Seroepidemiology of Hepatitis C Among Drug Users at a Detoxification Center in Southeast China

Dangui Zhang #1, Xubin Zhang #2, Lu Xu 2, D. Lorne Tyrrell 3, Michael Houghton 3 and William Ba-Thein 4, 5, *

1Research Center of Translational Medicine, The Second Affiliated Hospital of Shantou University Medical College, Shantou, China
2Department of Disease Control, Shantou Center for Disease Control and Prevention, Shantou, China
3Department of Medical Microbiology and Immunology and Li Ka Shing Institute of Virology, University of Alberta, Edmonton, Canada
4Department of Medical Microbiology and Immunology, Shantou University Medical College, Shantou, China
5Clinical Research Unit, Shantou University Medical College, Shantou, China

*Corresponding author: Clinical Research Unit, Shantou University Medical College, Science and Technology Building, 22 Xinling Road, Shantou, China. Tel: +86-07548890049, Email: wbathein@stu.edu.cn
# These authors are contributed equally as the first author.

Received 2019 October 30; Revised 2020 February 11; Accepted 2020 March 15.

Abstract

Background: Hepatitis C virus (HCV) infection is prevalent worldwide, especially among drug users. The epidemiology of HCV is rarely reported among drug users in developing countries, including China.

Objectives: We aimed to describe the seroepidemiology of HCV infection in drug users at a Detoxification Center in Southeast China.

Methods: With approval from the Shantou Center for Disease Control, the archived data of drug users (n = 5,228) at the largest monitored-detoxification center in Shantou during 2011 - 2017 were analyzed for demographics, risk behaviors, and HCV serology.

Results: Among HCV-tested drug users, 36.9% (1930/5228) were people who inject drugs (PWID). The mean annual HCV seroprevalence rate over the seven-year study period was 36.3% for all drug users, including 67.3% and 16.6% for PWID and non-PWID, respectively, with the highest prevalence (78.1%) in 2017 and the lowest prevalence (58.6%) in 2015 for PWID. Independent risk factors of HCV infection identified by multiple logistic regression analysis were engaging in unprotected sex (OR = 1.553, 95% CI = 1.078 - 2.236), injecting drugs (10.28, 8.98 - 11.763), and sharing needles/syringes (2.24, 1.129 - 4.445) for all drug users and sharing needles/syringes (2.062, 1.438 - 2.957) for PWID.

Conclusions: This study reports the seroepidemiology of drug users in the monitored Detoxification Center in Southeast China. A relatively high HCV positivity rate, especially among PWID, their high-risk behaviors and low education, and lack of institutional interventions of HCV monitoring and transmission call for government-sponsored educational programs to raise drug users’ awareness of the risk of HCV infection and other co-infections and monitoring of the infectious status and treatment of HCV-infected drug users.

Keywords: Hepatitis C, Epidemiology, Health Risk Behaviors, Risk Factors, Drug Users

1. Background

Hepatitis C, a blood-borne infection caused by the hepatitis C virus (HCV), poses a global healthcare burden, especially due to its consequences such as cirrhosis, hepatocellular carcinoma, liver failure, and death (1). People who inject drugs (PWID) are the main population with high HCV incidence and prevalence in most of the reporting countries (2-4). The regional prevalence of HCV infection in PWID varies widely, including 64.7% in Eastern Europe, 61.9% in Latin America, 57.1% in Australia, 55.2% in North America, 53.2% in Western Europe, and 38.6% in South Asia (3, 5).

Sharing needles/syringes or drug preparation and injection materials (such as cookers, cotton, water, ties, or alcohol swabs), duration of drug injection, using and injecting multiple types of drugs, unprotected sex, and male homosexual activity are considered the risk behaviors for HCV infection in PWID (6-9). Although these risk factors are variable depending on reporting countries, drug-injecting practices and sexual contact remain strongly associated with HCV infection (10).

Globally, there are around 13 million PWID, of which 67% have hepatitis C. Also, PWID account for more than half of the 2.2 million HCV/HIV (human immunodeficiency virus) co-infections worldwide (11). In China, there were about 2.4 million known drug users in 2018, with most of
them residing in Guangdong Province in the southeast of China (12). Guangdong was reportedly one of the Chinese provinces with the highest HCV infection rate among PWID in 2008 (10) and drug users in 2011 - 2013 (13). The current status of HCV prevalence in Guangdong PWID is, however, unknown.

2. Objectives

This study aimed to describe the serological prevalence of HCV among drug users during 2011 - 2017 in a Detoxification Center in Shantou City, Guangdong Province.

