Exploratory Analysis of the Association between New-Type Drug Use and Sexual Transmission of HIV in China

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Abstract

Background—A recent assessment by the Chinese government showed that sexual transmission is becoming the main mode of spreading human immunodeficiency virus (HIV) in China. The annual report on drug abuse demonstrated a seven-fold increase of use of Amphetamine Type Stimulants (ATS), which has been strongly correlated with sexual risk-taking behaviors, in 2007 than that in 2003. These observations suggest that ATS use may have contributed to the rapid increase in sexual transmission of HIV in China.

Objective—The present study aims to investigate the potential association between new drug users and transmission modes.

Methods—Partial Least Squares Path Model and Partial Least Squares Regression Models have been used to evaluate the potential correlation between ATS users and the sexual transmission of HIV.

Results—Our analysis indicates that HIV infection by drug use mode mainly results from heroin users (R = .5). ATS (R = −.9) and other drug users (R = −.4) have a negative relationship with HIV infection by drug use mode. However, for HIV infection by sexual transmission mode, ATS (R =

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5.5) and other drug users (R = .6) show a positive association. ATS, especially, presents a strongly association with the sexual transmission of HIV.

Conclusion—The study results suggest that ATS users significantly contribute to the sexual transmission of HIV.

Scientific Significance—It is helpful to evaluate and predict the potential risk factors related with epidemic of HIV in China and provide theoretical evidence for HIV/AIDS health officers and policy makers to better construct target interventions and implement control measures.

Keywords

Mode of spread of HIV; new-type drug user; Partial Least Squares Path Model

INTRODUCTION

In the past 20 years, China has experienced a resurgence in drug use, particularly heroin use, and a growing epidemic of human immunodeficiency virus (HIV/AIDS) infection. In China, nearly half of those living with HIV are believed to have been infected through drug use (1, 2). Based on a recent annual report of drug abuse in China, the HIV infection rate among individuals who share contaminated needles and injection paraphenalia is 12.7%, which is about six-fold greater than among general heroin injection drug users in 2007 (3). Heroin use has created a substantially high proportion of HIV infection cases and contributed to the morbidity and mortality of illicit drug use (1). However, a recent joint assessment of HIV/AIDS by the State Council HIV/AIDS Working Committee Office and the United Nations Theme Group on HIV/AIDS in China demonstrated a change of transmission modes (4). Sexual transmission is becoming the main mode of spreading HIV, and the proportion of transmission through heroin use is declining (43.3% in 2008 compared with 29.2% of new infections in 2007). A 2008 surveillance report on drug abuse showed that the decreasing prevalence of heroin use was attributable to the Chinese Government's "People's War on Drugs" initiated in 2005 (5), but new-type drug use, particular amphetamine-type stimulant (ATS) use and ATS polydrug use, have increased and are becoming the major sources of drug consumption in China (Fig. 1) (3, 6–9).

New-type drug use has been referred to as "21st century narcotics" of choice. ATSs can stimulate the central nervous system, producing euphoria, a sense of well-being, wakefulness, and alertness (10). Evidence from surveillance reports on drug abuse indicate that a wide range of people—among whom the 20–29-year-old age group exhibit the highest prevalence—use ATSs for various reasons and in various venues, such as private homes, nightclubs, bars, and dance parties in China (3, 6–9). ATS use is reported to be associated with a range of potentially negative health consequences, including stroke, heart problems, and kidney failure (10). In particular, ATS are reported to be associated with unsafe sexual behaviors (10). Several previous studies in China have demonstrated sexual transmission of HIV among heroin drug users (2, 11). However, the potential correlations between ATS use and the sexual transmission of HIV/AIDS has not been explored.

The present study presents findings from a pilot assessment of the association between ATS and the sexual transmission of HIV/AIDS by using the Partial Least Squares Path Model (12) and Partial Least Squares Regression Models (13).

