



## Full length article

# Differences in behavioral health disorders and unmet treatment needs between medical marijuana users and recreational marijuana users: Results from a national adult sample



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## ABSTRACT

**Background:** Available data suggest that medical marijuana users may have more mental health problems than recreational marijuana users. There is limited information about differences in behavioral health disorders and unmet treatment needs between medical and recreational marijuana users.

**Methods:** We compared past-year prevalence of behavioral health disorders and unmet treatment needs across three marijuana subgroups (recreational use only, medical use only, and both). Sex-stratified logistic regression was performed to determine their associations with marijuana use status. We analyzed data from adults ( $\geq 18$  years) who used marijuana in the past year ( $N = 15,440$ ) from 2013 to 2014 National Surveys on Drug Use and Health.

**Results:** Among 15,440 past-year marijuana users, 90.2% used recreational marijuana only, 6.2% used medical marijuana only, and 3.6% used both. Both users had the highest prevalence of behavioral health disorders and unmet treatment needs overall, with no significant sex differences. In the sex-specific logistic regression analysis, medical only users and both users showed somewhat different patterns of associations (reference group = recreational only users). Medical only users had decreased odds of alcohol or drug use disorders, and unmet need for alcohol or drug treatment among males and females. Additionally, female medical only users had decreased odds of opioid use disorder. Both users had increased odds of major depressive episode, hallucinogen use disorder, and unmet need for mental health services among males, and cocaine use disorder among females.

**Conclusions:** Different approaches tailored to individuals' sex and motives for marijuana use is needed for the prevention and treatment of behavioral health problems.

## 1. Introduction

Marijuana is the most commonly used recreational drug in the United States. According to data from the National Survey on Drug Use and Health (NSDUH), the prevalence of past-month marijuana use among people aged  $\geq 12$  years in the United States rose steadily from 6.2% in 2002–8.3% in 2015 (Center for Behavioral Health Statistics and Quality (CBHSQ), 2016). Over the past few years, legal status of marijuana has changed rapidly in the United States. In 2012, Colorado and Washington states have legalized recreational use of marijuana for adults (Room, 2014). Since then, six additional states (Alaska, California, Maine, Massachusetts, Nevada, and Oregon) and the District of Columbia approved the adult use of recreational marijuana (National

Conference of State Legislatures, 2017a). The medical use of marijuana is currently legal in 29 states and the District of Columbia (National Conference of State Legislatures, 2017b). Legalization of marijuana for either recreational or medical purposes may increase the availability of marijuana, marijuana-related health care utilization, and marijuana-related problems, such as marijuana-related driving accidents, burns, and a cyclic vomiting syndrome (Hall and Degenhardt, 2009; Joffe et al., 2004; Monte et al., 2015; Wang et al., 2013).

Problematic marijuana use (e.g., chronic or heavy use) is positively associated with the risk of substance use disorder (SUD) and mental illness (Blanco et al., 2016; Volkow et al., 2014). Prior findings revealed that medical marijuana users tended to have more anxiety disorder, but less alcohol use disorder than recreational marijuana users (Compton

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et al., 2017; Park and Wu, 2017). However, differences in patterns of other SUDs and treatment seeking have not been systematically examined in a large representative sample. Although it is recommended for physicians to evaluate patients' illness and substance use history when recommending medical marijuana (Chaudhry et al., 2016), specific guidelines regarding assessment and treatment planning of behavioral health problems are lacking in clinical practices. To inform intervention, this study seeks to explore the patterns of behavioral health disorders and unmet treatment needs, focusing on its correlates with marijuana use status. Such information could aid clinical decisions that will improve treatment effectiveness for behavioral health problems by developing tailored clinical interventions across marijuana subgroups.

An analysis of health care patients in Colorado found that individuals with state-authorized medical marijuana cards used marijuana more frequently, but they were less likely to be involved in risky substance use, such as alcohol, amphetamines, tobacco, any substance, and any controlled substance than individuals without cards (Richmond et al., 2015). Another study focusing on primary care patients in Washington reported similar results, suggesting that medical marijuana users experienced less severe levels of alcohol and drug problems than recreational marijuana users (Roy-Byrne et al., 2015). Likewise, a study of emergency department patients in Southern California found that medical marijuana users had more frequent marijuana use, but lower problematic drug use than recreational marijuana users (Woodruff and Shillington, 2016). These data from single-site or local samples revealed differences in substance use patterns between medical and recreational marijuana users that have clinical implications for treatment planning and research. Thus, it is important to further characterize the extent of mental disorders and SUDs, and their correlates with marijuana use status at a national level.

Moreover, there is limited information about behavioral health service utilization and treatment needs directly from medical marijuana users. Mental disorders and SUDs account for approximately 7.4% of disease burden globally (Whiteford et al., 2013). Despite this substantial burden, a large number of people with mental disorder/SUD remains untreated. According to results from 2014 NSDUH, 4.9% of adults aged  $\geq 18$  years in the United States reported unmet need for mental health services in the past year, which refers to needing mental health care or counseling in the past year, but not receiving it (Han et al., 2015). The number of people reporting unmet need for mental health services in the United States increased steadily from 4.3 million in 1997–7.2 million in 2010 (Roll et al., 2013). Unmet need for drug use treatment was disproportionately more common among individuals with SUDs and comorbid mood/anxiety disorders (Melchior et al., 2014). To date, the information on the extent of unmet need for mental health and substance use treatment among medical marijuana users is lacking. A study of medical marijuana patients at a dispensary in California ( $n = 303$ ) found that 8% were those who had desire to participate in substance abuse treatment but did not attend (Janicsek and Reiman, 2012). Given the differences in mental health and substance use problems by marijuana use status (Compton et al., 2017; Lin et al., 2016; Richmond et al., 2015; Roy-Byrne et al., 2015; Woodruff and Shillington, 2016), it is necessary to know unmet treatment needs across marijuana subgroups to inform appropriate clinical services.