3. Methods

3.1. Ethics Statement

This study was approved by the Ethics Committees of Shantou University Medical College and the Shantou Center for Disease Control and Prevention (CDC).

3.2. Study Population/Site

The study population was the drug users in the largest monitored-Detoxification Center in Shantou City, one of the 87 national HCV monitoring sentinels with mandatory screening for HCV by serology in focus groups including PWID. Shantou is the prefectural city of Guangdong Province with a population of 5.6 million as of 2017 (14).

3.3. HCV Screening

The HCV screening was done as an annual routine by the Shantou CDC. Two third-generation enzyme immunoassay (EIA) kits were used to test anti-HCV antibodies, one for screening (Kehua Biotech Co. Ltd, Shanghai, China) and the other for confirmation (Abbott HCV EIA 2.0 Abbott Laboratories, North Chicago, Illinois, USA). The samples positive in both tests were merely considered HCV-positive.

3.4. Data Collection and Analysis

Self-reported data including demographics, drug usage and practices, and sexual practices were collected from all the participants by the Shantou CDC.

The data were analyzed by SPSS version 13 (SPSS, Chicago, IL). Categorical variables, such as gender, education, origin of residence, marital status, and HCV test results, were analyzed by the chi-square test. Continuous variables, such as age, were analyzed by the t-test (for normally distributed data) or Mann-Whitney U test (for non-normally distributed data). The normality of continuous variables was tested by the Kolmogorov-Smirnov test. A multiple logistic regression model (Enter method) was used to assess the effect of different variables on HCV positivity. All statistical tests were two-tailed and P value < 0.05 was considered statistically significant.

4. Results

4.1. Sociodemographic Characteristics of Drug Users and HCV Positivity

As represented in Table 1, the demographic variables in all drug users and HCV-positive drug users, respectively, were as follows: males (92.5%, 4,837/5,228 and 93.5%, 1,746/1,868), non-local residents (13.1%, 685/5,228 and 12.7%, 237/1,868), low education, i.e., below high-school education, (89.7%, 4,688/5,228 and 89.5%, 1,672/1,868), and married/living together (57.5%, 3,008/5,228 and 58.0%, 1,084/1,868). Moreover, PWID accounted for 36.9% (1,930/5,228) of all drug users.

4.2. HCV Seroprevalence in Drug Users

As represented in Figure 1, overall, HCV Ab was positive in 35.7% (1,868/5,228) of all the drug users, including 67.2% (1,296/1,930) of PWID and 17.3% (572/3,298) of non-PWID. The HCV positivity was significantly associated with older age (P = 0.019) and low education (P < 0.001), but not with gender, the origin of residence, or marital status. The mean annual HCV seroprevalence rate over the seven-year study period was 36.3% for all drug users, including 67.3% and 16.6% for PWID and non-PWID, respectively, with the highest prevalence (78.1%) in 2017 and the lowest prevalence (58.6%) in 2015 for PWID. Significant differences were found in HCV positivity between different years for all drug users and PWID (P < 0.001).

4.3. High-risk Behaviors of Drug Users

As represented in Figure 2, nearly 90% of drug users (4,752/5,228) or PWID (1,770/1,930) did not use condoms whenever they had sex. Besides, 46.0% of drug users who were currently sexually active (985/2,142) had sex with prostitutes during the previous month, 77.2% (760/985) of which were without using condoms (data not shown). Engaging in unprotected sex was significantly associated with HCV infection for all drug users (P = 0.002) or PWID (P = 0.016) (data not shown). Among PWID, 33.0% (637/1930) shared needles or syringes with others every time.

4.4. Risk Factors of HCV Infection in Drug Users

Multiple regression analysis (Figure 3) showed that three types of behaviors, viz. engaging in unprotected sex (OR = 1.553, 95% CI = 1.078 - 2.236), injecting drugs (10.28, 8.98 - 11.763), and sharing needles/syringes (2.24, 1.129 - 4.445), were independent risk factors of HCV infection.
for drug users. For PWID, sharing needles/syringes (2.062, 1.438 - 2.957) was the only independent risk factor (data not shown).

5. Discussion

This study reports for the first time the HCV seroprevalence and high-risk behaviors of drug users in the
largest Detoxification Center in Shantou City, Guangdong Province, China.

5.1. HCV Epidemiology

Guangdong Province, which is the home of nearly 1/6 of drug users in China (11), reported an HCV positive rate of 46.5% among its drug users during 2011-2013 (15). Our study setting in Shantou, a prefectural-level City of Guangdong Province, had a similarly high positive rate (40.9%) among drug users during the same period (Figure 1).

