Is there a place for psychedelics in sports practice?

Marina A. M. Portes[1], Isabel Werle [1], and Leandro J. Bertoglio [1]*

[1]Department of Pharmacology, Federal University of Santa Catarina, Florianopolis, SC, Brazil, 88049-900.

***Corresponding author:** Professor Leandro J. Bertoglio, Departamento de Farmacologia, CCB, UFSC, Campus Universitário s/n, Florianópolis, SC, Brazil, 88049-900. Phone: +55 48 37212473; E-mail: leandro.bertoglio@ufsc.br

Orcids

Marina A. M. Portes: https://orcid.org/0009-0001-3246-1771

Isabel Werle: https://orcid.org/0000-0002-0870-1405

Leandro J. Bertoglio: https://orcid.org/0000-0003-2876-1143

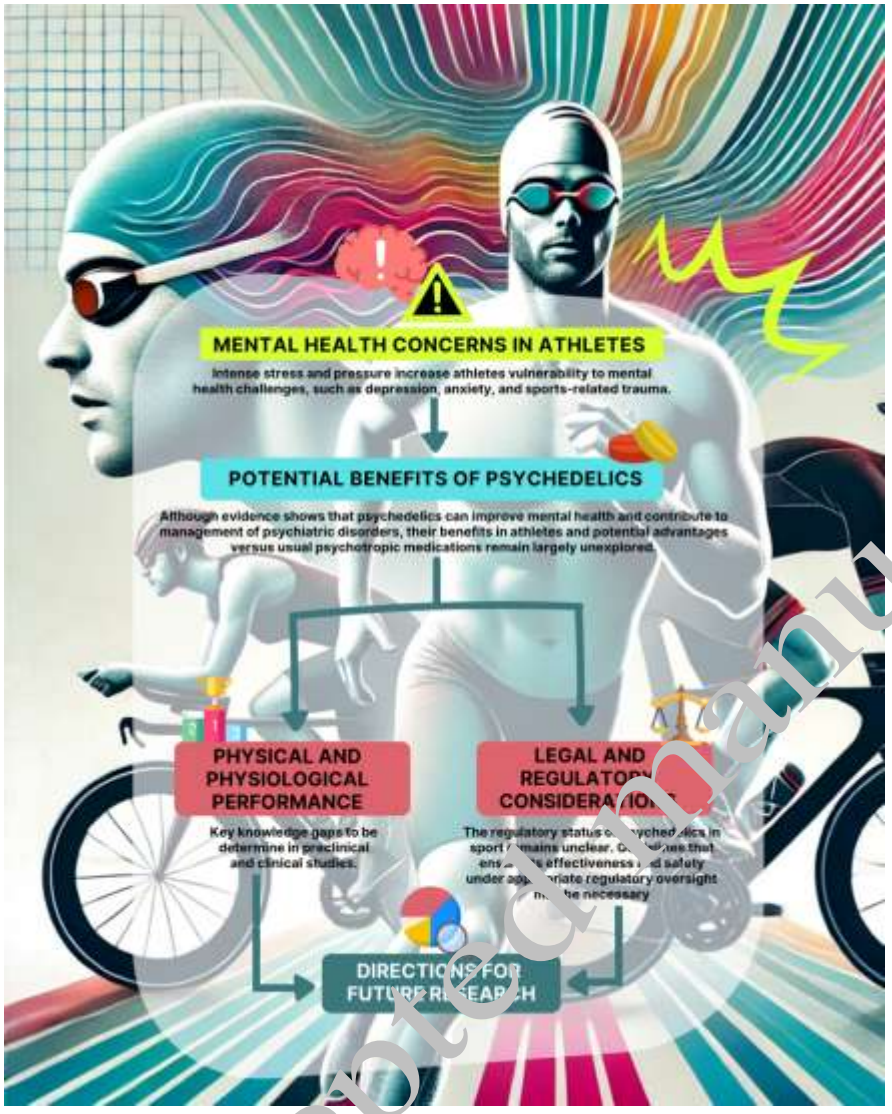
Running title: Psychedelics and athletic performance

ABSTRACT

Growing evidence suggests that psychedelic-assisted therapies can alleviate depression, anxiety, posttraumatic stress, and substance use disorder, offering relatively safe profiles, enhanced efficacy, and lasting effects after a few applications. Athletes often experience high levels of stress and pressure, making them susceptible to these psychiatric conditions. However, the effects of psychedelic substances on athletic performance remain largely unknown. Before potential acceptance, evaluating their impact on physical and physiological measures beyond mental health outcomes is crucial. Here, we aim to explore this topic and highlight research directions to advance our understanding. Preclinical studies suggest that psilocybin/psilocin, lysergic acid diethylamide (LSD), *N*,*N*-dimethyltryptamine (DMT), and ayahuasca possess anti-inflammatory and anti-nociceptive properties. Studies investigating the effects of classical psychedelics or 3,4-methylenedioxymethamphetamine (MDMA) on factors such as muscle strength, motor coordination, locomotion, endurance, fluid and electrolyte balance, hormonal regulation, and metabolism are still scarce. While adhering to regulatory frameworks, further research in animal models, athletes, and non-athletes is needed to address these gaps, compare psychedelics with commonly used psychoactive drugs, and explore the potential prophylactic and regenerative benefits of specific interventions.

Keywords: Resilience; Serotonin; Neuroplasticity; Inflammation; Pain; Ecstasy; Ketamine; Cannabis

GRAPHICAL ABSTRACT



HIGHLIGHTS

- Athletes frequently experience intense stress and pressure, increasing their vulnerability to mental health challenges such as depression, anxiety, and sports-related trauma.
- While psychedelics hold the potential for alleviating these issues, their impact on physical and physiological performance in athletes remains largely unexplored.
- This perspective explores the effects of psilocybin, LSD, DMT, and MDMA on mental and physical health, identifying key knowledge gaps and proposing future research directions using rodent models relevant to athletic populations.

SUMMATIONS

- Psychedelic-assisted therapies are increasingly known for their potential to mitigate symptoms of various psychiatric conditions.
- Psychedelics may offer intriguing possibilities for enhancing resilience, aiding recovery, and treating sports-related trauma.
- As scientific understanding evolves, specific psychedelic substances could emerge as complementary tools in sports medicine.

PERSPECTIVES

- Research on the effects of psychedelics on physical performance and physiological parameters is still limited in rodents and humans.
- Permitting specific psychedelics in sports competitions will require a strong scientific foundation and a revision of anti-doping regulations.
- Establishing proper guidelines, dosages, and usage contexts will be crucial to ensure their responsible application.

1. INTRODUCTION

Psychedelics are currently defined as psychoactive substances that alter sensory perception, thought patterns, mood, and emotional experiences, affecting numerous cognitive processes (Nichols, 2016). They induce profound changes in consciousness, including visual and auditory hallucinations, an altered perception of time, and a heightened sense of interconnectedness - effects often attributed to serotonin (5-HT) transmission in the brain (Osmond, 1957; Wittman et al., 2007; Nichols, 2016; Yanakieva et al., 2019; Vollenweider & Preller, 2020).

Psychedelic compounds can be classified according to their chemical structure or mechanism of action (Mitchell & Anderson, 2024). Serotonergic psychedelics fall into two main structural categories, characterized by modifications in the tryptamine or the phenethylamine group (Mendes et al., 2022). The first category includes psilocybin (psilocin is the active metabolite) found in certain mushrooms; *N*,*N*-dimethyltryptamine (**DMT**) present in ayahuasca[1]; and 5-methoxy-*N*,*N*-DMT (**5-MeO-DMT**) derived from certain toad species. The second comprises mescaline, the primary psychoactive component of peyote cacti, and synthetic compounds such as (±)-2,5-dimethoxy-4-iodoamphetamine hydrochloride (**DOI**). Lysergic acid diethylamide (**LSD**) is an ergoline-derived compound.

Classical psychedelics (psilocybin, DMT, 5-MeO-DMT, mescaline, and LSD) act as partial or full agonists at 5-HT receptors, primarily 5-HT_{2A}, 5-HT_{1A}, and 5-HT_{2C} (Werle & Bertoglio, 2024). In contrast, compounds like DOI are relatively more selective agonists at 5-HT_{2A} receptors (Werle & Bertoglio, 2024). Some substances associated with psychedelics act through distinct mechanisms. For example, 3,4-methylenedioxymethamphetamine (**MDMA**) produces psychoactive effects primarily by releasing monoamines (5-HT, noradrenaline, and dopamine) and inhibiting their reuptake; ketamine is a glutamate N-methyl-D-aspartate (**NMDA**) receptor antagonist; and ibogaine (noribogaine is the active metabolite) interacts with multiple molecular targets, including 5-HT_{2A} receptors, NMDA receptors, and monoamine transporters (Johnson et al., 2019; Mendes et al., 2022).

Activating 5-HT_{2A} receptors, primarily those expressed in the apical dendrites of human layer V cortical pyramidal neurons, is essential for the perceptual effects of

[1] It is a psychoactive brew from the Amazon, typically made from *Banisteriopsis caapi* and *Psychotria viridis*. The β-carbolines harmine, harmaline, and tetrahydroharmine present in *B. caapi* act as monoamine oxidase inhibitors, preventing the first-pass metabolism of DMT found in *P. viridis* and allowing it to become orally active. It is also worth noting that DMT is found in various other plants worldwide.

psychedelic experiences (Madsen et al., 2019). The canonical 5-HT_{2A} receptor signaling pathway involves the activation of $G_{\alpha q/11}$-proteins and subsequent activation of the enzyme phospholipase C, leading to hydrolysis of phosphatidylinositol-4,5-bisphosphate and the release of inositol triphosphate and diacylglycerol. 5-HT_{2A} receptors also interact with arrestins, recruiting intracellular signaling pathways dependent on these proteins (Kim et al., 2020; McClure-Begley & Roth, 2022; Wallach et al., 2023). The psychedelic potential of some phenethylamine analogs is associated with the efficacy of 5-HT_{2A}-Gq but not 5-HT_{2A}-β-arrestin-2 recruitment (Wallach et al., 2023).

Increasing evidence suggests that 5-HT_{2A} receptor agonism does not fully explain the pharmacological effects of psychedelics (Inserra et al., 2021; Mendes et al., 2022; Werle et al., 2024). Their action also involves the brain activation of other serotonergic and dopaminergic receptor subtypes (Werle & Bertoglio, 2024), tropomyosin receptor kinase B (**TrkB**) (Moliner et al., 2023; Shafiee et al., 2024), ionotropic glutamate receptor interactions (Heresco-Levy & Lerer, 2024), neurotransmitters release (White et al., 1996; Mason et al., 2020), increased expression of the brain-derived neurotrophic factor (**BDNF**; He et al., 2005; de Almeida et al., 2019; Marton et al., 2019; Hutten et al., 2020a; Shafiee et al., 2024), and epigenetic changes (Inserra et al., 2024). How psychedelics influence the abovementioned targets/mechanisms is complex, with each substance exhibiting particular features (Ray, 2010; Cameron et al., 2023).

The ability to induce adaptative structural and functional changes in the brain is a common feature of psychedelics shown in both preclinical and clinical studies (Ly et al., 2018; Lukasiewicz et al., 2021; de Vos et al., 2021; Liao et al., 2025). These substances induce neuroplasticity in response to intrinsic or extrinsic stimuli, modifying the strength and efficacy of synaptic transmission (Calder & Hasler, 2023). The cascade of cellular and molecular events implicated includes transmembrane and cytosolic receptor activation (Preller et al., 2018; Moliner et al., 2023; Vargas et al., 2023), recruitment of secondary messengers and proteins (Olson, 2022), changes in the number or complexity of dendritic spines (Ly et al., 2018; Shao et al., 2021), generation of new neurons (Lima da Cruz et al., 2018; Morales-Garcia et al., 2020), among others. Moreover, psychedelics can induce varying effects on functional connectivity across brain networks, such as decreased connectivity within the default mode network associated with self-referential thoughts and the sense of ego (Carhart-Harris et al., 2012; Palhano-Fontes et al., 2015; Carhart-Harris et al., 2016a; Preller et al., 2020; Daws et al., 2022; Siegel et al., 2024). These changes may shift rigid thought patterns into more integrated and flexible thinking, potentially leading

individuals to new insights and perspectives on life experiences. The altered states of consciousness induced by psychedelics may also affect emotional processing and facilitate coping with difficult emotions or traumatic experiences, leading to improved mental health outcomes and even therapeutic benefits (Kraehenmann et al., 2015; Barrett et al., 2020; Mertens et al., 2020; Arruda Sanchez et al., 2024; Stoliker et al., 2024; Melani et al., 2025).

Psychedelics were categorized as Schedule I substances under the Controlled Substances Act by the United States Drug Enforcement Administration in the 1970s, a decision mirrored by regulatory agencies in other countries. This classification significantly restricted academic and clinical research. However, over the past ten years, scientific and medical interest has been resurgent in exploring the pharmacological effects of these substances. As described in the following two sections, studies indicate that psychedelics have a relatively good safety profile, produce rapid benefits, and exert enduring effects after just a few doses (Riba et al., 2003; Palhano-Fontes et al., 2019; Mitchell et al., 2021; Gukasyan et al., 2022; Rhee et al., 2023; Dos Santos & Hallak, 2024; Hinkle et al., 2024). As a result, their therapeutic potential has been explored, presenting a promising approach for treating various psychiatric disorders, as detailed in Section 3 and **Table 1**. The subsequent sections will evaluate the potential applications of psychedelics for maintaining and improving mental wellness in athletes, their effects on physical and physiological parameters pertinent to athletic performance, and the relevant legal and regulatory frameworks.

