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Illicit Drug Use Among Men Who Have Sex with Men (MSM) and Men Who Have Sex with Men and Women (MSMW) in Online HIV Behavioral Survey in 2013

By

Morong Huang
Degree to be awarded: MPH

Epidemiology

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Committee Chair

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By

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B.S. Med
Capital Medical University
2014

Thesis Committee Chair: Travis Howard Sanchez, DVM, MPH

An abstract of
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Abstract

Illicit Drug Use Among Men Who Have Sex with Men (MSM) and Men Who Have Sex with Men and Women (MSMW) in Online HIV Behavioral Survey in 2013

By Morong Huang

Background: Different subgroups are disproportionally affected by HIV prevalence. Men who have sex with men (MSM), including men who have sex with men and women (MSMW), and the use of illicit drugs are considered risk factors for HIV infection. Few nationwide studies with large sample sizes have been done to explore the association between MSM and illicit drug use among different subgroups.

Objectives: To examine the association between MSM/MSMW and past illicit drug use, and the effect of HIV status on illicit drug use among MSM/MSMW.

Methods: This study extracted nationwide cross-sectional data from the 2013-2014 American Men's Internet Survey, including participants' demographic characteristics, sexual behaviors, and self-reported HIV status. Illicit drug use referred to using drugs that were not prescribed for participants at least one time. The outcomes were illicit drug use at last sex with a male partner, and illicit drug use in the past 12 months. This study examined the association between MSM/MSMW and the two drug use measures using multivariable modeling, and controlling for demographic factors and self-reported HIV status.

Result: A total of 10,377 MSM/MSMW were analyzed (90.46% MSM, 9.54%MSMW). In this study, 11.47% (N=1,074) MSM and 3.44% (N=34) MSMW were HIV positive. Among MSM and MSMW, 7.48%(N=693) and 11.13% (N=108) used illicit drugs at last sex, respectively. The prevalence of illicit drug use at last sex among MSMW was 1.60(95% CI: 1.30, 1.97) times the prevalence among MSM, adjusting for covariates. Overall, 27.25% MSM (N=2524) and 27.40%MSMW (N=268) used illicit drugs in the past 12 months. The prevalence of illicit drug use in the past 12 months among MSMW was 1.55(95% CI: 1.16, 2.08) times the prevalence among MSM, adjusting for covariates and interactions. Multivariable models suggested interactions between MSM/MSMW and age, and MSM/MSMW and HIV status.

Conclusions: The association was found between MSM/MSMW and illicit drug use in this study, among which the effect of being MSMW and having an HIV-positive status impacted illicit drug use in the past 12 months, and at last sex. The results implicate that more attention should be paid upon MSMW with HIV-positive statues in future prevention programs.

Key Words: Drug use, MSM, MSMW, HIV.

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Content

INTRODUCTION

Men who have sex with men (MSM) including those who also have sex with women (MSMW) contributed to the increase in HIV infections from 2010 through 2014 across the United States (1). Even though MSM are usually regarded as a homogenous group, there are behavioral distinctions within this population (2-4). MSMW is a subgroup of MSM, and have a different risk profile compared to other MSM in terms of HIV infection (5). There has been increasing interest in the role that MSMW play in the heterosexual HIV epidemic, and this is in part due to their potential role in connecting sexual transmission between MSM networks and men who have sex with women /women who have sex with men (MSW/WSM) networks (6,7).

Drug use is a risk factor for HIV.

Besides sexuality, many studies have confirmed the significant association between drug use and HIV infection or HIV prevalence among MSM populations in the past few years. Both intravenous and non-intravenous drugs have been associated with HIV infection and disease progression (8-10). Additionally, drug use has been associated with higher

HIV prevalence among MSM (11). Multiple drug use and drug over use behaviors increase one's likelihood of seroconversion (12). A commonly used predictor of HIV seroconversion among MSM is the concurrency of illicit drug use and sexual activity (12). It is important to consider the impacts of drug use among MSM when investigating HIV infection and prevalence.

Drug Use among MSM and MSMW

Similar to the situation with HIV prevalence, being MSM is associated with increased illicit drug use. A high prevalence of drug usage among MSM and high prevalence of underreporting drug use were found by White et al (13). A total of 314 participants (39%) reported the use of at least one of the 12 types of surveyed drug in the past twelve months, and 224 participants (28%) were tested positive for at least one of the five drugs screened in the urine assay (13). White and colleagues made distinctions about drug use behavior between MSM and MSMW. Even though MSMW are less likely to be HIV-positive or to engage in unprotected receptive anal intercourse compared with MSM, they are more likely to report drug use (14). Knight's research showed that MSMW were more likely to report recent non-injected drug use compared with MSW and MSM (15). MSMW were more likely than MSW to use non-injected stimulants, including crack, powder cocaine, and amphetamines as well as other non-injected drugs (15). They were also

more likely than MSM to use crack and cocaine, but equally likely to use amphetamines and other non-injected drugs (15). Concurrent sexual and substance use behaviors are more common in MSMW than MSM (16-21). MSMW also has a greater tendency than MSM to engage in trading sex for money or drugs, which may increase the illicit drug abuse among MSMW (1,22).

Current Study

The studies in this literature review have illustrated the impacts of being MSM/MSMW and illicit drug use upon HIV infections, and the difference in illicit drug use characteristics among MSM and MSMW. They were conducted only in a few major cities or states in the past few years. There is no current nationally representative study that documents the association between drug use and being MSM/MSMW. Additionally, prior studies failed to consider the interactions between demographic characteristics, HIV status and MSM/MSMW in their examination of correlates of drug use(23). Therefore the current study is conducted to fill this gap. This study is aimed at expanding the knowledge base of association between MSM/MSMW and past illicit drug use, the effect of demographic characteristics, and HIV status on illegal drug use among MSM/MSMW.

