Hallucinogen Use in Methamphetamine Addiction: Correlates and Treatment Outcomes

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This thesis is submitted in partial fulfilment of the Honours degree of Bachelor of Psychological Science (Honours)

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Word Count: 9006

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Abstract

Whilst the literature supports that drug addicts who engage in polysubstance use are more likely to experience poorer treatment outcomes and psychological distress, there is also some evidence that hallucinogens can treat addiction and psychological distress (Tupper et al., 2015). The aim of this research was to investigate whether individuals who are addicted to methamphetamine and consume hallucinogens achieve poorer treatment outcomes than individuals who are addicted to methamphetamine and abstain from hallucinogens. It was hypothesised that the individuals who engaged in hallucinogen use would experience greater levels of physical, psychological and social harm than those who abstained from hallucinogens. The sample included 1159 methamphetamine-addicted outpatients from Psychmed's Matrix program and the data was obtained through Psychmed's electronic database. Outpatients were coded into a "non-hallucinogen" group and a "hallucinogen" group. A repeated measures ANOVA compared outpatients' wellbeing and addiction scores obtained prior to treatment and post treatment. Although both the non-hallucinogen group and the hallucinogen group experienced an improvement in scores post treatment, the hallucinogen group consistently had greater levels of harm at baseline and upon completion of the program. This suggests that hallucinogen use is correlated with poorer treatment outcomes. As a result, outpatient rehabilitation programs need to encourage abstinence from all substances during treatment. This research will give outpatient drug rehabilitation programs the evidence to shift their focus onto addressing secondary substance use and how it interacts with primary addiction.

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University, and, to the best of my knowledge, this thesis contains no materials previously published except where due reference is made. I give permission for the digital repository, the Library Search and through web search engines, unless permission has been granted to by the School to restrict access for a period of time.

October 2021

Contribution Statement

In writing this thesis, my supervisor and I collaborated to generate research questions of interest and design the appropriate methodology. I conducted the literature search, while Psychmed deidentified the data and provided access to it for analysis. My supervisor calculated the ages of the participants, and we collaborated to conduct additional coding and data analysis in SPSS. I wrote up all sections of the thesis, with review by my supervisor.

Acknowledgements

Firstly, I would like to thank my supervisor, Professor Paul Delfabbro, for his endless guidance, patience and support throughout this strenuous year. You have been such a great mentor and it has been an absolute pleasure working with you, as I have learnt so many valuable things that I know will stay will me throughout my future professional life. I always appreciate how you still managed to make every meeting light-hearted, and will cherish all the times we bonded over the year. I would also like to thank Dr. Quentin Black and the staff at Psychmed, for taking the time out to meet with me on countless occasions and trusting me with such sensitive data. Without Psychmed, I would not have been able to research a topic that I am so passionate about.

To my loving parents and sister, thank you for all the pep-talks and wisdom you gave me when I needed it most. I would also like to thank my incredible partner, who was my ultimate support and kept pushing me even when I felt so discouraged. And finally, to my friends and fellow peers, it has been so wonderful going through this journey with all of you, and I will always cherish our uni bar hangouts.

Chapter 1. Introduction

1.1 Significance & Background

Methamphetamine (Meth) is a highly potent and addictive synthetic illicit substance. It is classified as a phenylethylamine psychostimulant and operates on the central nervous system (Pey et al., 2016). Meth's chemical structure is highly similar to amphetamine's structure, but it contains an added N-methyl group which increases lipid solubility and promotes a more rapid crossing of the blood–brain barrier. As a result, the onset of meth's effects are much quicker and more intense than other stimulants such as amphetamine and cocaine (Black et al., 2017). Meth is primarily produced in either a powder form which the user either snorts or injects, or in a crystallised form that can be smoked or injected (Budman et al., 2009). When ingested, meth forces neurons in the mesolimbic pathway of the brain to rapidly release stored monoamine neurotransmitters. It also inhibits reuptake of these substances back into the axon terminal, leading to high concentrations in neuronal synapses (Ferrucci et al., 2019). Although numerous different monoamine neurotransmitters are released, dopamine, norepinephrine and serotonin have the most significant effects on the individual (Black et al., 2017).

Dopamine regulates feelings of pleasure, with controlled amounts being released during enjoyable experiences such as eating, shopping, and sexual experiences. The high concentrations of dopamine produces intense euphoria, increased confidence, alertness, and a heightened sense of wellbeing (Berridge & Kringelbach, 2015; Lin et al., 2016). However, excess dopamine also disrupts the sleep cycle and promotes alertness and wakefulness, sometimes causing individuals who have ingested meth to stay awake for days at a time (Hedges et al., 2018; Radfar & Rawson, 2014). Serotonin's main functions are to regulate mood and appetite. While the increase in serotonin from meth improves mood and

focus, enabling users to be more productive and efficiently complete tasks, excessive amounts can suppress appetite and cause one to feel satisfied despite having an empty stomach. Consequently, individuals addicted to meth often experience excessive weight loss and malnourishment (Jaehne et al., 2017). Norepinephrine is released during stressful and dangerous situations, increasing ones arousal and alertness, acting as a protective mechanism for survival. However, excessive amounts of norepinephrine can lead to restlessness and anxiety as well as an increased heart rate, blood pressure, and body temperature. When overdosing on meth, these effects can lead to arrythmias, hyperpyrexia, hypertension, kidney failure, seizures, stroke, haemorrhages, coma and ultimately, death (Degenhardt et al., 2017). The positive effects of these neurotransmitters act as a reward for engaging in the experience, motivating them to repeatedly engage in the experience. As a result, the behaviour is repeatedly reinforced and could potentially lead to addiction (Godino et al., 2015). Long-term use can lead to dopamine and serotonin neuron damage which may cause: paranoia, increased aggression, depression, hallucinations, and psychosis (Kish et al., 2017).

Due to its addictive nature, meth users experience intense withdrawal which can significantly affect day-to-day functioning. This is because repeated use of meth disrupts the maintenance and depletes the levels of dopamine in the brain. As a result, intense cravings are experienced to compensate for the lack of dopamine and this commonly results in withdrawal symptoms (Courtney & Ray, 2014). There are two stages of meth withdrawal. An acute phase lasts 7-10 days and is symptomatic of excessive sleeping, eating and feelings of depression. The second, or sub-acute phase, persists for at least two weeks in which symptoms such as poor concentration and memory, fatigue, paranoia, irritability and agitation are experienced by the individual (McGregor et al., 2005). Meth cravings can continue for approximately five weeks, but the first two weeks are particularly vulnerable for relapse (Zorick et al., 2010).

1.2 Prevalence of Meth addiction and public health issues

Regular meth use in Australia has been steadily declining over the last two decades. In 2001, 3.4% of Australians aged 14 years old and over had used meth in the previous 12 months, decreasing to 1.3% in 2019 (Australian Institute of Health and Welfare, 2021). Although less Australians are consuming meth in comparison to the previous two decades, meth's burden on the community, public health, and the individual is increasing in severity. In particular, the use of methamphetamine hydrochloride, a purer and more potent crystallised form of meth has increased in usage between 2007- 2019 from 27% to 50% of Australian users respectively (Australian Institute of Health and Welfare, 2021). The increasing use of methamphetamine hydrochloride means that users are more vulnerable to experiencing adverse effects and overdose resulting on an increase burden on the health care system. According to information drawn from the National Hospital Morbidity Database, meth accounted for 4.5% of drug related hospital discharges in 2014-15, which increased to 8.6% of all drug related hospital discharges in 2018-19 (Australian Institute of Health and Welfare, 2021). The National Drug and Alcohol Research Centre revealed that there was an increase from 107 meth related deaths in 2011 to 478 meth related deaths in 2019 (Chrzanowska et al., 2021). As a result, the Australian Institute of Health and Welfare declared methamphetamine as Australia's main drug of concern in 2017 (Australian Institute of Health and Welfare, 2017). Moreover, whilst under the influence of meth, individuals are more susceptible to act impulsively and undertake acts of crime, violence and aggression (McKetin et al., 2014). The estimated social cost of health, crime and road accidents relating to meth use was $3.73b. AUD in 2007 and this increased to $5.024b. AUD in 2014 (Tait et al., 2018). This highlights the strong correlation between meth hydrochloride use and increased burden on society within Australia.

1.3 Correlates of meth addiction

There are many demographic characteristics that are correlated with meth use. In Australia, being male increases the likelihood of using meth. In 2019, 7% of Australia's male population and 5% of Australia's female population had used meth in their lifetime, while 2% of males and 0.8% of females had used meth in the previous 12 months (Australian Institute of Health and Welfare, 2021). However, males are more likely to seek treatment for their addiction than females. Between 2019 and 2020, 34,307 clients across Australia received treatment for meth, with approximately two-thirds (66%) of the clients being male. 3.1% of Aboriginal and Torres Strait Islander Australians have reportedly used meth in the previous 12 months, which is 2.2 times more likely than non-Indigenous Australians. Of the 34,307 clients that received treatment between 2019 and 2020, only 1 in 6 (18%) of clients were Indigenous or Torres Strait Islanders (Australian Institute of Health and Welfare, 2021b). These figures indicate that there are many Aboriginal Australians who are unlikely to have meth addictions that are going untreated. Other demographic risk factors include identifying as a homosexual or bisexual male. For individuals aged 14 years or older, the greatest number of recent methamphetamine use was found amongst men who identified as homosexual or bisexual, with 7.1% of this population confirming recent meth use (Australian Institute of Health and Welfare, 2021). Younger Australians aged in their 20s and 30s are at a significantly greater risk of using methamphetamine. In a sample of 34,307 meth users, 69% of males and 72% of females were aged between 20 and 39 years of age (Australian Institute of Health and Welfare, 2021b). Degenhardt et al. (2016) found that Australians aged between 25 and 34 years of age experienced the highest rates of meth use, with 1.50% of this cohort using meth (Degenhardt et al., 2016).

1.4 Comorbidities of Meth addiction

Meth users often possess multiple psychological, physical, and/or social comorbidities that exacerbate meth's negative effects. Poor mental health and high psychological distress have consistently been associated with meth use, with anxiety being one of the most common comorbidities in individuals who use meth (Darke et al., 2008; Zweben et al., 2004). In Australia, approximately 40% of meth users who attend treatment reported having a history of anxiety disorders (McKetan et al., 2008). Hall et al. (1996) also found that 76% of 301 regular meth users experienced severe anxiety and 33% experienced panic attacks after the onset of meth use. Of this sample, 48% reported having severe anxiety prior to meth use, and 11% experienced panic attacks (Hall et al., 1996). Furthermore, Conway et al. (2006) reported that 39% of meth users reported a lifetime prevalence of anxiety disorders, while Shoptaw et al. (2003) reported a lifetime prevalence of anxiety for 25% of meth users (Conway et al., 2006; Shoptaw et al., 2003). Hang Su et al. (2017) found that in a sample of 210 meth dependant individuals, 34% reported their anxiety symptoms as being high, in comparison to just 4% of the general population (Hang Su et al., 2017). Anxiety is also a prominent symptom during the first several weeks of meth withdrawal, which contributes to the likelihood of experiencing relapse (McGregor et al., 2005; Zorick et al., 2010). It is evident that many meth users already had anxiety prior to using methamphetamine; however, meth's use worsens these symptoms.