2. ON THE SAFETY OF PSYCHEDELICS

The acute toxicity of psychedelics is considered low. Reports of fatal overdoses associated with their use are rare (Haden & Woods, 2020; Darke et al., 2024; Thomas, 2024), with deaths primarily linked to extremely high doses (i.e., ≥ 20 times the typical dose) or the combination of psychedelics with other drugs or ethanol (Schlag et al., 2022; Lake & Lucas, 2024; Kopra et al., 2025). Clinical studies conducted in supervised settings have also demonstrated low addictive potential (Johnson et al., 2008; Johansen & Krebs, 2015; Johnson et al., 2018; Schlag et al., 2022; Hinkle et al., 2024). Compared to ethanol, opioids, cocaine, crack, amphetamines, and some psychostimulants, they have a low risk of addiction and intoxication (Nutt et al., 2010; Johnson et al., 2018). Noteworthy, clinical evidence suggests that psychedelics can alleviate psychological and physiological symptoms associated with dependence on other psychoactive substances (Vamvakopoulou & Nutt, 2024; Yao et al., 2024).

Challenging emotional experiences (e.g., anxiety and panic attacks), sensory and spatial distortions, headache, nausea and vomiting, and elevations in heart rate and blood pressure are changes induced by psychedelics as *transient* effects observed after administering usual doses but infrequently manifest in protocols using microdoses (Nichols, 2016; Polito & Stevenson, 2019; Schlag et al., 2022; Wsół, 2023; Murphy et al., 2024; Neumann et al., 2024; Yerubandi et al., 2024) or when used in controlled settings with appropriate inclusion criteria (Rhee et al., 2023; Hinkle et al., 2024; Klaiber et al., 2024; Romeo et al., 2024; Simon et al., 2024; Sabé et al., 2025). These relatively limited adverse reactions are associated with stimulating various 5-HT receptors (Johnson et al., 2008; Family et al., 2022; Holze et al., 2022). For example, the potential cardiovascular risk associated with serotonergic psychedelics is attributed to their interaction with 5-HT_{1B}, 5-HT_{2B}, and 5-HT_4 receptors (Wsół, 2023). However, no associations have been established between the lifetime use of classical psychedelics and the development of cardiometabolic diseases (Simonsson et al., 2021).

The relationship between psychedelic use and the risk of seizures is not fully understood, as clinical studies typically exclude individuals with a history of seizures or convulsions. While psychedelics may theoretically increase the risk in predisposed individuals due to cortical 5-HT_{2A} receptor hyperstimulation, most studies suggest that these substances have a low epileptogenic potential when used in controlled settings. The risk may be elevated when psychedelics are combined with factors common in athletic environments, such as sleep deprivation, stimulant use, or high-stress conditions, particularly in susceptible individuals. However, further investigation is needed to understand better the underlying mechanisms and associated risk factors (Freidel et al., 2024; Lewis et al., 2024; Soto-Angona et al., 2024). Based on this, caution is advised for athletes with a history of seizures and those using medications (e.g., bupropion) or supplements (e.g., high-dose caffeine) that may lower the seizure threshold.

The use of psychedelics, particularly MDMA, has been associated with an increased risk of hyponatremia in humans, primarily due to increased antidiuretic hormone (also known as vasopressin) release from the posterior pituitary and excessive fluid intake, leading to water retention and sodium dilution (Atila et al., 2024). This mechanism is attributed to MDMA's elevation of hypothalamic 5-HT and dopamine levels, stimulating vasopressin release and promoting water retention via vasopressin-2 receptors in the kidneys. Excessive water intake, driven by hyperthermia, dry mouth, and stimulant effects in physically demanding or hot environments, may exacerbate sodium dilution. Although this effect is self-limiting and

observed mainly acutely, this condition may be particularly concerning for endurance athletes. Temporary hyponatremia outside of competition may contribute to longer-term consequences, potentially predisposing them to a higher risk of injuries or reduced performance in subsequent training or competitions.

Evidence from both rodent and human studies has demonstrated an association between MDMA use and an increased risk of hyperthermia and rhabdomyolysis. MDMA-treated rodents exhibited significant increases in body temperature, sustained muscle contraction, and muscle damage resembling rhabdomyolysis. These effects were related to increases in neurotransmitters, primarily 5-HT and dopamine, and activation of the sympathetic nervous system (Sprague et al., 2004; Duarte et al., 2005; Rusyniak et al., 2005; Sprague et al., 2005; de Bragança et al., 2017). In humans, clinical and observational studies have reported similar effects, especially in intoxication or recreational settings involving prolonged physical activity, crowded environments, and inadequate thermoregulation (Screaton et al., 1992; Lehmann et al., 1995; Halachanova et al., 2001; Sue et al., 2002; Vanden Eede et al., 2012; Doyle et al., 2020). This could be relevant for endurance athletes if their MDMA use and physical exercise are not adequately spaced apart, as MDMA-induced hyperthermia and rhabdomyolysis can be exacerbated by the physiological demands of prolonged exertion, increasing the risk of severe complications and impairing athletic performance. Although the cited articles did not assess athletes under the acute effects of psychedelic substances, their findings indirectly underscore the importance of understanding the risks associated with MDMA use in physically demanding contexts, as well as the need for proper monitoring of signs and symptoms.

Evidence indicates that 5-HT is a key neuromodulator of locomotor activity (Bacqué-Cazenave et al., 2020; Flaive et al., 2020). As reviewed by Werle and Bertoglio (2024), published studies have demonstrated the biphasic effects of psychedelic substances on locomotion. In the open-field test, rats and mice exhibit either hyperlocomotion or hypolocomotion, depending on the dose. These effects are mediated by mechanisms involving the activation of 5-HT_{1A}, 5-HT_{2C}, and 5-HT_{2A} receptors (in the case of MDMA, they also involve the release of 5-HT and dopamine). Each substance has its particularities, although hypolocomotor effects (suggestive of sedation) generally predominate at moderate to high doses (Werle & Bertoglio, 2024). While it is unlikely and strongly discouraged for individuals to participate in sports while under the acute influence of psychedelics, it is worth

noting that rodent studies suggest psilocybin, LSD, DMT, ayahuasca, and MDMA can influence locomotor activity.

3. PSYCHEDELICS AND MENTAL HEALTH

Psychedelics can provide significant benefits across multiple domains of mental health and well-being in healthy individuals (Lebedev et al., 2016; Schmid & Liechti, 2018; Hutten et al., 2020a; Perkins et al., 2022). Of particular relevance to athletes are several potential effects, including reduced pain (Ramaekers et al., 2021; Askey et al., 2024; Strand et al., 2025) and improvements in sleep (Allen et al., 2024). Additionally, psychedelics may enhance stress management by reducing anxiety levels and promoting greater emotional resilience (Griffiths et al., 2011; Arruda Sanchez et al., 2024).

The growing interest and acceptance of psychedelic substances have driven clinical trials, advancing our understanding of their potential benefits (Nichols, 2016; Reiff et al., 2020; Nutt & Carhart-Harris, 2021; McClure-Begley & Roth, 2022). Their contribution to alleviating symptoms of depression, anxiety, posttraumatic stress disorder (PTSD), eating disorders, and substance use disorders has been documented (Reiff et al., 2020; Barber & Aaronson, 2022; Brewerton et al., 2022; Cavarra et al., 2022; Cuerva et al., 2024; Dos Santos & Hallak, 2024; Doss et al., 2024; Zaretsky et al., 2024). **Table 1** presents the details and primary findings of human studies examining the effects of psilocybin, LSD, DMT, ayahuasca, and MDMA on the mental health of individuals diagnosed with the aforementioned psychiatric conditions. Noteworthy, the association of psychedelics with psychotherapeutic support (i.e., psychedelic-assisted psychotherapy) has been shown to improve the integration of psychedelic experiences (Luoma et al., 2020).

Some of the studies reviewed (Table 1) also report that these substances are associated with significant and long-lasting symptom reduction, with therapeutic effects persisting for weeks or months following only a few administrations, even in patients resistant to typical pharmacological treatment. Psychedelics have also presented a favorable safety profile, as indicated by the relatively low incidence of severe adverse reactions when administered under controlled clinical conditions. Such features may be particularly relevant for health care in athletes, who often endure high levels of physical and mental stress and are vulnerable to various psychiatric disorders (Edwards, 2024). Hypothetically, psychedelic therapy could serve as a valuable tool for enhancing well-being in this population with minimal risk of impairing performance.

However, it is essential to address the methodological limitations of the studies published to date, as well as the gaps that still need to be clarified to enable a responsible application of psychedelic therapies in clinical practice. Some reviewed studies included small sample sizes and lacked double-blind methodologies or inactive placebos, which limits the generalizability of the observed results and increases the chance of confirmation bias. Furthermore, the majority of participants were White or Caucasian, which may limit the extrapolation of findings to other ethnic groups with distinct cultural or genetic characteristics, thus impacting the representativeness of these results when psychedelics are applied on a larger scale. Another issue is the variability in study protocols (e.g., dosage, number of administrations, and intervals between treatments). Greater methodological rigor and standardization are needed to understand better the actual clinical impact of psychedelic therapy on both the general population and athletes. Future research should also incorporate more objective evaluation methods, ideally including physiological or neurobiological measurements that can be correlated with the health status (or psychiatric disorder under investigation).

Table 1. Effects of single or repeated administration of psilocybin, LSD, ayahuasca, DMT, or MDMA on the mental health of individuals diagnosed with selected psychiatric disorders

Treatment		**Participants**			**Study features**					
Psychedelic substance	Dose, administration route, and posology	Number, age in years, sex	Ethnicity	Clinical condition	Design	Psychotherapeutic support	Effect on symptoms	Benefit duration	Report of severe adverse event(s)	Reference
Affective disorders (mainly depression)										
Psilocybin	10 and 25 mg (1st and 2nd session), oral, one week apart	12, 30-64, ♂♀	Mostly White or Caucasian (75%)	Moderate-to-severe MDD	Open-label	Yes	↓	At least 3 months post-treatment	No	Carhart-Harris et al., 2016b
Psilocybin	1 or 3 mg/70 kg (1st session) and 22 or 30 mg/70 kg (2nd session), oral, five weeks apart	51, 56.3 ±1.4 (mean ± SEM), ♂♀	Mostly White or Caucasian (94%)	Cancer-related anxiety and depression	R, D-B, cross-over	Yes	↓	At least 6 months post-treatment	No	Griffiths et al., 2016
Psilocybin	0.3 mg/kg, oral,	29, 56 ±13	Mostly	Cancer-	R, D-B,	Yes	↓	At least 6	No	Ross et al.,

	single administration	(mean ± SD), ♂♀	White or Caucasian (90%)	related anxiety and depression	P-C, cross-over			months post treatment		2016
Ayahuasca	120-200 ml (adjusted to contain 96-160 mg of DMT, and 25-42 mg of harmine), oral, single administration	17, 43 ± 12 (mean ± SD), ♂♀	n.d.	Moderate-to-severe TR-MDD	Open-label	n.d.	↓	At least 21 days post-treatment	No	Sanches et al., 2016
Psilocybin	10 and 25 mg (1st and 2nd session), oral, one week apart	19, 42.8 (mean), ♂♀	n.d.	TR-MDD	Open-label	n.d.	↓	At least 5 weeks post-treatment	n.d.	Carhart Harris et al., 2017
Psilocybin	10 and 25 mg (1st and 2nd session), oral, one week apart	20, 44 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (55%)	Severe MDD	Open-label	Yes	↓	At least 6 months post-treatment	No	Carhart-Harris et al., 2018
Ayahuasca	1 ml/kg (adjusted to	71, 42 ± 12 (mean	n.d.	TR-MDD	R, D-B, P-C	n.d.	n.d.	n.d.	n.d.	Galvão et al., 2018

	contain 0.36 mg/kg of DMT), oral, single administration	± SD), ♂♀								
Psilocybin	10 and 25 mg (1st and 2nd session), oral, one week apart	20, 45 ± 11 (mean ± SD), ♂♀	n.d.	Moderate-to-severe TR-MDD	Open-label	Yes		At least 3 to 5 weeks post-treatment	n.d.	Roseman et al., 2018
Ayahuasca	1 ml/kg, oral, single administration	83, 42 ± 11 (mean ± SD), ♂♀	n.d.	TR-MDD	R, D-B, P-C	n.d.	n.d.	n.d.	n.d.	de Almeida et al., 2019
Ayahuasca	1 ml/kg (adjusted to contain 0.36 mg/kg of DMT), oral, single administration	29, 40 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (64%)	Moderate-to-severe TR-MDD	R, D-B, P-C	n.d.	↓	At least 7 days post-treatment	No	Palhano-Fontes et al., 2019
Psilocybin	10 and 25 mg (1st and 2nd session), oral, one week apart	19, 45 ± 11 (mean ± SD), ♂♀	n.d.	Moderate-to-severe TR-MDD	Open-label	Yes	↓	At least 5 weeks post-treatment	n.d.	Mertens et al., 2020

