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Tobacco and Alcohol Use among Drug Users Receiving Methadone Maintenance Treatment in A Rural Prefecture of Yunnan Province, Southwest China

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Running head: Tobacco and alcohol use among MMT patients in China

ABSTRACT

Objective: To estimate the prevalence of ever, current and heavy tobacco and alcohol use and their correlates among patients undergoing methadone maintenance treatment (MMT).

Design: Cross-sectional questionnaire study.

Setting: The study was conducted in all of the five MMT clinics in Dehong prefecture, China.

Participants: 2,121 (91.0%) eligible MMT participants were included in study population.

Analysis: Ordinal logistic regression was used to estimate the odds ratios (OR) and their 95% confidence intervals (CI).

Results: The overall prevalence of ever, current and heavy smoking was 98.6%, 97.8% and 66.3%, respectively; while that of ever, current and hazardous alcohol drinking was 86.6%, 58.6% and 16.6%, respectively. Among HIV infected participants, the proportions of those experiencing harmful effects of tobacco and alcohol on AIDS were 53.6% and 72.5%, and respectively 16.9% and 49.3% had ever tried to quit after diagnosis with HIV. After adjusting for potential confounders, heavy smokers and hazardous drinkers were more likely to be those who were male, older, and less educated. Ethnic minorities were less likely to heavily smoke, but more likely to engage in hazardous drinking. In addition, hazardous drinking was negatively associated with longer years of MMT and HIV infection. Moreover, heavy smoking ($OR_{\geqslant 2}$ = 2.08, 95% CI: 1.16-3.73) and hazardous drinking ($OR_{\geqslant 2}$ = 2.46, 95% CI:1.53-3.97) were positively associated with having multiple sexual partners, and both were positively associated with each other.

Conclusion: Prevalence of tobacco and alcohol consumption was extraordinarily high among MMT participants in China, suggesting the urgent need of implementing comprehensive education and effective intervention programs.

Keywords: tobacco, alcohol, methadone maintenance treatment (MMT), HIV, prevalence

Strengths and limitations of this study:

The study is the first and the largest study to specifically examine tobacco and alcohol use among drug users receiving MMT particularly those living with HIV/AIDS in China.

Not only high prevalence of tobacco smoking and alcohol drinking were found in this population, but some significant correlates including gender, age, ethnicity, level of education, sexual activity, length of MMT and HIV infection were also discovered.

Our findings suggest the urgent need of implementing comprehensive education and effective intervention programs to reduce the harmful use of tobacco and alcohol among MMT patients in China.

Similar to all cross-sectional studies, causal inferences cannot be made and information bias may exist in our study.

INTRODUCTION

China's methadone maintenance treatment (MMT) program started with 8 pilot sites in five provinces in March 2004, scaled up nationwide in June 2006, and has become one of the largest opioid-substitution treatment and care systems in the world.[1 2] By the end of 2012, a total of 756 community-based MMT clinics had been established in 28 provinces and had provided treatment for 384,479 drug users (DUs).[3] At the end of 2015, 167,600 DUs were receiving treatment in 785 MMT clinics located in 29 provinces. Owing to successful implementation during the past decade, the MMT program in China has drastically reduced drug use and related morbidity and mortality, improved quality of life as well as the social and family well-being of drug users.[1 2 4] As MMT patients live longer because of the effectiveness of MMT, unhealthy life styles such as smoking and alcohol drinking have been suggested to be major causes of excess mortality for DUs.[5] Furthermore, a substantial proportion of MMT patients are living with HIV and are therefore at even higher risk of onset and rapid progression of comorbidities associated with tobacco and alcohol use.[6-8]

Both tobacco and alcoholic beverages are highly addictive substances and widely consumed throughout the world, especially in China.[9 10] Tobacco and alcohol consumption have serious effects on public health and are regarded as the most common modifiable and preventable risk factors for major non-communicable diseases.[11 12] They both contain well-established group I carcinogens and are causally associated with development of certain cancers,[13] and further contribute to the increasing health burden among persons living with HIV/AIDS (PLWHA).[14] Globally, a much higher prevalence of smoking (79%-93%) has been reported in active DUs and MMT patients than in the general population,[15-22] whereas the prevalence of alcohol drinking was reported to be varying from 13% to 49%, depending on definitions of heavy alcohol consumption and study area.[23-31]

However, no study has been designed to specifically examine tobacco and alcohol use among drug users receiving MMT particularly those living with HIV in China. To fill this gap, we conducted a cross-sectional study to specifically examine tobacco and alcohol use among a large sample of drug users receiving MMT in Dehong Prefecture of Yunnan Province at China's southwest border, where the first China's indigenous HIV outbreak was reported in 146 infected heroin users in 1989. Here, injection drug use (IDU) has been the predominant

mode of HIV transmission through the early 2000s and continues to be an important source of HIV infection.[32 33]

METHODS

Study design, setting and participants

Details of the study design have been described in a previous publication.[34] In brief, a cross-sectional survey was conducted from June to July in 2014 in Dehong Prefecture in Yunnan Province, China. We identified participants from all of the five MMT clinics in Dehong prefecture. Inclusion into the study was limited to MMT who were opioid users, aged 20 years or older (no age limitation for HIV infectors), had registered as local residents for at least 6 months where the clinic was located, and were capable of complete civil liability.[1 2] During the study period, a total of 2,600 DUs received MMT. To be eligible for this study, we further excluded those who could not complete the questionnaire due to drunkenness, disability (e.g. deaf-mute), or severe mental disorders. Of the 2,331 eligible patients, 197 did not appear at MMT sites and 13 participants were excluded because of excessive missing data. 2,121 (91.0%) eligible MMT participants were included in the final study population.

Data collection

The protocol of this study was approved by the Institutional Review Board (IRB) of Fudan University, Shanghai, China. All participants had to read and sign the informed consent form prior to participating in the survey.

Trained public health professionals collected epidemiologic data through face-to-face interviews using a structured questionnaire at a private location. The questionnaire had been tested in an early study.[35 36] The epidemiologic information included basic demographic characteristics (gender, age, ethnicity, marital status, and level of education), tobacco smoking [age at starting smoking, type of cigarettes, smoking frequency, smoking intensity and number of cigarettes smoked per day (CPD) in the past month], alcohol drinking (age at starting drinking, types of alcohol, drinking frequency, and quantity of drinking in the past month), tobacco smoking and alcohol drinking status during MMT, knowledge and quitting behavior for HIV infected individuals, and sexual behaviors (number of sexual partners in the

last year). Information on age at starting drug use, length of taking MMT, daily methadone dosage, and HIV and HCV infection status were obtained from MMT Data System.

Measures

Ever smokers were defined as having smoked at least 100 cigarettes in their lifetime,[36 37] while ever alcohol drinkers were defined as having drunk at least once per month for more than 1 year.[35] Current smokers and current drinkers were defined as those who smoke or drank in the month prior to the interview. Current smokers were further asked about cigarette type (manufactured only, hand-rolled only, or combination of the two), smoking frequency (none, sometimes or daily) and number of CPD in the past month. We summed absolute numbers of both types of cigarette, then defined heavy smoking as smoking at least 20 CPD, moderate smoking as 10–19 CPD, and light smoking as 0-9 CPD.[37] Current drinkers were further asked about alcohol type (Chinese white wine only, beer only or combination of the two), frequency of drinking (none or occasionally, often or daily) and quantity of alcohol consumed in the past month. Weekly consumption of pure ethanol (grams/week) on average were calculated with the standard of ethanol content of 4% for beer and 40% for Chinese white wine, and a conversion factor of 0.79.[38] According to the US National Institute on Alcohol Abuse and Alcoholism (NIAAA) guidelines for physicians, we defined hazardous level as having more than 14 drinks per week (196 gram of alcohol) for men and more than 7 drinks (98 gram) per week for women, and moderate level as drinking ethanol below hazardous levels.[25 39] Frequency of drinking in the past month was divided into four categories: daily or almost daily (at least 4 times per week), often (1–3 times per week), occasionally (1–3 times per month), and none. Frequency of drinking was dichotomized into 'often or daily' versus "none or occasionally" in the analysis.

Statistical analysis

SAS v9.2 package (SAS Institute Inc.,) was used to clean and analyze the data. The distribution of participants' socio-demographic characteristics, information on taking MMT, and tobacco and alcohol consumption by gender and by HIV infection status were described and compared using the Chi-squared test or Fisher's exact test, where appropriate. Univariate

ordinal logistic regressions were used to estimate odds ratios (ORs) and their 95% confidence intervals (CIs) to examine the associations between smoking/drinking behaviors and related factors. In multiple regression, ordinal logistic regression models were performed with 'forced entry' of all variables selected based on prior knowledge and confounding assessment, for intensity of smoking and levels of alcohol drinking in the past month, respectively.

RESULTS

Socio-demographic characteristics and status of HIV/HCV infection

Characteristics of MMT participants overall and by gender were summarized in Table 1. Of 2,121 participants, 2,041 (96.2%) were males; the mean age was 40.8 years old (SD = 10.0). Jingpo (42.9%) and Han (41.7%) were the largest two ethnic groups. Seventy percent of the participants were married, and 50.1% were illiterate or only had a primary school education. For HIV/HCV infection status, 21.3% had Western-Blot confirmed HIV infection while 37.1% were positive for serum HCV antibody. Male and female participants were significantly different in age, ethnicity and level of education.

Drug use, methadone maintenance treatment and sexual behavior

Among the study participants, 56.5% started using heroin before 25 years old. System data showed that 82.7% had received MMT for more than one year and 31.5% for more than five years, and 20.2% had daily methadone dosage greater than 100 ml. For sexual behavior, 3.5% reported having had two or more sex partners in the last year. No statistically significant difference was observed between males and females in these behaviors.

Tobacco use

The overall characteristics of tobacco smoking among MMT participants were presented in Table 2, and were compared by gender and further by HIV infection status. Among all participants, 98.6% were ever smokers, 97.8% self-reported as current smokers, and 61% started smoking before 18 years old; 62.8% had smoked for more than 20 years and 98% still smoked during MMT. Among current smokers, 66.3% smoked more than 20 cigarettes per day and were defined as heavy smokers in this study. Almost all smokers preferred

manufactured cigarettes. Smoking patterns were all significantly different by gender since men were more likely to smoke (99.2% vs. 83.8%, p<0.001), were more likely to start smoking before the age of 18 (61.8% vs. 38.8%, p<0.001), had a longer duration of smoking (proportion of smoked for more than 20 years: 64.2% vs. 20.9%, p<0.001), had a higher frequency of smoking (proportion of smoking daily: 93.4% vs. 66.3%, p<0.001) and higher intensity (heavy smoking: 68.1% vs. 20.0%, p<0.001). When stratified by gender, HIV positive individuals were more likely to start smoking before 18 in both male (74.1% vs. 58.4%, p<0.001) and female (63.2% vs. 29.2%, p=0.010), and had different preference in types of cigarettes compared to HIV negative participants in male. Among those HIV-infected individuals, 53.6% thought smoking have harmful effect on AIDS disease progression, while only 16.9% ever tried to quit smoking after diagnosed with HIV, with no statistically significant difference by gender.

The prevalence of light, moderate and heavy smoking and associated factors of tobacco smoking intensity among MMT patients are presented and examined by ordinal logistic regression models in Table 3. After adjusting for potential confounding factors, heavy smoking in the preceding month was positively associated with being male (OR = 13.10, 95% CI: 8.22-20.88), having more sexual partners in the past month ($OR_{\geqslant 2}$ = 2.08, 95% CI: 1.16-3.73), and engaging in hazardous drinking (OR = 1.57, 95% CI: 1.18-2.10), and negatively associated with being an ethnic minority (OR_{Jingpo} = 0.63, 95% CI: 0.51-0.79), having received higher education ($OR_{high\ or\ above}$ = 0.72, 95% CI: 0.53-1.00). Smoking intensity was not significantly associated with age, marital status, age at starting drug use, duration of taking MMT, daily methadone dose, or HIV or HCV infection.

Alcohol use

The characteristics of alcohol drinking among MMT participants were shown in Table 4. Of all subjects, 86.6% were ever drinkers, 51.9% started drinking before 18 years old, 59.4% had consumed alcohol for more than 20 years, and 73.3% were still drinking during MMT and also in the past month prior to interview. The prevalence of current drinking, drinking often or daily, and drinking at hazardous level were 58.6%, 24.5% and 16.6%, respectively. Males had significantly different alcohol drinking patterns from females. Men were more likely to drink,

had a longer duration of drinking, drank more Chinese white wine, drank more and had a higher drinking frequency. In males, compared to HIV-uninfected individuals, HIV cases had a lower prevalence of drinking during MMT (66.8% vs. 76.5%, p<0.001), smaller frequency of drinking in the past month (proportion of drinking often and daily: 17.6% vs. 27.3%, p<0.001), less Chinese white wine use (68.7% vs. 72.5%, p<0.001), and fewer had a hazardous level of drinking (9.3% vs. 19.1%, p<0.001). No significant difference was shown in females when comparing by HIV status. Among those HIV cases, 72.5% thought alcohol was harmful for AIDS disease progression, and 49.3% had ever tried to quit drinking after diagnosed with HIV, with no significant difference between males and females.

The prevalence of none, moderate, and hazardous alcohol drinking and associated factors among MMT patients were examined and shown in Table 5. After adjusting for potential confounding factors, higher levels of alcohol drinking in the preceding month were positively associated with being male (OR = 7.20, 95% CI: 3.83–13.54), at an older age (OR_{40-49} = 1.70, 95% CI: 1.23–2.35; OR_{50-79} = 1.76, 95% CI: 1.22–2.53), being an ethnic minority (OR_{Jingpo} = 2.58, 95% CI: 2.11–3.16; OR_{Dai} = 3.08, 95% CI: 2.31–4.11), having two or more sexual partners in the last year ($OR_{\geq 2}$ = 2.46, 95% CI:1.53-3.97), and being a heavy smoker (OR_{high} = 1.39, 95% CI: 1.03-1.88). Heavier drinking was negatively associated with having received higher education (OR_{middle} = 0.76, 95% CI: 0.63-0.93; $OR_{high\ or\ above}$ = 0.65, 95% CI: 0.48–0.89), having a longer duration of MMT ($OR_{>5}$ = 0.77, 95% CI: 0.59–1.00) and being HIV infected (OR = 0.53, 95% CI: 0.42-0.68). Quantity of alcohol consumption was not significantly associated with marital status, age of first drug use, daily methadone dose, or HCV infection.

DISCUSSION

In this cross-sectional study with 2,121 MMT participants from western China, we observed that participants were almost all ever smokers and rarely changed their smoking behavior during MMT; they also had a high prevalence of current alcohol consumption with a reduction after receiving MMT. We also found significantly different patterns of tobacco and alcohol consumption when comparing males and females, or HIV positive and negative participants. Moreover, we reported that gender, age, ethnicity, level of education, sexual

activity were associated with both smoking and drinking behaviors, while length of MMT and HIV infection were negatively associated with heavier drinking. Smoking and drinking were also correlates with each other in the models.

MMT patients in the survey showed an overall prevalence of current smoking of 97.8%, which was more than three times that of 28.3% in Chinese general adults. When looking by gender, the prevalence of current smoking was about twice and thirty times than that of Chinese males and females in the general population, respectively (male: 98.8% versus 53.3%, female: 73.7% versus 2.5%).[40] Among MMT patients in western counties, the overall prevalence of smoking was observed from 78.5% to 93.0%;[15-18] while there have been only two previous studies reported current smoking prevalence (91.4% and 92.9%, respectively) among Chinese MMT patients.[21 22] Those previous studies' sample sizes were less than 600, but consistent with our results, high prevalence of smoking was unanimously observed among MMT patients.

