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# Cannabis Expectancies for Sleep

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## Abstract

Up to 35% of adults in the United States suffer from sleep disturbances, which covary with a host of negative mental and physical health outcomes. Previous research suggests that cannabis' sedative effects may be associated with improved sleep. The present study examined the self-reported effect of cannabis use on individual's sleep-related problems. Participants included 311 individuals recruited online, who reported both sleep-related problems and cannabis use. Analyses revealed that participants expected cannabis to decrease the incidence of sleep-related problems, including allowing participants to have an earlier bedtime, to fall asleep more quickly, and to have a longer night's sleep. Moreover, expectancies about the influence of cannabis on sleep negatively covaried with cannabis-related problems. These findings suggest that individuals believe using cannabis might positively influence their sleep quality and believing so may be protective against cannabis problems. Randomized control trials of cannabis for insomnia appear justified.

### Keywords

Cannabis; sleep problems; cannabis expectancies; cannabis problems

## Introduction

The Centers for Disease Control and Prevention (CDC) suggest that adults between the ages of 18 and 60 should aim for seven or more hours of sleep per night to support their health and well-being (Watson et al. 2015). While both duration and quality sleep are necessary to promote optimal functioning, up to 35% of American adults suffer from sleep-related problems according to the Behavioral Risk Factor Surveillance System of 2014 (Centers for Disease Control 2016). These problems range from occasional trouble falling asleep or staying asleep, to more severe pathology including chronic insomnia, sleep apnea, and restless leg syndrome, all of which can be severely distressing. Moreover, the prevalence of individuals endorsing sleep problems is on the rise: from 1985 to 2012, the number

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of American adults endorsing less than 6 hours of sleep per night nearly doubled (Ford, Cunningham, and Croft 2015). The growing incidence of sleep-related problems calls for an in-depth exploration of this phenomenon, its associated outcomes, and treatment options.

Numerous risk factors can increase the likelihood of sleep problems. Old age, female gender, depression, and physical illness have consistently covaried with a heightened risk of sleep disturbances (Roth 2007; Smagula et al. 2016). Other predictors include stress, body mass index (BMI), socioeconomic status, and inactivity (Akerstedt et al. 2002; Hicks and Garcia 1987; Lund et al. 2010; Meyer et al. 2012; Mezick et al. 2010). The identification of these risk factors can inspire early interventions, potentially protecting individuals from experiencing long-lasting negative effects of sleep disturbances.

Sleep disturbances create short-term and long-term negative consequences. Immediately, sleep deficits might impact work or school performance, somatic complaints, and stress responsivity (Medic, Wille, and Hemels 2017). Sleep-related disturbances also covary with more distal health-related sequalae including psychopathology such as depression and anxiety, cognitive deficits, and an increased risk for medical conditions such as hypertension, diabetes, and obesity (Fortier-Brochu et al. 2012; Institute of Medicine (US) Committee on Sleep Medicine and Research 2006; Taylor et al. 2005). Moreover, sleep-related disturbances increase mortality, necessitating adequate treatment for sleep problems and their consequences (Cappuccio et al. 2010). The severity of these outcomes justifies exploring all potential avenues for treatment.

Currently, both nonpharmacological and pharmacological treatments effectively treat sleep problems. Nonpharmacological approaches include cognitive-behavioral components, such as stimulus control, relaxation, and sleep hygiene, which have demonstrated efficacy with moderate to large effect sizes across multiple studies (Saddicha 2010). Pharmacological treatments, such as benzodiazepines and hypnotics, treat sleep problems with some success. However, issues related to dosing, side effects that may exacerbate sleep and health problems, and dependence, raise concerns (Pagel and Parnes 2001). A combination of behavioral management with pharmacotherapy might be more effective than pharmacological treatments alone (Saddicha 2010).