Psilocybin	25 mg, oral, two admin. (one every 3 weeks)	59, 43 ±12 (mean ± SD), ♂♀	Mostly White or Caucasian (93%)	Moderate-to-severe MDD	R, D-B, controlled	Yes	↓	At least 6 weeks post-treatment	No	Carhart-Harris et al., 2021
Psilocybin	20 and 30 mg/70 kg (1st and 2nd session), oral, two admin. (1.6 weeks apart)	24, 40 ± 12 (mean ± SD), ♂♀	n.d.	Moderate-to-severe MDD	R	Yes	↓	At least 8 weeks post-treatment	No	Davis et al., 2021
Ayahuasca	2.2 ml/kg (adjusted to contain 0.8 mg/ml of DMT, 0.21 mg/ml of harmine, and no harmaline)	17, 43 ± 12 (mean ± SD), ♂♀	n.d.	TR-MDD	Open-label	No	↓	At least 21 days post-treatment	n.d.	Zeifman et al., 2021
DMT	0.1 or 0.3 mg/kg, i.v., two administrations (one every 4[illegible]	10, 24-59, ♂♀	Mostly White or Caucasian (70%)	TR-MDD	Open-label, fixed-order,	No	↓	At least 1 day post-treatment	Asymptomatic bradycardia and	D'Souza et al., 2022

	hours)				dose-escalation				hypotension (n=1)	
Psilocybin	1, 10, or 25 mg, oral, single administration	233, 40 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian (92.3%)	TR-MDD	R, D-B, parallel group	Yes	↔ (1 and 10 mg) ↓ (25 mg)	At least 3 weeks post-treatment	Suicidal behavior (n = 3), codeine withdrawal syndrome (n=1), and adjustment disorder with anxiety and depressed mood (n =1)	Goodwin et al., 2022
Psilocybin	20 or 30 mg/70 kg, oral, two administrations	24, 40 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian (92%)	Moderate-to-severe MDD	R, waiting-list controlle	Yes	↓	At least 12 months post-treatment	No	Gukasyan et al., 2022

	(one every 2 weeks)				d study					
Ayahuasca	50 ml (containing 3, 4, or 5 g of *Peganum harmala*, and 9, 15, or 16.67 g of *Mimosa hostilis*), oral, two administrations (one every 2.5 h)	20, 35 ± 10 (mean ± SD), ♂♀	n.d.	Chronic MDD (> 2 years)	Longitudinal observational study	n.d.	↓	At least 12 months post-treatment	n.d.	van Oorsouw et al., 2022
Psilocybin	25 mg, oral, single administration	19, 42 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (78.9%)	TR-MDD	Open-label	Yes	↓	At least 3 weeks post-treatment	No	Goodwin et al., 2023
Psilocybin	0.3 mg/kg, oral, single administration	25, 43 ± 14 (mean ± SD), ♂♀	n.d.	TR-MDD	D-B, P-C, within-subject	Yes	↓	At least 2 weeks post-treatment	n.d.	Skosnik et al., 2023

					study					
Psilocybin	0.3 mg/kg, oral, single administration	19, 43 ±14 (mean ± SD), ♂♀	Mostly White or Caucasian (84.2%)	TR-MDD	P-C, within-subject, fixed-order	Yes	↓	At least 2 months post-treatment	No	Sloshower et al., 2023
Psilocybin	1 or 25 mg, oral, two administrations (one every 3 weeks)	59, 43 ± 10 (mean ± SD), ♂♀	Mostly White or Caucasian (93.3%)	MDD	R, D-B	Yes	↔ (1 mg) ↓ (25 mg)	At least 6 weeks post-treatment	n.d.	Zeifman et al., 2023
Psilocybin	25 mg, oral, single administration	15, 38 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian (80%)	Bipolar disorder depression	Open-label	Yes	↓	At least 12 weeks post-treatment	No	Aaronson et al., 2024
Psilocybin	1, 10, or 25 mg, oral, single administration	11, 45.5 (mean), ♂♀	n.d.	TR-MDD	R, D-B	Yes	n.d.	At least 12 weeks post-treatment	n.d.	Breeksema et al., 2024
Psilocybin	1 or 25 mg, oral, two administrations	59, n.d., n.d.	n.d.	Moderate-to-severe MDD	R, D-B, two-arm, controlle	n.d.	↔ (1 mg)	At least 2 weeks post-treatment	n.d.	Peill et al., 2024

	(one every 3 weeks)				d trial		↓ (25 mg)			
Psilocybin	0.3 mg/kg, oral, single administration	15, 43 ± 14 (mean ± SD), ♂♀	Mostly White or Caucasian (84.2%)	Moderate-to-severe MDD	P-C, within-subject, fixed-order	Yes	↓	At least 16 months post-treatment	n.d.	Sloshower et al., 2024
Posttraumatic stress disorder										
MDMA	125 mg, oral, two administrations (one per month)	20, 21-70, ♂♀	100% White/ or Caucasian	PTSD	R, D-B, P-C	Yes	↓	At least 2 months post-treatment	No	Mithoefer et al., 2011
MDMA	125 to 187.5 mg, oral, two administrations (one per month)	19, n.d., n.d.	100% White/ or Caucasian	PTSD	Prospective long-term follow-up	Yes	↓	17 to 74 months post-treatment	n.d.	Mithoefer et al., 2013
MDMA	37.5 or 187.5 mg, oral, three administrations (interval n.d.)	12, 41 ± 11 (mean ± SD), ♂♀	n.d.	PTSD	R, D-B, active- P-C	Yea	↔ (37.5 mg) ↓ (187.5 mg)	At least 12 months post-treatment	No	Oehen et al., 2013
MDMA	30, 75, or 125	26, 37 ±	Mostly	PTSD	R, D-B	Yes	↔	At least 12	No	Mithoefer et

	mg, oral, two administrations (one every 3-5 weeks)	10 (mean ± SD), ♂♀	White or Caucasian (85%)				(30 mg) ↓ (75 and 125 mg)	weeks post-treatment		al., 2018
MDMA	40, 100, or 125 mg, oral, two administrations (one per month)	28, 42 ± 13 (mean ± SD), ♂♀	n.d.	PTSD	R, D-B	Yes	← (40 mg) ↓ (100 or 125 mg)	At least 2 months post-treatment	No	Ot'alora et al., 2018
MDMA	75 to 125 mg, oral, 2 or 3 administrations (one every 3 to 5 weeks)	105, 40 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (87.6%)	PTSD	R, D-B, P-C	Yes	↓	At least 1 to 2 months after two experimental sessions	No	Mithoefer et al., 2019
MDMA	75 to 187.5 mg, oral, two administrations (one every 3 to 5 weeks)	60, 41 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian (84.4%)	PTSD	R and two-blinded	Yes	↓	At least 1 to 2 months post-treatment	n.d.	Gorman et al., 2020

MDMA	75 to 125 mg, oral, 2 or 3 administrations (one every 2 to 3 weeks)	107, 40 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (89.7%)	PTSD	Blinded study segment, open-label cross-over, long-term follow-up	Yes	↓	At least 12 months post-treatment	n.d.	Jerome et al., 2020
MDMA	125 mg, oral, two administrations (one every 2 to 4 weeks)	18, 55 ± 8 (mean ± SD), ♂♀	Mostly White or Caucasian (60%)	Psychiatric medical history diagnosis of anxiety, major depression, PTSD, or/and insomnia	R, D-B, P-C	Yes	↓	At least 12 months post-treatment	n.d.	Wolfson et al., 2020
MDMA	75 to 187.5 mg, oral, three	13, 40.3 (mean), 1	One Afro-Brazilian	PTSD	Open-label	Yes	↓	At least 2 months	n.d.	Jardim et al., 2021

	administrations (one per month)	♂ and 2 ♀	and two Caucasian					post-treatment		
MDMA	80 to 180 mg, oral, three administrations (one every 4 weeks)	90, 41 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian (76.7%)	Severe PTSD	R, D-B, P-C	Yes	↓	At least 18 weeks post-treatment	n.d.	Mitchell et al., 2021
MDMA	75 to 187.5 mg, oral, 2 or 3 administrations (one every 3 to 5 weeks)	63, 41 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (85.7%)	PTSD	R, D-B, P-C	Yes	↓	At least 2 months post-treatment	n.d.	Ponte et al., 2021
MDMA	80 to 240 mg, oral, three administrations (one every 4 weeks)	89, 41 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian (78.16%)	PTSD	R, D-B, P-C pivotal trial	Yes	↓	n.d.	n.d.	Brewerton et al., 2022
MDMA	80 to 190 mg, oral, three administrations (interval n.d.)	127, 37.9 (mean), ♂♀	Mostly White or Caucasian (81.9%)	PTSD	Two Phase 2 open-label	n.d.	↓	n.d.	No	Ching et al., 2022

					trials and a Phase 3 R, blinded P-C trial					
MDMA	120 to 180 mg, oral, three administrations (one every 3 to 4 weeks)	82, 41 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian (80.25%)	PTSD plus SUD	R, three-blind, P-C	Yes	↓	At least 6 months post-treatment	n.d.	Nicholas et al., 2022
MDMA	120 to 180 mg, oral, three administrations (one per month)	104, 38 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (69.8%)	Moderate-to-severe PTSD	R, D-B, P-C	Yes	↓	At least 18 weeks post-treatment	No	Mitchell et al., 2023
MDMA	30, 75, or 125 mg, oral, two administrations	9, 41 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (89%)	PTSD	R, D-B	Yes	↓	At least 2 months post-treatment	n.d.	Singleton et al., 2023
MDMA	120 to 180 mg, oral, thr administrations	90, 41 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian	PTSD	R, D-B, P-C, multi-site	Yes	↓	At least 2 months post-	n.d.	van der Kolk et al., 2024

	(one every 4 weeks)		(80.3%)					treatment		
Anxiety disorders										
Psilocybin	0.2 mg/kg, oral, single administration	8, 36-58, ♂♀	n.d.	Advanced-stage cancer and anxiety	R, D-B, P-C	Yes	↓	At least 3 to 6 months post-treatment	No	Grob et al., 2011
LSD	20 or 200 µg, oral, two administrations (one every 2 to 3 weeks)	11, 52 ± 9 (mean ± SD), ♂♀	n.d.	Anxiety associated with life-threatening diseases	R, D-B, active P-C	Yes	↓	At least 12 months post-treatment	No	Gasser et al., 2014
LSD	20 or 200 µg, oral, two administrations (one every 4 to 6 weeks)	10, 51.1 (mean), ♂♀	n.d.	Anxiety associated with life-threatening	R, D-B, active P-C study followed by cross-over study	Yes	↓	At least 12 months post-treatment	No	Gasser et al., 2015
Psilocybin	1 or 3 mg/70 kg (1st session) and	51, 56 ± 1 (mean ±	Mostly White or	Cancer-related	R, D-B, cross-	Yes	↓	At least 6 months	No	Griffiths et al., 2016

	22 or 30 mg/70 kg (2nd session), oral, five weeks apart	SEM), ♂♀	Caucasian (94%)	anxiety and depression	over			post-treatment		
Psilocybin	0.3 mg/kg, oral, single administration	29, 56 ± 13 (mean ± SD), ♂♀	Mostly White or Caucasian (90%)	Cancer-related anxiety and depression	R, D-B, P-C, cross-over	Yes		At least 6 months post-treatment	No	Ross et al., 2016
MDMA	15, 100, or 125 mg, oral, two admin. (one per month)	12, 31 ± 9 (mean ± SD), ♂♀	Mostly White or Caucasian (50%)	Autism with social anxiety	R, D-B, P-C	Yes	↔ (15 mg) ↓ (100 or 125 mg)	At least 6 months post-treatment	No	Danforth et al., 2018
Ayahuasca	2 ml/kg, oral, single administration	17, 25 (mean) years, ♂♀	n.d.	SAD	R, D-B, P-C, parallel-group	No	↓	n.d.	n.d.	dos Santos et al., 2021
LSD	200 µg, oral, two admin. (one every 6 weeks)	42, 45 12 (mean ± SD), ♂♀	n.d.	Anxiety with and without a life-	R, D-B, P-C, cross-over	Yes	↓	At least 16 weeks post-treatment	Acute transient anxiety (2%)	Holze et al., 2023

				threatening illness						
Eating disorders										
Psilocybin	25 mg, oral, single administration	10, 28 ± 4 (mean ± SD), ♀	Mostly White or Caucasian (90%)	Anorexia nervosa	Open-label	Yes	↓	At least 3 months post-treatment	No	Peck et al., 2023
Psilocybin	25 mg, oral, single administration	12, 34 ± 9 (mean ± SD), ♂♀	Mostly White or Caucasian (75%)	Moderate-to-severe non-delusional body dysmorphic disorder unresponsive to serotonin reuptake inhibitor(s)	Open-label	Yes	↓	At least 12 weeks post-treatment	No	Schneier et al., 2023
Substance use disorders										
Psilocybin	20 or	15, 51 ±	Mostly	Nicotine	Open-	Yes	↓	n.d.	No	Johnson et

	30 mg/70 kg, oral, two administrations (one every 2 weeks)	10 (mean ± SD), ♂♀	White or Caucasian (93%)	dependent smokers	label					al., 2014
Psilocybin	0.3 or 0.4 mg/kg, oral, two administrations (one every 8 weeks)	10, 40 ± 10 (mean ± SD), ♂♀	Native American/ Alaska Native (n = 2), African American (n = 1), Hispanic (n = 4), and White non-Hispanic (n = 3)	Ethanol dependence	Open-label	Yes	↓	At least 36 weeks post-treatment	No	Bogenschutz et al., 2015
Psilocybin	20 or 30 mg/70 kg, oral, two administrations	15, 51 (mean), ♂♀	Mostly White or Caucasian (93%)	Nicotine-dependent smokers	Open-label	Yes	↓	At least 16 months post-treatment	No	Johnson et al., 2017

	(one every 2 weeks)									
Psilocybin	25 mg/70 kg (1st session) and 25 to 40 mg/70 kg (2nd session), oral, four weeks apart	96, 46 ± 12 (mean ± SD), ♂♀	Mostly White or Caucasian (79%)	Ethanol dependence	R, D-B, controlled trial	Yes	↓	At least 36 weeks post-treatment	No	Bogenschutz et al., 2022
Psilocybin	25 mg/70 kg, oral, single administration	11, 49 ± 11 (mean ± SD), ♂♀	Mostly White or Caucasian (72%)	AUD	R, D-B, P-C	Yes	n.d.	n.d.	n.d.	Pagni et al., 2024

Legend: ↔ = relatively no changes; ↓ = reduction; ♂ = men; ♀ = women; AUD = alcohol use disorder; D-B = double-blind; i.v. = intravenous route; MDD = major depressive disorder; MDMA = 3,4-Methylenedioxymethamphetamine; n.d. = not described; DMT = *N*,*N*-dimethyltryptamine; P-C = placebo-controlled; PTSD = post-traumatic stress disorder; R = randomized; SAD = social anxiety disorder; SD = standard deviation; SEM = standard error of mean; SUD = substance use disorder; TR-MDD = treatment-resistant major depressive disorder.

