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ORIGINAL ARTICLE

Demographic, Mental Health, and Substance Use Correlates of Self-Described Medicinal Use, Recreational Use, and Non-Use of Hallucinogenic Drugs

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Abstract

There is growing public interest in the use of hallucinogens to manage mental health symptoms (i.e., medicinal hallucinogen use). Yet, limited research has examined the correlates of hallucinogen use for self-described medicinal purposes—an important gap given that self-medication may confer increased risk for harm. Accordingly, this study examined the demographic, mental health, and substance use correlates of medicinal hallucinogen use relative to no hallucinogen use and to exclusively recreational hallucinogen use. Adults reporting no hallucinogen use ($n=4837$), medicinal hallucinogen use ($n=110$), and exclusively recreational hallucinogen use ($n=240$) were recruited from across Canada via Prolific and from six Canadian universities. Participants completed an online questionnaire assessing demographic characteristics, mental health, hallucinogen use, and other substance use. Logistic regression analyses showed that greater depression severity; more frequent use of alcohol, cannabis, and nicotine; and using several illegal and prescription drugs were associated with an increased likelihood of medicinal hallucinogen use relative to no hallucinogen use. Greater depression severity was also associated with an increased likelihood of medicinal hallucinogen use relative to exclusively recreational hallucinogen use. Further, participants who used hallucinogens for medicinal reasons reported more frequent hallucinogen use relative to those who used hallucinogens for exclusively recreational reasons. Results suggest that poorer mental health and greater use of other substances differentiate people who use hallucinogens for medicinal reasons from people who do not use hallucinogens or who use hallucinogens for exclusively recreational reasons. Further, medicinal hallucinogen use, relative to exclusively recreational hallucinogen use, is associated with using hallucinogens more frequently. Findings may inform targeted preventive and harm reduction interventions for hallucinogen use.

Keywords Hallucinogens · Self-medication · Psychedelics · Psilocybin · Ketamine · Substance use · College students

Hallucinogens refer broadly to a category of psychoactive substances that can produce alterations in mood and cognition, as well as hallucinations. Hallucinogens include both classic serotonergic hallucinogens (i.e., psychedelics) such as lysergic acid diethylamide

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(LSD), and dissociative agents such as ketamine (Livne et al., 2022; Nichols, 2016). The prevalence of hallucinogen use has steadily risen over the past two decades (Keyes & Patrick, 2023; Livne et al., 2022; Walsh et al., 2022), with recent estimates of past-year prevalence of hallucinogen use reaching approximately 2% in Canada in 2019 (Government of Canada, 2021) and 3% in the United States in 2022 (Substance Abuse & Mental Health Services, 2023). Research on the relative benefits and risks of hallucinogen use has yielded mixed results; whereas some studies point to potential therapeutic benefits (De Gregorio et al., 2021), others highlight risk for hallucinogen use disorder and other adverse physical and psychological consequences (Halpern et al., 2018; Johnson et al., 2018; Skryabin et al., 2018; Thomas & Malcolm, 2021; Wu et al., 2008). Thus, in light of the trend toward greater use of hallucinogens, there is growing interest in identifying correlates of hallucinogen use to inform targeted prevention and harm reduction interventions.

There has been limited research on the factors associated with hallucinogen use until recently, with only a handful of studies overall and most published in the last five years. Select studies have found that individuals who use (versus do not use) hallucinogens are more likely to report use of illegal drugs and prescription drug misuse (Grant et al., 2019; Hallock et al., 2013; Yockey et al., 2019), as well as to meet criteria for substance use disorders (Killion et al., 2021; Shalit et al., 2019). Several studies have also supported associations of hallucinogen use with poorer mental health, including symptoms of mood and anxiety disorders, eating disorders, personality disorders, posttraumatic stress disorder, and suicidality (Grant et al., 2019; Killion et al., 2021; Matzopoulos et al., 2022; Shalit et al., 2019; Yang et al., 2022). The association between hallucinogen use and poorer mental health may be attributable to self-medication; that is, poorer mental health could motivate some individuals to use hallucinogens to manage symptoms of mental health problems (Khantzian, 1997; Yang et al., 2022)—a trend that could potentially be on the rise with increased public interest in the therapeutic potential of hallucinogens. Supporting the notion that self-medication may play a role in rates of hallucinogen use, among the most common motives for hallucinogen use are managing mental health symptoms and improving subjective psychological well-being (Lea et al., 2020; Matzopoulos et al., 2022). Relatedly, in a sample of people reporting hallucinogen use to treat mental health problems, self-administered treatment with hallucinogens was perceived as more effective in managing symptoms than were other treatments offered by medical professionals (Mason & Kuypers, 2018). Qualitative reports also highlight treatment of mood and addictive disorders and longer-term improvements in psychological well-being as commonly perceived benefits of hallucinogen use (Carhart-Harris & Nutt, 2010). Further, recent data suggest that increased media attention toward the therapeutic use of hallucinogens and approval of selected hallucinogens for the treatment of depression, for some, may increase willingness to use hallucinogens, including for medicinal reasons (Grabski et al., 2022; Palamar & Le, 2022). Growing access to prescription hallucinogens (Zannese, 2022) and the proliferation of illegal hallucinogen dispensaries in countries such as Canada (The Canadian Press, 2023) may similarly drive more individuals to manage mental health symptoms using hallucinogens.

Although self-medication for mental health ostensibly constitutes a sizable portion of hallucinogen use, limited research has characterized individuals who use hallucinogens for medicinal reasons (i.e., to prevent or alleviate mental health symptoms), specifically. However, related research on medicinal cannabis use lends support to potential differences between people who self-medicate with a psychoactive drug that is purported to have therapeutic benefits relative to people who use the drug exclusively for recreational reasons. For example, people reporting medicinal cannabis use tend to report more frequent use relative to those who use cannabis exclusively non-medicinally (Hummer et al., 2021; Lin

et al., 2016; Loflin et al., 2017; Wardell, 2022; Wardell et al., 2021), perhaps to maximize symptom relief. Medicinal, relative to non-medicinal, cannabis use has also been linked to poorer mental health (Hummer et al., 2021; Loflin et al., 2017; Wardell, 2022), especially among individuals using cannabis to manage mental health symptoms, specifically (Coelho & Wardell, 2023). Further, although associated with lighter alcohol use and lower risk for alcohol use disorder (Lin et al., 2016; Loflin et al., 2017; Roy-Byrne et al., 2015; Wardell, 2022), medicinal cannabis use has been found to correlate with the use of select other substances, such as sedatives and tranquilizers (Wardell, 2022; Wardell et al., 2021). It is conceivable that similar differences may be observed between people who use hallucinogens for medicinal reasons compared to those who use hallucinogens exclusively recreationally. Recent data support associations of hallucinogen use, broadly, with poorer mental health (Grant et al., 2019; Killion et al., 2021; Matzopoulos et al., 2022; Shalit et al., 2019; Yang et al., 2022). However, whether poorer mental health, among other factors, also distinguishes people who use hallucinogens for medicinal reasons, specifically, from people who do not use hallucinogens or who use hallucinogens exclusively recreationally is unknown.

