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Epidemiology of HIV and hepatitis C infection among women who inject drugs in Northeast India: A respondent-driven sampling study

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Abstract

Background and aims—Despite extensive research on HIV and hepatitis C (HCV) among people who inject drugs (PWID), there remains a gap in knowledge on the burden among women who inject drugs and their unique contexts and risk factors. This analysis compares HIV and HCV prevalence in female and male PWID and estimates injection and sexual risk correlates of prevalent HIV and HCV infection among women in Northeast India.

Design—Cross-sectional sample accrued using respondent-driven sampling.

Setting—Seven cities in Northeast India, 2013.

Participants—6,457 adult PWID.

Measurements—Participants completed an interviewer-administered survey. HIV infection was diagnosed onsite and HCV antibody testing was done on stored specimens. HIV and HCV prevalence estimates were stratified by gender. Among women, the association of risk correlates with HIV and HCV were estimated using multi-level logistic regression models.

Findings—796 (16%) of the PWID were women, of whom 53% (95% confidence interval [CI]: 49–57%) were HIV-infected and 22% (CI: 20–25%) were HCV-infected. HIV and HCV prevalence among men was 17% (CI: 17–18%) and 32% (CI: 31–32%), respectively. Among women, correlates of HIV were widowhood (adjusted odds ratio [aOR] vs. currently married: 4.0, CI: 2.1–7.6) and a higher number of lifetime sexual partners (aOR 8 vs. none: 3.1, CI: 1.1–8.9). Correlates of HCV were longer injection duration (aOR per 10 years: 1.7, CI: 1.3–2.3), injecting only heroin and a combination of drugs (aOR vs. pharmaceuticals only: 5.6, CI: 1.7–18.9 and aOR: 2.6, CI: 1.6–4.2, respectively), sharing needles/syringes (aOR: 2.5, CI: 1.3–4.6) and a larger PWID network (aOR 51 vs. 1–5: 4.2, CI: 2.4–7.2).

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Conclusions—Women who inject drugs in Northeast India have a high HIV prevalence which was more than double their hepatitis C (HCV) prevalence, an opposite pattern than is typically observed among male PWID. HIV infection is associated with sexual risk factors while injection-related behaviors appear to drive HCV infection.

Keywords

intravenous drug abuse; India; women; hepatitis C; HIV

INTRODUCTION

Injection drug use remains a major global health challenge that includes its role in the transmission of blood-borne infections such as HIV and hepatitis C virus (HCV) and their associated morbidity and mortality. In 2007, there were an estimated 16 million people who inject drugs (PWID) worldwide, with Asia and eastern Europe having a comparatively larger injecting population(1). HIV prevalence among PWID generally ranges from 20–40% and HCV from 60–80%(2). Due to the higher per-act transmission probability of HCV compared to HIV when sharing injection paraphernalia(3, 4), PWID most often have a higher prevalence of HCV than HIV(5).

While the epidemiology of HCV and HIV infection in PWID has been extensively studied, the large majority focus on men leading to a gap in knowledge on the burden among women and their unique context and risk profile(6, 7). A review from 2010 found a third of people who use drugs are women, with 3.8 million women injecting drugs globally(8). Consequently, scholars and the United Nations Office on Drugs and Crime have called for researchers to distinguish between the different risks and burden of infections among men and women who who use drugs(7, 9).

Injection drug use continues to be a major driver of the HIV epidemic in some regions of India, with an estimated 1.1 million PWID(10). The Northeast region, near the opium producing area ‘Golden Triangle’, has the oldest injection drug use epidemic(11). Government and non-government operated prevention interventions targeting PWID have slowed the epidemic there (12–14); however, the Northeast continues to see a consistently higher HIV prevalence(15–17). The Northeast is also home to the vast majority of women who inject drugs in India, with an emerging population of women injecting heroin and pharmaceutical opioids(15, 18, 19). A prior study among PWID in the Northeast found women more likely to be HIV-infected than men(16). This is consistent with other contexts in which women are more vulnerable to HIV and other health-related harms because of stigma, violence, and riskier sexual and injecting behaviors(19–21). Our findings from a prior analysis among PWID in India support this higher vulnerability to HIV infection among women(15); however, in contrast, we found women had lower odds of HCV compared to men(22). Therefore, our objective is to 1) compare the prevalence of HIV and HCV in women and men who inject drugs and 2) estimate associations between injection and sexual risk correlates and prevalent HIV and HCV infection among women who inject drugs in Northeast India.

