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Prevalence and Correlates of Marijuana Use among HIV-Seropositive and Seronegative Men in the Multicenter AIDS Cohort Study (MACS), 1984–2013

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Abstract

Background—Marijuana use is common among HIV+ individuals, but few studies have examined long-term trends in prevalence and correlates of use.

Methods—We evaluated trends (1984–2013) in the annual prevalence of *current* (past six-month use) and *daily* (among *current* users) marijuana use and determined correlates of use among 2,742 HIV-seropositive (HIV+) and 3,172 HIV-seronegative (HIV−) men who have sex with men (MSM) in the Multicenter AIDS Cohort Study (MACS). Poisson regression models was used to estimate prevalence ratios of marijuana use separately for the men who were enrolled before 2001 (early-cohort) and after 2001 (late-cohort).

Results—Over the 29 years of the study, the prevalence of *current* marijuana use declined significantly, whereas, *daily* use among users increased among all men in the early and late-cohorts. A HIV+ status was associated with higher prevalence of marijuana use among the men in the early-cohort (adjusted prevalence ratio (aPR) =1.53, 95% confidence interval (CI):1.42, 1.64,

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Conflicts of Interest

No conflicts declared

p=<.0001), but not in the men in the late-cohort (aPR=0.90, 95% CI: 0.79, 1.03, p=.1424). Among the HIV+ men in the late-cohort, lower CD4+ count and having a detectable HIV viral load were positively associated with *current* marijuana use.

Conclusions—Although the annual prevalence of *current* marijuana use decreased significantly over time in the MACS, *daily* use among users increased significantly. As nearly half of states in the US now have laws allowing medical or recreational marijuana use, there is a need to continually monitor trends in marijuana use among HIV+ and HIV− MSM.

Keywords

Marijuana; prevalence; correlates; men who have sex with men; HIV positive and HIV negative

Introduction

State laws and attitudes toward marijuana use have continued to evolve: twenty-three states and the District of Columbia now allow marijuana use for medical or recreational purposes (1,2). Several reports have documented an increase in marijuana use (3,4) as well as daily or near daily use (3–5) in the general US population since the mid-2000s. Research among HIV-seropositive (HIV+) individuals in the US suggests that marijuana use is common and higher than the general uninfected population. Rates of *current* (or past-six months) marijuana use among HIV+ individuals have ranged from 14% to 56% (6–13) as compared to 8.5% in the general US population 18+ years of age (4). With widespread use of antiretroviral therapy (ART), HIV+ individuals are living longer and the focus of clinical care has shifted to the management of a chronic disease. Observational studies of HIV+ individuals cite therapeutic benefits of marijuana; including relief of HIV-related symptoms and side effects of ART (6,9,11,12,14), although empirical data on the efficacy and safety of use is limited (15). Importantly, marijuana use among HIV+ individuals has been associated with reduced ART adherence (16–18), cognitive impairment (19,20) and poorer quality of life (21).

Data on long term trends and patterns of marijuana use among HIV+ individuals have also been scarce. In a recent study that assessed longitudinal patterns of marijuana use among women living with HIV, prevalence of *current* marijuana use decreased significantly from 21% to 14% over a 16 year period (1994–2010); however, daily use (among users) increased by more than three-fold, increasing from 14.8% in 1994 to 51% in 2010 (6).

Past studies of correlates of marijuana use among HIV+ individuals have found younger age (16,22), lower educational level (16), alcohol, cigarette and other illicit substances to be positively associated with marijuana use (9,16,21), although most of these studies have been cross sectional. Using data from a longitudinal cohort of HIV+ women, Kuo et al. (2004) found lower initiation of weekly marijuana use among women with an undetectable HIV viral load and those receiving highly active antiretroviral therapy (HAART)(23). A follow-up study in HIV+ women found marijuana users to be less likely to be on ART, but daily marijuana use to be associated with higher CD4 count (6). In addition, passage of medical marijuana laws (MMLs) may be associated with increased availability and easier access to marijuana and may contribute to increased use of marijuana. Several studies have showed

that passage of MMLs is associated with increased marijuana use (2,24). Other studies either indicate no effect (1,25) or a decrease in marijuana use following passage of MMLs (26). However, nearly all of these were among adolescents. Given that most state MMLs list HIV/AIDS as a qualifying condition for medical use of marijuana (27), passage of MMLs may be associated with increased marijuana use among HIV+ individuals.

The aim of the present study was to: (1) assess trends in the annual prevalence of *current* and *daily* marijuana use over time (1984–2013) among HIV+ and HIV− individuals (2) determine correlates of *current* and *daily* marijuana use over time (3) and explore whether passage of MMLs is associated with increased marijuana use.

Methods

Study design and Administration

The Multicenter AIDS Cohort Study (MACS) is an ongoing prospective cohort study of the natural and treated history of HIV infection among men who have sex with men (MSM) in the United States. A total of 6,972 men were enrolled during the project in three waves: 4,954 men in 1984–1985, 668 in 1987–1991, and 1350 in 2001–2003 and at four centers located in Baltimore/Washington DC, Chicago, Los Angeles, and Pittsburgh. The study design of the MACS has been described previously (28–30) and only the design relevant to the present analyses are described here. The study questionnaires used in the MACS are available at: www.statepi.jhsph.edu/macs/forms.html. Institutional review boards at each study site approved the MACS study protocols and informed consent was obtained from all participants.

MACS participants return every 6 months for a physical examination, collection of blood specimens and complete a detailed interview and questionnaires. The interview and questionnaires collect demographic, psychosocial, behavioral and medical history data. The questions about recreational drug use, including marijuana, alcohol, poppers, cocaine, crack, heroin, methamphetamine, ecstasy, injection drug use as well as smoking history were collected using audio computer assisted self-interviewing, an approach previously demonstrated to provide more accurate assessments of ‘sensitive behaviors’ than interview-administered questionnaires among MSM (31).