Despite the established efficacy of these treatments, individuals may opt to self-medicate with substances, perhaps to attain immediate relief from the distress of sleep-related disturbances. For instance, some individuals use alcohol to promote more restful sleep at night. However, alcohol at high doses may lead to greater sleep disturbances or individuals may develop a tolerance to alcohol's sedative effects (Roehrs and Roth 2001). Likewise, prolonged alcohol use for sedative purposes increases daytime sleepiness, potentially exacerbating other problems (Johnson et al. 1998). Similarly, individuals might self-administer over-the-counter (OTC) drugs to improve their sleep quality. However, they may misuse these drugs by selecting inappropriate products, administering them for longer than suggested, and doing so without consulting medical professionals (Abraham et al. 2017). Moreover, some OTC drugs contain chemicals such as diphenhydramine or doxylamine, that can induce or worsen other symptoms or interact with other medications producing unintended negative effects (Johnson et al. 1998). Although individuals might

find short-term relief with alcohol or OTC medications, the consequences associated with these drugs call for alternatives for those who would rather self-medicate than see a medical professional or psychologist.

Individuals might also self-administer cannabis to promote better sleep. Self-report measures suggest cannabis might alleviate sleep-related disturbances, especially among those who have experienced a traumatic event (Bonn-Miller, Babson, and Vandrey 2014). Coincidingly, many users report that cannabis promotes relaxation, reduces tension, or enhances sleep (Ogborne, Smart, and Adlaf 2000; Pedersen and Sandberg 2013). Findings on the physiological effects of cannabis are mixed (Gates, Albertella, and Copeland 2014). Some studies report that cannabis in acute doses improves sleep onset and stage 4 sleep (Schierenbeck et al. 2008) while others suggest that THC, the psychoactive component of the cannabis plant, actually reduces REM sleep (Nicholson et al. 2004). Still, other data show that cannabis products can improve sleep for individuals suffering from pain with minimal side effects (Russo, Guy, and Robson 2007). In the short-term, cannabis can provide sleep benefits; however, prolonged and chronic use might harm the sleep cycle (Babson, Sottile, and Morabito 2017). These mixed findings call for continued efforts in an attempt to elucidate the role of cannabis in alleviating or increasing sleep problems. Nevertheless, good sleep hygiene and cognitive behavioral interventions should remain a first approach to treating sleep problems (Murawski et al. 2018).

Despite the effects that cannabis might induce on users who experience sleep problems, the reported negative side effects and long-term health consequences are noteworthy (Bigand et al. 2018; Calabria et al. 2010; Volkow et al. 2014). Importantly, up to 9 percent of cannabis users might meet criteria for a cannabis use disorder (Lopez-Quintero et al. 2011). Given the potential impact of cannabis on the brain, adolescents should abstain (Mechoulam and Parker 2013). Documented respiratory irritation suggests that smoking is a bad idea for any user (Macleod et al. 2015; Tashkin 2013). Similarly, the potential to exaggerate risk for some forms of cancer deserves considerable attention (Huang et al. 2015). Covariation with other drugs with documented negative health effects suggests that all users need detailed information on risk from alcohol, tobacco, and illicit substances (Hall and Pacula 2003). These concerns about the drug's safety, in conjunction with the mixed findings regarding the effectiveness of cannabis as a sleep aid, suggest individual differences in cannabis' impact on sleep that might generate a range of expectancies.

Expectancies about the effect of cannabis can influence outcomes and individual's use patterns. Research shows that when participants believe they have ingested cannabis, but have not actually done so, they experience outcomes associated with cannabis use (Loflin et al. 2017; Metrik et al. 2012). For instance, using a balanced-placebo design, one study found that participants who were told they received THC, but received placebo, reported subjective effects consistent with ingesting THC (Metrik et al. 2009). These reports suggest that expectancies of cannabis can generate powerful subjective experiences that can influence an individual's proclivity to use the substance. Additionally, the valence of the expectancy can impact an individual's use pattern. Those who hold negative expectancies about cannabis' influence are more likely to abstain whereas individuals who hold positive expectancies

about the effects of cannabis have an increased likelihood of using cannabis more often and in greater frequencies (Metrik et al. 2009; Schafer and Brown 1991).