Currently, PWID are the main target population for the prevention of HCV infection in many parts of the world. The HCV prevalence in PWID varies considerably across countries (3) or even within a country and over time. The HCV prevalence (67.2%) in Shantou PWID is slightly lower than that of Hong Kong PWID during 2013-2014 (76.4%) (16), and similar to the global prevalence (67%) (17); however, a very high prevalence up to 81.9% was reported during 2008-2011 in the southwest and central parts of China (7). One likely reason could be the special geographic factor, as southwest and central China is known as “the China Channel” for opium trafficking from the production bases in “the golden triangle” to other regions in China (9).

5.2. HCV Transmission Risk

Some modes of HCV transmission among drug users are well recognized (18) as unsafe sex (13) and high-risk sexual practices such as homosexual activity (19). Sharing injecting equipment such as needles and syringes is also considered a significant risk factor for HCV infection in PWID (20).

Because of the shared modes of transmission, people at risk for HCV infection are also at risk for hepatitis B virus (HBV) or HIV infection. It is estimated that HCV-HBV co-infection affects an estimated 2.6 million PWID globally (17). Besides, HCV-positive PWID are at disproportionately high risk of HIV infection, as is evident from the fact that PWID account for more than half of the 2.2 million HCV/HIV co-infections worldwide (17, 21) and yet, 40% to 85% of persons infected with HCV are reportedly not aware of their HCV infection status (22). In China, 15% of PWID in Yunnan Province were co-infected with HCV/HIV during 2009-2011 (23). Therefore, the risk of HCV/HIV co-infection in Shantou PWID cannot be ignored and screening should be done.

Further, PWID not only are ignorant of their risk of HCV infection or necessity for testing (20) but also have no understanding of HCV test results and health implications (24). The high-risk behaviors of PWID in this study were most likely due to their low health literacy because people with less than high school education are known to have low health literacy (25) and the majority (> 89%) of the drug users or HCV-positive drug users in this study had low education.

As reported previously in Iran (26), there is a significant
Table 1. Demographics of Drug Users and HCV Seroprevalence in the Detoxification Center, Shantou, China (2011-2017) 

| Gender  | Total (N = 5228) | HCV Positive (N = 1868) |
|---------|-----------------|------------------------|
| Male    | 4837 (92.5)     | 1746 (93.5)            |
| Female  | 391 (7.5)       | 122 (6.5)              |
| Age     | 32.91 ± 8.8     | 33.29 ± 8.5            |
| Origin of residence |         |                        |
| Local person | 4543 (86.9) | 1631 (87.3)         |
| Non-local person | 685 (13.1) | 231 (12.7)           |
| Education |             |                        |
| No education | 298 (5.7) | 133 (7.1)            |
| Primary school | 2267 (43.4) | 849 (45.4)         |
| Middle school | 2323 (44.6) | 690 (36.9)         |
| High school  | 318 (6.1)      | 121 (6.5)             |
| College or above | 48 (0.9) | 13 (0.7)            |
| Missing data | 174 (3.3) | 62 (3.4)             |
| Marital status |         |                        |
| Single    | 1884 (36.0)    | 650 (34.8)            |
| Married   | 2604 (50.0)    | 940 (50.3)            |
| Living together | 394 (7.5) | 144 (7.7)           |
| Divorced  | 336 (6.5)      | 134 (7.2)             |
| People who inject drugs (PWID) |         |                        |
| Yes       | 1930 (36.9)    | 1296 (69.4)           |
| No        | 3298 (63.1)    | 572 (30.6)            |

aValues are expressed as No. (%) or mean ± SD.
bP < 0.05 by t-test.
cP < 0.01 by chi-square test for HCV-positive vs. HCV-negative, as diagnosed by two HCV-Ab tests (see methods for detail).

5.3. Study Limitations

Although there are three Detoxification centers in Shantou, our study setting is the largest and the only monitored center for HCV infection. Therefore, the results presented herein represent only reported drug users in the monitored Center in Shantou. Besides, we could not report HCV incidence because HCV antibody tests used in this study could not distinguish acute from chronic HCV infection. The HCV/HIV co-infection rate was not known as relevant data were not available. We also cannot assure the credibility of self-reported personal behaviors about drugs and sexual activities.

5.4. Conclusions

This study provides HCV seroepidemiology and high-risk behaviors among drug users in the monitored Detoxification Center in Shantou. The study findings should lay the groundwork for future interventions such as government-sponsored educational programs to raise drug users’ awareness of HCV and other co-infections, and monitoring of the infection status and treatment of HCV-infected drug users.

