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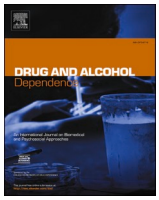

Beyond the first try: How many quit attempts are necessary to achieve substance use cessation?

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ABSTRACT

Substance use disorder (SUD) is a chronically relapsing disorder; thus, individuals with SUD may require several attempts before achieving abstinence. The goal of the present study was to investigate what variables are associated with the number of quit attempts before successful abstinence was achieved. Data were collected from 421 International Quit & Recovery Registry participants. Participants answered several questions for each substance they reported being in recovery, including how many times they had attempted to quit that substance and whether they still used that substance. The results showed that the number of quit attempts was associated with the substance one was trying to quit, SUD severity (i.e., mild, moderate, severe SUD) for that substance, the number of years using that substance, and the age of use onset. Pairwise comparisons among substances indicated that pain medication and opioids had a significantly higher number of quit attempts than all other substances ($ps < .001$) but were not different from each other ($p = 1.0$). Pairwise comparisons across levels of SUD severity showed a significantly higher number of attempts for those with moderate than mild SUD ($p < .001$) and for those with severe than mild or moderate SUD ($ps < .001$). Overall, the results indicate that individuals who use opioids and pain medication, have more severe SUD, and more years of use need significantly more attempts before achieving successful abstinence. Thus, those might benefit from more targeted and effective interventions.

Background and aims: Substance use disorder (SUD) is a chronically relapsing disorder. Thus, individuals with SUD may need several attempts before achieving abstinence. The present study investigated the variables associated with the number of quit attempts before achieving successful abstinence.

Methods: Data were collected from 421 International Quit & Recovery Registry participants. Participants answered several questions for each substance they reported being in recovery from, such as the age of first use, how many times they had attempted to quit that substance, and whether they still used that substance.

Results: The number of quit attempts was associated with the substance one was trying to quit, SUD severity (i.e., mild, moderate, severe SUD) for that substance, the number of years using that substance, and the age of use onset. Pairwise comparisons among substances indicated that pain medication and opioids had a significantly higher number of quit attempts than all other substances ($ps < .001$) but were not different from each other ($p = 1.0$). Pairwise comparisons across levels of SUD severity showed a significantly higher number of attempts for those with moderate than mild SUD ($p < .001$) and for those with severe than mild or moderate SUD ($ps < .001$).

Conclusions: Opioids and pain medication require significantly more attempts than all other substances, according to our findings. Thus, such substances might need more targeted and effective interventions. Additionally, more severe SUD and more years of use were also associated with more quit attempts. Such findings suggest the need for more effective early interventions to decrease the number of attempts before successful abstinence.

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1. Introduction

Substance use disorder (SUD) is considered a chronically relapsing disorder (Garcia, 2023; National Institute on Drug Abuse, 2024), suggesting that individuals with SUD may require several attempts before successfully achieving abstinence. Epidemiological data on SUD indicate high rates of reoccurrence (National Institute on Drug Abuse, 2024) and treatment readmission (Dennis et al., 2005; Hines et al., 2014; Reif et al., 2017), corroborating the idea that several quit attempts might be required to achieve abstinence for those with SUD.

Research on the number of attempts needed to achieve successful abstinence from SUDs is limited, with most studies focusing on smoking (Chaiton et al., 2016; Layoun et al., 2017; Rafful et al., 2013). However, differences in the addictive potential among substances suggest that some may be harder to quit than others and, thus, require more attempts (Bonnet et al., 2020; Drug Scheduling, 2024; Henningfield et al., 1991; Nutt, 2020). Indeed, evidence suggests that treatment outcomes and treatment discontinuation rates vary as a function of the substance (Dutra et al., 2008; Lappan et al., 2020). For example, a meta-analysis showed that psychosocial treatments targeting cannabis are more efficacious than treatments targeting multiple substances and that cocaine treatments have a more significant discontinuation rate than treatment for other substances (Dutra et al., 2008). Yet, little is known about differences in the number of quit attempts between substances.

Kelly et al. (2019) conducted a study on the number of attempts necessary to overcome alcohol and other drug use. The results showed a mean of 5.35 and a median of 2 attempts (mean of 6.14 and median of 3 when considering only those who reported at least one attempt), with no significant differences based on the primary substance used (i.e., "drug of choice"). However, the study did not directly investigate the impact of each substance on the number of quit attempts, especially in cases of polysubstance use. Therefore, gaining a better understanding of the number of attempts needed to achieve successful abstinence for each substance could greatly inform SUD treatments and policies.