To the best of our knowledge, no previous studies had reported the prevalence of heavy smoking among MMT patients. Of all subjects in our analysis, the prevalence of heavy smoking was 66.3% in overall, 68.1% in male, and 20.0% in female, which were extremely high compared to the general Chinese population aged 15 years and over (overall: 10.1%, male: 22.8%, and female: 0.6%),[41] and were higher than those of 2.6% and 7.2% of adults in California and the remaining United States in 2007, respectively.[37] As almost all MMT patients are smokers, smoking intensity may be a better exposure measure when examining the seriousness of smoking effects on health. Meanwhile the published literature suggested that interventions among MMT patients have been largely unsuccessful in achieving sustained smoking abstinence.[42] Therefore, implementation of innovative smoking cessation programs is urgent and smoking reduction may be the primary and more important intervention among heavy smokers.

The overall prevalence of current alcohol drinking in the study population was 58.6%, which was twice that of Chinese general adults (28.8%).[43] This prevalence was higher than that (30.3%) in central China,[30] and also higher than that (44.0% and 49.0%) among MMT patients of the Beth Israel Medical Center (BIMC) in the United States.[24 25] The prevalence (16.6%) of participating in hazardous alcohol drinking among all study participants was lower

than those (22%-35%) reported in the BIMC with the same criterion of hazardous alcohol level.[23-25] We observed that the proportion declined by 28.0% from ever drinking to current drinking, especially for female (by 50.1%), suggesting that alcohol consumption was negatively affected during the course of MMT, although a systematic review found no change when patients had been on MMT (Three studies supported an increase, three supported a decrease, and nine supported no change in alcohol use).[27]

It was not surprising to find that both heavy smoking and hazardous alcohol drinking in the preceding month were positively associated with being male, which was observed in the Chinese general population.[44 45] Meanwhile, results showed that those who were older and had little education were more likely to have heavy smoking and hazardous drinking, which was not consist with previous results.[29] Ethnic minorities were more likely than ethnic Han to engage in high level of alcohol consumption, which was consistent with the finding among HIV-infected patients who were also from Dehong Prefecture.[35] But ethnic minorities showed less heavy smoking, which might be due to different ethnic cultures.[46] This suggested that tobacco and alcohol cessation programs in future should be mindfully conducted according to different demographic characteristics in target populations.

As we mentioned above, patients in MMT were more likely to drink less, and hazardous drinking was further found to be negatively associated with the length of receiving MMT. In addition, of PLWHA in our study, a large proportion (72.5%) have realized the harmful effects of alcohol on AIDS, and half ever tried to quit drinking. Therefore, it was not a surprise hazardous drinking was observed to be negatively associated with HIV infection, whereas no difference of ever drinking was observed between HIV-infected individuals and HIV-uninfected individuals. Meanwhile, a relatively small percent were aware of tobacco's harmful effects and less than a quarter ever tried to quit smoking, resulting in a null association between heavy smoking and HIV infection. There will be great value to enhance MMT patients' awareness of harmful effects of tobacco and alcohol consumption by carrying out health propaganda education.

Furthermore, risky behaviors of heavy smoking and hazardous drinking were positively associated with each other, and both were positively associated with more sexual partners in this study. This might probably explain or be due to the fact that DUs worldwide are likely to

engage in high levels of risky sexual behaviors.[47 48] and often have coexisted unhealthy substance use behaviors.[49] Consistent with our results, previous studies have shown that alcohol drinking was positively associated with a number of sexual risk behaviors including multiple sexual partners.[23 25 50]

Limitations

This study has certain limitations. First, similar to all cross-sectional studies, causal inferences cannot be made. Second, information bias may exist in our study. However, the primary variables asked about in the preceding month prior to interviews were asked by well-trained public health professional in a private place that will minimize recall bias and deliberate concealment of sensitive personal topics.

CONCLUSIONS

The present study suggested high prevalence of current tobacco smoking, current alcohol drinking, heavy smoking and hazardous drinking among MMT patients in China. It is vital to implement comprehensive education and effective intervention programs to reduce the harmful use of tobacco and alcohol among MMT patients. Furthermore, the comparative risk assessment of disease burden attributable to tobacco and alcohol consumption, and the evidence for the effectiveness and cost-effectiveness of interventions to prevent and reduce tobacco and alcohol related harm are needed in the further studies.

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Authors' contributions

The study was conceived by NH and SD. YY, RY, RT, MG and YD performed the survey, had supervision and organized data. ZJ analyzed the data, drafted and revised the manuscript. XL and NH provided edits and all authors critiqued the manuscript for intellectual content.

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Competing interests statement:

All authors declare that they have no conflict of interests.

Data sharing statement:

No additional data are available

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Table 1. Characteristics of study MMT patients.

Variables [a]	Total (%;N=2,121)	Male (%;N=2,041)	Female (%;N=80)
Age (years) (*P*=0.024)			
18-29	251(11.8)	243(11.9)	8(10.0)
30-39	811(38.2)	769(37.7)	42(52.5)
40-49	653(30.8)	639(31.3)	14(17.5)
50-79	406(19.1)	390(19.1)	16(20.0)
Ethnicity (*P*=0.023)			
Han	885(41.7)	854(41.8)	31(38.8)
Jingpo	909(42.9)	880(43.1)	29(36.3)
Dai	249(11.7)	231(11.3)	18(22.5)
Others	78(3.7)	76(3.7)	2(2.5)
Marital status (*P*=0.156)			
Never married	378(17.8)	368(18.0)	10(12.5)
Current married	1,495(70.5)	1,439(70.5)	56(70.0)
Divorced or widowed	248(11.7)	234(11.5)	14(17.5)
Education level (*P*=0.001)			
Illiteracy or primary	1,063(50.1)	1,038(50.9)	25(31.3)
Middle	816(38.5)	777(38.1)	39(48.8)
High or above	242(11.4)	226(11.1)	16(20.0)
Age at first drug use (years) (*P*=0.778)			
<25	1,199(56.5)	1,155(56.6)	44(55.0)
⩾25	922(43.5)	886(43.4)	36(45.0)
Length of MMT (years) (*P*=0.086)			
<1	367(17.3)	360(17.6)	7(8.8)
1-5	1,085(51.2)	1,043(51.1)	42(52.5)
>5	669(31.5)	638(31.3)	31(38.8)
Daily methadone dose (ml) (*P*=0.444)			
⩽30	335(16.4)	327(16.7)	8(10.1)
31-60	765(37.5)	732(37.3)	33(41.8)
61-99	528(25.9)	508(25.9)	20(25.3)
≥100	411(20.2)	393(20.1)	18(22.8)
Number of sexual partners in the past year (P=0.357)			
0	601(28.4)	581(28.5)	20(25.0)
1	1,441(68.1)	1,386(68.0)	55(68.8)
≥2	75(3.5)	70(3.4)	5(6.3)
HIV infection (*P*=0.405)			
No	1,670(78.7)	1,610(78.9)	60(75.0)
Yes	451(21.3)	431(21.1)	20(25.0)
HCV infection (*P*=0.698)			
No	1,335(62.9)	1,283(62.9)	52(65.0)
Yes	786(37.1)	758(37.1)	28(35.0)

[a] *P*-value obtained from Chi-squared tests.

Table 2. Characteristics of tobacco smoking among study MMT patients [a].

Variables	Total (%;N=2,121)	Male (%;N=2,041)	Female (%;N=80)	Male		Female	
				HIV+ (%;N=431)	HIV- (%;N=1,610)	HIV+ (N=20)	HIV- (N=60)
Ever smoking		p<0.001		p=0.550		p=0.168	
No	30(1.4)	17(0.8)	13(16.3)	2(0.5)	15(0.9)	1(5.0)	12(20.0)
Yes	2,091(98.6)	2,024(99.2)	67(83.8)	429(99.5)	1,595(99.1)	19(95.0)	48(80.0)
Smoking initiation age (years)		p<0.001		p<0.001		p=0.010	
≥18	815(39.0)	774(38.2)	41(61.2)	111(25.9)	663(41.6)	7(36.8)	34(70.8)
<18	1,276(61.0)	1,250(61.8)	26(38.8)	318(74.1)	932(58.4)	12(63.2)	14(29.2)
Smoking years		p<0.001		p=0.596		p=0.196	
<20	778(37.2)	725(35.8)	53(79.1)	149(34.7)	576(36.1)	13(68.4)	40(83.3)
≥20	1,313(62.8)	1,299(64.2)	14(20.9)	280(65.3)	1,019(63.9)	6(31.6)	8(16.7)
Smoking during MMT		p<0.001		p=1.000		p=0.074	
No	42(2.0)	22(1.1)	20(25.0)	4(0.9)	18(1.1)	2(10.0)	18(30.0)
Yes	2,079(98.0)	2,019(98.9)	60(75.0)	427(99.1)	1,592(98.9)	18(90.0)	42(70.0)
Smoking frequency in the past month		p<0.001		p=0.071		p=0.078	
None	46(2.2)	25(1.2)	21(26.3)	3(0.7)	22(1.4)	2(10.0)	19(31.7)
Sometimes	116(5.5)	110(5.4)	6(7.5)	15(3.5)	95(5.9)	3(15.0)	3(5.0)
Daily	1,959(92.4)	1,906(93.4)	53(66.3)	413(95.8)	1,493(92.7)	15(75.0)	38(63.3)
Smoking types		p<0.001		p<0.001		p=1.000	
Manufactured only	1,845(88.9)	1,788(88.7)	57(96.6)	410(95.8)	1,378(86.8)	18(100.0)	39(95.1)
Hand-rolled only	43(2.1)	42(2.1)	1(1.7)	4(0.9)	38(2.4)	0(0.0)	1(2.4)
Both above	187(9.0)	186(9.2)	1(1.7)	14(3.3)	172(10.8)	0(0.0)	1(2.4)
Smoking intensity in the past month		p<0.001		p=0.626		p=0.765	
Low	226(10.7)	177(8.7)	49(61.3)	42(9.7)	135(8.4)	11(55.0)	38(63.3)
Moderate	489(23.1)	474(23.2)	15(18.8)	96(22.3)	378(23.5)	4(20.0)	11(18.3)
Heavy	1,406(66.3)	1,390(68.1)	16(20.0)	293(68.0)	1,097(68.1)	5(25.0)	11(18.3)
Attitude to effect of smoking on AIDS		p=0.489					
Good	6(1.4)	6(1.5)	0(0.0)	-	-	-	-
Harmful	231(53.6)	219(53.0)	12(66.7)	-	-	-	-
No effect	194(45.0)	188(45.5)	6(33.3)	-	-	-	-
Ever tried to quit smoking after diagnosed with HIV		p=0.523					
Yes	73(16.9)	69(16.7)	4(22.2)	-	-	-	-
No	358(83.1)	344(83.3)	14(77.8)	-	-	-	-

[a] P-value obtained from Chi-squared tests or Fisher's exact tests.

Table 3. Prevalence and associated factors of tobacco smoking intensity among study MMT patients.

Variables	Light (%;N=226)	Moderate (%;N=489)	Heavy (%;N=1,406)	Univariate		Multivariate [a]	
				OR(95%CI)	*p*	OR(95%CI)	*p*
Gender							
Female	49(61.3)	15(18.8)	16(20.0)	1.00		1.00	
Male	177(8.7)	474(23.2)	1,390(68.1)	**14.04(8.96-22.01)**	**<0.001**	**13.10(8.22-20.88)**	**<0.001**
Age (years)							
18-29	33(13.1)	61(24.3)	157(62.5)	1.00		1.00	
30-39	89(11.0)	197(24.3)	525(64.7)	1.12(0.84-1.49)	0.441	1.20(0.88-1.64)	0.247
40-49	62(9.5)	142(21.7)	449(68.8)	**1.34(0.99-1.80)**	0.056	1.30(0.92-1.84)	0.133
50-79	42(10.3)	89(21.9)	275(67.7)	1.27(0.92-1.75)	0.149	1.34(0.90-2.00)	0.147
Ethnicity							
Han	79(8.9)	194(21.9)	612(69.2)	1.00		1.00	
Jingpo	106(11.7)	224(24.6)	579(63.7)	**0.78(0.64-0.94)**	**0.011**	**0.63(0.51-0.79)**	**<0.001**
Dai	28(11.2)	56(22.5)	165(66.3)	0.86(0.64-1.16)	0.322	0.77(0.56-1.06)	0.106
Others	13(16.7)	15(19.2)	50(64.1)	0.73(0.46-1.17)	0.190	0.64(0.39-1.03)	0.066
Marital status							
Never married	46(12.2)	97(25.7)	235(62.2)	1.00		1.00	
In marriage	152(10.2)	336(22.5)	1,007(67.4)	**1.25(0.99-1.57)**	0.056	1.18(0.87-1.60)	0.279
Divorced or widowed	28(11.3)	56(22.6)	164(66.1)	1.17(0.84-1.63)	0.342	1.21(0.85-1.72)	0.293
Education level							
Illiteracy or primary	112(10.5)	221(20.8)	730(68.7)	1.00		1.00	
Middle	81(9.9)	207(25.4)	528(64.7)	0.86(0.71-1.05)	0.133	0.86(0.69-1.07)	0.180
High or above	33(13.6)	61(25.2)	148(61.2)	**0.72(0.54-0.95)**	**0.022**	**0.72(0.53-1.00)**	**0.049**
Age at first drug use (years)							
<25	122(10.2)	285(23.8)	792(66.1)	1.00		1.00	
≥25	104(11.3)	204(22.1)	614(66.6)	1.00(0.84-1.20)	0.959	0.90(0.72-1.13)	0.372
Length of MMT (years)							
<1	32(8.7)	86(23.4)	249(67.8)	1.00		1.00	
1-5	114(10.5)	240(22.1)	731(67.4)	0.96(0.75-1.23)	0.728	0.97(0.75-1.26)	0.813
>5	80(12.0)	163(24.4)	426(63.7)	0.81(0.62-1.06)	0.129	0.81(0.61-1.09)	0.160
Daily methadone dose (ml)							
≤30	36(10.7)	78(23.3)	221(66.0)	1.00		1.00	
31-60	85(11.1)	182(23.8)	498(65.1)	1.02(0.80-1.30)	0.890	1.02(0.80-1.32)	0.859
61-99	50(9.5)	115(21.8)	363(68.8)	1.20(0.92-1.57)	0.178	1.29(0.97-1.70)	0.077
≥100	51(12.4)	82(20.0)	278(67.6)	1.10(0.83-1.46)	0.502	1.25(0.92-1.70)	0.156
Number of sexual partners in the last year							
0	76(12.6)	140(23.3)	385(64.1)	1.00		1.00	
1	143(9.9)	337(23.4)	961(66.7)	**1.31(1.08-1.58)**	**0.006**	1.15(0.88-1.51)	0.311
≥2	7(9.3)	11(14.7)	57(76.0)	**1.55(1.27-1.89)**	**<0.001**	**2.08(1.16-3.73)**	**0.014**
Alcohol use in the past month							
None	129(14.7)	203(23.1)	547(62.2)	1.00		1.00	
Moderate	63(7.1)	227(25.5)	599(67.4)	**1.36(1.12-1.64)**	**0.002**	1.19(0.97-1.47)	0.098
Hazardous	34(9.6)	59(16.7)	260(73.7)	**1.71(1.31-2.24)**	**<0.001**	**1.57(1.18-2.10)**	**0.002**
HIV infection							

No	173(10.4)	389(23.3)	1,108(66.3)	1.00		1.00	
Yes	53(11.8)	100(22.2)	298(66.1)	0.97(0.78-1.20)	0.780	1.00(0.77-1.29)	0.973
HCV infection							
No	141(10.6)	309(23.1)	885(66.3)	1.00		1.00	
Yes	85(10.8)	180(22.9)	521(66.3)	1.00(0.83-1.20)	0.966	0.99(0.81-1.22)	0.955

[a] Adjusted for potential confounding variables listed in the table by multivariate ordinal logistic regression analysis.

Table 4. Characteristics of alcohol drinking among study MMT patients.