Depression is also often correlated with meth use. A cross sectional survey of 500 individuals who are seeking treatment for meth addiction in Brisbane and Sydney revealed that 40% of the sample had identified that they had suffered major depression at some point in the previous year (McKetan et al., 2011). Furthermore, a study of 526 meth users found that their severity of depression was significantly associated with their self-reported use of

meth 30 days prior to receiving treatment, and that more frequent users had higher Beck Depression Index scores (M = 13.7. *SD* = 9.5) than those who abstained (M = 7.7, *SD* = 8.1) (Glassner-Edwards et al., 2009). Finally, there is a significant increase in the probability of the individual having a history of physical and/or sexual abuse, mental health illness and suicidal ideation in those who engage in polysubstance use (Christian et al., 2007).

There are several environmental factors that are correlated with meth use. Being unemployed puts individuals at a higher risk of abusing meth. The National Drug Strategy Household Survey of 2016 found that in the previous 12 months, unemployed individuals were 3.1 times more likely (4.6%) to use meth than employed individuals (1.5%) (National Drug Strategy Household Survey, 2016). The literature also supports this, with a sample of 1238 meth users from the National Survey of Drug Use and Health reporting that 91% of the sample were unemployed (Swanke and Flowers, 2013). Additionally, level of education has also been associated with meth use, with one study finding that fewer years of schooling (OR = 0.8) and homelessness (OR = 2.5) in the previous months were significant predictors of meth use (Rognli et al., 2014). Between 2015 and 2018, there was a 22% increase in individuals who have obtained a high school diploma or less, and those who had received government assistance experienced a 26.2% increase (Palamar et al., 2020). When comparing meth users to non-users, non-meth users had completed more years of education than individuals who use meth (WMD =2.45 to 2.80) (Yen & Chong, 2006). An additional study demonstrated that non meth users were 1.3 times more likely to have studied at higher levels of education (Sattah et al., 2002). Lower levels of education and current unemployment is associated with ongoing meth use.

Polysubstance use is common among meth users (Australian Institute of Health and Welfare, 2017; Connor et al., 2014). Alcohol and cannabis are prevalent among meth users, with 73% engaging in risky drinking and 74% frequently consuming cannabis

(Australian Institute of Health and Welfare, 2017). Furthermore, other common secondary substances include benzodiazepines and heroin. These four substances are considered central nervous system depressants which are commonly used during the 'comedown' period after meth ingestion (Quinn et al., 2020; Herbeck et al., 2013). These substances reportedly assist with moderating the effects of withdrawal including: anxiety levels, sleep difficulties and pain (Hall et al., 2013). Polysubstance use has negative effects on meth recovery and the overall wellbeing of the individual. Hindering abstinence from the primary drug, polysubstance use has universally been associated with poorer treatment engagement and outcomes. Relapse and dropout rates are higher in those who engage in polysubstance use, with an odds ratio of 2.51 for polysubstance users and 1.39 for non-polysubstance users (Andersson et al., 2021). Abstaining from secondary substance use is strongly associated with decreased frequency of engaging with the primary drug (Wang et al., 2017). Secondary drugs cannabis and benzodiazepines have been associated with major depression (OR= 2.3, OR= 2.1 respectively). Additionally, 42% of those who engaged in cannabis and/or benzodiazepine use in the previous month experienced major depression compared to 26% who abstained from polysubstance use (McKetin et al., 2011). Polysubstance use has also been associated with increased levels of anxiety during meth withdrawal (OR= 3.86) (Su et al., 2017). A longitudinal study from 2005-2015 confirmed that polysubstance use was associated with anxiety and depression (Burdzovic et al., 2015). Moreover, drug induced psychosis has been associated with meth users who engage in polysubstance use, in particular frequent alcohol and cannabis use (Arunogiri et al., 2018). Overall, polysubstance use has been associated with poorer recovery outcomes.

Amongst potential poly-use substances, hallucinogens are a class of drug that can produce an altered state of consciousness by inducing hallucinations and distorting ones' perception of reality (Carhart-Harris & Goodwin, 2017). The most commonly abused

hallucinogens by meth users include Lysergic Acid Diethylamide (LSD), Psilocybin mushrooms, commonly referred to as “magic” mushrooms, and 3,4-Methylenedioxymethamphetamine (MDMA). Although it is an amphetamine and has stimulant properties, MDMA produces hallucinogenic effects and can be classed as an hallucinogen (Meyer, 2013). Emerging evidence in recent years has suggested therapeutic benefits of LSD, psilocybin mushrooms and MDMA in treating addiction, depression, anxiety and post-traumatic stress disorder (Garcia-Romeu et al., 2016; Tupper et al., 2015). This evidence contradicts the literature surrounding polysubstance use and meth addiction which indicates poorer treatment outcomes for individuals engaging in multiple drug use (Andersson et al., 2021). Evidently, the type of drug consumed by the individual may impact the success of the treatment outcome. As this field is relatively new, it is hard to obtain exact figures relating to the proportion of meth users that engage in hallucinogen use.

1.5 Treatment Strategies

Within Australia, primary, secondary and tertiary strategies are utilised within the community to prevent or treat drug and alcohol addiction. Primary intervention involves public health initiatives which attempt to prevent youth from engaging in substance use (Coomber et al., 2013). Programs such as the ‘Life Education’ Van visits schools across Australia and educate youth on the risks associated with substance use, encouraging them to make safer choices (Life Education, 2021). Secondary intervention aims to encourage a reduction and safer use for those already engaging in substance use (Coomber et al., 2013). For example, needle and syringe programs provide clean and sterilised needles and sharps containers to ensure safe disposal of used needles in the community (Carruthers, 2018). Tertiary interventions refers to the active treatment of substance abuse with the eventual goal of achieving abstinence (Coomber et al., 2013). Hospital detox programs provide medical support and care through psychosocial and psychopharmacology interventions. Medications

used to counter meth withdrawal symptoms are utilised to help reduce cravings and promote abstinence (Karila et al., 2010). Residential programs are long term rehabilitation services from 4-6 months in duration which support the individual to recover from their addiction whilst living in a safe, drug and alcohol free environment. For example, the 'Woolshed' is a program in South Australia that not only assists with recovery, but aims to improve the individual's lifestyle, overall health and wellbeing as well as social and work skills. Group and individual counselling sessions are conducted as well as stress management classes (Drug and Alcohol Services Australia, 2020).

In addition, there are outpatient programs assist with overcoming addiction whilst the individual continues to live and work in their own environment. Outpatient programs are the most commonly utilised addiction treatment in Australia, with education and counselling being the primary treatment strategies (McKetin et al., 2013b). The Matrix program, to be discussed presently, is an example of an successful outpatients program, and utilises trained psychologists, lived experience mentors and community engagement to assist with recovery. Relapse prevention classes are also applied to the programs (Black et al., 2017). Addiction services within Australia are utilised on a primary, secondary and tertiary strategy basis, with community outpatient services the most common modality of receiving meth addiction treatment.

Individuals recovering from meth addiction have found long term abstinence challenging. Brecht and Herbeck (2014) found that after one year of receiving outpatient treatment, 61% of users relapsed whilst two to five years later, a further 25% had also relapsed. It is evident that barriers to meth addiction recovery are prevalent within the community, with continued polysubstance use potentially hindering ongoing abstinence (Brecht & Herbeck, 2014). However, there is a lack of research on how polysubstance use, with a focus on hallucinogens, impacts primary meth use.

1.6 The Matrix Program

Between 2005 and 2015, clinicians from the South Australian non-government organisation Psychmed, noticed a significant increase in the number of people with meth use comorbidities. As a response to Australia's meth epidemic, in 2016, Psychmed implemented a pilot trial of a drug rehabilitation program in Adelaide. Named the Matrix program, the rehabilitation program was first designed and implemented in 1986 by the Matrix Institute of Addictions in Los Angeles, the United States of America in response to the countries growing cocaine epidemic (Rawson, 1986). Within the first year of its operation, follow-up data demonstrated that clients used significantly less cocaine than when first admitted into the program (Rawson et al., 1986). In both 1991 and 1996, replications of this study produced similar outcomes, demonstrating the efficacy of the Matrix program (Rawson et al., 1991; 1995). When implemented in Adelaide, the Matrix program was modified, with its focus being shifted from cocaine addiction to meth addiction. It also included Australian language and statistics, lived experience mentors, and was extended from a 16-week program to a 20-week program.

The matrix program supports voluntary individuals who are willing and ready to undergo rehabilitation. The aim of the program is to encourage and help support individuals with substance addiction to achieve abstinence from their preferred substance and increase longevity in remaining in the treatment program. A further goal is to provide education to the clients on addiction, relapse and withdrawal symptoms (Black et al., 2017). Through receiving support from an accredited therapist, the program also values personal accountability and commitment. Weekly urine tests are utilised as a strategy to maintain this accountability. For the first five weeks of the program, the outpatient is required to attend two early recovery skills sessions per week. Additionally, relapse prevention sessions are offered twice a week, 12-step individual sessions are offered three times a week, and once a week

family education sessions and gender group sessions are provided. Six weeks into the Matrix program, outpatients begin receiving social support sessions once a week, with this continuing for the next 118 weeks.

Trained Psychmed psychologists conduct all the sessions, which are also co-facilitated by a lived experience mentor. The therapeutic approaches that are utilised by psychologists include Motivational Interviewing and Cognitive Behavioural Therapy. Three individual sessions are also offered which allow outpatients to experience community engagement, such as having access to haircuts and makeovers, movie passes, gym attendance and relaxation training. The Matrix program has also been effective in Australia. Whilst the average remission rate across Australian drug and alcohol rehabilitation programs is only 20 to 30 percent, the remission rate for the six Adelaide-based Matrix programs averages between 55 and 70 percent (Black et al., 2017).

Whilst the primary aim of the Matrix program in Adelaide is to assist individuals in personal recovery from their meth addiction, the program also collects extensive data with the individuals consent to assist with government research. As part of its aims to achieve ongoing improvements, the Matrix Program is endeavouring to build a stronger evidence, both in relation to the targeting of its service to particular at-risk populations, but also to evaluate its outcomes (Black et al., 2017). The research presented in this thesis will examine other presenting comorbidities that may be a detriment to meth recovery; namely, polysubstance use and examine whether improvements in outcomes across the duration of the program differ depending upon the presence of polysubstance use.

1.7 Aims & Hypothesis

The aim of this research was to investigate whether hallucinogen use is related to higher or lower levels of psychological, physical and social harm in individuals who are addicted to meth, at intake and upon completion of the Matrix program. It was hypothesised

that outpatients who engaged in hallucinogen use will experience greater levels of harm at program intake and upon completion, than those who are addicted to meth and abstain from hallucinogen use. The study also examined whether the presence of poly-substance use (hallucinogens) was associated with poorer outcomes as based upon a comparison of psychological outcome measures recorded at the baseline assessment in the program and at program treatment. The study also explored whether there were age and gender differences in outcomes to help PsychMed better tailor its services to different populations.