METHODS

Recruitment and Enrollment

The American Men's Internet Survey (AMIS) is an annual, nationwide, cross-sectional survey of MSM currently residing in the U.S. The survey collects data each year from about 10,000 MSM using banner advertisements and email blasts through several websites and listservs. The AMIS-2013 cycle collected data from December 2013 to May 2014. Participants in this survey were recruited through convenience sampling. The details of recruitment and enrollment have been discussed in a previous paper published by the study team "The Annual American Men's Internet Survey of Behaviors of Men Who Have Sex With Men in the United States: Protocol and Key Indicators Report 2013" (24). Briefly, the advertisements were placed in a variety of websites, including two gay social networking websites, three gay general interest websites, a general social networking website, and a geospatial social networking mobile application. Men who clicked on the advertisements were directed to the first page of the AMIS, which had a description of the survey. Individuals who provided consent were directed to a standardized survey, starting with eligibility screening. The survey included questions asked about demographics, sexual behavior, HIV testing history, drug and alcohol use, and exposure to HIV prevention services. Participants were free to decline answering any question. Survey eligibility criteria included: participants who were 18 years and above, considered themselves to be male, currently resided in the US and reported that they had ever had oral or anal sex with a male partner. Additional inclusion criteria were applied for the analyses reported here: participants must have reported oral or anal sex with a male partner in the past 12 months, they must have successfully finished the online survey, and they must have responded to at least one question about illicit drug use. A total of 10377 unduplicated male US participants who had sex with another man in the past 12 months successfully completed the online survey.

Human Subjects Protections

The study was conducted in compliance with federal regulations of human subjects protection. It was reviewed and approved by the institutional review board (IRB) of Emory University. No incentive was provided to the participants. Datasets for analyses are stored on secure data servers with access only granted to study staff. The study data are protected under a federal certificate of confidentiality that prevents legal action to force data release.

Measures

The dependent variables for the present study were illicit drug use in the past 12 months and illicit drug use during or before the last time a participant had sex with a male partner. The AMIS-2013 illicit drug use questions are provided in Appendix 1 of this manuscript. Illicit drugs were defined as those that were not prescribed to participants. Drug use may have been via injection or other route of administration (non-injected drugs). Injection drug use means using drugs with a needle, either by mainlining, skin popping, or muscling.

The main independent variable for this study was whether a participant was MSM or MSMW. All participants included in the present study were male and had sex with a male partner in the past 12 months. MSMW was defined as responding "yes" to the question "In the past 12 months, have you had oral, vaginal, or anal sex with a woman". All other participants were considered to be just MSM.

Other covariates considered in the analysis were a participant's self-reported HIV status, race and ethnicity, annual household income, education, area of residence, and healthcare visit in the past 12 months. The increase of HIV infection was found to be associated with high level of drug usage among MSM (12). Self-reported HIV status was defined using responses to questions about the most recent HIV test result and whether the participant ever had a positive HIV test. Responses were categorized as HIV status being either HIV-positive or HIV-negative/unknown. Race and ethnicity of participants was examined as a covariate because previous research has shown that the prevalence of drug use was higher among white MSM compared to black MSM in the White et al. study (13). Similarly, Goldstein et al. confirmed that drug use was more prevalent in white MSM compared with black and Hispanic MSM (25). Race/ethnicity was categorized into mutually exclusive categories of white, black, Hispanic/Latino, and other/multiple races. Income and education are associated with drug usage and MSM, thus need to be controlled for in data analysis (26,17). Household income in the past 12 months was from all sources before taxes and was dichotomized into $0 to $19,999 annually (0 to $1667 monthly) and $20,000 or above annually ($1,668 or above monthly). Annual household income below $20,000 was considered poverty-level at which people cannot afford the basic needs in daily life, such as food and housing. MSMW were more likely to report income of less than $20,000 than MSM in a previous study (23). Education was defined as the highest level of education of completed. The present study categorized education into four levels: "Some high school or below", "High school diploma or GED", "Some college, Associate's degree, or Technical degree", and "College, post graduate or professional school". Previous studies showed that there is a difference in illicit drug use among urban MSM subgroups (15,28). The present study dichotomized locality into urban/suburban or rural

based on 2010 US Census data to determine population density of the zip codes that participants reported residing in. Healthcare visit in last year was defined using "yes" or "no" to the question "In the past 12 months**,** have you seen a doctor, nurse, or other healthcare providers about your own health?"

Analysis

Dummy variables were created for covariates with more than two categories. Two multivariable logistic regression models were created to examine the association between MSM/MSMW and illicit drug use in the past 12 months, and the association between MSM/MSMW and illicit drug use at last sex. We began models with MSM/MSMW and all possible covariates and two-way interactions between MSM/MSMW and covariates. To create the models, we used a backward elimination approach, keeping MSM/MSMW in each iteration and dropping the least significant interactions and covariates. The Hosmer and Lemeshow Goodness of Fit tests were examined at each iteration until all interactions and covariates remaining in the model were at least $p<0.05$ and the model fit the study data well (29). If an interaction between MSM/MSMW and a covariate was identified, stratified bivariate analyses were performed to elucidate the interaction. If the interaction included a continuous variable, a one-way ANOVA with Scheffe's approach was performed. All statistical analyses were performed in SAS version 9.3 (SAS Institute; Cary, NC) and SUDAAN 11.0.1 (RTI; Research Triangle Park, NC). The significant covariates and interaction terms from the backward elimination modeling process were entered into the final logistic regression models that used the predicted margins approach to produced adjusted prevalence ratios with 95% confidence intervals for illicit drug use in the past 12 months and illicit drug use at last sex among MSM and MSMW. Associations were considered significant at $p<0.05$.