Data reveal mixed findings on whether expectancies of cannabis' impact covary with cannabis-related problems. Some research suggests that individuals with positive cannabis expectancies might develop cannabis problems (Hayaki et al. 2010; Pedersen et al. 2015) while some highlight that positive expectancies can be protective against problems (Phillips et al. 2017; Slavin et al. 2017). Similarly, mixed findings exist for the impact of negative expectancies (Buckner and Schmidt 2008; Kristjansson et al. 2012; Neighbors, Geisner, and Lee 2008). Future research needs to continue to explore cannabis expectancies and their relation to use-related problems.

Due to the negative consequences of sleep problems, and the potential usefulness of cannabis for treating these disturbances, the objective of this study is to promote a greater understanding of individual's expectancies about cannabis' potential influence on sleep-related disturbances. We hypothesized that individuals would report positive expectancies about cannabis' potential impact on sleep onset. We also explored if these expectancies might be related to negative consequences. Should individuals believe that cannabis improves sleep but correlates with adverse outcomes, consumers should turn to alternative approaches. In contrast, if expecting cannabis to improve sleep does not lead to more problems, further work on the safety and effectiveness of cannabis as a sleep aid appears warranted.

## Methods

### Participants and procedure

Individuals who reported experiencing sleep-related problems and lifetime use of cannabis (N = 311) completed an online survey assessing self-reported cannabis use, sleep-related problems, expectancies of cannabis use on sleep-related problems, and problems associated with cannabis use. Participants were recruited via advertisements sent out to members of a listserv for a cannabis activism organization (NORML) as well as via an advertisement on Craigslist. These advertisements asked interested individuals to participate in a study on cannabis and sleep for a chance to win a cash prize. The advertisement directed interested participants to a link for the survey, administered using SurveyMonkey. The first page of the online study requested participant consent. Participants who agreed to the terms of the survey then had the opportunity to complete the survey. After completion of the survey, participants were invited to send their email address and a secret number to an email account for a chance to win a cash prize. All procedures were approved by the University at Albany, State University of New York, Institutional Review Board.

### Measures

**Demographics—**Demographic variables included age, sex, race/ethnicity and highest level of education achieved. Participants ranged in age from 18 to 75 (M = 42.39, SD = 13.44). The sample was predominantly Caucasian (88%) and male (55%). Educational

attainment ranged from some high school through advanced degree, with the majority of the sample endorsing some college (31%).

**Cannabis use—**Participants first reported on lifetime use of cannabis. Individuals who did not endorse lifetime use of cannabis were directed to the end of the study and thanked for their time. Participants who endorsed lifetime use of cannabis also reported the amount of cannabis they used per month (in ounces). This monthly use of cannabis variable was used in all subsequent analyses.

**Marijuana use problems—**The Marijuana Problems Scale (MPS; Stephens, Roffman, and Curtin 2000) assessed life impairment associated with cannabis use. This 19-item self-report assessment queries participants about problems related to cannabis use in a variety of domains, including interpersonal problems, occupational responsibilities, physical symptoms, financial and legal difficulties, and self-concept. Participants rated the occurrence of each of these problems on a Likert scale from 0 (none) to 5 (a serious problem). Cronbach's alpha was .852.

**Sleep habits—**Participants reported on their past month sleep habits via the Pittsburgh Sleep Quality Index (PSQI; Buysse et al. 1989). This 19-item self-report measure assesses individual sleep habits and sleep quality without the use of sleep assistance. The first four questions ask participants to report on their bedtime (e.g. "Without sleep assistance, when have you usually gone to bed at night?"), waketime, time to fall asleep, and sleep duration. Other domains assessed include sleep efficiency, sleep disturbances (e.g. "Without sleep assistance, how often do you have trouble sleeping because you wake up in the middle of the night or early morning?"), use of sleep medications, and dysfunction during wakefulness (e.g. "Without sleep assistance, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?"). A global score of 5 or greater is indicative of poor sleep quality. Cronbach's alpha for this scale was .758.