Chapter 2. Method

2.1 Participants

The sample was gathered from Psychmed's Matrix program data which has recorded every outpatient who has ever attempted or completed the Matrix program at the South, City and North Psychmed locations from 2016 to the present day. Adults over 18 years of age are eligible to participate in the Matrix program, with some exceptions being made for a limited number of 16 and 17-year olds. Outpatients are required to have been abstinent from meth for two weeks prior to commencing the program. Outpatients may choose to attend the Matrix program, or are referred by a medical professional. If outpatients continued their meth use throughout the first two to four weeks of the program or had relapsed during the program, they are encouraged to attend an inpatient detox prior to recommencing the program (Black et al., 2017)

The sample comprised 1159 outpatients that had participated in the Psychmed's Matrix program sometime between 2016 to present day. Table 2.1 summarises the demographic characteristics of the sample. As indicated, 62.4% were male and 37.6% were female. A total of 39 (3.4%) of the sample identified as Aboriginal or Torres Straight Islander (ATSI), while the remaining 96.6% identified as Caucasian or other. Participant age ranged from 16 years of age to 67 years of age, with around 70% aged between 25 and 45 years. Fewer participants were older or very young. All outpatients were considered "severely addicted" to meth, as indicated by the ASSIST questionnaire. Stratified sampling was used to categorise outpatients into subgroups based on their type of hallucinogen use. Table 2.1 shows that 789 (68.1%) of the sample fell into the meth only group, a meth and LSD group comprised of 209 (18%) outpatients were categorised into a meth and LSD group, 28 (2.4%) identified with being meth and psilocybin users,105 (9.1%) identified as being meth, LSD

and psilocybin users, and finally, 28 (2.4%) individuals indicated that they were meth and MDMA users.

Table 2.1

Demographics characteristics of the sample (n = 1159)

	N (%)
Gender	
Male	723 (62.4)
Female	436 (37.6)
Aboriginal/Torres Strait Islander	
Yes	39 (6.6)
No	1120 (93.4)
Age	
16-25	90 (7.8)
25-35	409 (35.3)
35-45	425 (36.7)
45-67	194 (16.7)
Polyuse	
None	789 (23.1)
LSD	209 (18.0)
Psilocybin	28 (2.4)
LSD & Psilocybin	105 (9.1)
MDMA	28 (2.4)

2.2 Measures

Several different questionnaires were utilised pre and post treatment to assess outpatients' severity of physical, psychological, and social harm.

(a)The Opiate Treatment Index (OTI) for methamphetamine examines the severity of recent drug use, by asking the user five questions relating to when their three most recent days of drug use occurred, and the quantity that they used on their previous two occasions. The amounts consumed in the last two occasions are added together, and the interval between

the most recent day of drug use and the time before that are added with the interval between the second and third last days of drug use. Then, the total amount consumed is divided by the total of the two intervals between use, providing an average amount consumed per day. A score of 0.00 indicates abstinence, 0.01 to 0.13 indicates once a week or less, more than once a week is 0.14 to 0.99, daily use is between 1.00 and 1.99, and more than once a day is 2.00 or more. The OTI for social functioning assesses social integration in the previous six months by asking the user twelve questions relating to their employment status, residential stability, social support, and interpersonal conflict. Additionally, their involvement in drug subculture, specifically the number of meth users they reside with and associate with is also gathered. The scores of each question are added together, with a higher score representing a greater level of dysfunction (Darke et al., 1991).

(b)The timeline follow back (TLFB) is a self-reported quantitative estimate of the frequency of drug use within the previous three months of the interview (Sobell et al., 1996).

(c)Severity of cravings are assessed via the visual analogue scale (VAS). The VAS is a continuous scale utilising a 100mm fixed horizontal line, ranging from a score of zero (no cravings) to a score of 10 (most cravings ever experienced). It contains only one item, which asks the participant to indicate the severity of their cravings on the horizontal line (Jensen et al., 2003).

(d)The severity of dependence scale (SDS) is a self-administered questionnaire containing five questions which explores certain behavioural elements of drug dependence, such as the amount, frequency, duration of use, and the amount of time associating with other users. The SDS utilises a 4-point Likert scale, which ranges from 0 (never/almost never) to 3 (always/nearly always). For methamphetamine, a score of four or more indicates drug dependence (Gossop et al., 1995).

(e)The World Health Organisation Quality of Life Scale (WHOQoL) is a self-reported measure of the individual's perception of their overall quality of life in the previous four weeks. It consists of four domains, including physical health, psychological wellbeing, social relationships and environment. There are twenty-six items altogether, with one item asking a question to each of the domain's facets. Physical health contains the facets: activities of daily living, dependence on medicinal substances and medical aids, energy and fatigue, mobility, pain and discomfort, sleep and rest, and work Capacity. Psychological wellbeing consists of: bodily image and appearance, negative feelings, positive feelings, self-esteem spirituality/religion/personal beliefs, and thinking, learning, memory and concentration. Social relationships is made up of personal relationships, social support, and sexual activity. Environment entails the sub-facets: financial resources, freedom, physical safety and security, health and social care: accessibility and quality, home environment, opportunities for acquiring new information and skills, participation in and opportunities for recreation/leisure activities, physical environment (pollution/noise/traffic/climate) and transport. The questionnaire utilises a five-point Likert scale, where a score of one represents "very poor/very dissatisfied/not at all or never" and five indicates "always/very satisfied/very well/completely/extremely/very good or an extreme amount." All facets' scores within each domain are added together to calculate an overall domain score, which is then multiplied by four to obtain a value out of one hundred (Skevington et al., 2004).

(f)The Depression, Anxiety and Stress Scale (DASS- 21) assesses the severity of the individual's reported depression, anxiety and stress. It contains twenty-one items which are measured on a four-point Likert scale, ranging from zero (did not apply to me at all) to three (applied to me very much, or most of the time). For the measure of depression, 0 to 4 indicates a normal range, 5 to 6 is mild, 7 to 10 is moderate, 11 to 13 is severe and 14+ is considered extremely severe. The anxiety measure is characterised by 0 to 3 being a normal

range, 4 to 5 being mild, 6 to 7 as moderate, 8 to 9 being severe, and 10+ being extremely severe. Finally, for stress, a score of 0 to 7 is in the normal range, 8 to 9 is mild, 10 to 12 is moderate, 13 to 16 is severe and 17+ is considered extremely severe stress (Lovibond & Lovibond,1995).

(g)The Kessler-10 (K10) reports the individuals' levels of psychological stress within the previous twenty-eight days. The self-administered questionnaire contains ten items across a five-point Likert scale ranging from one "none of the time" to five "all of the time". A score between ten and twenty points indicates a healthy range, a score between twenty and twenty-four suggests a mild level of stress, moderate stress is represented by a score of twenty-five to twenty-nine, and a score of thirty to fifty indicates severe mental stress (Kessler et al., 2003)

2.3 Procedure

Longitudinal data were available in that the outpatients were assessed at two different time points, the first being prior to program commencement and then 16 weeks later, upon finishing the program. After initially contacting PsychMed, outpatients determined their eligibility for the program by completing the World Health Organisation Alcohol, Smoking and Substance Involvement Screening Test (ASSIST), which screened for risky and problematic substance use. Participants were assigned to either a "mild," "moderate" or "severe" group. If they were considered "severely" addicted to meth, then they were accepted into the program. All outpatients were required to attend an induction session and had provided their informed consent by signing a program contract. They were then debriefed on the program's rules and were introduced to the psychologists and the lived experience mentor. At both the initial and post treatment assessments, the TLFB; OTI for methamphetamine use and social functioning; WHOQoL overall raw score, physical health, psychological, social relationships, and environment; K10; DASS-21; SDS and VAS scores were obtained (Black et al., 2017).

2.4 Analytical approach

A new variable which categorised methamphetamine and hallucinogen combinations was also created. 0 = no hallucinogen use, that is, those who purely use methamphetamine; 1 = methamphetamine and LSD use; 2 = methamphetamine and psilocybin use; 3 = methamphetamine, LSD and psilocybin use; and 4 = methamphetamine and MDMA use. An additional variable was created, which categorised participants into either a methamphetamine only group or a methamphetamine and hallucinogen group, which combined all use of any hallucinogens together. For the reliable change indices (RCI) test, the difference between the post Matrix program mean score and the pre Matrix program mean scores for each significant measure were calculated, and made into new separate variables.

Chi squared tests were used to test whether gender, ATSI status, and age were associated with abstaining or engaging in hallucinogen use. An ANOVA was used to observe whether the differences in each measure's mean scores between non hallucinogen, LSD, psilocybin and MDMA users were significant. To test whether the differences in mean scores between 16 to 25 year olds, 25 to 35 year olds, 35 to 45 year olds, and 45 to 67 year olds were significant, an ANOVA was also conducted. T-Tests were utilised to compare the significance in the differences in mean scores between hallucinogen and non hallucinogen users, and in males and females. For the final analyses, a mixed ANOVA was conducted to test the significance of the differences in mean scores between non hallucinogen and hallucinogen users at intake into Matrix program and post Matrix program completion. Additionally, this test identified the measures that displayed time as a significant main effect. Finally, a reliable change indices test was run to determine each measure's exact score that represented a reliable change across the two time points. Then, the number of cases that displayed an improvement, deterioration and no change in scores could be determined. Chi squared tests were conducted for each significant measure, which indicated if using or not

using hallucinogens were associated with the improvement or deterioration in mean scores over time for each significant measure.

Chapter 3. Results

3.1 Analysis of baseline Scores based on hallucinogen usage

Table 2.

Comparison of non-hallucinogen use and hallucinogen-use for gender, ATSI status, and age

Demographic Characteristics	No hallucinogens (*n*)	LSD, Psilocybin, MDMA (*n*)	χ^2
Gender			
Male	145	249	11.45***
Female	123	121	
Aboriginal/Torres Strait Islander			
Yes	12	22	.303
No	166	248	
Age			
16-25	18	29	.481
25-35	99	131	
35-45	97	135	
45-67	46	68	

*** p<.001

Table 3.

Comparison of scores at baseline between different substance groups

Measure	No hallucinogens (n = 268) M (SD)	LSD (n = 209) M (SD)	Psilocybin (n = 28) M (SD)	LSD & Psilocybin (n = 105) M (SD)	MDMA (n = 28) M (SD)	F-value	η^2
DASS-21							
Depression	15.8(11.4)	16.9(11.7)	20.7(9.6)	18.6(11.1)	16.0(12.1)	1.818	.012
Anxiety	13.3 (9.9)	14.1(9.9)	20.0(7.7)	14.1(9.2)	13.8(10.2)	2.548*	.017
Stress	17.1(10.6)	18.2(10.5)	21.5(8.9)	19.0(9.5)	18.3(10.5)	1.424	.010
WHOQoL							
Overall Raw Score	6.1(2.4)	5.8(1.8)	5.4(1.3)	5.6(1.8)	9.2(15.1)	5.437***	.035
Physical Health	43.3(25.1)	41.0(22.6)	40.6(15.3)	38.6(21.9)	38.3(20.5)	.914	.006
Psychological	35.7(22.0)	35.9(21.6)	34.4(18.2)	35.8(21.4)	32.8(20.0)	.148	.001
Social Relationships	38.9(29.1)	39.5(25.7)	35.6(19.9)	38.4(25.9)	39.1(23.5)	.123	.001
Environment	48.0(24.4)	49.3(22.8)	49.4(19.3)	47.1(23.9)	48.5(18.2)	.186	.001
K-10	27.2(9.5)	27.1(9.4)	31.6(7.3)	28.4(9.0)	26.6(9.6)	1.772	.011
OTI							
Methamphetamine	1.3(2.2)	2.0(6.2)	1.3(1.9)	2.0(3.3)	1.1(1.9)	1.147	.007
Social Functioning	17.9(7.2)	18.1(7.5)	18.8(5.6)	18.9(7.1)	15.0(6.5)	1.684	.011
SDS	8.2(3.7)	8.8(7.5)	8.8(3.7)	8.7(4.0)	7.7(4.5)	.509	.003
VAS	5.7(3.0)	6.6(7.2)	6.5(2.9)	6.6(2.6)	6.3(3.5)	1.219	.008
TLFB	35.3(30.2)	32.8(30.7)	35.4(27.8)	35.3(29.9)	33.3(30.4)	.230	.001

*p<.05 **p<. 01 *** p<.001

Table 4.