RESULTS

Of the 10377 male participants who reported having sex with a male partner in past 12 months, those who only had sex with men (MSM) accounted for 90.46% (N=9361) and those who had sex with both men and women (MSMW) accounted for 9.54% (N=987). The mean age and median age of overall participants were 39.48 years and 38 years. Participants were mainly white, had come college education, and reported residing in an urban/suburban area (Table 1). About four-fifths of participants lived in a household with an annual income of at least $20,000.

Table 1. Demographic and behavior characteristics of MSM and MSMW, American Men's Internet Survey, United States, 2013-2014. (N=10377)

	Category	MSM*(N=9361) n(%)	MSMW**(N=987) n(%)
Age	Mean(SE)	39.37(14.37)	40.54(15.17)
Race/ethnicity	White	7291 (77.89%)	763(77.30%)
	Black	319(3.41%)	33(3.34%)
	Hispanic/Latino	976(10.43%)	106(10.74%)
	Other/Multiple	614(6.56%)	60(6.08%)
	Missing	161(1.72%)	25(2.53%)
Education	Some high school or below	96(1.03%)	16(1.62%)
	High school diploma or GED	823(8.79%)	119(12.06%)
	Some college, Associate's Degree, or Technical Degree	2970(31.73%)	349(35.36%)
	College, post graduate or professional school	5422(57.92%)	497(50.35%)
	Missing	50(0.53%)	6(0.61%)
Annual Household Income	$0 to $19,999 annually	1334(14.25%)	114(11.55%)
	$20,000 or above annually	7342(78.43%)	786(79.64%)
	Missing	685(7.32%)	87(8.81%)
Locality	Urban	5852 (62.51%)	520(52.68%)
	Rural	3509(37.49%)	467(47.32%)
Healthcare visit in past 12months	No	1282(13.70%)	125(12.66%)
	Yes	7964(85.08%)	842(85.31%)
	Missing	115(1.23%)	20(2.03%)
Self-reported HIV status	Negative or unknown	8130(86.85%)	929(94.12%)
	Positive	1074(11.47%)	34(3.44%)
	Missing	157(1.68%)	24(2.43%)
Illicit drug use in past 12 months	No	6740(72.00%)	710(71.94%)
	Yes	2524(26.96%)	268(27.15%)
	Missing	97(1.04%)	9(0.91%)
Illicit drug use during or before last sex with a male partner	No	8566(91.51%)	862(87.34%)
	Yes	693(7.40%)	108(10.94%)
	Missing or unknown	102(1.09%)	17(1.72%)

*MSM: Male who haven't had oral, vaginal, or anal sex with a woman in the past 12 months.
**MSMW: Male have had oral, vaginal, or anal sex with a woman in the past 12 months.

Illicit Drug Use in the Past 12 Months

Of the 10242 participants (9264 MSM and 978 MSMW) who answered the questions about illicit drug use in the past 12 months, 2792 (27.26%) reported using drugs - 2524 MSM (27.25%) and 268 MSMW (27.40%) (Table 2).

There were 2 significant interactions in the final model of illicit drug use in the past 12 months - MSM/MSMW and age and MSM/MSMW and HIV status (Table 2). All covariates were independently significant in this study. Controlling for these significant covariates and the two interaction product terms, MSMW had a significantly higher prevalence of illicit drug use in past 12 months than MSM (adjusted prevalence ratio [aPR] = 1.56; 95% confidence interval [95% CI]: 1.16, 2.10; Table 2). The prevalence ratio in the crude model became significant after adjusting for covariates and interactions.

Table 2. Crude and adjusted prevalence ratios of illicit drug use in the past 12 months and before or during last sex with a male partner among MSM and MSMW participants, American Men's Internet Survey, United States, 2013-2014.

	Total	**Drug use in past 12 months n (%)**	**Crude PR (95%CI)**	**Adjusted PR (95%CI)***
MSM	9264	2524(27.25)	Ref	ref
MSMW	978	268(27.40)	1.01(0.90,1.12)	1.55 (1.16,2.08)
	Total	**Drug use at last sex n (%)**	**Crude PR (95%CI)**	**Adjusted PR (95%CI)****
MSM	9259	693(7.48)	Ref	ref
MSMW	970	108(11.13)	1.49(1.23,1.80)	1.60(1.30,1.97)

*Adjusted model controlled for self-reported HIV status, age, locality, income, MSM/MSMW *age and MSM/MSMW*self-reported HIV status among participants who use illicit drug in the past year.

** Adjusted model controlled for self-reported HIV status, age and income among participants who use illicit drug before or during in last sex with a male partner.

The association between MSM/MSMW and illicit drug usage in the past 12 months differed by the two interactions: age and self-reported HIV status. No significant prevalence difference in illicit drug using was found between MSM and MSMW among those who reported themselves as HIV negative or unknown status ([aPR]=1.00; [95% CI]: 0.96, 1.04)(Table 3). However, for those who were HIV positive, the prevalence of using illicit in the past 12 months among MSMW was 1.69(95% CI: 1.10, 2.60) times the prevalence of using illicit drug among MSM. HIV-negative MSM and MSMW had very similar prevalence of using illicit drugs and this prevalence is relatively low compared with the prevalence of illicit drug use among HIV-positive participants, especially HIV-positive MSMW (Figure 1). There was a significant difference ($F=107.24$; $p<0.0001$) in mean age by illicit drug usage in the past 12 months among MSM and MSMW (Table 4). The overall pattern was that those who used illicit drugs were younger than those who did not, but the mean age gap between drug users and non-users was wider for MSMW compared with MSM using two-way comparisons. For non-users, MSMW tended to be older than MSM, whereas for drug users, no difference in mean age was found for those two groups. Illicit drug usage decreased with age for both MSM and MSMW (Figure 2). MSMW 37 years of age and younger tended to have a higher drug use prevalence than MSM. MSMW older than 37 years, had a lower drug use prevalence than MSM.

