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## Original Article

## A Case-control Study of HIV Infection Among Incarcerated Female Drug Users: Impact of Sharing Needles and Having Drug-using Sexual Partners

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**Background/Purpose:** Taiwan experienced a rapid surge in human immunodeficiency virus (HIV) among injection drug users (IDUs) from 2003 to 2005. The male-to-female ratio of HIV cases decreased from 20:1 in 2003 to 6:1 in 2006. This change is primarily due to increasing numbers of female injection drug users in Taiwan. Our primary objective was to identify the risk factors associated with HIV infection among incarcerated female drug users.

**Methods:** A case-control design involved recruitment of all eligible HIV-infected female inmates from all 24 prisons in Taiwan from November to December, 2007. Eligible HIV seronegative controls were chosen within the same prison and matched to the cases by age (within 3 years) and by history of illicit drug use. A subsample of these matches was randomly selected since there were many more eligible controls than HIV-infected cases. An anonymous self-administered questionnaire was completed with assistance from trained research assistants.

**Results:** A total of 114 cases and 149 control participants were recruited, with a response rate of 82% and 54%. Injectible heroin use was significantly greater ( $p=0.02$ ) among HIV-infected cases (93.0%) than uninfected controls (84.6%). Compared to seronegative controls, HIV-infected cases were more likely to share drug paraphernalia and have drug-using sexual partners. Multiple logistic regression analysis revealed that the number of imprisonments (between 2–5 times; OR=5.23), sharing mainly dilutes (OR=63.47), and sharing dilutes concurrently with needles (OR=127.33) significantly predicted HIV seroconversion, after controlling for age and years of education.

**Conclusion:** Sharing needles/dilutes and practicing unsafe intercourse with drug-using sexual partners places female drug users at considerable risk.

**Key Words:** case-control, female drug users, HIV, sharing needles

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Epidemiological trends are alarming among incarcerated women, who are 15 times more likely to be human immunodeficiency virus positive (HIV+) than non-incarcerated women.<sup>1</sup> This is particularly true in Taiwan, which experienced a rapid rise in HIV infection among injection drug users (IDUs) from 2003 to 2005.<sup>2</sup> The proportion of newly diagnosed HIV-infected cases attributed to IDUs dramatically increased from 2.5% in 2002 to 8.9% in 2003, and to 70.3% in 2005.<sup>2,3</sup>

Boerma and Weir<sup>4</sup> presented a proximate-determinants framework, i.e. identification of a set of variables, to study HIV infection by combining demographic and epidemiological approaches. Bingenheimer and Geronimus<sup>5</sup> proposed three categories of proximate determinants—behavioral mechanisms, biological mechanisms, and demographic and biomedical factors—as a conceptual framework to guide HIV epidemiological research. Female incarcerated populations include large proportions of IDUs, who are at high risk of contracting or transmitting HIV. Their HIV infection risk is the result of biological factors,<sup>6–8</sup> demographic factors,<sup>9,10</sup> and behavioral and social factors.<sup>11–15</sup>

Women are more likely than men to acquire HIV from injecting drugs and heterosexual transmission.<sup>16</sup> Demographic factors, e.g. low educational attainment and limited condom use, enhance women's vulnerability to HIV.<sup>9,10</sup> In addition to biological factors that enhance the risk of women contracting HIV,<sup>6–8</sup> social and cultural factors may play a pivotal role.<sup>17</sup> Srirak et al<sup>11</sup> found that history of incarceration, history of injection drug, experiencing sexual abuse, and trading sex for money were related to HIV among female drug users in northern Thailand. Female IDUs reported more commercial sex than males, which might place them at higher HIV risk.<sup>14</sup> Gender influences injection practices in regular heterosexual relationships; male IDUs reported more frequent injections, and were more likely to inject their partners.<sup>15</sup> HIV-infected female inmates tend to share injection paraphernalia more frequently, and had more drug-using family members or sexual partners.<sup>12</sup> A recent study indicates

that half of female IDUs had a regular IDU sex partner.<sup>13</sup>

Notably, the male-to-female ratio of HIV-infected cases in Taiwan decreased from 20:1 in 2003 to 6:1 in 2006. This is primarily due to an increase in the number of female injection drug users.<sup>3</sup> However, little data is available on Taiwanese female HIV-infected inmates. A previous Taiwanese study indicates higher HIV prevalence among incarcerated drug-using inmates in males (11.6%) than females (8.6%).<sup>18</sup>