Participants—The present study uses data from 5,914 men who answered questions about marijuana use for at least two or more semi-annual visits. For the present analyses, we defined two enrollment periods: the men in the early-cohort were enrolled before 2001 and those in the late-cohort were recruited after 2001. The enrollment cohorts were analyzed separately because of differences in the individuals that were recruited: the men in the early-cohort were predominantly non-Hispanic white, had more years of education, and had fewer symptoms of depression than those in the late cohort (32). We included data collected from marijuana use questions from semiannual study visit 1 (data collection starting in April 1, 1984) through visit 59 (data collection ending in September 30, 2013) for the men in the early-cohort. The period covered for the men in the late-cohort included: semiannual visit 40 (data collection starting in October 1, 2003) through visit 59. We selected visit 40 as the

baseline for the late-cohort as this was when the sample size reached its maximum after the expansion of the cohort between 2001 and 2003.

Measures

Outcome Measure: Marijuana use: Current marijuana use at each study visit was assessed with the following question "*Have you used any pot, marijuana or hash since your last visit*? Participants who responded '*No*' to this question were classified as non-users. Among those who responded 'Yes', frequency of use was asked with the following question "*How often did you use pot, marijuana or hash since your last visit*?" with the following response options: "daily"; "weekly"; "monthly" and "less often".

Covariates

Socio-demographic Characteristics: Participant's age at each visit was calculated from their self-reported date of birth. The baseline visit was used to define a three level categorical variable for race/ethnicity status (Non-Hispanic White, Non-Hispanic Black and other), educational attainment (High school diploma or less, some college or college degree, Graduate work or more) and current employment (employed, unemployed). Participants were classified according to the MACS study center and whether they were enrolled prior to or after 2001.

Depressive symptoms: The Center for Epidemiologic Studies Depression (CES-D) scale, was used to measure clinically significant symptoms of depression at each visit (33). This assessment was developed for use with community populations and includes components of depressed mood, feelings of worthlessness, sense of hopelessness, sleep disturbance, loss of appetite, and concentration difficulties. Scores on the CES-D of 16 or more suggests a clinically significant level of psychological distress (33).

Alcohol use: Using data regarding frequency of drinking and average number of alcoholic drinks since last study visit, alcohol consumption at baseline and at each visit was categorized as low-moderate (1 to 2 drinks/day, or 3 to 4 drinks/day no more than once a month), heavy (3 to 4 drinks/day more than once a month, or 5 or more drinks/day less than once a month or 5 or more drinks/day at least once a month) or no alcohol use (34).

Cigarette use: Participants were classified as never, former and current smokers at each study visit. Questions about smoking includes "Did you ever smoke cigarettes?" and "Do you smoke cigarettes now?". Participants who answered 'yes' to both questions were considered to be current smokers. Participants were classified as former smokers if the answered 'yes' to the first question and 'no' to the second question and never smokers if they responded with a 'no' to both questions (34).

Stimulant use: At each study visit participants were considered to be users of stimulant drugs if they reported the use of any of the following drugs since last study visit: (1) crack cocaine, (2) other forms of cocaine, (3) methamphetamines (or speed, meth or ice), (4) other recreational drugs such as "ecstasy" or MDMA (3,4-methylenedioxy-*N*-methylamphetamine).

Clinical factors: HIV serostatus was assessed using enzyme-linked immunosorbent assay with confirmatory Western blot tests on all MACS participants at each participant's initial visit and at every semiannual visit for participants who were initially HIV−. However, only participants who were seropositive as at the time of enrollment were included. Detailed descriptions of additional laboratory measures have been published elsewhere (35). Cluster of differentiation (CD4+) T-lymphocyte subset levels were categorized as <500 and ≥ 500 CD4+ cells/μL. Levels of plasma HIV ribonucleic acid (RNA) were used to create a dichotomous variable to denote detectable (> 40 copies per mL) versus undetectable. Hepatitis C virus (HCV) infection status was categorized as HCV negative if HCV antibody testing was negative. Participants were classified at each semiannual visit as HCV positive if they were found to be in the process of seroconversion, acute infection, chronic infection, clearing (between RNA+ and RNA−), or previously HCV positive, but now clear of HCV RNA. In addition to the covariates described above, we considered that the prevalence of marijuana use among HIV+ participants may be influenced by factors specific to HIV-infection such as ART usage has been previously reported (6). Antiretroviral medications were self-reported at each semiannual visit and summarized to define HAART usage (yes/no). HAART was defined according to the U.S. Department of Health and Human Services/Kaiser Panel guidelines (36).

Data Analysis

Characteristics of the sample at their baseline visit stratified by HIV serostatus and cohort enrollment were described using frequencies and percentages for categorical variables and means for continuous variables. Yearly prevalence of *current* marijuana use was calculated as the number of participants reporting marijuana use divided by the number of participants seen in the MACS for a given year. *Daily* marijuana use was calculated as the number of participants reporting daily use divided by the number of *current* users for each given year. We plotted both prevalence of *current* and *daily* marijuana use over the follow-up period by calendar year stratified by HIV-serostatus and cohort enrollment. In order to better understand the trends, we additionally calculated and plotted the prevalence of daily use as the number of participants reporting daily marijuana use divided by the total number of participants seen in the MACS. Univariate and multivariate Poisson regression models was used to estimate population-averaged effects (37) of correlates on *current* and *daily* marijuana use over time. These models were performed using generalized estimating equations (38). We accounted for the dependency between the repeated measurements of the outcome (i.e. marijuana use) by robust estimation of the error variances and specifying an unstructured correlation structure for the repeated observations (39). Separate analyses were conducted for the men in the early and late cohorts. Within each enrollment cohort, analyses were conducted separately for the combined group (i.e. HIV+ and HIV− men) as well as the HIV+ men. For the analysis limited to only the HIV+ men, we selected semiannual visit 25 (data collection starting in April 1, 1996) and visit 40 as the baseline for the men in the early- and late- cohorts respectively. We selected visit 25 as the baseline for the HIV+ men in the early cohort because we were interested in the effect of HAART use on rate of marijuana use, which only became available in 1996.