The Current Study

The current study examined the correlates of using hallucinogens for medicinal reasons, defined as the use of hallucinogens to prevent or treat symptoms of a mental health problem with or without medical supervision. Specifically, we aimed to identify demographic, mental health, and substance-use-related factors uniquely predictive of reporting medicinal hallucinogen use relative to both not using hallucinogens and using hallucinogens exclusively for recreational reasons. Informed by research on medicinal cannabis use, we hypothesized that greater mental health problems and use of other substances would be associated with an increased likelihood of using hallucinogens for medicinal reasons compared to not using hallucinogens or using hallucinogens for exclusively recreational reasons. Further, we compared frequency of hallucinogen use between participants reporting medicinal versus exclusively recreational hallucinogen use, hypothesizing that medicinal hallucinogen use would be associated with more frequent hallucinogen use relative to exclusively recreational hallucinogen use.

Method

Participants and Recruitment

This cross-sectional study combined data from two convenience samples: a student sample and a community sample, each recruited from Canada. Given the larger study's focus on alcohol use and other addictive behaviours, all participants were at or above the legal drinking age in their respective area of residence (18 years or older in Alberta, Manitoba, or Quebec; 19 years or older in all other Canadian provinces). Recruitment and data collection for the community subsample occurred via Prolific, which is an online crowdsourcing platform with a pool of more than 200,000 verified research participants. Members of the Prolific participant pool, each assigned a unique Prolific identifier and account, have passed onboarding checks based on attention, comprehension, and honesty. Prolific also checks that participants' IP addresses are valid and verifies participants' identities using

bank-grade identity checks to prevent the inclusion of false participants (e.g., bots) and duplicate participants. Members of the Prolific participant pool are sent brief descriptions of studies in which they are eligible to participate through their online Prolific account. The current study was described as an online questionnaire investigating the psychological and behavioural factors associated with mental health disorders and addictions among undergraduate students in Canada.

The student subsample was recruited from undergraduate psychology student research pools at six universities across Canada (campuses in urban areas in British Columbia, Alberta, Ontario, and Nova Scotia). Recruitment and data collection for the student subsample occurred via Sona Systems, which is a participant recruitment and study management platform. Specifically, students enrolled in introductory psychology courses were each assigned a unique Sona identifier and account with which to access their department's Sona platform, where they could view brief descriptions of a range of psychology research studies in which they could participate to receive course credit. The current study was described as an online questionnaire investigating the psychological and behavioural factors associated with mental health disorders and addictions among undergraduate students in Canada.

In the student and community subsamples, a participant identifier variable in the online questionnaire was autopopulated with participants' Prolific or Sona identifiers, respectively, and Prolific (community subsample) or Sona (student subsample) prevented multiple entries from the same account. The participant identifier variable was used to detect rare cases when a participant still completed the online questionnaire more than once, and duplicate entries were removed. After removing duplicate entries, 1089 unique community participants provided informed consent to participate in the study, 1036 of whom completed the online questionnaire (95.13% completion rate), and 5440 unique student participants provided informed consent to participate in the study, 5217 of whom completed the online questionnaire (95.90% completion rate); only participants who completed the online questionnaire were included in analyses. Of the 1036 community participants and 5217 student participants who completed the online questionnaire, 88 (8.49%) community participants and 976 (18.71%) student participants were excluded from the sample due to failing one or more attention check questions, completing the study in under five minutes, or not confirming having provided honest, high-quality responses to all items (in two face-valid questions included at the end of the questionnaire). An additional two student participants did not complete measures of hallucinogen use and were excluded from the analytic sample. Thus, our analytic sample included 948 community participants and 4241 student participants, resulting in a combined sample size of 5187. Sample demographic characteristics are in Table 1 and sample mental health and substance use characteristics are in Table 2.

Procedures

Data collection for the current study took place between September of 2023 and February of 2024. After providing informed consent, participants completed a 45-min online questionnaire that included measures of demographic characteristics, substance use, and mental health; all participants completed these measures in the same order. Throughout the online questionnaire, participants could return to earlier measures to review and change their responses. Adaptive questioning was used to conditionally display select items based on responses to previous items, reducing participant burden. Following completion of

Table 1 Demographic characteristics of the full sample and of participants reporting no hallucinogen use, medicinal hallucinogen use, and recreational hallucinogen use