Incarcerated female drug users are at higher risk for heterosexual transmission of HIV infection than their non-incarcerated counterparts are. Sharing needles and dilutes or having unprotected sex were the most influential risk factors for HIV infection in female drug users.<sup>11</sup> In Taiwan, the situation of incarcerated female drug users is not documented well, as it is for males (e.g. Peng et al<sup>19</sup>).

Incarceration is often linked to HIV transmission,<sup>20</sup> particularly with IDUs,<sup>21</sup> but research has yet to document whether this is applicable for Taiwan. At this critical junction in the outbreak of HIV among IDUs in Taiwan, it is important to investigate the proximate-determinants of HIV in female drug users. This study attempts to identify the risk factors associated with HIV infection among incarcerated female drug users.

## Methods

### *Study population and sampling procedure*

HIV surveillance of Taiwan prison inmates was officially established in 1990 as dictated by the "AIDS Prevention and Control Act," which was amended in 2007 as the "HIV Infection Control and Patient Rights Protection Act".<sup>22</sup> The Act requires mandatory HIV testing upon incarceration,<sup>22</sup> with confirmation of their positive findings through Western blot HIV testing. Prisoners identified as HIV-positive are subsequently separated from seronegative prisoners. Unlike many other countries,<sup>20,21</sup> Taiwan has never encountered an HIV infection outbreak in the prison setting.

In Taiwan, HIV testing occurs upon imprisonment to ensure the separate housing of infected and uninfected inmates. This procedure made it possible for this study to enroll seropositive participants without conducting independent HIV testing. This study covers the period from November to December, 2007. At that time, there were 24 prisons in Taiwan, holding 3013 female inmates, including 146 HIV-positive and 2867 HIV-negative female inmates.

In the first of two study stages, participants completed a self-administered anonymous census survey without providing any identifying information to the researcher. We recruited 2486 participants, including 139 HIV-positive and 2347 HIV-negative female inmates.<sup>18</sup> In the second stage, 114 of the 139 HIV-seropositive female inmates agreed to participate in the present survey, achieving a response rate of 82%.

These 139 participants were assigned to the Cases group for the Case-Control design adopted in this study. In the same prison where the case participants resided, we selected 2347 eligible seronegative inmates from the census survey using two criteria ("age  $\pm$  3 years" and "had ever used any illicit drugs"). Each eligible control candidate was given a "random number" which was listed in sequential order. We then contacted the first eligible control candidate. If she refused to participate, we contacted the next one. All control subjects were selected randomly with a match ratio of 2:1 to ensure that the estimated control sample size would be approximately 2 times that of the cases. We proportionately selected control subjects until we arrived at our estimated sample size, including oversampling for non-participants. Consequently, there were 278 eligible HIV-negative inmates contacted, and 149 of them agreed to participate, for a response rate of 54%.

### **Measures**

The research instrument was a structured questionnaire focusing on three areas that might influence HIV transmission risk: demographics and select characteristics, behavioral factors prior to incarceration, and social factors prior to incarceration.

### **Demographic and select characteristics**

Age, years of education, marital status, number of children, employment status prior to incarceration, and other historical/demographic information were collected. Other information gathered included participants' sexual orientation (heterosexual, homosexual, bisexual), history of sexually transmitted diseases in the past year, current criminal charges, number or times imprisoned, prior drug-related recidivism (a previous drug offense convictions).