Table 3. Stratified analysis of illicit drug use in the past12 months by self-reported HIV status among MSM and MSMW participants, American Men's Internet Survey, United States, 2013-2014.

	HIV negative/unknown (26.32%)	**TOTAL**	**Crude PR (95%CI)**
MSM	2118	8047	ref
MSMW	242	920	1.00(0.96,1.04)
	HIV positive (36.03%)	**TOTAL**	**Crude PR (95%CI)**
MSM	375	1065	ref
MSMW	21	34	1.69(1.10,2.60)

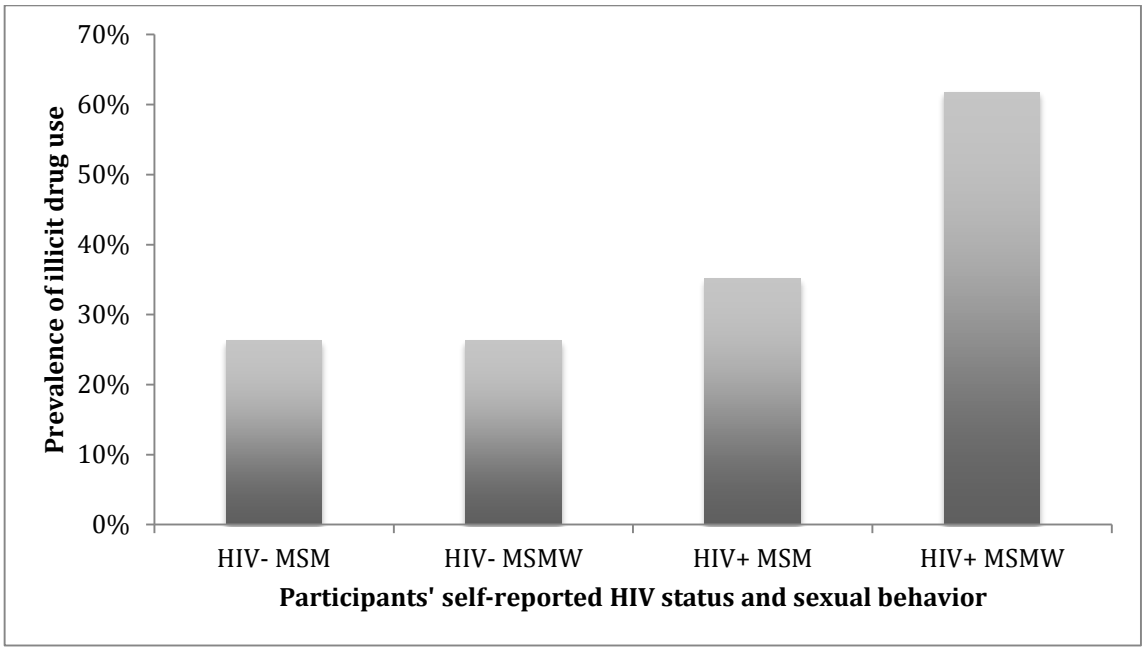

Figure 1. The prevalence of illicit drug use in the past 12 months by self-reported HIV status among MSM and MSMW participants, American Men's Internet Survey, United States, 2013-2014.

Illicit Drug Use at Last Sex with a Male Partner

Of the 10229 participants (9259 MSM and 970 MSMW) who answered the questions about illicit drug use before or during the last time they had sex with a male partner, 801 (7.83%) reported using drugs - 693 MSM (7.48%) and 108 MSMW (11.13%) (Table 2).

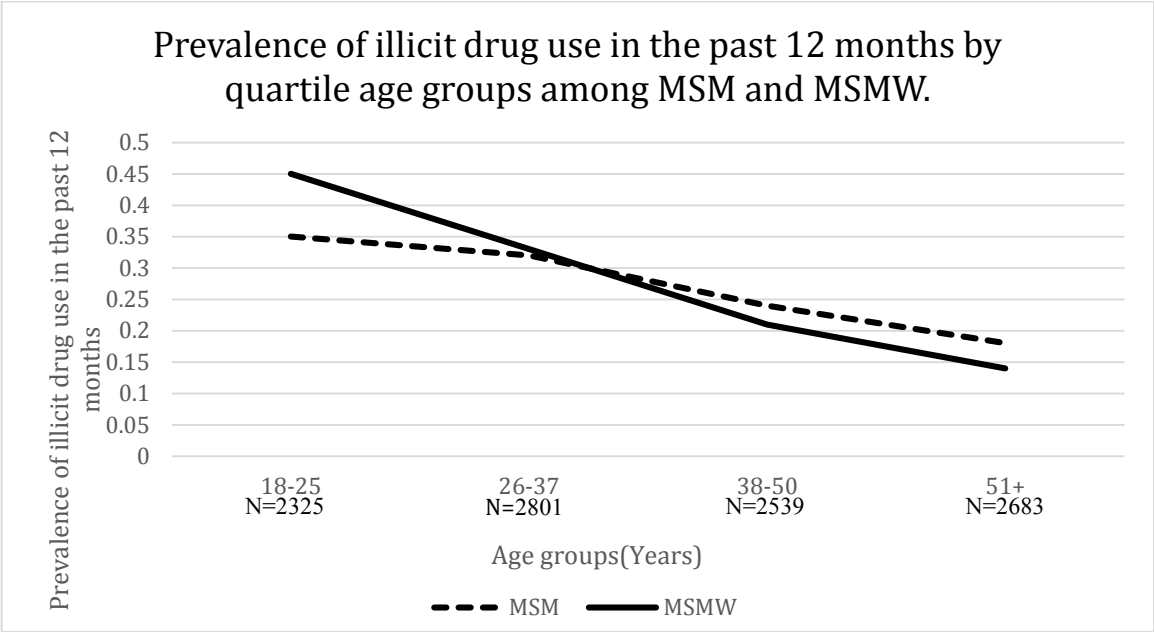

Figure 2. Prevalence of illicit drug use in the past 12 months at different age groups by MSM/MSMW in the American Men's Internet Survey, United States, 2013.

