



## Research paper

## Prevalence and risk factors associated with HIV and tuberculosis in people who use drugs in Abidjan, Ivory Coast



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## ABSTRACT

**Background:** The number of people who use drugs (PWUD) has dramatically increased in West Africa over the last 15 years, but targeted interventions are falling behind, notably because of the lack of awareness of the health needs of PWUD. We aimed to assess prevalence and factors associated with HIV and other infections in PWUD in Abidjan, Ivory Coast, one of the countries most affected by HIV in Western Africa.

**Methods:** We used respondent-driven-sampling to obtain a representative sample of heroin or cocaine/crack users aged 18 years or more. Socio-behavioral data were obtained by face-to-face questionnaires. Blood samples were collected and tested for HIV. Two sputa were obtained in tuberculosis (TB) symptomatic participants for acid-fast-bacilli (AFB) smear testing. After a descriptive analysis, crude prevalence were calculated, then weighted to take account of the sampling method. Factors associated with HIV and TB were studied using adjusted log-binomial regression. Population size was estimated by capture–recapture.

**Results:** 450 PWUD were recruited in May 2014. The mean age was 33.5 years; 10.9% were women. Smoking was the main mode of consumption, ever injecting was reported by 12.7% of the participants (3.6% in the past month). Sex work was reported by 15.8% of the PWUD (13.7% of the men), and 10.2% of the men reported sexual relationships with other men (MSM). We found a weighted prevalence of 9.5% for HIV. Women were 3.4 times more likely to be infected than men. Among men, being a sex worker (SW) (adjusted OR 2.9 [95CI 1.06–7.98]) or MSM (adjusted OR 11.5 [95CI 4.22–31.42]) were the main factors associated with HIV infection in adjusted analysis. Injection was not associated with HIV. TB weighted prevalence was 1.8%, associated with poor living arrangements in adjusted analysis. We estimated that 3521; 95CI 3049–3993 PWUD live in Abidjan.

**Conclusion:** PWUD in Abidjan are at high risk of HIV due to sexual transmission, especially in women, SW and MSM who also use drugs. Interventions should be developed to improve HIV prevention and linkage to care in these specific populations. More generally, improving the health of PWUD involves a broader reflection on the living environment and access to health care of slum residents in large African cities.

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## Introduction

In West Africa, institutional weakness due to decades of political conflict has led to a worrying growth of cocaine and other drug trafficking. Local consumption has also dramatically increased, though the real extent of illicit drug use remains unknown. While efforts to address the problem have mostly focused on arrests of users and petty drug dealers, very few

investments have been made in treatment and harm reduction services (WACD, 2014).

Yet drug use poses significant public health risks. Globally, injecting drug users (IDU) are disproportionately infected with HIV, with incidence estimated to be up to 22 times greater than in the general population (Mathers et al., 2008). Increased HIV prevalence is also reported in non-injecting drug users (NIDU), especially because of increased sexual risk behaviors, and overlapping social and sexual networks with IDU (Strathdee & Stockman, 2010). The small amount of data available in West Africa reports higher HIV rates in People who use drugs (PWUD) than in the general population (5.2% in Senegal, and between 3%

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and 9.3% in Nigeria) (Eluwa, Strathdee, Adebayo, Ahonsi, & Adebajo, 2013; Leprêtre et al., 2015). PWUD also remain disproportionately affected by viral hepatitis B and C (HBV, HCV), and syphilis (Coffin et al., 2010; Nelson et al., 2011). In addition, drug use is associated with a number of factors that together contribute to higher risks of tuberculosis (TB), including direct detrimental effect on the immune system, use of tobacco, homelessness, or repeated incarcerations (Deiss, Rodwell, & Garfein, 2009).

With a HIV prevalence of 3.7% in the general population, Ivory Coast is one of the most affected countries of West Africa (DHS, 2013). Abidjan, the main city, shows even higher rates, with an HIV prevalence estimated at 5.1% (DHS, 2013). The smoking of heroin “*Pao*” and crack cocaine “*Yo*” is very common in Abidjan, taking place most of the time in “*fumoirs*”, which are insalubrious and crowded spaces dispersed within urban slums. Heroin is mainly used in a rolled cigarette of cannabis, whereas crack cocaine is smoked using handmade pipes “*Zeb*”. Other, less frequent, consumption patterns are observed, such as chasing the dragon, snorting cocaine, or oral consumption of psychotropic pharmaceutical drugs (amphetamine pills known as “*Bleu bleu*”, clonazepam “*Rivo*”, barbiturate “*sekou touré*” and different ephedrine combinations). Injecting drug use exists, but is uncommon and deprecated by Ivorian PWUD.