Variables	Total (N=2,121)	Male (N=2,041)	Female (N=80)	Male		Female	
				HIV+ (N=431)	HIV- (N=1,610)	HIV+ (N=20)	HIV- (N=60)
Ever alcohol drinking		p<0.001		p=0.349		p=0.682	
No	284(13.4)	257(12.6)	27(33.8)	60(13.9)	197(12.2)	6(30.0)	21(35.0)
Yes	1,837(86.6)	1,784(87.4)	53(66.3)	371(86.1)	1,413(87.8)	14(70.0)	39(65.0)
Drinking initiation age (years)		p=0.210		p=0.001		p=0.066	
≥18	884(48.1)	854(47.9)	30(56.6)	149(40.2)	705(49.9)	5(35.7)	25(64.1)
<18	953(51.9)	930(52.1)	23(43.4)	222(59.8)	708(50.1)	9(64.3)	14(35.9)
Drinking years		p<0.001		p=0.355		p=0.510	
<20	745(40.6)	708(39.7)	37(69.8)	155(41.8)	553(39.1)	11(78.6)	26(66.7)
≥20	1,092(59.4)	1,076(60.3)	16(30.2)	216(58.2)	860(60.9)	3(21.4)	13(33.3)
Drinking during MMT		p<0.001		p<0.001		p=0.515	
No	566(26.7)	521(25.5)	45(56.3)	143(33.2)	378(23.5)	10(50.0)	35(58.3)
Yes	1,555(73.3)	1,520(74.5)	35(43.8)	288(66.8)	1,232(76.5)	10(50.0)	25(41.7)
Drinking frequency in the past month		p<0.001		p<0.001		p=1.000	
None and occasionally	1,602(75.5)	1,526(74.8)	76(95.0)	355(82.4)	1,171(72.7)	19(95.0)	57(95.0)
Often and daily	519(24.5)	515(25.2)	4(5.0)	76(17.6)	439(27.3)	1(5.0)	3(5.0)
Drinking types		p<0.001		p<0.001		p=0.329	
Chinese white wine only	563(45.3)	560(45.6)	3(23.1)	90(44.8)	470(45.7)	0(0.0)	3(30.0)
Beer only	355(28.6)	346(28.2)	9(69.2)	63(31.3)	283(27.5)	2(66.7)	7(70.0)
Both above	324(26.1)	323(26.3)	1(7.7)	48(23.9)	275(26.8)	1(33.3)	0(0.0)
Alcohol use in the past month		p<0.001		p<0.001		p=0.583	
None	879(41.4)	812(39.8)	67(83.8)	230(53.4)	582(36.1)	17(85.0)	50(83.3)
Moderate	889(41.9)	881(43.2)	8(10.0)	161(37.4)	720(44.7)	1(5.0)	7(11.7)
Hazardous	353(16.6)	348(17.1)	5(6.3)	40(9.3)	308(19.1)	2(10.0)	3(5.0)
Attitude to effect of drinking on AIDS		p=1.000					
Good	8(2.2)	8(2.3)	0(0.0)	8(2.3)	-	-	-
Harmful	266(72.5)	255(72.2)	11(78.6)	255(72.2)	-	-	-
No effect	93(25.3)	90(25.5)	3(21.4)	90(25.5)	-	-	-
Ever tried to quit drinking after diagnosed with HIV		p=0.959					
Yes	181(49.3)	174(49.3)	7(50.0)	174(49.3)	-	-	-
No	186(50.7)	179(50.7)	7(50.0)	179(50.7)	-	-	-

[a] P-value obtained from Chi-squared tests or Fisher's exact tests.

Table 5. Prevalence and associated factors of alcohol drinking quantity among study MMT patients.

Variables	None (%;N=879)	Moderate (%;N=889)	Hazardous (%;N=353)	Univariate		Multivariate [a]	
				OR(95%CI)	*p*	OR(95%CI)	*p*
Gender							
Female	67(83.8)	8(10.0)	5(6.3)	1.00		1.00	
Male	812(39.8)	881(43.2)	348(17.1)	**7.43(4.12-13.42)**	**<0.001**	**7.20(3.83-13.54)**	**<0.001**
Age (years)							
18-29	107(42.6)	114(45.4)	30(12.0)	1.00		1.00	
30-39	375(46.2)	338(41.7)	98(12.1)	0.90(0.69-1.18)	0.437	1.22(0.91-1.64)	0.181
40-49	258(39.5)	272(41.7)	123(18.8)	1.26(0.96-1.66)	0.097	**1.70(1.23-2.35)**	**0.001**
50-79	139(34.2)	165(40.6)	102(25.1)	**1.69(1.26-2.28)**	**0.001**	**1.76(1.22-2.53)**	**0.003**
Ethnicity							
Han	498(56.3)	297(33.6)	90(10.2)	1.00		1.00	
Jingpo	267(29.4)	452(49.7)	190(20.9)	**2.85(2.38-3.42)**	**<0.001**	**2.58(2.11-3.16)**	**<0.001**
Dai	74(29.7)	118(47.4)	57(22.9)	**2.97(2.27-3.88)**	**<0.001**	**3.08(2.31-4.11)**	**<0.001**
Others	40(51.3)	22(28.2)	16(20.5)	1.45(0.93-2.25)	0.099	**1.56(0.99-2.47)**	**0.056**
Marital status							
Never married	184(48.7)	147(38.9)	47(12.4)	1.00		1.00	
Current married	590(39.5)	639(42.7)	266(17.8)	**1.47(1.19-1.82)**	**<0.001**	0.93(0.70-1.24)	0.618
Divorced or widowed	105(42.3)	103(41.5)	40(16.1)	1.31(0.96-1.77)	0.085	1.17(0.85-1.63)	0.341
Education level							
Illiteracy or primary	345(32.5)	487(45.8)	231(21.7)	1.00		1.00	
Middle	398(48.8)	318(39.0)	100(12.3)	**0.50(0.42-0.60)**	**<0.001**	**0.76(0.63-0.93)**	**0.007**
High or above	136(56.2)	84(34.7)	22(9.1)	**0.37(0.28-0.49)**	**<0.001**	**0.65(0.48-0.89)**	**0.006**
Age at first drug use (years)							
<25	544(45.4)	472(39.4)	183(15.3)	1.00		1.00	
≥25	335(36.3)	417(45.2)	170(18.4)	**1.39(1.18-1.64)**	**<0.001**	0.89(0.73-1.09)	0.262
Length of MMT (years)							
<1	115(31.3)	203(55.3)	49(13.4)	1.00		1.00	
1-5	417(38.4)	484(44.6)	184(17.0)	0.89(0.71-1.11)	0.295	0.92(0.73-1.16)	0.468
>5	347(51.9)	202(30.2)	120(17.9)	**0.60(0.47-0.76)**	**<0.001**	**0.77(0.59-1.00)**	**0.050**
Daily methadone dose (ml)							
≤30	133(39.7)	150(44.8)	52(15.5)	1.00		1.00	
31-60	281(36.7)	327(42.7)	157(20.5)	1.17(0.93-1.46)	0.180	**1.29(1.02-1.63)**	**0.032**
61-99	228(43.2)	217(41.1)	83(15.7)	0.87(0.68-1.11)	0.261	1.04(0.81-1.35)	0.742
≥100	213(51.8)	146(35.5)	52(12.7)	**0.63(0.48-0.81)**	**<0.001**	0.97(0.73-1.29)	0.851
Number of sexual partners in the last year							
0	286(47.6)	226(37.6)	89(14.8)	1.00		1.00	
1	568(39.4)	625(43.4)	248(17.2)	**1.35(1.13-1.61)**	**0.001**	**1.34(1.04-1.73)**	**0.022**
≥2	23(30.7)	36(48.0)	16(21.3)	**1.88(1.20-2.94)**	**0.006**	**2.46(1.53-3.97)**	**<0.001**
Smoking intensity in the past month							
Low	129(57.1)	63(27.9)	34(15.0)	1.00		1.00	
Moderate	203(41.5)	227(46.4)	59(12.1)	**1.56(1.15-2.11)**	**0.004**	1.11(0.80-1.55)	0.522
High	547(38.9)	599(42.6)	260(18.5)	**1.92(1.46-2.52)**	**<0.001**	**1.39(1.03-1.88)**	**0.031**

HIV infection							
No	632(37.8)	727(43.5)	311(18.6)	1.00		1.00	
Yes	247(54.8)	162(35.9)	42(9.3)	**0.49(0.40-0.60)**	**<0.001**	**0.53(0.42-0.68)**	**<0.001**
HCV infection							
No	504(37.8)	598(44.8)	233(17.5)	1.00		1.00	
Yes	375(47.7)	291(37.0)	120(15.3)	**0.71(0.60-0.84)**	**<0.001**	0.86(0.71-1.04)	0.109

[a] Adjusted for potential confounding variables listed in the table by multivariate ordinal logistic regression analysis.

STROBE Statement—checklist of items that should be included in reports of observational studies

(page number in our MS)	Item No	Recommendation
Title (1)**and abstract**(2)	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction(4-5)		
Background/rationale(4)	2	Explain the scientific background and rationale for the investigation being reported
Objectives(4-5)	3	State specific objectives, including any prespecified hypotheses
Methods(5-7)		
Study design(5)	4	Present key elements of study design early in the paper
Setting(5)	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants(5)	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables(5-6)	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement(6)	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias(5)	9	Describe any efforts to address potential sources of bias
Study size(5)	10	Explain how the study size was arrived at
Quantitative variables(6)	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods(6-7)	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results(7-9)		
Participants(7)	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data(7-9)	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data(7-9)	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results(7-9)	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses(7-9)	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion(9-12)		
Key results(9)	18	Summarise key results with reference to study objectives
Limitations(12)	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation(10-11)	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability(12)	21	Discuss the generalisability (external validity) of the study results
Other information(13)		
Funding(13)	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Tobacco and Alcohol Use among Drug Users Receiving Methadone Maintenance Treatment: A Cross Sectional Study in A Rural Prefecture of Yunnan Province, Southwest China

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Tobacco and Alcohol Use among Drug Users Receiving Methadone Maintenance Treatment: A Cross Sectional Study in A Rural Prefecture of Yunnan Province, Southwest China

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Running head: Tobacco and alcohol use among MMT patients in China

ABSTRACT

Objective: To estimate the prevalence of ever, current and heavy tobacco and alcohol use and their correlates among patients undergoing methadone maintenance treatment (MMT).

Design: Cross-sectional study.

Setting: The study was conducted in all of the five MMT clinics in Dehong prefecture, China.

Participants: 2,121 (81.6%) eligible MMT participants were included in study population.

Analysis: Ordinal logistic regression was used to estimate the odds ratios (OR) and their 95% confidence intervals (CI).

Results: The overall prevalence of ever, current and heavy smoking was 98.6%, 97.8% and 66.3%, respectively; while that of ever, current and hazardous alcohol drinking was 86.6%, 58.6% and 16.6%, respectively. Among HIV infected participants, the proportions of those experiencing harmful effects of tobacco and alcohol on AIDS were 53.6% and 72.5%, and respectively 16.9% and 49.3% had ever tried to quit after diagnosis with HIV. After adjusting for potential confounders, heavier smokers and more hazardous drinkers were more likely to be those who were male, older, and less educated. Ethnic minorities were less likely to heavily smoke, but more likely to engage in hazardous drinking. In addition, hazardous drinking was negatively associated with longer years of MMT and HIV infection. Moreover, heavier smoking ($OR_{\geqslant 2}$ = 2.08, 95% CI: 1.16-3.73) and more hazardous drinking ($OR_{\geqslant 2}$ = 2.46, 95% CI:1.53-3.97) were positively associated with having multiple sexual partners, and both were positively associated with each other.

Conclusion: Prevalence of tobacco and alcohol consumption was extraordinarily high among MMT participants in China, suggesting the urgent need of enhancing MMT patients' awareness of the harmful effects of tobacco and alcohol consumption and implementing comprehensive education and effective intervention programs.

Keywords: tobacco, alcohol, methadone maintenance treatment (MMT), HIV, prevalence

Strengths and limitations of this study:

This is the first study specifically examining tobacco and alcohol use and their correlates among drug users receiving methadone maintenance treatment (MMT) with a large sample size in China.

The results revealed a high prevalence of drinking and smoking, helping to target population at higher risk for tobacco/alcohol related diseases in MMT population.

This cross-sectional study is unable to make causal inferences between associated factors and tobacco and alcohol use.

Self-reported data were used for risk behaviors, so information bias may exist.

Participants were recruited from Dehong prefecture, the findings might not be generalizable to MMT patients in other areas.

INTRODUCTION

China's methadone maintenance treatment (MMT) program started with 8 pilot sites in five provinces in March 2004, scaled up nationwide in June 2006, and has become one of the largest opioid-substitution treatment and care systems in the world.[1 2] By the end of 2012, a total of 756 community-based MMT clinics had been established in 28 provinces and had provided treatment for 384,479 drug users (DUs).[3] At the end of 2015, 167,600 DUs were receiving treatment in 785 MMT clinics located in 29 provinces. Owing to successful implementation during the past decade, the MMT program in China has drastically reduced drug use and related morbidity and mortality, improved quality of life as well as the social and family well-being of drug users.[1 2 4] As MMT patients live longer because of the effectiveness of MMT, unhealthy life styles such as smoking and alcohol drinking have been suggested to be major causes of excess mortality for DUs.[5] Furthermore, more than 10% and 60% of MMT patients are living with HIV and HCV, respectively, and are therefore at even higher risk of onset and rapid progression of comorbidities associated with tobacco and alcohol use.[6-10]

Both tobacco and alcoholic beverages are highly addictive substances and widely consumed throughout the world, especially in China.[11 12] Tobacco and alcohol consumption have serious effects on public health and are regarded as the most common modifiable and preventable risk factors for major non-communicable diseases.[13 14] They both contain well-established group I carcinogens and are causally associated with development of certain cancers,[15] and further contribute to the increasing health burden among persons living with HIV/AIDS (PLWHA).[16] Globally, a much higher prevalence of smoking (79%-93%) has been reported in active DUs and MMT patients than in the general population,[17-24] whereas the prevalence of alcohol drinking was reported to be varying from 13% to 49%, depending on definitions of alcohol consumption and study area.[25-33]

However, no study has been designed to specifically examine tobacco and alcohol use among drug users receiving MMT particularly those living with HIV in China. To fill this gap, we conducted a cross-sectional study to specifically examine tobacco and alcohol use and their correlates, and further to explore by gender and by HIV infection status among a large sample of drug users receiving MMT in Dehong Prefecture of Yunnan Province at China's southwest border, where the first China's indigenous HIV outbreak was reported in 146

infected heroin users in 1989, and injection drug use (IDU) had been the predominant mode of HIV transmission through the early 2000s and continues to be an important source of HIV infection.[34 35]

METHODS

Study design, setting and participants

Details of the study design have been described in a previous publication, which showed the prevalence of illicit drug use was 10.4%, 12.9% and 9.2% for morphine, methamphetamine and both of them, respectively in the study population.[36] In brief, a cross-sectional survey was conducted from June to July in 2014 in Dehong Prefecture in Yunnan Province, China. The participants were identified from all of the five MMT clinics in Dehong prefecture and were former opioid users, aged 20 years or older, had registered as local residents for at least 6 months where the clinic was located, and were capable of completing civil liability.[1 2] During the study period, a total of 2,600 DUs were receiving MMT. However, 269 participants could not complete the questionnaire due to drunkenness, disability (e.g. deaf-mute), or severe mental disorders, 197 did not appear at MMT sites and 13 participants were excluded because of excessive missing data. At last, 2,121 (81.6%) eligible MMT participants were included in the final analysis.

Data collection

The protocol of this study was approved by the Institutional Review Board (IRB) of Fudan University, Shanghai, China. All participants had to read and sign the informed consent form prior to participating in the survey.