METHODS

Data

The drug use data for the study were obtained from the National Institute on Drug Dependence (NIDD), Peking University, from January 2003 to December 2007. Because the incidence of new drug users is an indicator of drug use trends, we restricted our analysis only to new drug users from 2003 to 2007. A "new drug user" is defined as a person who began using a drug during the report year and who had not previously been treated by clinical detoxification. HIV/AIDS cases for the same years were obtained from the routine surveillance system of the Center of HIV/AIDS in China Centers for Disease Control (AIDSCDC). NIDD and AIDSCDC are China's national surveillance departments responsible for monitoring and collecting information regarding drug user and HIV/AIDS, respectively.

Assumptions

To assess the association between HIV transmission and type of drug use, we classified HIV transmission mode into three categories: drug transmission (DT), sexual transmission (ST), and other transmission (OT). Drug use was divided into heroin use (HU), ATS, and other use (OU). We then set $X = \{HU, ATS, OU\}$ and $Y = \{DT, ST, OT\}$. However, HU, ATS, OU, DT, ST, and OT can be observed directly and classified as manifest variables; X and Y are unobserved constructs and cannot be observed or measured directly, but have to be inferred through the observed indicators, so they are classified as compositional variables or latent variables.

Partial Least Squares Path Model and Partial Least Squares Regression Model

These two models are important statistical tools in behavioral sciences (also in economics science) and usually are used to explore the potential causal relationships among several variables that can be either directly observed variables (manifest variables) or unobserved hypothetical variables (compositional variables).

Based on our assumption, X and Y were fitted into the Partial Least Squares Path Model first as two compositional variables (12). (All analyses were conducted using PLS-GUI software v.1.0.) Then we fitted X and Y into the Partial Least Squares Regression Model (13) as formula 1 to estimate the correlation between each composition within the mode of HIV transmission and the type of drug use. (All analyses were conducted using SMCA-P software v.11.5).

$$Y = AX + B$$

$$\begin{pmatrix} DT \\ ST \\ OT \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{pmatrix} HU \\ \text{ATS} \\ OU \end{pmatrix} + \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix} \quad [1]$$

RESULTS

The direct path coefficient was .839, and the goodness-of-fit test for the Partial Least Squares Path Model was .803, which indicates that the type of drug use had a significant effect on the mode of HIV transmission. Table 1, results of the Partial Least Squares Regression Model, indicates that HIV infection by drug use mode mainly results from heroin use (R = .5), and ATS (R = −.9) and other drug use (R = −.4) have a negative relationship with HIV infection by drug use mode. However, for HIV infection by the sexual transmission mode, ATS (R= 5.5) and other drug use (R = .6) shows a positive association. ATS in particular, indicates = a strong association with the sexual transmission of HIV.

DISCUSSION

The present study suggests that the type of drug use is directly associated with the mode of HIV/AIDS transmission. This finding is consistent with multiple previous studies in China (2, 11, 14). Statistical analyses further reveals that the drug transmission mode of HIV/AIDS has a positive association with heroin use (Table 1) and a negative association with ATS use and other drug use. These findings concur with the official Chinese report on drug dependence (Fig. 1) and the HIV/AIDS epidemic, according to which the number of heroin users as well as the proportion of the drug use transmission of HIV/AIDS is decreasing. The decline of heroin use can, in part, be attributed to China's government-driven war on drugs. In 2005, the Chinese government launched the "People's War on Drugs," an initiative with a series of strict policies that impose significant consequences on heroin manufacturers, traffickers, and dealers to include jail time. (5). Additionally, methadone maintenance treatment programs were implemented throughout the country in 2006, which largely decreased the incidence of heroin abuse. The government's forceful polices, including methadone maintenance treatment in China, directly resulted in a decline of heroin use, and then resulted in a related decrease in the transmission rates of HIV/AIDS by drug use mode. However, the overall effects of that policy require further study.