		Full sample ($N=5187$)	No hallucinogen use ($n=4837$)	Medicinal hallucinogen use ($n=110$)	Exclusively recreational hallucinogen use ($n=240$)			
	n	*n* (%)	*n* (%)	*n* (%)	*n* (%)	X^2 (*df*)	*p*	Cramer's *V*
Sex	5185					22.93 (2)	< .001	0.07
Male		1231 (23.73)	1113 (23.01)[a]	32 (29.09)[a,b]	86 (35.83)[b]			
Female		3954 (76.23)	3723 (76.97)[a]	78 (70.91)[a,b]	153 (63.75)[b]			
Gender	5176					25.35[d]	.003	0.04
Man		1203 (23.19)	1089 (22.51)[a]	30 (27.27)[a,b]	84 (35.00)[b]			
Woman		3797 (73.2)	3577 (73.95)[a]	76 (69.09)[a,b]	144 (60.00)[b]			
Non-binary		134 (2.58)	122 (2.52)[a]	2 (1.82)[a]	10 (4.17)[a]			
Transgender		42 (0.81)	39 (0.81)[a]	1 (0.91)[a]	2 (0.83)[a]			
Race/ethnicity	5186					107.41[d]	< .001	0.10
Black		227 (4.38)	218 (4.51)[a]	4 (3.64)[a]	5 (2.08)[a]			
East Asian		1117 (21.53)	1066 (22.04)[a]	12 (10.91)[a]	39 (16.25)[a]			
Latine/Latin American/Hispanic		160 (3.08)	148 (3.06)[a]	1 (0.91)[a]	11 (4.58)[a]			
Middle Eastern		316 (6.09)	302 (6.24)[a]	6 (5.45)[a]	8 (3.33)[a]			
South Asian		762 (14.69)	734 (15.17)[a]	12 (10.91)[a,b]	16 (6.67)[b]			
Southeast Asian		393 (7.58)	388 (8.02)[a]	1 (0.91)[a,b]	4 (1.67)[b]			
White		1852 (35.7)	1660 (34.32)[a]	60 (54.55)[b]	132 (55.00)[b]			
Indigenous		75 (1.45)	65 (1.34)[a]	6 (5.45)[b]	4 (1.67)[a,b]			
Not listed		284 (5.48)	255 (5.27)[a]	8 (7.27)[a]	21 (8.75)[a]			
Sexual orientation	5184					116.55[d]	< .001	0.11
Asexual		152 (2.93)	146 (3.02)[a]	0 (0.00)[a]	6 (2.50)[a]			
Bisexual		659 (12.7)	589 (12.18)[a]	31 (28.18)[a]	39 (16.25)[a]			
Gay		68 (1.31)	62 (1.28)[a]	0 (0.00)[a]	6 (2.50)[a]			
Lesbian		112 (2.16)	96 (1.98)[a]	5 (4.55)[a]	11 (4.58)[a]			

Table 1 (continued)

		Full sample ($N=5187$)	No hallucinogen use ($n=4837$)	Medicinal hallucinogen use ($n=110$)	Exclusively recreational hallucinogen use ($n=240$)			
	n	*n (%)*	*n* (%)	*n* (%)	*n* (%)	X^2 (*df*)	*p*	Cramer's *V*
Pansexual		149 (2.87)	133 (2.75)[a]	9 (8.18)[b]	7 (2.92)[a,b]			
Queer		158 (3.05)	132 (2.73)[a]	14 (12.73)[b]	12 (5.00)[a,b]			
Straight/heterosexual		3854 (74.3)	3648 (75.42)[a]	48 (43.64)[b]	158 (65.83)[c]			
Not listed		32 (0.62)	28 (0.58)[a]	3 (2.73)[a]	1 (0.42)[a]			
Highest level of education	5187					30.30[d]	.001	0.05
High school diploma or less		1674 (32.27)	1607 (33.22)[a]	20 (18.18)[b]	47 (19.58)[b]			
Some college/university, technical certification, or associates degree		2343 (45.17)	2151 (44.47)[a]	62 (56.36)[a,b]	130 (54.17)[b]			
Bachelors degree		958 (18.47)	885 (18.3)[a]	23 (20.91)[a]	50 (20.83)[a]			
Post-graduate work or degree		212 (4.09)	194 (4.01)[a]	5 (4.55)[a]	13 (5.42)[a]			
Subsample	5187					13.36 (2)	.001	0.05
Community		948 (18.28)	864 (17.86)[a]	34 (30.91)[b]	50 (20.83)[a,b]			
Student		4239 (81.72)	3973 (82.14)[a]	76 (69.09)[b]	190 (79.17)[a,b]			
	n	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*F* (*df*)	*p*	η^2
Age	5187	22.73 (7.91)	22.64 (7.99)[a]	25.24 (7.64)[b]	23.32 (5.92)[a,b]	6.48 (2)	.002	<0.01

M = mean; *SD* = standard deviation; *df* = degrees of freedom. [a,b,c]Superscripts in common denote the lack of a statistically significant pairwise difference; [d]No degrees of freedom as *p* value simulated (with 2000 replications) due to small expected values

Table 2 Mental health and substance use characteristics of the full sample and of participants reporting no hallucinogen use, medicinal hallucinogen use, and recreational hallucinogen use

		Full sample ($N=5187$)	No hallucinogen use group ($n=4837$)	Medicinal hallucinogen use group ($n=110$)	Exclusively recreational hallucinogen use group ($n=240$)			
	n	*n* (%)	*n* (%)	*n* (%)	*n* (%)	X^2 (df)	*p*	Cramer's *V*
Past-three-month cocaine use (yes)	5187	118 (2.27)	54 (1.12)[a]	17 (15.45)[b]	47 (19.58)[b]	438.56[d]	< .001	0.29
Past-three-month prescription stimulant use (yes)	5187	458 (8.83)	348 (7.19)[a]	40 (36.36)[b]	70 (29.17)[b]	242.74 (2)	< .001	0.22
Past-three-month methamphetamine use (yes)	5187	40 (0.77)	16 (0.33)[a]	3 (2.73)[b]	21 (8.75)[b]	217.28[d]	< .001	0.20
Past-three-month inhalant use (yes)	5187	51 (0.98)	23 (0.48)[a]	8 (7.27)[b]	20 (8.33)[b]	190.55[d]	< .001	0.19
Past-three-month sedative use (yes)	5187	343 (6.61)	275 (5.69)[a]	23 (20.91)[b]	45 (18.75)[b]	100.32 (2)	< .001	0.14
Past-three-month non-prescription opioid use (yes)	5187	21 (0.4)	2 (0.04)[a]	3 (2.73)[b]	16 (6.67)[b]	263.78[d]	< .001	0.23
Past-three-month prescription opioid use (yes)	5187	121 (2.33)	86 (1.78)[a]	9 (8.18)[b]	26 (10.83)[b]	99.14[d]	< .001	0.14
	n	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*F* (df)	*p*	η^2
DASS-21 depression score	5172	12.54 (10.04)	12.36 (9.95)[a]	20.17 (11.89)[b]	12.70 (9.67)[a]	32.57 (2)	< .001	0.01
DASS-21 anxiety score	5178	9.96 (8.26)	9.85 (8.22)[a]	14.18 (9.49)[b]	10.13 (7.94)[a]	14.94 (2)	< .001	0.01
LEC total score	5152	8.64 (5.20)	8.53 (5.21)[a]	9.96 (4.53)[b]	10.15 (5.01)[b]	14.61 (2)	< .001	0.01
WHO-5-WBI total score	5181	12.73 (5.17)	12.80 (5.18)[a]	10.21 (4.96)[b]	12.60 (4.83)[a]	13.62 (2)	< .001	0.01
Past-30-day alcohol use frequency (number of days)	5184	3.24 (4.47)	3.03 (4.31)[a]	6.45 (6.32)[b]	5.85 (5.24)[b]	76.44 (2)	< .001	0.03
Past-30-day cannabis use frequency (number of days)	5185	2.41 (6.47)	1.88 (5.67)[a]	11.95 (11.96)[b]	8.67 (10.35)[c]	274.00 (2)	< .001	0.10