Sex-differences in mental disorders and SUDs have been documented. Findings from U.S. national survey revealed that males have a higher prevalence of SUDs, but a lower prevalence of mental disorders than females (Grant, 1995; Grant et al., 2004a; Kessler et al., 1993; Kessler et al., 1994). Sex is also an important determinant of treatment seeking. Kessler et al. (1981) found that females have more capacity than males to translate nonspecific psychological distress into conscious awareness of mental health problems, which may explain high mental health treatment rates among females. However, females tend to feel more social stigma associated with drug use than males, which may serve as a barrier for treatment seeking for substance abuse problems (Brady and Randall, 1999). To enhance treatment effectiveness, it is

important to have a complete understanding of these sex differences. To date, no previous study has documented whether behavioral health disorders and treatment seeking patterns vary by sex across marijuana subgroups.

In this study, past-year adult marijuana users ( $\geq 18$  years) were categorized into three marijuana subgroups according to self-reported reasons for use: (1) recreational use only, (2) medical use only, and (3) both. This study aims (1) to compare past-year prevalence of behavioral health disorders (major depressive episode [MDE], alcohol and 9 specific SUDs) and unmet treatment needs across three marijuana subgroups, and (2) to determine its associations with marijuana use status. To investigate whether sex differences exist for these associations, sex-stratified analyses were performed.

## 2. Methods

### 2.1. Data source

Data were from 2013 and 2014 NSDUH public use data files. The annual NSDUH is an independent, cross-sectional survey designed to provide ongoing, national estimates of licit and illicit substance use and mental health in the civilian, noninstitutionalized population aged  $\geq 12$  years in the United States (Center for Behavioral Health Statistics and Quality (CBHSQ), 2015). Active military personnel, those of no fixed address (e.g., homeless), and people living in jails, hospitals, or other institutional group quarters were excluded from the survey. The NSUDH employed a multistage area probability sampling strategy, which consists of (1) selection of census tracts, (2) selection of census block groups within census tracts, (3) area segments within census block groups, and (4) selection of dwelling units within segments (Center for Behavioral Health Statistics and Quality (CBHSQ), 2015). The NSDUH used a computer-assisted personal interviewing to assess respondents' demographic characteristics. The NSDUH also used an audio computer-assisted self-interviewing to improve reliability and accuracy of self-reports of mental health and substance use. Weighted screening and interview response rates for household were 83.9% and 71.7%, respectively, in 2013 and 81.9% and 71.2%, respectively, in 2014; refusal rate was 20.9% in 2013 and 21% in 2014 (Center for Behavioral Health Statistics and Quality (CBHSQ), 2015; Center for Behavioral Health Statistics and Quality (CBHSQ), 2014).

In this study, we focused on adults ( $\geq 18$  years) who reported past-year marijuana use. We analyzed 2013–2014 NSDUH because questions regarding medical marijuana use status were included in the survey since 2013. Prior findings suggested that children and adolescents accounted for a very small proportion ( $< 1\%$ ) of medical marijuana users (Fairman, 2016). As a result, a total of 15,440 past-year adult marijuana users (2013:  $n = 7770$ ; 2014:  $n = 7670$ ) were included for the analysis.

### 2.2. Study variables

#### 2.2.1. Sociodemographic variables

Sociodemographic variables included age (18–25, 26–34, 35–49, 50 or older), sex (male, female), race/ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic Native American or Alaska Native, Native Hawaiian or other Pacific Islander/Asian, more than one race, Hispanic), education (less than high school, high school graduate, some college, college graduate), marital status (married, widowed/divorced/separated, never been married), household income ( $\leq \$49,999$ ,  $\$50,000$ – $\$74,999$ ,  $\geq \$75,000$ ), and frequency of past-year marijuana use (1–11 days, 12–49 days, 50–99 days, 100–299 days, 300–365 days). These sociodemographic variables were included as control variables in the analysis because they were found to be associated with behavioral health disorders and treatment seeking (Chen et al., 1997; Grant et al., 2009; Wang et al., 2005). Survey year (2013 and 2014) was included as a categorical covariate to control for year effects.