In addition to the substance, other variables impact SUD recovery and treatment outcomes, such as the number of SUDs one meets the criteria for and SUD severity (i.e., mild, moderate, or severe). For example, research shows that individuals with polySUD have poorer treatment outcomes than individuals with single SUD (Bamsey, 2017; Dutra et al., 2008; McCabe et al., 2006) and that individuals with more severe SUD at baseline have fewer abstinence days at follow-up and require more prolonged or more intense treatment interventions than those with less severe SUDs (Simpson, 2004; Simpson et al., 1999; Tiet et al., 2007). Furthermore, evidence shows that earlier substance use onset is typically associated with longer SUD careers (i.e., years of use) and longer treatments before successful recovery (Dennis et al., 2005; Grant and Dawson, 1997; Gruber et al., 1996; Warner and White, 2003). Given that the number of SUDs, SUD severity, age of onset, and years of use are associated with treatment outcomes (Dennis et al., 2005; Kelly et al., 2019), such variables might also impact the number of times one tries to quit before achieving abstinence. Therefore, the goal of the present study was to investigate whether these variables predict the number of quit attempts before successful cessation.

2. Methods

2.1. Participants

Data were collected from participants of the International Quit and Recovery Registry (IQRR; www.quitandrecovery.org). The IQRR is an online recovery community for adults (18+ years old) consisting of approximately 4000 participants who meet lifetime criteria for at least one SUD and self-reported being in recovery from any SUD (see Athamneh et al., 2017; Athamneh et al., 2022; Dwyer et al., 2023; Tomlinson et al., 2020 for more details). All IQRR participants were invited to complete the monthly online survey and compensated for completing the assessment. Participants received the link to the survey via email or could access the link by logging into the IQRR website. To avoid non-registrants from answering the survey, participants could only start the survey after providing their IQRR registered email for authentication. Because the present study focused on the number of quit attempts to achieve abstinence, only participants who reported successful abstinence for at least one substance (by answering "No" to the question "Do you still use [name of the substance]?") were included in the current study. The analytical sample had 421 participants. Consent was inferred from the completion and submission of the survey questionnaires. Ethical approval for this study was obtained from the Institutional Review Board at Virginia Polytechnic and State University.

2.2. Procedures

All data were collected online using Qualtrics Survey Software (Provo, UT, 2020). All assessment data were collected during August 2023, and demographic data were obtained from prior surveys. Race, ethnicity, sex, and birth year were retrieved from the initial survey participants completed to become part of IQRR. Education and income were collected trimonthly, and data were retrieved from each participant's most recently completed survey (74 % collected within two months; 99.99 % within four months).

2.3. Measures

Participants were asked to indicate from a list of 12 substances (i.e., nicotine, alcohol, cannabis, cocaine, opioids, stimulants, prescription pain relievers, hallucinogens, anesthetics, tranquilizers, inhalants, or others; see Supplemental Table S1 for a comprehensive list) which substances they had used ten or more times in their lives. For those substances indicated, participants were then asked the 11 DSM-5 questions about lifetime use. SUD severity was categorized according to the DSM-5 criteria (mild for any 3 or fewer criteria, moderate for any 4 or 5 criteria, and severe for any 6 or more criteria). Additionally, they were asked which substance they considered to be their primary one (i.e., "drug of choice") and for which substances they had initiated recovery. In all IQRR assessments, recovery is defined as starting to change substance use behavior actively and doing things to cut down or stop using, regardless of whether being successful or not. Participants are provided with examples of such actions (e.g., limiting social interaction with other individuals who use substancesusers, starting therapy, etc.) (Athamneh et al., 2017; Athamneh, Freitas-Lemos et al., 2022; Tomlinson et al., 2020). For each substance a participant reported being in recovery from, they were asked: 1) age of first use; 2) age that they started using that substance regularly (at least once a week); 3) approximately how many times they had attempted to quit that substance; 4) age of first quit attempt; 5) whether they still used that substance; and 6) at what age they stopped using that substance. Quit was defined the same way as recovery (i.e., actively doing things to cut down or stop using, regardless of whether successful or not). Years of substance use were calculated for each substance by subtracting the age of first use from the age at which they stopped using that substance. Time since the last use was calculated by subtracting the age at which they stopped using that substance from their current age.