Footnotes

Authors’ Contribution: Dangui Zhang, Xubin Zhang, and William Ba-Thein designed the study. Xubin Zhang and Lu Xu collected the data. Dangui Zhang analyzed the data. Dangui Zhang and William Ba-Thein interpreted the data. Dangui Zhang wrote the manuscript. Lorne Tyrrell, Michael Houghton, and William Ba-Thein edited the manuscript.

Conflict of Interests: The authors declare that they have no competing interests.

Ethical Approval: This study was approved by the Ethics Committees of Shantou University Medical College and the Shantou Center for Disease Control and Prevention (CDC).

Funding/Support: This work was supported by the Oxford Clinical Research Project (grant no. LD0701), the Li Ka Shing Foundation, and the Health, Science, and Technology Planning Project of Shantou City, China, 2017.

References

1. Messina JP, Humphreys I, Flaxman A, Brown A, Cooke GS, Pybus OG, et al. Global distribution and prevalence of hepatitis C virus genotypes. Hepatology. 2015;61(1):77-87. doi: 10.1002/hep.27259. [PubMed: 25069599]. [PubMed Central: PMC4303918].
2. Zare F, Fattahi MR, Sepehrimanesh M, Safarpour AR. Economic burden of hepatitis C virus infection in different stages of disease: A report from Southern Iran. Hepat Mon. 2016;16(4). e32654. doi: 10.5812/hepatmon.32654. [PubMed: 27257424]. [PubMed Central: PMC4887962].
3. Degenhardt L, Peacock A, Colledge S, Leung J, Grebely J, Vickerman P, et al. Global prevalence of injecting drug use and sociodemographic characteristics and prevalence of HIV, HBV, and HCV in people who inject drugs: A multisite systematic review. Lancet Infect Dis. 2015;15(9):1002-13.
10. Xia X, Luo J, Bai J, Yu R. Epidemiology of hepatitis C virus infection and its related risk factors among the rural population of Fars Province, Southern Iran. *Hepat Mon*. 2020;20(3):e99249. [PubMed: 29074409]. [PubMed Central: PMC6583718].

4. Fattahi MR, Safarpour A, Sepehrimanesh M, Hosseini Ast SM, Mohammadoust F. The prevalence of hepatitis C virus infection and its related risk factors among the rural population of Fars Province, Southern Iran. *Hepat Mon*. 2015;5(2):e24734. doi: 10.5812/hepatmon.24734. [PubMed: 25788957]. [PubMed Central: PMC4350256].

5. Granados-Garcia V, Flores YN, Diaz-Trejo LI, Mendez-Sanchez L, Liu S, Salinas-Escudero G, et al. Estimating the prevalence of hepatitis C among intravenous drug users in upper middle income countries: A systematic review and meta-analysis. *PloS One*. 2019;14(2). e0221558. doi: 10.1371/journal.pone.0221558. [PubMed: 30807590]. [PubMed Central: PMC6391024].

6. Cox J, Morissette C, De P, Tremblay C, Allard R, Graves L, et al. Access to sterile injecting equipment is more important than awareness of HCV status for injection risk behaviors among drug users. *Subst Use Misuse*. 2009;44(4):548-68. doi: 10.1080/10826080802544349. [PubMed: 19242861]. [PubMed Central: PMC2929254].

7. Hahn JA, Evans JL, Davidson PJ, Lum PJ, Page K. Hepatitis C virus risk behaviors among the partnerships of young injecting drug users. *Addiction*. 2000;95(7):1254-64. doi: 10.1046/j.1360-0443.2000.02949.x. [PubMed: 20497254]. [PubMed Central: PMC2907461].

8. Li L, Assanangkornchai S, Duo L, McNeil E, Li J. Risk behaviors, prevalence of HIV and hepatitis C virus infection and population size of current injection drug users in a China-Myanmar border city: Results from a Respondent-Driven Sampling survey in 2012. *PloS One*. 2014;9(9). e106899. doi: 10.1371/journal.pone.0106899. [PubMed: 25201256]. [PubMed Central: PMC4159231].

9. Jin F, Matthews GV, Grulich AE. Sexual transmission of hepatitis C virus among gay and bisexual men: A systematic review. *Sex Health*. 2017;14(1):28-41. doi: 10.1071/SH16141. [PubMed: 27726168].

10. Xia X, Luo J, Bai J, Yu R. Epidemiology of hepatitis C virus infection among injection drug users in China: Systematic review and meta-analysis. *Public Health*. 2008;122(10):990-1003. doi: 10.1016/j.puhe.2008.01.014. [PubMed: 18446955].

11. Guangdong Provincial Narcotics Control Commission. *Press conference of narcotics effectiveness in Guangdong in 2016*. 2016, [cited 2016 Jun 27]. Available from: http://www.gdjd626.com/#/index.