METHODS

Study Design and Population

The study population comprises of PWID across 7 cities in Northeast India, a subset of 14,481 PWID across 15 Indian cities recruited as part of the baseline cross-sectional assessment of a cluster-randomized trial (23) (ClinicalTrials.gov Identifier: NCT01686750). Cities (state) included in this analysis are: Aizawl and Lunglei (Mizoram), Churachandpur, Imphal, and Moreh (Manipur), Dimapur (Nagaland), and Gangtok (Sikkim). Eligibility criteria included: age ≥ 18 years, informed consent, valid referral coupon, and self-reported drug injection in the prior two years. 1000 participants per city, except Moreh (n=457), were recruited using respondent-driven sampling (RDS), a chain-referral strategy(23–26). Participants completed an interviewer-administered survey with modules on sexual and injection drug use risk factors. HIV infection was diagnosed onsite using three rapid tests: Alere™ Determine™ HIV-1/2 (Alere Medical Co., Ltd., Chiba, Japan), First response HIV card test 1–2.0 (PMC Medical India Pvt Ltd, Daman, India), and Signal Flow Through HIV 1+2 Spot/Immunodot Test kit (Span Diagnostics Ltd, Surat, India). Hepatitis C (HCV) antibody testing was done on stored specimens using the Genedia HCV ELISA 3.0 (Green Cross Medical Science, Chungbuk, Korea). Detailed study procedures have been previously published(15, 27).

Statistical Analysis

HIV and HCV prevalence estimates were stratified by gender for comparison. City-level HIV and HCV prevalence were calculated with RDS-II weights using network size (i.e., number of PWID seen in the prior 30 days) to compensate for non-random sampling(28). Population estimates with all cities combined were calculated using a composite weight which accounts for the relative PWID population size in each city derived from state-level data(29) and the RDS-II weight.

Restricting to women, correlates of prevalent HIV and HCV infection were estimated using multi-level logistic regression models with a random intercept for city, thus interpretation of odds ratios is conditional on city, and RDS-II weights as sampling weights. Correlates were considered for inclusion in the multivariable model if significant at p-value<0.1 in univariable and retained if significant at p-value<0.05 after adjustment, with the exception of age and duration of injection drug use, which were included regardless of significance. Unweighted analyses are in Supplementary material(30). Analyses were performed using RDS Analyst version 1.0 (<http://hpmrg.org>) and Stata version 13.1 (Stata Corp., College Station, TX, USA).

RESULTS

Among 6,457 PWID recruited, 796 (15.9%) were women. Median age among women was 30 years (interquartile range: 25 – 35) (Table 1); 52.6% were married and over a quarter were divorced, separated, or widowed. Nearly 30% injected only heroin, 42.6% only buprenorphine/pharmaceuticals, and 28.0% a combination of drugs. One third reported sex

with another PWID in the prior 6 months, nearly half (47.3%) reported unprotected sex in the prior 6 months and 12.6% had a history of sex work.

Overall HIV prevalence among women was 52.9% (95% confidence interval [CI]: 49.3 – 56.5%) and HCV prevalence was 22.3% (95% CI: 19.9 – 24.7%). For comparison, among men HIV prevalence was 17.4% (95% CI: 16.9 – 17.9%) and HCV prevalence was 30.4% (95% CI: 31.2 – 32.0%). There was considerable city-level variability; HIV among women ranged from 10.4 – 74.8% and HCV ranged from 0 – 56.6% (Figure 1). HIV in women was higher than HCV in five of the seven cities. In contrast, for men, five of the seven cities had lower HIV than HCV. Unweighted prevalence estimates were generally higher than weighted estimates (Table S2). Co-infection among women was 11.0% (95% CI: 8.9 – 13.1%). Among HIV-infected women, 20.8% were co-infected with HCV; conversely, among those HCV-infected, 49.4% were co-infected with HIV (see Table S3 and S4 for estimates by city and for men). Unweighted prevalence estimates by additional sub-groups are in Table S6.