4. MENTAL HEALTH ISSUES IN ATHLETES

studies indicate that the prevalence of psychiatric disorders in high-performance athletes (both amateur and professional) may be similar or even higher than in the general population, which likely arises from intense physical and emotional stressors often experienced (Gouttebarge et al., 2019; Reardon et al., 2019; Glick et al., 2020; Marí-Sanchis et al., 2022; McDonald et al., 2023; Smith et al., 2023; Thuany et al., 2023; Beable et al., 2024). Among them are the high demand for physical and sports performance, overtraining, interpersonal conflicts in competitions, the imbalance between personal life and training, injuries, and early retirement (Chang et al., 2020). Furthermore, due to self-pressure to demonstrate mental resilience, athletes may not report their health concerns, accept professional assistance, or adhere to treatment. Additionally, athletes may often avoid pharmacological treatment due to concerns about doping, potential adverse reactions, and the effects of medication on athletic performance (Reardon, 2016; Bomim, 2020). As a result, a cycle of untreated suffering can develop, compromising both mental health and physical aspects. Early identification of these factors and appropriate clinical intervention are essential to ensure performance and longevity in sports practice as well as the psychological well-being of athletes (Glick et al., 2012; Chang et al., 2020). Consequently, there is growing interest in sports research to assess the mental health of athletes such as long-distance runners, cyclists, swimmers, triathletes, and others (Berger et al., 2024).

Drugs currently available for the management of psychiatric disorders in athletes present significant limitations (Morris, 2015; Reardon & Creado, 2016; Tso & Pelliccia, 2022). Antidepressants and anxiolytics currently approved for clinical use are administered daily and can cause side effects that negatively affect athletic performance, such as drowsiness, changes in appetite, and weight gain (Reardon, 2016; Reardon & Creado, 2016; Edwards, 2024). In addition, individual variability in response to these medications can hinder treatment effectiveness. For example, while approximately 15% of participants in clinical trials experience a significant antidepressant effect beyond that of a placebo (Stone et al., 2022), around 30% of individuals diagnosed with major depressive disorder are resistant to conventional treatment, further increasing the social and economic burden of this condition (McIntyre et al., 2023). In this scenario, psychedelic therapy could emerge as either a complementary or an alternative for the treatment of psychiatric disorders in athletes.

5. PSYCHEDELICS TO MAINTAIN AND IMPROVE MENTAL HEALTH IN ATHLETES

Several clinical studies have demonstrated the efficacy of psychedelic-assisted psychotherapy (**Table 1**; Nichols, 2016; Reiff et al., 2020; Nutt & Carhart-Harris, 2021; Cavarra et al., 2022; Knudsen et al., 2023). Following approval by the Therapeutic Goods Administration in 2023, Australia became the first country to authorize and regulate the medicinal use of psilocybin and MDMA for the treatment of depression and PTSD, respectively (Nutt et al., 2024). Similarly, Oregon and Colorado became the first American states to legalize psilocybin, issuing official licenses to specialized mental health care service centers for use (Korthuis et al., 2024).

To date, the potential of psychedelics to enhance mental health or treat psychiatric disorders in athletes remains unknown. However, considering the evidence from the general population (**Table 1**), several aspects of psychedelic therapy may be beneficial for these individuals (Carhart-Harris & Goodwin, 2017; Barber & Aaronson, 2022; Holze et al., 2024). In healthy athletes, the administration of psychedelics may offer benefits in promoting mental health and well-being, aiding in the management of psychological and emotional challenges. By enhancing resilience and emotional flexibility, psychedelic therapy could mitigate the effects of everyday stressors in high-performance sports, including intensive training routines, self-imposed demands for physical performance, and sustained competitiveness. Moreover, in athletes diagnosed with psychiatric disorders, psychedelic-assisted psychotherapy could offer some advantages over conventional treatments. Unlike daily medications, only a few sessions spaced over days to weeks are typically sufficient to promote long-term mental health benefits that are maintained over several months (Yao et al., 2024). Furthermore, the half-life of these substances lasts only a few hours, not producing withdrawal symptoms. Although psychedelic therapy may result in adverse reactions, they are transient and manifest mainly in the following hours after administration. Thus, potential concerns associated with impaired sports performance can be reduced, even if athletes are in training or competition periods (Reardon & Creado, 2016; Edwards, 2024). Yousefi et al. (2025) have meta-analyzed psilocybin's acute effects on executive functions and attention. Psilocybin increased reaction times dose-dependently without significantly affecting accuracy, suggesting an impairment in executive function that may be relevant to specific sports. However, its impact on performance is potentially less concerning, as athletes are not expected to compete while under the influence of psychedelics.

Several psychedelic substances produce prosocial effects in rodent and human studies (Dumont et al., 2009; Hysek et al., 2014; Kamilar-Britt & Bedi, 2015; Griffiths et al., 2018; De Gregorio et al., 2021; Bhatt & Weissman, 2024). While systematic research on psychedelics in sports is limited, their potential prospective effects may include improved social dynamics during training or competition, team cohesion, reduced anxiety, enhanced resilience among athletes, and sports-related mild traumatic brain injury (e.g., concussion) (VanderZwaag et al., 2024). However, the use of psychedelics in sports raises potential issues. Serotonergic psychedelics and related compounds produce varying effects in tests of negative social interactions, often assessing aggression, in rodents through their action on 5-HT_{2A} and 5-HT_{1A} receptors (Odland et al., 2022). Future studies must establish optimal dosages, contexts, and protocols that maximize potential benefits while minimizing risks.

Scientific evidence on the interactions between psychedelic substances and antidepressants, antipsychotics, anxiolytics, and mood stabilizers, remains limited. However, it has been reported that psychedelics and certain psychiatric medications may share overlapping pharmacological targets, molecular pathways interactions, and hepatic metabolism via similar enzymes (Sarparast et al., 2023; Rhee et al., 2023; Halman et al., 2024). Consequently, drug interactions between psychedelic substances and medications already used by athletes should be considered, as they may potentiate or attenuate the actions of both substances. Therefore, adequate clinical monitoring will be essential to mitigate the risks of adverse reactions, toxicity, or inadequate management of psychiatric symptoms.

6. EFFECTS OF PSYCHEDELICS ON PHYSICAL AND PHYSIOLOGICAL PARAMETERS

Administration of the psychedelic substance DOI has been shown to reduce circulating levels of total cholesterol and low-density lipoprotein (**LDL**) in a high-fat diet-fed apolipoprotein E knockout mice model without affecting food intake or body weight. DOI administration was also associated with a reduction in the increased serum levels of the pro-inflammatory cytokine CXCL10 induced by high-fat diet-fed and reduced expression of pro-inflammatory marker genes in the aortic arch (Flanagan et al., 2019a). On the other hand, preclinical studies have shown potentially conflicting results of the psilocybin administration on metabolic parameters and body weight regulation. Although the administration of a high dose of psilocybin was associated with a modest but significant reduction in body weight, decreased consumption of the high-calorie diet, and decreased central adiposity in a rodent model of obesity (Huang et al., 2022), neither a single nor repeated administration of

psilocybin had significant metabolic effects. It did not lower body weight or food intake in diet-induced obese mice or genetic mouse models of obesity (Fadahunsi et al., 2022). Moreover, increased creatine kinase, aspartate aminotransferase, and chloride have been reported in male and female mice treated with psilocybin (Shakir et al., 2024). Preclinical studies have shown that MDMA treatment may increase serum levels of total and LDL cholesterol, corticosterone, aspartate transaminase, alanine transaminase, or glucose in rodents (Graham et al., 2010; Shahraki & Irani, 2014; Golchoobian et al., 2017), although hypoglycemia has also been reported (Soto-Montenegro et al., 2007; Golchoobian et al., 2017).

In addition to regulating body weight, lipid metabolism is also essential for cellular mechanisms related to inflammation and nociception/pain, and the anti-inflammatory and immunomodulatory properties of psychedelics have also been reported (Flanagan & Nichols, 2022). Lipid mediators, including arachidonic acid (AA) can be metabolized by cyclooxygenase (COX), lipoxygenase (LOX), and cytochrome P450 (CYP450) enzymes and converted to pro-inflammatory metabolites such as prostaglandins (PG), thromboxane (Tx), leukotrienes (LTs), and hydroxyeicosatetraenoic acids (HETEs). In rodents, the psychedelic bufotenine has been shown to induce an anti-nociceptive effect and promote the downregulation of inflammatory mediators from COX, LOX, CYP450, linoleic acid (LA), docosahexaenoic acid (DHA), and other pro-inflammatory pathways (Wang et al., 2021a; Shen et al., 2022). Askey et al. (2024) have reviewed the psilocybin potential as an anti-nociceptive agent, focusing on preclinical animal models and exploring serotonergic mechanisms and neuroplastic actions that improve functional connectivity in brain regions involved in chronic pain. They also discuss its broader effects on pain and associated emotional and inflammatory components. The review by Strand et al. (2025) has examined psilocybin, LSD, and ketamine as potential treatments for chronic pain. It focuses on their pharmacology, effects on neuropathic pain, clinical implications, safety profiles, and patient responses.

Preclinical and clinical data also indicate that psychedelics increase the release of anti-inflammatory interleukins (e.g., IL-10) and reduce the expression and activity of other pro-inflammatory markers, including IL-6, IL-1β, tumor necrosis factor-alpha (**TNF-α**), and nuclear factor kappa B (**NF-kB**). Thus, administration of these substances may attenuate the activation of genes and downstream signaling pathways that contribute to inflammation (dos Santos, 2014; Boxler et al., 2018; Flanagan & Nichols, 2022; Mason et al., 2023; Low et al., 2025). DOI can inhibit TNF-α-induced inflammation by mitigating the expression of genes

encoding intracellular adhesion molecule-1 (ICAM-1), vascular cell adhesion molecule-1 (VCAM-1), and IL-6 through serotonin 5-HT_{2A} receptor activation in both *in vitro* and *in vivo* (Yu et al., 2008; Nau et al., 2013). Furthermore, DOI administration blocked the activation and translocation of NF-kB and decreased nitric oxide synthase activity (Yu et al., 2008).

In vitro studies have demonstrated that psilocybin-containing mushroom extracts inhibited lipopolysaccharide (**LPS**)-induced increases in TNF-α and IL-1β, besides decreasing COX-2 concentrations in treated human U937 macrophage cells (Nkadimeng et al., 2021; Laabi et al., 2024). In healthy volunteers, a single dose of psilocybin reduced plasma levels of TNF-α immediately after administration, and IL-6 and C-reactive protein were reduced in the psilocybin group seven days later. The persisting reductions in pro-inflammatory markers correlated with clinical improvement of mood and sociability (Mason et al., 2023).

Possible opposite effects have been reported regarding MDMA. Acute administration of MDMA appears to promote an anti-inflammatory effect. It impairs the secretion of IL-1β and TNF-α induced by LPS administration in rodents (Connor et al., 2000), besides suppressing innate IFN-γ production by increasing IL-10 levels (Boyle & Connor, 2007). On the other hand, in human plasma samples collected at different time points after a single oral administration of MDMA, an increase in cortisol and lipidic mediators of inflammation was observed, suggesting stimulation of inflammatory pathways (Boxler et al., 2018).

Immunomodulatory effects of psychedelic substances and other chemical compounds derived from ayahuasca have also been reported (dos Santos, 2014; Galvão-Coelho et al., 2020). Harmine has been proposed to exert anti-inflammatory and antioxidant effects through several mechanisms, such as AMPK/Nrf2 pathway activation, reduced caspase-3 expression by repressing the Bax/Bcl2 ratio, inhibition of the c-Jun N-terminal kinase (**JNK**), down-regulation of LC3B II/I, p38 MAPK, TLR4, and NF-κB levels. Furthermore, it appears to increase the expression of p62, Bcl-2, Beclin1, ULK1, and p-mTOR (Hamsa & Kuttan, 2010; Liu et al., 2017a; Niu et al., 2019; Ma et al., 2024; Tabaa et al., 2024). Harmine also attenuated bone destruction induced by an inflammatory response. It shifted the polarization of macrophages from M1 to M2 phenotypes both *in vitro* and *in vivo* in a murine model (Wang et al., 2021b). A three-day ayahuasca treatment prevented anxiety and oxidative stress induced by an inflammatory insult in rats. Additionally, it increased cortical levels of the anti-inflammatory cytokine IL-4 and BDNF (de Camargo et al., 2024).