12. National Narcotics Control Office. *National Narcotics control report in 2018*. 2018, [cited 2019 Jun 18]. Available from: http://www.gov.cn/xinwen/2019-06/18/content_5401230.htm.

13. Wu J, Huang J, Xu D, Lu C, Deng X, Zhou X. Infection status and risk factors of HIV, HBV, HCV, and syphilis among drug users in Guangdong: a cross-sectional study. *BMJ Public Health*. 2010;20(10). doi: 10.1088/1748-4839-6-10-657. [PubMed: 20404549]. [PubMed Central: PMC3019570].

14. Shantou Statistical Information Network. *Statistical report of national economic and social development in Shantou in 2017*. 2018, [cited 2020 Feb 4]. Available from: http://www.tj.cn/jgjw/19gd/35444_5.html.

15. Huang XM, Lin P, Li Y, Fu XB. Analysis on HCV seroprevalence and related risk factors among drug users, Guangdong Province, 2011-2013. *Prev Med Trib*. 2016;22:88-94.

16. Chan DP, Lee KC, Lee SS, Tan TY. Community-based molecular epidemiology study of hepatitis C virus infection in injection drug users. *Hong Kong Med J*. 2007;13 Suppl 5(1):27-30. [PubMed: 18943522].

17. World Health Organization. *People who inject drugs*. 2020, [cited 2020 Feb 4]. Available from: http://www.who.int/hiv/topics/idu/en/.

18. Zhou B, Cai GF, Lv HKK, Xu SFF, Wang ZTT, Jiang ZZG, et al. Factors correlating to the development of hepatitis C virus infection among drug users-findings from a systematic review and meta-analysis. *Int J Environ Res Public Health*. 2019;16(1). doi: 10.3390/ijerph16010244. [PubMed: 31269774]. [PubMed Central: PMC6558283].

19. Turner JM, Rider AT, Imrie J, Copas AJ, Edwards SG, Dodds JP, et al. Behavioural predictors of subsequent hepatitis C diagnosis in a UK clinic sample of HIV positive men who have sex with men. *Sex Transm Infect*. 2008;84(2):298-300. doi: 10.1136/sti.2005.018166. [PubMed: 16877578]. [PubMed Central: PMC2564711].

20. Aitken CK, Agius PA, Higgs PG, Stoooe MA, Bowden DS, Dietze PM. The effects of needle-sharing and opioid substitution therapy on incidence of hepatitis C virus infection and reinfection in people who inject drugs. *Epidemiol Infect*. 2017;145(4):796-801. doi: 10.1017/S0950268816002882. [PubMed: 27927256].

21. Zamani S, Radfar R, Nematollahi P, Fadaie R, Meshkati M, Mortazavi S, et al. Prevalence of HIV/HCV/HBV infections and drug-related risk behaviours amongst IDUs recruited through peer-driven sampling in Iran. *Int J Drug Policy*. 2010;21(6):493-500. doi: 10.1016/j.drugpo.2010.04.006. [PubMed: 20485378].

22. Spach DH. *HCV epidemiology in the United States*. 2016, [cited 2020 Feb 4]. Available from: http://www.hepatitis.uc.edu/go/screening-diagnosis/epidemiology/us-core-concept/all.

23. Zhou YH, Yao ZH, Liu FL, Li H, Jiang L, Zhu JW, et al. High prevalence of HIV, HCV, HBV and co-infection and associated risk factors among injecting drug users in Yunnan Province, China. *PloS One*. 2012;7(4). e42937. doi: 10.1371/journal.pone.0042937. [PubMed: 22916815]. [PubMed Central: PMC3420897].

24. Jordan AE, Masson CL, Mateu-Gelabert P, McKnight C, Pepper N, Bouché K, et al. Perceptions of drug users regarding hepatitis C screening and care: A qualitative study. *Harm Reduct J*. 2013;10(1). doi: 10.1186/1477-7517-10-10. [PubMed: 23786800]. [PubMed Central: PMC3695813].

25. US Department of Health and Human Service. *Quick guide to health literacy*. 2020, [cited 2020 Feb 4]. Available from: https://health.gov/communication/literacy/quickguide/factsbasic.htm.

26. Lankarani KB, Ardebili M, Sepehrimanesh M, Nejabat M, Hemmati M, Hong Kong Med J. 2017;23 Suppl 5(1):27-30. [PubMed: 28943522].

27. World Health Organization. *People who inject drugs*. 2020, [cited 2020 Feb 4]. Available from: http://www.who.int/hiv/topics/idu/en/.