In univariable analysis, HIV infection among women was associated with being older, widowed, having children, longer duration of injection drug use, less frequent injection in the prior 6 months, ever sharing a needle/syringe, and a higher number of lifetime sexual partners (Table 1). Women that were never married and had ever used opioid agonist therapy were significantly less likely to have HIV. In multivariable analysis, widows were 4 times as likely to be HIV-infected (adjusted odds ratio [aOR]: 4.03) compared to those currently married; 8 or more lifetime sexual partners was associated with 3 times higher odds of HIV compared to those with none (aOR: 3.08). Findings were inconclusive as to whether HCV was associated with HIV and vice versa.

In univariable analysis, HCV infection was associated with being divorced/separated, longer duration of injection drug use, only injecting heroin or a combination of drugs, ever sharing a needle/syringe, harm reduction use, a higher number of lifetime sexual partners, and a PWID network >50. In multivariable analysis, increasing duration of injection drug use was associated with 70% higher odds of HCV (aOR: 1.70, per 10 years). Injecting only heroin was associated with 5.6 times higher odds of HCV (aOR: 5.63) and combination drug use had 2.6 times higher odds (aOR: 2.58) compared to injecting only pharmaceutical opioids. A history of ever sharing needles or syringes was associated with 2.5 times higher odds of HCV (aOR: 2.46) and those with a network of >50 PWID were 4.2 times more likely to have HCV (aOR: 4.17) compared to those with a network of 1–5.

DISCUSSION

Among a sample of women who inject drugs in Northeast India, we observed a higher prevalence of HIV than HCV, 53% and 22%, respectively. This pattern of a higher HIV burden than HCV was fairly consistent - within 5 of the 7 cities - and contrasts with what we observed among men in the same region. Among most populations of PWID, HCV prevalence is an order of magnitude higher than HIV (31, 32). Notably, we found HCV was higher than HIV prevalence among women in two cities - Aizawl and Imphal - where HCV prevalence was highest among men. This may reflect differential drug availability (e.g.,

increased heroin availability in Imphal) and consequently injection patterns among women in these settings.

A prior study in Nagaland and Mizoram among women PWID found a more typical pattern of HIV and HCV prevalence, 24% and 67%, respectively - with women having a higher HIV and HCV burden compared to men(16). However, this sample of women was small and recruited from drop-in centers, rather than a network-based strategy, which may be more representative of the underlying population including those not seeking services.

This unusual pattern of HIV and HCV prevalence among women is coupled with contrasting correlates for the two infections. HCV was associated with typical injection-related risk behaviors including sharing needles/syringes, a larger PWID network, longer duration of injection, and injecting only heroin or a combination of drugs. Drug types may represent differing injection frequency, preparation, or injection environments.

On the other hand, HIV was primarily associated with sexual risk factors - high numbers of sexual partners and being widowed. The relationship between HIV and widowhood has been observed among women attending sexually transmitted infection clinics in India(33). A considerable amount of Indian women's HIV risk comes from heterosexual sex with one partner, generally their husband(34–37). The univariable finding of a higher likelihood of HIV with lower frequency of recent injection is likely due to cessation or reduction in use after diagnosis; more than 70% of those HIV-infected were aware of their infection. Our results suggest that sex remains a substantial route of HIV acquisition for women injectors in India, as seen in other contexts(38–41). Similarly, a longitudinal study in the US found that high-risk heterosexual activity but not injection-related factors was associated with HIV seroconversion among women PWID(39). Our previous analysis of the combined sample of PWID from the Northeast, North, and Central regions of India, which consisted largely of men (>90%), found no sexual risk factors were independently associated with HIV infection, rather only injection-related factors were associated with HIV(15).

Prior research among women PWID has found a significant link between intimate relationships and riskier behaviors. Compared to men who inject, women are more likely to have unprotected sex with a primary partner(21), more likely to have sexual partners who are also PWID, and are more often initiated to drug injection by a sexual partner(8, 42). Male PWID often report inconsistent condom usage, especially with regular partners(37, 43–47). Indeed, in our study, a third of the women reported recent sex with another PWID and almost half had unprotected sex. Sexual networks, relationships and risk behaviors among women differ substantively from men who inject drugs, which has direct consequences for HIV prevention efforts.

Our study has limitations. Cross-sectional data does not allow for establishment of temporality or causality between the factors of interest and prevalent HIV/HCV infection. RDS weighting schemes should provide unbiased population estimates. However, we cannot confirm that the sample or estimates are representative of the underlying population.