Ivorian authorities are determined to develop a public health approach adapted to populations at high risk of HIV. They already work closely with sex workers (SW) and men having sex with men (MSM), who face alarmingly high HIV prevalence rates: 26.6% in female SW (Vuylsteke et al., 2012a) and 50% in male SW (Vuylsteke et al., 2012b), and 18% in MSM (Hakim et al., 2015). However, PWUD's health needs are barely known, and very few health organizations are currently working with this population. Our study aimed to collect reliable data on HIV, TB, viral hepatitis, and syphilis among highly vulnerable PWUD in Abidjan.

## Methods

We conducted a four-month situational analysis prior to the survey, in collaboration with key informants. The objectives of this preliminary step were to assess major drug use patterns in Abidjan, to map out places of consumption and notably the different “*fumoirs*”, and to inform the development of the quantitative questionnaire.

### Selection of participants

We used Respondent-Driven-Sampling (RDS) to obtain a representative sample of heroin and/or cocaine users (Heckathorn, 1997; Johnston & Sabin, 2010). People over 18 living in Abidjan, who had used heroin or cocaine at least once during the month prior to the survey, whatever the mode of use, were eligible for inclusion. To participate, PWUD should have received a recruitment coupon from a peer. Each respondent participated only once.

Recruitment started with nine seeds. Two women and seven men were deliberately chosen to reflect the theoretical range of drug users in Abidjan. Two were IDU, two were SW (one woman and one MSM), and three of the seeds were infected with HIV (of which one was not aware of his HIV status before the survey). Seeds were given three coupons to recruit people who met the inclusion criteria from their social network of peers. People recruited were then asked themselves to recruit three people and so on. In compliance with RDS methodology, participants received a primary incentive of 5000 FCFA (8.7 USD) for their participation and a secondary incentive of 3000 FCFA for each peer recruited. The recruitment process continued until the required sample size

(at least 450) and equilibrium for the main variables measured (sex, age and proportion of HIV positive) were achieved.

To confirm their eligibility, participants had to undergo an inclusion interview with a peer worker. This process included: checking the validity of the coupon, a test composed of a series of specific questions on drugs and drug use utilizing partly local jargon (e.g. effects and ways of consumption), and recording of biometric measures to avoid multiple participation.

### Data collection

The study took place in May 2014 at a central site in Abidjan, in the premises of *La Croix Bleue*, an NGO working in the field of addiction. Except for the nurses, most of the team was composed of PWUD or former PWUD trained for the survey.

Interviewers obtained written, informed consent and conducted a face-to-face interview in French at the study site, using an anonymous, structured, quantitative questionnaire. The following data was collected: social background (age, gender, employment, family, accommodation, and education), drug use (substances, mode and frequency of use), sexual behavior (number of partners, sex work, same sex relationship, and condom use), HIV (general knowledge, previous testing and access to care), history of incarceration, and network of peers. The substances queried in the questionnaire were heroin, cocaine powder, crack cocaine, cannabis, and psychotropic pharmaceutical medicines.

After the interview, a blood sample was collected and a clinical screening for TB was performed by a qualified nurse. In the case of TB symptoms (i.e. according to the national protocol: coughing for at least three weeks OR presence of the four following criteria simultaneously: fever, loss of weight, night sweats for at least three weeks, and contact with a person with active pulmonary TB), two sputa were immediately collected.

### Laboratory testing

All samples of intravenous blood were sent to the Center for HIV/AIDS Diagnostics and Research (*Centre de Diagnostic et de Recherche sur le SIDA*) in Abidjan. HIV-1 and 2 screening was conducted using enzyme-linked immunoassay. The presence of HBs antigen and anti-HCV antibody was detected by ELISA. Syphilis screening was performed using VDRL and TPHA plasma-testing. The sputa were sent to the Tuberculosis Center of Adjamé (*Centre Anti-Tuberculeux d'Adjamé*) for Acid-Fast-Bacilli (AFB) smear testing (Ziehl Neelsen coloration) within 48 h.