Trained public health professionals within the local clinics collected epidemiologic data through face-to-face interviews using a structured questionnaire at a private location. The questionnaire had been tested in an early study.[37 38] The epidemiologic information included basic demographic characteristics (gender, age, ethnicity, marital status, and level of education), tobacco smoking [age at starting smoking, type of cigarettes, smoking frequency, smoking intensity and number of cigarettes smoked per day (CPD) in the past month], alcohol drinking (age at starting drinking, types of alcohol, drinking frequency, and quantity of drinking in the past month), tobacco smoking and alcohol drinking status during MMT,

knowledge and quitting behavior for HIV infected individuals, and sexual behaviors (number of sexual partners in the last year). Information on age at starting drug use, length of taking MMT, daily methadone dosage, and HIV and HCV infection status were obtained from MMT Data System.

Measures

The minimum unit for measuring smoking and alcohol drinking was one cigarette and one standard drink, respectively. Ever smokers were defined as having smoked at least 100 cigarettes in their lifetime,[39] while ever alcohol drinkers were defined as having drunk at least once per month for more than 1 year.[37] Current smokers and current drinkers were defined as those who smoke or drank in the month prior to the interview. Current smokers were further asked about cigarette type (manufactured only, hand-rolled only, or combination of the two), smoking frequency (none, sometimes or daily) and number of CPD in the past month. We summed absolute numbers of both types of cigarette, then defined heavy smoking as smoking at least 20 CPD, moderate smoking as 10–19 CPD, and light smoking as 0-9 CPD.[39] Current drinkers were further asked about alcohol type (distilled spirits only, beer only or combination of the two), frequency of drinking [none, occasionally (1–3 times per month), often (1–3 times per week) almost daily (at least 4 times per week) or daily] and quantity of alcohol consumed in the past month. Weekly consumption of pure ethanol (grams/week) on average were calculated with the standard of ethanol content of 4% for beer and 40% for distilled spirits, and a conversion factor of 0.79.[40] According to the US National Institute on Alcohol Abuse and Alcoholism (NIAAA) guidelines for physicians, we defined hazardous level as having more than 14 drinks per week (196 gram of alcohol) for men and more than 7 drinks (98 gram) per week for women, and moderate level as drinking ethanol below hazardous levels.[27 41] Frequency of drinking was dichotomized into 'often or daily' versus "none or occasionally" in the analysis.

Statistical analysis

SAS v9.2 package (SAS Institute Inc.,) was used to clean and analyze the data. The distribution of participants' socio-demographic characteristics, information on taking MMT,

and tobacco and alcohol consumption by gender and by HIV infection status were described and compared using the Chi-squared test or Fisher's exact test, where appropriate. Univariate ordinal logistic regressions were used to estimate odds ratios (ORs) and their 95% confidence intervals (CIs) to examine the associations between smoking/drinking behaviors and related factors. In multiple regression, ordinal logistic regression models were performed with 'forced entry' of all variables selected based on prior knowledge and confounding assessment, for intensity of smoking and levels of alcohol drinking in the past month, respectively; These included gender (female/male), age (years, 18-29/30-39/40-49/50-79), ethnicity (Han/Jingpo/Dai/others), marital status (never married/in marriage/divorced or widowed), education level (illiteracy or primary/middle/high or above), age at first drug use (years, <25/ ⩾25), length of MMT (years, <1/1-5/>5), daily methadone dose (ml, ⩽30/31-60/61-99/⩾ 100), number of sexual partners in the last year (0/1/⩾2), HIV infection(no/yes), HCV infection(no/yes), alcohol use in the past month(none/moderate/hazardous, except for alcohol use) and smoking intensity in the past month (low/moderate/high, except for smoking).

RESULTS

Socio-demographic characteristics and status of HIV/HCV infection

Characteristics of MMT participants overall and by gender were summarized in Table 1. Of 2,121 participants, 2,041 (96.2%) were males; the mean age was 40.8 years old (SD = 10.0). Jingpo (42.9%) and Han (41.7%) were the largest two ethnic groups. Seventy percent of the participants were married, and 1,063 (50.1%) were illiterate or only had a primary school education. For HIV/HCV infection status, 451 (21.3%) had Western-Blot confirmed HIV infection while 786 (37.1%) were positive for serum HCV antibody. Male and female participants were significantly different in age, ethnicity and level of education.

Drug use, methadone maintenance treatment and sexual behavior

Among the study participants, 1,199 (56.5%) started using heroin before 25 years old. System data showed that 1,754 (82.7%) had received MMT for more than one year and 669 (31.5%) for more than five years, and 411 (20.2%) had daily methadone dosage greater than 100 ml. For sexual behavior, 75 (3.5%) reported having had two or more sex partners in the

last year. No statistically significant difference was observed between males and females in these behaviors.

Tobacco use

The overall characteristics of tobacco smoking among MMT participants were presented in Table 2, and were compared by gender and further by HIV infection status. Among all participants, 2,091 (98.6%) were ever smokers, 2,075 (97.8%) self-reported as current smokers, and 1,276 (61.0%) started smoking before 18 years old; 1,313 (62.8%) had smoked for more than 20 years and 2,079 (98.0%) still smoked during MMT. Among current smokers, 1,406 (66.3%) smoked more than 20 cigarettes per day and were defined as heavy smokers in this study. Almost all smokers preferred manufactured cigarettes. Smoking patterns were all significantly different by gender since men were more likely to smoke (99.2% vs. 83.8%, $p<0.001$), were more likely to start smoking before the age of 18 (61.8% vs. 38.8%, $p<0.001$), had a longer duration of smoking (proportion of smoked for more than 20 years: 64.2% vs. 20.9%, $p<0.001$), had a higher frequency of smoking (proportion of smoking daily: 93.4% vs. 66.3%, $p<0.001$) and higher intensity (heavy smoking: 68.1% vs. 20.0%, $p<0.001$). When stratified by gender, HIV positive individuals were more likely to start smoking before 18 in both male (74.1% vs. 58.4%, $p<0.001$) and female (63.2% vs. 29.2%, $p=0.010$), and to prefer manufactured cigarettes (95.8% vs 86.8%, $p<0.001$) compared to HIV negative participants in male. Among those HIV-infected individuals, 231 (53.6%) thought smoking has harmful effect on AIDS disease progression, while only 73 (16.9%) ever tried to quit smoking after diagnosed with HIV, with no statistically significant difference by gender.

The prevalence of light, moderate and heavy smoking and associated factors of tobacco smoking intensity among MMT patients are presented and examined by ordinal logistic regression models in Table 3. After adjusting for potential confounding factors, heavier smoking in the preceding month was positively associated with being male (OR = 13.10, 95% CI: 8.22-20.88), having more sexual partners in the past month ($OR_{\geqslant 2}$ = 2.08, 95% CI: 1.16-3.73), and engaging in hazardous drinking (OR = 1.57, 95% CI: 1.18-2.10), and negatively associated with being an ethnic minority (OR_{Jingpo} = 0.63, 95% CI: 0.51-0.79), having received higher education ($OR_{high\ or\ above}$ = 0.72, 95% CI: 0.53-1.00). Smoking

intensity was not significantly associated with age, marital status, age at starting drug use, duration of taking MMT, daily methadone dose, or HIV or HCV infection.

Alcohol use

The characteristics of alcohol drinking among MMT participants were shown in Table 4. Of all subjects, 1,837 (86.6%) were ever drinkers, 953 (51.9%) started drinking before 18 years old, 1,092 (59.4%) had consumed alcohol for more than 20 years, and 1,555 (73.3%) were still drinking during MMT and also in the past month prior to interview. The prevalence of current drinking, drinking often or daily, and drinking at hazardous level were 58.6%, 24.5% and 16.6%, respectively. Males had significantly different alcohol drinking patterns from females. Men were more likely to drink, had a longer duration of drinking, drank more distilled spirits, drank more and had a higher drinking frequency. In males, compared to HIV-uninfected individuals, HIV cases had a lower prevalence of drinking during MMT (66.8% vs. 76.5%, p<0.001), smaller frequency of drinking in the past month (proportion of drinking often and daily: 17.6% vs. 27.3%, p<0.001), less distilled spirits use (68.7% vs. 72.5%, p<0.001), and fewer had a hazardous level of drinking (9.3% vs. 19.1%, p<0.001). No significant difference was shown in females when comparing by HIV status. Among those HIV cases, 266 (72.5%) thought alcohol was harmful for AIDS disease progression, and 181 (49.3%) had ever tried to quit drinking after diagnosed with HIV, with no significant difference between males and females.

The prevalence of none, moderate, and hazardous alcohol drinking and associated factors among MMT patients were examined and shown in Table 5. After adjusting for potential confounding factors, higher levels of alcohol drinking in the preceding month were positively associated with being male (OR = 7.20, 95% CI: 3.83–13.54), at an older age (OR_{40-49} = 1.70, 95% CI: 1.23–2.35; OR_{50-79} = 1.76, 95% CI: 1.22–2.53), being an ethnic minority (OR_{Jingpo} = 2.58, 95% CI: 2.11–3.16; OR_{Dai} = 3.08, 95% CI: 2.31–4.11), having two or more sexual partners in the last year ($OR_{\geq 2}$ = 2.46, 95% CI:1.53-3.97), and being a heavy smoker (OR_{high} = 1.39, 95% CI: 1.03-1.88). Heavier drinking was negatively associated with having received higher education (OR_{middle} = 0.76, 95% CI: 0.63-0.93; $OR_{high\ or\ above}$ = 0.65, 95% CI: 0.48–0.89), having a longer duration of MMT ($OR_{>5}$ = 0.77, 95% CI: 0.59–1.00) and being HIV

infected (OR = 0.53, 95% CI: 0.42-0.68). Quantity of alcohol consumption was not significantly associated with marital status, age of first drug use, daily methadone dose, or HCV infection.

DISCUSSION

In this cross-sectional study with 2,121 MMT participants from western China, we observed the overall prevalence of ever, current and heavy/hazardous for smoking was 98.6%, 97.8% and 66.3%, respectively; and the prevalence for alcohol drinking was 86.6%, 58.6% and 16.6%, respectively. We also found significantly different patterns of tobacco and alcohol consumption when comparing males and females, or HIV positive and negative participants. Moreover, we reported that gender, age, ethnicity, level of education, sexual activity were associated with both smoking and drinking behaviors, while length of MMT and HIV infection were negatively associated with heavier drinking. Smoking and drinking were also correlates with each other in the models.

MMT patients in the survey showed an overall prevalence of current smoking of 97.8%, which was more than three times that of 28.3% in Chinese general adults. When looking by gender, the prevalence of current smoking was about twice and thirty times than that of Chinese males and females in the general population, respectively (male: 98.8% versus 53.3%, female: 73.7% versus 2.5%).[42] Among MMT patients in western counties, the overall prevalence of smoking was observed from 78.5% to 93.0%;[17-20] while there have been only two previous studies reported current smoking prevalence (91.4% and 92.9%, respectively) among Chinese MMT patients.[23 24] Those previous studies' sample sizes were less than 600, but consistent with our results, high prevalence of smoking was unanimously observed among MMT patients.

To the best of our knowledge, no previous study had reported the prevalence of heavy smoking among MMT patients in China. There was only one study measuring heavy smoking using the same method as ours, however, it only recruited 32 MMT participants from Los Angeles and reported 11 heavy smokers.[43] Of all subjects in our analysis, the prevalence of heavy smoking was 66.3% in overall, 68.1% in male, and 20.0% in female, which were extremely high compared to the general Chinese population aged 15 years and over (overall:

10.1%, male: 22.8%, and female: 0.6%),[44] and were higher than those of 2.6% and 7.2% of adults in California and the remaining United States in 2007, respectively.[39] As almost all MMT patients are smokers, smoking intensity may be a better exposure measure when examining the seriousness of smoking effects on health. Meanwhile the published literature suggested that interventions among MMT patients have been largely unsuccessful in achieving sustained smoking abstinence.[45] Therefore, implementation of innovative smoking cessation programs is urgent and smoking reduction may be the primary and more important intervention among heavy smokers.

The overall prevalence of current alcohol drinking in the study population was 58.6%, which was twice that of Chinese general adults (28.8%).[46] This prevalence was higher than that (30.3%) in central China,[32] and also higher than that (44.0% and 49.0%) among MMT patients of the Beth Israel Medical Center (BIMC) in the United States.[26 27] The prevalence (16.6%) of participating in hazardous alcohol drinking among all study participants was lower than those (22%-35%) reported in the BIMC with the same criterion of hazardous alcohol level.[25-27] We observed that the proportion declined by 28.0% from ever drinking to current drinking, especially for female (by 50.1%), suggesting that alcohol consumption was negatively affected during the course of MMT, although a systematic review found no change when patients had been on MMT (Three studies supported an increase, three supported a decrease, and nine supported no change in alcohol use).[29]

It was not surprising to find that both heavier smoking and higher lever alcohol drinking in the preceding month were positively associated with being male, which was observed in the Chinese general population.[47 48] Meanwhile, results showed that those who were older and had little education were more likely to have heavier smoking and hazardous drinking, which was not consist with previous results.[31] Ethnic minorities were more likely than ethnic Han to engage in high level of alcohol consumption, which was consistent with the finding among HIV-infected patients who were also from Dehong Prefecture.[37] But ethnic minorities showed less heavier smoking, which might be due to different ethnic cultures.[49] This suggested that tobacco and alcohol cessation programs in future should be mindfully conducted according to different demographic characteristics in target populations.

As we mentioned above, patients in MMT were more likely to drink less, and hazardous drinking was further found to be negatively associated with the length of receiving MMT. In addition, of PLWHA in our study, a large proportion (72.5%) have realized the harmful effects of alcohol on AIDS, and half ever tried to quit drinking. Therefore, it was not a surprise hazardous drinking was observed to be negatively associated with HIV infection, whereas no difference of ever drinking was observed between HIV-infected individuals and HIV-uninfected individuals. Meanwhile, a relatively small percent were aware of tobacco's harmful effects and less than a quarter ever tried to quit smoking, resulting in a null association between heavier smoking and HIV infection. There will be great value to enhance MMT patients' awareness of harmful effects of tobacco and alcohol consumption by carrying out health education program.

Furthermore, risky behaviors of heavier smoking and more hazardous drinking were positively associated with each other, and both were positively associated with more sexual partners in this study. This might probably explain or be due to the fact that DUs worldwide are likely to engage in high levels of risky sexual behaviors.[50 51] and often have coexisted unhealthy substance use behaviors.[52] Consistent with our results, previous studies have shown that alcohol drinking was positively associated with a number of sexual risk behaviors including multiple sexual partners.[25 27 53]

Limitations

This study has certain limitations. First, similar to all cross-sectional studies, causal inferences cannot be made. Rather, we are reporting the subgroups of participants with even higher prevalence of use to target the population who are at higher risk for alcohol and tobacco related health problems for focused intervention. Second, self-reported data were used for health-related risk behaviors and behaviors in the past. There might be underreporting of health-related risk behaviors such as number of sexual partners in the last year. And it could be more difficult to recall the memory of long time ago such as age at first drug use, smoking/drinking initiation age, etc. So information bias may exist in our study. However, the primary variables asked about in the preceding month prior to interviews were asked by well-trained public health professional in a private place that will minimize recall

bias and deliberate concealment of sensitive personal topics. Third, the sample size of female MMT patients in the study was only 80 (3.8%), and substantial differences were not found significant when comparing by HIV status in women. A study with larger sample size of women is needed to better explore the association between characteristics and behaviors with alcohol and tobacco use in female DUs receiving MMT. Fourth, all participants were recruited from Dehong, the observed results of tobacco smoking and alcohol drinking in our study might not be generalizable to MMT patients in other areas, and may not be generalizable to those drug users who do not attend MMT clinic.

CONCLUSIONS

The present study suggested high prevalence of current tobacco smoking, current alcohol drinking, heavy smoking and hazardous drinking among MMT patients in China. It is vital to implement comprehensive education and effective intervention programs to reduce the harmful use of tobacco and alcohol among MMT patients. Furthermore, the comparative risk assessment of disease burden attributable to tobacco and alcohol consumption, and the evidence for the effectiveness and cost-effectiveness of interventions to prevent and reduce tobacco and alcohol related harm are needed in the further studies. In addition, confirmation of associated factors, changing trends in the prevalence and comorbid mental health conditions of tobacco and alcohol use among MMT patients warrant further longitudinal cohort studies.