Our strategy for constructing the multivariate models was to include correlates that were significant ($p \leq .10$) in the univariate analyses. The covariates considered for inclusion in the multivariate model for the combined group included age, race, educational attainment, employment, study center, depressive symptoms, alcohol, smoking, stimulant drug use, intravenous drug use (IDU), and HCV status. Furthermore, to compare the prevalence rates of the HIV+ to the HIV− men, the model for the combined group included a variable to denote participant's HIV-serostatus. A variable was also included to estimate the effect of MML passage on marijuana use (see supplemental material). The models for the HIV+ group examined HIV-related clinical factors including: CD4+ cell count, detectable HIV viral load status and HAART use. In addition, for the analysis in the men in the early cohort, we estimated models for the period 2002–2013 in order to better compare the results with the men in the late cohort.

Missing data for correlates were imputed using multiple imputation with chained equations (MICE)(40). Five imputed datasets were generated for missing baseline and time-varying correlates which range from 0.2% (HAART use) to 14.8% (detectable HIV viral load) and the estimates were combined according to Rubin's rules (41). Because of the large sample size and number of person-visits, small prevalence ratios may be statistically significant. Thus we calculated a measure of effect size (Cohen's h or d) for the adjusted prevalence ratios (42). Cohen h or d of 0.2, 0.5 and 0.8 are small, medium and large effect sizes respectively (42). Throughout the analyses, P values were not adjusted for multiple comparisons. However, we highlight results where effect sizes equal or exceed the criteria for 'small' effects (i.e. Cohen's h or $d \geq 0.20$). Statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, North Carolina, USA) and STATA version 11.

Results

Sample Characteristics at Baseline

Table 1 displays the baseline characteristics of the 5,914 participants in this study stratified by HIV serostatus and cohort enrollment. The mean age at baseline ranged from 33 years [standard deviation (SD) =6.7] among the HIV+ men in the early-cohort to 39 years (SD=8.2) among the HIV+ men in the late-cohort. The men in the early-cohort were predominantly non-Hispanic, white (88% in HIV− and 79% in HIV+ men), whereas the majority of the men in the late-cohort were non-Hispanic, black (48% in the HIV− and HIV + men respectively). At baseline, the men in the early-cohort were more educated (88% of the HIV− and 84% of the HIV+ men completing a college degree or more) than the men in the late-cohort (67% in the HIV− and 58% in the HIV+ men completing a college degree or more). At baseline, the prevalence of marijuana use was highest among the HIV+ men in the early-cohort (76%) and lowest among the HIV+ men in the late-cohort (36%). However, daily marijuana use, among current users, was highest among the HIV+ men in the late-cohort (20%) and lowest among the HIV− men in the early-cohort (9%).

Trends in the Prevalence of Marijuana

Among the men in the early cohort, the annual prevalence of *current* marijuana use declined significantly from 80% in 1984 to 33% in 2013 among the HIV+ men and from 58% in 1984

to 22% in 2013 among the HIV− men (both p for trend <.0001; Figure 1). The prevalence of *daily* marijuana use among *current users* increased significantly from 14% in 1984 to 32% in 2013 among the HIV+ men and from 9% in 1984 to 22% among the HIV− men (both *p* for trend <.0001). Among the men in the late cohort, prevalence of *current* marijuana use declined modestly from 32% in 2002 to 29% in 2013 among the HIV+ men, and decreased significantly from 37% in 2003 to 26% in 2013 among the HIV− men (*p* for trend <.0001; Figure 2). However, *daily* marijuana use among *current* users increased significantly from 17% in 2002 to 37% in 2013 among the HIV+ men and from 16% in 2002 to 34% in 2013 among the HIV− men (both *p* for trend <.0001). Overall, the prevalence of daily marijuana use among all men in both the early and late cohorts were relatively stable across the follow-up period (Figures 1 and 2). The number of observations contributing to the yearly prevalence estimates for each cohort are displayed in supplemental tables S3 and S4.

Factors Associated Marijuana Use

In the multivariate analyses of data from the combined sample, among the men in the early-cohort, a HIV+ serostatus compared to a HIV− serostatus was significantly associated with a 53% higher prevalence of *current* marijuana use [adjusted prevalence ratio (aPR) =1.53, 95% confidence interval (CI):1.42, 1.64; $p<0.0001$; Table 2) and *daily* marijuana use (aPR=1.70, 95% CI: 1.44, 2.01; $p<0.0001$, supplemental Table S1) with both effects reaching Cohen's small effect size. However, among the men in the late-cohort, there was no statistically significant association between a HIV+ status and prevalence of *current* or *daily* use (Table 2). In both the early (aPR=1.57, 95% CI: 1.51, 1.63, $p<0.0001$) and late (aPR=1.93, 95% CI: 1.73, 2.15, $p<0.0001$) cohorts, heavy alcohol use as compared to non-use was significantly associated with higher prevalence of current marijuana use with both effects reaching Cohen's small effect size. Among the men in the early-cohort, the annual prevalence of *current* marijuana use was significantly10% higher after passage of a MML (aPR=1.10, 95% CI: 1.07, 1.13; $p<0.0001$; Table 2), although this effect did not reach Cohen's small effect size.

In the analysis restricted to the HIV+ men, among participants in the late-cohort, heavy alcohol use as compared to non-use was significantly associated with *current* marijuana use (aPR=1.83, 95% CI: 1.59, 2.12; $p<0.0001$; Table 3). Also, current smoking as compared to never smoked was significantly associated with current marijuana use (aPR=1.67, 95% CI: 1.21, 2.26; $p<0.0001$; Table 3). Both of these associations reach Cohen's small effect size. The associations between CD4+ cell count and detectable HIV viral load and prevalence of marijuana use, though statistically significant did not reach Cohen's small effect size (Table 3). There were several similarities in correlates of use when the analyses for the men in the early and late cohorts were limited to the same time period (i.e. 2002–2013). However, only the association between current smoking as compared to never smoked (late-cohort; aPR=1.69, 95% CI: 1.33, 2.16; $p<0.0001$; Table 3) reached Cohen's small effect size.