**Expectancies of cannabis-induced changes in sleep habits—**This self-report measure used the same items as the PSQI but asked about sleep behaviors after using cannabis. Thus, participants reported their bedtime (e.g. "When I use cannabis, my usual bed time is —"), time to fall asleep, waketime, and hours of sleep per night after they used cannabis. We used this data in combination with the PSQI to compute how much better or worse each of these time variables became when participants used cannabis. Additionally, participants reported on their sleep efficiency, sleep disturbances (e.g. "When I have trouble sleeping due to waking up in the middle of the night or early morning, cannabis makes this issue—"), use of other sleep medications, and dysfunction during wakefulness after using cannabis. Participants rated how cannabis affects these problems using a five-point Likert scale from extremely worse (−2) to extremely better (+2). Cronbach's alpha for this scale was .903. Previous work has used similar methodologies to assess expectancies about how cannabis might affect symptoms of posttraumatic stress disorder (PTSD), premenstrual syndrome (PMS), and menopause (Earleywine and Bolles 2014; Slavin et al. 2017; Slavin, Farmer, and Earleywine 2016).

### Data analysis

One-sample t-tests were used to determine whether mean expected relief differed from zero for each expectancy related to cannabis' impact on sleep. Next, we performed paired t-tests to determine whether participants expected greater cannabis-induced relief for some sleep-problems more than others. Third, we examined correlations among variables. Finally, we performed a regression analysis that included all theoretically-relevant predictors to determine whether cannabis expectancies still accounted for a significant amount of unique variance in cannabis-associated problems.

## Results

### Differences among sleep-related expectancies

All cannabis-induced sleep-related expectancies including time to fall asleep, hours of sleep, and bedtime were significantly different from 0, $p < .001$, (t (309) ranging from 14.12 to 21.75), except for expectancies toward cannabis' impact on time to wake in the morning, ($t(308) = 1.088$, $p = .278$; See Table 1). Additionally, we calculated Cohen's d effect sizes for these expectancies and converted these to time variables to understand their real world impact. Cohen's d's for the significant variables were all relatively large (ranging from .80 to 1.24) and had a real-world impact of allowing participants to fall asleep 15 minutes earlier, get 2 more hours of sleep per night, and get to bed 1.5 hours earlier. Paired t-tests were performed on all expectancies and revealed significant differences among all means with expectancies for time to fall asleep receiving the highest score (Mean = 1.29, SD = 1.04) and waketime receiving the lowest (Mean = .06, SD = .94; See Table 2).

### Bivariate correlations

Multiple items for sleep-related problems, cannabis-induced sleep relief expectancies, and cannabis-associated problems were collapsed into single variables by calculating total scores. Additionally, we included a monthly cannabis use variable and participant age variable. Both the amount of cannabis used monthly (in ounces) and the aggregated cannabis-problems score were positively skewed so BoxCox transformations were applied to minimize the skew (skew = 1.241; transformed skew = − .180 and skew = 2.234; transformed skew = 1.218, respectively; Osborne 2013). All subsequent analyses used these transformed variables. Basic descriptive information and correlations among all study variables appear in Table 3. Sleep-problems correlated positively with amount of monthly use. Cannabis-induced sleep relief expectancies correlated positively with sleep-related problems. Cannabis-related problems correlated negatively with expectancies about cannabis' relief on sleep-problems. That is, as sleep expectancies increased, problems decreased. Age correlated negatively with cannabis-related problems.

### Links to cannabis-related problems

A standard linear regression analysis was performed with cannabis-related problems as the outcome variable and sleep-related expectancies, sleep problems, age, and amount of monthly cannabis use as the predictors. The regression analysis was significant $F_{(4,222)} = 8.701$, $p < .001$ (See Table 4). In this model, both sleep-related expectancies (Beta = −

.275, $p < .001$) and age (Beta = − .217, $p < .01$) had significant main effects on cannabis-related problems. The negative coefficients suggest that problems decreased as sleep-related expectancies and age increased. The overall fit of the model was $R^2 = .136$.

## Discussion

Our results indicate participants believe cannabis mitigates sleep-related problems with moderate to large effect sizes. These findings are bolstered by other research suggesting that individuals are motivated to use cannabis due to its perceived beneficial effects on sleep (Blevins et al. 2016; Lee et al. 2009). Participants in our study endorsed that using cannabis improved their sleep with large effect sizes. Using cannabis allowed participants to fall asleep approximately 15 minutes earlier, sleep about 2 hours longer per night, and have a 1.5 hour earlier bedtime. Participants did not expect cannabis to alter their wake-time. These self-reported expectancies were significantly different from each other, suggesting that cannabis use may be associated with more effective improvement for some sleep disturbances than others. Specifically, participants believed that cannabis would have the greatest effect on reducing the time it takes to fall asleep at night. The next largest expected impact concerned the total number of hours they would sleep, followed by the time they would go to bed, and then the time they would awaken. Thus, the plant might offer considerable relief for sleep-onset insomnia but might not help other types.