Comparison of scores at baseline between non-hallucinogen use and hallucinogen-use

Measure	No Hallucinogens (n = 268) M (SD)	LSD, Psilocybin, MDMA (n = 370) M (SD)	t	Cohen's d
DASS-21				
Depression	15.8(11.4)	17.6(11.4)	1.896	.158
Anxiety	13.3 (10.0)	14.5(9.7)	1.345	.122
Stress	17.2(10.7)	18.7(10.1)	1.766	.144
WHOQoL				
Overall Raw Score	6.1(2.4)	6.0(4.5)	.415	.022
Physical Health***	43.4(25.1)	40.1(21.7)	1.741	.141
Psychological	35.7(22.1)	35.5(21.1)	.094	.009
Social Relationships***	38.8(29.1)	38.9(25.1)	0.26	.004
Environment*	48.1(24.5)	48.6(22.5)	.262	.021
K-10	27.2(9.5)	27.8(9.2)	.741	.064
OTI				
Methamphetamine**	1.3(2.2)	1.9(5.0)	1.729	.170
Social Functioning	17.9(7.2)	18.2(7.2)	.372	.042
SDS	8.2(3.7)	8.7(6.2)	1.115	.101
VAS	5.7(3.0)	6.6(5.7)	2.244*	.207
TLFB	35.3(30.2)	33.8(30.1)	.618	.050

*p<.05 **p<. 01 *** p<.001

Table 2 indicates the association between demographic characteristics and hallucinogen use. The results indicate that usage differed by gender, with significantly more males reporting having used LSD, psilocybin and MDMA than women. Women were more likely to report not using hallucinogens, predominantly only using meth. Further comparisons of baseline scores for psychological measures are provided in Table 3. As indicated, LSD, psilocybin and MDMA users obtained higher scores for the DASS-21 Anxiety subscale, but no differences were observed for the other subscales. No significant differences were observed for any other measure, except for the overall raw score for the WHOQoL which was

found to be significantly higher in the MDMA group than in the other three groups. Further comparisons (Table 4) based on a binary classification of clients in users and non-users of hallucinogen users revealed no significant differences except for the VAS. Hallucinogen users had higher VAS or urges scores than non-users.

3.2 Gender and age comparisons

Table 5.

Comparison of scores at baseline across gender

Measure	Male (n = 723) M (SD)	Female (n = 436) M (SD)	t	Cohen's d
DASS-21				
Depression	16.9(11.4)	17.8(12.0)	1.376	.077
Anxiety	13.8(10.0)	15.0(10.2)	1.781	.119
Stress	18.0(10.4)	19.1(10.7)	1.525	.104
WHOQoL				
Overall Raw Score	6.3(5.4)	5.8(2.2)	1.417	.132
Physical Health	43.0(22.9)	42.3(23.7)	.506	.030
Psychological	37.3(21.3)	34.1(21.2)	2.297*	.151
Social Relationships	37.8(26.6)	38.6(27.6)	.465	.030
Environment	48.8(22.6)	47.9(23.7)	.621	.039
K-10	27.6(8.9)	28.9(9.6)	2.151*	.141
OTI				
Methamphetamine	1.8(3.1)	1.8(5.0)	.021	.001
Social Functioning	17.2(7.1)	19.5(7.4)	5.123***	.317
SDS	8.2(3.6)	8.6(6.1)	1.464	.082
VAS	6.1(2.9)	6.3(5.4)	.726	.048
TLFB	34.2(29.9)	35.4(31.0)	.647	.039

*p<.05 **p<. 01 *** p<.001

Table 6.

Comparison of scores at baseline across different age groups

	Age Groups					
	16 – 25	25 - 35	35 - 45	45 - 67		
Measure	(*n* = 90) M (SD)	(*n* = 409) M (SD)	(*n* = 425) M (SD)	(*n* = 194) M (SD)	*F* value	η^2
DASS-21						
Depression	19.9(11.8)	16.4(11.4)	17.3(11.7)	18.1(11.6)	2.006	.007
Anxiety	18.2(9.0)	14.1(10.6)	13.6(9.8)	14.1(9.8)	3.748*	.013
Stress	21.7(9.7)	18.2(10.8)	18.4(10.5)	17.5(9.9)	2.476	.008
WHOQoL						
Overall Raw Score	7.3(11.9)	5.9(1.7)	6.2(4.8)	5.5(1.9)	2.625*	.009
Physical Health	42.0(21.6)	42.4(23.2)	43.5(23.7)	40.0(22.6)	.902	.003
Psychological	33(19.3)	35.8(20.5)	36.8(22.5)	35.1(21.7)	.821	.003
Social Relationships	37.9(27.3)	40.0(26.6)	36.8(22.5)	36.9(27.3)	.842	.003
Environment	46.1(21.1)	49.0(23.0)	48.6(22.9)	47.0(24.1)	.542	.002
K-10	30.0(9.8)	27.8(8.9)	28.1(9.4)	27.9(9.1)	1.446	.004
OTI						
Methamphetamine	2.9(4.8)	2.0(5.2)	1.5(2.5)	1.5(2.6)	3.418*	.010
Social Functioning	18.4(7.1)	18.5(7.3)	17.6(7.3)	17.6(7.4)	1.184	.003
SDS	8.0(4.2)	8.4(3.9)	8.4(5.8)	8.3(3.8)	.201	.001
VAS	6.0(3.2)	6.2(3.0)	6.2(5.5)	6.3(3.0)	.143	.000
TLFB	36.9(31.6)	34.49(30.4)	34.2(29.4)	35.6(30.9)	.260	.001

*p<.05 **p<. 01 *** p<.001

It was also important to examine whether baseline scores differed by gender (Table 5). These comparisons indicated that women had poorer psychological quality of life scores, higher K10 scores, but better social functioning scores. All other comparisons were non-significant. Age differences are presented in Table 6 and showed that the youngest age group, despite having the highest raw overall quality of life score, scored higher on

methamphetamine OTI and highest on DASS anxiety. All other differences were non-significant.

3.3. Post treatment outcomes

Table 7.

Mixed ANOVA comparing scores pre and post treatment

	Baseline scores		Outcome scores					
Measure	No Hallucinogens M (SD)	Hallucinogens M (SD)	No Hallucinogens M (SD)	Hallucinogens M (SD)	Time Main effect F	Group main effect F	Gender main effect F	Time x Group F
DASS-21								
Depression	10.8(9.3)	15.1(11.5)	6.1(7.1)	9.2(8.5)	1.856	5.261*	.627	.242
Anxiety	10.6(10.2)	12.4(10.2)	5.2(7.2)	7.7(7.9)	5.232*	1.419	.652	.193
Stress	13.8(10.6)	16.5(10.8)	8.4(9.4)	10.8(8.5)	2.069	2.168	.192	.033
WHOQoL								
Overall Raw Score	7.2(4.0)	6.1(1.5)	10.0(16.2)	6.9(1.6)	.001	2.344	2.295	.547
Physical Health	46.1(26.6)	36.3(20.9)	51.5(26.5)	47.0(27.5)	3.610	2.998	.518	.682
Psychological	36.6(22.6)	31.1(19.5)	45.9(26.2)	39.3(24.1)	4.250*	2.482	.495	.129
Social Relationships	38.2(28.7)	31.4(25.3)	38.9(25.8)	40.0(30.6)	2.091	.366	.010	.460
Environment	47.7(23.8)	43.2(21.8)	54.1(24.2)	51.2(28.5)	5.723*	.784	.090	.006
K-10	24.4(10.)	26.9(10.5)	19.4(8.6)	21.1(9.4)	5.276*	1.402	.627	.113
OTI								
Methamphetamine	1.2(2.4)	2.9(9.9)	.07(.25)	.71(2.8)	.363	3.142	2.954	.846
Social Functioning	16.9(6.9)	17.3(7.6)	13.6(7.5)	14.3(6.6)	2.055	.657	3.639	.022
SDS	7.1(3.7)	8.4(4.7)	2.3(3.6)	3.5(4.1)	5.715*	2.692	.814	.099
VAS	5.1(3.4)	5.7(3.1)	3.2(3.3)	3.7(3.4)	4.423*	.893	.145	.002
TLFB	32.4(29.4)	33.3(31.7)	4.0(15.2)	4.4(9.2)	14.865***	.089	.312	.009

*p<.05 **p< .01 ***p< .001

A 2 Group x 2 Time mixed ANOVA was conducted to examine group differences in outcomes across time (Table 7). Table 7 indicates a significant Time main effect for TLFB scores had a highly significant main affect for time. Other significant main effects for Time included the DASS-21 for anxiety, the WHOQoL psychological scores and environment

scores, the Kessler-10, the SDS and the VAS. All these results indicated that scores on these measures had improved over time. There was one significant Group main effect for DASS depression with the hallucinogen group found to have generally higher scores (note that this is a subsample of the larger sample for whom data was available at both time points).

3.4 Reliable change indices

Table 8.

Reliable Change Indices indicating improvement, deterioration, and no change in scores

Measure	*n*	Required Difference	Improvement		Deterioration		No Reliable Change	
			n	(%)	*n*	(%)	*n*	(%)
DASS-21								
Anxiety	131	-9	35	27	5	4	91	69
WHOQoL								
Psychological	151	+24	39	26	15	10	97	64
Environment	151	+29	30	20	6	4	115	76
K-10	186	-9	75	40	7	4	104	56
SDS	179	-7	55	31	0	0	124	69
VAS	178	-3	77	43	13	7	88	49
TLFB	294	-31	124	42	0	0	170	58

Reliable change indices (RCIs) were calculated to determine the percentage of cases for the important outcome measures that had experienced statistically reliable changes in scores (Table 8). Table 8 indicates that 27% of cases had reliable improvements in DASS Anxiety scores, 40% had reliable improvement in K10 scores, and over 40% reliable reductions in urges and usage as based on the TLFB measure.