The correlates for *daily* marijuana use were similar to those observed for *current* marijuana use (supplemental Table S1 & S2). However, completing graduate work or more as compared to completing a high school diploma or less was significantly associated with lower prevalence of *daily* marijuana use in both the men in the early (aPR= 0.37, 95% CI:

0.29, 0.48; $p<0.0001$; Table S1) and late cohorts (aPR= 0.43, 95% CI: 0.21, 0.86; *p=0.0065*; Table S1) with both effects reaching Cohen's small effect size.

Discussion

In this analyses of the MACS cohort, the annual prevalence of *current* marijuana use decreased over time among all men (1984–2013). However, in contrast, *daily* marijuana use, among those who used marijuana in the previous six months, increased among the HIV+ and HIV− men in both the early- and late- cohort enrollment: increasing by more than two-folds in nearly all groups. Among the participants enrolled before 2001 in the MACS, the HIV+ men reported significantly higher prevalence of *current* and *daily* marijuana use as compared to the HIV− men with results reaching Cohen's small effect size but no significant difference in marijuana use by HIV serostatus among the men enrolled after 2001. Alcohol use, particularly heavy alcohol use was significantly associated with *current* marijuana use and reaching Cohen's small effect size in the analyses for both the early- and late- cohorts. Completing a graduate work or more was negatively associated with *daily* marijuana use and reaching Cohen's small effect size in the analyses for both the early- and late- cohorts. The prevalence of marijuana use increased after passage of a MML in the analysis that included all men in the early-cohort but not for the men in the late-cohort, though these results did not reach Cohen's small effect size. None of the significant associations between HAART use, CD4+ cell count and detectable HIV viral load and prevalence of marijuana use reached Cohen's small effect size.

The contrasting decline in annual prevalence of *current* marijuana use but increasing prevalence of *daily* marijuana use among users found in the current study is consistent with recent data from HIV+ women in the Women's Interagency Study (WIHS) (6), where the authors found that between 1994 to 2010, there was a significant decrease in prevalence of current marijuana use from 21% to 14%. The most plausible explanation for the declining trend in *current* marijuana use may be the advancing age of participants in the MACS. The current study also found that *daily* use (among *current users*) increased significantly in both the HIV+ and HIV− men. One likely explanation for the increase in *daily* use (among users) may be that occasional marijuana users declined use over time. The relatively stable trend in the prevalence of daily use (among all men; Figures 1 & 2) over time supports this explanation.

Between 1984 and 2013 – the period of this study – 3 of the 4 states that have MACS sites passed laws legalizing marijuana for medical purposes. In recent years, attitudes about marijuana use in the US have tempered and there has been an increase in population acceptance of marijuana use (43). Though not reaching Cohen's small effect size, among the men in the early-cohort, passage of a MML was associated with an increase in the prevalence of *current* marijuana use in the analysis including all men, but not in the analysis that included only the HIV+ men. It is possible that the HIV+ men in the early-cohort may have already formed attitudes regarding marijuana use that passage of a MML did not influence their use. Among the men in the late-cohort, passage of MML was not significantly associated with increased marijuana use. This finding may in part be due to the

short time periods pre and post enactment of the laws which may not have provided sufficient time to detect a change in their prevalence of use.

Among the HIV+ men in current study, there were few significant associations between HAART use, CD4+ cell count, detectable viral load and prevalence of marijuana use and of those that were significant none reached Cohen's small effect size. These findings are similar to prior studies that report no significant or clinically meaningful differences in HIV viral load (44,45) or CD4+ cell count among marijuana users (46–48) as compared to non-users. Yet others have found significantly lower HIV viral load (49,50) and higher CD4+ count (49) in marijuana users, although these studies differ methodologically as well as in the samples included. Taken together, these findings underscore the complex relationship between marijuana use and markers of HIV disease stage/progression and therefore warrant further study.

There are some limitations to our study. We relied on self-report of marijuana use and no biological marker of marijuana use was used to confirm the self-reported data. Furthermore, data in the current analyses was collected from an ongoing longitudinal study with extended follow-up, thus attrition due to death or loss to follow-up may have influenced the prevalence estimates. This study did not assess prevalence or trends in marijuana use disorder, recreational versus medical use or other parameters of marijuana use (including route of administration, dose/quantity, or tetrahydrocannabinol potency). Also, it is important to note that the effects for passage of MML and marijuana use reported in this study should not be interpreted as causal. Our study included only four states and two states had insufficient time windows pre and post enactment of laws to provided enough information to discern a change in trend. Despite these limitations, our study has notable strengths. Our study utilized data from a large and diverse sample of HIV+ and HIV− MSM with extensive follow-up period to assess changes in prevalence of and correlates for marijuana use.