Participants who endorsed greater sleep problems reported overall greater monthly cannabis use. The positive association between greater sleep problems and greater monthly use appeared previously (Conroy et al. 2016). Individuals with sleep problems might turn to cannabis to alleviate symptoms, but cannabis might also create new sleep disturbances or exaggerate current troubles. Additionally, results indicated a positive association between cannabis use and cannabis-induced sleep-related expectancies. This finding is consistent with other reports that positive expectancies about substances are correlated with greater use patterns (Schafer and Brown 1991). More specifically, these results align with previous work suggesting a major motive of cannabis use is to promote better sleep and this relation promotes more frequent use (Blevins et al. 2016; Lee et al. 2009). Interestingly, we also found that holding positive cannabis-induced sleep expectancies negatively covaries with cannabis problems, suggesting that these positive expectancies are associated with a decreased likelihood of developing cannabis use problems. Other research echoes this finding that some positive expectancies about cannabis-induced sleep need not increase cannabis-related problems. These findings have been reported in other studies (Phillips et al. 2017; Slavin et al. 2017). On the contrary, individuals who hold positive expectancies of cannabis' effects might minimize or underreport problems associated with their use (Chen and Anthony 2003; Johnson and Fendrich 2005). Additionally, as a portion of participants in this study were recruited via NORML, these participants may have been motivated to trivialize consequences associated with their use. These potential explanations deserve further exploration.

Participants who held positive cannabis-induced sleep expectancies had a decreased likelihood of experiencing cannabis-related problems, irrespective of their sleep-related problems, age, or amount of monthly cannabis use. These findings mirror recent studies

that have also found an inverse relationship between positive cannabis expectancies and cannabis-related problems (Slavin et al. 2017). Nevertheless, the cross-sectional nature of the current data prevent any conclusions about potential negative consequences of cannabis use after years of continued consumption. Moving forward, research on this topic should opt for longitudinal designs to determine whether cannabis use for sleep enhancement is associated with increases in cannabis-related consequences in the future.

Participant age negatively covaried with cannabis-related problems, suggesting that older individuals within our sample were less likely to experience negative consequences associated with their use. This finding corroborates other data that reveal younger individuals might have a heightened risk for experiencing cannabis-related problems and developing cannabis use disorder (Huag et al. 2017; Richter, Pugh, and Ball 2017). While older individuals can still experience consequences associated with their use, these findings call for interventions specifically targeting young cannabis users. Taken together, these results imply that older individuals who hold positive cannabis-induced sleep-relief expectancies may be at a decreased risk for developing cannabis problems compared to the general population.

This study has several limitations. First, the average monthly use of cannabis in this study was small (M = 0.75 ounces). While monthly cannabis ranged from .125 ounces per month to 3 ounces per month, the lower average might explain why this sample did not endorse many problems associated with their use. Future studies might examine whether amount of monthly cannabis use moderates the relations between sleep problems and cannabis problems. Second, findings may be biased due to reliance on self-report measures. Additionally, participants might have experienced difficulty with recall in reporting on their cannabis use or might have unintentionally reported inaccurate measurements. We attempted to control for these biases through the use of anonymous surveys. However, future studies might add cohort reports, behavioral trackers of sleep, and other approaches such as ecological momentary assessment to improve validity. Three additional factors limit generalizability. The sample was predominantly Caucasian, Persons without internet or computer access could not be included, and a large number of participants in the study were recruited from an activist listserv. Cannabis users and supporters might be more likely to hold positive views regarding cannabis, and may underreport negative consequences associated with their cannabis use (Gaher and Simons 2007). Another limitation is that we did not control for type of cannabis used and, as such, are potentially comparing strains with different concentrations of THC and CBD. Moreover, conclusions about problems associated with cannabis use are limited, in that the Marijuana Problems Scale does not directly assess medical consequences associated with use. Further work might improve upon these findings by examining whether or not cannabis use for purposes of sleep enhancement leads to negative medical sequalae. Finally, due to the cross-sectional design of this study, we are unable to draw any causal inferences.