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Authors' contributions

The study was conceived and supervised by NH and SD. YY, RY, RT, MG and YD conducted the survey. ZJ analyzed the data and drafted the manuscript. XL and NH critically reviewed and revised the manuscript.

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Competing interests statement:

All authors declare that they have no conflict of interests.

Data sharing statement:

No additional data are available

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Table 1 Characteristics of study participants

Variables [a]	Total (N=2,121)	Male (N=2,041)	Female (N=80)
Age (years) (*P*=0.024)			
18-29	251(11.8)	243(11.9)	8(10.0)
30-39	811(38.2)	769(37.7)	42(52.5)
40-49	653(30.8)	639(31.3)	14(17.5)
50-79	406(19.1)	390(19.1)	16(20.0)
Ethnicity (*P*=0.023)			
Han	885(41.7)	854(41.8)	31(38.8)
Jingpo	909(42.9)	880(43.1)	29(36.3)
Dai	249(11.7)	231(11.3)	18(22.5)
Others	78(3.7)	76(3.7)	2(2.5)
Marital status (*P*=0.156)			
Never married	378(17.8)	368(18.0)	10(12.5)
Current married	1,495(70.5)	1,439(70.5)	56(70.0)
Divorced or widowed	248(11.7)	234(11.5)	14(17.5)
Education level (*P*=0.001)			
Illiteracy or primary	1,063(50.1)	1,038(50.9)	25(31.3)
Middle	816(38.5)	777(38.1)	39(48.8)
High or above	242(11.4)	226(11.1)	16(20.0)
Age at first drug use (years) (*P*=0.778)			
<25	1,199(56.5)	1,155(56.6)	44(55.0)
⩾25	922(43.5)	886(43.4)	36(45.0)
Length of MMT (years) (*P*=0.086)			
<1	367(17.3)	360(17.6)	7(8.8)
1-5	1,085(51.2)	1,043(51.1)	42(52.5)
>5	669(31.5)	638(31.3)	31(38.8)
Daily methadone dose (ml) (*P*=0.444)			
⩽30	335(16.4)	327(16.7)	8(10.1)
31-60	765(37.5)	732(37.3)	33(41.8)
61-99	528(25.9)	508(25.9)	20(25.3)
≥100	411(20.2)	393(20.1)	18(22.8)
Number of sexual partners in the past year (P=0.357)			
0	601(28.4)	581(28.5)	20(25.0)
1	1,441(68.1)	1,386(68.0)	55(68.8)
≥2	75(3.5)	70(3.4)	5(6.3)
HIV infection (*P*=0.405)			
No	1,670(78.7)	1,610(78.9)	60(75.0)
Yes	451(21.3)	431(21.1)	20(25.0)
HCV infection (*P*=0.698)			
No	1,335(62.9)	1,283(62.9)	52(65.0)
Yes	786(37.1)	758(37.1)	28(35.0)

[a] *P*-value obtained from Chi-squared tests.

Table 2 Characteristics of tobacco smoking among study participants [a]

Variables	Total (N=2,121)	Male (N=2,041)	Female (N=80)	Male		Female	
				HIV+ (N=431)	HIV- (N=1,610)	HIV+ (N=20)	HIV- (N=60)
Ever smoking		***					
No	30(1.4)	17(0.8)	13(16.3)	2(0.5)	15(0.9)	1(5.0)	12(20.0)
Yes	2,091(98.6)	2,024(99.2)	67(83.8)	429(99.5)	1,595(99.1)	19(95.0)	48(80.0)
Smoking initiation age (years)		***		***		*	
≥18	815(39.0)	774(38.2)	41(61.2)	111(25.9)	663(41.6)	7(36.8)	34(70.8)
<18	1,276(61.0)	1,250(61.8)	26(38.8)	318(74.1)	932(58.4)	12(63.2)	14(29.2)
Smoking years		***					
<20	778(37.2)	725(35.8)	53(79.1)	149(34.7)	576(36.1)	13(68.4)	40(83.3)
≥20	1,313(62.8)	1,299(64.2)	14(20.9)	280(65.3)	1,019(63.9)	6(31.6)	8(16.7)
Smoking during MMT		***					
No	42(2.0)	22(1.1)	20(25.0)	4(0.9)	18(1.1)	2(10.0)	18(30.0)
Yes	2,079(98.0)	2,019(98.9)	60(75.0)	427(99.1)	1,592(98.9)	18(90.0)	42(70.0)
Smoking frequency in the past month		***					
None	46(2.2)	25(1.2)	21(26.3)	3(0.7)	22(1.4)	2(10.0)	19(31.7)
Sometimes	116(5.5)	110(5.4)	6(7.5)	15(3.5)	95(5.9)	3(15.0)	3(5.0)
Daily	1,959(92.4)	1,906(93.4)	53(66.3)	413(95.8)	1,493(92.7)	15(75.0)	38(63.3)
Smoking types		***		***			
Manufactured only	1,845(88.9)	1,788(88.7)	57(96.6)	410(95.8)	1,378(86.8)	18(100.0)	39(95.1)
Hand-rolled only	43(2.1)	42(2.1)	1(1.7)	4(0.9)	38(2.4)	0(0.0)	1(2.4)
Both above	187(9.0)	186(9.2)	1(1.7)	14(3.3)	172(10.8)	0(0.0)	1(2.4)
Smoking intensity in the past month		***					
Low	226(10.7)	177(8.7)	49(61.3)	42(9.7)	135(8.4)	11(55.0)	38(63.3)
Moderate	489(23.1)	474(23.2)	15(18.8)	96(22.3)	378(23.5)	4(20.0)	11(18.3)
Heavy	1,406(66.3)	1,390(68.1)	16(20.0)	293(68.0)	1,097(68.1)	5(25.0)	11(18.3)
Attitude to effect of smoking on AIDS							
Good	6(1.4)	6(1.5)	0(0.0)	6(1.5)	-	0(0.0)	-
Harmful	231(53.6)	219(53.0)	12(66.7)	219(53.0)	-	12(66.7)	-
No effect	194(45.0)	188(45.5)	6(33.3)	188(45.5)	-	6(33.3)	-
Ever tried to quit smoking after diagnosed with HIV							
Yes	73(16.9)	69(16.7)	4(22.2)	69(16.7)	-	4(22.2)	-
No	358(83.1)	344(83.3)	14(77.8)	344(83.3)	-	14(77.8)	-

[a] *P*-value obtained from Chi-squared tests or Fisher's exact tests.

* $P<0.05$; *** $P<0.001$.

Table 3 Prevalence and associated factors of tobacco smoking intensity among study participants

Variables	Low (N=226)	Moderate (N=489)	High (N=1,406)	Crude OR(95%CI)	Adjusted OR(95%CI) [a]
Gender					
Female	49(61.3)	15(18.8)	16(20.0)	1.00	1.00
Male	177(8.7)	474(23.2)	1,390(68.1)	**14.04(8.96-22.01)*****	**13.10(8.22-20.88)*****
Age (years)					
18-29	33(13.1)	61(24.3)	157(62.5)	1.00	1.00
30-39	89(11.0)	197(24.3)	525(64.7)	1.12(0.84-1.49)	1.20(0.88-1.64)
40-49	62(9.5)	142(21.7)	449(68.8)	1.34(0.99-1.80)	1.30(0.92-1.84)
50-79	42(10.3)	89(21.9)	275(67.7)	1.27(0.92-1.75)	1.34(0.90-2.00)
Ethnicity					
Han	79(8.9)	194(21.9)	612(69.2)	1.00	1.00
Jingpo	106(11.7)	224(24.6)	579(63.7)	0.78(0.64-0.94)*	**0.63(0.51-0.79)*****
Dai	28(11.2)	56(22.5)	165(66.3)	0.86(0.64-1.16)	0.77(0.56-1.06)
Others	13(16.7)	15(19.2)	50(64.1)	0.73(0.46-1.17)	0.64(0.39-1.03)
Marital status					
Never married	46(12.2)	97(25.7)	235(62.2)	1.00	1.00
Current married	152(10.2)	336(22.5)	1,007(67.4)	1.25(0.99-1.57)	1.18(0.87-1.60)
Divorced or widowed	28(11.3)	56(22.6)	164(66.1)	1.17(0.84-1.63)	1.21(0.85-1.72)
Education level					
Illiteracy or primary	112(10.5)	221(20.8)	730(68.7)	1.00	1.00
Middle	81(9.9)	207(25.4)	528(64.7)	0.86(0.71-1.05)	0.86(0.69-1.07)
High or above	33(13.6)	61(25.2)	148(61.2)	**0.72(0.54-0.95)***	**0.72(0.53-1.00)***
Age at first drug use (years)					
<25	122(10.2)	285(23.8)	792(66.1)	1.00	1.00
≥25	104(11.3)	204(22.1)	614(66.6)	1.00(0.84-1.20)	0.90(0.72-1.13)
Length of MMT (years)					
<1	32(8.7)	86(23.4)	249(67.8)	1.00	1.00
1-5	114(10.5)	240(22.1)	731(67.4)	0.96(0.75-1.23)	0.97(0.75-1.26)
>5	80(12.0)	163(24.4)	426(63.7)	0.81(0.62-1.06)	0.81(0.61-1.09)
Daily methadone dose (ml)					
≤30	36(10.7)	78(23.3)	221(66.0)	1.00	1.00
31-60	85(11.1)	182(23.8)	498(65.1)	1.02(0.80-1.30)	1.02(0.80-1.32)
61-99	50(9.5)	115(21.8)	363(68.8)	1.20(0.92-1.57)	1.29(0.97-1.70)
≥100	51(12.4)	82(20.0)	278(67.6)	1.10(0.83-1.46)	1.25(0.92-1.70)
Number of sexual partners in the last year					
0	76(12.6)	140(23.3)	385(64.1)	1.00	1.00
1	143(9.9)	337(23.4)	961(66.7)	**1.31(1.08-1.58)****	1.15(0.88-1.51)
≥2	7(9.3)	11(14.7)	57(76.0)	**1.55(1.27-1.89)*****	**2.08(1.16-3.73)***
Alcohol use in the past month					
None	129(14.7)	203(23.1)	547(62.2)	1.00	1.00
Moderate	63(7.1)	227(25.5)	599(67.4)	**1.36(1.12-1.64)****	1.19(0.97-1.47)
Hazardous	34(9.6)	59(16.7)	260(73.7)	**1.71(1.31-2.24)*****	**1.57(1.18-2.10)****

HIV infection					
No	173(10.4)	389(23.3)	1,108(66.3)	1.00	1.00
Yes	53(11.8)	100(22.2)	298(66.1)	0.97(0.78-1.20)	1.00(0.77-1.29)
HCV infection					
No	141(10.6)	309(23.1)	885(66.3)	1.00	1.00
Yes	85(10.8)	180(22.9)	521(66.3)	1.00(0.83-1.20)	0.99(0.81-1.22)

[a] Adjusted for potential confounding variables listed in the table by multivariate ordinal logistic regression analysis.

* $P<0.05$; ** $P<0.01$; *** $P<0.001$.

Table 4 Characteristics of alcohol drinking among study participants

Variables	Total (N=2,121)	Male (N=2,041)	Female (N=80)	Male		Female	
				HIV+ (N=431)	HIV- (N=1,610)	HIV+ (N=20)	HIV- (N=60)
Ever alcohol drinking		***					
No	284(13.4)	257(12.6)	27(33.8)	60(13.9)	197(12.2)	6(30.0)	21(35.0)
Yes	1,837(86.6)	1,784(87.4)	53(66.3)	371(86.1)	1,413(87.8)	14(70.0)	39(65.0)
Drinking initiation age (years)				**			
≥18	884(48.1)	854(47.9)	30(56.6)	149(40.2)	705(49.9)	5(35.7)	25(64.1)
<18	953(51.9)	930(52.1)	23(43.4)	222(59.8)	708(50.1)	9(64.3)	14(35.9)
Drinking years		***					
<20	745(40.6)	708(39.7)	37(69.8)	155(41.8)	553(39.1)	11(78.6)	26(66.7)
≥20	1,092(59.4)	1,076(60.3)	16(30.2)	216(58.2)	860(60.9)	3(21.4)	13(33.3)
Drinking during MMT		***		***			
No	566(26.7)	521(25.5)	45(56.3)	143(33.2)	378(23.5)	10(50.0)	35(58.3)
Yes	1,555(73.3)	1,520(74.5)	35(43.8)	288(66.8)	1,232(76.5)	10(50.0)	25(41.7)
Drinking frequency in the past month		***		***			
None and occasionally	1,602(75.5)	1,526(74.8)	76(95.0)	355(82.4)	1,171(72.7)	19(95.0)	57(95.0)
Often and daily	519(24.5)	515(25.2)	4(5.0)	76(17.6)	439(27.3)	1(5.0)	3(5.0)
Drinking types		***		***			
Distilled spirits only	563(45.3)	560(45.6)	3(23.1)	90(44.8)	470(45.7)	0(0.0)	3(30.0)
Beer only	355(28.6)	346(28.2)	9(69.2)	63(31.3)	283(27.5)	2(66.7)	7(70.0)
Both of the above	324(26.1)	323(26.3)	1(7.7)	48(23.9)	275(26.8)	1(33.3)	0(0.0)
Alcohol use in the past month		***		***			
None	879(41.4)	812(39.8)	67(83.8)	230(53.4)	582(36.1)	17(85.0)	50(83.3)
Moderate	889(41.9)	881(43.2)	8(10.0)	161(37.4)	720(44.7)	1(5.0)	7(11.7)
Hazardous	353(16.6)	348(17.1)	5(6.3)	40(9.3)	308(19.1)	2(10.0)	3(5.0)
Attitude to effect of drinking on AIDS							
Good	8(2.2)	8(2.3)	0(0.0)	8(2.3)	-	0(0.0)	-
Harmful	266(72.5)	255(72.2)	11(78.6)	255(72.2)	-	11(78.6)	-
No effect	93(25.3)	90(25.5)	3(21.4)	90(25.5)	-	3(21.4)	-
Ever tried to quit drinking after diagnosed with HIV							
Yes	181(49.3)	174(49.3)	7(50.0)	174(49.3)	-	7(50.0)	-
No	186(50.7)	179(50.7)	7(50.0)	179(50.7)	-	7(50.0)	-

[a] *P*-value obtained from Chi-squared tests or Fisher's exact tests.