Table 2 (continued)

		Full sample ($N=5187$)	No hallucinogen use group ($n=4837$)	Medicinal hallucinogen use group ($n=110$)	Exclusively recreational hallucinogen use group ($n=240$)			
Past-30-day cigarette use frequency (number of days)	5186	1.03 (4.44)	0.88 (4.21)[a]	3.55 (7.19)[b]	2.72 (6.31)[b]	38.18 (2)	< .001	0.01
Past-30-day electronic nicotine use frequency (number of days)	5197	2.63 (7.55)	2.31 (7.10)[a]	7.95 (11.81)[b]	6.71 (11.02)[b]	68.36 (2)	< .001	0.03
	n	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	Mann–Whitney *U*	*p*	*r*
Past-three-month hallucinogen use frequency	350[e]	2.26 (0.68)	–[e]	2.17 (0.56)[a]	2.45 (0.86)[b]	10886	< .001	0.21

M = mean; *SD* = standard deviation; *df* = degrees of freedom; DASS-21 = Depression, Anxiety, and Stress Scale; LEC = Life Events Checklist; WHO-WBI = World Health Organization Wellbeing Index. Hallucinogen use frequency was coded as 0 = never, 2 = once or twice, 3 = monthly, 4 = weekly, 6 = daily or almost daily, per the National Institute on Drug Abuse Alcohol, Smoking, and Substance Involvement Screening Test. Participants who did not endorse past-three-month hallucinogen use did not report the frequency of their use. [a,b,c]Superscripts in common denote the lack of a statistically significant pairwise difference; [d]No degrees of freedom as *p* value simulated (with 2000 replications) due to small expected values; [e]Only participants reporting past-three-month hallucinogen use reported their past-three-month hallucinogen use frequency

the online questionnaire, community participants received $12.75 CAD and student participants received course credit. Study procedures were approved by the Research Ethics Boards at each participating institution.

Measures

Demographic Characteristics

Participants reported their age, sex assigned at birth, self-identified gender, race/ethnicity, sexual orientation, and highest level of education (see Table 1 for response options for each variable). For gender, race/ethnicity, and sexual orientation, participants were first asked to select all response options that applied, and then were asked to select just one response to be used in analyses requiring mutually exclusive categories; the latter categorizations were used in analyses.

Hallucinogen Use

Participants were first asked how frequently they had used hallucinogens (with examples of LSD, acid, mushrooms, PCP, Special K, and ecstasy) in the past three months using an item from the National Institute on Drug Abuse (NIDA) Modified Alcohol, Smoking, and Substance Involvement Screening Test (NM-ASSIST; NIDA, 2009) (0 = *never,* 2 = *once or twice,* 3 = *monthly,* 4 = *weekly,* 6 = *daily or almost daily*). Participants reporting any past-three-month hallucinogen use were subsequently asked whether they had used hallucinogens medicinally in the past three months, as follows: "*Have you used hallucinogens/psychedelics in the past three months to treat or manage symptoms of a mental health problem (e.g., depression, PTSD, addiction), either on your own or with the support of a mental health professional?"* Participants responding affirmatively were then asked to report the types of hallucinogens they had used in the past three months, with options including psilocybin, ketamine, methylenedioxy-methylamphetamine (MDMA), lysergic acid diethylamide (LSD), dimethyltryptamine (DMT), peyote, ayahuasca, and other. They were also asked to report the mental health symptoms they had used hallucinogens to treat in the past three months, with options including depression, anxiety, posttraumatic stress disorder (PTSD), addiction or other substance use, or other.

Other Substance Use

Participants reported on how many days in the past 30 days they had used each of alcohol, cannabis, combustible cigarettes, and electronic nicotine products. They also reported how frequently they had used each of cocaine, prescription stimulants, methamphetamine, inhalants, sedatives, non-prescription opioids, and prescription opioids in the past three months (0 = *never,* 2 = *once or twice,* 3 = *monthly,* 4 = *weekly,* 6 = *daily or almost daily*), using items from the NM-ASSIST (NIDA, 2009). Given that most prescription and illegal drugs were infrequently endorsed, these items were dichotomized to indicate whether the drug was used.

Mental Health

Depression and anxiety symptom severity were assessed using subscales of the 21-item Depression, Anxiety, and Stress Scale (DASS-21; Henry & Crawford, 2005). Seven items comprise each subscale and are rated from 0 = *did not apply to me at all* to 3 = *applied to me very much or most of the time,* based on the past week. Items within each subscale are summed and then multiplied by two to obtain subscale scores (depression: $\alpha = 0.92$; anxiety: $\alpha = 0.82$), with higher scores indicating greater depression or anxiety symptom severity.

Lifetime traumatic event exposure was assessed using the Life Events Checklist for DSM-5 (LEC-5; Weathers et al., 2013). The LEC-5 lists 17 potentially traumatic events, each of which participants rate as *happened to me, witnessed it, learned about it, part of my job, not sure,* or *doesn't apply.* Scores are the total number of items endorsed (i.e., as experienced, witnessed, learned about, or part of job; $\alpha = 0.91$), with higher scores indicating greater traumatic event exposure.

The World Health Organization Five-Item Well-Being Index (WHO-5-WBI; World Health Organization, 1998) was used to assess subjective psychological well-being. The five items of the WHO-5-WBI are each rated from 0 = *at no time* to 5 = *all of the time,* based on the past two weeks. Items are summed to obtain scores ($\alpha = 0.90$), with higher scores indicating greater subjective psychological well-being.