Double vulnerability stemming from sexual and injection-related factors among women underscores the need for complete availability of the 9-component comprehensive harm

reduction package for PWID(48) and tailored delivery of these services with women's specific context and needs in mind. Focusing solely on injection drug use-related services such as needle/syringe exchange and opioid substitution therapy will likely be inadequate to address HIV in this population. Partner counseling, safe sex education, pre-exposure prophylaxis and other sexual health services should be better emphasized and integrated with other harm reduction strategies. Services must be delivered in a woman-friendly format, since most harm reduction interventions are designed for men(41, 49). Women who inject drugs are often out-of-sight and out-of-mind but with a growing number of vulnerable women injecting in Northeast India, strategies to reach and engage women in HIV and HCV prevention interventions are urgently needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Mathers BM, Degenhardt L, Phillips B, Wiessing L, Hickman M, Strathdee SA, et al. Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. *The Lancet*. 2008; 372(9651):1733–45.
2. Nelson PK, Mathers BM, Cowie B, Hagan H, Des Jarlais D, Horyniak D, et al. Global epidemiology of hepatitis B and hepatitis C in people who inject drugs: results of systematic reviews. *The Lancet*. 2011; 378(9791):571–83.
3. van Beek I, Dwyer R, Dore GJ, Luo K, Kaldor JM. Infection with HIV and hepatitis C virus among injecting drug users in a prevention setting: retrospective cohort study. *BMJ*. 1998; 317(7156):433–7. [PubMed: 9703523]
4. Patrick DM, Tyndall MW, Cornelisse PG, Li K, Sherlock CH, Rekart ML, et al. Incidence of hepatitis C virus infection among injection drug users during an outbreak of HIV infection. *Canadian Medical Association Journal*. 2001; 165(7):889–95. [PubMed: 11599327]
5. Vickerman P, Hickman M, May M, Kretzschmar M, Wiessing L. Can hepatitis C virus prevalence be used as a measure of injection-related human immunodeficiency virus risk in populations of injecting drug users? An ecological analysis. *Addiction*. 2010; 105(2):311–8. [PubMed: 19922515]
6. El-Bassel N, Strathdee SA. Women Who Use or Inject Drugs: An Action Agenda for Women-Specific, Multilevel, and Combination HIV Prevention and Research. *JAIDS*. 2015; 69:S182–S90. [PubMed: 25978486]
7. El-Bassel N, Strathdee SA. Bringing Female Substance Users to the Center of the Global HIV Response. *JAIDS*. 2015; 69:S94–S5. [PubMed: 25978488]
8. Larney S, Mathers BM, Poteat T, Kamarulzaman A, Degenhardt L. Global Epidemiology of HIV Among Women and Girls Who Use or Inject Drugs: Current Knowledge and Limitations of