### **Pre-incarceration behavioral risk factors**

The major behavioral risk factors for HIV infection were measured by two factors. The first was drug-usage related risk, including drug-usage history regarding specific drug preferences, patterns and mode of administration (such as if drugs were smoked or injected) and experience sharing needles or dilutes. The second factor was sexual related risk, including unsafe sexual behavior measured by the frequency of condom use during the six months prior to incarceration (never, seldom, half of the time, most of the time, always).

### **Pre-incarceration social risk factors**

Social risk factors were measured by several indicator including: (1) having drug-using sexual partners within six months prior to incarceration; (2) working in nightclubs or bars; (3) experience of physical abuse; or (4) exchanging sex for money or drugs.

### **Statistical analyses**

The data collected in this study was managed using Microsoft Office Excel 2003, and analyzed using SPSS software (version 14.0; SPSS Inc, Chicago IL, USA). Continuous variables were described using mean and standard deviation. Categorical variables were presented as proportions. Univariate analysis, Fisher's exact test, and  $\chi^2$  test for between-group comparisons were applied where appropriate. Age and years of education served as control variables in the multiple logistic regression analysis. If two variables were thought to be highly correlated to each other, then only one was included in multivariate analysis. Selection of variables was

based on the previous literature or those variables with larger chi-square values. A  $p$  value of  $< 0.05$  was considered statistically significant.

## Results

Table 1 presents demographic data and other relevant characteristics of participants. Participants varied from age 18 to 51 years (mean = 32.0; SD = 7.0). Only three participants were younger than 20, and two older than 50. Over half (61.3%)

had completed at least 9 years of formal education. A high percentage (77.8%) were never married, divorced, separated, or widowed. About 41.1% were unemployed prior to incarceration.

Most participants (91.0%) were incarcerated on drug offenses, and 76.7% had previous drug-related convictions. The case and control groups differed significantly in years of formal education, episodes of imprisonment, and drug-related recidivism.

Table 2 displays the participants' behavioral and social risk factors related to HIV. Nearly 25.3%

**Table 1.** Demographic and select characteristics of participants

Variables	HIV+ case ( $n = 114$ )	Controls ( $n = 149$ )	Total ( $n = 263$ )	$p$
Age				0.19
$\leq 30$	56 (51.4)	65 (45.4)	121 (48.0)	
31–40	42 (38.5)	52 (36.4)	94 (37.3)	
$\geq 41$	11 (10.1)	26 (18.2)	37 (14.7)	
Years of education				$< 0.05$
$\leq 9$	78 (69.6)	80 (54.8)	158 (61.3)	
$\geq 10$	34 (30.4)	66 (45.2)	100 (38.7)	
Marital status				0.46
Never married	38 (34.2)	61 (41.8)	99 (38.5)	
Divorced/separated/widowed	46 (41.4)	55 (37.7)	101 (39.3)	
Married or cohabiting	27 (24.3)	30 (20.5)	57 (22.2)	
Number of children				0.2
None	31 (27.2)	53 (35.6)	84 (31.9)	
One or more	83 (72.8)	96 (64.4)	179 (68.1)	
Working status prior to incarceration				0.08
Employed	59 (51.8)	93 (62.4)	152 (58.9)	
Unemployed	55 (48.2)	56 (37.6)	106 (41.1)	
Sex orientation				0.35
Heterosexual	101 (91.0)	126 (86.3)	227 (88.3)	
Lesbian or bisexual	10 (9.0)	20 (13.7)	30 (11.7)	
Current conviction				0.83
Drug offense	101 (91.0)	132 (91.0)	233 (91.0)	
Others	10 (9.0)	13 (9.0)	23 (9.0)	
Drug-related recidivism	93 (83.0)	105 (71.9)	198 (76.7)	$< 0.05$
Number of times imprisoned				$< 0.001$
1 (first time)	22 (19.6)	63 (43.5)	85 (33.1)	
2–5	85 (75.9)	77 (53.1)	162 (63.0)	
$\geq 6$	5 (4.5)	5 (3.4)	10 (3.9)	
Had sexually transmitted diseases in the past year	13 (12.0)	27 (18.6)	40 (15.8)	0.21

Data are presented as  $n$  (%). Missing data were excluded.