**Table 1**  
Sociodemographic characteristics of adults (aged ≥ 18 years) who used marijuana in the past-year.

| Characteristics, column%                | Overall (N = 15,440) | Medical use only<br>(n = 597;6.2%) | Medical and Recreational use<br>(n = 499; 3.6%) | Recreational use only (n = 14,344;<br>90.2%) |
|---|----------------------|------------------------------------|---|--|
|   | % (SE)               | % (95% CI)                         | % (95% CI)                                      | % (95% CI)                                   |
| <b>Age in years</b>                     |                      |                                    |   |  |
| 18–25                                   | 35.97 (0.64)         | 15.45 (12.40–18.50)                | 31.56 (26.00–37.11)                             | 37.55 (36.17–38.92)                          |
| 26–34                                   | 25.25 (0.62)         | 25.06 (20.63–29.50)                | 23.30 (18.22–28.38)                             | 25.34 (24.06–26.61)                          |
| 35–49                                   | 19.95 (0.50)         | 25.82 (21.29–30.35)                | 23.33 (18.69–27.96)                             | 19.41 (18.36–20.45)                          |
| 50 +                                    | 18.83 (0.77)         | 33.65 (26.17–41.13)                | 21.81 (15.02–28.58)                             | 17.70 (16.16–19.23)                          |
| <b>Sex</b>                              |                      |                                    |   |  |
| Male                                    | 60.86 (0.68)         | 61.77 (55.88–67.66)                | 59.52 (52.68–66.35)                             | 60.85 (59.47–62.22)                          |
| Female                                  | 39.14 (0.68)         | 38.22 (32.33–44.11)                | 40.48 (33.64–47.31)                             | 39.15 (37.77–40.52)                          |
| <b>Race/ethnicity</b>                   |                      |                                    |   |  |
| Non-Hispanic White                      | 68.08 (0.66)         | 70.02 (63.58–76.46)                | 74.15 (68.99–79.30)                             | 67.70 (66.38–69.01)                          |
| Non-Hispanic Black                      | 13.84 (0.48)         | 7.48 (3.70–11.26)                  | 7.41 (5.04–9.78)                                | 14.53 (13.52–15.52)                          |
| AIAN                                    | 0.78 (0.08)          | 1.41 (0.35–2.46)                   | 0.50 (0.14–0.85)                                | 0.75 (0.58–0.91)                             |
| NHPI/Asian                              | 2.44 (0.19)          | 1.95 (0.65–3.23)                   | 2.72 (0.68–4.75)                                | 2.47 (2.07–2.86)                             |
| More than one race                      | 2.69 (0.20)          | 4.93 (2.52–7.33)                   | 2.77 (1.60–3.94)                                | 2.53 (2.08–2.98)                             |
| Hispanic                                | 12.17 (0.41)         | 14.21 (10.16–18.25)                | 12.45 (9.08–15.79)                              | 12.02 (11.14–12.89)                          |
| <b>Education</b>                        |                      |                                    |   |  |
| Less than High school                   | 13.55 (0.45)         | 14.07 (10.02–18.11)                | 17.14 (12.56–21.70)                             | 13.38 (12.44–14.31)                          |
| High school graduate                    | 29.79 (0.61)         | 29.37 (23.47–35.25)                | 27.95 (22.79–33.11)                             | 29.89 (28.61–31.16)                          |
| Some college                            | 31.76 (0.60)         | 36.69 (31.17–42.20)                | 34.25 (28.00–40.50)                             | 31.32 (30.12–32.51)                          |
| College graduate                        | 24.90 (0.67)         | 19.87 (15.52–24.22)                | 20.66 (14.31–26.99)                             | 25.41 (24.02–26.79)                          |
| <b>Marital status</b>                   |                      |                                    |   |  |
| Married                                 | 26.55 (0.68)         | 34.17 (28.92–39.42)                | 22.38 (17.17–27.59)                             | 26.19 (24.75–27.63)                          |
| Widowed/Divorced/Separated              | 14.37 (0.50)         | 24.29 (18.99–29.58)                | 24.21 (17.80–30.61)                             | 13.30 (12.23–14.35)                          |
| Never been married                      | 59.08 (0.79)         | 41.54 (34.95–48.12)                | 53.41 (47.30–59.51)                             | 60.51 (58.80–62.20)                          |
| <b>Total household Income</b>           |                      |                                    |   |  |
| ≤ \$49,999                              | 57.97 (0.65)         | 65.34 (59.73–70.95)                | 65.57 (57.64–73.51)                             | 57.17 (55.81–58.53)                          |
| \$50,000–\$74,999                       | 14.54 (0.49)         | 15.82 (11.80–19.83)                | 11.76 (7.99–15.54)                              | 14.56 (13.52–15.59)                          |
| ≥ \$75,000                              | 27.49 (0.64)         | 18.84 (14.26–23.40)                | 22.65 (15.54–29.76)                             | 28.27 (26.91–29.62)                          |
| <b>Frequency of marijuana use (/yr)</b> |                      |                                    |   |  |
| 1–11 days                               | 28.76 (0.59)         | 12.51 (8.76–16.25)                 | 9.18 (6.04–12.32)                               | 30.64 (29.42–31.85)                          |
| 12–49 days                              | 17.62 (0.50)         | 9.13 (5.74–12.50)                  | 12.64 (6.61–18.66)                              | 18.40 (17.29–19.49)                          |
| 50–99 days                              | 10.06 (0.38)         | 7.51 (5.47–9.55)                   | 7.70 (5.05–10.34)                               | 10.32 (9.46–11.18)                           |
| 100–299 days                            | 24.22 (0.63)         | 29.16 (24.96–33.34)                | 33.88 (28.27–39.47)                             | 23.50 (22.16–24.83)                          |
| 300–365 days                            | 19.34 (0.59)         | 41.69 (36.06–47.30)                | 36.60 (30.33–42.86)                             | 17.14 (15.96–18.31)                          |
| <b>Survey Year</b>                      |                      |                                    |   |  |
| Year 2013                               | 48.11 (0.67)         | 44.79 (38.39–51.19)                | 45.81 (39.43–52.18)                             | 48.43(46.99–49.85)                           |
| Year 2014                               | 51.89 (0.67)         | 55.20 (48.80–61.60)                | 54.19 (47.81–60.56)                             | 51.57 (50.14–53.00)                          |

Sample size is unweight, and results are weighted estimates.

SE = Standard Error; CI = Confidence Interval; AIAN = American Indian and Alaska Natives; NHPI = Native Hawaiian and Pacific Islander.

**2.2.2. Marijuana use status**

In the NSDUH, individuals who reported marijuana use in the past 12 months were asked “Earlier, you reported using marijuana in the past year. Was any of your marijuana use in the past 12 months recommended by a doctor?” Individuals who answered ‘no’ to this question were considered as recreational only users. Among individuals who indicated any medical marijuana use in the past 12 months, respondents were considered as medical only users if they answered ‘yes’ to the following question: “Was all of your marijuana use in the past 12 months recommended by a doctor or other health care professional?” Any past-year medical marijuana users who answered ‘no’ to this question were considered as both users.

**2.2.3. Diagnostic variables of past-Year behavioral health disorders**

Diagnostic variables of past-year behavioral health disorders included MDE, alcohol and 9 specific SUDs. In the NSDUH, MDE was assessed based on the DSM-IV criteria (American Psychiatric Association APA, 2000; Kessler et al., 2005). Respondents were classified as having a lifetime MDE if they had at least five or more of nine MDE symptoms during a 2-week period in their lifetime, in which at least one of the MDE symptoms was a depressed mood or loss of interest or pleasure in daily activities. Individuals who had a lifetime MDE were considered as having a past-year MDE if the depressed mood or loss of

interest or pleasure has been presented for at least 2-week period in the past 12 months, while also having some of other lifetime MDE symptoms. Based on the DSM-IV (American Psychiatric Association APA, 2000), alcohol and 9 specific SUDs (including abuse of or dependence on marijuana, inhalants, hallucinogens, tranquilizers, cocaine, heroin, opioid pain relievers, sedatives, and stimulants) were defined. For example, respondents were considered as having a specific SUD if they met abuse or dependence criteria for the given substance use.