Chapter 4. Discussion

4.1 Overview of Results

Analyses of the Matrix program data was undertaken to assert whether hallucinogen use is related to higher or lower levels of psychological, physical and social harm in people addicted to meth upon intake and completion of the program. As hypothesised, individuals who engaged in hallucinogen use had higher levels of harm than those who consumed meth only. This took the form of higher scores for the DASS depression and anxiety subscales as well as the VAS. A secondary aim of the study was to explore whether age and gender differences impact treatment outcomes in those participating in the Matrix program regardless of polysubstance use. Although women did not engage in as much polysubstance use as men, they reported poorer psychological quality of life scores, higher K10 scores and, unexpectedly, better social functioning scores. Moreover, when comparing different age groups, the youngest age group (sixteen to twenty- five year olds) presented the highest raw overall quality of life scores as well as highest methamphetamine OTI and DASS anxiety scores. Finally, the study provided insights into the outcomes for the program. These analyses showed that drug rehabilitation should tailor their programs to these vulnerable populations in order to improve treatment outcomes.

At baseline, the scores for the DASS-21 anxiety subscale where higher for LSD, psilocybin and MDMA users than meth only users. Although there is emerging research that hallucinogens may be beneficial for treating addiction and anxiety, they can also induce “bad trips” (Gashi et al., 2021). A “bad trip” is a negative psychedelic experience in which the user may experience distressing and frightening visual and/or auditory hallucinations, evoking severe paranoia, anxiety attacks, and psychosis (Van Amsterdan et al., 2011). Research has shown that individuals who use multiple drugs and have pre-existing mental illnesses are particularly vulnerable to experiencing “bad trips” (Roberts et al., 2020). Adverse effects of

hallucinogens are relatively common, with a 2004 survey from the United Kingdom revealing that out of 174 psilocybin users, approximately one third experienced anxiety and one third experienced paranoia (Riley & Blackman, 2008).

As a result, it can be speculated that Matrix program outpatients who also use hallucinogens would have an increased risk of experiencing a "bad trip" and the associated negative effects of hallucinogens. This may explain why Matrix outpatients who use hallucinogens have higher rates of anxiety than those who abstain from hallucinogens. Furthermore, the use of hallucinogens can sometimes exacerbate pre-existing mental illnesses, with anxiety disorders being the most prone, and can also elicit an earlier onset in mental illnesses which have not emerged yet (Nichols, 2016).

It must be stressed that the therapeutic benefits of hallucinogens have primarily been demonstrated in clinical settings, where the dosage and purity of the hallucinogens have been monitored and controlled by scientists and health professionals (Krebs & Johansen, 2013). Due to the illegality of these substances, outpatients of the Matrix program only have access through the black market, where the manufacturing is unknown and the purity is unregulated. This is typically an issue for MDMA, as its pill form means adulterants such as amphetamine, methamphetamine, cocaine and ketamine can be discretely added by black market manufacturers to stretch the supply of the drug and maximise profit. With stimulants being the most common adulterants, the compounding effects of these with meth can severely increase anxiety, paranoia and psychosis (Saleemi et al., 2017). Furthermore, not moderating the dosage and frequency of using hallucinogens can also contribute to mental health issues and poorer outcomes. Research that is in favour of hallucinogen use emphasises that the greatest benefits are experienced when individuals micro-dose such substances (Anderson et al., 2019). However, for individuals who are addicted to meth, it is easy to abuse hallucinogens, and take them in excess amounts (Wu et al., 2006). Although there is

emerging evidence supporting the use of hallucinogens in treating mental illness, specific dosing and environmental factors are necessary to achieve positive outcomes and therefore use in the community by Matrix program users have shown to be negatively impacting treatment outcomes.

Although all scores improved from baseline upon completion of the Matrix program, outpatients who use hallucinogens still obtained higher DASS depression scores than the remainder of the sample. Many individuals who engage in polysubstance use have a pre-existing history of mental illness, specifically depression and can self-medicate with hallucinogens as a way to treat their symptoms (University of Queensland, 2021). Feelings of enlightenment and acceptance are often expected to be experienced by the individual after consuming hallucinogens. However, self-medication may elicit a paradoxical effect due to the drugs unpredictable nature and may result in adverse effects on the person's mental health. For example, an individual who experiences depressive thoughts during a psychedelic trip may become convinced that these thoughts are true about themselves, leading to a self-fulfilling prophecy (Nesvag et al., 2015). Therefore, it is speculated that individuals consuming hallucinogens may have bad experiences which results in worse depressive symptoms compared to meth only people. Moreover, it can be speculated that for individuals taking MDMA, a drug which depletes serotonin, the comedown can often result in depressive symptoms that may last for up to a week after use (Mustafa et al., 2020). Hallucinogen persisting perception disorder was added to the DSM- 5 in 2012 and consists of the re-occurrence of unpleasant visual and auditory sensations related to negative trips (Martinotti et al., 2018). Although the acute effects of a bad trip may have subsided, individuals may experience feelings of depression even months after consuming hallucinogens. Evidently, outpatients engaging in polysubstance use have higher post treatment DASS depression scores than the meth only cohort.

The higher VAS craving scores among hallucinogen users was also expected, as these outpatients were detoxing from multiple substances. Although hallucinogens are not physically addictive, there is still evidence that they may be psychologically addictive (Nichols, 2016). Like meth, hallucinogens, especially MDMA also cause an increase in serotonin when consumed, also resulting in a significant depletion of it when the effects eventually subside. This causes a strong desire and craving to repeat the dose in order to replenish serotonin levels (Kish et al., 2017). If these effects are compounded with meth use, this means that there is an even greater "crash" and depletion of serotonin, which increases the severity of cravings for multiple drugs, rather than just a single drug (Mustafa et al., 2020). The risk of developing a tolerance, even after only consuming a few doses, is also quite high for hallucinogen use. Each time, users may need to increase their dosage to obtain the desirable effects, causing users to develop a greater craving for certain hallucinogens (Nichols, 2016).

Although men had higher levels of hallucinogen use, women experienced higher levels of anxiety on the K10 scale and poorer psychological quality of life scores. This is consistent with the literature which consistently indicates that women possess a higher prevalence of generalised anxiety disorder, panic disorder, social anxiety disorder, and posttraumatic stress disorder (Vesga-Lopez et al. 2008). Women also have been shown to have a higher risk of anxiety symptoms during meth detox and withdrawal (Su et al., 2017). Female meth users were also associated with having a greater psychological burden, greater childhood emotional and sexual trauma, and were more prone to emotional-coping strategies (Simpson et al., 2016). It has also been found that depression and depression-like symptoms are a more common comorbidity in female meth users than male users (Dluzen & Liu, 2008).

Furthermore, women report self-medicating with meth to escape emotional problems and improve their mood more frequently than men (Hser et al., 2005; Semple et al., 2004).

Despite depression and anxiety being apparent comorbidities, women reported better social relationship quality of life scores than men. It was expected that women would have lower social relationships and support, as unwanted pregnancies and single parenting are common among female meth users (Dyba et al., 2019). Female meth users are more likely to have children younger than eighteen years old, have less emotional support, and higher parental role strain as a result of carrying the burden of raising their children. Similarly, meth-using mothers are more likely to face social stigma and criticism due to traditional societal expectations of them being more nurturing and the primary caregiver (Semple et al., 2011). Single mothers who use are also vulnerable to losing custody of their children. Other research (e.g., Semple et al., 2009) indicates that conflict with other family members in relation to the care and protection of underage children is a significant contributing factor to female meth users possessing lower quality personal relationships. However, this was not consistently observed in this study in that female meth-users reported positive sexual relationships. Research has found that women experience increased desire, pleasure, disinhibition and feelings of power and agency while engaging in sexual acts under the influence of methamphetamine (Kittirattanapaiboon et al., 2017).

The youngest cohort of polysubstance users had the highest raw overall quality of life score. Younger meth users may perceive their overall quality of life to be better for a variety of reasons. Younger people have less physical health-related comorbidities. Additionally, younger users are more likely to have been using meth for a shorter period of time, meaning the long-term negative effects may have not yet emerged or may be less pronounced than in older users (Russell et al., 2008). Younger meth users also have the financial security of relying on their parents and being dependant on them. As a result, younger users are less

likely to be homeless than older users (Fast et al., 2014). Younger people also have more social protective factors, having larger groups and numbers of friends, and reportedly being significantly less lonely than older people (Bungay et al., 2009). Additionally, younger users are less likely to have the added pressures and responsibilities of having their own children to look after (Asante & Lentoor, 2017).

Despite having the highest raw overall quality of life score, the cohort of sixteen to twenty-five-year-olds scored higher on the DASS anxiety than those aged between twenty-five and sixty-seven years of age. This is supported by the literature, which demonstrates that Australians aged between sixteen and twenty-four years old have the highest prevalence of mental illness than any other age group, showing a decrease with age. Approximately one in five Australians aged between fifteen and nineteen years of age have a mental illness, compared to only one in twenty for Australians aged seventy-five to eighty-five years. Anxiety disorders are also the most prevalent among the fifteen- to nineteen-year-old cohort (Ivancic et al., 2014). It is impossible to determine the exact reasons why younger me Australians who use meth are more anxious than older meth users, but one possible explanation is the prevalence of peer pressure. Peer pressure was identified as a strong motivator for young Australians trying meth for the first time (Kelly et al., 2013). It can be assumed that the pressure of fitting in for young and impressionable individuals would have higher levels of anxiety. Social media use is also strongly associated with higher rates of anxiety in younger people (Barthorpe et al., 2020). It can be very misleading, often depicting only the most desirable and glamourous aspects of other people's lives. This can make young people feel inadequate and inferior, often constantly comparing themselves to one another, and feeling pressure to gain more likes and followers (Hollis et al., 2020).

The study's findings that Matrix program clients aged between sixteen and twenty-five years of age experienced the highest scores on the OTI for methamphetamine was

expected. The literature consistently reports that meth use in Australia is highest amongst teenagers and individuals in their twenties (Australian Institute of Health and Welfare, 2021b; Degenhart et al., 2016). Although there is no specific evidence on why this may be the case, there are some trends in meth usage that are more commonly associated with younger people. It is widely reported that meth is often used socially while partying at nightclubs and at house parties, with frequent clubbing being correlated with higher meth use (Green et al., 2016; The Australian Government Department of Health, 2008). Specifically, social users are attracted to its effects of increased confidence and assertiveness in social interactions, and increased energy, which allows them to dance for hours at a time and party for days at a time (Degenhart et al., 2009). It can be assumed that younger meth users, would be more inclined to use meth for dancing and excessive partying, making it more popular among this cohort than older among older users.

Meth is also reportedly used among high school and university students to increase alertness, concentration and productivity while studying (Fast et al., 2014). In particular, students report that meth's energy increasing effects allows them to study for hours at a time and until the early hours of the morning (Peterson et al., 2013). In an American study of college students, existing meth users were prone to increasing their meth use in their final years of college to help them cope with the increased stress associated with their final exams. Additionally, the reduction in fatigue, increased reading comprehension and interest, and improved memory were other benefits to using meth for studying (DeSantis et al., 2010). Finally, younger people may be more likely to use meth due to its affordability in comparison to other stimulants, such as cocaine and amphetamines. Since the Covid-19 pandemic, in Australia, a gram of meth costs $250 on average, whereas a gram of cocaine costs $450 (Rawsthorne, 2020). The affordability of meth means that it would be considerably more accessible to young users, who may still be studying or not yet have an established career.