**Table 2.** Behavioral and social risk factors of participants prior to incarceration

Variables	HIV+ case (n = 114)	Controls (n = 149)	Total (n = 263)	<i>p</i>
<b>Behavioral factors</b>				
Had ever used any illicit drug	108 (94.7)	142 (95.3)	250 (95.1)	0.98
Had ever used injectable heroin	106 (93.0)	126 (84.6)	232 (88.2)	0.02
Sharing drug paraphernalia behavior				<0.001
No	7 (6.2)	113 (76.4)	120 (46.2)	
Sharing mainly dilutes	28 (25.0)	16 (10.8)	44 (16.9)	
Sharing dilutes and needles	77 (68.8)	19 (12.8)	96 (36.9)	
Condom usage within six months prior to incarceration				0.58
Never used condoms	31 (27.4)	35 (23.6)	66 (25.3)	
Occasionally or often used condoms	82 (72.6)	113 (76.4)	195 (74.7)	
<b>Social factors</b>				
Ever worked in nightclubs or bars	63 (55.3)	78 (52.3)	141 (53.4)	0.73
Ever been physically abused by significant others	81 (73.0)	108 (75.5)	189 (74.4)	0.64
Ever exchange sex for money or drugs	8 (7.0)	8 (5.4)	16 (6.1)	0.76
Having drug-using sexual partners	73 (64.0)	56 (37.6)	129 (49.0)	<0.001
Had drug-using sexual partners as well as sharing drug paraphernalia (n = 129)	72 (98.6)	18 (32.1)	90 (69.8)	<0.001

Data are presented as n (%). Missing data were excluded.

of the participants in each group reported never using condoms during penetrative intercourse. More than half had worked at nightclubs or bars, and over 70% in each group reported being physically abused by significant others. Roughly, 6.1% reported exchanging sex for money or drugs before incarceration.

The most commonly used drugs were heroin (71.9%), methamphetamine (25.4%), and marijuana (2.3%). Significant differences in injectable heroin use ( $p=0.02$ ) appeared between the HIV infected (93.0%) and non-infected (84.6%) groups. HIV-positive cases had a higher rate of sharing drug paraphernalia than controls, particularly in sharing mainly dilutes (25.0% vs. 10.8%), and sharing dilutes simultaneously with needles (68.8% vs. 12.8%). Participants reported that their experiences of "sharing dilutes only" included two situations: "sharing dilutes only" or "sharing needles only." Yet, those with "sharing needles only" included only two participants in HIV+ groups, and four in non-infected controls. Hence, these two categories were combined into one category in the analysis.

HIV-positive cases reported higher rates of having drug-using sexual partners than control cases (64.0% vs. 37.6%,  $p<0.001$ ). Among participants with drug-using sexual partners ( $n=129$ ), the HIV-positive cases had considerably higher rates of sharing injection equipment with their sexual partners than seronegative controls (98.6% vs. 32.1%,  $p<0.001$ ).

Table 3 shows multiple logistic regression analyses of HIV infection risk. This data indicates that repeated imprisonment of between 2–5 times (OR=5.23), sharing mainly dilutes only (OR=63.47), and sharing dilutes simultaneously with needles (OR=127.33) predicted HIV serostatus after controlling for age and years of education. The mixture of sharing dilutes simultaneously with needles increases the risk of contracting HIV.

## Discussion

This study reveals several key findings. First, sharing needles and/or dilutes with drug-using sexual partners most strongly predicted HIV seropositivity.

