, 1.17; 95% CI, 1.05–1.32; $p = 0.006$), family support (OR, 0.91; 95% CI, 0.85–0.98; $p = 0.010$), sharing injection paraphernalia (OR, 20.59; 95% CI, 10.78–39.32; $p < 0.001$), and HIV infection (OR, 2.75; 95% CI, 1.47–5.15; $p = 0.002$). The VIF also showed limited multicollinearity in the model selection process (Table 3).

Discussion

The results showed a high rate of HIV infection (20.7%) among the heroin users seeking treatment at the MMT program. The prevalence was much higher than that of the

Table 3 Multivariate logistic regression analysis for needle sharing among 781 heroin users in Central Taiwan, 2006–2010.

Variables	Odds ratio		<i>p</i>	Variance inflation factor
	Estimate	(95% CI)		
Severity of heroin dependence (SDS, total score)	1.17	1.05–1.32	0.006	1.03
Family support (APGAR)	0.91	0.85–0.98	0.01	1.01
Paraphernalia sharing	20.59	10.78–39.32	<0.001	1.19
HIV infection (serostatus)	2.75	1.47–5.15	0.002	1.17

APGAR = adaptation, partnership, growth, affection, resolve score; CI = Confidence interval; SDS = Severity of Dependence Scale.

general population in Taiwan (0.082% in 2009) [4]. The HIV rate among those who used heroin by injection was 23%. Among the general population in Taiwan, the prevalence of chronic HBV carriers is estimated to be 15–20% and the prevalence of HCV infection 3–4% [34]. Our findings show a high prevalence of HBV (66.2%) and HCV (90.1%) infection among heroin users. The high prevalence of HIV infection among this study population should be viewed in the context of the findings from other Asian countries. The HIV prevalence among injecting heroin users is as low as 2.6% in Australia, and as high as 28% in Indonesia [2] or 52% in Thailand [2]. The rate in other countries ranges from 1% in New Mexico, USA [35]; 20.4% in Vancouver, Canada [13,36]; to 31.7% in Madrid and Barcelona, Spain [13]. In Taiwan, Chen et al. [7] reported a higher HIV-infection frequency (38%) than that of our study, possibly because their patients belonged to a higher-risk population (male incarcerated IDUs).

Our results also indicated that HIV-positive heroin users were more likely to be those who injected heroin, and shared needles and other injection paraphernalia.

A previous study in Taiwan also found that a shift in heroin administration from smoking to injection, and increased needle-sharing behaviors further exacerbated the HIV epidemic [7]. HIV prevalence among drug addicts has reduced by half within the past 4 years. However, among the HIV-infected population, the proportion of drug users remains approximately one-third [4]. Our study results indicated that drug injection is still a crucial factor associated with HIV infection in Taiwan.

Our results are consistent with the results of several other studies regarding the strong association between sharing needles and/or injection paraphernalia and HIV infection [11]. Needle-sharing behaviors are typically associated with outbreaks of HIV/AIDS in Thailand, India, Malaysia, Burma, China, and Vietnam [31]. The prevalence of injecting and sharing injection equipment becomes lower in patients admitted to addiction treatment service programs [37]. The proportion of drug users remains high

among the HIV-infected population [4]. Our findings suggest that sharing needles/injections and/or paraphernalia remain important factors relating to HIV infection. Counseling for IDUs should emphasize the risks of indirect sharing and use of injection paraphernalia [13].

Heroin users in our study group first used heroin at a mean age of 23.9 years (SD ± 5.7). Patients whose initial use of heroin occurred at a younger age were more likely to test positive for HIV infection. This finding is consistent with the findings of other studies conducted in India [11], indicating that earlier heroin use was related to injecting heroin at an earlier age [38], and younger IDUs were reported to borrow current injection equipment more often than older IDUs [39]. Greater attention should be focused on the needs of younger heroin users to help delay or prevent the onset of drug injecting [39]. HIV-positive heroin users were more likely to have nondrug criminal convictions in this study group. Although other studies have examined drug-related criminal convictions and HIV infection [18,23], none has investigated nondrug-related criminal convictions among heroin users and HIV infection. Our study is the first in Asia to examine the perceptions of HIV status among heroin users, and our results show that more than 90% of HIV-positive patients know their status. Because similar studies on heroin users do not exist, a comparison was not feasible. Compared with the findings from other populations, our findings are similar to previous reports on the general population in Malawi (71%) [22] and on men who have sex with men in Brazil (kappa = 0.88) [40], but contrary to those on the general population of Nigerians [41]. The high-risk perception may be because of good public health education in Taiwan. We did not have information on the influence of their risk perception on their own heroin-related behaviors, such as engaging in fewer unprotected sexual acts, and sharing needles or paraphernalia. Further research is necessary to explore this issue.

Our study findings should be interpreted according to certain study design limitations. The cross-sectional study design is limited to determining the causality relationship among variables; the measurement of psychosocial factors is based on self-reported behaviors. The potential for social desirability bias exists, such as underestimating impulsivity characteristics. The sample was not selected randomly and was recruited from a psychiatric center in Central Taiwan; therefore, our results might not be applicable to other settings. These heroin users may be a highly select group with greater dependence severity and higher risk behaviors. The prevalence of HIV infection may be overestimated among this population. The information regarding sexual behavior is insufficient; in certain countries such as China, heterosexual transmission has become the dominant mode of HIV transmission [42].

Our study also has certain strengths. It is the first study to examine risk perceptions of HIV status among heroin users in Asia. Of the studies related to heroin use and HIV infection in Taiwan [7,43], our study contains the largest group sample and is the only study investigating the population of both injecting and noninjecting heroin users. We explored psychosocial and heroin-related behaviors comprehensively in this study to provide more complete information on the current trends of HIV infection among

heroin users in Taiwan. Our study is beneficial for advancing further the effectiveness of current treatment programs, including maintenance-related programs.

In conclusion, we identified the current factors associated with HIV infection among heroin users in Taiwan. Our results are helpful for formulating and modifying prevention programs in the country. Prevention programs should emphasize on disseminating knowledge about drug addiction and HIV infection in adults and younger groups prior to people using illegal drugs. Although a harm-reduction program has been pursued for approximately 4 years in Taiwan, needle- and injection paraphernalia-sharing behaviors are strongly associated with HIV infection among heroin users in the country. Educational programs should apply greater emphasis on perceiving the risks of drug-use behavioral patterns to increase the motivation for behavioral change. Providing specific advice on avoiding alcohol or heavy drinking is critical because of the high rate of viral hepatitis among HIV-infected patients. Establishing a close liaison between MMT services and medical services is also vital to provide antiretroviral or liver disease treatments.

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