- Existing Data. JAIDS Journal of Acquired Immune Deficiency Syndromes. 2015; 69:S100–S9. [PubMed: 25978476]
9. United Nations Office on Drugs and Crime. Policy Brief Women who inject drugs and HIV: Addressing specific needs. 2014.
 10. Aceijas C, Friedman SR, Cooper HLF, Wiessing L, Stimson GV, Hickman M. Estimates of injecting drug users at the national and local level in developing and transitional countries, and gender and age distribution. Sexually Transmitted Infections. 2006; 82(Suppl 3):iii10–iii7. [PubMed: 16735287]
 11. Dorabjee J, Samson L. A multi-centre rapid assessment of injecting drug use in India. International Journal of Drug Policy. 2000; 11(1):99–112. [PubMed: 10699547]
 12. Armstrong G, Humtsoe C, Kermode M. HIV risk behaviours among injecting drug users in Northeast India following scale-up of a targeted HIV prevention programme. BMC Public Health. 2011; 11(Suppl 6):S9–S.
 13. Department of AIDS Control Indian Ministry of Health & Family Welfare. Annual Report 2013–14. 2013. [Available from: http://www.naco.gov.in/NACO/Quick_Links/Publication/Annual_Report/NACO_Annual_Report/]
 14. Goswami P, Medhi GK, Armstrong G, Setia MS, Mathew S, Thongamba G, et al. An assessment of an HIV prevention intervention among People Who Inject Drugs in the states of Manipur and Nagaland, India. International Journal of Drug Policy. 2014; 25(5):853–64. [PubMed: 24925819]
 15. Lucas GM, Solomon SS, Srikrishnan AK, Agrawal A, Iqbal S, Laeyendecker O, et al. High HIV burden among people who inject drugs in 15 Indian cities. AIDS. 2015; 29(5):619–28. [PubMed: 25715105]
 16. Mahanta J, Borkakoty B, Das HK, Chelleng PK. The risk of HIV and HCV infections among injection drug users in northeast India. AIDS Care. 2009; 21(11):1420–4. [PubMed: 20024719]
 17. National Institute of Medical Statistics & National AIDS Control Organization (India) Ministry of Health & Family Welfare. Technical Report: India HIV Estimates. 2012.
 18. Kumar, MS., Oinam, A., Mukherjee, D., Kishore, K., Mittal, A. Women who use drugs in Northeast India. United Nations Office on Drugs and Crime, Regional Office for South Asia; 2015.
 19. Kumar MS, Sharma M. Women and Substance Use in India and Bangladesh. Substance Use & Misuse. 2008; 43(8/9):1062–77. [PubMed: 18649230]
 20. Pinkham S, Malinowska-Sempruch K. Women, Harm Reduction and HIV. Reproductive Health Matters. 2008; 16(31):168–81. [PubMed: 18513618]
 21. Cleland C, Des Jarlais D, Perlis T, Stimson G, Poznyak V. the WHO Phase II Drug Injection Collaborative Study Group. HIV risk behaviors among female IDUs in developing and transitional countries. BMC Public Health. 2007; 7(1):271. [PubMed: 17908299]
 22. Solomon SS, Mehta SH, Srikrishnan AK, Solomon S, McFall AM, Laeyendecker O, et al. Burden of hepatitis C virus disease and access to hepatitis C virus services in people who inject drugs in India: a cross-sectional study. The Lancet Infectious Diseases. 2015; 15(1):36–45. [PubMed: 25486851]
 23. Solomon SS, Lucas GM, Celentano DD, Sifakis F, Mehta SH. Beyond Surveillance: A Role for Respondent-driven Sampling in Implementation Science. American Journal of Epidemiology. 2013; 178(2):260–7. [PubMed: 23801014]
 24. Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. Social problems. 1997; 44(2):174–99.
 25. White RG, Lansky A, Goel S, Wilson D, Hladik W, Hakim A, et al. Respondent driven sampling—where we are and where should we be going? Sexually Transmitted Infections. 2012; 88(6):397–9. [PubMed: 23012492]
 26. Heckathorn DD. Respondent-driven sampling II: deriving valid population estimates from chain-referral samples of hidden populations. Social Problems. 2002; 49(1):11–34.
 27. Solomon SS, Lucas GM, Celentano DD, McFall AM, Ogburn E, Moulton LH, et al. Design of the Indian NCA study (Indian national collaboration on AIDS): a cluster randomized trial to evaluate the effectiveness of integrated care centers to improve HIV outcomes among men who have sex with men and persons who inject drugs in India. BMC Health Services Research. 2016; 16(1):652. [PubMed: 27842543]