Although the precise molecular mechanisms related to the effects of psychedelics on immunity and inflammatory responses remain to be elucidated, the involvement of 5-HT_{2A} receptor activation has been proposed. 5-HT_{2A} receptor is widely distributed in tissues and cells regulating innate and adaptive immune responses, such as the spleen, thymus, circulating lymphocytes, T cells, eosinophils, and mononuclear cells (Herr et al., 2017; Thompson & Szabo, 2020). While the 5-HT_{2A} receptor activation by 5-HT primarily contributes to inflammation, psychedelics appear to recruit anti-inflammatory intracellular signaling pathways through activation of the same receptor, possibly by stabilizing it in a slightly different structural and functional conformation, i.e., biased agonism (Raote et al., 2007; Shan et al., 2012; Flanagan et al., 2024). The anti-inflammatory effects of psychedelics resulting from the activation of the 5-HT_{2A} receptor have also been associated with improved respiratory and neurological function, demonstrating benefits in animal models of asthma (Stankevicius et al., 2012; Nau et al., 2015; Flanagan et al., 2019b; Flanagan et al., 2020) and attenuating the functional consequences of neuroinflammation (Zhong et al., 2015; Liu et al., 2017b; Sun et al., 2019; Nardai et al., 2020; Xin et al., 2021; Goulart da Silva et al., 2022; Zanikov et al., 2023; Zheng et al., 2023; Floris et al., 2024).

A significant knowledge gap in psychedelic research, particularly regarding their potential use in athletes, is the lack of studies evaluating their effects on physical health and metabolic parameters. Based on the evidence outlined above and its potential translational implications, treating athletes with psychedelic substances may offer benefits. The improved mental well-being and emotional control associated with psychedelic therapy could contribute to performance by making them more focused and resilient. At the same time, these substances' anti-inflammatory and analgesic effects could mitigate physical stress, reduce muscle fatigue, and facilitate recovery after prolonged or intense exercise. By reducing inflammation, psychedelics could also improve mental health and reduce symptoms in individuals with psychiatric disorders such as depression or anxiety, as convergent evidence points to an increase in inflammatory markers in these clinical conditions and the significant role of inflammation in their pathophysiology (Bauer & Teixeira, 2019; Beurel et al., 2020; Zeng et al., 2024). Since research on the use of psychedelic substances in sports contexts is incipient (**Figure 1**), far more studies are needed before potentially establishing guidelines on their safe and effective use.

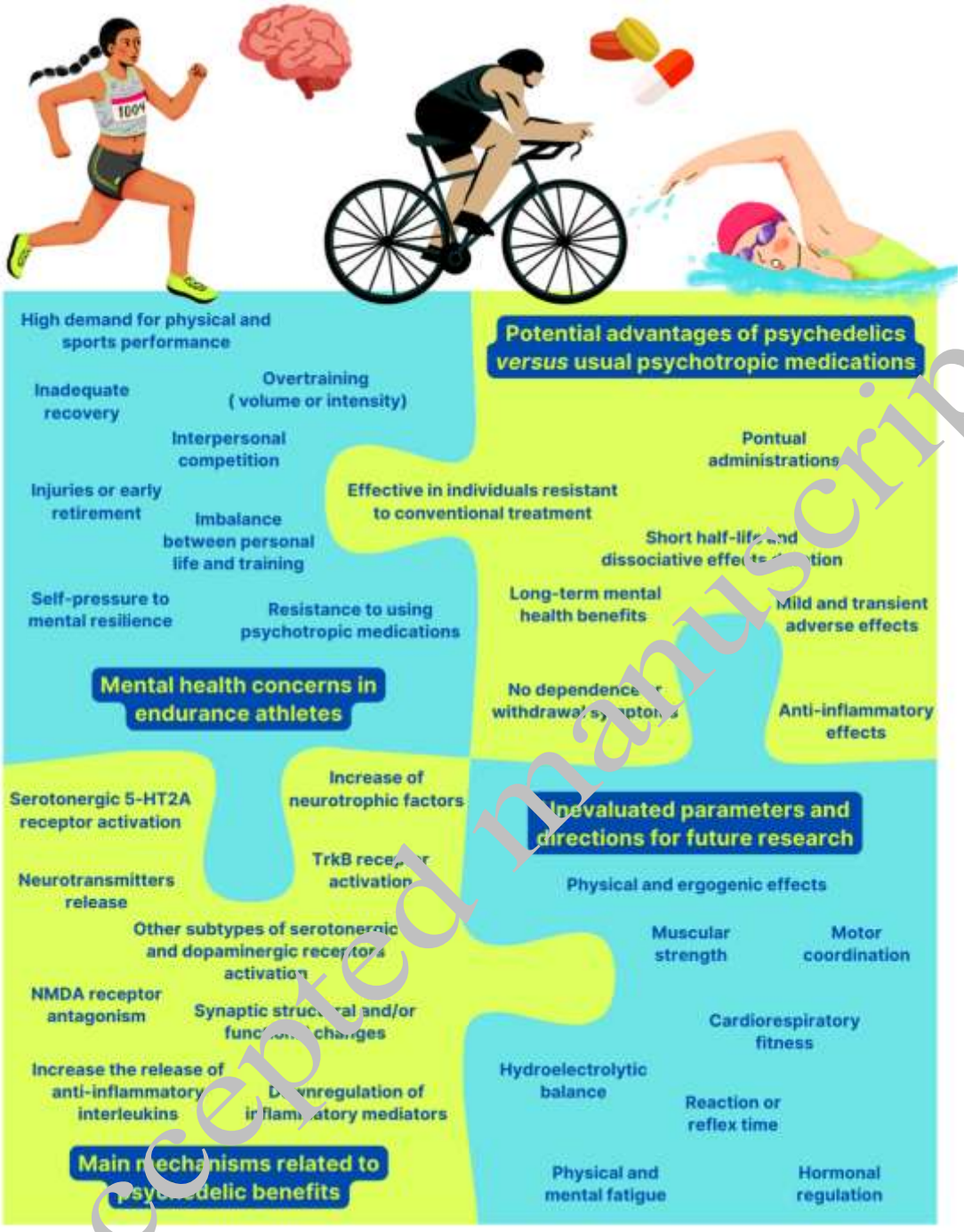


Figure 1. An overview of the current landscape of psychedelics and athletic performance.

7. PSYCHEDELICS IN SPORTS COMPETITIONS: LEGAL AND REGULATORY CONSIDERATIONS

Psychedelic substances have been classified as prohibited or controlled substances in most countries, posing challenges for establishing potential guidelines that ensure treatment efficacy and safety under appropriate regulatory oversight. In sports competitions, the World Anti-Doping Agency (**WADA**; https://www.wada-ama.org/en/prohibited-list) does not list psychedelics as "prohibited substances", except for MDMA, which is classified as a stimulant amphetamine.

For a substance or method to be included in WADA's Prohibited Substances List under the World Anti-Doping Code, it must meet at least two of the following three criteria: (1) it enhances or has the potential to enhance sports performance, (2) it poses an actual or potential risk to athlete health, and (3) it violates the spirit of sport as defined in the Code (https://www.wada-ama.org/en/resources/world-anti-doping-code-and-international-standards/world-anti-doping-code). To date, no clinical evidence has suggested that psychedelics act as ergogenic aids. WADA regularly updates its prohibited and restricted substances list based on evolving scientific evidence. For example, while cannabis/Δ^9-tetrahydrocannabinol (**THC**) remains prohibited in competition due to its potential to impair the performance, pose safety risks, and violate the "spirit of sport", cannabidiol (**CBD**) has been permitted, as it lacks these properties. As research on psychedelics progresses, the regulatory status of specific compounds in sports may be reevaluated, potentially leading to updates similar to the removal of CBD from the prohibited list.

8. CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Several clinical studies have highlighted the mental health benefits of psychedelics and their potential role as therapeutic adjuncts to improve the quality of life, but significant considerations remain. A critical knowledge gap in evaluating these substances' effects on physical health in humans persists. Similarly, the impact of psychedelics on physiological responses relevant to athletic performance, such as muscular strength, motor coordination, locomotion, endurance, cardiorespiratory capacity, fluid and electrolyte balance, hormonal regulation, fatigue, and reflexes, remains largely unexplored scientifically. Moreover, it is worth noting the ethical and legal concerns associated with performance-enhancing substances and the importance of distinguishing between the use of psychedelics within and outside the acute performance/sports context.

Rodent research can provide a valuable foundation for understanding the potential effects of psychedelic therapy on physical performance in humans (**Figure 2**). The rotarod test has been used to assess motor coordination and balance in rodents. The gait analysis test provides a detailed assessment of movement patterns and gait symmetry, which is crucial for identifying motor coordination changes (Carter et al., 2001; Deacon, 2013). Muscular strength is typically evaluated through the grip strength test, which measures the animal's grip force by stimulating traction of the forelimbs or hind limbs (Munier et al., 2022). It provides a direct measure of muscle strength, relevant for assessing whether psychedelics could influence aspects of muscular endurance in humans, an essential factor in the performance of athletes. The treadmill running test (Dougherty et al., 2016; Castro & Kuang, 2017) is a tool for exploring the effects of psychedelic substances on endurance and cardiorespiratory capacity. Rodents are encouraged to run on a treadmill, allowing for analysis of aerobic capacity, fatigue, and prolonged exercise tolerance. These data help understand the potential of psychedelics to enhance aerobic performance and to observe possible indirect cardiorespiratory impacts from their administration. Stress resilience is also essential for high-performance athletes, and the forced swim test is a tool for assessing stress-coping strategy in rodents (Commons et al., 2017; Slattery & Cryan, 2012). In this test, the duration of immobility in a forced swim scenario reflects the animal's ability to persist under adverse conditions. Several psychedelics have been shown to decrease immobility and increase active behaviors, including swimming and climbing (Cameron et al., 2018; Hibicke et al., 2020; Odland et al., 2021; Rakoczy et al., 2024). Metabolic parameters and overall physical condition can be monitored through assessments such as food and water intake (to evaluate impacts on basal metabolism and caloric needs) and body condition scoring, which provides a qualitative assessment of the animal's overall physical state by monitoring body composition and body mass index.

Overall, these methods could provide preclinical evidence to elucidate the influence of psychedelics on motor, metabolic, and cardiorespiratory functions, as well as their impact on stress resilience. This knowledge could inform the design of safer and more effective clinical protocols to explore the potential benefits of psychedelics as adjunctive therapies in enhancing the mental health and physical performance of athletes and non-athletes. Such studies could also illuminate the underlying mechanisms of action, identify potential effects on organs and tissues beyond the central nervous system, and investigate potential sex differences or genetic and metabolic influences (Rakoczy et al., 2024; Werle & Bertoglio, 2024).

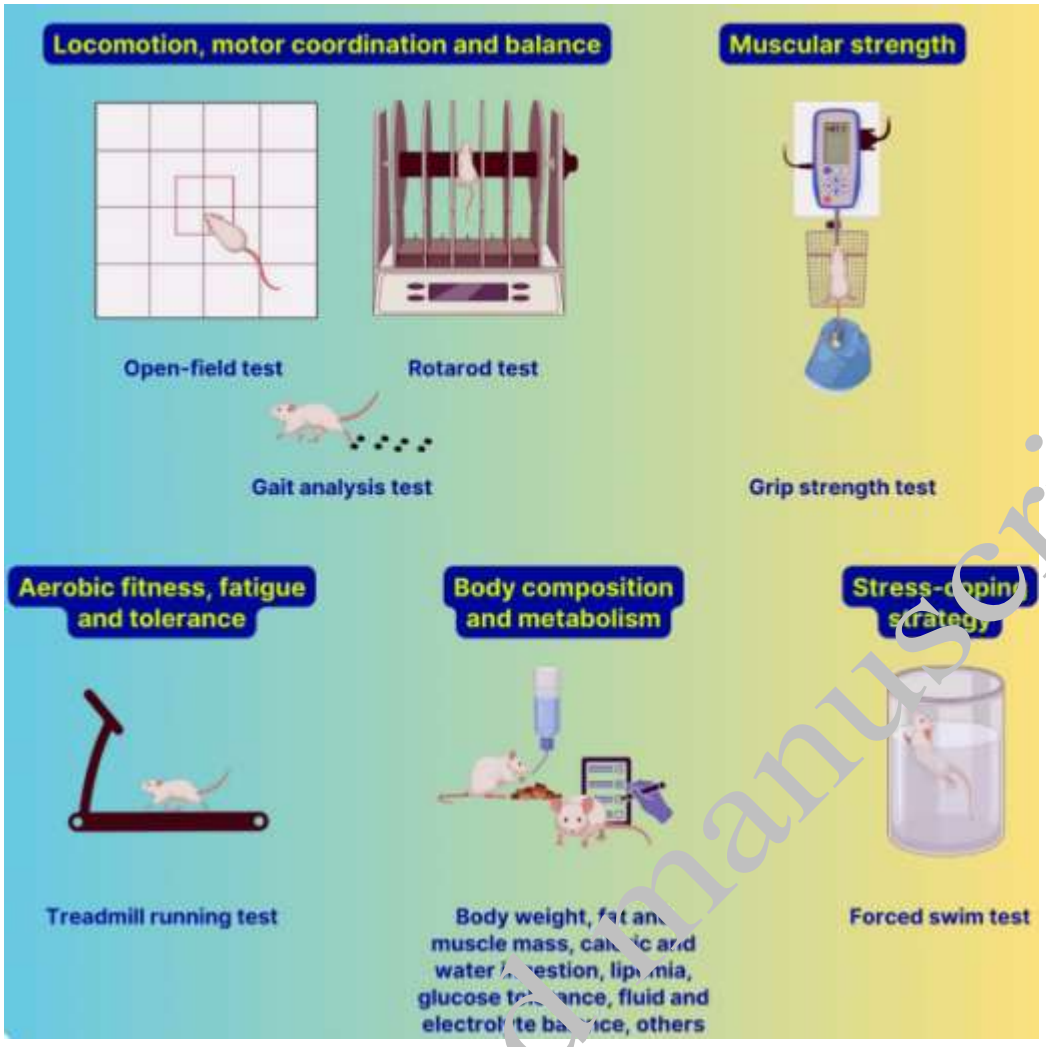


Figure 2. Helpful behavioral and physiological responses in rodents for inferring the physical effects of psychedelic drugs in humans.