Controlling for the covariates (age, self-reported HIV status, race/ethnicity, annual household income, education, area of residence and healthcare visit in the past 12 months), MSMW had a significantly higher prevalence of illicit drug use before or during last time had sex with a male partner than MSM (adjusted prevalence ratio [aPR] = 1.56; 95% confidence interval [95% CI]: 1.27, 1.93; Table 2). There were no significant interactions between MSM/MSMW and other covariates in the model of drug use at last sex.

Table 4. Mean years of age of MSM and MSMW by drug usage in the past 12 months, American Men's Internet Survey, United States, 2013-2014*.

	Illicit drug use in the past 12 months	
	NO	**YES**
MSM	40.72	35.64
MSMW	43.07	33.92

*P-value<0.0001

DISCUSSION

This study that included MSM and MSMW from every US state showed that more than one-quarter (27.26%) had used illicit drugs in the past 12 months. Less than one-tenth (7.83%) of study participants had used illicit drugs at last sex with a male partner. The prevalence of illicit drug use was significantly higher among MSMW than MSM, but that association may be dependent upon other factors such as a person's HIV status and age.

The main findings of our study are consistent with the previously published literature but provide additional evidence that the association between MSM/MSMW and drug use may be real and not isolated to specific geographic areas or sub-groups. Compared to previous studies, the present study was conducted in a larger geographic area, involving larger sample size, and may have included a less risky group of MSM/MSMW. A study using street-based sample in Los Angeles (LA) presented a higher proportion of injection drug use in MSMW than MSM (22). This LA study covered a large percentage of poor or homeless individuals with smaller sample size, and reported very high HIV prevalence among study participants: 12% among MSMW and 65% among MSM, which was much higher than in the present study. In another study whose participants were drug users or MSM, MSMW also reported more illicit drug use than MSM, but the prevalence of drug use was much higher than what is commonly reported for general studies among MSM (30). Another 4-site study that involved a sample of only black MSM and MSMW confirmed that MSMW were more likely to have used drugs than MSM (28). Similar results were also reported in a randomized controlled trial of illicit drug users found that MSMW were significantly more engaged in both injection drug and non-injection drug in the past three months compared with MSM (15).

It is worth noting that the association between drug use and MSM/MSMW only existed in the fully adjusted model in this study. On the contrary, Knight et al. found significant association between MSM/MSMW and injected drug use, and between MSM/MSMW and non-injected drug use even in crude analyses (15). The difference between our results and theirs may be due to the two main different characteristics of the participants, the HIV prevalence and age distribution. In Knight's study, all participants had HIV-positive serostatus, while the participants who reported HIV-positive status in our study was below 10%. Because every participant was HIV-positive, Knight's study may be better to explore the crude association between MSM/MSMW and drug use, with the result of higher prevalence of drug use among MSMW. This relationship is consistent with our finding of interaction of HIV status and MSM/MSMW that those MSMW who were HIV-positive were more likely had used drugs. Additionally, with a wider set of ages, our study revealed that

relationship between MSM/MSMW and drug use was differed by age groups. Ages were clustered around 41 years in Knight's study (interquartile range: 36 to 45 years for MSM, 37.5 to 44 years for MSMW). Ages in our study showed a much wider range (interquartile range: 26 to 51 years for MSM, and 26 to 53 years for MSMW). The larger numbers of older participants may have increased the chance of identifying an interaction of MSM/MSMW and age that the other study was not able to find. In our study, HIV-positive MSMW were more likely to have used illicit drugs than HIV-positive MSM in the past 12 months. Previous studies have shown that HIV-positive participants were more likely to engaged in illicit drugs (31). Hence it is possible that HIV positive status and being MSMW could synergistically increase the risk of illicit drug use. Therefore in order to prevent illicit drug use among MSM, it is critical to target the subgroup of MSMW when designing and implementing interventions for HIV prevention. Similarly, the interaction between age and MSM/MSMW status may also escalate the use of illegal drugs in the past 12 months (Figure 2). Despite an overall downward trend of illicit drug use with the increase in age, there were slight differences between MSM and MSMWs in this trend. Compared with MSM, MSMW had a higher prevalence of drug use in younger age group, but a lower prevalence in older age group. This interaction of age and MSM/MSMW implicated that the interventions of reducing illicit drug use should focus more on young MSMW and elderly MSM.

Concurrency of illicit drug use and last sex with a male partner happened more prevalent among MSMW than MSM in our study. This relationship may be explained by that MSMW suffered from severe internalized homophobia and more likely to use drugs during same-gender sex to escape from it (32). Trading sex for drug or money is another possibility to explain the higher prevalence of currency of sex and drug among MSMW than MSM (28). Future studies need to examine the potential effects of contextual factors such as trading sex or money for sex on drug use among MSM and MSMW. This may be particularly important for this behavior because of the connection between drug use before/during sex and risk for HIV and other sexually transmitted infections (33,34).

The findings from this study have implications for the intervention of drug use. MSMW had significantly higher risk for illicit drug use than MSM, and need more protection from public health interventions. HIV positive status renders MSM/MSMW more vulnerable to drug use, thus calling for more comprehensive interventions to reduce illicit drug use, especially among HIV-positive MSMW. For instance, a blanket intervention programs could be designed to include drug use interventions that are proven effective, including screening, counseling, behavioral change, and treatment. For instance, previous studies have shown effectiveness of behavioral change programs that target illicit drug use in

HIV-positive MSM (35,36). Given the aforementioned interaction between age and MSM/MSMW status, future drugs intervention programs also need to pay more attention to young MSMW as a high-risk group. The global burdens of disease attributed to drug use and alcohol use was approximately 5% in 2010 (37). The interventions, such as motivational interviewing, worked well on reducing drugs and alcohol use in the general population; however, they were less effective for MSM (38-41). An effective network-oriented intervention trial was found to lead to decrease in drug use among young people (42). More suitable interventions are needed to develop to reduce drugs prevalence for MSM, and MSMW in the future.