** $P<0.01$; *** $P<0.001$.

Table 5 Prevalence and associated factors of alcohol drinking quantity among study participants

Variables	None (N=879)	Moderate (N=889)	Hazardous (N=353)	Crude OR(95%CI)	Adjusted OR(95%CI) [a]
Gender					
Female	67(83.8)	8(10.0)	5(6.3)	1.00	1.00
Male	812(39.8)	881(43.2)	348(17.1)	**7.43(4.12-13.42)*****	**7.20(3.83-13.54)*****
Age (years)					
18-29	107(42.6)	114(45.4)	30(12.0)	1.00	1.00
30-39	375(46.2)	338(41.7)	98(12.1)	0.90(0.69-1.18)	1.22(0.91-1.64)
40-49	258(39.5)	272(41.7)	123(18.8)	1.26(0.96-1.66)	**1.70(1.23-2.35)****
50-79	139(34.2)	165(40.6)	102(25.1)	**1.69(1.26-2.28)****	**1.76(1.22-2.53)****
Ethnicity					
Han	498(56.3)	297(33.6)	90(10.2)	1.00	1.00
Jingpo	267(29.4)	452(49.7)	190(20.9)	**2.85(2.38-3.42)*****	**2.58(2.11-3.16)*****
Dai	74(29.7)	118(47.4)	57(22.9)	**2.97(2.27-3.88)*****	**3.08(2.31-4.11)*****
Others	40(51.3)	22(28.2)	16(20.5)	1.45(0.93-2.25)	1.56(0.99-2.47)
Marital status					
Never married	184(48.7)	147(38.9)	47(12.4)	1.00	1.00
Currently married	590(39.5)	639(42.7)	266(17.8)	**1.47(1.19-1.82)****	0.93(0.70-1.24)
Divorced or widowed	105(42.3)	103(41.5)	40(16.1)	1.31(0.96-1.77)	1.17(0.85-1.63)
Education level					
Illiteracy or primary	345(32.5)	487(45.8)	231(21.7)	1.00	1.00
Middle	398(48.8)	318(39.0)	100(12.3)	**0.50(0.42-0.60)*****	**0.76(0.63-0.93)****
High or above	136(56.2)	84(34.7)	22(9.1)	**0.37(0.28-0.49)*****	**0.65(0.48-0.89)****
Age at first drug use (years)					
<25	544(45.4)	472(39.4)	183(15.3)	1.00	1.00
≥25	335(36.3)	417(45.2)	170(18.4)	**1.39(1.18-1.64)*****	0.89(0.73-1.09)
Length of MMT (years)					
<1	115(31.3)	203(55.3)	49(13.4)	1.00	1.00
1-5	417(38.4)	484(44.6)	184(17.0)	0.89(0.71-1.11)	0.92(0.73-1.16)
>5	347(51.9)	202(30.2)	120(17.9)	**0.60(0.47-0.76)*****	**0.77(0.59-1.00)***
Daily methadone dose (ml)					
≤30	133(39.7)	150(44.8)	52(15.5)	1.00	1.00
31-60	281(36.7)	327(42.7)	157(20.5)	1.17(0.93-1.46)	**1.29(1.02-1.63)***
61-99	228(43.2)	217(41.1)	83(15.7)	0.87(0.68-1.11)	1.04(0.81-1.35)
≥100	213(51.8)	146(35.5)	52(12.7)	**0.63(0.48-0.81)****	0.97(0.73-1.29)
Number of sexual partners in the last year					
0	286(47.6)	226(37.6)	89(14.8)	1.00	1.00
1	568(39.4)	625(43.4)	248(17.2)	**1.35(1.13-1.61)****	**1.34(1.04-1.73)***
≥2	23(30.7)	36(48.0)	16(21.3)	**1.88(1.20-2.94)****	**2.46(1.53-3.97)****
Smoking intensity in the past month					

Low	129(57.1)	63(27.9)	34(15.0)	1.00	1.00
Moderate	203(41.5)	227(46.4)	59(12.1)	**1.56(1.15-2.11)****	1.11(0.80-1.55)
High	547(38.9)	599(42.6)	260(18.5)	**1.92(1.46-2.52)*****	**1.39(1.03-1.88)***
HIV infection					
No	632(37.8)	727(43.5)	311(18.6)	1.00	1.00
Yes	247(54.8)	162(35.9)	42(9.3)	**0.49(0.40-0.60)*****	**0.53(0.42-0.68)*****
HCV infection					
No	504(37.8)	598(44.8)	233(17.5)	1.00	1.00
Yes	375(47.7)	291(37.0)	120(15.3)	**0.71(0.60-0.84)*****	0.86(0.71-1.04)

[a] Adjusted for potential confounding variables listed in the table by multivariate ordinal logistic regression analysis.

* $P<0.05$; ** $P<0.01$; *** $P<0.001$.

STROBE Statement—checklist of items that should be included in reports of observational studies

(page number in our MS)	Item No	Recommendation
Title (1)**and abstract**(2)	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction(4-5)		
Background/rationale(4)	2	Explain the scientific background and rationale for the investigation being reported
Objectives(4-5)	3	State specific objectives, including any prespecified hypotheses
Methods(5-7)		
Study design(5)	4	Present key elements of study design early in the paper
Setting(5)	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants(5)	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables(5-6)	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement(6)	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias(5)	9	Describe any efforts to address potential sources of bias
Study size(5)	10	Explain how the study size was arrived at
Quantitative variables(6)	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods(6-7)	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results(7-9)		
Participants(7)	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data(7-9)	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data(7-9)	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results(7-9)	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses(7-9)	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion(9-12)		
Key results(9)	18	Summarise key results with reference to study objectives
Limitations(12)	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation(10-11)	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability(12)	21	Discuss the generalisability (external validity) of the study results
Other information(13)		
Funding(13)	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Tobacco and Alcohol Use among Drug Users Receiving Methadone Maintenance Treatment: A Cross Sectional Study in A Rural Prefecture of Yunnan Province, Southwest China

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Tobacco and Alcohol Use among Drug Users Receiving Methadone Maintenance Treatment: A Cross Sectional Study in A Rural Prefecture of Yunnan Province, Southwest China

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Running head: Tobacco and alcohol use among MMT patients in China

ABSTRACT

Objective: To estimate the prevalence of ever, current and heavy tobacco and alcohol use and their correlates among patients undergoing methadone maintenance treatment (MMT).

Design: Cross-sectional study.

Setting: The study was conducted in all of the five MMT clinics in Dehong prefecture, China.

Participants: 2,121 (81.6%) eligible MMT participants were included in study population.

Analysis: Ordinal logistic regression was used to estimate the odds ratios (OR) and their 95% confidence intervals (CI).

Results: The overall prevalence of ever, current and heavy smoking was 98.6%, 97.8% and 66.3%, respectively; while that of ever, current and hazardous alcohol drinking was 86.6%, 58.6% and 16.6%, respectively. Among HIV infected participants, the proportions of those experiencing harmful effects of tobacco and alcohol on AIDS were 53.6% and 72.5%, and respectively 16.9% and 49.3% had ever tried to quit after diagnosis with HIV. After adjusting for potential confounders, heavier smokers and more hazardous drinkers were more likely to be those who were male, older, and less educated. Ethnic minorities were less likely to heavily smoke, but more likely to engage in hazardous drinking. In addition, hazardous drinking was negatively associated with longer years of MMT and HIV infection. Moreover, heavier smoking (OR $_{\geqslant 2}$ = 2.08, 95% CI: 1.16-3.73) and more hazardous drinking (OR $_{\geqslant 2}$ = 2.46, 95% CI:1.53-3.97) were positively associated with having multiple sexual partners, and both were positively associated with each other.

Conclusion: Prevalence of tobacco and alcohol consumption was extraordinarily high among MMT participants in China, suggesting the urgent need of enhancing MMT patients' awareness of the harmful effects of tobacco and alcohol consumption and implementing comprehensive education and effective intervention programs.

Keywords: tobacco, alcohol, methadone maintenance treatment (MMT), HIV, prevalence

Strengths and limitations of this study:

This is the first study specifically examining tobacco and alcohol use and their correlates among drug users receiving methadone maintenance treatment (MMT) with a large sample size in China.

The results provide a better understanding of the prevalence and severity of current tobacco and alcohol consumption among MMT patients, particularly among those infected with HIV, helping to target population at higher risk for tobacco/alcohol related diseases in MMT population.

This cross-sectional study is unable to make causal inferences between associated factors and tobacco and alcohol use.

Self-reported data were used for risk behaviors, so information bias may exist.

Participants were recruited from Dehong prefecture, the findings might not be generalizable to MMT patients in other areas.

INTRODUCTION

China's methadone maintenance treatment (MMT) program started with 8 pilot sites in five provinces in March 2004, scaled up nationwide in June 2006, and has become one of the largest opioid-substitution treatment and care systems in the world.[1 2] By the end of 2012, a total of 756 community-based MMT clinics had been established in 28 provinces and had provided treatment for 384,479 drug users (DUs).[3] At the end of 2015, 167,600 DUs were receiving treatment in 785 MMT clinics located in 29 provinces. Owing to successful implementation during the past decade, the MMT program in China has drastically reduced drug use and related morbidity and mortality, improved quality of life as well as the social and family well-being of drug users.[1 2 4] As MMT patients live longer because of the effectiveness of MMT, unhealthy life styles such as smoking and alcohol drinking have been suggested to be major causes of excess mortality for DUs.[5] Furthermore, more than 10% and 60% of MMT patients are living with HIV and HCV, respectively, and are therefore at even higher risk of onset and rapid progression of comorbidities associated with tobacco and alcohol use.[6-10]

Both tobacco and alcoholic beverages are highly addictive substances and widely consumed throughout the world, especially in China.[11 12] Tobacco and alcohol consumption have serious effects on public health and are regarded as the most common modifiable and preventable risk factors for major non-communicable diseases.[13 14] They both contain well-established group I carcinogens and are causally associated with development of certain cancers,[15] and further contribute to the increasing health burden among persons living with HIV/AIDS (PLWHA).[16] Globally, a much higher prevalence of smoking (79%-93%) has been reported in active DUs and MMT patients than in the general population,[17-24] whereas the prevalence of alcohol drinking was reported to be varying from 13% to 49%, depending on definitions of alcohol consumption and study area.[25-33]

However, no study has been designed to specifically examine tobacco and alcohol use among drug users receiving MMT particularly those living with HIV in China. To fill this gap, we conducted a cross-sectional study to specifically examine tobacco and alcohol use and their correlates, and further to explore by gender and by HIV infection status among a large sample of drug users receiving MMT in Dehong Prefecture of Yunnan Province at China's southwest border, where the first China's indigenous HIV outbreak was reported in 146

infected heroin users in 1989, and injection drug use (IDU) had been the predominant mode of HIV transmission through the early 2000s and continues to be an important source of HIV infection.[34 35]

METHODS

Study design, setting and participants

Details of the study design have been described in a previous publication, which showed the prevalence of illicit drug use was 10.4%, 12.9% and 9.2% for morphine, methamphetamine and both of them, respectively in the study population.[36] In brief, a cross-sectional survey was conducted from June to July in 2014 in Dehong Prefecture in Yunnan Province, China. The participants were identified from all of the five MMT clinics in Dehong prefecture and were former opioid users, aged 20 years or older, had registered as local residents for at least 6 months where the clinic was located, and were capable of completing civil liability (e.g. of age and sound mind).[1 2]

Data collection

The protocol of this study was approved by the Institutional Review Board (IRB) of Fudan University, Shanghai, China. All participants had to read and sign the informed consent form prior to participating in the survey.

Trained public health professionals within the local clinics collected epidemiologic data through face-to-face interviews using a structured questionnaire at a private location. The questionnaire had been tested in an early study.[37 38] The epidemiologic data included basic demographic characteristics (gender, age, ethnicity, marital status, and level of education), tobacco smoking [age at starting smoking, type of cigarettes, smoking frequency, smoking intensity and number of cigarettes smoked per day (CPD) in the past month], alcohol drinking (age at starting drinking, types of alcoholic beverage, drinking frequency, and quantity of drinking in the past month), tobacco smoking and alcohol drinking status during MMT, knowledge and quitting behavior for HIV infected individuals, and sexual behaviors (number of sexual partners in the last year). Information on age at starting drug use, length of taking MMT, daily methadone dosage, and HIV and HCV infection status were obtained from MMT Data System.

Measures

Ever smokers were defined as having smoked at least 100 cigarettes in their lifetime,[39] while ever alcohol drinkers were defined as having drunk at least once per month for more than 1 year.[37] Current smokers and current drinkers were defined as those who smoke or drank in the month prior to the interview. Current smokers were further asked about cigarette type (manufactured only, hand-rolled only, or combination of the two), smoking frequency (none, sometimes or daily) and number of CPD in the past month. We summed absolute numbers of both types of cigarette, then defined heavy smoking as smoking at least 20 CPD, moderate smoking as 10–19 CPD, and light smoking as 0-9 CPD.[39] As distilled spirits and beer were the mostly common consumed alcoholic beverage, alcohol type was classified into three categories in the analysis: distilled spirits only, beer only or combination of the two. Current drinkers were further asked about frequency of drinking [none, occasionally (1–3 times per month), often (1–3 times per week) almost daily (at least 4 times per week) or daily] and quantity of alcohol consumed in the past month. Weekly consumption of pure ethanol (grams/week) on average were calculated with the standard of ethanol content of 4% for beer and 40% for distilled spirits, and a conversion factor of 0.79.[40] According to the US National Institute on Alcohol Abuse and Alcoholism (NIAAA) guidelines for physicians, the definition of standard drinks was 14 grams of pure alcohol per drink. And we defined hazardous level as having more than 14 drinks per week (196 gram of alcohol) for men and more than 7 drinks (98 gram) per week for women, and moderate level as drinking ethanol below hazardous levels.[41] Frequency of drinking was dichotomized into 'often or daily' versus "none or occasionally" in the analysis.

Statistical analysis

SAS v9.2 package (SAS Institute Inc.,) was used to clean and analyze the data. The distribution of participants' socio-demographic characteristics, information on taking MMT, and tobacco and alcohol consumption by gender and by HIV infection status were described and compared using the Chi-squared test or Fisher's exact test, where appropriate. Univariate ordinal logistic regressions were used to estimate odds ratios (ORs) and their 95% confidence

intervals (CIs) to examine the associations between smoking/drinking behaviors and related factors. In multiple regression, ordinal logistic regression models were performed with 'forced entry' of all variables selected based on prior knowledge and confounding assessment, for intensity of smoking and levels of alcohol drinking in the past month, respectively; These included gender (female/male), age (years, 18-29/30-39/40-49/50-79), ethnicity (Han/Jingpo/Dai/others), marital status (never married/in marriage/divorced or widowed), education level (illiteracy or primary/middle/high or above), age at first drug use (years, <25/ ⩾25), length of MMT (years, <1/1-5/>5), daily methadone dose (ml, ⩽30/31-60/61-99/⩾ 100), number of sexual partners in the last year (0/1/⩾2), HIV infection(no/yes), HCV infection(no/yes), alcohol use in the past month(none/moderate/hazardous, except for alcohol use) and smoking intensity in the past month (low/moderate/high, except for smoking).

RESULTS

Socio-demographic characteristics and status of HIV/HCV infection

Characteristics of MMT participants overall and by gender were summarized in Table 1. During the study period, a total of 2,600 DUs were receiving MMT. However, 269 participants could not complete the questionnaire due to intoxication, disability (e.g. deaf-mute), or severe mental disorders. These conditions were determined by clinical judgments of the trained public health professionals conducting the face-to-face interviews. In addition, 197 did not appear at MMT sites and 13 participants were excluded because of excessive missing data. At last, 2,121 (81.6%) eligible MMT participants were included in the final analysis. Of 2,121 participants, 2,041 (96.2%) were males; the mean age was 40.8 years old (SD = 10.0). Jingpo (42.9%) and Han (41.7%) were the largest two ethnic groups. Seventy percent of the participants were married, and 1,063 (50.1%) were illiterate or only had a primary school education. For HIV/HCV infection status, 451 (21.3%) had Western-Blot confirmed HIV infection while 786 (37.1%) were positive for serum HCV antibody. Male and female participants were significantly different in age, ethnicity and level of education.

Drug use, methadone maintenance treatment and sexual behavior

Among the study participants, 1,199 (56.5%) started using heroin before 25 years old. System data showed that 1,754 (82.7%) had received MMT for more than one year and 669 (31.5%) for more than five years, and 411 (20.2%) had daily methadone dosage greater than 100 ml. For sexual behavior, 75 (3.5%) reported having had two or more sex partners in the last year. No statistically significant difference was observed between males and females in these behaviors.