**2.2.4. Past-Year unmet needs for mental health and substance use treatment**

Unmet need for mental health services in the past year among adults (≥ 18 years) was assessed based on a question “During the past 12 months, was there any time when you needed mental health treatment or counseling for yourself but didn’t get it?” As an indication of unmet need for substance use treatment, the NSDUH measured people who needed treatment for alcohol and/or drugs but did not receive it at a special facility (hospitals/inpatient, rehabilitation facilities/inpatient or outpatient, or mental health centers) in the past year (Han et al., 2015). Based on the NSDUH, respondents were considered as needing treatment if they had abuse or dependence, or if they had received treatment at a special facility in the past year.

### 2.3. Data analysis

We examined differences in the sociodemographic characteristics across three marijuana use subgroups ( $\geq 18$  years). We then estimated past-year prevalence of behavioral health disorders and unmet treatment needs across three marijuana use subgroups. To account for sex variations in behavioral health disorders and treatment seeking patterns (Brady and Randall, 1999), we stratified our analysis by sex. Sex-stratified logistic regression analysis was performed to examine associations of each of behavioral health disorders and unmet treatment needs with marijuana use status (reference group = recreational only users), adjusting for age, race/ethnicity, education, marital status, household income, frequency of past-year marijuana use, and survey year. All analyses were conducted on data weighted by the NSDUH-defined weighting, clustering, and stratification variables to account for the NSDUH's complex survey design. All results, except for sample size, are weighted figures to reflect national estimates. 95% confidence intervals (CI) are reported for each prevalence estimate and adjusted odds ratio to ease interpretation. All analyses were performed using SAS version 9.4 (SAS Institute, INC., Cary, NC).

## 3. Results

### 3.1. Sociodemographic characteristics (Table 1)

Among 15,440 adults who used marijuana in the past year, 90.2% (95% CI: 89.36–91.18) used recreational marijuana only, 6.2% (95% CI: 5.37–6.95) used medical marijuana only, and 3.6% (95% CI: 3.04–4.06) used both. Among adults who reported any medical marijuana use in the past year, 36.6% (95% CI: 31.98–41.18) also reported recreational use. More than one-half of respondents in all marijuana subgroups were male, white, and individuals with a household income  $\leq$  \$49,999. Medical only users and both users had relatively higher frequency of past-year marijuana use than recreational only users.

### 3.2. Past-year prevalence of behavioral health disorders (Table 2)

Table 2 displays past-year prevalence of behavioral health disorders across three marijuana subgroups. Both users had the highest prevalence of drug or alcohol use disorders (37.26%, 95% CI: 31.04–43.48) and MDE (20.40%, 95% CI: 15.51–25.30) overall, with no significant differences between males and females. The prevalence of 9 specific SUDs was modestly similar across three marijuana subgroups, except for marijuana and cocaine, which were considerably higher among both users. The lowest prevalence of drug or alcohol use disorders was noted among medical only users (21.84%, 95% CI: 17.47–26.21), and there were no significant sex differences. Recreational only users had the lowest prevalence of MDE overall (11.11%, 95% CI: 10.37–11.86), with significant differences between males (8.24%, 95% CI: 7.30–9.19) and females (15.57%, 95% CI: 14.21–16.92). Additionally, male recreational only users reported more SUDs, particularly alcohol and marijuana, than female recreational only users.

### 3.3. Adjusted analysis of past-Year behavioral health disorders by marijuana use status (Table 3)

Table 3 displays results of sex-stratified logistic regression that determined the associations of each of the behavioral health disorders with marijuana use status, adjusting for age, race/ethnicity, education, marital status, household income, frequency of past-year marijuana use, and survey year. In the sex-stratified analysis, medical only users and both users yielded somewhat different patterns of associations. When compared with recreational only users, medical only users had decreased odds of alcohol or drug use disorders among both males and females. In addition, female medical only users had decreased odds of opioid use disorder. Unlike medical only users, both users had increased

odds of MDE and hallucinogen use disorder among males. Among females, both users had increased odds of cocaine use disorder.

### 3.4. Past-year prevalence of unmet needs for mental health and substance use treatment (Table 4)

Both users had the highest prevalence of unmet need for mental health services (20.07%, 95% CI: 15.63–24.52) and alcohol or drug use treatment utilization (33.93%, 95% CI: 28.12–39.73) overall, with no significant sex differences. Medical only users had the lowest prevalence of unmet need for drug or alcohol use treatment (19.70%, 95% CI: 15.70–23.70), with no significant sex differences. The lowest prevalence of unmet need for mental health services was noted among recreational only users (10.73%, 95% CI: 9.82–11.63) overall, with significant differences between males (7.26%, 95% CI: 6.28–8.25) and females (16.10%, 95% CI: 14.42–17.78). Additionally, male recreational only users (32.18%, 95% CI: 30.59–33.78) reported more unmet need for drug or alcohol use treatment than female recreation only users (25.88% 95% CI: 24.07–27.70).

### 3.5. Adjusted analysis of unmet need for mental health and substance use treatment by marijuana use status (Table 5)

The sex-stratified logistic regression analysis showed similarities and differences in the associations of unmet treatment needs with marijuana use status. When compared with recreational only use, medical only use was negatively associated with unmet need for drug or alcohol use treatment among both males and females. Both use was positively associated with unmet need for mental health services among males but not among females.

## 4. Discussion

We analyzed 2013–2014 NSDUH using sex-stratified analysis to estimate the prevalence of behavioral health disorders and unmet treatment needs across three marijuana use subgroups (recreational use only, medical use only, and both) and to determine their associations with marijuana use status. This study revealed that the prevalence of behavioral health disorders and unmet treatment needs differed across three marijuana use subgroups, with the highest prevalence in both users overall. This may be partially explained by the possibility that combined use of medical and recreational marijuana may worsen health risks of regular or heavy marijuana use, such as development of addiction and mental disorder (Fergusson et al., 2006; Volkow et al., 2014). Given the high prevalence of behavior health disorders among both users, it is not surprising that both users also had the highest unmet treatment needs, compared to other two groups. Based on these findings, health professionals should expect that both users may be more likely to suffer from behavior health problems and difficulties in seeking help than medical or recreational only users. In clinical practice, it is important to enhance screening for mental health and substance abuse problems as a routine checkup for both users before and after a physician recommends medical marijuana. In contrast to previous studies conducted in the general US adult samples (Compton et al., 2007; Eaton et al., 2012), sex differences in the prevalence of behavior health disorders were not seen in medical marijuana user groups, with the exception of MDE among medical only users. The magnitude of sex differences may be attenuated by use of medical marijuana as a psychopharmacological treatment for mental problems or a substitute for alcohol or drugs (Lucas et al., 2016; Reiman, 2007; Reiman, 2009; Walsh et al., 2013; Webb and Webb, 2014).