28. Volz E, Heckathorn DD. Probability based estimation theory for respondent driven sampling. *Journal of Official Statistics*. 2008; 24(1):79.
29. National Institute of Medical Statistics and National Aids Control Organisation (India). Technical Report: India HIV Estimates. 2010. [Available from: <http://naco.gov.in/upload/Surveillance/Reports & Publication/Technical Report India HIV Estimates 2010.pdf>]
30. White RG, Hakim AJ, Salganik MJ, Spiller MW, Johnston LG, Kerr L, et al. Strengthening the Reporting of Observational Studies in Epidemiology for respondent-driven sampling studies: “STROBE-RDS” statement. *Journal of Clinical Epidemiology*. 2015; 68(12):1463–71. [PubMed: 26112433]
31. Aceijas C, Rhodes T. Global estimates of prevalence of HCV infection among injecting drug users. *International Journal of Drug Policy*. 2007; 18(5):352–8. [PubMed: 17854722]
32. Aceijas C, Stimson GV, Hickman M, Rhodes T. Global overview of injecting drug use and HIV infection among injecting drug users. *Aids*. 2004; 18(17):2295–303. [PubMed: 15577542]
33. Mehta SH, Gupta A, Sahay S, Godbole SV, Joshi SN, Reynolds SJ, et al. High HIV prevalence among a high-risk subgroup of women attending sexually transmitted infection clinics in Pune, India. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 2006; 41(1):75–80. [PubMed: 16340477]
34. Gangakhedkar RR, Bentley ME, Divekar AD, Gadkari D, Mehendale SM, Shepherd ME, et al. Spread of HIV infection in married monogamous women in India. *Jama*. 1997; 278(23):2090–2. [PubMed: 9403424]
35. Newmann S, Sarin P, Kumarasamy N, Amalraj E, Rogers M, Madhivanan P, et al. Marriage, monogamy and HIV: a profile of HIV-infected women in south India. *International journal of STD & AIDS*. 2000; 11(4):250–3. [PubMed: 10772089]
36. Solomon S, Buck J, Chaguturu SK, Ganesh A, Kumarasamy N. Stopping HIV before it begins: issues faced by women in India. *Nature Immunology*. 2003; 4(8)
37. Solomon S, Srikrishnan A, Celentano D, Johnson S, Vasudevan C, Murugavel K, et al. The intersection between sex and drugs: a cross-sectional study among the spouses of injection drug users in Chennai, India. *BMC Public Health*. 2011; 11(1):39. [PubMed: 21235816]
38. Strathdee S, Sherman S. The role of sexual transmission of HIV infection among injection and non-injection drug users. *J Urban Health*. 2003; 80(3):iii7–iii14. [PubMed: 14713667]
39. Strathdee SA, Galai N, Safaiean M, et al. Sex differences in risk factors for hiv seroconversion among injection drug users: A 10-year perspective. *Archives of Internal Medicine*. 2001; 161(10):1281–8. [PubMed: 11371255]
40. Kral AH, Bluthenthal RN, Lorvick J, Gee L, Bacchetti P, Edlin BR. Sexual transmission of HIV-1 among injection drug users in San Francisco, USA: risk-factor analysis. *The Lancet*. 2001; 357(9266):1397–401.
41. Iversen J, Page K, Madden A, Maher L. HIV, HCV, and Health-Related Harms Among Women Who Inject Drugs: Implications for Prevention and Treatment. *JAIDS*. 2015; 69:S176–S81. [PubMed: 25978485]
42. Miller M, Neaigus A. Networks, resources and risk among women who use drugs. *Social Science & Medicine*. 2001; 52(6):967–78. [PubMed: 11234869]
43. Go VF, Quan VM, Voytek C, Celentano D, Nam LV. Intra-couple communication dynamics of HIV risk behavior among injecting drug users and their sexual partners in northern Vietnam. *Drug and Alcohol Dependence*. 2006; 84(1):69–76. [PubMed: 16413145]
44. Murthy, P. Female injecting drug users and female sex partners of men who inject drugs: Assessing care needs and developing responsive services. New Delhi, India: 2012.
45. Mishra R, Ganju D, Ramesh S, Lalmuanpuui M, Biangtung L, Humtsoe C, et al. HIV risk behaviors of male injecting drug users and associated non-condom use with regular female sexual partners in north-east India. *Harm Reduction Journal*. 2014; 11(1):5. [PubMed: 24520914]
46. Kermode M, Armstrong G, Medhi GK, Humtsoe C, Langkham B, Mahanta J. Sexual behaviours of men who inject drugs in Northeast India. *Harm reduction journal*. 2015; 12(1):4. [PubMed: 25889291]

47. Suohu K, Humtsoe C, Saggurti N, Sabarwal S, Mahapatra B, Kermode M. Understanding the association between injecting and sexual risk behaviors of injecting drug users in Manipur and Nagaland, India. *Harm Reduction Journal*. 2012; 9(1):40. [PubMed: 23249619]
48. World Health Organization, United Nations Office on Drugs, Crime United Nations Programme on HIV/AIDS. WHO, UNODC, UNAIDS Technical Guide for countries to set targets for universal access to HIV prevention, treatment and care for injecting drug users. Geneva: WHO/UNAIDS/UNODC; 2009.
49. Malinowska-Sempruch K. What Interventions Are Needed for Women and Girls Who Use Drugs? A Global Perspective. *JAIDS*. 2015; 69:S96–S7. [PubMed: 25978489]
50. Babor, TF., Higgins-Biddle, JC., Saunders, JB., Monteiro, MG. The Alcohol Use Disorders Identification Test: Guidelines for Use in Primary Care. World Health Organization Department of Mental Health and Substance Dependence; 2001.
51. Saunders JB, Aasland OG, Babor TF, De la Fuente JR, Grant M. Development of the alcohol use disorders identification test (AUDIT). WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction*. 1993; 88:791. [PubMed: 8329970]