4.2 Limitations

There were several limitations to this study that prevented the generalisation of the results. First, the vulnerability of the cohort and the high level of commitment needed to complete the Matrix program meant that the program was prone to high levels of attrition. As a result, the follow-up data was biased and positive outcomes may have been overrepresented, containing outcome scores only from motivated meth users. Another limitation was that the number of times outpatients had attempted treatment and rehabilitation in the past was not gathered. Being aware of this would help Matrix program staff predict which outpatients are most at risk of dropping out of the program, allowing them to provide extra support and guidance in areas that have made outpatients susceptible to relapse.

Second, many important confounding factors that influence the amount of harm experienced by outpatients were not reported or taken into consideration. For example, outpatients' preferred method of consumption was not indicated. The literature widely reports that the smoking of methamphetamine hydrochloride, as opposed to injecting or snorting powder methamphetamine, significantly increases the level of psychological and physical harm to the user, as well as the interaction it has with secondary substances (Kalaitzopoulos et al., 2018). Undoubtedly, this distinction would influence the level of comorbidity and type of treatment outpatients require. Similarly, many comorbidities were also not reported, such as pre-existing medical and psychological diagnoses. Being aware of such information would allow medical professionals to determine how certain confounding factors influence polysubstance use, and which populations of meth users are most vulnerable.

A third issue is that most of the measures are self-report based which increases the likelihood of social-desirability bias. Due to concerns about privacy, people may have under-reported their level of usage or the range of problems being experienced. Finally, there may be demographic biases in the sample. Rates of meth use amongst Aboriginal and Torres Strait

Islander people is known to be three times higher than the rest of the Australian population (Australian Institute of Health and Welfare, 2017). However, only 3.4% of the 1159 Matrix clients identified as Aboriginal or Torres Strait Islander, suggesting that treatment accessibility may be an issue for this population. To improve this, mobile treatment services that visit rural Indigenous communities should be more readily available to provide education about the negative effects of meth addiction, and where to access treatment. Finally, another important comorbidity that was not investigated was the number of times outpatients had previously relapsed. This is an important detail because poorer mental health and social support is associated higher relapse rates (Brecht & Herbeck, 2014).

4.3 Implications & Future Directions

Research suggests that polysubstance use is associated with greater and more severe comorbidities than singular drug use. Consequently, individuals who engage in polysubstance use need to receive more attention and receive treatment that is tailored to the combination of drugs they consume. An individualised approach is required to treat individuals who engage in polysubstance use. This means training clinicians to provide personalised recovery plans to address the issues that are related to the myriad of substances the individual may be using, and also exploring the patterns of their drug use combinations and the reasons in engaging in polysubstance use (Black et al., 2017). It is often that multiple drugs are used for their unique differences in effects. For instance, meth may be used to increase productivity at work or while studying, whereas MDMA may be used socially in a nightclub setting (Radfar & Rawson, 2014; Degenhart et al., 2009). Treating an individual's primary substance and neglecting the treatment of secondary substances will make them more susceptible to relapse (Brecht & Herbeck, 2014) This is because they are still involved in the drug subculture despite detoxing from the primary substance. Polysubstance users need to be educated on

how their polysubstance use is related to their primary drug use, and how this hinders treatment outcomes.

Future research also needs to explore whether treating all substance abuse simultaneously is more effective than treating each substance abuse individually. The literature currently has only investigated how meth interacts with depressants, such as alcohol and opioids, and stimulants, such as cocaine. Future research should explore how hallucinogens interacts with meth, so clinicians can gain an in depth understanding of why hallucinogens are associated with lower treatment outcomes. An abstinence model, rather than a harm reduction model, needs to be encouraged during outpatient order to ensure positive treatment outcomes (Subbaraman & Witbrodt, 2014). For individuals who are prone to addiction, they may "swap out" their primary addiction for the secondary substances they are already consuming, which is why it is best to abstain from all substances entirely during recovery (Fernandez et al., 2020). This research will give outpatient drug rehabilitation programs the evidence to shift their focus onto addressing secondary substance use and how it interacts with primary addiction. Moreover, while there are acceptable levels of alcohol consumption, there are no acceptable levels of drug use, even if they are less harmful like hallucinogens. With consent granted from the government, rehabilitation programs for individuals addicted to methamphetamine can trial micro-dosing of hallucinogens to treat addiction. Many scientific trials have already been conducted in Australia, however, currently there have been no trials for hallucinogen use in treating meth addiction.

4.4 Conclusion

With meth's severe detriment on the livelihood of individuals and its increasing burden on the public health system, it has been more important than ever to study the comorbidities that contribute to meth addiction. A common comorbidity among meth users is polysubstance use. While the literature has explored the interaction between meth and

depressants and other stimulants, there is limited research on the combination of meth use and hallucinogen use. Therefore, this study addressed the gap in the literature by comparing outpatients in rehabilitation who are addicted to meth and consume LSD, psilocybin, and/or MDMA, with outpatients who only use meth. The study's aims were to explore whether meth users who use hallucinogens experience worse physical, psychological and social harm than users who only use meth. Confirming the hypothesis, the results revealed that higher levels of harm were experienced by meth users who use hallucinogens than individuals who only use meth. Specifically, meth and hallucinogen users obtained higher scores for the DASS depression and anxiety subscales, and higher VAS scores. Gender and age differences were also investigated in meth outpatients, with women obtaining poorer psychological quality of life scores, higher K10 scores and, unexpectedly, better social functioning scores. Furthermore, outpatients aged between sixteen and twenty-five years old achieved the highest raw overall quality of life scores as well as highest methamphetamine OTI and DASS anxiety scores. These findings will aid public health initiatives and rehabilitation programs in identifying which populations are most vulnerable, allowing their services to be better tailored to them, and ultimately, improve treatment outcomes.

Chapter 5. References

Anderson, T., Petranker, R., Christopher, A., Rosenbaum, D., Weissman, C., Dinh-Williams, L., Hui, K. & Hapke, E. (2019). Psychedelic microdosing benefits and challenges: an empirical codebook. *Harm Reduct J, 16*(43), https://doi.org/10.1186/s12954-019-0308-4

Andersson, H. W., Lauvsnes, A., & Nordfjærn, T. (2021). Emerging Adults in Inpatient Substance Use Treatment: A Prospective Cohort Study of Patient Characteristics and Treatment Outcomes. *European addiction research*, *27*(3), 206–215. https://doi.org/10.1159/000512156

Asante, K. O., & Lentoor, A. G. (2017). Use of crystal methamphetamine among male adolescents in Cape Town, South Africa: Caregivers' experiences. *Substance Abuse Treatment, Prevention, and Policy, 12(*18), https://doi.org/10.1186/s13011-017-0102-9

Arunogiri, S., Foulds, J. A., McKetin, R., & Lubman, D. I. (2018). A systematic review of risk factors for methamphetamine-associated psychosis. *The Australian and New Zealand journal of psychiatry*, *52*(6), 514–529. https://doi.org/10.1177/0004867417748750

Australian Institute of Health and Welfare. (2017). Alcohol and other drug treatment National Minimum Data set (AODTS NMDS 2015–16). Canberra: Australian Government.

Australian Institute of Health and Welfare. (2021). *Alcohol and other drug treatment services in Australia annual report.* Retrieved from https://www.aihw.gov.au/reports/alcohol-other-drug-treatment-services/alcohol-other-drug-treatment-services-australia

Australian Institute of Health and Welfare. (2021a). *Alcohol, tobacco & other drugs in Australia.* Retrieved from https://www.aihw.gov.au/reports/alcohol/alcohol-tobacco-other-drugs-australia

Barthorpe, A., Winstone, L., Mars, B., & Moran, P. (2020). Is social media screen time really associated with poor adolescent mental health? A time use diary study. *Journal of affective disorders, 274,* 864–870. https://doi.org/10.1016/j.jad.2020.05.106

Berridge, K. C., & Kringelbach, M. L. (2015). Pleasure systems in the brain. *Neuron*, *86*(3), 646–664. https://doi.org/10.1016/j.neuron.2015.02.018

Black, Q.C., Watson, E.J. & Black C.D. (2018). Introducing the Matrix methamphetamine treatment program to Australia: The pilot, development of the Australian Matrix protocol, establishment of the national Matrix network and some preliminary research findings from South Australian multisite trials.

Brecht, M. L., & Herbeck, D. (2014). Time to relapse following treatment for methamphetamine use: a long-term perspective on patterns and predictors. *Drug and alcohol dependence*, *139*, 18–25. https://doi.org/10.1016/j.drugalcdep.2014.02.702

Burdzovic Andreas, J., Lauritzen, G., & Nordfjaern, T. (2015). Co-occurrence between mental distress and poly-drug use: a ten year prospective study of patients from substance abuse treatment. *Addictive behaviors*, *48*, 71–78. https://doi.org/10.1016/j.addbeh.2015.05.001

Carhart-Harris, R. L., & Goodwin, G. M. (2017). The Therapeutic Potential of Psychedelic Drugs: Past, Present, and Future. *Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology*, *42*(11), 2105–2113. https://doi.org/10.1038/npp.2017.84

Carruthers, S. (2018). Needle and Syringe Programs in Australia: Peer-led Best Practice. *Australian Injecting and Illicit Drug Users League.* Canberra, Australia

Chrzanowska, A., Man, A., Sutherland, R., Degenhardt, L. & Peacock, A. (2021). Trends in drug-induced deaths in Australia, 1997–2019. *Drug Trends Bulletin Series.* Sydney: National Drug and Alcohol Research Centre, UNSW.