Data Analysis

Participants were first assigned to one of three groups based on their past-three-month hallucinogen use: (1) *no hallucinogen use* ($n = 4837$); (2) *medicinal hallucinogen use* ($n = 110$); and (3) *exclusively recreational hallucinogen use* (which included participants who endorsed hallucinogen use, but did not endorse medicinal reasons for use; $n = 240$). The three groups were first compared on each demographic, substance use, and mental health variable. Chi-square tests with Bonferroni-adjusted post-hoc pairwise comparisons were used to examine group differences on categorical variables, and one-way analyses of variances (ANOVAs) with Tukey's honestly significant difference (HSD) tests were used to compare groups on continuous variables. Further, we used a Mann–Whitney *U* test to compare the medicinal and exclusively recreational hallucinogen use groups on past-three-month hallucinogen use frequency, which was treated as an ordinal variable using values assigned to each response option in the NM-ASSIST (see *Measures*).

Next, a multinomial logistic regression model was used to examine unique predictors of likelihood of medicinal hallucinogen use compared to each of no hallucinogen use and exclusively recreational hallucinogen use; as the current study focused on the correlates of using hallucinogens for medicinal reasons, medicinal hallucinogen use was specified as the referent category to provide comparisons of medicinal hallucinogen use with both no hallucinogen use and exclusively recreational hallucinogen use. All variables on which statistically significant univariate group differences were observed were entered simultaneously as predictors in the model.[1] To examine associations of reason for hallucinogen use with

[1] When used in regression models, response options from demographic variables with small cell sizes were collapsed; specifically, race/ethnicity was coded as non-White versus White, and sexual orientation was coded as Lesbian, Gay, Bisexual, Queer + (LGBQ +) versus straight/heterosexual.

frequency of hallucinogen use, a binary logistic regression model limiting to participants reporting past-three-month hallucinogen use was specified with reason for hallucinogen use (0 = *exclusively recreational*, 1 = *medicinal*) predicting past-three-month hallucinogen use frequency, controlling for any variables on which statistically significant univariate differences between participants reporting medicinal versus exclusively recreational hallucinogen use were observed. Past-three-month hallucinogen use frequency was dichotomized in models as *0 = less than monthly hallucinogen use* versus 1 = *monthly or more frequent hallucinogen use* due to a large majority of the participants reporting past-three-month hallucinogen use having used hallucinogens less than monthly past three months ($n = 289$; 82.57%), and consequently, small cell sizes for higher-frequency categories. Variance inflation factors for predictors in each model were all ≤ 2.9.

Variable-level missing data ranged from 0–0.67% and were thus handled using listwise deletion across analyses. Logistic regression models were fit using iteratively reweighted least squares estimation. All analyses were conducted in R, using the *ltm, misty, tidyverse,* and *VGAM* packages (R Core Team, 2022; Rizopoulos, 2022; Wickham et al., 2019; Yanagida, 2023; Yee & Moler, 2023).

Results

Descriptive Statistics

Across the full sample, 6.75% of participants ($n = 350$) reported any past-three-month hallucinogen use, of whom 31.43% ($n = 110$) reported medicinal hallucinogen use and 68.57% ($n = 240$) reported exclusively recreational hallucinogen use. Among participants reporting medicinal hallucinogen use, past-three-month hallucinogen use was reported as once or twice by 70.91% ($n = 78$), monthly by 18.18% ($n = 20$), weekly by 8.18% ($n = 9$), and daily or almost daily by 2.73% ($n = 3$), and among participants reporting exclusively recreational hallucinogen use, past-three-month hallucinogen use was reported as once or twice by 87.92% ($n = 211$), monthly by 9.58% ($n = 23$), weekly by 1.25% ($n = 3$), and daily or almost daily by 1.25% ($n = 3$).

Among participants reporting medicinal hallucinogen use, the most common types of hallucinogens used for medicinal reasons were psilocybin ($n = 98$, 89.09%), LSD ($n = 23$, 20.91%), and MDMA ($n = 15$, 13.64%). Most participants reported using just one type of hallucinogen medicinally ($n = 77$, 70.00%), whereas 30.00% ($n = 33$) of participants reported using multiple (ranging from two to seven) types of hallucinogens medicinally. A majority of participants endorsed using hallucinogens to treat symptoms of anxiety ($n = 86$, 78.18%) and depression ($n = 84$, 76.36%). Most participants ($n = 80$, 72.73%) reported using hallucinogens to treat multiple (ranging from two to four) mental health symptoms. Further descriptive statistics on medicinal hallucinogen use are shown in Table 3.

Univariate Group Comparisons

Tests of univariate differences between the groups defined by hallucinogen use status are summarized in Tables 1 and 2. Compared to participants reporting no hallucinogen use, participants reporting medicinal hallucinogen use were older, more likely to identify as White or as Indigenous, more likely to identify as pansexual or queer, less likely to have

a high school diploma or less education, and more likely to belong to the community subsample. Further, compared both to participants reporting no hallucinogen use and to participants reporting exclusively recreational use, participants reporting medicinal use were less likely to identify as straight/heterosexual. Finally, compared to participants reporting no hallucinogen use, participants reporting exclusively recreational hallucinogen use were more likely to be assigned male at birth, more likely to identify as men, more likely to identify as White and less likely to identify as South Asian or as Southeast Asian, less likely to identify as straight/heterosexual, less likely to have a high school diploma or less education, and more likely to have some college or university education or a technical or associates degree.

In univariate comparisons on substance use and mental health variables, compared to participants reporting no hallucinogen use, both participants reporting medicinal hallucinogen use and participants reporting exclusively recreational hallucinogen use were more likely to report using each type of prescription or illegal drug, and they reported higher traumatic event exposure and more frequent use of alcohol, cannabis, cigarettes, and electronic nicotine products. Participants reporting medicinal hallucinogen use also reported higher depression symptom severity, higher anxiety symptom severity, lower subjective psychological well-being, and more frequent cannabis use relative both to participants reporting no hallucinogen use and to participants reporting exclusively recreational hallucinogen use. Further, compared to participants reporting exclusively recreational hallucinogen use, participants reporting medicinal hallucinogen use reported more frequent hallucinogen use.