Tobacco use

The overall characteristics of tobacco smoking among MMT participants were presented in Table 2, and were compared by gender and further by HIV infection status. Among all participants, 2,091 (98.6%) were ever smokers, 2,075 (97.8%) self-reported as current smokers, and 1,276 (61.0%) started smoking before 18 years old; 1,313 (62.8%) had smoked for more than 20 years and 2,079 (98.0%) still smoked during MMT. Among current smokers, 1,406 (66.3%) smoked more than 20 cigarettes per day and were defined as heavy smokers in this study. Almost all smokers preferred manufactured cigarettes. Smoking patterns were all significantly different by gender since men were more likely to smoke (99.2% vs. 83.8%, $p<0.001$), were more likely to start smoking before the age of 18 (61.8% vs. 38.8%, $p<0.001$), had a longer duration of smoking (proportion of smoked for more than 20 years: 64.2% vs. 20.9%, $p<0.001$), had a higher frequency of smoking (proportion of smoking daily: 93.4% vs. 66.3%, $p<0.001$) and higher intensity (heavy smoking: 68.1% vs. 20.0%, $p<0.001$). When stratified by gender, HIV positive individuals were more likely to start smoking before 18 in both male (74.1% vs. 58.4%, $p<0.001$) and female (63.2% vs. 29.2%, $p=0.010$), and to prefer manufactured cigarettes (95.8% vs 86.8%, $p<0.001$) compared to HIV negative participants in male. Among those HIV-infected individuals, 231 (53.6%) thought smoking has harmful effect on AIDS disease progression, while only 73 (16.9%) ever tried to quit smoking after diagnosed with HIV, with no statistically significant difference by gender.

The prevalence of light, moderate and heavy smoking and associated factors of tobacco smoking intensity among MMT patients are presented and examined by ordinal logistic regression models in Table 3. After adjusting for potential confounding factors, heavier smoking in the preceding month was positively associated with being male (OR = 13.10, 95%

CI: 8.22-20.88), having more sexual partners in the past month (OR $_{\geqslant 2}$ = 2.08, 95% CI: 1.16-3.73), and engaging in hazardous drinking (OR = 1.57, 95% CI: 1.18-2.10), and negatively associated with being an ethnic minority (OR $_{Jingpo}$ = 0.63, 95% CI: 0.51-0.79), having received higher education (OR $_{high\ or\ above}$ = 0.72, 95% CI: 0.53-1.00). Smoking intensity was not significantly associated with age, marital status, age at starting drug use, duration of taking MMT, daily methadone dose, or HIV or HCV infection.

Alcohol use

The characteristics of alcohol drinking among MMT participants were shown in Table 4. Of all subjects, 1,837 (86.6%) were ever drinkers, 953 (51.9%) started drinking before 18 years old, 1,092 (59.4%) had consumed alcohol for more than 20 years, and 1,555 (73.3%) were still drinking during MMT and also in the past month prior to interview. The prevalence of current drinking, drinking often or daily, and drinking at hazardous level were 58.6%, 24.5% and 16.6%, respectively. Males had significantly different alcohol drinking patterns from females. Men were more likely to drink, had a longer duration of drinking, drank more distilled spirits, drank more and had a higher drinking frequency. In males, compared to HIV-uninfected individuals, HIV cases had a lower prevalence of drinking during MMT (66.8% vs. 76.5%, p<0.001), smaller frequency of drinking in the past month (proportion of drinking often and daily: 17.6% vs. 27.3%, p<0.001), less distilled spirits use (68.7% vs. 72.5%, p<0.001), and fewer had a hazardous level of drinking (9.3% vs. 19.1%, p<0.001). No significant difference was shown in females when comparing by HIV status. Among those HIV cases, 266 (72.5%) thought alcohol was harmful for AIDS disease progression, and 181 (49.3%) had ever tried to quit drinking after diagnosed with HIV, with no significant difference between males and females.

The prevalence of none, moderate, and hazardous alcohol drinking and associated factors among MMT patients were examined and shown in Table 5. After adjusting for potential confounding factors, higher levels of alcohol drinking in the preceding month were positively associated with being male (OR = 7.20, 95% CI: 3.83–13.54), at an older age (OR $_{40-49}$ = 1.70, 95% CI: 1.23–2.35; OR $_{50-79}$ = 1.76, 95% CI: 1.22–2.53), being an ethnic minority (OR $_{Jingpo}$ = 2.58, 95% CI: 2.11–3.16; OR $_{Dai}$ = 3.08, 95% CI: 2.31–4.11), having two or more sexual

partners in the last year (OR $_{\geq 2}$ = 2.46, 95% CI:1.53-3.97), and being a heavy smoker (OR $_{high}$ = 1.39, 95% CI: 1.03-1.88). Heavier drinking was negatively associated with having received higher education (OR $_{middle}$ = 0.76, 95% CI: 0.63-0.93; OR $_{high\ or\ above}$ = 0.65, 95% CI: 0.48–0.89), having a longer duration of MMT (OR $_{>5}$ = 0.77, 95% CI: 0.59–1.00) and being HIV infected (OR = 0.53, 95% CI: 0.42-0.68). Quantity of alcohol consumption was not significantly associated with marital status, age of first drug use, daily methadone dose, or HCV infection.

DISCUSSION

In this cross-sectional study with 2,121 MMT participants from western China, we observed the overall prevalence of ever, current and heavy/hazardous for smoking was 98.6%, 97.8% and 66.3%, respectively; and the prevalence for alcohol drinking was 86.6%, 58.6% and 16.6%, respectively. We also found significantly different patterns of tobacco and alcohol consumption when comparing males and females, or HIV positive and negative participants. Moreover, we reported that gender, age, ethnicity, level of education, sexual activity were associated with both smoking and drinking behaviors, while length of MMT and HIV infection were negatively associated with heavier drinking. Smoking and drinking were also correlates with each other in the models.

MMT patients in the survey showed an overall prevalence of current smoking of 97.8%, which was more than three times that of 28.3% in Chinese general adults. When looking by gender, the prevalence of current smoking was about twice and thirty times than that of Chinese males and females in the general population, respectively (male: 98.8% versus 53.3%, female: 73.7% versus 2.5%).[42] Among MMT patients in western counties, the overall prevalence of smoking was observed from 78.5% to 93.0%;[17-20] while there have been only two previous studies reported current smoking prevalence (91.4% and 92.9%, respectively) among Chinese MMT patients.[23 24] Those previous studies' sample sizes were less than 600, but consistent with our results, high prevalence of smoking was unanimously observed among MMT patients.

To the best of our knowledge, no previous study had reported the prevalence of heavy smoking among MMT patients in China. There was only one study measuring heavy smoking

using the same method as ours, however, it only recruited 32 MMT participants from Los Angeles and reported 11 heavy smokers.[43] Of all subjects in our analysis, the prevalence of heavy smoking was 66.3% in overall, 68.1% in male, and 20.0% in female, which were extremely high compared to the general Chinese population aged 15 years and over (overall: 10.1%, male: 22.8%, and female: 0.6%),[44] and were higher than those of 2.6% and 7.2% of adults in California and the remaining United States in 2007, respectively.[39] As almost all MMT patients are smokers, smoking intensity may be a better exposure measure when examining the seriousness of smoking effects on health. Meanwhile the published literature suggested that interventions among MMT patients have been largely unsuccessful in achieving sustained smoking abstinence.[45] Therefore, implementation of innovative smoking cessation programs is urgent and smoking reduction may be the primary and more important intervention among heavy smokers.

The overall prevalence of current alcohol drinking in the study population was 58.6%, which was twice that of Chinese general adults (28.8%).[46] This prevalence was higher than that (30.3%) in central China,[32] and also higher than that (44.0% and 49.0%) among MMT patients of the Beth Israel Medical Center (BIMC) in the United States.[26 27] The prevalence (16.6%) of participating in hazardous alcohol drinking among all study participants was lower than those (22%-35%) reported in the BIMC with the same criterion of hazardous alcohol level.[25-27] We observed that the proportion declined by 28.0% from ever drinking to current drinking, especially for female (by 50.1%), suggesting that alcohol consumption was negatively affected during the course of MMT, although a systematic review found no change when patients had been on MMT (Three studies supported an increase, three supported a decrease, and nine supported no change in alcohol use).[29]

It was not surprising to find that both heavier smoking and higher lever alcohol drinking in the preceding month were positively associated with being male, which was observed in the Chinese general population.[47 48] Meanwhile, results showed that those who were older and had little education were more likely to have heavier smoking and hazardous drinking, which was not consistent with previous results.[31] Ethnic minorities were more likely than ethnic Han to engage in high level of alcohol consumption, which was consistent with the finding among HIV-infected patients who were also from Dehong Prefecture.[37] But ethnic minorities showed

less heavier smoking, which might be due to different ethnic cultures.[49] This suggested that tobacco and alcohol cessation programs in future should be mindfully conducted according to different demographic characteristics in target populations.

As we mentioned above, patients in MMT were more likely to drink less, and hazardous drinking was further found to be negatively associated with the length of receiving MMT. In addition, of PLWHA in our study, a large proportion (72.5%) have realized the harmful effects of alcohol on AIDS, and half ever tried to quit drinking. Therefore, it was not a surprise hazardous drinking was observed to be negatively associated with HIV infection, whereas no difference of ever drinking was observed between HIV-infected individuals and HIV-uninfected individuals. Meanwhile, a relatively small percent were aware of tobacco's harmful effects and less than a quarter ever tried to quit smoking, resulting in a null association between heavier smoking and HIV infection. There will be great value to enhance MMT patients' awareness of harmful effects of tobacco and alcohol consumption by carrying out health education program.

Furthermore, risky behaviors of heavier smoking and more hazardous drinking were positively associated with each other, and both were positively associated with more sexual partners in this study. This might probably explain or be due to the fact that DUs worldwide are likely to engage in high levels of risky sexual behaviors.[50 51] and often have coexisted unhealthy substance use behaviors.[52] Consistent with our results, previous studies have shown that alcohol drinking was positively associated with a number of sexual risk behaviors including multiple sexual partners.[25 27 53]

Limitations

This study has certain limitations. First, similar to all cross-sectional studies, causal inferences cannot be made. Rather, we are reporting the subgroups of participants with even higher prevalence of use to target the population who are at higher risk for alcohol and tobacco related health problems for focused intervention. Second, self-reported data were used for health-related risk behaviors and behaviors in the past. There might be underreporting of health-related risk behaviors such as number of sexual partners in the last year. And it could be more difficult to recall the memory of long time ago such as age at first

drug use, smoking/drinking initiation age, etc. So information bias may exist in our study. However, the primary variables asked about in the preceding month prior to interviews were asked by well-trained public health professional in a private setting that will minimize recall bias and deliberate concealment of sensitive personal topics. Third, the sample size of female MMT patients in the study was only 80 (3.8%), and substantial differences were not found significant when comparing by HIV status in women. A study with larger sample size of women is needed to better explore the association between characteristics and behaviors with alcohol and tobacco use in female DUs receiving MMT. Fourth, all participants were recruited from Dehong, the observed results of tobacco smoking and alcohol drinking in our study might not be generalizable to MMT patients in other areas, and may not be generalizable to those drug users who do not attend MMT clinic. Fifth, the validity and reliability of questions measuring tobacco and alcohol use should better to be specifically verified among MMT patients in future research, although these questions were previously used for HIV-infected people including HIV-infected drug users in the same study area. [37 38]

CONCLUSIONS

The present study suggested high prevalence of current tobacco smoking, current alcohol drinking, heavy smoking and hazardous drinking among MMT patients in China. It is vital to implement comprehensive education and effective intervention programs to reduce the harmful use of tobacco and alcohol among MMT patients. Furthermore, the comparative risk assessment of disease burden attributable to tobacco and alcohol consumption, and the evidence for the effectiveness and cost-effectiveness of interventions to prevent and reduce tobacco and alcohol related harm are needed in the further studies. In addition, confirmation of associated factors, changing trends in the prevalence and comorbid mental health conditions of tobacco and alcohol use among MMT patients warrant further longitudinal cohort studies.

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Authors' contributions

The study was conceived and supervised by NH and SD. YY, RY, RT, MG and YD conducted the survey. ZJ analyzed the data and drafted the manuscript. XL and NH critically reviewed and revised the manuscript.

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Competing interests statement:

All authors declare that they have no conflict of interests.

Data sharing statement:

No additional data are available

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Table 1 Characteristics of study participants

Variables [a]	Total (N=2,121)	Male (N=2,041)	Female (N=80)
Age (years) (*P*=0.024)			
18-29	251(11.8)	243(11.9)	8(10.0)
30-39	811(38.2)	769(37.7)	42(52.5)
40-49	653(30.8)	639(31.3)	14(17.5)
50-79	406(19.1)	390(19.1)	16(20.0)
Ethnicity (*P*=0.023)			
Han	885(41.7)	854(41.8)	31(38.8)
Jingpo	909(42.9)	880(43.1)	29(36.3)
Dai	249(11.7)	231(11.3)	18(22.5)
Others	78(3.7)	76(3.7)	2(2.5)
Marital status (*P*=0.156)			
Never married	378(17.8)	368(18.0)	10(12.5)
Current married	1,495(70.5)	1,439(70.5)	56(70.0)
Divorced or widowed	248(11.7)	234(11.5)	14(17.5)
Education level (*P*=0.001)			
Illiteracy or primary	1,063(50.1)	1,038(50.9)	25(31.3)
Middle	816(38.5)	777(38.1)	39(48.8)
High or above	242(11.4)	226(11.1)	16(20.0)
Age at first drug use (years) (*P*=0.778)			
<25	1,199(56.5)	1,155(56.6)	44(55.0)
⩾25	922(43.5)	886(43.4)	36(45.0)
Length of MMT (years) (*P*=0.086)			
<1	367(17.3)	360(17.6)	7(8.8)
1-5	1,085(51.2)	1,043(51.1)	42(52.5)
>5	669(31.5)	638(31.3)	31(38.8)
Daily methadone dose (ml) (*P*=0.444)			
⩽30	335(16.4)	327(16.7)	8(10.1)
31-60	765(37.5)	732(37.3)	33(41.8)
61-99	528(25.9)	508(25.9)	20(25.3)
≥100	411(20.2)	393(20.1)	18(22.8)
Number of sexual partners in the past year (P=0.357)			
0	601(28.4)	581(28.5)	20(25.0)
1	1,441(68.1)	1,386(68.0)	55(68.8)
≥2	75(3.5)	70(3.4)	5(6.3)
HIV infection (*P*=0.405)			
No	1,670(78.7)	1,610(78.9)	60(75.0)
Yes	451(21.3)	431(21.1)	20(25.0)
HCV infection (*P*=0.698)			
No	1,335(62.9)	1,283(62.9)	52(65.0)
Yes	786(37.1)	758(37.1)	28(35.0)

[a] *P*-value obtained from Chi-squared tests.

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Table 2 Characteristics of tobacco smoking among study participants [a]

Variables	Total (N=2,121)	Male (N=2,041)	Female (N=80)	Male		Female	
				HIV+ (N=431)	HIV- (N=1,610)	HIV+ (N=20)	HIV- (N=60)
Ever smoking		***					
No	30(1.4)	17(0.8)	13(16.3)	2(0.5)	15(0.9)	1(5.0)	12(20.0)
Yes	2,091(98.6)	2,024(99.2)	67(83.8)	429(99.5)	1,595(99.1)	19(95.0)	48(80.0)
Smoking initiation age (years)		***		***		*	
≥18	815(39.0)	774(38.2)	41(61.2)	111(25.9)	663(41.6)	7(36.8)	34(70.8)
<18	1,276(61.0)	1,250(61.8)	26(38.8)	318(74.1)	932(58.4)	12(63.2)	14(29.2)
Smoking years		***					
<20	778(37.2)	725(35.8)	53(79.1)	149(34.7)	576(36.1)	13(68.4)	40(83.3)
≥20	1,313(62.8)	1,299(64.2)	14(20.9)	280(65.3)	1,019(63.9)	6(31.6)	8(16.7)
Smoking during MMT		***					
No	42(2.0)	22(1.1)	20(25.0)	4(0.9)	18(1.1)	2(10.0)	18(30.0)
Yes	2,079(98.0)	2,019(98.9)	60(75.0)	427(99.1)	1,592(98.9)	18(90.0)	42(70.0)
Smoking frequency in the past month		***					
None	46(2.2)	25(1.2)	21(26.3)	3(0.7)	22(1.4)	2(10.0)	19(31.7)
Sometimes	116(5.5)	110(5.4)	6(7.5)	15(3.5)	95(5.9)	3(15.0)	3(5.0)
Daily	1,959(92.4)	1,906(93.4)	53(66.3)	413(95.8)	1,493(92.7)	15(75.0)	38(63.3)
Smoking types		***		***			
Manufactured only	1,845(88.9)	1,788(88.7)	57(96.6)	410(95.8)	1,378(86.8)	18(100.0)	39(95.1)
Hand-rolled only	43(2.1)	42(2.1)	1(1.7)	4(0.9)	38(2.4)	0(0.0)	1(2.4)
Both above	187(9.0)	186(9.2)	1(1.7)	14(3.3)	172(10.8)	0(0.0)	1(2.4)
Smoking intensity in the past month		***					
Low	226(10.7)	177(8.7)	49(61.3)	42(9.7)	135(8.4)	11(55.0)	38(63.3)
Moderate	489(23.1)	474(23.2)	15(18.8)	96(22.3)	378(23.5)	4(20.0)	11(18.3)
Heavy	1,406(66.3)	1,390(68.1)	16(20.0)	293(68.0)	1,097(68.1)	5(25.0)	11(18.3)
Attitude to effect of smoking on AIDS							
Good	6(1.4)	6(1.5)	0(0.0)	6(1.5)	-	0(0.0)	-
Harmful	231(53.6)	219(53.0)	12(66.7)	219(53.0)	-	12(66.7)	-
No effect	194(45.0)	188(45.5)	6(33.3)	188(45.5)	-	6(33.3)	-
Ever tried to quit smoking after diagnosed with HIV							
Yes	73(16.9)	69(16.7)	4(22.2)	69(16.7)	-	4(22.2)	-
No	358(83.1)	344(83.3)	14(77.8)	344(83.3)	-	14(77.8)	-

[a] *P*-value obtained from Chi-squared tests or Fisher's exact tests.