The associations of each of behavior health disorders and unmet treatment needs with marijuana use status varied by sex. In addition, it is worth noting that medical only users and both users had different patterns of sex-specific associations. Consistent with previous findings (Compton et al., 2017), medical use only was negatively associated

**Table 2**  
Prevalence of past-year behavioral health disorders by past-year marijuana use status.

| a. Medical use only               |                      | Prevalence% (95% CI)       |                            |  |
|-----------------------------------|----------------------|----------------------------|----------------------------|--|
| Behavioral health disorder        | Overall (N = 597)    | Male (n = 365)             | Female (n = 232)           |  |
| MDE                               | 14.11 (10.66–17.55)  | <b>9.73 (4.73–14.73)</b>   | <b>21.18 (16.96–25.40)</b> |  |
| Alcohol                           | 12.35 (9.05–15.64)   | 12.57 (8.79–16.35)         | 11.99 (7.78–16.19)         |  |
| Marijuana                         | 11.45 (7.56–15.35)   | 13.25 (7.94–18.55)         | 8.56 (5.58–11.53)          |  |
| Opioid pain reliever              | 2.29 (0.87–3.70)     | 3.02 (1.17–4.88)           | 1.10 (0.35–1.84)           |  |
| Cocaine                           | 1.43 (0.15–2.72)     | 1.00 (0.00–2.05)           | 2.13 (1.35–2.91)           |  |
| Tranquilizer <sup>a</sup>         | 0.47 (0.00–1.14)     | 0.76 (0.00–1.85)           | 0                          |  |
| Hallucinogen <sup>a</sup>         | 0.45 (0.00–0.94)     | 0.60 (0.00–1.36)           | 0.22 (0.00–0.59)           |  |
| Stimulant <sup>a</sup>            | 0.36 (0.00–0.82)     | 0.48 (0.00–1.19)           | 0.18 (0.00–0.54)           |  |
| Heroin <sup>a</sup>               | 0.51 (0.02–1.01)     | 0.71 (0.00–1.48)           | 0.21 (0.00–0.58)           |  |
| Sedative <sup>a</sup>             | 0.008 (0.00–0.02)    | 0                          | 0.02 (0.01–0.02)           |  |
| Inhalant <sup>a</sup>             | 0.23 (0.00–0.55)     | 0.37 (0.00–0.74)           | 0                          |  |
| Illicit drug                      | 13.94 (9.89–17.99)   | 15.72 (10.23–21.21)        | 11.06 (7.89–14.23)         |  |
| illicit drug other than marijuana | 4.51 (2.71–6.30)     | 5.37 (3.48–7.25)           | 3.12 (1.88–4.36)           |  |
| Illicit drug or alcohol           | 21.84 (17.47–26.21)  | 23.65 (19.22–28.08)        | 18.92 (13.51–24.33)        |  |
| b. Medical and recreational use   |                      | Prevalence% (95% CI)       |                            |  |
| Behavioral health disorder        | Overall (N = 499)    | Male (n = 298)             | Female (n = 201)           |  |
| MDE                               | 20.40 (15.51–25.30)  | 21.87 (16.35–27.39)        | 18.25 (10.16–26.33)        |  |
| Alcohol                           | 20.20 (15.31–25.09)  | 23.14 (17.32–28.97)        | 15.87 (10.21–21.54)        |  |
| Marijuana                         | 19.22 (15.38–23.07)  | 20.12 (14.72–25.52)        | 17.90 (13.46–22.33)        |  |
| Opioid pain reliever              | 3.64 (1.58–5.70)     | 4.01 (1.56–6.47)           | 3.10 (0.98–5.23)           |  |
| Cocaine                           | 4.85 (3.14–6.56)     | 4.51 (2.27–6.76)           | 5.34 (3.55–7.14)           |  |
| Tranquilizer <sup>a</sup>         | 1.83 (0.57–3.09)     | 1.74 (0.46–3.03)           | 1.95 (1.59–2.32)           |  |
| Hallucinogen <sup>a</sup>         | 1.73 (0.21–3.24)     | 2.64 (0.17–5.10)           | 0.39 (0.32–0.47)           |  |
| Stimulant <sup>a</sup>            | 1.48 (0.70–2.26)     | 2.01 (0.85–3.18)           | 0.70 (0.04–1.37)           |  |
| Heroin <sup>a</sup>               | 2.37 (1.08–3.65)     | 2.44 (1.53–3.35)           | 2.26 (0.13–4.39)           |  |
| Sedative <sup>a</sup>             | 0.39 (0.00–1.16)     | 0                          | 0.96 (0.78–1.14)           |  |
| Inhalant <sup>a</sup>             | 0.35 (0.30–0.39)     | 0.58 (0.49–0.68)           | 0                          |  |
| Illicit drug                      | 24.18 (19.95–28.41)  | 24.22 (18.53–29.90)        | 24.12 (18.53–29.71)        |  |
| illicit drug other than marijuana | 9.36 (6.75–11.97)    | 8.80 (5.94–11.66)          | 10.19 (6.88–13.49)         |  |
| Illicit drug or alcohol           | 37.26 (31.04–43.48)  | 40.25 (33.53–46.98)        | 32.86 (25.29–40.44)        |  |
| c. Recreational use only          |                      | Prevalence% (95% CI)       |                            |  |
| Behavioral health disorder        | Overall (N = 14,344) | Male (n = 8074)            | Female (n = 6270)          |  |
| MDE                               | 11.11 (10.37–11.86)  | <b>8.24 (7.30–9.19)</b>    | <b>15.57 (14.21–16.92)</b> |  |
| Alcohol                           | 23.01 (21.90–24.12)  | <b>24.75 (23.20–26.30)</b> | <b>20.31 (18.52–22.09)</b> |  |
| Marijuana                         | 10.94 (10.19–11.69)  | <b>12.13 (11.14–13.12)</b> | <b>9.09 (7.80–10.38)</b>   |  |
| Opioid pain reliever              | 3.22 (2.71–3.72)     | 3.23 (2.65–3.80)           | 3.20 (2.36–4.05)           |  |
| Cocaine                           | 1.75 (1.40–2.09)     | 2.00 (1.50–2.50)           | 1.36 (0.90–1.81)           |  |
| Tranquilizer <sup>a</sup>         | 0.80 (0.58–1.02)     | 0.71 (0.45–0.97)           | 0.93 (0.55–1.31)           |  |
| Hallucinogen <sup>a</sup>         | 0.40 (0.31–0.49)     | 0.40 (0.28–0.53)           | 0.40 (0.25–0.54)           |  |
| Stimulant <sup>a</sup>            | 0.89 (0.57–1.22)     | 0.76 (0.53–0.99)           | 1.10 (0.41–1.80)           |  |
| Heroin <sup>a</sup>               | 1.29 (1.03–1.56)     | 1.47 (1.11–1.83)           | 1.02 (0.70–1.34)           |  |
| Sedative <sup>a</sup>             | 0.14 (0.05–0.22)     | 0.12 (0.00–0.24)           | 0.16 (0.02–0.29)           |  |
| Inhalant <sup>a</sup>             | 0.06 (0.02–0.10)     | 0.06 (0.00–0.11)           | 0.07 (0.01–0.13)           |  |
| Illicit drug                      | 15.43 (14.63–16.23)  | <b>16.69 (15.60–17.77)</b> | <b>13.48 (12.03–14.92)</b> |  |
| illicit drug other than marijuana | 6.07 (5.41–6.74)     | 6.32 (5.56–7.08)           | 5.69 (4.62–6.75)           |  |
| Illicit drug or alcohol           | 32.27 (31.01–33.53)  | <b>34.77 (33.03–36.50)</b> | <b>28.39 (26.48–30.30)</b> |  |