9. ACKNOWLEDGMENTS AND FUNDING STATEMENT

We thank the Brazilian Federal Government for free access to scientific articles through the Periodicals Portal of the Coordination for the Improvement of Higher Education Personnel (CAPES). Figures were created with BioRender.com.

This study was supported by grants from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq; 304851/2022-1; 140296/2023-9) and Fundação de Amparo à Pesquisa e Inovação do Estado Santa Catarina (FAPESC; 20/2024), which did not influence the review, collection and interpretation of data or the decision to submit the article for publication.

10. AUTHOR CONTRIBUTIONS

- M.A.M.P.: conception, methodology, data collection, writing, and editing of the text;
- I.W.: data collection, writing, and editing of the text;
- L.J.B.: conception, administration, project supervision, writing, and editing.

11. DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflicts of interest.

12. Declaration of Generative AI and AI-assisted technologies in the writing process

In preparing this work, we leveraged ChatGPT and Grammarly, artificial intelligence-powered language technologies, to enhance readability, language, and style. We subsequently reviewed and edited the content for clarity and accuracy, and we take full responsibility for the final publication.

13. REFERENCES

Aaronson ST, van der Vaart A, Miller T, LaPratt J, Swartz K, Shoultz A, Lauterbach M, Sackeim HA, Suppes T (2024) Single-Dose Synthetic Psilocybin With Psychotherapy for Treatment-Resistant Bipolar Type II Major Depressive Episodes: A Nonrandomized Open-Label Trial. *JAMA Psychiatry* **81**(6):555-562. https://doi.org/10.1001/jamapsychiatry.2023.4685

Allen N, Jeremiah A, Murphy R, Sumner R, Forsyth A, Hoeh N, Menkes DB, Evans W, Muthukumaraswamy S, Sundram F, Roop P (2024) LSD increases sleep duration the night after microdosing. *Translational Psychiatry* **14**(1):191. https://doi.org/10.1038/s41398-024-02900-4

Arruda Sanchez T, Ramos LR, Araujo F, Schenberg EE, Yonamine M, Lobo I, de Araujo DB, Luna LE (2024) Emotion regulation effects of Ayahuasca in experienced subjects during implicit aversive stimulation: An fMRI study. *Journal of Ethnopharmacology* **320**:117430. https://doi.org/10.1016/j.jep.2023.117430

Askey T, Lasrado R, Maiarú M, Stephens GJ (2024) Psilocybin as a novel treatment for chronic pain. *British Journal of Pharmacology*. https://doi.org/10.1111/bph.17420

Atila C, Straumann I, Vizeli P, Beck J, Monnerat S, Holze F, Liechti ME, Christ-Crain M (2024) Oxytocin and the Role of Fluid Restriction in MDMA-Induced Hyponatremia: A Secondary Analysis of 4 Randomized Clinical Trials. *JAMA Network Open* **7**(11):e2445278. https://doi.org/10.1001/jamanetworkopen.2024.45278

Bacqué-Cazenave J, Bharatiya R, Barrière G, Delbecque JP, Bouguiyoud N, Di Giovanni G, Cattaert D, De Deurwaerdère P (2020) Serotonin in Animal Cognition and Behavior. *International Journal of Molecular Sciences* **21**(5):1649. https://doi.org/10.3390/ijms21051649

Barber GS, Aaronson ST (2022) The Emerging Field of Psychedelic Psychotherapy. *Current Psychiatry Reports* **24**(10):583-590. https://doi.org/10.1007/s11920-022-01363-y

Barrett FS, Doss MK, Sepeda ND, Pekar JJ, Griffiths RR (2020) Emotions and brain function are altered up to one month after a single high dose of psilocybin. *Scientific Reports* **10**(1):2214. https://doi.org/10.1038/s41598-020-59282-y

Bauer ME, Teixeira AL (2019) Inflammation in psychiatric disorders: what comes first? *Annals of the New York Academy of Sciences* **1437**(1):57-67. https://doi.org/10.1111/nyas.13712

Beable SE (2024) Depressive Disorders in Athletes. *Clinical Journal of Sport Medicine* **43**(1):53-70. https://doi.org/10.1016/j.csm.2023.06.011

Berger NJA, Best R, Best AW, Lane AM, Millet GY, Barwood M, Marcora S, Wilson P, Bearden S (2024) Limits of Ultra: Towards an Interdisciplinary Understanding of Ultra-Endurance Running Performance. *Sports Medicine* **54**(1):73-93. https://doi.org/10.1007/s40279-023-01936-8

Beurel E, Toups M, Nemeroff CB (2020) The Bidirectional Relationship of Depression and Inflammation: Double Trouble. *Neuron* **107**(2):234-256. https://doi.org/10.1016/j.neuron.2020.06.002

Bhatt KV, Weissman CR (2024) The effect of psilocybin on empathy and prosocial behavior: a proposed mechanism for enduring antidepressant effects. *Mental Health Research* **3**(1):7. https://doi.org/10.1038/s44184-023-00053-8

Bogenschutz MP, Forcehimes AA, Pommy JA, Wilcox CE, Barbosa PC, Strassman RJ (2015) Psilocybin-assisted treatment for alcohol dependence: a proof-of-concept study. *Journal of Psychopharmacology* **29**(3):289-99. https://doi.org/10.1177/0269881114565144

Bogenschutz MP, Ross S, Bhatt S, Baron T, Forcehimes AA, Laska E, Mennenga SE, O'Donnell K, Owens LT, Podrebarac S, Rotrosen J, Tonigan JS, Worth L (2022) Percentage of Heavy Drinking Days Following Psilocybin-Assisted Psychotherapy vs Placebo in the Treatment of Adult Patients With Alcohol Use Disorder: A Randomized Clinical Trial. *JAMA Psychiatry* **79**(10):953-962. https://doi.org/10.1001/jamapsychiatry.2022.2096

Bomfim JHGG (2020) Pharmaceutical Care in Sports. *Pharmacy (Basel)* **8**(4):218. https://doi.org/10.3390/pharmacy8040218

Boxler MI, Streun GL, Lieberherr M, Schmid Y, Kraemer T, Steuer AE (2018) Human Metabolome Changes after a Single Dose of 3,4-Methylenedioxymethamphetamine (MDMA) with Special Focus on Steroid Metabolism and Inflammation Processes. *Journal of Proteome Research* **17**(8):2900-2907. https://doi.org/10.1021/acs.jproteome.8b00438

Boyle NT, Connor TJ (2007) MDMA ("Ecstasy") suppresses the innate IFN-gamma response in vivo: a critical role for the anti-inflammatory cytokine IL-10. *European Journal of Pharmacology* **572**(2-3):228-38. https://doi.org/10.1016/j.ejphar.2007.07.020

Breeksema JJ, Niemeijer A, Krediet E, Karsten T, Kamphuis J, Vermetten E, van den Brink W, Schoevers R (2024) Patient perspectives and experiences with psilocybin treatment for treatment-resistant depression: a qualitative study. *Scientific Reports* **14**(1):2929. https://doi.org/10.1038/s41598-024-53188-9

Brewerton TD, Wang JB, Lafrance A, Pamplin C, Mithoefer M, Yazar-Klosinki B, Emerson A, Doblin R (2022) MDMA-assisted therapy significantly reduces eating disorder symptoms in a randomized placebo-controlled trial of adults with severe PTSD. *Journal of Psychiatric Research* **149**:128-135. https://doi.org/10.1016/j.jpsychires.2022.03.008

Calder AE, Hasler G (2023) Towards an understanding of psychedelic-induced neuroplasticity. *Neuropsychopharmacology* **48**(1):104-112. https://doi.org/10.1038/s41386-022-01389-z

Cameron LP, Benetatos J, Lewis V, Bonniwell EM, Jaster AM, Moliner R, Castrén E, McCorvy JD, Palner M, Aguilar-Valles A (2023) Beyond the 5-HT_{2A} Receptor: Classic and Nonclassic Targets in Psychedelic Drug Action. *Journal of Neuroscience* **43**(45):7472-7482. https://doi.org/10.1523/JNEUROSCI.1384-23.2023

Cameron LP, Benson CJ, Dunlap LE, Olson DE (2018) Effects of N, N-Dimethyltryptamine on Rat Behaviors Relevant to Anxiety and Depression. *ACS Chemical Neuroscience* **9**(7):1582-1590. https://doi.org/10.1021/acschemneuro.8b00134

Carhart-Harris R, Giribaldi B, Watts R, Baker-Jones M, Murphy-Beiner A, Murphy R, Martell J, Blemings A, Erritzoe D, Nutt DJ (2021) Trial of Psilocybin versus Escitalopram for Depression. *New England Journal of Medicine* **384**(15):1402-1411. https://doi.org/10.1056/NEJMoa2032994

Carhart-Harris RL, Bolstridge M, Day CMJ, Rucker J, Watts R, Erritzoe DE, Kaelen **M, Giribaldi B, Bloomfield M, Pilling S, Rickard JA, Forbes B, Feilding A, Taylor D, Curran HV, Nutt DJ** (2018) Psilocybin with psychological support for treatment-resistant depression: six-month follow-up. *Psychopharmacology* **235**(2):399-408. https://doi.org/10.1007/s00213-017-4771-x

Carhart-Harris RL, Bolstridge M, Rucker J, Day CM, Erritzoe D, Kaelen M, Bloomfield M, Rickard JA, Forbes B, Feilding A, Taylor D, Pilling S, Curran VH, Nutt DJ (2016) Psilocybin with psychological support for treatment-resistant depression: an open-label feasibility study. *Lancet Psychiatry* **3**(7):619-27. https://doi.org/10.1016/S2215-0366(16)30065-7

Carhart-Harris RL, Erritzoe D, Williams T, Stone JM, Reed LJ, Colasanti A, Tyacke RJ, Leech R, Malizia AL, Murphy K, Hobden P, Evans J, Feilding A, Wise RG, Nutt DJ (2012) Neural correlates of the psychedelic state as determined by fMRI studies with psilocybin. *National Academy of Sciences U.S.A.* **109**(6):2138-43. doi:

10.1073/pnas.1119598109. https://doi.org/10.1073/pnas.1119598109

Carhart-Harris RL, Goodwin GM (2017) The Therapeutic Potential of Psychedelic Drugs: Past, Present, and Future. *Neuropsychopharmacology* **42**(11):2105-2113. https://doi.org/10.1038/npp.2017.84

Carhart-Harris RL, Muthukumaraswamy S, Roseman L, Kaelen M, Droog W, Murphy K, Tagliazucchi E, Schenberg EE, Nest T, Orban C, Leech R, Williams LT, Williams TM, Bolstridge M, Sessa B, McGonigle J, Sereno MI, Nichols D, Hellyer PJ, Hobden P, Evans J, Singh KD, Wise RG, Curran HV, Feilding A, Nutt DJ (2016) Neural correlates of the LSD experience revealed by multimodal neuroimaging. *National Academy of Sciences U.S.A* **113**(17):4853-8. https://doi.org/10.1073/pnas.1518377113

Carhart-Harris RL, Roseman L, Bolstridge M, Demetriou L, Pannekoek JN, Wall MB, Tanner M, Kaelen M, McGonigle J, Murphy K, Leech R, Curran HV, Nutt DJ (2017) Psilocybin for treatment-resistant depression: fMRI-measured brain mechanisms. *Scientific Reports* **7**(1):13187. https://doi.org/10.1038/s41598-017-13282-7

Carter RJ, Morton J, Dunnett SB (2001) Motor coordination and balance in rodents. *Current Protocols in Neuroscience* **8**(8):12. https://doi.org/10.1002/0471142301.ns0812s15

Castro B, Kuang S (2017) Evaluation of Muscle Performance in Mice by Treadmill Exhaustion Test and Whole-limb Grip Strength Assay. *Bio Protocol* **7**(8):e2237. https://doi.org/10.21769/BioProtoc.2237

Cavarra M, Falzone A, Ramaekers JG, Kuypers KPC, Mento C (2022) Psychedelic-Assisted Psychotherapy-A Systematic Review of Associated Psychological Interventions. *Frontiers of Psychology* **13**:887255. https://doi.org/10.3389/fpsyg.2022.887255

Chang C, Putukian M, Aerni G, Diamond A, Hong G, Ingram Y, Reardon CL, Wolanin A (2020) Mental health issues and psychological factors in athletes: detection, management, effect on performance and prevention: American Medical Society for Sports Medicine Position Statement-Executive Summary. *British Journal of Sports Medicine* **54**(4):216-220. https://doi.org/10.1136/bjsports-2019-101583