### Variables and statistical analysis

Statistical analysis included the seeds. According to the distribution and the headcount, we used a  $\chi^2$  test or a Fisher exact test to compare categorical data, and a Student *t*-test or a Kruskal Wallis test to compare continuous data in univariate analysis.

The crude rate of relevant infections was calculated and then weighted to take account of the RDS method. We studied the factors associated with HIV and TB using generalized linear models (log-binomial regression), results are reported as adjusted odd ratios (aOR). Age and the covariates associated with  $p < 0.125$  at univariate analysis were kept for adjustment in multivariate analysis.

For HIV, analysis was performed separately for men and women because of major interactions between the sex and the other covariates. We conducted multivariate analysis for men only, as no variable except the age reached a sufficient *p*-value in women.

Participants who reported at least one sexual relationship within the last 12 months were considered sexually active. Participants who had received money or other benefits for sexual relationships

within the last 12 months were defined as SW. Participants who declared they had given money or other benefits against sexual relationships within the last 12 months were considered to be SW's clients. Men who had had a sexual relationship with another man were defined as MSM. Participants who had injected drugs were considered to be IDU, while those who had injected drugs in the last month were considered to be current IDU. Overdose was defined as a loss of consciousness following drug consumption. In the statistical analysis, participants were considered as negative for TB if we failed to collect a sputum.

Tests were considered significant for a two-sided alpha level of 0.05. Analysis was performed using STATA software 12.1, and RDSAT for the RDS weighted estimates (Spiller, Cameron, & Heckathorn, 2012).

#### Population size estimation

We used capture–recapture methodology to estimate the number of PWUD in Abidjan. This method was initially developed in ecology to count wildlife populations and the methodology is described elsewhere (International Working Group for Disease Monitoring and Forecasting, 1995). In our case, the capture phase consisted of a T-Shirt distribution to the target population two weeks before the survey. Over three days, 1025 T-Shirts were given to people who met the inclusion criteria on 10 consumption sites, which were randomly selected from those mapped out prior to the survey. The RDS survey was considered as the recapture sample. We used the Lincoln Petersen estimator (Seber, 1982) to calculate the total number of PWUD in Abidjan.

#### Prevention messages and orientation of participants

A prevention session with distribution of flyers, condoms and clean filters for pipes was offered to each participant at the end of the interview. Voluntary HIV counselling and rapid testing was offered at the interview site at the time of participation. In addition, participants were invited to come back to the site within 15 days to collect their biological results, with their transportation being paid for by the survey. In case of HIV or TB positivity, they were directed to free care in line with the Ivorian health policy. If needed, syphilis treatment was available on site. Finally, HBV vaccination was offered to participants who were not immunized (participants who came back for their results which showed negative for HB antigen were tested for HB antibodies).

#### Ethical statement

The protocol received ethical clearance from the National Ethics Committee (Comité National d'Ethique et de la Recherche de Côte d'Ivoire). Written informed consent was obtained for each participant before the data collection. Respondents were assured of confidentiality and informed that participation was voluntary and that they could withdraw at any time without explanation. Results of HIV and other diseases were linked to behavioral data using a unique study code. The site coordinator was the only person able to de-anonymize the individual sheets with laboratory results for the participants who came to get their biological results. The anonymization key kept by the coordinator was destroyed after the end of the survey.

## Results

#### Population, demographics, drug use and sexual behavior (Table 1)

In May 2014, the survey recruited 450 participants within 11 waves. Equilibrium was reached as early as the 4th wave for the

following variables: proportion of men, age (mean), and proportion of people positive for HIV. Among the surveyed participants, 131 had received one of the 1025 T-shirts distributed a few weeks before, during the capture phase. We estimate that there are 3521 [95CI 3049–3993] heroin and/or cocaine/crack users in Abidjan.

Mean age was 33.5 (standard error 8.6, interquartile ranges 28–32.5–38), 10.9% of participants were women. Almost half of the participants had been incarcerated at some point (47.8%).