Logistic Regression Analyses

Results of the multinomial logistic regression model predicting likelihood of medicinal hallucinogen use relative to no hallucinogen use and exclusively recreational hallucinogen use are reported in Table 4. In this model, greater depressive symptom severity was significantly

Table 3 Descriptive statistics on medicinal hallucinogen use among the $N = 113$ participants reporting using hallucinogens medicinally

Variable	*n* (%)
Types of hallucinogens used for medicinal reasons	
Psylocibin	98 (89.09)
Lysergic acid diethylamide (LSD)	23 (20.91)
Methylenedioxy-methylamphetamine (MDMA)	15 (13.64)
Ketamine	7 (6.36)
Dimethyltryptamine (DMT)	4 (3.64)
Other	4 (3.64)
Ayahuasca	3 (2.73)
Peyote	1 (0.91)
Mental health symptoms treated using hallucinogens	
Anxiety	86 (78.18)
Depression	84 (76.36)
Posttraumatic stress disorder (PTSD)	29 (26.36)
Addiction/other substance use	17 (15.45)
Other	10 (9.09)

For each variable, participants could select more than one response option

Table 4 Multinomial logistic regression model with demographic, mental health, and substance use variables predicting the likelihood of medicinal hallucinogen use relative to no hallucinogen use and recreational hallucinogen use

	No hallucinogen use vs. medicinal hallucinogen use [ref.]				Exclusively recreational hallucinogen use vs. medicinal hallucinogen use [ref.]			
	OR	Estimate	*SE*	*p*	OR	Estimate	*SE*	*p*
DASS-21 depression score	**0.96**	**-0.05**	**0.01**	**.002**	**0.94**	**-0.06**	**0.02**	**<.001**
DASS-21 anxiety score	1.01	0.01	0.02	.619	0.99	-0.01	0.02	.478
LEC total score	1.01	0.01	0.02	.687	1.03	0.03	0.03	.249
WHO-5-WBI total score	1.00	0.00	0.03	.900	0.98	-0.02	0.03	.535
Past-30-day alcohol use frequency (number of days)	**0.96**	**-0.04**	**0.02**	**.018**	1.00	0.00	0.02	.939
Past-30-day cannabis use frequency (number of days)	**0.93**	**-0.08**	**0.01**	**<.001**	1.00	0.00	0.01	.690
Past-30-day cigarette use frequency (number of days)	0.98	-0.02	0.01	.148	1.00	0.00	0.02	.808
Past-30-day electronic nicotine use frequency (number of days)	**0.98**	**-0.02**	**0.01**	**.020**	1.00	0.00	0.01	.734
Past-three-month cocaine use (0 = no, 1 = yes)	**0.13**	**-2.04**	**0.37**	**<.001**	1.10	0.10	0.38	.796
Past-three-month prescription stimulant use (0 = no, 1 = yes)	**0.44**	**-0.81**	**0.25**	**.001**	0.83	-0.19	0.29	.522
Past-three-month methamphetamine use (0 = no, 1 = yes)	1.51	0.41	1.02	.686	**7.79**	**2.05**	**0.99**	**.038**
Past-three-month inhalant use (0 = no, 1 = yes)	**0.22**	**-1.53**	**0.58**	**.008**	0.47	-0.75	0.60	.211
Past-three-month sedative use (0 = no, 1 = yes)	0.64	-0.45	0.30	.131	1.02	0.02	0.35	.945
Past-three-month non-prescription opioid use (0 = no, 1 = yes)	0.35	-1.05	1.23	.391	1.09	0.09	1.09	.936
Past-three-month prescription opioid use (0 = no, 1 = yes)	0.92	-0.08	0.50	.874	1.02	0.02	0.54	.972
Sex (0 = male, 1 = female)	**1.72**	**0.54**	**0.25**	**.031**	0.85	-0.16	0.28	.580
Race/ethnicity (0 = non-White, 1 = White)	0.71	-0.34	0.22	.128	1.38	0.33	0.26	.207
Sexual orientation (0 = LGBQ+, 1 = straight/heterosexual)	**3.26**	**1.18**	**0.22**	**<.001**	**2.25**	**0.81**	**0.26**	**.002**
Highest level of education[a]	0.81	-0.21	0.15	.158	1.23	0.21	0.17	.231
Age (years)	0.99	-0.01	0.02	.638	0.97	-0.03	0.02	.104
Subsample (0 = community, 1 = student)	1.11	0.10	0.32	.746	1.93	0.66	0.38	.085

OR = odds ratio; *SE* = standard error; ref. = referent category; DASS-21 = Depression, Anxiety, and Stress Scale; LEC = Life Events Checklist; WHO-WBI = World Health Organization Wellbeing Index; LGBQ+ = Lesbian, Gay, Bisexual, Queer+. Gender was excluded from the model due to high overlap with sex and small cell sizes for some gender categories. Bolding denotes statistical significance ($p < 0.05$). [a]Highest level of education was treated as an ordinal variable and coded as 1 = high school diploma or less; 2 = some college/university, technical certification, or associates degree; 3 = bachelors degree; and 4 = post-graduate work or degree

associated with an increased likelihood of reporting medicinal hallucinogen use relative to both no hallucinogen use and to recreational hallucinogen use, such that a one-point increase in depression score was associated with a 4% and 6% greater likelihood of reporting medicinal hallucinogen use relative to no hallucinogen use and to recreational hallucinogen use, respectively. Participants who identified as LGBTQ were also a respective 3.23 and 2.27 times more likely to report medicinal hallucinogen use relative to no hallucinogen use and to recreational hallucinogen use. Each additional day in the past 30 days on which alcohol, cannabis, and electronic nicotine products were used was associated with a respective 4%, 8%, and 2% greater likelihood of reporting medicinal hallucinogen use relative to no hallucinogen use, and participants who used cocaine, prescription stimulants, and inhalants were a respective 7.69, 2.27, and 4.55 times more likely to report medicinal hallucinogen use relative to no hallucinogen use. Participants who were male (versus female) were also 1.72 times more likely to report medicinal hallucinogen use relative to no hallucinogen use. Further, participants who used methamphetamine were 7.69 times more likely to report recreational hallucinogen use relative to medicinal hallucinogen use.