Ching TH, Williams MT, Wang JB, Jerome L, Yazar-Klosinski B, Emerson A, Doblin R (2022) MDMA-assisted therapy for posttraumatic stress disorder: A pooled analysis of ethnoracial differences in efficacy and safety from two Phase 2 open-label lead-in trials and a Phase 3 randomized, blinded placebo-controlled trial. *Journal of Psychopharmacology* **36**(8):974-986. https://doi.org/10.1177/02698811221104052

Commons KG, Cholanians AB, Babb JA, Ehlinger DG (2017) The Rodent Forced Swim

Test Measures Stress-Coping Strategy, Not Depression-like Behavior. *ACS Chemical Neuroscience* **8**(5):955-960. https://doi.org/10.1021/acschemneuro.7b00042

Connor TJ, Kelly JP, McGee M, Leonard BE (2000) Methylenedioxymethamphetamine (MDMA; Ecstasy) suppresses IL-1beta and TNF-alpha secretion following an in vivo lipopolysaccharide challenge. *Life Science* **67**(13):1601-12. https://doi.org/10.1016/s0024-3205(00)00743-8

Cuerva K, Spirou D, Cuerva A, Delaquis C, Raman J (2024) Perspectives and preliminary experiences of psychedelics for the treatment of eating disorders: A systematic scoping review. *European Eating Disorders Review* **32**(5):986-1001. https://doi.org/10.1002/erv.3101

Danforth AL, Grob CS, Struble C, Feduccia AA, Walker N, Jerome L, Yazar-Klosinski B, Emerson A (2018) Reduction in social anxiety after MDMA-assisted psychotherapy with autistic adults: a randomized, double-blind, placebo-controlled pilot study. *Psychopharmacology (Berl)* **235**(11):3137-3148. https://doi.org/10.1007/s00213-018-5010-9

Darke S, Duflou J, Peacock A, Farrell M, Hall W, Lappin J (2024) A retrospective study of the characteristics and toxicology of cases of lysergic acid diethylamide (LSD)- and psilocybin-related death in Australia. *Addiction* **119**(9):1564-1571. https://doi.org/10.1111/add.16518

Davis AK, Barrett FS, May DG, Cosimano MP, Sepeda ND, Johnson MW, Finan PH, Griffiths RR (2021) Effects of Psilocybin-Assisted Therapy on Major Depressive Disorder: A Randomized Clinical Trial. *JAMA Psychiatry* **78**(5):481-489. https://doi.org/10.1001/jamapsychiatry.2020.3285

Daws RE, Timmermann C, Giribaldi B, Sexton JD, Wall MB, Erritzoe D, Roseman L, Nutt D, Carhart-Harris R (2022) Increased global integration in the brain after psilocybin therapy for depression. *Nature Medicine* **28**(4):844-851. https://doi.org/10.1038/s41591-022-01744-z

de Almeida RN, Galvão ACM, da Silva FS, Silva EADS, Palhano-Fontes F, Maia-de-Oliveira JP, de Araújo LB, Lobão-Soares B, Galvão-Coelho NL (2019) Modulation of Serum Brain-Derived Neurotrophic Factor by a Single Dose of Ayahuasca: Observation From a Randomized Controlled Trial. *Frontiers of Psychology* **10**:1234. https://doi.org/10.3389/fpsyg.2019.01234

de Bragança AC, Moreau RLM, de Brito T, Shimizu MHM, Canale D, de Jesus DA, Silva AMG, Gois PH, Seguro AC, Magaldi AJ (2017) Ecstasy induces reactive oxygen

species, kidney water absorption and rhabdomyolysis in normal rats. Effect of N-acetylcysteine and Allopurinol in oxidative stress and muscle fiber damage. *PLoS One* **12**(7):e0179199. https://doi.org/10.1371/journal.pone.0179199

de Camargo RW, Joaquim L, Machado RS, de Souza Ramos S, da Rosa LR, de Novais Junior LR, Mathias K, Maximiano L, Strickert YR, Nord R, Gava ML, Scarpari E, Martins HM, Lins EMF, Chaves JS, da Silva LE, de Oliveira MP, da Silva MR, Fernandes BB, Tiscoski ADB, Piacentini N, Santos FP, Inserra A, Bobinski F, Razin GT, Yonamine M, Petronilho F, de Bitencourt RM (2024) Ayahuasca Pretreatment Prevents Sepsis-Induced Anxiety-Like Behavior, Neuroinflammation, and Oxidative Stress, and Increases Brain-Derived Neurotrophic Factor. *Molecular Neurobiology*. https://doi.org/10.1007/s12035-024-04597-4

De Gregorio D, Popic J, Enns JP, Inserra A, Skalecka A, Markopoulos A, Posa L, Lopez-Canul M, He Q, Lafferty CK, Britt JP, Comai S, Aguilar-Valles A, Sonenberg N, Gobbi G (2021) Lysergic acid diethylamide (LSD) promotes social behavior through mTORC1 in the excitatory neurotransmission. *Proceedings of the National Academy of Sciences of the United States of America* **118**(5):e2020705118. https://doi.org/10.1073/pnas.2020705118

de Vos CMH, Mason NL, Kuypers KPC (2021) Psychedelics and Neuroplasticity: A Systematic Review Unraveling the Biological Underpinnings of Psychedelics. *Frontiers of Psychology* **12**:724606. https://doi.org/10.3389/fpsyt.2021.724606

Deacon RM (2013) Measuring motor coordination in mice. *Journal of Visualized Experiments* **75**:e2609. https://doi.org/10.3791/2609

Dolder PC, Schmid Y, Müller F, Borgwardt S, Liechti ME (2016) LSD Acutely Impairs Fear Recognition and Enhances Emotional Empathy and Sociality. *Neuropsychopharmacology* **41**(11):2638-46. https://doi.org/10.1038/npp.2016.82

Dos Santos RG, Hallak JEC (2024) Ayahuasca: pharmacology, safety, and therapeutic effects. *CNS Spectrums* **20**:1-9. https://doi.org/10.1017/s109285292400213x

Dos Santos RG, Osório FL, Rocha JM, Rossi GN, Bouso JC, Rodrigues LS, de Oliveira Silveira G, Yonamine M, Hallak JEC (2021) Ayahuasca Improves Self-perception of Speech Performance in Subjects With Social Anxiety Disorder: A Pilot, Proof-of-Concept, Randomized, Placebo-Controlled Trial. *Journal of Clinical Psychopharmacology* **41**(5):540-550. https://doi.org/10.1097/JCP.0000000000001428

dos Santos RG (2014) Immunological effects of ayahuasca in humans. *Journal of Psychoactive Drugs* **46**(5):383-8. https://doi.org/10.1080/02791072.2014.960113

Doss MK, DeMarco A, Dunsmoor JE, Cisler JM, Fonzo GA, Nemeroff CB (2024) How Psychedelics Modulate Multiple Memory Mechanisms in Posttraumatic Stress Disorder. *Drugs* **84**(11):1419-1443. https://doi.org/10.1007/s40265-024-02106-4

Dougherty JP, Springer DA, Gershengorn MC (2016) The Treadmill Fatigue Test: A Simple, High-throughput Assay of Fatigue-like Behavior for the Mouse. *Journal of Visualized Experiments* **31**(111):54052. https://doi.org/10.3791/54052

Doyle AJ, Meyer J, Breen K, Hunt BJ (2020) N-Methyl-3,4-methylendioxymethamphetamine (MDMA)-related coagulopathy and rhabdomyolysis: A case series and literature review. *Research and Practice in Thrombosis and Haemostasis* **4**(5):829-834. https://doi.org/10.1002/rth2.12360

D'Souza DC, Syed SA, Flynn LT, Safi-Aghdam H, Cozzi NV, Ranganathan M (2022) Exploratory study of the dose-related safety, tolerability and efficacy of dimethyltryptamine (DMT) in healthy volunteers and major depressive disorder. *Neuropsychopharmacology* **47**(10):1854-1862. https://doi.org/10.1038/s41386-022-01344-y

Duarte JA, Leão A, Magalhães J, Ascensão A, Bastos ML, Amado FL, Vilarinho L, Quelhas D, Appell HJ, Carvalho F (2005) Strenuous exercise aggravates MDMA-induced skeletal muscle damage in mice. *Toxicology* **206**(3):349-58. https://doi.org/10.1016/j.tox.2004.07.012

Duerler P, Schilbach L, Stämpfli P, Vollenweider FX, Preller KH (2020) LSD-induced increases in social adaptation to opinions similar to one's own are associated with stimulation of serotonin receptors. *Scientific Reports* **10**(1):12181. https://doi.org/10.1038/s41598-020-68899-y

Dumont GJ, Sweep FC, van der Steen R, Hermsen R, Donders AR, Touw DJ, van Gerven JM, Buitelaar JK, Verkes RJ (2009) Increased oxytocin concentrations and prosocial feelings in humans after ecstasy (3,4-methylenedioxymethamphetamine) administration. *Society for Neuroscience* **4**(4):359-66. https://doi.org/10.1080/17470910802649470

Edwards CD (2024) Management of Mental Health Challenges in Athletes: Screening, Pharmacology, and Behavioral Approaches. *Clinical Sports Medicine* **43**(1):13-31. https://doi.org/10.1016/j.csm.2023.06.006

Fadahunsi N, Lund J, Breum AW, Mathiesen CV, Larsen IB, Knudsen GM, Klein AB, Clemmensen C (2022) Acute and long-term effects of psilocybin on energy balance and feeding behavior in mice. *Translational Psychiatry* **12**(1):330.

https://doi.org/10.1038/s41398-022-02103-9

Family N, Hendricks PS, Williams LT, Luke D, Krediet E, Maillet EL, Raz S (2022) Safety, tolerability, pharmacokinetics, and subjective effects of 50, 75, and 100 µg LSD in healthy participants within a novel intervention paradigm: A proof-of-concept study. *Journal of Psychopharmacology* **36**(3):321-336. https://doi.org/10.1177/02698811211069103

Flaive A, Fougère M, van der Zouwen CI, Ryczko D (2020) Serotonergic Modulation of Locomotor Activity From Basal Vertebrates to Mammals. *Frontiers Neural Circuits* **14**:590299. https://doi.org/10.3389/fncir.2020.590299

Flanagan TW, Billac GB, Landry AN, Sebastian MN, Cormier SA, Nichols CD (2020) Structure-Activity Relationship Analysis of Psychedelics in a Rat Model of Asthma Reveals the Anti-Inflammatory Pharmacophore. *ACS Pharmacology & Translational Science* **4**(2):488-502. https://doi.org/10.1021/acsptsci.0c00063

Flanagan TW, Foster TP, Galbato TE, Lum PY, Louis K, Song G, Halberstadt AL, Billac GB, Nichols CD (2024) Serotonin-2 Receptor Agonists Produce Anti-inflammatory Effects through Functionally Selective Mechanisms That Involve the Suppression of Disease-Induced Arginase 1 Expression. *ACS Pharmacology & Translational Science* **7**(2):478-492. https://doi.org/10.1021/acsptsci.3c00297

Flanagan TW, Nichols CD (2022) Psychedelics and Anti-inflammatory Activity in Animal Models. *Current Topics in Behavioral Neurosciences* **56**:229-245. https://doi.org/10.1007/7854_2022_367

Flanagan TW, Sebastian MN, Battaglia DM, Foster TP, Cormier SA, Nichols CD (2019) 5-HT_2 receptor activation alleviates airway inflammation and structural remodeling in a chronic mouse asthma model. *Life Science* **236**:116790. https://doi.org/10.1016/j.lfs.2019.116790

Flanagan TW, Sebastian MN, Battaglia DM, Foster TP, Maillet EL, Nichols CD (2019) Activation of 5-HT_2 Receptors Reduces Inflammation in Vascular Tissue and Cholesterol Levels in High-Fat Diet-Fed Apolipoprotein E Knockout Mice. *Scientific Reports* **9**(1):13444. https://doi.org/10.1038/s41598-019-49987-0

Floris G, Dabrowski KR, Zanda MT, Daws SE (2024) Psilocybin reduces heroin seeking behavior and modulates inflammatory gene expression in the nucleus accumbens and prefrontal cortex of male rats. *Molecular Psychiatry.* https://doi.org/10.1038/s41380-024-02788-y

Freidel N, Kreuder L, Rabinovitch BS, Chen FY, Huang RST, Lewis EC (2024)

Psychedelics, epilepsy, and seizures: a review. *Frontiers of Psychology* **14**:1326815. https://doi.org/10.3389/fphar.2023.1326815

Galvão ACM, de Almeida RN, Silva EADS, Freire FAM, Palhano-Fontes F, Onias H, Arcoverde E, Maia-de-Oliveira JP, de Araújo DB, Lobão-Soares B, Galvão-Coelho NL (2018) Cortisol Modulation by Ayahuasca in Patients With Treatment Resistant Depression and Healthy Controls. *Frontiers of Psychology* **9**:185. https://doi.org/10.3389/fpsyt.2018.00185

Galvão-Coelho NL, de Menezes Galvão AC, de Almeida RN, Palhano-Fontes F, Campos Braga I, Lobão Soares B, Maia-de-Oliveira JP, Perkins D, Sarris J, de Araujo DB (2020) Changes in inflammatory biomarkers are related to the antidepressant effects of Ayahuasca. *Journal of Psychopharmacology* **34**(10):1125-1133. https://doi.org/10.1177/0269881120936486