The consumption of heroin and cocaine in the last month was reported by 98.2% and 82.2% of participants respectively. Smoking was the main mode of consumption, reported by almost all participants for both heroin and crack cocaine. Injecting drug use at least once was reported by 57 people (12.7%), including 16 (3.6%) who had injected drugs during the past month. Among the latter, three reported re-using and one had shared a syringe during this period. Suppliers of needles and syringes were mainly street vendors (reported by 6 IDU) and pharmacies (5 IDU). An overdose during the past 12 months was reported by 15.3% of participants.

Sex work was reported by 15.8% of the sample (32.7% of women and 13.7% of men). Among male PWUD, 10.2% were MSM, while 20% reported being SW's clients.

#### HIV infection

We found 44 cases of HIV, corresponding to a crude prevalence of 9.8% [95CI 7–12.5%], and a weighted prevalence of 9.5%. HIV prevalence among high risk sub-populations were 5.2% [95CI 0–11.2%] for IDUs, 22.5% [95CI 12.7–32.4%] for SW, and 39% [95CI 23.4–54.6%] for MSM (52.6% in MSM reporting sex work, 27.3% in MSM not reporting sex work) (Table 2).

Women were infected with HIV in 26.5% of cases, against 7.7% of men ( $p < 0.001$ ). Among women, increasing age was the only factor found associated with HIV. In men, SW, MSM, employment status and consistent condom use were significantly associated with HIV in univariate analysis (Table 3).

SW, MSM and employment status remained significantly associated after adjustment in men, with the following ORs respectively: 2.9 [95CI 1.06–7.98], 11.5; [95CI 4.22–31.42], and 0.41 [95CI 0.18–0.97] for male PWUD employed compared to those with no activity.

#### HIV knowledge and testing (Table 4)

An HIV knowledge score of 6 out of 6 was obtained by 48.7% (80.5% of MSM gave all 6 correct answers), and 20.9% of the participants gave 3 or fewer correct answers. Previous HIV testing was reported by 212 participants (47.1%), including 99 in the past 12 months (22.2%). According to the participants' declaration, 94.8% were aware of this last test result.

However, only 3 of the 44 HIV positive participants were actually aware of being infected before the survey. All three were already being treated for their HIV infection. Recent reported testing was significantly associated with being SW (31.4% of SW reported having been tested in the last 12 months), and being MSM (37.5% of MSM reported having been tested in the last 12 months). Among the 15 MSM recently tested and reporting a negative test, 6 were found HIV positive in the survey.

Rapid testing at the time of the interview was accepted by 55% of participants, and 61.8% came back to collect the additional results which had been sent to the lab.

#### Tuberculosis and other infections

We found 101 suspected cases, and 13 confirmed cases of active pulmonary TB, corresponding to a prevalence of 2.9% [95CI 1.3–4.4%]

**Table 1**  
Population, drug use and sexual behaviors.

	Total sample		Women (n=49)	Men (n=401)	p
	n	%	%	%	
<i>Sociodemographics</i>					
<i>Age</i>					
<25	60	13.3%	28.6%	11.5%	<b>0.001</b>
25–34	215	47.8%	53.1%	47.1%	
35+	175	38.9%	18.4%	41.4%	
<i>Married/couple</i>					
At least one child	107	23.8%	38.8%	22.0%	<b>0.009</b>
260		57.8%	59.2%	57.6%	0.833
<i>Employment</i>					
No activity	156	34.7%	46.9%	33.2%	0.16
Student	21	4.7%	4.1%	4.7%	
Income generating activity	273	60.7%	49.0%	62.1%	
Secondary education or more	269	59.8%	46.9%	61.4%	0.052
<i>Living arrangement</i>					
Homeless (street/fumoir)	65	14.4%	12.2%	14.7%	0.847
Housed by a relative	233	51.8%	51.0%	51.9%	
Own home	162	33.8%	36.7%	33.4%	
History of incarceration	215	47.8%	32.7%	49.6%	<b>0.025</b>
<i>Drug use</i>					
Heroin	442	98.2%	98.0%	98.3%	0.605
Crack cocaine	358	79.6%	67.4%	81.1%	0.037
Snorted cocaine	17	3.8%	2.0%	4.0%	1
Pharmaceutical narcotics	74	16.4%	8.2%	17.5%	0.106
<i>Injection</i>					
At least once	57	12.7%	8.2%	13.2%	0.494
During the past month	16	3.6%	4.1%	3.5%	0.689
Systematic crack pipe sharing	300	66.7%	51.0%	68.6%	<b>0.014</b>
Overdose in the past 12 months	69	15.3%	14.3%	15.5%	0.829
<i>Sexual behaviors</i>					
Sex work in the past 12 months	71	15.8%	32.7%	13.7%	<b>0.001</b>
Sex worker's client	70	–	–	20.0%	–
MSM	41	–	–	10.2%	–
Sexual intercourse <12 months	327	72.7%	85.7%	71.1%	<b>0.030</b>
Number of partners <12 months		3.9; 5.9 (1–2–4)	4.8; 7.7 (1–1–5)	3.7; 5.5 (1–2–4)	0.402
<i>Condom use</i>					
At last sex	165	50.5%	45.2%	51.2%	0.469
<i>During the past 12 months</i>					
Never	100	30.6%	35.7%	29.8%	0.464
Sometimes	113	34.6%	26.2%	35.8%	
Consistent	114	34.9%	38.1%	34.4%	