		All NE	Aizawl	Lunglei	Churachandpur	Imphal	Moreh	Dimapur	Gangtok
Women	% HIV+	52.9	41.9	34.1	33.6	43.7	74.8	65.2	10.4
	% HCV+	22.3	56.6	17.3	19.4	56.3	22.9	6.0	0
men	% HIV+	17.4	21.6	8.4	19.1	29.4	36.0	14.7	11.3
	% HCV+	30.4	66.2	15.0	59.4	66.2	46.7	9.5	5.2

Note: 95% confidence intervals for prevalence estimates in **Table S1**

Figure 1.
Percentage point difference between HIV and Hepatitis C (HCV) prevalence by gender

Table 1
Correlates of prevalent HIV infection and Hepatitis C infection among 796 women who inject drugs in Northeast India

	Total		HIV infection		Hepatitis C infection	
	n (%)	median (IQR) [^]	n (%)	median (IQR) of HIV-infected women (N=368) [^]	Unadjusted Odds Ratio [†] (95% CI)	Adjusted Odds Ratio [†] (95% CI)
City						
Aizawl	149 (14.7)	81 (11.7)			94 (37.3)	
Lunglei	112 (14.7)	30 (9.5)			18 (11.4)	
Churachandpur	200 (9.0)	75 (5.7)			59 (7.8)	
Imphal	77 (9.0)	33 (7.5)	--	--	49 (22.7)	--
Moreh	94 (9.0)	69 (12.8)			18 (9.3)	
Dimapur	112 (42.7)	75 (52.7)			7 (11.4)	
Gangtok	52 (0.8)	5 (0.2)			0 (0)	
Socio-demographics						
Age (years) ¹	30 (25 – 35)	32 (27 – 36)	1.82 (1.26 – 2.64)	1.04 (0.57 – 1.88)	30 (26 – 35)	1.09 (0.70 – 1.70) 0.84 (0.53 – 1.32)
Marital status						
Currently married	356 (52.6)	170 (58.3)	REF	REF	90 (37.0)	REF
Never married	150 (19.7)	45 (12.9)	0.48 (0.28 – 0.81)	0.71 (0.29 – 1.72)	45 (14.3)	1.08 (0.41 – 2.83)
Divorced/separated	175 (15.9)	73 (11.3)	0.80 (0.46 – 1.38)	0.75 (0.49 – 1.17)	81 (34.0)	2.61 (1.14 – 6.01)
Widowed	115 (11.9)	80 (17.6)	4.21 (2.16 – 8.23)	4.03 (2.13 – 7.60)	29 (14.6)	1.45 (0.32 – 6.58)
Educational attainment						
Primary school or less	264 (31.6)	129 (31.0)	REF	REF	68 (35.1)	REF
Secondary school	419 (54.7)	196 (55.8)	1.43 (0.82 – 2.51)	--	142 (54.5)	1.19 (0.71 – 2.01)
High school or above	112 (13.7)	42 (13.2)	1.12 (0.55 – 2.26)		35 (10.4)	0.99 (0.22 – 4.49)
One or more children	526 (66.2)	259 (73.9)	1.77 (1.02 – 3.06)	--	150 (66.3)	1.38 (0.71 – 2.70)
Recent Risk Behaviors						
Alcohol use ²						--