A remarkable finding in our study was that ATS use is significantly associated with the sexual transmission mode of HIV (Table 1). The routine monitoring data compiled by the government suggest that the increasing proportion of sexual transmission of HIV/AIDS may be a result of the dramatic increase in ATS use in China (Fig. 1). Generally, drug related transmission of HIV/AIDS in China usually refers to heroin use because the direct spread of HIV/AIDS generally results from needle-sharing subpopulations. In fact, ATS use has a potentially greater risk for HIV/AIDS spreading among a wide population because such new drugs are extensively used among diverse groups (including young people) with a variety of using patterns which are more difficult to track.

The Partial Least Squares Path Model is a general, confirmatory, and powerful multivariate analysis technique for showing potential causal relationships. The model generally focuses not on hypothesis testing (at least not on a particular relationship among variables) but, rather, on a broader picture (16). Furthermore, Partial Least Squares testing is suitable in situations in which the number of observations is limited, missing data are numerous, or correlations between predictor variables are high, all factors in severely limiting a traditional multivariate analyses (17). Our 5-year observational data included variables for the type of drug use and HIV/AIDS transmission mode, but these are typically compiled as composite variables and, therefore, could not be analyzed by traditional model, which requires independent variables. The Partial Least Squares Path Model and Regression Model were thus chosen as our exploratory analysis tools.

Clearly, our study has limitations. For example, we only conducted an exploratory analysis of the correlation between drug use and HIV transmission mode because of limitations imposed by available data. Detailed demographic information would have been a helpful inclusion and should be considered in future studies. Further, while this study acknowledges the impact of China's mandated implementation of methadone maintenance treatment and needle exchange programs as a contributory factor in the decline of heroin use in China, this was not considered in the current analysis because the emphasis of this study was simply to detect an association, if any, between new drug use and sexual transmission of HIV/AIDS.

In conclusion, drug use plays an important role in the transmission of HIV in China, contributing directly to infection through injection drug use and indirectly through promoting sexual behavior which can lead to HIV infection. Control of drug use of both types—heroin injection and ATS—will be important in the fight against HIV/AIDS in China.

Acknowledgments

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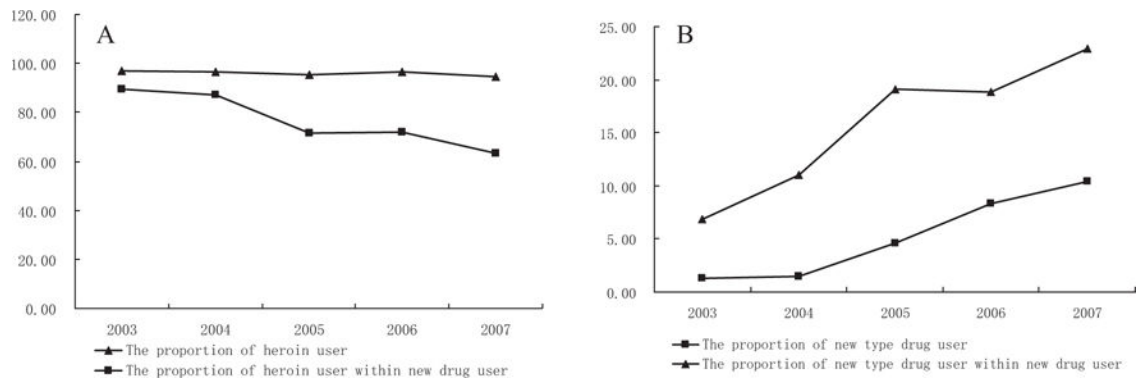
FIG. 1.

Change in heroin and new-type drug use, 2003–2007. (A) Change in heroin use, 2003–2007.

(B) Change in new-type drug use, 2003–2007.

TABLE 1

Results of Partial Least Squares Regression Model.

	Drug transmission	Sexual transmission	Other transmission
CONS	−.488	2.276	−1.788
Heroin use	.460	−.857	.698
Amphetamine-type stimulants	−.902	5.535	−4.633
Other use	−.418	.622	−.505