2.4. Data analysis

2.4.1. Data cleaning

Participants were excluded from the analysis if they reported inconsistent age in any of the age-related questions (e.g., reported age of first use lower than 6 years of age, or higher than current age; reported age of regular use lower than 6 years of age, lower than the age of first use, or higher than current age; reported age of first quit attempt lower than age of first use, or higher than current age; reported age of last use lower than age of first use or age first quit attempt, or higher than

current age (n = 75)). Reports of a number of quit attempts higher than 100 were also excluded from the analysis. Nine observations across six participants included reports of a number of attempts higher than 100. Out of those six participants, two participants were excluded entirely because they only reported one substance and had a number of quit attempts higher than 100 (i.e., 450 and 10,000) for that substance. For the other four participants, only the substances they reported having tried to quit more than 100 times were excluded (e.g., if they reported more than 100 quit attempts for cocaine but less than 100 attempts for alcohol, we retained the responses related to alcohol and excluded the responses about cocaine). Of those seven excluded observations, the total number of quit attempts ranged from 200 to 1000,000. The final analytical sample had 344 participants.

2.4.2. Statistical analysis

All analyses were conducted using R software (version 4.2.2). The primary outcome measure used for the analyses was the number of quit attempts per substance (i.e., the number of times each participant reported having tried to quit each substance). The distribution of the number of quit attempts was assessed for skewness using the *e1071* package (Meyer et al., 2024). A generalized linear mixed effects model with participants as a random effect was used to estimate the total number of quit attempts. Because the distribution of the number of quit attempts was positively skewed, a Poisson outcome distribution was used. Estimates of central tendency from our regression are reported as estimated marginal means, as opposed to medians, because the use of a Poisson distribution considers the data's positive skew. An exhaustive model space search was performed to determine the optimal variables associated with the number of quit attempts. The variables included in the model selection were substance, primary substance, number of lifetime SUDs, SUD severity, number of substances they reported being in recovery from, age of first use, and years of substance use. The number of substances they reported being in recovery from was included in the model search both as a numeric variable and as a binary variable (i.e., "one" vs. "multiple"). The optimal model had the lowest Bayesian Information Criterion (BIC (Chakrabarti and Ghosh, 2011)). For the analyses, all continuous variables were scaled. The final model was fitted using the *lme4* package (Bates et al., 2014). All pairwise comparisons were corrected using the Tukey method.

3. Results

Table 1 shows the sociodemographic characteristics of the sample. The average age of the sample was 43.8 ± 11.8 years old, with 63.7 % women, 85.6 % White, and 92.8 % not Hispanic or Latino. The majority of the sample met lifetime DSM-5 criteria (86 %) for two or more substances. Fig. 1 shows the distribution of lifetime SUDs and combinations of substances, among the sample. The most common lifetime SUDs were alcohol, cannabis, and nicotine, as well as the co-occurrence of the three. Alcohol was also the most frequently selected primary substance (i.e., "drug of choice"; see Table 1).

Table 2 shows descriptive statistics (mean and median number of quit attempts, mean age of first use, mean number of years of use, mean number of years since last use (i.e., time in abstinence), and skewness) for each substance participants reported being in recovery from and no longer using, regardless of the level of severity. Figure S1 in the Supplemental Materials shows the distribution of the number of attempts for each substance. Less than 1 % of the sample reported zero number of attempts for any substance (i.e., four out of 1099 observations). The distribution was positively skewed for all substances; thus the mean was higher than the median number of quit attempts for all substances. Alcohol was the substance with the highest mean (10.9), followed closely by opioids (10.4), and nicotine was the substance with the highest median (5.0). Conversely, hallucinogens had both the lowest mean (3.9) and median (1.0). Alcohol and nicotine had the lowest mean onset age (14.6 years old), and stimulants had the highest mean onset age (23.5 years old). Anesthetics had the lowest mean number of years of use (8 years), and nicotine had the highest mean number of years of use (23.8 years). A significant negative correlation was observed between the age of first use and years of use (r = -0.42, p <.001). Lastly, the lowest mean time in abstinence (i.e., years since last use) was observed for those in recovery from alcohol (7.7 years), and the highest mean time in abstinence was observed for those in recovery from inhalants (17.8 years) and anesthetics (17.6 years).

Table 1
Sample demographics.