	Total		HIV infection		Hepatitis C infection	
	n (%) / median (IQR) ^	n (%) / median (IQR) of HIV-infected women (N=368) ^	Unadjusted Odds Ratio ^ (95% CI)	Adjusted Odds Ratio ^ (95% CI)	Unadjusted Odds Ratio ^ (95% CI)	Adjusted Odds Ratio ^ (95% CI)
None/limited use	573 (77.5)	280 (84.5)	REF	REF	REF	REF
Harmful/hazardous use	99 (9.3)	36 (9.1)	1.00 (0.63 – 1.61)	--	1.47 (0.70 – 3.07)	--
Alcohol dependence	124 (13.1)	52 (6.4)	0.51 (0.20 – 1.30)	--	1.59 (0.78 – 3.22)	--
Injection frequency in prior 6 months						
None	136 (34.8)	91 (46.5)	REF	REF	REF	REF
Less than daily	239 (24.2)	104 (16.5)	0.24 (0.06 – 0.96)	--	0.95 (0.70 – 1.29)	--
Daily	421 (41.0)	173 (37.0)	0.25 (0.07 – 0.97)	--	2.02 (1.13 – 3.61)	--
PWID network size ³						
1–5	229 (69.0)	102 (70.9)	REF	REF	REF	REF
6–10	186 (18.6)	78 (16.9)	0.81 (0.41 – 1.61)	--	1.00 (0.44 – 2.25)	0.78 (0.37 – 1.64)
11–50	329 (12.0)	161 (11.9)	1.15 (0.61 – 2.17)	--	1.21 (0.65 – 2.24)	0.88 (0.40 – 1.92)
51 or more	52 (0.4)	27 (0.3)	1.12 (0.43 – 2.92)	--	4.85 (3.63 – 6.49)	4.17 (2.43 – 7.17)
Lifetime Risk Behaviors						
Years of injection duration ¹	6 (3 – 11)	8 (4 – 14)	2.74 (1.21 – 6.19)	2.33 (0.79 – 6.87)	1.61 (1.10 – 2.36)	1.70 (1.25 – 2.27)
Drugs ever injected						
Buprenorphine/pharmac-euticals only	347 (29.4)	93 (45.7)	REF	REF	REF	REF
Heroin only	218 (42.6)	172 (27.4)	0.56 (0.16 – 1.97)	--	5.83 (2.00 – 17.0)	5.63 (1.68 – 18.9)
Combination	231 (28.0)	103 (26.9)	0.74 (0.48 – 1.15)	--	3.10 (1.96 – 4.88)	2.58 (1.60 – 4.16)
Ever shared needle/syringe	490 (46.3)	238 (48.1)	1.82 (1.15 – 2.88)	--	2.65 (1.20 – 5.87)	2.46 (1.29 – 4.56)
Ever used needle exchange program	282 (23.2)	130 (17.9)	0.97 (0.46 – 2.05)	--	2.74 (1.49 – 5.02)	--
Ever used opioid agonist therapy	92 (10.5)	33 (4.4)	0.36 (0.13 – 0.98)	--	3.70 (1.58 – 8.70)	--
History of sex work	153 (12.6)	78 (10.0)	1.57 (0.57 – 4.33)	--	1.49 (0.78 – 2.83)	--
Number of lifetime sexual partners						
None	92 (6.7)	31 (3.8)	REF	REF	REF	REF

	Total	HIV infection			Hepatitis C infection			
		n (%) / median (IQR) ^	n (%) / median (IQR) of HIV-infected women (N=368) ^	Unadjusted Odds Ratio ^ (95% CI)	Adjusted Odds Ratio ^ (95% CI)	n (%) / median (IQR) of HCV-infected women (N=245) ^	Unadjusted Odds Ratio ^ (95% CI)	Adjusted Odds Ratio ^ (95% CI)
1-2		337 (51.2)	143 (48.6)	1.94 (0.97 – 3.90)	1.24 (0.62 – 2.47)	79 (38.0)	1.45 (0.83 – 2.53)	
3-7		231 (28.1)	103 (30.5)	2.60 (1.71 – 3.95)	1.66 (0.83 – 3.35)	68 (28.2)	1.53 (0.70 – 3.32)	--
8 or more		136 (14.1)	67 (17.0)	4.65 (1.80 – 12.0)	3.08 (1.07 – 8.86)	61 (26.6)	2.33 (1.14 – 4.79)	
HIV infection		368 (52.9)	--	--	--	--	1.43 (0.95 – 2.16)	--
Hepatitis C infection		245 (22.3)	133 (20.8)	1.43 (0.94 – 2.16)	--	133 (49.4)	--	--
Random intercept variance					0.95			1.55

[†] Multi-level logistic regression model with random intercept for each city, incorporating scaled RDS-II weights.

[^] All percentages and medians/IQRs calculated using a composite weight including relative PWID population size and RDS-II weights.

¹ : For logistic models, odds ratio is for an increase in 10 years;

² : Assessed using AUDIT(50, 51);

³ : Number of people who inject drugs that participant has seen in the prior 30 days in the city