## Conclusion

The present study asked cannabis users to report on their sleep problems with and without the use of cannabis. The results found a significant positive correlation between reported

sleep problems without the use of cannabis and cannabis use. This finding might imply that one motivation of use might be self-medication. Those concerned about increasing quantities of cannabis use each month might benefit from adding behavioral interventions (such as improved sleep hygiene) to their daily routine in an effort to keep use to a minimum. Conversely, individuals who use cannabis might be prone to experience a greater number of sleep deficits. This hypothesis necessitates longitudinal research to untangle the complicated relation between cannabis use and sleep problems. Additionally, our results suggest cannabis users expect cannabis to alleviate sleep problems by allowing participants to fall asleep more quickly, have a longer sleep duration at night, and go to bed earlier. Moreover, these cannabis-induced sleep-related expectancies negatively covary with cannabis-related problems, suggesting that holding these positive expectancies need not be associated with an increase in negative consequences. While these results are promising, these findings warrant cautious interpretation due to potential negative effects associated with cannabis use and the limited research on this topic. For individuals experiencing sleep-related problems, a first- line treatment should be nonpharmacological or doctor-recommended pharmacological treatments; however, for those who are choosing to self-medicate, cannabis might be a viable alternative. A randomized, placebo-controlled experiment using cannabis to treat insomnia appears justified.

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**Table 1.**

Magnitude of Sleep-Related Cannabis Expectancies.

| Expectancy | t Value | Cohen's d | Real World Impact |
|---|---|---|---|
| Time to fall asleep | 21.75* | 1.24 | ~15 minutes less to fall asleep |
| Hours of sleep | 18.05* | 1.02 | ~2 more hours of sleep |
| Bedtime | 14.12* | .80 | ~1.5 hours earlier bedtime |
| Waketime | 1.09 | .06 | ~A few minutes later waketime |

* $p < .001$.

**Table 2.**

Differences among cannabis-induced expectancies for sleep problems.

| Sleep-Related Expectancies | Mean | (SD) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 1. Time to fall asleep | 1.29 | (1.04) | | * | * | * |
| 2. Hours of sleep | 0.94 | (.92) | * | | * | * |
| 3. Bedtime | 0.81 | (1.01) | * | * | | * |
| 4. Waketime | 0.06 | (.94) | * | * | * | |

* $p < .001$. Expectancies are ordered highest (greatest expected cannabis-induced relief) to lowest. Each expectancy is significantly greater than subsequent ones listed below.

**Table 3.**

Table of correlations.

| Variables | Mean (SD) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| 1. Monthly Use | .75 (3.14) | | | | |
| 2. Sleep Problems | 35.10 (7.69) | .144* | | | |
| 3. Sleep Expectancies | 62.17 (8.14) | .109 | .287** | | |
| 4. Cannabis Problems | 28.16 (8.38) | .051 | −.048 | −.274** | |
| 5. Age | 42.39 (13.43) | −.024 | .063 | .066 | −.280** |

*$p < .05$

**$p < .01$

Monthly use = Amount of cannabis used monthly (in ounces).

Sleep Problems = Indicated by global score on the PSQI.

Sleep Expectancies = Expected cannabis-induced relief of sleep problems.

Cannabis Problems = Indicated by global score on the Marijuana Problems Scale.

**Table 4.**

Predicting cannabis-related problems from sleep expectancies, sleep problems, age, and cannabis.

| Variable | B | SEB | Beta | T | p-value |
|---|---|---|---|---|---|
| Sleep Expectancies | −.008 | .002 | −.275 | −4.161 | .001 |
| Sleep Problems | .001 | .002 | .036 | .548 | .584 |
| Age | −.004 | .001 | −.217 | −3.460 | .001 |
| Cannabis Use | .048 | .030 | .104 | 1.632 | .104 |