Demographics	Mean (SD) / Frequency (%)
n	344
Age	43.8 (11.8)
Sex	
Female	212 (63.7)
Male	121 (36.3)
Race	
American Indian or Alaska Native	9 (2.7)
Asian	4 (1.2)
Black/African American	19 (5.7)
More than one race	14 (4.2)
White/Caucasian	285 (85.6)
Other	2 (0.6)
Ethnicity	
Hispanic/Latino	24 (7.2)
Not Hispanic/Latino	309 (92.8)
Education	
Less than High School	12 (3.5)
High school diploma	58 (16.9)
Some College or Associate's Degree	150 (43.9)
Bachelor's Degree	66 (19.3)
Masters, professional, doctorate	56 (16.4)
Income (annual)[b]	
Less than $10,000	51 (14.9)
$10,000–$29,999	78 (22.8)
$30,000–$49,999	69 (20.2)
$50,000–$79,999	54 (15.8)
$80,000-$119,999	47 (13.7)
$120,000 +	43 (12.6)
Number of lifetime SUD	
1	48 (14)
2	50 (14.5)
3 +	246 (71.5)
Number of substances in recovery	
1	63 (18.3)
2	54 (15.7)
3 +	227 (66)
Primary Substance	
Alcohol	140 (40.7)
Anesthetics	1 (0.3)
Cannabis	26 (7.5)
Cocaine	23 (6.7)
Hallucinogens	0 (0)
Inhalants	1 (0.3)
Pain Medication	19 (5.5)
Nicotine	23 (6.7)
Opioids	56 (16.3)
Stimulants	51 (14.8)
Tranquilizers	4 (1.2)

We sought to evaluate the factors associated with the number of quit attempts. After model selection, the optimal model included significant fixed effects of substance ($\chi^2(10) = 302.04$, $p < .001$), SUD severity ($\chi^2(2) = 195.10$, $p < .001$), age of first use ($b = 0.10$; $\chi^2(1) = 20.24$, $p < .001$), and years of substance use ($b = 0.47$; $\chi^2(1) = 369.90$, $p < .001$). Additionally, we performed a sensitivity analysis, including observations of number of attempts greater than 100, and observed similar results to those reported herein.

Fig. 2 shows the estimated marginal means from the model for each substance participants reported being in recovery from and no longer using, averaged across levels of SUD severity. The estimated marginal mean is the mean for each variable level (i.e., substance) adjusted for the other variables in the model. Follow-up pairwise comparisons among