Connor, J. P., Gullo, M. J., White, A., & Kelly, A. B. (2014). Polysubstance use: diagnostic challenges, patterns of use and health. *Current opinion in psychiatry*, *27*(4), 269–275. https://doi.org/10.1097/YCO.0000000000000069

Conway, K. P., Compton, W., Stinson, F. S., & Grant, B. F. (2006). Lifetime comorbidity of DSM-IV mood and anxiety disorders and specific drug use disorders: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *The Journal of clinical psychiatry*, *67*(2), 247–257. https://doi.org/10.4088/jcp.v67n0211

Coomber, R., McElrath, K., Measham, F., & Moore, K. (2013). Prevention: primary, secondary and tertiary. In *Key concepts in drugs and society*, 143-146, SAGE Publications, Ltd., https://www.doi.org/10.4135/9781526401670.n29

Courtney, K. E., & Ray, L. A. (2014). Methamphetamine: an update on epidemiology, pharmacology, clinical phenomenology, and treatment literature. *Drug and alcohol dependence*, *143*, 11–21. https://doi.org/10.1016/j.drugalcdep.2014.08.003

Darke, S., Kaye, S., McKetin, R., & Duflou, J. (2008). Major physical and psychological harms of methamphetamine use. *Drug and alcohol review*, *27*(3), 253–262. https://doi.org/10.1080/09595230801923702

Degenhardt, L., Copeland, J., & Dillon, P. (2005). Recent trends in the use of "club drugs": an Australian review. *Substance use & misuse, 40*(9-10), 1241–1256. https://doi.org/10.1081/JA-200066777

Degenhardt, L., Larney, S., Chan, G., Dobbins, T., Weier, M., Roxburgh, A., Hall, W. D., & McKetin, R. (2016). Estimating the number of regular and dependent methamphetamine users in Australia, 2002-2014. *The Medical journal of Australia*, *204*(4), 153. https://doi.org/10.5694/mja15.00671

Degenhardt, L., Sara, G., McKetin, R., Roxburgh, A., Dobbins, T., Farrell, M., Burns, L., & Hall, W. D. (2017). Crystalline methamphetamine use and methamphetamine-related harms in Australia. *Drug and alcohol review*, *36*(2), 160–170. https://doi.org/10.1111/dar.12426

DeSantis, A., Noar, S. M., & Webb, E. M. (2010). Speeding through the frat house: a qualitative exploration of nonmedical ADHD stimulant use in fraternities. *Journal of drug education*, *40*(2), 157–171. https://doi.org/10.2190/DE.40.2.d

Dluzen, D. E., & Liu, B. (2008). Gender differences in methamphetamine use and responses: a review. *Gender medicine*, *5*(1), 24–35. https://doi.org/10.1016/s1550-8579(08)80005-8

Dyba, J., Moesgen, D., Klein, M., Pels, F., & Leyendecker, B. (2019). Evaluation of a family-oriented parenting intervention for methamphetamine-involved mothers and fathers - The SHIFT Parent Training. *Addictive behaviors reports*, *9*, 100173. https://doi.org/10.1016/j.abrep.2019.100173

Fast, D., Kerr, T., Wood, E., & Small, W. (2014). The multiple truths about crystal meth among young people entrenched in an urban drug scene: a longitudinal ethnographic investigation. *Social science & medicine (1982)*, *110*, 41–48. https://doi.org/10.1016/j.socscimed.2014.03.029

Fernandez, D. P., Kuss, D. J., & Griffiths, M. D. (2020). Short-term abstinence effects across potential behavioral addictions: A systematic review. *Clinical psychology review*, *76*, 101828. https://doi.org/10.1016/j.cpr.2020.101828

Ferrucci, M., Limanaqi, F., Ryskalin, L., Biagioni, F., Busceti, C. L., & Fornai, F. (2019). The Effects of Amphetamine and Methamphetamine on the Release of Norepinephrine, Dopamine and Acetylcholine From the Brainstem Reticular Formation. *Frontiers in neuroanatomy*, *13*, 48. https://doi.org/10.3389/fnana.2019.00048

Garcia-Romeu, A., Kersgaard, B., & Addy, P. H. (2016). Clinical applications of hallucinogens: A review. *Experimental and clinical psychopharmacology*, *24*(4), 229–268. https://doi.org/10.1037/pha0000084

Gashi, L., Sandberg, S., & Pedersen, W. (2021). Making "bad trips" good: How users of psychedelics narratively transform challenging trips into valuable experiences. *The International journal on drug policy*, *87*, 102997. https://doi.org/10.1016/j.drugpo.2020.102997

Glasner-Edwards, S., Marinelli-Casey, P., Hillhouse, M., Ang, A., Mooney, L. J., Rawson, R., & Methamphetamine Treatment Project Corporate Authors (2009). Depression among methamphetamine users: association with outcomes from the Methamphetamine Treatment Project at 3-year follow-up. *The Journal of nervous and mental disease*, *197*(4), 225–231. https://doi.org/10.1097/NMD.0b013e31819db6fe

Godino, A., Jayanthi, S., & Cadet, J. L. (2015). Epigenetic landscape of amphetamine and methamphetamine addiction in rodents. *Epigenetics*, *10*(7), 574–580. https://doi.org/10.1080/15592294.2015.1055441

Gossop, M., Darke, S., Griffiths, P., Hando, J., Powis, B., Hall, W., & Strang, J. (1995). The Severity of Dependence Scale (SDS): psychometric properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction (Abingdon, England)*, *90*(5), 607–614. https://doi.org/10.1046/j.1360-0443.1995.9056072.x

Green, R. (2016). 'I wonder what age you grow out of it?': Negotiation of recreational drug use and the transistion to adulthood among an Australian ethnographic sample. *Drugs Educ Prev Policy, 23,* 202-211

Hall, K., Simpson, A. & Best, D. (2013). Ready 2 Change (R2C). *Turning Point.* Deakin University, Victoria, Australia

Hall, W., Hando, J., Darke, S., & Ross, J. (1996). Psychological morbidity and route of administration among amphetamine users in Sydney, Australia. *Addiction (Abingdon, England)*, *91*(1), 81–87. https://doi.org/10.1046/j.1360-0443.1996.9118110.x

Hedges, D. M., Obray, J. D., Yorgason, J. T., Jang, E. Y., Weerasekara, V. K., Uys, J. D., Bellinger, F. P., & Steffensen, S. C. (2018). Methamphetamine Induces Dopamine Release in the Nucleus Accumbens Through a Sigma Receptor-Mediated Pathway. *Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology*, *43*(6), 1405–1414. https://doi.org/10.1038/npp.2017.291

Herbeck, D. M., Brecht, M. L., Lovinger, K., Raihan, A., Christou, D., & Sheaff, P. (2013). Poly-drug and marijuana use among adults who primarily used methamphetamine. *Journal of psychoactive drugs*, *45*(2), 132–140. https://doi.org/10.1080/02791072.2013.785824

Hollis, C., Livingstone, S., & Sonuga-Barke, E. (2020). Editorial: The role of digital technology in children and young people's mental health - a triple-edged sword?. *Journal of*

child psychology and psychiatry, and allied disciplines, 61(8), 837–841. https://doi.org/10.1111/jcpp.13302

Hser, Y. I., Evans, E., & Huang, Y. C. (2005). Treatment outcomes among women and men methamphetamine abusers in California. *Journal of substance abuse treatment*, *28*(1), 77–85. https://doi.org/10.1016/j.jsat.2004.10.009

Ivancic, L., Perrens, B., Fildes, J., Perry, Y. and Christensen, H. (2014). Youth Mental Health Report, June 2014. *Mission Australia and Black Dog Institute,* Sydney.

Jaehne, E. J., Ameti, D., Paiva, T., & van den Buuse, M. (2017). Investigating the Role of Serotonin in Methamphetamine Psychosis: Unaltered Behavioral Effects of Chronic Methamphetamine in 5-HT_{1A} Knockout Mice. *Frontiers in psychiatry*, *8*, 61. https://doi.org/10.3389/fpsyt.2017.00061

Jensen, M. P., Chen, C., & Brugger, A. M. (2003). Interpretation of visual analog scale ratings and change scores: a reanalysis of two clinical trials of postoperative pain. *The journal of pain*, *4*(7), 407–414. https://doi.org/10.1016/s1526-5900(03)00716-8

Kalaitzopoulos, D. R., Chatzistergiou, K., Amylidi, A. L., Kokkinidis, D. G., & Goulis, D. G. (2018). Effect of Methamphetamine Hydrochloride on Pregnancy Outcome: A Systematic Review and Meta-analysis. *Journal of addiction medicine*, *12*(3), 220–226. https://doi.org/10.1097/ADM.0000000000000391

Karila, L., Weinstein, A., Aubin, H. J., Benyamina, A., Reynaud, M., & Batki, S. L. (2010). Pharmacological approaches to methamphetamine dependence: a focused review. *British journal of clinical pharmacology*, *69*(6), 578–592. https://doi.org/10.1111/j.1365-2125.2010.03639.x

Kelly, B. C., LeClair, A., & Parsons, J. T. (2013). Methamphetamine use in club subcultures. *Substance use & misuse*, *48*(14), 1541–1552. https://doi.org/10.3109/10826084.2013.808217

Kenny, P., Harney, A., Lee, N. K. & Pennay, A. (2011). Treatment utilization and barriers to treatment: Results of a survey of dependent methamphetamine users. *Substance Abuse Treatment, Prevention, and Policy, 6*(3). doi:10.1186/1747-597X-6-3

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., Howes, M. J., Normand, S. L., Manderscheid, R. W., Walters, E. E., & Zaslavsky, A. M. (2003). Screening for serious mental illness in the general population. *Archives of general psychiatry*, *60*(2), 184–189. https://doi.org/10.1001/archpsyc.60.2.184

Kish, S. J., Boileau, I., Callaghan, R. C., Tong, J., & Bolam, P. (2017). Brain dopamine neurone "damage": methamphetamine users vs. Parkinson's disease – a critical assessment of the evidence. *The European Journal of Neuroscience*, *45*(1), 58–66. https://doi.org/10.1111/ejn.13363

Kittirattanapaiboon, P., Srikosai, S., & Wittayanookulluk, A. (2017). Methamphetamine use and dependence in vulnerable female populations. *Current opinion in psychiatry*, *30*(4), 247–252. https://doi.org/10.1097/YCO.0000000000000335

Krebs, T. S., & Johansen, P. Ø. (2013). Psychedelics and mental health: a population study. *PloS one*, *8*(8), e63972. https://doi.org/10.1371/journal.pone.0063972

Lin, M., Sambo, D., & Khoshbouei, H. (2016). Methamphetamine Regulation of Firing Activity of Dopamine Neurons. *The Journal of neuroscience : the official journal of the Society for Neuroscience*, *36*(40), 10376–10391. https://doi.org/10.1523/JNEUROSCI.1392-16.2016

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour research and therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-u

Martinotti, G., Santacroce, R., Pettorruso, M., Montemitro, C., Spano, M. C., Lorusso, M., di Giannantonio, M., & Lerner, A. G. (2018). Hallucinogen Persisting Perception Disorder: Etiology, Clinical Features, and Therapeutic Perspectives. *Brain sciences*, *8*(3), 47. https://doi.org/10.3390/brainsci8030047

McGregor, C., Srisurapanont, M., Jittiwutikarn, J., Laobhripatr, S., Wongtan, T., & White, J. M. (2005). The nature, time course and severity of methamphetamine

withdrawal. *Addiction (Abingdon, England)*, *100*(9), 1320–1329. https://doi.org/10.1111/j.1360-0443.2005.01160.x

McKetin, R., Dunlop, A. J., Holland, R. M., Sutherland, R. A., Baker, A. L., Salmon, A. M., & Hudson, S. L. (2013). Treatment outcomes for methamphetamine users receiving outpatient counselling from the Stimulant Treatment Program in Australia. *Drug and alcohol review*, *32*(1), 80–87. https://doi.org/10.1111/j.1465-3362.2012.00471.x

McKetin, R., Lubman, D. I., Lee, N. M., Ross, J. E., & Slade, T. N. (2011). Major depression among methamphetamine users entering drug treatment programs. *The Medical journal of Australia*, *195*(3), S51–S55. https://doi.org/10.5694/j.1326-5377.2011.tb03266.x

McKetin, R., Lubman, D. I., Najman, J. M., Dawe, S., Butterworth, P., & Baker, A. L. (2014). Does methamphetamine use increase violent behaviour? Evidence from a prospective longitudinal study. *Addiction (Abingdon, England)*, *109*(5), 798–806. https://doi.org/10.1111/add.12474

McKetin, R., Ross, J., Kelly, E., Baker, A., Lee, N., Lubman, D. I., & Mattick, R. (2008). Characteristics and harms associated with injecting versus smoking methamphetamine among methamphetamine treatment entrants. *Drug and alcohol review*, *27*(3), 277–285. https://doi.org/10.1080/09595230801919486

Meyer, J. S. (2013). "3,4-methylenedioxymethamphetamine (MDMA): current perspectives". *Substance Abuse and Rehabilitation*. *4,* 83–99. doi:10.2147/SAR.S37258.