Sample size is unweight, and results are weighted estimates.

MDE = Major Depressive Episode; CI = Confidence Interval. Bold-faced: significant sex differences ( $p < 0.05$ ).

Note: Illicit drug use disorders referred to any drug abuse of or dependence on any of the following drugs: marijuana, hallucinogens, inhalants, tranquilizers, cocaine, heroin, opioid pain relievers, stimulants, or sedatives.

<sup>a</sup> These estimates are limited by a small sample size and considered preliminary.

with drug or alcohol use disorders and unmet need for drug use disorder treatment among both males and females. This is probably due to use of medical marijuana as a substitute for alcohol or other drugs (Lucas et al., 2016; Reiman, 2007; Reiman, 2009), which might be related to reduction in alcohol use and alcohol-related problems (Mikuriya, 2004). Medical use only was also negatively associated with opioid use disorder among females. Available evidence suggests that medical marijuana can be used as an alternative to opioids, which may be related to a decrease in opioid misuse (Boehnke et al., 2016; Piper et al., 2017; Powell et al., 2015). As more attention is given to use of medical

marijuana to manage pain, further longitudinal research is warranted to examine changes in opioid misuse/use disorder among female medical only users. Interestingly, different patterns of associations were found among both users. Among males, both use was positively associated with hallucinogen use disorder, MDE, and unmet need for mental health services. A small proportion of people with hallucinogen use disorder might contribute to the strong association. Among females, both use was positively associated with cocaine use disorder. Previous studies indicated that marijuana may serve as a gateway to cocaine use (Desimone, 1998; van Ours, 2003). Thus, it is important to establish

**Table 3**  
Adjusted logistic regression model of past-year behavioral health disorders in relation to past-year marijuana use status.

| Behavioral health disorder (DV)   | Adjusted OR (95% CI)                              |   |   |   |   |   |
|-----------------------------------|---|---|---|---|---|---|
|                                   | Overall (n = 15,440)                              |   | Male (n = 8737)                                   |   | Female (n = 6703)                                 |   |
|                                   | Medical use only vs. recreational use only (ref.) | Medical and recreational use vs. recreational use only (ref.) | Medical use only vs. recreational use only (ref.) | Medical and recreational use vs. recreational use only (ref.) | Medical use only vs. recreational use only (ref.) | Medical and recreational use vs. recreational use only (ref.) |
| MDE                               | 1.19 (0.85–1.66)                                  | <b>1.74 (1.19–2.56)</b>                                       | 1.06 (0.59–1.90)                                  | <b>2.64 (1.64–4.27)</b>                                       | 1.29 (0.81–2.07)                                  | 1.03 (0.59–1.80)  |
| Alcohol                           | <b>0.49 (0.36–0.67)</b>                           | 0.83 (0.60–1.16)  | <b>0.45 (0.31–0.65)</b>                           | 0.88 (0.61–1.27)  | 0.59 (0.31–1.10)                                  | 0.79 (0.44–1.42)  |
| Marijuana                         | 0.78 (0.50–1.20)                                  | 1.31 (0.97–1.76)  | 0.88 (0.52–1.48)                                  | 1.28 (0.85–1.95)  | 0.53 (0.26–1.07)                                  | 1.30 (0.76–2.22)  |
| Opioid pain reliever              | 0.58 (0.30–1.12)                                  | 0.86 (0.44–1.67)  | 0.83 (0.39–1.80)                                  | 0.96 (0.42–2.23)  | <b>0.26 (0.10–0.68)</b>                           | 0.74 (0.25–2.16)  |
| Cocaine                           | 0.76 (0.28–2.03)                                  | <b>2.56 (1.53–4.27)</b>                                       | 0.48 (0.14–1.58)                                  | 2.08 (0.96–4.50)  | 1.37 (0.34–5.53)                                  | <b>4.18 (1.68–10.37)</b>                                      |
| Tranquilizer                      | 0.60 (0.14–2.50)                                  | 1.97 (0.75–5.18)  | 1.12 (0.25–4.99)                                  | 2.32 (0.73–7.36)  | – <sup>a</sup>                                    | 1.91 (0.56–6.43)  |
| Hallucinogen                      | 1.51 (0.47–4.78)                                  | <b>2.91 (1.14–7.41)</b>                                       | 1.79 (0.43–7.32)                                  | <b>3.71 (1.39–9.88)</b>                                       | 1.07 (0.18–6.21)                                  | 0.72 (0.09–5.82)  |
| Stimulant                         | 0.45 (0.12–1.61)                                  | 1.54 (0.70–3.38)  | 0.68 (0.14–3.14)                                  | 2.37 (0.99–5.69)  | 0.16 (0.02–1.35)                                  | 0.63 (0.15–2.55)  |
| Heroin                            | 0.38 (0.14–1.03)                                  | 1.51 (0.71–3.22)  | 0.46 (0.14–1.50)                                  | 1.27 (0.45–3.52)  | 0.19 (0.03–1.20)                                  | 2.22 (0.79–6.21)  |
| Sedative                          | – <sup>a</sup>                                    | – <sup>a</sup>  | – <sup>a</sup>                                    | – <sup>a</sup>  | 0.17 (0.01–1.78)                                  | 4.95 (0.36–66.77)   |
| Inhalant                          | 4.94 (0.68–35.90)                                 | 4.00 (0.30–53.04)   | 10.21 (0.92–112.89)                               | 6.96 (0.32–148.87)  | – <sup>a</sup>                                    | – <sup>a</sup>  |
| Illicit drug                      | 0.69 (0.48–1.01)                                  | 1.24 (0.94–1.63)  | 0.78 (0.49–1.24)                                  | 1.16 (0.78–1.72)  | <b>0.49 (0.26–0.91)</b>                           | 1.33 (0.82–2.15)  |
| Illicit drug other than marijuana | 0.65 (0.42–1.01)                                  | 1.29 (0.86–1.92)  | 0.78 (0.50–1.21)                                  | 1.12 (0.65–1.93)  | 0.44 (0.15–1.31)                                  | 1.59 (0.84–2.99)  |
| Illicit drug or alcohol           | <b>0.53 (0.40–0.69)</b>                           | 1.05 (0.79–1.41)  | <b>0.54 (0.41–0.72)</b>                           | 1.08 (0.78–1.51)  | <b>0.49 (0.29–0.80)</b>                           | 1.01 (0.63–1.61)  |