Results of the binary logistic regression model with reason for hallucinogen use predicting past-three-month hallucinogen use frequency are reported in Table 5. In this model, adjusting for covariates, participants reporting medicinal (relatively to exclusively recreational) hallucinogen use were 3.24 times more likely to report monthly or more frequent (relative to less than monthly) hallucinogen use in the past three months.

Discussion

Given rising rates of hallucinogen use and growing public interest in the therapeutic potential of hallucinogens, the current study examined the correlates of using hallucinogens to prevent or treat symptoms of mental health problems (i.e., for medicinal reasons). Consistent with hypotheses, participants reporting medicinal hallucinogen use exhibited poorer mental

Table 5 Binary logistic regression model with hallucinogen use frequency predicting the likelihood of medicinal hallucinogen use relative to recreational hallucinogen use

	Monthly or more frequent hallucinogen use vs. less than monthly hallucinogen use [ref.]			
	OR	Estimate	*SE*	*p*
Reason for hallucinogen use (0 = exclusively recreational, 1 = medicinal)	**3.24**	**1.18**	**0.32**	**< .001**
DASS-21 depression score	1.02	0.02	0.02	.291
DASS-21 anxiety score	1.01	0.01	0.02	.759
WHO-5-WBI total score	1.04	0.04	0.04	.269
Past-30-day cannabis use frequency (number of days)	0.97	-0.03	0.01	.070
Sexual orientation (0 = LGBQ+, 1 = straight/heterosexual)	1.39	0.33	0.31	.292

OR = odds ratio; *SE* = standard error; ref. = referent category; DASS-21 = Depression, Anxiety, and Stress Scale; WHO-WBI = World Health Organization Wellbeing Index; LGBQ+ = Lesbian, Gay, Bisexual, Queer+. Bolding denotes statistical significance ($p < .05$). Hallucinogen use frequency was coded as 0 = never, 2 = once or twice, 3 = monthly, 4 = weekly, 6 = daily or almost daily, per the National Institute on Drug Abuse Alcohol, Smoking, and Substance Involvement Screening Test

health. Specifically, in univariate analyses, participants who used hallucinogens medicinally reported greater depression and anxiety symptom severity and lower subjective psychological wellbeing relative to both participants who did not use hallucinogens and those who used hallucinogens exclusively recreationally, and greater traumatic event exposure relative to participants who did not use hallucinogens. These associations broadly converge with studies finding poorer mental health among people who use hallucinogens relative to people who do not (Grant et al., 2019; Killion et al., 2021; Matzopoulos et al., 2022; Shalit et al., 2019; Yang et al., 2022), and are the first to demonstrate poorer mental health among people who use hallucinogens for medicinal reasons, specifically, relative to people who do not use hallucinogens. Further, we extend prior research by demonstrating that poorer mental health not only characterizes people who use hallucinogens, but distinguishes those who use for medicinal reasons from those who use exclusively for recreational reasons, aligning with studies reporting similar differences in mental health between those who used cannabis for medicinal versus non-medicinal reasons (Hummer et al., 2021; Loflin et al., 2017; Wardell, 2022). Although a link between poorer mental health with medicinal (relative to recreational) reasons for hallucinogen use appears intuitive in that perceived mental health problems are ostensibly a requisite for using hallucinogens to manage mental health symptoms rather than for exclusively recreational reasons, our study is the first to demonstrate this association empirically, suggesting that individuals are more likely to perceive their hallucinogen use as "medicinal" when they have elevated mental health symptoms. Further research is needed to provide a more nuanced understanding of the association of mental health symptoms with medicinal hallucinogen use—for example, studies assessing mental health symptoms both pre and post using hallucinogens for medicinal reasons, or exploring individuals' perceptions of the effectiveness of hallucinogens in managing their mental health symptoms.

Notably, in the logistic regression model controlling for shared variance among demographic, mental health, and substance use variables, greater depression symptom severity was the only mental health variable that uniquely differentiated participants reporting medicinal hallucinogen use from participants reporting no hallucinogen use and from participants reporting exclusively recreational hallucinogen use. That depression was the mental health variable that was most robustly associated with medicinal hallucinogen use may reflect increasing research and media attention toward the therapeutic use of hallucinogens for treatment-resistant depression (Alnefeesi et al., 2022; Grabski et al., 2022; Kalfas et al., 2023; Palamar & Le, 2022; Wong et al., 2024). Results support a potential self-medication effect; more specifically, people experiencing mental health problems, and especially depression, may be at increased likelihood of using hallucinogens, and they may do so specifically to alleviate symptoms. Given heterogeneity across research on the relative therapeutic benefits and risks of hallucinogen use (De Gregorio et al., 2021; Halpern et al., 2018; Johnson et al., 2018; Skryabin et al., 2018; Thomas & Malcolm, 2021), our findings suggest a need for targeted hallucinogen education efforts for people with mental health problems who may be at increased likelihood of using hallucinogens to manage symptoms. That is, growing media attention toward the therapeutic use of hallucinogens for treatment-resistant depression and other mental health problems should be accompanied by more widespread public education initiatives that provide lay audiences with evidence-based information on the therapeutic benefits and risks of hallucinogen use. For example, it may be important to inform lay audiences that hallucinogens, alone, may be insufficient in treating mental health problems, and should be administered in combination with psychotherapy. These public education initiatives may also benefit from resources supporting those interested in using hallucinogens to manage their mental health symptoms in seeking appropriate medical guidance, given the potential harms of self-medication.

Participants reporting medicinal hallucinogen use also generally reported greater use of other substances, including more frequent use of alcohol, cannabis, cigarettes, and electronic nicotine products, and greater likelihood of using several prescription and illegal drugs, compared to those who did not use hallucinogens. They also reported more frequent cannabis use than did participants who used hallucinogens exclusively recreationally. Further, in the logistic regression model controlling for shared variance among variables, more frequent alcohol and cannabis use and using cocaine, prescription stimulants, and inhalants were each uniquely associated with a greater likelihood of reporting medicinal hallucinogen use relative to no hallucinogen use. These findings extend prior research linking hallucinogen use, broadly, to illegal drug use and prescription drug misuse (Grant et al., 2019; Hallock et al., 2013; Yockey et al., 2019), and suggest that even among people who use hallucinogens for medicinal reasons, other drug use may still be elevated compared to among people who do not use hallucinogens at all or who use hallucinogens exclusively recreationally. Perhaps individuals who have experience with other substance use may be more likely to use hallucinogens to self-medicate their mental health problems, as a substitute for, or adjunct to, other forms of mental health treatment such as psychotherapy or standard prescription medications. Alternatively, using hallucinogens to self-medicate mental health symptoms may predispose individuals to initiate other drug use. Future research is needed to test mechanisms of associations between medicinal hallucinogen use and other drug use.