Mustafa, N. S., Bakar, N., Mohamad, N., Adnan, L., Fauzi, N., Thoarlim, A., Omar, S., Hamzah, M. S., Yusoff, Z., Jufri, M., & Ahmad, R. (2020). MDMA and the Brain: A Short Review on the Role of Neurotransmitters in Neurotoxicity. *Basic and clinical neuroscience*, *11*(4), 381–388. https://doi.org/10.32598/bcn.9.10.485

Nesvåg, R., Bramness, J. G., & Ystrom, E. (2015). The link between use of psychedelic drugs and mental health problems. *Journal of Psychopharmacology*, *29*(9), 1035-1040. https://doi.org/10.1177/0269881115596156

Nichols D. E. (2016). Psychedelics. *Pharmacological reviews, 68*(2), 264–355. https://doi.org/10.1124/pr.115.011478

Palamar, J. J., Han, B. H., & Keyes, K. M. (2020). Trends in characteristics of individuals who use methamphetamine in the United States, 2015-2018. *Drug and alcohol dependence*, *213*, 108089. Advance online publication. https://doi.org/10.1016/j.drugalcdep.2020.108089

Pei, Y., Asif-Malik, A., & Canales, J. J. (2016). Trace Amines and the Trace Amine-Associated Receptor 1: Pharmacology, Neurochemistry, and Clinical Implications. *Frontiers in neuroscience*, *10*, 148. https://doi.org/10.3389/fnins.2016.00148

Peterson, S. A., PhD., Geiger, J., Zittle, F. J., Billings, C., & Pullen, B. A. (2013). Exposure to methamphetamine and quality of life among college students. *Journal of Alcohol*

and Drug Education, 57(3), 7-17. http://proxy.library.adelaide.edu.au/login?url=https://www.proquest.com/scholarly-journals/exposure-methamphetamine-quality-life-among/docview/1493991653/se-2?accountid=8203

Quinn, B. T., Stoove, M., Papanastasiou, C., & Dietze, P. (2020). Methamphetamine use in Melbourne, Australia: baseline characteristics of a prospective methamphetamine-using cohort and correlates of methamphetamine dependence. *Journal of Substance Use*, *18*(5), 349 - 362. https://doi.org/10.3109/14659891.2012.675400

Radfar, S. R., & Rawson, R. A. (2014). Current research on methamphetamine: epidemiology, medical and psychiatric effects, treatment, and harm reduction efforts. *Addiction & health*, *6*(3-4), 146–154.

Rawsthorne, S. (2020). Profits 'through the roof' as drug dealers hike prices amid pandemic, Sydney Morning Herald, Retrieved from https://www.smh.com.au/national/profits-through-the-roof-as-drug-dealers-hike-prices-amid-pandemic-20200710-p55atw.html

Riley, S. C., & Blackman, G. (2008). Between prohibitions: patterns and meanings of magic mushroom use in the UK. *Substance Use & Misuse*, *43*(1), 55-71. https://doi.org/10.1080/10826080701772363

Roberts, C. A., Osborne-Miller, I., Cole, J., Gage, S. H., & Christiansen, P. (2020). Perceived harm, motivations for use and subjective experiences of recreational psychedelic

'magic' mushroom use. *Journal of psychopharmacology (Oxford, England)*, *34*(9), 999–1007. https://doi.org/10.1177/0269881120936508

Rognli, E. B., Håkansson, A., Berge, J., & Bramness, J. G. (2014). Does the pattern of amphetamine use prior to incarceration predict later psychosis?--a longitudinal study of amphetamine users in the Swedish criminal justice system. *Drug and alcohol dependence*, *143*, 219–224. https://doi.org/10.1016/j.drugalcdep.2014.07.037

Russell, K., Dryden, D. M., Liang, Y., Friesen, C., O'Gorman, K., Durec, T., Wild, T. C., & Klassen, T. P. (2008). Risk factors for methamphetamine use in youth: a systematic review. *BMC pediatrics*, *8*(48). https://doi.org/10.1186/1471-2431-8-48

Saleemi, S., Pennybaker, S. J., Wooldridge, M., & Johnson, M. W. (2017). Who is 'Molly'? MDMA adulterants by product name and the impact of harm-reduction services at raves. *Journal of psychopharmacology (Oxford, England)*, *31*(8), 1056–1060. https://doi.org/10.1177/0269881117715596

Sattah, M. V., Supawitkul, S., Dondero, T. J., Kilmarx, P. H., Young, N. L., Mastro, T. D., Chaikummao, S., Manopaiboon, C., & Griensven, F. v. (2002). Prevalence of and risk factors for methamphetamine use in northern Thai youth: results of an audio-computer-assisted self-interviewing survey with urine testing. *Addiction (Abingdon, England)*, *97*(7), 801–808. https://doi.org/10.1046/j.1360-0443.2002.00131.x

Scott, C. K., Dennis, M. L., Laudet, A., Funk, R. R., & Simeone, R. S. (2011). Surviving drug addiction: the effect of treatment and abstinence on mortality. *American journal of public health*, *101*(4), 737–744. https://doi.org/10.2105/AJPH.2010.197038

Semple, S. J., Strathdee, S. A., Zians, J., & Patterson, T. L. (2009). Family conflict and depression in HIV-negative heterosexuals: the role of methamphetamine use. *Psychology of addictive behaviors : journal of the Society of Psychologists in Addictive Behaviors*, *23*(2), 341–347. https://doi.org/10.1037/a0015260

Semple, S. J., Strathdee, S. A., Zians, J., & Patterson, T. L. (2011). Methamphetamine-using parents: the relationship between parental role strain and depressive symptoms. *Journal of studies on alcohol and drugs*, *72*(6), 954–964. https://doi.org/10.15288/jsad.2011.72.954

Shoptaw, S., Peck, J., Reback, C. J., & Rotheram-Fuller, E. (2003). Psychiatric and substance dependence comorbidities, sexually transmitted diseases, and risk behaviors among methamphetamine-dependent gay and bisexual men seeking outpatient drug abuse treatment. *Journal of Psychoactive Drugs, 35*(Suppl 1), 161–168. https://doi.org/10.1080/02791072.2003.10400511

Simpson, J. L., Grant, K. L., Daly, P. M., Kelley, S. G., Carlo, G., & Bevins, R. A. (2016) Psychological Burden and Gender Differences in Methamphetamine-Dependent Individuals in Treatment, *Journal of Psychoactive Drugs, 48*(4), 261-269. DOI: 10.1080/02791072.2016.1213470

Skevington, S. M., Lotfy, M., O'Connell, K. A., & WHOQOL Group (2004). The World Health Organization's WHOQOL-BREF quality of life assessment: psychometric properties and results of the international field trial. A report from the WHOQOL group. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation*, *13*(2), 299–310. https://doi.org/10.1023/B:QURE.0000018486.91360.00

Sobell, L. C., Brown, J., Leo, G. I., & Sobell, M. B. (1996). The reliability of the Alcohol Timeline Followback when administered by telephone and by computer. *Drug and alcohol dependence*, *42*(1), 49–54. https://doi.org/10.1016/0376-8716(96)01263-x

Su, H., Zhang, J., Ren, W., Xie, Y., Tao, J., Zhang, X., & He, J. (2017). Anxiety level and correlates in methamphetamine-dependent patients during acute withdrawal. *Medicine*, *96*(15), e6434. https://doi.org/10.1097/MD.0000000000006434

Subbaraman, M. S., & Witbrodt, J. (2014). Differences between abstinent and non-abstinent individuals in recovery from alcohol use disorders. *Addictive behaviors, 39*(12), 1730–1735. https://doi.org/10.1016/j.addbeh.2014.07.010

Swanke, J. R. & Flowers, C. (2013) Employment Among Methamphetamine-Involved Clients, *Journal of Social Work Practice in the Addictions, 13*(2), 179-191, DOI: 10.1080/1533256X.2013.784690

Tait, R. J., Whetton, S., Shanahan, M., Cartwright, K., Ferrante, A., Gray, D., Kaye, S., McKetin, R., Pidd, K., Ritter, A., Roche, A., & Allsop, S. (2018). Quantifying the societal

cost of methamphetamine use to Australia. *International Journal of Drug Policy*, *62*, 30-36. https://doi.org/10.1016/j.drugpo.2018.08.015

The Australian Department of Health. (2008). Specific types of methamphetamine users and behavioural contexts. Retrieved from https://www1.health.gov.au/internet/publications/publishing.nsf/Content/phd-npi-methamphetamine-report-feb09-l~users

The University of Queensland. (2021). More Australians Use Psychedelics to Self-Treat Mental Health. Retrieved from https://medicine.uq.edu.au/article/2021/03/more-australians-use-psychedelics-self-treat-mental-health

Tupper, K. W., Wood, E., Yensen, R., & Johnson, M. W. (2015). Psychedelic medicine: a re-emerging therapeutic paradigm. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, *187*(14), 1054–1059. https://doi.org/10.1503/cmaj.141124

van Amsterdam, J., Opperhuizen, A., & van den Brink, W. (2011). Harm potential of magic mushroom use: a review. *Regulatory toxicology and pharmacology : RTP*, *59*(3), 423–429. https://doi.org/10.1016/j.yrtph.2011.01.006

Vesga-López, O., Schneier, F. R., Wang, S., Heimberg, R. G., Liu, S. M., Hasin, D. S., & Blanco, C. (2008). Gender differences in generalized anxiety disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). *The Journal of clinical psychiatry*, *69*(10), 1606–1616.

Wu, L. T., Schlenger, W. E., & Galvin, D. M. (2006). Concurrent use of methamphetamine, MDMA, LSD, ketamine, GHB, and flunitrazepam among American youths. *Drug and alcohol dependence*, *84*(1), 102–113. https://doi.org/10.1016/j.drugalcdep.2006.01.002

Yen, C. F., & Chong, M. Y. (2006). Comorbid psychiatric disorders, sex, and methamphetamine use in adolescents: a case-control study. *Comprehensive psychiatry*, *47*(3), 215–220. https://doi.org/10.1016/j.comppsych.2005.07.006

Zorick, T., Nestor, L., Miotto, K., Sugar, C., Hellemann, G., Scanlon, G., Rawson, R., & London, E. D. (2010). Withdrawal symptoms in abstinent methamphetamine-dependent subjects. *Addiction (Abingdon, England)*, *105*(10), 1809–1818. https://doi.org/10.1111/j.1360-0443.2010.03066.x

Zweben, J. E., Cohen, J. B., Christian, D., Galloway, G. P., Salinardi, M., Parent, D., Iguchi, M., & Methamphetamine Treatment Project (2004). Psychiatric symptoms in methamphetamine users. *The American journal on addictions*, *13*(2), 181–190. https://doi.org/10.1080/10550490490436055