Results for number of partners and condom use only concern participants having had at least one sexual intercourse during the past 12 months. Significant values ( $p < 0.05$ ) are in bold.

(weighted prevalence 1.8%). Living arrangements was the only factor significantly associated with confirmed TB, with 0.7% in participants having their own home against 6.2% of cases among those living in the street or in the “fumoirs”, corresponding to an OR of 0.1 [95CI 0.01–0.88,  $p$  0.038] after adjustment for age and sex (Table 5).

Prevalences of other infections in PWUD were 10.9% [95CI 8.0–13.8%] (weighted prevalence 11%) for HBV, 2.4% [95CI 1.0–3.9%] (weighted prevalence 2.8%) for HCV, and 2.4% [95CI 1.0–3.9%], (weighted prevalence of 1.1%) for syphilis. In HIV positive PWUD, the prevalence rates were as follows: 2.3% for pulmonary TB, 9.1% for VHB, 4.5% for HCV, and 2.3% for syphilis.

## Conclusion and discussion

### Principal findings and interpretation

This work is the first to assess PWUD's health needs in Abidjan, Ivory Coast. Moreover, very few publications are available with regards to the West African region where drug use is a growing concern. We relied on PWUD key informants to design and implement the study, and we used an appropriate methodology to survey hard-to-reach populations. Although smoking is the main way of consuming heroin and crack cocaine, PWUD in Abidjan show a prevalence of HIV (9.5%) almost two times higher than the

general population. The significantly higher HIV rates in female PWUD, MSM and SW suggest an epidemic in PWUD mainly spread through sexual contact.

The HIV prevalence of 4.2% in men not reporting sexual intercourse with other men is comparable to the one in the general male population. In female PWUD conversely, the 26.5% prevalence is five times higher than the one reported for the general female population in Abidjan (DHS, 2013), but is close to the 26.6% observed in female SW in the country (Vuylsteke et al., 2012a). However, female PWUD reporting sex work in the past 12 months, who constitute about one third of the women sampled, did not have a significantly different HIV prevalence than other female PWUD. Very informal forms of transactional sex might have been underreported in our sample, and we did not ask about former sex work. In addition to sex trading, women who use drugs are known to be at higher HIV risk because of a lack of power to negotiate safer sex (Wechsberg et al., 2008), and a higher exposition to sexual and physical intimate partner violence, especially in crack cocaine users (El Bassel, Gilbert, Witte, Wu, & Chang, 2011). Furthermore, crack use before sex is a known factor of sexual risk taking, especially in the case of binge use, which is associated with a greater number of sexual partners and inconsistent condom use (Harzck, Williams, & Bowen, 2009; Hoffman, Klein, Eber, & Crosby, 2000). High HIV prevalence in MSM who are also PWUD could also