Conclusion

In sum, our study indicates a decline over time in the prevalence of *current* marijuana use in this sample of HIV+ and HIV− MSM in the MACS, but in contrast *daily* use among users increased over time. Given that nearly half of states in the US now have laws allowing medical or recreational marijuana use, there is a need for research to continually monitor patterns of marijuana use among HIV+ and HIV− MSM and to further explore the role of passage of medical marijuana laws on marijuana use in these populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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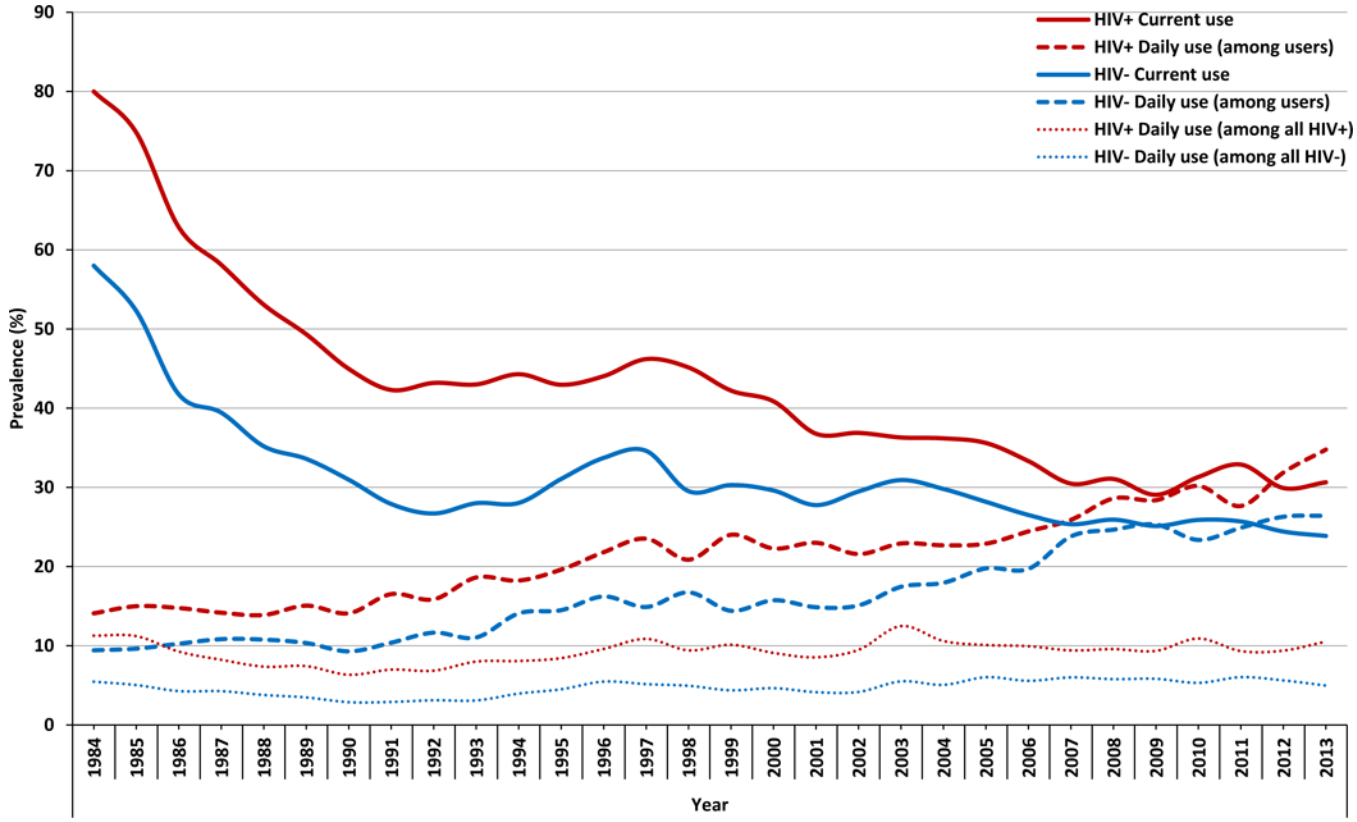

Figure 1.

Annual prevalence of current and daily marijuana use among HIV+ and HIV− MSM in the Multicenter AIDS Cohort Study (MACS): Early-Cohort