LIMITATIONS

All variables used in this analysis were based on self-reported data, including the outcome variables "illicit drug use in the past 12 months" and "illicit drug use in last sex". Participants may under-reported sensitive information such as drug use and positive HIV status and we cannot verify the validity and accuracy of these variables (27). However, it has been shown that MSM provided valid information by self-report compared with drug tests in some kinds of drug use (43).

Another limitation of this study is sampling bias. Because this online survey was implemented with a convenience sampling approach, we cannot determine whether those who were sampled were representative of all MSM who received the recruitment ads. Additionally, because this survey is online, MSM/MSMW who surfed the Internet infrequently would have been less likely to partake in this survey. Participants were relatively young compared to face-to-face personal interviews within MSM (22,25). They may have been more concerned about the MSM and HIV issues included in this research, which may not be representative sample of all MSM. Therefore we cannot generalize our findings to other MSM subgroups, especially those who don't have frequent access to the recruitment websites that we used.

FUTURE DIRECTIONS

This study showed a significantly higher prevalence of illicit drug use both in the past 12 months, and at last sex with a male partner in MSMW than in MSM. To improve upon these findings, future studies of this issue should be designed to enroll a larger number of participants, use more systematic sampling methods, and include more diversity of settings, such as healthcare institutions and gay bars.. It will also provide the evidence that whether interacting effects between HIV status and MSM/MSMW, and age and MSM/MSMW appear in using drug in the past 12 months among a larger and more generalizable MSM sample. Moreover, the effect of trading sex for drugs at last sex needs to be solved in the next step. To fully measure transactional sex involvement of drugs and no exchanges when using drugs independently, we can better understand the association of concurrency of drug use and sex.

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APPENDICES:

Appendix 1: AMIS-2013 Survey - Illicit Drug Use Questions

ID-1. Have you ever in your life shot up or injected any drugs other than those prescribed for you? By shooting up, we mean anytime you might have used drugs with a needle, either by mainlining, skin popping, or muscling.

(0) No

(1) Yes

(7) I prefer not to answer

(9) Don't know

ID-2. In the past 12 months, on average, how often did you inject?

(0) Never

(1) More than once a day

(2) Once a day

(3) More than once a week

(4) Once a week

(5) More than once a month

(6) Once a month

(7) Less than once a month

(77) I prefer not to answer

(99) Don't know

ND-1. In the past 12 months, have you used any non-injection drugs (drugs you did not inject), other than those prescribed for you.

(0) No

(1) Yes

(7) I prefer not to answer

(9) Don't know

SX-16. Before or during the last time you had sex with the male partner, did you use:

(1) Alcohol

(2) Drugs

(3) Both alcohol and drugs

(4) Neither one

(7) I prefer not to answer

(9) Don't know

Appendix 2: SAS Code

```
libname m"T:\epiprojs\Sex is the Question Data Share";
libname library"T:\epiprojs\Sex is the Question Data Share";

options nofmterr;
proc contents data=m.sitq2013finalanalyses_students;run;
proc print data=m.sitq2013finalanalyses_students(obs=10);run;


*create a temp dataset, which same as the original one. There are 10377 obs in total ;
data temp;
set m.sitq2013finalanalyses_students;run;



*********************************************************************************
Creat a new variable named illictg combined injection and non-injection drug use in past
year;
proc freq data=temp;
table avginj/missing;
run; *no 77,99;
*avginj is char variable;
*evrinj is num variable;
*niuse12 is a num;
data temp;
set temp;
if avginj="0" then avginj=0;
else if avginj="1" then avginj=1;
else if avginj="2" then avginj=2;
else if avginj="3" then avginj=3;
else if avginj="4" then avginj=4;
else if avginj="5" then avginj=5;
else if avginj="6" then avginj=6;
else if avginj="7" then avginj=7;
else  avginj=.;
run;
proc freq data=temp;*9981 missing;
table avginj;
run;

data illicitd;
set temp;
if evrinj=0 and niuse12=0 then illicitg=0;
else if evrinj=1 and avginj=0 then illicitg=0;
else if evrinj=1 and avginj=1 then illicitg=1;
else if evrinj=1 and avginj=2 then illicitg=1;
else if evrinj=1 and avginj=3 then illicitg=1;
else if evrinj=1 and avginj=4 then illicitg=1;
else if evrinj=1 and avginj=5 then illicitg=1;
else if evrinj=1 and avginj=6 then illicitg=1;
else if evrinj=1 and avginj=7 then illicitg=1;
else if niuse12=1 then illicitg=1;
else illicitg=.;
run;
proc freq data=illicitd; *107 missing;
table illicitg;run;

/*Check:missing 107 obs
proc freq data=illicitd;
table _rural10/missing; *0 missing;
run;

proc freq data=illicitd; *36 missing;
table m_mlhi;
run;
```

```
*check participants #;
data illicitl;
set illicitd;
if m_mlhi=2 or m_mlhi=3 then illicit=1;
else if m_mlhi=1 or m_mlhi=4 then illicit=0;
else if m_mlhi in (7,9) then illicit=9;
else illicit=.;
run;

proc freq data=illicitl; *36 missing, consistent;
tables illicit;
run;


data test;
set illicitl;
if illicitg in (0,1) then participant=1;
if illicit in (0,1,9) then participant=1;
run;
proc freq data=test;
table participant;run;
*10377, no missing;

*/

data illicitd;
set illicitd;
if m_fsx12m=7 then m_fsx12m=.;
if m_fsx12m=9 then m_fsx12m=.;
run;



**********************************;
*creat illict drug use for last sex;

data illicitl;
set illicitd;
if m_mlhi=2 or m_mlhi=3 then illicit=1;
else if m_mlhi=1 or m_mlhi=4 then illicit=0;
else if m_mlhi in (7,9) then illicit=9;
else if illicit=.;
run;

proc freq data=illicitl;
table illicit;
run;


*create subset data include participant who answer at least one drug use question;
data illicithiv;
set illicitl;
if illicitg=. and illicit=. then delete;
run;
/*Check total participants again;
proc freq data=illicithiv;
table illicitg*illicit/missing;
run;
*/

data illicithiv;
set illicithiv;
if illicit=9 then illicit=.;
run;
```

```
*2*2 table of MSMW/MSM *illicit drug use in last sex;
proc freq data=illicithiv ;
table m_fsx12m*illicit/expected chisq relrisk;
run;

*Categorize HIV status into two binary:positive/negtive or unknown;
proc freq data=illicithiv;
table _hivstat;
run;

data illicithiv;
set illicithiv;
if _hivstat=2 then HIVSELF=1; *HIV+;
ELSE IF  _hivstat in (1,3,4,5) then HIVSELF=0;*HIV- or unknown;
else if _hivstat=. then hivself=.;
run;
proc freq data=illicithiv;
table HIVSELF;
run;




*************************************;
*Table 1: Analysis for Descrptive Table;
*************************************;
proc freq data=illicithiv;
table m_fsx12m;
run;


data illicithiv;
set illicithiv;
if m_fsx12m=. then delete;
run;


data illicithiv;
set illicithiv;
if HLEDUCAT in (77,99) then HLEDUCAT=.;
ELSE IF HLEDUCAT IN (0,1,2) then EDUCAT=0;
ELSE IF HLEDUCAT =3 then EDUCAT=1;
ELSE IF HLEDUCAT =4 then EDUCAT=2;
ELSE IF HLEDUCAT =5 then EDUCAT=3;
if HHINCOM in (77,99) then HHINCOM=.;
if SEEHCP in (7,9) then SEEHCP=.;
run;

data msmhiv;
set illicithiv;
if _raceomb=5 then nrace=1;*White;
else if _raceomb=3 then nrace=2; *Black;
else if _raceomb=4 then nrace=3;*Hispanic/Latino White;
else if _raceomb in (1,2,6) then nrace=4;*Others;
if HHINCOM=0 then INCOMEL=0;
else if HHINCOM in (1,2,3) then INCOMEL=1;
run;


proc univariate data=msmhiv ;
class m_fsx12m;
var age;
run;
```

```
PROC TTEST DATA=msmhiv ALPHA=0.05 ;
    VAR age; *continuous variable here;
    CLASS m_fsx12m; *2-level categorical variable here;
RUN;


proc freq data=msmhiv;
tables nrace*m_fsx12m/ missing expected chisq norow;
run;


proc freq data=msmhiv;
tables EDUCAT*m_fsx12m/missing expected chisq norow;
run;

proc freq data=MSMHIV;
tables INCOMEL*m_fsx12m/missing expected chisq norow;
run;

proc freq data=msmhiv;
tables _rural10*m_fsx12m/missing expected chisq norow;
run;

proc freq data=msmhiv;
tables seehcp*m_fsx12m/missing expected chisq norow;
run;

proc freq data=msmhiv;
tables hivself*m_fsx12m/missing expected chisq norow;
run;

proc freq data=msmhiv;
tables illicitg*m_fsx12m/missing expected chisq norow;
run;

proc freq data=msmhiv;
tables illicit*m_fsx12m/missing expected chisq norow;
run;


*************************************************************************************;
*Table 2: models for illicit drug use both in last year and last sex with his male partner*/
*************************************************************************************;

data nmsmhiv;
set msmhiv;
if nrace=2 then nrace1=1;else nrace1=0;*nrace=1 white, is reference group;
if nrace=3 then nrace2=1;else nrace2=0;
if nrace=4 then nrace3=1;else nrace3=0;

if EDUCAT=1 then EDUCAT1=1;else EDUCAT1=0;
if EDUCAT=2 then EDUCAT2=1;else EDUCAT2=0;
if EDUCAT=3 then EDUCAT3=1;else EDUCAT3=0;
MA=m_fsx12m*age;
MH=m_fsx12m*HIVSELF;
MN1=m_fsx12m*nrace1;
MN2=m_fsx12m*nrace2;
MN3=m_fsx12m*nrace3;
ME1=m_fsx12m*EDUCAT1;
ME2=m_fsx12m*EDUCAT2;
ME3=m_fsx12m*EDUCAT3;
MI=m_fsx12m*INCOMEL;
MR=m_fsx12m*_rural10;
MHEAl=m_fsx12m*seehcp;
run; *MA MH MN1 MN2 MN3 ME1 ME2 ME3  MI MR MHEAL;
```

```