**Table 2**  
HIV and risk factors, univariate analysis.

	Total sample		Women (n = 49)		Men (n = 401)	
	% HIV	p	% HIV	p	% HIV	p
<i>Sociodemographics</i>						
<i>Sex</i>						
Men	7.7%	<b>&lt;0.001</b>	–	–	–	–
Women	26.5%		–	–	–	–
<i>Age</i>						
<25	5.0%	0.351	14.3%	<b>0.018</b>	2.2%	0.325
25–34	9.8%		19.2%		8.5%	
35+	11.4%		66.7%		8.4%	
<i>Family situation</i>						
Single	10.2%	0.586	33.3%	0.205	8.0%	0.717
Married/couple	8.4%		15.8%		6.8%	
<i>Employment</i>						
No activity	15.4%	<b>0.004</b>	30.4%	0.56	12.8%	<b>0.008</b>
In activity	8.8%		23.1%		5.2%	
<i>Education</i>						
Primary or less	12.7%	0.086	26.9%	0.947	10.3%	0.123
Secondary or more	7.8%		26.1%		6.1%	
<i>Living arrangement</i>						
Homeless	7.7%	0.374	33.3%	0.906	5.1%	0.323
Housed by a relative	8.6%		24.0%		6.7%	
Own home	12.5%		27.8%		10.5%	
<i>History of incarceration</i>						
No	11.1%	0.337	21.2%	0.226	9.4%	0.206
Yes	8.9%		37.5%		6.1%	
<i>Drug use</i>						
<i>IDU</i>						
No	10.4%	0.219	28.9%	0.562	8.1%	0.783
Yes	5.2%		0.0%		5.7%	
<i>Systematic crack pipe sharing</i>						
No	12.7%	0.145	33.3%	0.291	8.7%	0.612
Yes	8.3%		20.0%		7.3%	
<i>Sexual behaviors</i>						
<i>Sex work</i>						
No	7.4%	<b>&lt;0.001</b>	30.3%	0.502	5.2%	<b>&lt;0.001</b>
Yes	22.5%		18.8%		23.6%	
<i>Sex worker's client</i>						
No	–	–	–	–	7.2%	0.396
Yes	–	–	–	–	10.0%	
<i>MSM</i>						
No	–	–	–	–	4.2%	<b>&lt;0.001</b>
Yes	–	–	–	–	39.0%	
<i>Number partners last 12 months</i>						
0	5.7%	0.094	42.9%	0.334	3.5%	0.067
1	9.0%		17.5%		7.4%	
2 or more	13.1%		31.6%		11.0%	
<i>Consistent condom use in the last 12 months among sexually actives</i>						
Yes	8.0%	<b>0.009</b>	19.2%	0.374	6.4%	<b>0.015</b>
No	17.5%		31.3%		15.3%	

Significant values ( $p < 0.05$ ) are in bold.

be one of the factors explaining the results in women, as more than half of the MSM living in Abidjan report having frequent sexual relationships with women (Hakim et al., 2015).

In MSM, who constitute 10% of the sample, the 39.0% HIV prevalence observed is much higher than the 18.0% reported by a survey conducted in 2012 among 601 MSM from Abidjan (Hakim et al., 2015). This result can partly be explained by the higher proportion of SW (46.3% versus 23.5%), the older age (median age 29 versus 23 years) and less frequent condom use (58.5% versus 63.8% with women to 69.6% with men during last sexual contact) among MSM drug users in our study as compared to the MSM in the 2012 survey. The factors associated with HIV in this survey have been reported in other studies of MSM. This includes receptive anal intercourse and condom use with male partners which are described as being influenced by use of crack and other stimulants before sex (Mimiaga et al., 2010; Purcell, Parsons, Halkitis, Mizuno, & Woods, 2001). As with women, a history of physical abuse and forced sex are common among MSM who use

drugs (Braitstein et al., 2006), and were also significantly associated with HIV in MSM living in Abidjan.

Programs targeting MSM have been underway for a few years in Ivory Coast, and seem to be efficient in spreading prevention messages as we found better general HIV knowledge in this subpopulation. In addition, MSM reported to have been recently tested more frequently than the other participants. However, 93.2% of the HIV positive MSM did not know their HIV status before the study, including 6 out of the 15 reporting a negative test in the last 12 months. These results are close to those observed in the above-mentioned survey (62.6% had been tested, but 86.4% of HIV-positive MSM were unaware of their status) and may indicate an alarming HIV incidence in MSM drug users in spite of their rather good knowledge and testing behaviors. However, this very well informed group might have over-reported recent testing history. In addition, potential misunderstanding of testing procedures and results may partially explain these findings.