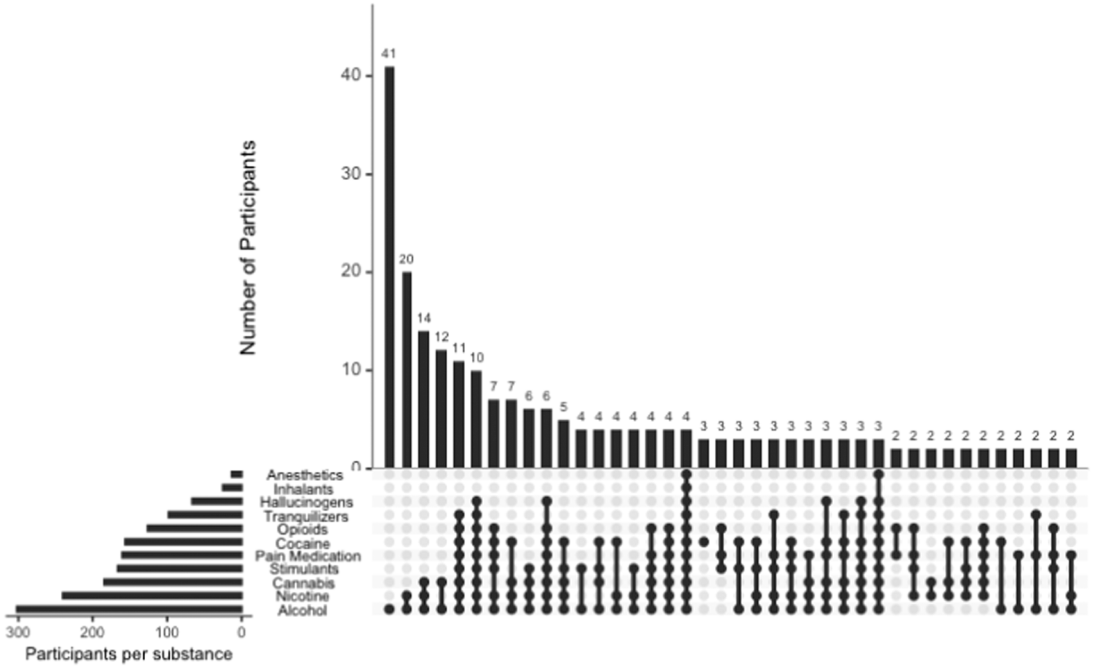

Fig. 1. Frequency of lifetime SUDs and combinations of SUDs among all 344 participants. Horizontal bars show the frequency of participants who met DSM-5 criteria for each substance. Vertical bars show the frequency of different SUD combinations. Filled circles under vertical bars show the SUD combinations.

Table 2
Summary of the number of quit attempts, age of first use, number of years of use, and number of years since last use for each substance participants (n = 344) reported being in recovery from and no longer using.

Substance	Mean (SD) Number of Quit Attempts	Median (IQR) Number of Quit Attempts	Mean (SD) Age of First Use	Mean (SD) Years of Use	Mean (SD) Years Since Last Use	Skewness
Alcohol (n = 230)	10.9 (20.1)	3.5 (2.0, 10.0)	14.6 (3.2)	23.0 (11.0)	7.7 (8.6)	3.35
Anesthetics (n = 14)	7.4 (13.6)	1.5 (1.0, 4.5)	20.5 (8.7)	8.0 (9.8)	17.6 (16.3)	2.20
Cannabis (n = 119)	6.2 (13.8)	2 (1.0, 5.0)	15.6 (4.0)	16.0 (8.6)	13.0 (11.6)	5.45
Cocaine (n = 131)	5.7 (7.8)	3 (1.0, 6.5)	20.3 (5.6)	13.1 (9.5)	11.3 (10.7)	3.50
Hallucinogens (n = 49)	3.9 (7.9)	1 (1.0, 3.0)	19.2 (7.2)	9.3 (8.0)	13.9 (11.6)	4.40
Inhalants (n = 26)	7.0 (19.5)	2 (1.0, 2.0)	16.8 (7.7)	10.6 (11.5)	17.8 (15.5)	4.12
Pain Medication (n = 136)	8.8 (17.7)	3.5 (2.0, 9.25)	21.5 (8.2)	12.0 (7.6)	8.2 (7.1)	4.20
Nicotine (n = 91)	7.5 (11.4)	5 (2.5, 9.5)	14.6 (5.6)	23.8 (12.4)	8.7 (10.2)	6.05
Opioids (n = 109)	10.4 (18.2)	4 (2.0, 10.0)	22.2 (7.4)	11.1 (7.5)	8.0 (9.2)	3.60
Stimulants (n = 111)	7.5 (15.0)	3 (1.5, 5.0)	23.4 (8.4)	11.1 (8.7)	8.6 (10.0)	4.60
Tranquilizers (n = 83)	6.5 (10.4)	2 (1.0, 5.5)	21.1 (6.8)	11.1 (8.1)	10.0 (9.2)	3.03

Note. SD: Standard Deviation, IQR: Interquartile Range

substances indicated that when averaged across SUD severity, pain medication, and opioids had a significantly higher number of quit attempts than all other substances (*ps* < .001) but were not different from each other (*p* = 1.0). Additionally, both alcohol and stimulants had a significantly higher number of quit attempts than cannabis, cocaine, hallucinogens, and nicotine (*ps* ≤.03). Lastly, tranquilizers had a substantially higher number of quit attempts than hallucinogens (*p* = .003). All other pairwise comparisons were insignificant (*ps* > .08; see Supplemental Table S2).

Fig. 3 shows the estimated marginal means as a function of SUD severity averaged across substances. Pairwise comparisons across levels of SUD severity indicated that, when averaged across substances, those with moderate SUD reported a significantly higher number of attempts than those with mild SUD (*p* < .001). Furthermore, those with severe SUD reported a higher number of attempts than those with mild or moderate SUD (*ps* < .001).

4. Discussion

The present study aimed to investigate (1) whether the number of quit attempts varies across different substances and (2) which variables are associated with the number of quit attempts. Our findings indicate that (1) the number of quit attempts differs across substances, with pain medication and opioids requiring a significantly higher number of attempts than all other substances, and (2) a higher number of quit attempts is associated with more severe SUDs, more years of use, and later onset age. We expand upon these findings below.