Sample size is unweight, and results are weighted estimates.

Bold-faced:  $p < 0.05$ .

OR = Odds Ratio; CI = Confidence Interval; MDE = Major Depressive Episode; DV = Dependent Variable.

Note: Separate sex-specific logistic regression model was performed to examine the associations between each of the behavioral health disorders (DVs) with past-year marijuana use status (key independent variable, reference group = recreational use only), adjusting for age, race/ethnicity, education, marital status, household income, frequency of past-year marijuana use, and survey year.

<sup>a</sup> OR was not generated due to a small sample size.

**Table 4**  
Past-year prevalence of unmet need for mental health and substance use treatment by past-year marijuana use status.

| a. Medical use only                   | Prevalence%(95% CI)  |                            |                            |
|---------------------------------------|----------------------|----------------------------|----------------------------|
| Unmet need for                        | Overall (N = 597)    | Male (n = 365)             | Female (n = 232)           |
| Mental health treatment               | 13.12 (9.21–17.02)   | 10.27 (5.03–15.50)         | 17.73 (13.15–22.31)        |
| Alcohol use treatment                 | 11.00 (7.80–14.20)   | 11.37 (7.79–14.95)         | 10.41 (6.72–14.09)         |
| Illicit drug use treatment            | 13.37 (9.60–17.13)   | 15.72 (10.23–21.21)        | 9.57 (6.56–12.57)          |
| Illicit drug or alcohol use treatment | 19.70 (15.70–23.70)  | 21.95 (17.39–26.50)        | 16.07 (11.14–21.00)        |
| b. Medical and recreational use       | Prevalence% (95% CI) |                            |                            |
| Unmet need for                        | Overall (N = 499)    | Male (n = 298)             | Female (n = 201)           |
| Mental health treatment               | 20.07 (15.63–24.52)  | 17.74 (13.90–21.57)        | 23.51 (15.43–31.59)        |
| Alcohol use treatment                 | 19.32 (14.60–24.05)  | 21.67 (15.96–27.38)        | 15.87 (10.21–21.54)        |
| Illicit drug use treatment            | 21.46 (17.47–25.45)  | 21.62 (16.42–26.83)        | 21.22 (16.10–26.34)        |
| Illicit drug or alcohol use treatment | 33.93 (28.12–39.73)  | 36.77 (30.37–43.18)        | 29.74 (22.65–36.83)        |
| c. Recreational use only              | Prevalence% (95% CI) |                            |                            |
| Unmet need for                        | Overall (N = 14,344) | Male (n = 8074)            | Female (n = 6270)          |
| Mental health treatment               | 10.73 (9.82–11.63)   | <b>7.26 (6.28–8.25)</b>    | <b>16.10 (14.42–17.78)</b> |
| Alcohol use treatment                 | 21.73 (20.61–22.85)  | <b>23.41 (21.89–24.93)</b> | <b>19.13 (17.41–20.84)</b> |
| Illicit drug use treatment            | 13.89 (13.14–14.65)  | <b>15.06 (14.08–16.05)</b> | <b>12.07 (10.69–13.45)</b> |
| Illicit drug or alcohol use treatment | 29.72 (28.53–30.90)  | <b>32.18 (30.59–33.78)</b> | <b>25.88 (24.07–27.70)</b> |

Sample size is unweight, and results are weighted estimates.

CI = Confidence Interval. Bold-faced: significant sex differences ( $p < 0.05$ ).

temporal and causal relationship between combined use of medical and recreational marijuana and the course of cocaine use disorder. Unlike males, both use was not associated with unmet need for mental health services among females. This finding may be related to sex difference in help-seeking, as prior data suggested that males had more social stigma associated with treatment-seeking for mental health problems than

females (Eisenberg et al., 2009).