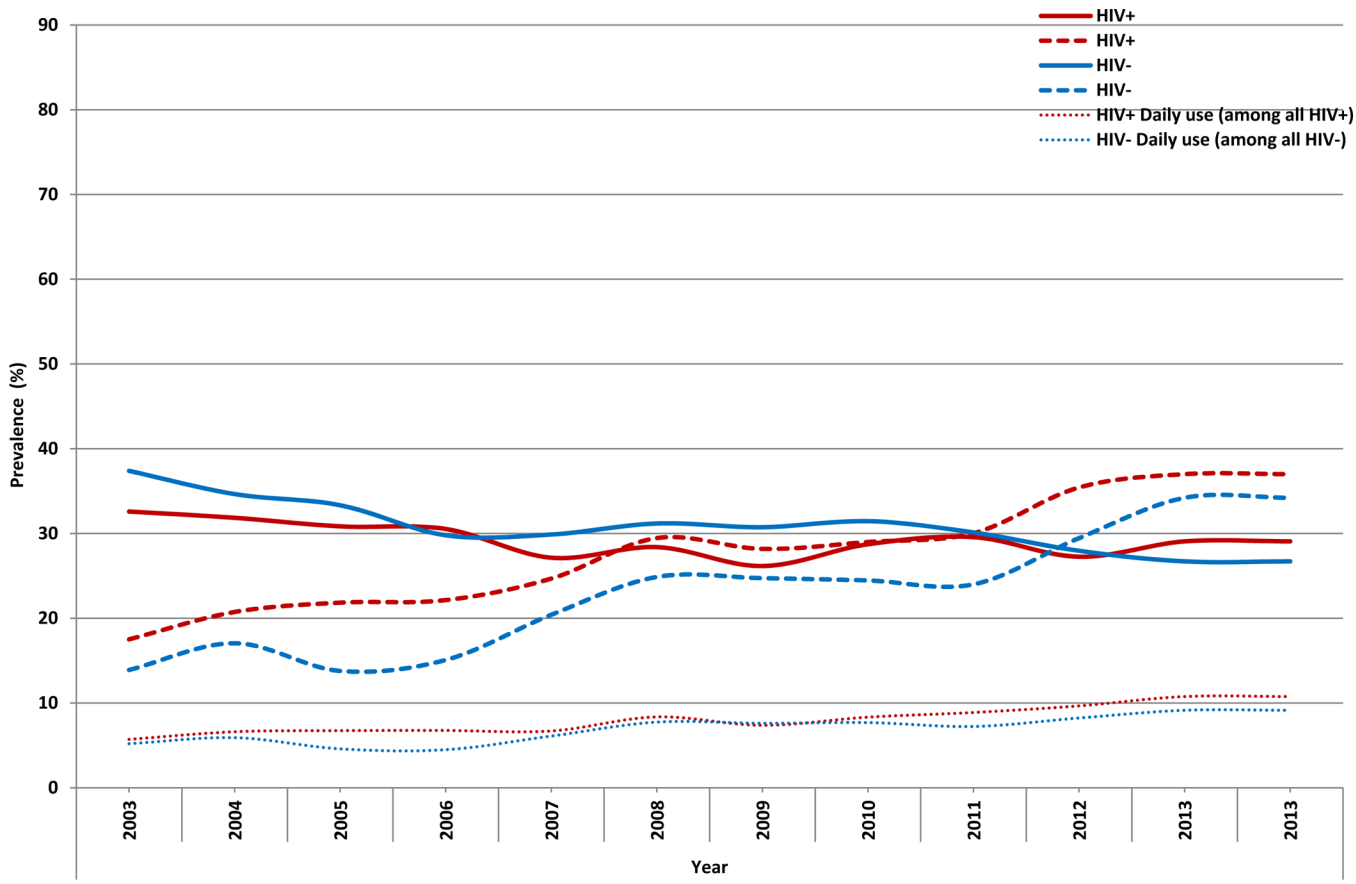

Figure 2.

Annual prevalence of current and daily marijuana use among HIV+ and HIV− MSM in the Multicenter AIDS Cohort Study (MACS): Late-Cohort

Table 1

MACS Participants at Baseline by Enrollment Cohort

Characteristics	Early-Cohort (N=4,775)		Late-Cohort (N=1,139)	
	HIV− (n=2,677)	HIV+ (n=2,098)	HIV− (n=495)	HIV+ (n=644)
	n (%)	n (%)	n (%)	n (%)
Age (mean, SD)	34 (8.3)	33 (6.7)	37 (9.7)	39 (8.2)
Race				
Non-Hispanic, Whites	2355 (88)	1663 (79)	170 (34)	168 (26)
Non-Hispanic, Blacks	183 (7)	262 (13)	235 (48)	309 (48)
Other	137 (5)	173 (8)	90 (18)	167 (26)
Education				
High school diploma or less	305 (12)	328 (16)	166 (34)	272 (42)
Some college or college degree	1309 (49)	1178 (57)	221 (45)	275 (43)
Graduate work or more	1038 (39)	572 (27)	108 (22)	96 (15)
Unemployed	133 (5)	109 (6)	137 (30)	139 (23)
Study center				
Pittsburgh	667 (25)	334 (16)	152 (31)	131 (20)
Baltimore/Washington DC	732 (27)	456 (22)	134 (27)	160 (25)
Chicago	592 (22)	511 (24)	91 (18)	162 (25)
Los Angeles	686 (26)	797 (38)	118 (24)	191 (30)
Depressive symptoms [a]				
CESD ≥ 16	488 (19)	446 (23)	161 (33)	246 (40)
Alcohol use				
None	201 (8)	128 (6)	65 (13)	114 (18)
Low-moderate	1144 (43)	780 (38)	206 (42)	238 (38)
Heavy	1295 (49)	1156 (56)	216 (44)	273 (44)
Smoking				
Never	1180 (44)	820 (39)	126 (26)	173 (28)
Former	550 (21)	400 (19)	101 (21)	125 (20)
Current	936 (35)	864 (41)	260 (53)	327 (52)
Stimulant drug use[b]	1697 (63)	1692 (81)	190 (39)	260 (42)
IDU[c]	76 (3)	231 (12)	71 (15)	105 (17)
Positive Hepatitis C virus antibody	79 (3)	189 (9)	68 (14)	122 (19)
HAART Use[d†]				
No	–	389 (76)	–	226 (35)
Yes	–	121 (23)	–	418 (65)
$CD4^+$ count (cells/cubic milliliter)				
> 500	–	1203 (59)	–	287 (46)
< 500	–	850 (41)	–	338 (54)
HIV viral load				

Characteristics	Early-Cohort (N=4,775)		Late-Cohort (N=1,139)	
	HIV− (n=2,677)	HIV+ (n=2,098)	HIV− (n=495)	HIV+ (n=644)
	n (%)	n (%)	n (%)	n (%)
Undetectable	–	71 (5)	–	312 (49)
Detectable	–	1256 (95)	–	325 (51)
Marijuana use				
No	1151 (43)	495 (24)	290 (60)	399 (64)
Yes	1523 (57)	1599 (76)	197 (40)	222 (36)
Less Often	739 (49)	597 (37)	93 (47)	98 (44)
Monthly	274 (18)	284 (18)	21 (11)	28 (13)
Weekly	369 (24)	486 (30)	53 (27)	52 (23)
Daily	141 (9)	232 (15)	30 (15)	44 (20)

Note.

[a] CESD= Center for Epidemiological Depression Scale;

[b] Includes crack cocaine, methamphetamines (or speed, meth or ice), Ecstasy;

[c] IDU=Intravenous drug use;

[d] HAART=Highly active antiretroviral therapy;

[†] Data for HAART use for the early cohort is obtained from MACS visit 25 (data collection in April1996 – September 1996).