**Table 3**  
HIV risk factors in men, multivariate analysis.

	aOR; 95CI	<i>p</i>
Age		
<25	Ref	
25–34	3.76; 0.44–31.9	0.226
35+	6.48; 0.74–56.74	0.092
Employment		
No activity	Ref	
In activity	0.41; 0.18–0.97	<b>0.041</b>
Education		
Primary or less	Ref	
Secondary or more	0.53; 0.22–1.26	0.151
Sex work		
No	Ref	
Yes	2.9; 1.06–7.98	<b>0.039</b>
MSM		
No	Ref	
Yes	11.5; 4.22–31.42	<b>&lt;0.001</b>
Number partners last 12 months		
0	Ref	
1	1.61; 0.44–5.90	0.47
2 or more	1.38; 0.35–5.36	0.643

aOR: adjusted odd ratio.

Variables in the model are those associated with a *p* level <0.125 at univariate analysis.

Because it concerned only a subsample of sexually active participants, condom use in the last 12 months has not been included in the adjusted results reported in the table. However, this covariate was not significantly associated with HIV after adjustment in analyses among sexually active participants.

Significant values (*p* < 0.05) are in bold.

HIV does not seem to be directly associated with drug consumption in Abidjan's PWUD. The common sharing of crack pipes does not appear to be associated with HIV transmission. Surprisingly, the participants who had a history of drug injection

**Table 5**  
Factors associated to active pulmonary tuberculosis.

	% Active pulmonary TB	<i>p</i>
Sex		
Men	6.1%	0.159
Women	2.5%	
Age		
<25	3.3%	0.792
25–34	3.3%	
35+	2.3%	
Family situation		
Single	3.2%	0.742
Married/couple	1.9%	
Employment		
No activity	3.9%	0.377
In activity	2.4%	
Education		
Primary or less	3.9%	0.309
Secondary or more	2.2%	
Living arrangement		
Homeless	6.2%	<b>0.033</b>
Housed by a relative	3.4%	
Own home	0.7%	
History of incarceration		
No	2.6%	0.657
Yes	3.3%	
Systematic crack pipe sharing		
No	2.7%	1
Yes	3.0%	
HIV		
Negative	3.0%	1
Positive	2.3%	

Significant values (*p* < 0.05) are in bold.

were not infected more than the NIDU. However, most of them had stopped injecting drugs, and the current IDU were too few to draw a conclusion.

**Table 4**  
General HIV knowledge and testing behaviors.

	Knowledge score of 6 out of 6 <sup>a</sup>		Knows where to be tested <sup>b</sup>		Tested <12 months <sup>b</sup>	
	%	<i>p</i>	%	<i>p</i>	%	<i>p</i>
Total sample	48.7%		65.1%		22.4%	
Sex						
Men	46.9%	0.798	66.7%	0.81	22.9%	0.892
Women	48.9%		64.9%		22.6%	
Age						
<25	36.7%	<b>0.002</b>	67.4%	0.893	27.1%	0.614
25–34	57.2%		64.5%		21.5%	
35+	42.3%		64.9%		21.3%	
Family situation						
Single	52.2%	<b>0.007</b>	67.7%	<b>0.036</b>	22.9%	0.507
Married/couple	27.4%		56.6%		19.8%	
Employment						
No activity	55.8%	<b>0.028</b>	69.3%	0.181	20.3%	0.488
In activity	44.9%		62.9%		23.1%	
Education						
Primary or less	38.1%	<b>&lt;0.001</b>	50.6%	<b>&lt;0.001</b>	18.9%	0.173
Secondary or more	55.8%		74.9%		24.3%	
IDU						
No	48.4%	0.721	63.9%	0.173	22.0%	0.837
Yes	50.9%		73.2%		23.2%	
SW						
No	50.4%	0.09	64.7%	0.696	20.4%	<b>0.042</b>
Yes	39.4%		67.1%		31.4%	
SW clients						
No	52.7%	<b>&lt;0.001</b>	66.0%	0.372	21.5%	0.455
Yes	30.0%		60.8%		25.3%	
MSM						
No	45.5%	<b>&lt;0.001</b>	62.7%	<b>0.001</b>	20.6%	<b>0.014</b>
Yes	80.5%		90.0%		37.5%	

Significant values (*p* < 0.05) are in bold.