*Interaction assessment.Using hierarchical backwards elimination stratigy to obtain better
model;
*Full model;
proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH MN1 MN2 MN3 ME1 ME2 ME3  MI MR MHEAL;
run;
*P for MNs are least significant and larger than 0.05;

*Remove MI;
proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp MA MH MN1 MN2 MN3 ME1 ME2 ME3 MR MHEAL;
run;

*Remove MNs;
proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH ME1 ME2 ME3 MR MHEAL;
run;

*Remove MEs;
proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH  MR MHEAL;
run;

*Remove MHEAL;
proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH  MR ;
run;

*Remove MR;
proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp MA MH   ;
run;


************************************************************;
*Best model for last year, with interaction term MA and MH ;
************************************************************;
proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp MA MH /lackfit;
run;
*p=0.8716;


************************************************************;
*Confounding assessment                                ****;

proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age  _rural10 INCOMEL seehcp
MA MH /lackfit;
run;

proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF  _rural10 INCOMEL seehcp  MA MH /lackfit;
run;
```

```
*The final model for drug use in the past 12 months;
proc logistic data=nmsmhiv descending;
model illicitg=m_fsx12m HIVSELF  age  _rural10 INCOMEL  MA MH/lackfit   ;
run;



/*Interaction assessment for last sex*/

proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH MN1 MN2 MN3 ME1 ME2 ME3  MI MR MHEAL;
run;
*remove MEs;
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH MN1 MN2 MN3  MI MR MHEAL;
run;
*remove MNs;
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH  MI MR MHEAL;
run;

*remove MHeal;
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH  MI MR;
run;

*remove MR;
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp  MA MH  MI;
run;

*remove MH;
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp MA  MI;
run;

*remove MI;
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp MA;
run;

*remove MA;
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp ;
run;

************************************************;
*Best model for last sex, without interaction term;
************************************************;
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL seehcp;
run;

************************************************;
*Confounding assessment                        ***;
```

```
proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3 _rural10
INCOMEL;
run;

proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF nrace1 nrace2 nrace3 age EDUCAT1 EDUCAT2 EDUCAT3  INCOMEL;
run;

proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF  age EDUCAT1 EDUCAT2 EDUCAT3  INCOMEL;
run;

proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF  age  INCOME;
run;

****************************************;
*Final model for drug use at last sex;

proc logistic data=nmsmhiv descending;
model illicit=m_fsx12m HIVSELF  age INCOMEL;
run;




*For table 2;
proc freq data=nmsmhiv;
tables m_fsx12m;
run;
proc freq data=nmsmhiv;
tables m_fsx12m*illicitg;
run;
proc freq data=nmsmhiv;
tables m_fsx12m*illicit;
run;



**Sudaan FOR LAST YEAR in table 2;
proc rlogist data=nmsmhiv filetype=sas design=srs;
class m_fsx12m;
reflev m_fsx12m=0;
model illicitg=m_fsx12m ;
condmarg m_fsx12m(0)/adjrr;
run;

proc rlogist data=nmsmhiv filetype=sas design=srs;
class m_fsx12m;
reflev m_fsx12m=0;
model illicitg=m_fsx12m HIVSELF  age  _rural10 INCOMEL  MA MH ;
condmarg m_fsx12m(0)/adjrr;
run;




*For last sex in table 2;
proc rlogist data=nmsmhiv filetype=sas design=srs;
class m_fsx12m;
reflev m_fsx12m=0;
model illicit=m_fsx12m;
```

```
condmarg m_fsx12m(0)/adjrr;
run;

proc rlogist data=nmsmhiv filetype=sas design=srs;
class m_fsx12m;
reflev m_fsx12m=0;
model illicit=m_fsx12m HIVSELF age  INCOMEL;
condmarg m_fsx12m(0)/adjrr;
run;


**Sudaan FOR LAST YEAR in table 3;


proc rlogist data=nmsmhiv1 filetype=sas design=srs;
class m_fsx12m;
subgroup hivstatus;
levels 2;
reflev m_fsx12m=0;
model illicitg=m_fsx12m ;
condmarg m_fsx12m(0)/adjrr;
run;




/*Table 3. stratified analysis for MSMW/MSM *illicit drug use in past 12 months by HIV status*/
*2*2 table of MSMW/MSM *illicit drug use in past 12 months by HIV status(negtive or unknown);
proc freq data=nmsmhiv ;
where HIVSELF=0;
table m_fsx12m*illicitg/expected chisq relrisk;
run;

*2*2 table of MSMW/MSM *illicit drug use in past 12 months by HIV status(postitive);
proc freq data=nmsmhiv ;
where HIVSELF=1;
table m_fsx12m*illicitg/expected chisq relrisk;
run;


/*Table 4: stratified on age*/
*create a table to show the age differences between MSM/MSMW AND DRUG USE in past year;
*explain the binary association/interaction MA;
DATA AGETEMP;
SET NMSMHIV;
IF illicitg=0 AND m_fsx12m=0 THEN NEWVAR=1;
ELSE IF illicitg=0 AND m_fsx12m=1 THEN NEWVAR=2;
ELSE IF illicitg=1 AND m_fsx12m=0 THEN NEWVAR=3;
ELSE IF illicitg=1 AND m_fsx12m=1 THEN NEWVAR=4;
RUN;
PROC univariate data=AGETEMP;
class NEWVAR;
var age;
run;



/* CHECK
PROC univariate data=nmsmhiv;
where illicitg=0;
class m_fsx12m;
var age;
run;

PROC univariate data=nmsmhiv;
```

```
where illicitg=1;
class m_fsx12m;
var age;
run;
*/

*one way ANOVA to test four mean ages;
proc glm data=agetemp;
class newvar;
model age=newvar;
run;

proc glm data=agetemp plots=none;
  class newvar;
  model age=newvar;
  means newvar/scheffe cldiff lines;
  title"Scheffe's Approach";
run;


*do plot for last year;
proc freq data=agetemp;
where m_fsx12m=0;
tables age*illicitg/nocol nofreq nopercent;
run;
proc freq data=agetemp;
where m_fsx12m=1;
tables age*illicitg/nocol nofreq nopercent;
run;
proc freq data=agetemp;
tables age;
run;

*graph in excel;

*Classify age to groups;
*Quartiles;
proc means data=nmsmhiv nmiss q1 median q3;
var age;
run;
*26,38,51;

data quartile;
set nmsmhiv;
if age<26 then agegr=1;
else if 26=<age< 38 then agegr=2;
else if 38=<age< 51 then agegr=3;
else if 51=<age then agegr=4;
run;

proc freq data=quartile;
table agegr;
run;

proc freq data=quartile;
table agegr*m_fsx12m*illicitg ;

run;
```