**Table 3.** Multiple logistic regression of factors associated with HIV infection

Variable	OR (95% CI)	<i>p</i>
<b>Age</b>		
≤30	1 (reference)	
31–40	1.00 (0.44–2.30)	0.998
≥41	1.12 (0.30–4.12)	0.869
<b>Years of education</b>		
≤9	1 (reference)	
≥10	1.01 (0.44–2.31)	0.988
<b>Number of times imprisoned</b>		
1 (first time)	1 (reference)	
2–5	5.23 (1.97–13.91)	0.001
≥6	1.21 (0.22–6.60)	0.826
<b>Sharing drug paraphernalia</b>		
No	1 (reference)	
Sharing mainly dilutes	63.47 (17.49–230.32)	0.000
Sharing dilutes and needles	127.33 (37.36–433.98)	0.000

OR = odds ratio; CI = confidence interval.

Second, the number of imprisonments significantly predicted HIV-infection risk. Third, condom use was relatively infrequent in both groups.

Multiple logistic regression findings demonstrate that HIV-infected female inmates were much more likely to share needles and/or dilutes than their non-infected counterparts, and particularly those involved with drug-using sexual partners. This finding suggests a complex interactive relationship between sexual and drug-using partners among female IDUs.<sup>12,23</sup> Prior surveillance research, e.g. Strathdee et al,<sup>24</sup> showed marked gender differences in the risk factors for HIV seropositivity. Consistent with this literature, the current study shows that women who had drug-using sexual partners had over a 98% likelihood of sharing needles or paraphernalia with their sexual partners, thus greatly enhancing sexual and injection risks for transmitting HIV.

HIV seropositivity and low educational attainment significantly predicted episodes of recidivism and imprisonment,<sup>25,26</sup> which were relatively

high among study participants. Notably, significantly more HIV+ cases (69.6%) than controls (54.8%) failed to complete more than 9 years of formal education. Education to 9 years is compulsory in Taiwan. However, only 34.4% of Taiwanese aged 15 years or over have failed to go beyond nine years of junior high school.<sup>27</sup> Hence, our seropositive participants tended to not exceed an educational level as those in the general population.

Pre-incarceration, study participants reported relatively infrequent use of condoms during penetrative intercourse regardless of serostatus; specifically, 27.4% of HIV-infected cases and 23.6% of controls reported never using condoms. Several factors may discourage safer sex practices in our target population. Since seropositive individuals frequently fail to disclose their HIV status,<sup>28</sup> their partners' perception of self-risk might be unrealistically low. Because perceptions often influence motivations and behaviors, our female participants might possess a false sense of safety, which discourages condom use, especially with their primary sexual partner.<sup>10,29</sup> In addition, women are usually less empowered to influence condom use and other safe sex decisions, given their frequent economic dependence on their partners,<sup>30</sup> and the high percentage of reported physical abuse among present study participants.

As suggested by participants' infrequent condom use, female drug users with incarceration experience continue to represent a key "bridge" population, transmitting HIV to their drug-using partners and/or through commercial sex consumers, and then in turn to the general population. Thus, jails and prisons may present an ideal opportunity to conduct sexual education and drug resistance programs in a population that would otherwise be "hard to reach". Mental health education is an important factor for the incarcerated population.<sup>19,31</sup> Strengthening HIV/AIDS education in jail settings may help reduce our high observed recidivism rates, despite the fact that there has been some level of education programming officially been operating for many years in Taiwan.<sup>32</sup>

### Limitations

The findings of this study are subject to several limitations. First, the significance of our findings is limited to the incarcerated female population, and therefore lacks generalizability. Second, even though 46% of enrolled HIV-negative controls did not participate in this study, their ages were similar to those of the cases. Since we did not collect detailed demographic information, self-selection bias might exist. Third, there was a wide range in some variables in the 95% confidence intervals. Although this is related to a small sample size in this study, the findings must be interpreted with caution. Finally, regardless of serostatus, the experience of trading sex for money or drugs (only reported as 6%) may have been under-reported, since most of our participants had worked in nightclubs or bars.

In conclusion, the routes of HIV infection for female drug users, including sharing needles and/or dilutes, and practicing unsafe intercourse with their drug-using sexual partners, places them at considerable risk.

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