As hypothesized, participants who used hallucinogens medicinally reported more frequent hallucinogen use relative to participants who used hallucinogens exclusively recreationally. This finding aligns with the cannabis literature, wherein medicinal, relative to non-medicinal, reasons for cannabis use predict using cannabis more frequently (Hummer et al., 2021; Lin et al., 2016; Loflin et al., 2017; Wardell, 2022; Wardell et al., 2021). More frequent hallucinogen use among people who use hallucinogens medicinally may reflect efforts to maximize symptom relief. However, despite this relative elevation in hallucinogen use frequency, worth noting is that hallucinogens were still relatively infrequently used in each group, with a majority reporting having used hallucinogens only once or twice in the past three months. This contrasts with the cannabis use literature, wherein people reporting medicinal reasons for cannabis use often use cannabis daily or almost daily (Lin et al., 2016; Wardell, 2022; Wardell et al., 2021). Thus, although people who use hallucinogens medicinally may use hallucinogens more frequently than do people who use hallucinogens exclusively recreationally, hallucinogen use to manage mental health symptoms still appears relatively infrequent overall, at least in this non-clinical sample of community and student participants.

Notably, although several factors significantly differentiated participants reporting hallucinogen use from participants reporting no use, we observed fewer significant differences between participants reporting medicinal and exclusively recreational hallucinogen use. This lack of observed differences may reflect overlap between medicinal and exclusively recreational hallucinogen use; that is, people who use hallucinogens for medicinal versus exclusively recreational reasons may be more alike than they are different. However, some behaviours on which we compared the hallucinogen use groups had relatively low base rates (e.g., illegal and prescription drug use), potentially limiting our ability to detect group differences without larger samples. As this is the first study to our knowledge to distinguish between those who use hallucinogens medicinally versus exclusively recreationally, further research with larger samples of people who use hallucinogens is needed to clarify the extent of overlap between medicinal and recreational hallucinogen use.

Limitations

Results of this study should be interpreted with consideration of several limitations. Our assessment of medicinal hallucinogen use did not differentiate between hallucinogen use with versus without medical authorization or the support of a mental health professional and did not ascertain the sources from which hallucinogens were obtained. Still, as hallucinogens are not yet widely prescribed (Zannese, 2022), it is likely that medicinal hallucinogen use in our sample largely reflected self-medication. In addition, the item assessing past-three-month medicinal hallucinogen use listed only depression, PTSD, and addiction as example mental health problems that hallucinogens may be used to manage; although examples were not meant to constitute an exhaustive list, including additional examples (e.g., anxiety) may have prompted more participants to describe their hallucinogen use as medicinal. Further, although participants reported the types of hallucinogens they used for medicinal reasons, we did not assess the types of hallucinogens used for recreational reasons. We also did not assess whether participants who reported using hallucinogens medicinally were also using hallucinogens recreationally, and thus we could not distinguish between participants reporting exclusively medicinal hallucinogen use versus both medicinal and recreational hallucinogen use. Moreover, when assessing hallucinogen use frequency, we did not differentiate between frequency of medicinal versus recreational use, and participants did not report hallucinogen dosage information. Given these limitations, future studies obtaining more detailed information about both medicinal and recreational hallucinogen use are needed.

The current study was also cross-sectional, precluding causal inferences. The association between medicinal hallucinogen use and poorer mental health may also reflect risk for psychopathology posed by hallucinogen use, for example via impairments to cognitive functioning (dos Santos et al., 2017; Pokorny et al., 2020; Yang et al., 2022), which should be explored in future research. Further, as hallucinogen use is a low-base-rate behaviour for which we did not oversample, the proportion of participants in our sample reporting hallucinogen use was relatively low. However, given our large overall sample, a subsample of $n=350$ participants reporting hallucinogen use was still relatively large, sufficiently so to conduct group comparisons. An additional limitation is that although we used data from two large, demographically diverse samples, they were each convenience samples, potentially engendering sampling bias. For example, participants in the student subsample, all of whom were enrolled in introductory psychology courses and the majority of whom were young adults, may have been more aware of their mental health symptoms and of growing research attention toward the therapeutic potential of hallucinogenic drugs, perhaps consequently exhibiting elevated rates of using hallucinogens to manage mental health symptoms. Select studies have also identified demographic differences between online crowdsourced and probability-based samples, with the former tending to be younger, more educated, and more liberal (Chandler et al., 2019; Weinberg et al., 2014). Further, as subsamples were each non-clinical samples, it is not clear whether findings are generalizable to clinical populations. Thus, findings of our study should be replicated in representative samples.

Conclusions

This study extends prior research on the correlates of hallucinogen use by examining the correlates of using hallucinogens for medicinal reasons, specifically, relative to both not using hallucinogens and using hallucinogens exclusively for recreational reasons. Results suggest that poorer mental health and greater use of other substances characterize people who use hallucinogens medicinally relative to people who do not use

hallucinogens or who use hallucinogens exclusively recreationally, and that medicinal, relative to exclusively recreational, reasons for hallucinogen use are associated with using hallucinogens more frequently. Findings provide novel insight into the characteristics of people who use hallucinogens medicinally and may inform targeted preventive and harm reduction interventions for hallucinogen use.

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Data Availability De-identified data from this study, code for analyses, and study material will be made available (as allowable according to institutional IRB standards) by emailing the corresponding author.

Declarations

Ethics Approval Approval was obtained from the research ethics boards of Toronto Metropolitan University, the University of British Columbia, University of Calgary, York University, Carleton University, and Mount Saint Vincent University. The procedures used in this study adhere to the relevant tenets of the Declaration of Helsinki.

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study.

Conflicts of Interest The authors declare no conflicts of interest.

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