First, our findings replicate previously reported findings that SUD is a chronically relapsing disorder that requires multiple quit attempts before successful abstinence (Dennis et al., 2005; Kelly et al., 2019). Notably, a comparable number of attempts was observed in the present study (mean of 8.1 and median of 3) and the previous study by Kelly et al. (2019) (mean of 6.14 and median of 3, when only considering individuals that reported at least one quit attempt – the subsample

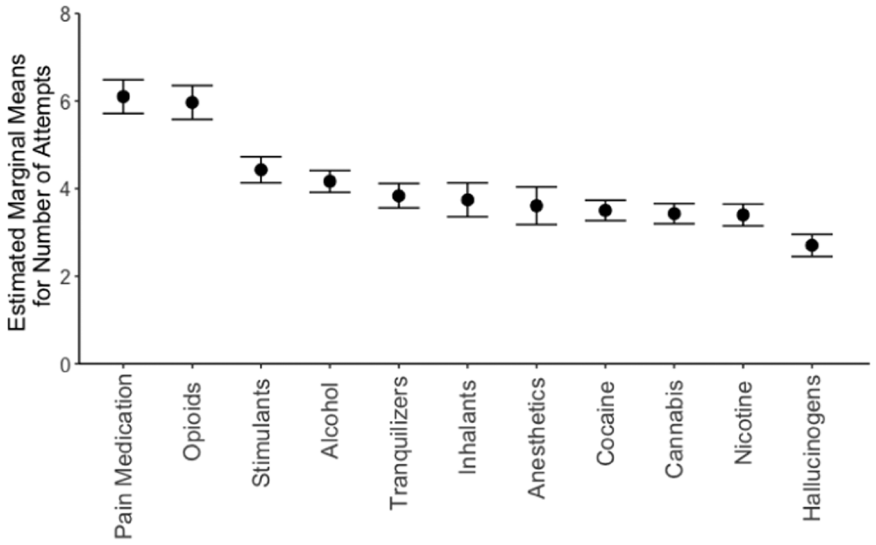

Fig. 2. Estimated marginal means from the model for each substance (averaged across levels of SUD severity). Error bars represent the Standard Error of the mean. Number of participants for each substance: Pain Medication = 136; Opioids = 109; Stimulants = 111; Alcohol = 230; Tranquilizers = 83; Inhalants = 26; Anesthetics = 14; Cocaine = 131; Cannabis = 119; Nicotine = 91; Hallucinogens = 49.

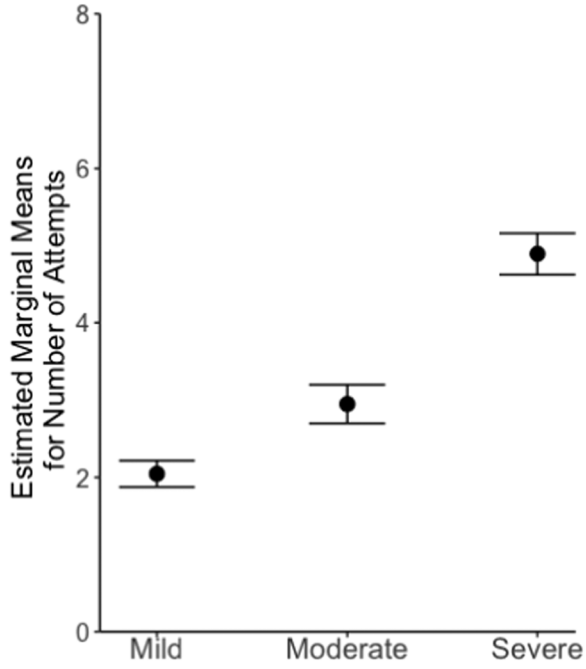

Fig. 3. Estimated marginal means from the model across levels of SUD severity (averaged across substances). Error bars represent the Standard Error of the mean. Number of observations (n = number of participants) for each level of severity: Mild = 154 (n = 79); Moderate = 82 (n = 65); Severe = 863 (n = 322).

analogous to our sample), despite methodological differences. For example, Kelly et al.'s sample was composed of people who considered themselves to no longer have "problems with drugs or alcohol", but who were not necessarily abstinent. Conversely, we operationally defined resolving an alcohol or drug problem as no longer using that substance (i.e., answering "No" to the question "Do you still use [name of substance]?") and only included in the sample participants who reported successful abstinence for at least one substance.