Table 2

Prevalence Ratios of Risk Factors Associated with Current Marijuana Use among All Men

	Prevalence Ratios (95% CI)				
	Early-Cohort			Late-Cohort	
	1984–2013		2003–2013‡	2003–2013‡	
Characteristics	**Univariate**	**Multivariate**	**Multivariate**	**Univariate**	**Multivariate**
Age, per 10-year increase	0.83 (0.79, 0.87)**	0.90 (086, 0.94)**	0.78 (0.63, 0.97)*	0.71 (0.65, 0.78)**	0.79 (0.73, 0.87)**
Race					
White, non-Hispanic	Reference	Reference	Reference	Reference	Reference
Black, non-Hispanic	1.20 (1.06, 1.36)**	1.09 (0.95, 1.25)	1.32 (1.05, 1.65)*	1.07 (0.90, 1.27)	1.23 (1.01, 1.48)*
Other	1.34 (1.18, 1.53)**	1.12 (0.99, 1.27)	0.80 (0.59, 1.08)	1.14 (0.93, 1.42)	0.94 (0.73, 1.20)
Education					
High school diploma or less	Reference	Reference	Reference	Reference	Reference
Some college or college degree	0.80 (0.72, 0.89)**	0.86 (0.78, 0.96)**	0.95 (0.75, 1.19)	1.00 (0.86, 1.17)	0.98 (0.86, 1.13)
Graduate work or more	0.59 (0.53, 0.66)**	0.76 (0.68, 0.85)**	0.93 (0.72, 1.21)	0.53 (0.41, 0.70)**	0.68 (0.52, 0.90)*
Employment					
Employed	Reference	Reference	Reference	Reference	–
Unemployed	1.04 (1.02, 1.07)**	1.02 (1.00, 1.04)*	1.04 (0.97, 1.12)	1.04 (0.99, 1.10)	–
Study center					
Pittsburgh	Reference	Reference	Reference	Reference	Reference
Baltimore/Washington DC	1.01 (0.91, 1.14)	1.15 (1.03, 1.29)*	0.90 (0.69, 1.17)	0.75 (0.60, 0.94)*	0.93 (0.74 1.15)
Chicago	1.32 (1.18, 1.48)**	1.25 (1.11, 1.41)**	1.00 (0.79, 1.28)	0.75 (0.61, 0.93)*	0.79 (0.66, 0.95)*
Los Angeles	1.14 (1.03, 1.27)**	1.22 (1.10, 1.35)**	1.35 (1.06, 1.71)*	1.09 (0.89, 1.33)	1.03 (0.84, 1.27)
Depressive symptoms[a]					
CESD < 16	Reference	Reference	Reference	Reference	Reference
CESD ≥ 16	1.00 (0.99, 1.02)	1.00 (0.99, 1.02)	1.02 (0.98, 1.07)	1.05 (0.99, 1.10)	1.02 (0.97, 1.07)
Alcohol use					
None	Reference	Reference	Reference	Reference	Reference

	Prevalence Ratios (95% CI)				
	Early-Cohort			Late-Cohort	
	1984–2013		2003–2013‡	2003–2013‡	
Characteristics	**Univariate**	**Multivariate**	**Multivariate**	**Univariate**	**Multivariate**
Low-moderate	1.58 (1.52, 1.64) **	1.44 (1.39, 1.49) **	1.44 (1.30, 1.60) **	1.82 (1.64, 2.03) **	1.61 (1.47, 1.77) **
Heavy	1.83 (1.76, 1.91) **	1.57 (1.51, 1.63) **†	1.53 (1.35, 1.74) **	2.33 (2.05, 2.63) **	1.93 (1.73, 2.15) **†
Smoking					
Never	Reference	Reference	Reference	Reference	Reference
Former	1.07 (1.03, 1.11) **	1.17 (1.03, 1.11) **	1.67 (1.35, 2.07) **	1.37 (1.06, 1.77) *	1.26 (0.99, 1.62)
Current	1.28 (1.23, 1.34) **	1.18 (1.14, 1.23) **	1.96 (1.58, 2.45) **	1.92 (1.49, 2.49) **	1.58 (1.22, 2.03) *
Stimulant drug use[b]					
No	Reference	Reference	Reference	Reference	Reference
Yes	1.50 (1.46, 1.52) **	1.40 (1.37, 1.42) **	1.38 (1.28, 1.48) **	1.65 (1.52, 1.78) **	1.51 (1.40, 1.63) **
IDU[c]					
No	Reference	Reference	Reference	Reference	Reference
Yes	1.33 (1.26, 1.40) **	1.09 (1.04, 1.14) **	1.27 (1.02, 1.58) *	1.37 (1.15, 1.64) **	1.12 (0.94, 1.33)
Hepatitis C virus antibody					
Negative	Reference	–	–	Reference	–
Positive	1.04 (0.98, 1.10)	–	–	1.00 (0.88, 1.14)	–
HIV-Serostatus					
HIV−	Reference	Reference	Reference	Reference	Reference
HIV+	1.80 (1.67, 1.93) **	1.53 (1.42, 1.64) **†	1.35 (1.17, 1.55) **	0.85 (0.73, 0.99) *	0.90 (0.79, 1.03)
Medical Marijuana Law					
No	Reference	Reference	Reference	Reference	
Yes	1.17 (1.14, 1.30) **	1.10 (1.07, 1.13) **	1.05 (0.90, 1.22)	1.09 (0.98, 1.21)	–

Note.

[a]CESD= Center for Epidemiological Depression Scale;

[b]Includes crack cocaine, methamphetamines (or speed, meth or ice), Ecstasy;

[c] IDU=Intravenous drug use;

[≠] Results for both cohorts can be compared as analyses spanned the same time period;

[*] P<0.001;

[**] p<0.0001;

[†] Represents a 'small' effect size or greater (Cohen's h or d ≥0.20).