<sup>a</sup> Question to assess general HIV knowledge were the following: (1) "Having sexual relationship with only one faithful partner who is not infected with HIV can reduce the risk of HIV transmission". (2) "Condom use reduce the risk of HIV transmission". (3) "A person who looks healthy can be infected with HIV". (4) "One can get HIV by sharing a meal with an HIV-infected person". (5) "Mosquito bite can transmit HIV". (6) "Religious practice may protect against HIV infection".

<sup>b</sup> The 3 people already knowing their positive HIV status for more than one year are excluded from these analyses.

HIV is known to be influenced by social factors, such as criminalization, stigma, or gender inequity. Beyond individual risk taking, higher HIV prevalence in women, SW and MSM of the sample, the marginalized among the marginalized, may suggest a significant role of discrimination and stigma in the HIV epidemic among PWUD. The legal frameworks and the systematic discrimination tend to distance them from the prevention and treatment programs, and to exclude them from participation in the decision making processes that affect their life. Poverty and disadvantaged living conditions are additional environmental factors that appear to influence the health of PWUD. A higher rate of HIV was observed among unemployed men in our sample, which supports previous research showing that poverty is associated with HIV in urban settings in Sub-Saharan Africa (Magadi, 2013). Furthermore, the conditions in urban slums is known to be favorable to the spread of contagious diseases, including TB (Hargreaves et al., 2011). Our study found a high prevalence of active pulmonary TB, which was significantly associated with living conditions with almost nine times more cases in people living in the street or in the “fumoires” in comparison with those having their own home. The 1.8% weighted prevalence of TB is about 10 times more than that reported by the WHO for Ivory Coast (WHO, 2014) which relied mainly on passive case reporting. Moreover, we can expect an underestimation of TB prevalence in this work, firstly because AFB without confirmation is not the most sensitive diagnostic method, but also because of difficulties in collecting samples (we did not manage to obtain a sputum for 15 of the 101 suspected TB cases). Although our cross sectional design failed to find a significant association with active pulmonary TB, almost half of the participants reported having been in prison at least once, which is a known reservoir of the disease.

This study has some limitations to keep in mind when interpreting the findings. First, as interviews were conducted face-to-face, certain behaviors, in particular sex work and HIV testing, might have been affected by social desirability bias. In addition, the cross-sectional design and the low absolute number of HIV cases in some sub-groups could have restricted an accurate analysis of specific associations. Besides these common biases, the main limit could result from the difficulty to penetrate the drug environment. Like many surveys of PWUD, we were limited by the challenges of recruiting wealthier PWUD, who are likely to have different practices, including injecting drug use. Also, some “fumoires” were out of our reach as their chief prevented us from approaching them. Therefore, the study could have missed a part of the PWUD frequenting these other “fumoires”. In consequence, our capture and recapture samples were not completely independent, and we might have underestimated the number of PWUD in Abidjan. However, to our knowledge, PWUD are quite mobile and generally consume in several different “fumoires” within Abidjan, and this restriction should have only a minor impact on the results.

### Implications

These results offer an improved knowledge regarding PWUD's health behaviors and needs and notably HIV related issues in Abidjan, Ivory Coast. They should help in designing adapted programs targeting this most-at-risk population. Even though injection drug use is a marginal phenomenon in Abidjan, PWUD can be considered at high risk of HIV due to sexual transmission, especially among women, female and male SW, and MSM who use drugs.

Further field research is needed to better understand the specific sexual risk practices in these specific subpopulations, in order to adjust HIV prevention strategies. In addition, the substantial gender differences in this population should be thoroughly studied. Female PWUD appear especially vulnerable to HIV and should be given special attention when designing and

implementing programs targeting PWUD. A better understanding of challenges related to HIV counselling and testing is also needed, especially with regards to MSM drug users, in order to improve HIV testing and linkage to care. Outreach interventions for TB and primary health care should also be considered essential. More generally, improving the health of PWUD involves a broader reflection on the living environment and the access to health care of slum residents in large African cities.

Beyond the research goals, this study has enabled the mobilization of PWUD and the initiation of a self-support dynamic, through the participation of PWUD in all steps of the research process. Our experience indicates that PWUD are willing to take control of their health, and want to be involved in HIV prevention projects. The links established with the peer driven networks during the survey shall greatly facilitate the implementation of public health interventions in the community.

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### Conflict of interest statement

The authors declare that there is no conflict of interest.

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