Additionally, our findings expand the previous literature by showing that the number of quit attempts differs across substances. Interestingly, the substances identified as more challenging to quit (i.e., requiring more attempts) in the present study are also the ones with low short-term effectiveness of treatment and high rates of reocurrence (e.g., reocurrence rates are over 90 % for opioids (Smyth et al., 2010), 60–80 % for alcohol (Dousset et al., 2020; Nguyen et al., 2020), and 60–70 % for stimulants (Brecht and Herbeck, 2014; Chen et al., 2015; Wang et al., 2018)). Conversely, the substance identified as the less challenging to quit (i.e., requiring fewer attempts; hallucinogens) exhibits a low misuse liability and a different clinical profile than other commonly misused substances (Schlag et al., 2022). Indeed, evidence suggests a low prevalence of hallucinogen use disorder (Shalit et al., 2019), with the majority of individuals who use hallucinogens not transitioning to dependence (Stone et al., 2006). Physiologically, the substances associated with a higher number of attempts are known to induce significant physical dependence (Pergolizzi et al., 2020; Ruetsch, 2010), leading to severe withdrawal symptoms such as pain, nausea, and anxiety (Canver et al., 2024; Pergolizzi et al., 2020), which may hinder cessation efforts. Concomitantly, the combination of the relief from pain and the euphoria provided by these drugs can render them more reinforcing (Pergolizzi et al., 2020; Volkow and McLellan, 2016). From a social perspective, individuals who use such substances (e.g., long-term prescriptions for pain management or alcohol) may have continuous access to social environments that normalize their use (Chou et al., 2014; Fischer et al., 2023; McCabe et al., 2007). Therefore, the differences in the number of quit attempts between substances likely result from a combination of physiological, psychological, and social factors. Future studies should explore these psychosocial factors and their associations with quit attempts.

Second, our results expand previous findings by showing that those who meet more DSM-5 criteria (i.e., more severe SUDs) or have a more extended history of SUD might need more attempts before achieving abstinence. These findings are in line with prior research showing that more severe SUDs (Anglin et al., 1997; Gottheil et al., 1992; Simpson, 2004) and more years of use (Anglin et al., 1997; Simpson, 2004) are associated with a more extensive and repeated history of SUD treatment and poorer treatment outcomes. Taken together, these results suggest that individuals with a more severe and longer history of SUD are less likely to achieve successful abstinence after their first quit attempt and might be at a greater risk of resuming substance use. Therefore, a better understanding of variables that predict reocurrence of substance use may improve treatment approaches by informing who would benefit from personalized interventions.

Overall, our results highlight the need for more substance-specific analyses in the addiction recovery literature because addiction and recovery patterns might not be the same for all substances. Furthermore, our findings suggest that analyses based on the primary substance may obscure the overall pattern of substance use behavior and recovery. For example, Kelly et al. (2019) did not observe differences in the number of quit attempts as a function of the primary substance. This finding was replicated in the present study since primary substance was not selected in the optimal model, suggesting that primary substance might not be among the most relevant factors for the number of quit attempts. Thus, by analyzing the number of attempts to overcome each SUD individually, the present study provided a more granular picture of differences in the number of attempts between substances that might not be captured when looking at the primary substance only. Nonetheless, our findings should not be interpreted to suggest that a focus on primary substance has no clinical validity and utility since the primary substance might be the most life-threatening and debilitating and, in some cases, the most relevant for one to quit. Instead, our goal is to highlight that different substances may have different profiles and recovery pathways.

The current and prior findings collectively have essential implications for SUD treatment approaches. First, the results corroborate the chronic nature of SUD by indicating that abstinence requires several attempts. Such evidence suggests the need for a shift in treatment paradigm toward continued care strategies because acute treatment approaches may not address the chronicity of SUD, resulting in unsatisfactory outcomes and high rates of reocurrence and readmission (Dennis et al., 2005; McLellan et al., 2000, 2005). Additionally, treatment approaches and professionals should recognize that each substance has a distinct clinical profile, recovery trajectory, and resolution process. Recognizing the unique challenges of different substances and individual circumstances at intake allows treatment providers to create personalized plans that effectively address substance use disorders and support long-term recovery. For example, individuals with more severe SUD and more years of use may require more intense or a combination of interventions relative to those with less severe or fewer years of use. Furthermore, interventions for individuals with more severe SUD might also require clinicians to attend to other environmental risk factors that can contribute to reocurrence of substance use and thus undermine clinical efforts.