Table 3

Prevalence Ratios of Risk Factors Associated with Current Marijuana Use among HIV+ Men

	Prevalence Ratios (95% CI)				
	Early-Cohort			Late-Cohort	
	1996–2013		2003–2013 ‡	2003–2013 ‡	
Characteristics	**Univariate**	**Multivariate**	**Multivariate**	**Univariate**	**Multivariate**
Age, per 10-year increase	0.78 (0.68, 0.88)**	0.82 (0.70, 0.97)*	0.73 (0.54, 1.00)	0.72 (0.65, 0.83)**	0.77 (0.68, 0.88)**
Race					
White, non-Hispanic	Reference	Reference	Reference	Reference	Reference
Black, non-Hispanic	1.21 (0.97, 1.51)	1.28 (1.04, 1.59)*	1.38 (1.07, 1.79)*	1.09 (0.85, 1.40)	1.29 (0.98, 1.70)
Other	1.15 (0.84, 1.58)	1.06 (0.80, 1.40)	0.78 (0.49, 1.11)	1.19 (0.88, 1.60)	1.14 (0.80, 1.63)
Education					
High school diploma or less	Reference	Reference	Reference	Reference	Reference
Some college or college degree	0.88 (0.69, 1.11)	0.83 (0.67, 1.04)	1.11 (0.81, 1.53)	1.88 (0.96, 1.46)	1.19 (0.98, 1.44)
Graduate work or more	0.71 (0.55, 0.93)*	0.78 (0.60, 1.01)	1.15 (0.80, 1.65)	0.51 (0.33, 0.77)*	0.71 (0.45, 1.10)
Employment					
Employed	Reference	Reference	Reference	Reference	–
Unemployed	1.08 (1.01, 1.17)*	1.07 (1.00, 1.14)*	1.03 (0.93, 1.14)	1.02 (0.94, 1.12)	–
Study center					
Pittsburgh	Reference	Reference	Reference	Reference	Reference
Baltimore/Washington DC	0.99 (0.73, 1.32)	1.06 (0.81, 1.39)	0.97 (0.68, 1.38)	0.81 (0.60, 1.11)	0.80 (0.55, 1.14)
Chicago	1.25 (0.96, 1.63)	1.20 (0.92, 1.57)	1.03 (0.74, 1.42)	0.66 (0.50, 0.88)*	0.63 (0.49, 0.80)**
Los Angeles	1.40 (1.09, 1.79)*	1.51 (1.18, 1.93)*	1.42 (1.03, 1.95)*	0.99 (0.75, 1.31)	0.71 (0.48, 1.02)
Depressive symptoms[a]					
CESD < 16	Reference	–	–	Reference	–
CESD ≥ 16	1.03 (0.99, 1.08)	–	–	1.04 (0.97, 1.10)	–
Alcohol use					
None	Reference	Reference	Reference	Reference	Reference
Low-moderate	1.50 (1.34, 1.67)**	1.41 (1.27, 1.57)**	1.46 (1.24, 1.70)**	1.69 (1.48, 1.93)**	1.50 (1.34, 1.70)**

	Prevalence Ratios (95% CI)				
	Early-Cohort			Late-Cohort	
	1996–2013		2003–2013 ‡	2003–2013 ‡	
Characteristics	**Univariate**	**Multivariate**	**Multivariate**	**Univariate**	**Multivariate**
Heavy	1.67 (1.48, 1.89) **	1.51 (1.65, 1.71) **	1.57 (1.32, 1.86) **	2.18 (1.86, 2.55) **	1.83 (1.59, 2.12) **†
Smoking					
Never	Reference	Reference	Reference	Reference	Reference
Former	1.33 (1.13, 1.58) **	1.34 (1.17, 1.54) **	1.50 (1.17, 1.91) *	1.43 (1.01, 2.01) *	1.35 (1.00, 1.80) *
Current	1.52 (1.28, 1.81) **	1.44 (1.24, 1.68) **	1.69 (1.33, 2.16) **†	1.99 (1.40, 2.81) **	1.67 (1.21, 2.26) **†
Stimulant drug use[c]					
No	Reference	Reference	Reference	Reference	Reference
Yes	1.51 (1.41, 1.62) **	1.45 (1.36, 1.55) **	1.43 (1.30, 1.58) **	1.61 (1.45, 1.80) **	1.48 (1.34, 1.64) **
IDU[d]					
No	Reference	Reference	Reference	Reference	–
Yes	1.40 (1.10, 1.77) *	1.19 (0.98, 1.44)	1.27 (1.02, 1.56) *	1.23 (1.02, 1.48) *	–
Hepatitis C virus antibody					
Negative	Reference	–	–	Reference	–
Positive	0.93 (0.82, 1.04)	–	–	1.09 (0.91, 1.29)	–
HAART Use[e]					
No	Reference	–	Reference	Reference	Reference
Yes	1.00 (0.96, 1.05)	–	1.08 (1.01, 1.18) *	0.92 (0.85, 1.00)	1.03 (0.93, 1.14)
$CD4^+$ count (cells/cubic milliliter)					
> 500	Reference	–	–	Reference	Reference
< 500	0.98 (0.93, 1.03)	–	–	1.11 (1.05, 1.17) **	1.07 (1.01, 1.14) *
HIV viral load					
Undetectable	Reference	–	Reference	Reference	Reference
Detectable	1.01 (0.97, 1.06)	–	1.07 (0.99, 1.16)	1.13 (1.05, 1.21) **	1.10 (1.01, 1.20) *
Medical Marijuana Law				1.13 (0.99, 1.29)	1.11 (0.91, 1.36)
No	Reference	Reference	References		

	Prevalence Ratios (95% CI)				
	Early-Cohort			Late-Cohort	
	1996–2013		2003–2013 ‡	2003–2013 ‡	
Characteristics	**Univariate**	**Multivariate**	**Multivariate**	**Univariate**	**Multivariate**
Yes	1.10 (1.00, 1.21) *	1.04 (0.92, 1.16)	1.06 (0.87, 1.28)	–	–

Note.

[a] CESD= Center for Epidemiological Depression Scale;

[c] Includes crack cocaine, methamphetamines (or speed, meth or ice), Ecstasy;

[d] IDU=Intravenous drug use;

[e] HAART=Highly active antiretroviral therapy;

‡ Results for both cohorts can be compared as analyses spanned the same time period;

* P<0.001;

** p<0.0001;

† Represents a ‘small’ effect size or greater (Cohen’s h or d ≥0.20).