Overall, our findings suggest that clinical assessments and interventions for marijuana-using individuals should consider sex differences in mental health as well as their motives and patterns of marijuana use. Specifically, the management of patients who use both medical and recreational marijuana may include targeted screening and

**Table 5**  
Adjusted logistic regression model of unmet need for mental health and substance use treatment in relation to past-year marijuana use status.

| Unmet need for (DV)                   | Adjusted OR (95% CI)                         |  |  |  |  |  |
|---------------------------------------|--|--|--|--|--|--|
|                                       | Overall (n = 15,440)                         |  | Male (n = 8737)                              |  | Female (n = 6703)                            |  |
|                                       | Medical use only vs. recreational use (ref.) | Medical and recreational use vs. recreational use (ref.) | Medical use only vs. recreational use (ref.) | Medical and recreational use vs. recreational use (ref.) | Medical use only vs. recreational use (ref.) | Medical and recreational use vs. recreational use (ref.) |
| Mental health treatment               | 1.14 (0.78–1.69)                             | <b>1.76 (1.22–2.56)</b>                                  | 1.22 (0.64–2.31)                             | <b>2.19 (1.33–3.60)</b>                                  | 1.07 (0.68–1.67)                             | 1.42 (0.85–2.37)   |
| Alcohol use treatment                 | <b>0.47 (0.33–0.66)</b>                      | 0.86 (0.63–1.18)   | <b>0.43 (0.30–0.63)</b>                      | 0.89 (0.62–1.28)   | 0.54 (0.27–1.09)                             | 0.84 (0.46–1.51)   |
| Illicit drug use treatment            | 0.74 (0.52–1.07)                             | 1.19 (0.91–1.55)   | 0.90 (0.57–1.41)                             | 1.12 (0.76–1.66)   | <b>0.46 (0.24–0.88)</b>                      | 1.23 (0.76–2.01)   |
| Illicit drug or alcohol use treatment | <b>0.53 (0.41–0.69)</b>                      | 1.04 (0.79–1.37)   | <b>0.56 (0.42–0.75)</b>                      | 1.07 (0.78–1.47)   | <b>0.46 (0.26–0.79)</b>                      | 0.98 (0.61–1.59)   |

Sample size is unweight, and results are weighted estimates.

Bold-faced:  $p < 0.05$ .

OR = Odds Ratio; CI = Confidence Interval; DV = Dependent Variable.

Note: Separate sex-specific logistic regression model was performed to examine the association between each of the unmet treatment needs (DVs) with past-year marijuana use status (key independent variable, reference group = recreational use only), adjusting for age, race/ethnicity, education, marital status, household income, frequency of past-year marijuana use, and survey year.

treatment for mental problems and hallucinogen use disorder for males, and cocaine use disorder for females. It is also important to improve accessibility and availability of male-specific mental health treatment programs to close treatment gap. Given the high possibility of co-occurrence of mental disorders and SUDs (Grant et al., 2004b; Regier et al., 1990), additional clinical efforts should focus on treating comorbid mental and drug use disorders among both users. Although medical only users appeared to have decreased odds of drug or alcohol use disorders and unmet need for drug treatment, consistent monitoring of the development of mental disorders and SUDs may be needed given insufficient evidence of long-term health effects of medical marijuana (Wang et al., 2008). At the community level, medical facilities may play an important role in closing treatment gap among medical marijuana users. Reiman (2008) suggested that a service integration approach that targets healthcare need from multiple domains (e.g., Narcotics or Alcoholics Anonymous, Harm reduction, social services/support groups, and cannabis-related services) at medical marijuana facilities could improve accessibility of a continuum of care and achieve high levels of patient satisfaction. Additional research is also needed to clarify barriers to treatment receipt for mental health and drug use disorders among medical marijuana users that will guide specific efforts regarding how to reduce treatment barriers.

This study has some limitations. First, we could not capture causal relationship between each of behavioral health disorders and unmet treatment needs with marijuana use status due to the cross-sectional design. Future research should therefore examine the role of combined use of medical and recreational marijuana in the development of mental disorders and SUDs. The prevalence of behavioral health disorders and unmet treatment needs was estimated based on respondents' self-reports, which may undermine the reliability of the study findings. The severity of mental disorders and SUDs was not considered in this study, which might contribute to inaccurate prevalence estimations of unmet treatment needs. Additionally, despite the use of a national sample, the results for some SUDs (tranquilizer, hallucinogen, stimulant, heroin, sedative, and inhalant) are limited due to a small sample size and considered preliminary. Caution is needed to interpret these results because odds ratios could be overestimated by a small sample size (Nemes et al., 2009). Nevertheless, this is the first study to study the prevalence of each of behavioral health disorders and unmet treatment needs across three marijuana use subgroups at a national level. To date, empirical researches are insufficient to characterize the patterns of behavior health disorders across marijuana subgroups. Our study

findings could help inform subgroup-specific treatment decisions to meet diverse treatment needs of medical and/or recreational users.

Our study findings have implications for the prevention and treatment of behavior health problems across marijuana subgroups. The highest prevalence of behavior health disorders and unmet treatment needs was observed in both users. Considering that a substantial proportion of medical marijuana users may also consume recreational marijuana (Furler et al., 2004), it is recommended for physicians to be more attentive to their patients' behavior health problems if they have a history of both medical and recreational marijuana use. This study also demonstrated that medical only users and both users showed different patterns of sex-specific associations with behavioral health indicators. In clinical practice, targeted screening and assessment for behavioral health as well as treatment services should be implemented based on a patient's sex and marijuana use status. At the same time, physicians and allied health professions should recognize the presence that medical only users can differ from both users in terms of behavior health problems and treatment needs. Future longitudinal research is needed to investigate pathway to the development of behavior health disorders among adult marijuana users, particularly individuals who consume both medical and recreational marijuana.

**Contributors**

Ji-Yeun Park contributed to the design and concept for this manuscript, conducted statistical analysis, and drafted the manuscripts. Li-Tzy Wu contributed to the design and concept for this manuscript, drafted the manuscripts, and supervised the work. All authors have read and approved the final manuscript before submission.

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**Conflict of interest**

Li-Tzy Wu has received research funding from Alkermes Inc. Ji-Yeun

Park has no conflict of interest to report.

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