Additionally, our findings also suggest the need for more effective early interventions to prevent the escalation of substance misuse to severe levels and help reduce the number of attempts before successful abstinence. Thus, research informing how and when to intervene to prevent the escalation of the SUD and decrease the number of attempts needed before SUD resolution is warranted. Lastly, understanding the differences in recovery pathways between substances and degrees of severity may serve to inform patients about what to expect and help them stay engaged in the treatment despite reocurrence episodes. Such efforts can utilize resource management during treatment and ensure that the correct "dosage" is employed based on patients' needs.

5. Limitations

We recognize that this study presents some limitations. First, the results were based on self-report of past events, which may have resulted in inaccurate counts of the exact number of quit attempts or other variables (e.g., age of first use, age of last use, etc.). Second, our cleaning criteria resulted in the exclusion of about 18 % of the participants. Although our exclusion criteria might have been strict, we chose to err on the side of caution and exclude more rather than fewer participants to preserve the quality of the data. Third, because SUD is a chronically relapsing disorder, the number of quit attempts reported at this time point might not be final due to future relapses. As a result, our number of quit estimates is likely a lower bound than what may be expected.

Additionally, we limited our analyses to those who reported abstaining from using a given substance (i.e., answering "No" to the question "Do you still use [substance name]?), which does not necessarily equate to successful recovery. Although abstinence has been the main emphasis in recovery definitions and approaches, more recent discussions about recovery have emphasized changes in wellness and quality of life (Hagman et al., 2022). Thus, our sample and analyses do not include the number of attempts that individuals might need until achieving successful improvements in wellness and quality of life despite still using the substance. Future studies should investigate whether the number of recovery attempts varies depending on the recovery outcome goal (e.g., abstinence vs. harm reduction; improvement in quality of life and well-being). Lastly, the majority of our sample was white (85.6 %), non-Hispanic or Latino (92.8 %), and limited to people with access to the internet, thus our results might not generalize to other populations as we know that demographics and socioeconomic status can influence recovery outcomes and pathways (McQuaid et al., 2018; Saloner and Lê Cook, 2013; Stahler et al., 2016). Furthermore, other variables that might impact quit attempts were not assessed in the current study (e.g., previous and current treatments for SUD, types of treatment, psychiatric comorbidities, etc.). Therefore, the factors associated with the number of quit attempts identified in the current study should not be interpreted as exhaustive.

6. Conclusion

Overall, the present study suggests that the number of attempts before successful abstinence is associated with the substance, the severity of the SUD, and the number of years of use. Importantly, our findings indicate that opioids and pain medication require significantly more attempts than all other substances. Thus, such substances might need more targeted and effective interventions. Additionally, more severe SUD and more years of use were also associated with more quit attempts. Such findings highlight that interventions that target individuals earlier in the SUD and before progression to moderate or severe dependence could potentially result in fewer total attempts before successful cessation, thereby increasing treatment success.

Authors disclosure

We confirm that this work is original, has not been published previously, and is not under consideration for publication elsewhere. Its publication and the order of authorship are approved by all authors. Allison Tegge will serve as corresponding author for this submission. If accepted, all authors will confirm authorship.

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CRediT authorship contribution statement

Allison N. Tegge: Writing – review & editing, Visualization, Supervision, Formal analysis, Data curation. **Rafaela M. Fontes:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Warren K Bickel:** Writing – review & editing, Supervision, Resources, Funding acquisition, Conceptualization. **Daniel Cabral:** Writing – review & editing, Visualization. **Roberta Freitas-Lemos:** Writing – review & editing, Visualization, Conceptualization.

Declaration of Competing Interest

Although the following activities/relationships do not create a conflict of interest pertaining to this manuscript, in the interest of full disclosure, Dr. Bickel would like to report the following: W. K. Bickel is a principal of HealthSim, LLC; BEAM Diagnostics, Inc.; and Red 5 Group,

LLC. In addition, he serves on the scientific advisory board for Ria Health and as a consultant for Lumanity and AlphaSights. Dr. Tegge would like to report the following: A. N. Tegge works on a project supported by Indivior, Inc.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.drugalcdep.2024.112525.

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