* $P<0.05$; *** $P<0.001$.

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Table 3 Prevalence and associated factors of tobacco smoking intensity among study participants

Variables	Low (N=226)	Moderate (N=489)	High (N=1,406)	Crude OR(95%CI)	Adjusted OR(95%CI) [a]
Gender					
Female	49(61.3)	15(18.8)	16(20.0)	1.00	1.00
Male	177(8.7)	474(23.2)	1,390(68.1)	**14.04(8.96-22.01)*****	**13.10(8.22-20.88)*****
Age (years)					
18-29	33(13.1)	61(24.3)	157(62.5)	1.00	1.00
30-39	89(11.0)	197(24.3)	525(64.7)	1.12(0.84-1.49)	1.20(0.88-1.64)
40-49	62(9.5)	142(21.7)	449(68.8)	1.34(0.99-1.80)	1.30(0.92-1.84)
50-79	42(10.3)	89(21.9)	275(67.7)	1.27(0.92-1.75)	1.34(0.90-2.00)
Ethnicity					
Han	79(8.9)	194(21.9)	612(69.2)	1.00	1.00
Jingpo	106(11.7)	224(24.6)	579(63.7)	0.78(0.64-0.94)*	**0.63(0.51-0.79)*****
Dai	28(11.2)	56(22.5)	165(66.3)	0.86(0.64-1.16)	0.77(0.56-1.06)
Others	13(16.7)	15(19.2)	50(64.1)	0.73(0.46-1.17)	0.64(0.39-1.03)
Marital status					
Never married	46(12.2)	97(25.7)	235(62.2)	1.00	1.00
Current married	152(10.2)	336(22.5)	1,007(67.4)	1.25(0.99-1.57)	1.18(0.87-1.60)
Divorced or widowed	28(11.3)	56(22.6)	164(66.1)	1.17(0.84-1.63)	1.21(0.85-1.72)
Education level					
Illiteracy or primary	112(10.5)	221(20.8)	730(68.7)	1.00	1.00
Middle	81(9.9)	207(25.4)	528(64.7)	0.86(0.71-1.05)	0.86(0.69-1.07)
High or above	33(13.6)	61(25.2)	148(61.2)	**0.72(0.54-0.95)***	**0.72(0.53-1.00)***
Age at first drug use (years)					
<25	122(10.2)	285(23.8)	792(66.1)	1.00	1.00
≥25	104(11.3)	204(22.1)	614(66.6)	1.00(0.84-1.20)	0.90(0.72-1.13)
Length of MMT (years)					
<1	32(8.7)	86(23.4)	249(67.8)	1.00	1.00
1-5	114(10.5)	240(22.1)	731(67.4)	0.96(0.75-1.23)	0.97(0.75-1.26)
>5	80(12.0)	163(24.4)	426(63.7)	0.81(0.62-1.06)	0.81(0.61-1.09)
Daily methadone dose (ml)					
≤30	36(10.7)	78(23.3)	221(66.0)	1.00	1.00
31-60	85(11.1)	182(23.8)	498(65.1)	1.02(0.80-1.30)	1.02(0.80-1.32)
61-99	50(9.5)	115(21.8)	363(68.8)	1.20(0.92-1.57)	1.29(0.97-1.70)
≥100	51(12.4)	82(20.0)	278(67.6)	1.10(0.83-1.46)	1.25(0.92-1.70)
Number of sexual partners in the last year					
0	76(12.6)	140(23.3)	385(64.1)	1.00	1.00
1	143(9.9)	337(23.4)	961(66.7)	**1.31(1.08-1.58)****	1.15(0.88-1.51)
≥2	7(9.3)	11(14.7)	57(76.0)	**1.55(1.27-1.89)*****	**2.08(1.16-3.73)***
Alcohol use in the past month					
None	129(14.7)	203(23.1)	547(62.2)	1.00	1.00
Moderate	63(7.1)	227(25.5)	599(67.4)	**1.36(1.12-1.64)****	1.19(0.97-1.47)
Hazardous	34(9.6)	59(16.7)	260(73.7)	**1.71(1.31-2.24)*****	**1.57(1.18-2.10)****

HIV infection					
No	173(10.4)	389(23.3)	1,108(66.3)	1.00	1.00
Yes	53(11.8)	100(22.2)	298(66.1)	0.97(0.78-1.20)	1.00(0.77-1.29)
HCV infection					
No	141(10.6)	309(23.1)	885(66.3)	1.00	1.00
Yes	85(10.8)	180(22.9)	521(66.3)	1.00(0.83-1.20)	0.99(0.81-1.22)

[a] Adjusted for potential confounding variables listed in the table by multivariate ordinal logistic regression analysis.

* $P<0.05$; ** $P<0.01$; *** $P<0.001$.

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Table 4 Characteristics of alcohol drinking among study participants

Variables	Total (N=2,121)	Male (N=2,041)	Female (N=80)	Male		Female	
				HIV+ (N=431)	HIV- (N=1,610)	HIV+ (N=20)	HIV- (N=60)
Ever alcohol drinking		***					
No	284(13.4)	257(12.6)	27(33.8)	60(13.9)	197(12.2)	6(30.0)	21(35.0)
Yes	1,837(86.6)	1,784(87.4)	53(66.3)	371(86.1)	1,413(87.8)	14(70.0)	39(65.0)
Drinking initiation age (years)				**			
≥18	884(48.1)	854(47.9)	30(56.6)	149(40.2)	705(49.9)	5(35.7)	25(64.1)
<18	953(51.9)	930(52.1)	23(43.4)	222(59.8)	708(50.1)	9(64.3)	14(35.9)
Drinking years		***					
<20	745(40.6)	708(39.7)	37(69.8)	155(41.8)	553(39.1)	11(78.6)	26(66.7)
≥20	1,092(59.4)	1,076(60.3)	16(30.2)	216(58.2)	860(60.9)	3(21.4)	13(33.3)
Drinking during MMT		***		***			
No	566(26.7)	521(25.5)	45(56.3)	143(33.2)	378(23.5)	10(50.0)	35(58.3)
Yes	1,555(73.3)	1,520(74.5)	35(43.8)	288(66.8)	1,232(76.5)	10(50.0)	25(41.7)
Drinking frequency in the past month		***		***			
None and occasionally	1,602(75.5)	1,526(74.8)	76(95.0)	355(82.4)	1,171(72.7)	19(95.0)	57(95.0)
Often and daily	519(24.5)	515(25.2)	4(5.0)	76(17.6)	439(27.3)	1(5.0)	3(5.0)
Drinking types		***		***			
Distilled spirits only	563(45.3)	560(45.6)	3(23.1)	90(44.8)	470(45.7)	0(0.0)	3(30.0)
Beer only	355(28.6)	346(28.2)	9(69.2)	63(31.3)	283(27.5)	2(66.7)	7(70.0)
Both of the above	324(26.1)	323(26.3)	1(7.7)	48(23.9)	275(26.8)	1(33.3)	0(0.0)
Alcohol use in the past month		***		***			
None	879(41.4)	812(39.8)	67(83.8)	230(53.4)	582(36.1)	17(85.0)	50(83.3)
Moderate	889(41.9)	881(43.2)	8(10.0)	161(37.4)	720(44.7)	1(5.0)	7(11.7)
Hazardous	353(16.6)	348(17.1)	5(6.3)	40(9.3)	308(19.1)	2(10.0)	3(5.0)
Attitude to effect of drinking on AIDS							
Good	8(2.2)	8(2.3)	0(0.0)	8(2.3)	-	0(0.0)	-
Harmful	266(72.5)	255(72.2)	11(78.6)	255(72.2)	-	11(78.6)	-
No effect	93(25.3)	90(25.5)	3(21.4)	90(25.5)	-	3(21.4)	-
Ever tried to quit drinking after diagnosed with HIV							
Yes	181(49.3)	174(49.3)	7(50.0)	174(49.3)	-	7(50.0)	-
No	186(50.7)	179(50.7)	7(50.0)	179(50.7)	-	7(50.0)	-

[a] *P*-value obtained from Chi-squared tests or Fisher's exact tests.

** *P*<0.01; *** *P*<0.001.

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Table 5 Prevalence and associated factors of alcohol drinking quantity among study participants

Variables	None (N=879)	Moderate (N=889)	Hazardous (N=353)	Crude OR(95%CI)	Adjusted OR(95%CI) [a]
Gender					
Female	67(83.8)	8(10.0)	5(6.3)	1.00	1.00
Male	812(39.8)	881(43.2)	348(17.1)	**7.43(4.12-13.42)*****	**7.20(3.83-13.54)*****
Age (years)					
18-29	107(42.6)	114(45.4)	30(12.0)	1.00	1.00
30-39	375(46.2)	338(41.7)	98(12.1)	0.90(0.69-1.18)	1.22(0.91-1.64)
40-49	258(39.5)	272(41.7)	123(18.8)	1.26(0.96-1.66)	**1.70(1.23-2.35)****
50-79	139(34.2)	165(40.6)	102(25.1)	**1.69(1.26-2.28)****	**1.76(1.22-2.53)****
Ethnicity					
Han	498(56.3)	297(33.6)	90(10.2)	1.00	1.00
Jingpo	267(29.4)	452(49.7)	190(20.9)	**2.85(2.38-3.42)*****	**2.58(2.11-3.16)*****
Dai	74(29.7)	118(47.4)	57(22.9)	**2.97(2.27-3.88)*****	**3.08(2.31-4.11)*****
Others	40(51.3)	22(28.2)	16(20.5)	1.45(0.93-2.25)	1.56(0.99-2.47)
Marital status					
Never married	184(48.7)	147(38.9)	47(12.4)	1.00	1.00
Currently married	590(39.5)	639(42.7)	266(17.8)	**1.47(1.19-1.82)****	0.93(0.70-1.24)
Divorced or widowed	105(42.3)	103(41.5)	40(16.1)	1.31(0.96-1.77)	1.17(0.85-1.63)
Education level					
Illiteracy or primary	345(32.5)	487(45.8)	231(21.7)	1.00	1.00
Middle	398(48.8)	318(39.0)	100(12.3)	**0.50(0.42-0.60)*****	**0.76(0.63-0.93)****
High or above	136(56.2)	84(34.7)	22(9.1)	**0.37(0.28-0.49)*****	**0.65(0.48-0.89)****
Age at first drug use (years)					
<25	544(45.4)	472(39.4)	183(15.3)	1.00	1.00
≥25	335(36.3)	417(45.2)	170(18.4)	**1.39(1.18-1.64)*****	0.89(0.73-1.09)
Length of MMT (years)					
<1	115(31.3)	203(55.3)	49(13.4)	1.00	1.00
1-5	417(38.4)	484(44.6)	184(17.0)	0.89(0.71-1.11)	0.92(0.73-1.16)
>5	347(51.9)	202(30.2)	120(17.9)	**0.60(0.47-0.76)*****	**0.77(0.59-1.00)***
Daily methadone dose (ml)					
≤30	133(39.7)	150(44.8)	52(15.5)	1.00	1.00
31-60	281(36.7)	327(42.7)	157(20.5)	1.17(0.93-1.46)	**1.29(1.02-1.63)***
61-99	228(43.2)	217(41.1)	83(15.7)	0.87(0.68-1.11)	1.04(0.81-1.35)
≥100	213(51.8)	146(35.5)	52(12.7)	**0.63(0.48-0.81)****	0.97(0.73-1.29)
Number of sexual partners in the last year					
0	286(47.6)	226(37.6)	89(14.8)	1.00	1.00
1	568(39.4)	625(43.4)	248(17.2)	**1.35(1.13-1.61)****	**1.34(1.04-1.73)***
≥2	23(30.7)	36(48.0)	16(21.3)	**1.88(1.20-2.94)****	**2.46(1.53-3.97)****
Smoking intensity in the past month					

Low	129(57.1)	63(27.9)	34(15.0)	1.00	1.00
Moderate	203(41.5)	227(46.4)	59(12.1)	**1.56(1.15-2.11)****	1.11(0.80-1.55)
High	547(38.9)	599(42.6)	260(18.5)	**1.92(1.46-2.52)*****	**1.39(1.03-1.88)***
HIV infection					
No	632(37.8)	727(43.5)	311(18.6)	1.00	1.00
Yes	247(54.8)	162(35.9)	42(9.3)	**0.49(0.40-0.60)*****	**0.53(0.42-0.68)*****
HCV infection					
No	504(37.8)	598(44.8)	233(17.5)	1.00	1.00
Yes	375(47.7)	291(37.0)	120(15.3)	**0.71(0.60-0.84)*****	0.86(0.71-1.04)

[a] Adjusted for potential confounding variables listed in the table by multivariate ordinal logistic regression analysis.

* $P<0.05$; ** $P<0.01$; *** $P<0.001$.

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STROBE Statement—checklist of items that should be included in reports of observational studies

(page number,lines in our MS)	Item No	Recommendation
Title (P1,L1-3)**and abstract**(P2,L1-24)	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction(P4-5)		
Background/rationale(P4,L2-24)	2	Explain the scientific background and rationale for the investigation being reported
Objectives(P4,L25-L30 + P5,L1-3)	3	State specific objectives, including any prespecified hypotheses
Methods(P5-7)		
Study design(P5,L6-10)	4	Present key elements of study design early in the paper
Setting(P5,L8-10)	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants(P5,L10-13)	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables(P5,L21-30)	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement(P6,L3-23)	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias(P5,L10-13)	9	Describe any efforts to address potential sources of bias
Study size(P5,L10)	10	Explain how the study size was arrived at
Quantitative variables(P6,L8-22)	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods(P6,L25-30 + P7,L1-11)	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Results(P7-10)		
Participants(P7,L15-22)	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data(P7,L22-27)	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data(P8, L1-26 +P9,L9-24)	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results(P8,L27-30 + P9,L1-6 + P9,L25-30 + P10,L1-7)	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses(P8,L15-26 + P9,L14-24 + P10,L1-3)	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion(P10-13)		
Key results(P10,L10-18)	18	Summarise key results with reference to study objectives
Limitations(P12,L24-30 + P13,L1-14)	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation(P13,L17-26)	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability(P13,L8-11)	21	Discuss the generalisability (external validity) of the study results
Other information(P14)		
Funding(P14,L9-12)	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based