Gasser P, Holstein D, Michel Y, Doblin R, Yazar-Klosinski B, Passie T, Brenneisen R (2014) Safety and efficacy of lysergic acid diethylamide-assisted psychotherapy for anxiety associated with life-threatening diseases. *Journal of Nervous and Mental Disease* **202**(7):513-20. https://doi.org/10.1097/NMD.0000000000000113

Gasser P, Kirchner K, Passie T (2015) LSD-assisted psychotherapy for anxiety associated with a life-threatening disease: a qualitative study of acute and sustained subjective effects. *Journal of Psychopharmacology* **29**(1):57-68. https://doi.org/10.1177/0269881114555249

Glick ID, Stillman MA, McGuff D (2020) Update on integrative treatment of psychiatric symptoms and disorders in athletes. *Physician and Sportsmedicine* **48**(4):385-391. https://doi.org/10.1080/00913847.2020.1757370

Glick ID, Stillman MA, Reardon CL, Ritvo EC (2012) Managing psychiatric issues in elite athletes. *Journal of Clinical Psychiatry* **73**(5):640-4. https://doi.org/10.4088/jcp.11r07381

Golchoobian R, Nabavizadeh F, Roghani M, Foroumadi A, Mohammadian M. Ghrelin (2017) Alleviates MDMA-Induced Disturbance of Serum Glucose and Lipids Levels in the Rat. *Acta Medica Iranica* **55**(12):736-743. https://pubmed.ncbi.nlm.nih.gov/29373879/

Goodwin GM, Aaronson ST, Alvarez O, Arden PC, Baker A, Bennett JC, Bird C, Blom RE, Brennan C, Brusch D, Burke L, Campbell-Coker K, Carhart-Harris R, Cattell J, Daniel A, DeBattista C, Dunlop BW, Eisen K, Feifel D, Forbes M, Haumann HM, Hellerstein DJ, Hoppe AI, Husain MI, Jelen LA, Kamphuis J, Kawasaki J, Kelly JR, Key RE, Kishon R, Knatz Peck S, Knight G, Koolen MHB, Lean M, Licht RW, Maples-Keller JL, Mars J, Marwood L, McElhiney MC, Miller TL, Mirow A, Mistry

S, Mletzko-Crowe T, Modlin LN, Nielsen RE, Nielson EM, Offerhaus SR, O'Keane V, Páleníček T, Printz D, Rademaker MC, van Reemst A, Reinholdt F, Repantis D, Rucker J, Rudow S, Ruffell S, Rush AJ, Schoevers RA, Seynaeve M, Shao S, Soares JC, Somers M, Stansfield SC, Sterling D, Strockis A, Tsai J, Visser L, Wahba M, Williams S, Young AH, Ywema P, Zisook S, Malievskaia E (2022) Single-Dose Psilocybin for a Treatment-Resistant Episode of Major Depression. *New England Journal of Medicine* **387**(18):1637-1648. https://doi.org/10.1056/NEJMoa2206443

Goodwin GM, Croal M, Feifel D, Kelly JR, Marwood L, Mistry S, O'Keane V, Peck SK, Simmons H, Sisa C, Stansfield SC, Tsai J, Williams S, Malievskaia E (2023) Psilocybin for treatment resistant depression in patients taking a concomitant SSRI medication. *Neuropsychopharmacology* **48**(10):1492-1499. https://doi.org/10.1038/s41386-023-01648-7

Gorman I, Belser AB, Jerome L, Hennigan C, Shechet B, Hamilton S, Yazar-Klosinski B, Emerson A, Feduccia AA (2020) Posttraumatic Growth After MDMA-Assisted Psychotherapy for Posttraumatic Stress Disorder. *Journal of Traumatic Stress* **33**(2):161-170. https://doi.org/10.1002/jts.22479

Goulart da Silva M, Daros GC, Santos FP, Yonamine M, de Bitencourt RM (2022) Antidepressant and anxiolytic-like effects of ayahuasca in rats subjected to LPS-induced neuroinflammation. *Behavioural Brain Research* **434**:114007. https://doi.org/10.1016/j.bbr.2022.114007

Gouttebarge V, Castaldelli-Maia JM, Gorczynski P, Hainline B, Hitchcock ME, Kerkhoffs GM, Rice SM, Reardon CL (2019) Occurrence of mental health symptoms and disorders in current and former elite athletes: a systematic review and meta-analysis. *British Journal of Sports Medicine* **53**(11):700-706. https://doi.org/10.1136/bjsports-2019-100671

Graham DL, Herring NR, Schaefer TL, Vorhees CV, Williams MT (2010) Glucose and corticosterone changes in developing and adult rats following exposure to (+/-)-3,4-methylendioxymethamphetamine or 5-methoxydiisopropyltryptamine. *Neurotoxicology and Teratology* **32**(2):152-7. https://doi.org/10.1016/j.ntt.2009.08.012

Griffiths RR, Johnson MW, Carducci MA, Umbricht A, Richards WA, Richards BD, Cosimano MP, Klinedinst MA (2016) Psilocybin produces substantial and sustained decreases in depression and anxiety in patients with life-threatening cancer: A randomized double-blind trial. *Journal of Psychopharmacology* **30**(12):1181-1197. https://doi.org/10.1177/0269881116675513

Griffiths RR, Johnson MW, Richards WA, Richards BD, Jesse R, MacLean KA, Barrett FS, Cosimano MP, Klinedinst MA (2018) Psilocybin-occasioned mystical-type experience in combination with meditation and other spiritual practices produces enduring positive changes in psychological functioning and in trait measures of prosocial attitudes and behaviors. *Journal of Psychopharmacology* **32**(1):49-69. https://doi.org/10.1177/0269881117731279

Griffiths RR, Johnson MW, Richards WA, Richards BD, McCann U, Jesse R (2011) Psilocybin occasioned mystical-type experiences: immediate and persisting dose related effects. *Psychopharmacology (Berl)* **218**(4):649-65. https://doi.org/10.1007/s00213-011-2358-5

Grob CS, Danforth AL, Chopra GS, Hagerty M, McKay CR, Halberstadt AL, Greer GR (2011) Pilot study of psilocybin treatment for anxiety in patients with advanced-stage cancer. *Archives Of General Psychiatry* **68**(1):71-8. https://doi.org/10.1001/archgenpsychiatry.2010.116

Gukasyan N, Davis AK, Barrett FS, Cosimano MP, Sepeda ND, Johnson MW, Griffiths RR (2022) Efficacy and safety of psilocybin-assisted treatment for major depressive disorder: Prospective 12-month follow-up. *Journal of Psychopharmacology* **36**(2):151-158. https://doi.org/10.1177/02698811211073759

Haden M, Woods B (2020) LSD Overdoses: Three Case Reports. *Journal of Studies on Alcohol and Drugs* **81**(1):115-118. https://doi.org/10.15288/jsad.2020.81.115

Halachanova V, Sansone RA, McDonald S (2001) Delayed rhabdomyolysis after ecstasy use. *Mayo Clinic Proceedings* **76**(1):112-3. https://doi.org/10.4065/76.1.112

Halman A, Kong G, Sarris J, Perkins D (2024) Drug-drug interactions involving classic psychedelics: A systematic review. *Journal of Psychopharmacology* **38**(1):3-18. https://doi.org/10.1177/02698811231211219

Hamsa TP, Kuttan G (2010) Harmine inhibits tumour specific neo-vessel formation by regulating VEGF, MMP, TIMP and pro-inflammatory mediators both in vivo and in vitro. *European Journal of Pharmacology* **649**(1-3):64-73. https://doi.org/10.1016/j.ejphar.2010.09.010

He DY, McGough NN, Ravindranathan A, Jeanblanc J, Logrip ML, Phamluong K, Janak PH, Ron D (2005) Glial cell line-derived neurotrophic factor mediates the desirable actions of the anti-addiction drug ibogaine against alcohol consumption. Journal of Neurosciences **25**(3):619-28. https://doi.org/10.1523/JNEUROSCI.3959-04.2005

Heresco-Levy U, Lerer B (2024) Synergistic psychedelic - NMDAR modulator treatment

for neuropsychiatric disorders. *Molecular Psychiatry* **29**(1):146-152. https://doi.org/10.1038/s41380-023-02312-8

Herr N, Bode C, Duerschmied D (2017) The Effects of Serotonin in Immune Cells. *Frontiers in Cardiovascular Medicine* **4**:48. https://doi.org/10.3389/fcvm.2017.00048

Hibicke M, Landry AN, Kramer HM, Talman ZK, Nichols CD (2020) Psychedelics, but Not Ketamine, Produce Persistent Antidepressant-like Effects in a Rodent Experimental System for the Study of Depression. *ACS Chemical Neuroscience* **11**(6):864-871. https://doi.org/10.1021/acschemneuro.9b00493

Hinkle JT, Graziosi M, Nayak SM, Yaden DB (2024) Adverse Events in Studies of Classic Psychedelics: A Systematic Review and Meta-Analysis. *JAMA Psychiatry* **81**(12):1225-1235. https://doi.org/10.1001/jamapsychiatry.2024.2546

Holze F, Caluori TV, Vizeli P, Liechti ME (2022) Safety pharmacology of acute LSD administration in healthy subjects. *Psychopharmacology (Berl)* **239**(6):1893-1905. https://doi.org/10.1007/s00213-021-05978-6

Holze F, Gasser P, Müller F, Dolder PC, Liechti ME (2023) Lysergic Acid Diethylamide-Assisted Therapy in Patients With Anxiety With and Without a Life-Threatening Illness: A Randomized, Double-Blind, Placebo-Controlled Phase II Study. *Biological Psychiatry* **93**(3):215-223. https://doi.org/10.1016/j.biopsych.2022.08.025

Holze F, Singh N, Liechti ME, D'Souza DC (2024) Serotonergic Psychedelics: A Comparative Review of Efficacy, Safety, Pharmacokinetics, and Binding Profile. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging* **9**(5):472-489. https://doi.org/10.1016/j.bpsc.2024.01.007

Huang J, Pham M, Panenka WJ, Honer WG, Barr AM (2022) Chronic Treatment With Psilocybin Decreases Changes in Body Weight in a Rodent Model of Obesity. *Frontiers in Psychiatry* **13**:891512. https://doi.org/10.3389/fpsyt.2022.891512

Hutten NRPW, Mason NL, Dolder PC, Theunissen EL, Holze F, Liechti ME, Varghese N, Eckert A, Feilding A, Ramaekers JG, Kuypers KPC (2020) Low Doses of LSD Acutely Increase BDNF Blood Plasma Levels in Healthy Volunteers. *ACS Pharmacology & Translational Science* **4**(2):461-466. https://doi.org/10.1021/acsptsci.0c00099

Hutten NRPW, Mason NL, Dolder PC, Theunissen EL, Holze F, Liechti ME, Feilding A, Ramaekers JG, Kuypers KPC (2020) Mood and cognition after administration of low LSD doses in healthy volunteers: A placebo controlled dose-effect finding study. *European Neuropsychopharmacology* **41**:81-91.

https://doi.org/10.1016/j.euroneuro.2020.10.002

Hysek CM, Schmid Y, Simmler LD, Domes G, Heinrichs M, Eisenegger C, Preller KH, Quednow BB, Liechti ME (2014) MDMA enhances emotional empathy and prosocial behavior. *Social Cognitive and Affective Neuroscience* **9**(11):1645-52. https://doi.org/10.1093/scan/nst161

Inserra A, Campanale A, Rezai T, Romualdi P, Rubino T (2024) Epigenetic mechanisms of rapid-acting antidepressants. *Translational Psychiatry* **14**(1):359. https://doi.org/10.1038/s41398-024-03055-y

Inserra A, De Gregorio D, Gobbi G (2021) Psychedelics in Psychiatry: Neuroplastic, Immunomodulatory, and Neurotransmitter Mechanisms. *Pharmacological Reviews* **73**(1):202-277. https://doi.org/10.1124/pharmrev.120.000056

Jardim AV, Jardim DV, Chaves BR, Steglich M, Ot'alora G M, Mithoefer MC, da Silveira DX, Tófoli LF, Ribeiro S, Matthews R, Doblin R, Schenberg EE (2021) 3,4-methylenedioxymethamphetamine (MDMA)-assisted psychotherapy for victims of sexual abuse with severe post-traumatic stress disorder: an open label pilot study in Brazil. *Brazilian Journal of Psychiatry* **43**(2):181-185. https://doi.org/10.1590/1516-4446-2020-0980

Jerome L, Feduccia AA, Wang JB, Hamilton S, Yazar-Klosinski B, Emerson A, Mithoefer MC, Doblin R (2020) Long-term follow-up outcomes of MDMA-assisted psychotherapy for treatment of PTSD: a longitudinal pooled analysis of six phase 2 trials. *Psychopharmacology (Berl)* **237**(8):2485-2497. https://doi.org/10.1007/s00213-020-05548-2

Johansen PØ, Krebs TS (2015) Psychedelics not linked to mental health problems or suicidal behavior: a population study. *Journal of Psychopharmacology* **29**(3):270-9. https://doi.org/10.1177/0269881114568039

Johnson M, Richards W, Griffiths R (2008) Human hallucinogen research: guidelines for safety. *Journal of Psychopharmacology* **22**(6):603-20. https://doi.org/10.1177/0269881108093587

Johnson MW, Garcia-Romeu A, Cosimano MP, Griffiths RR (2014) Pilot study of the 5-HT2AR agonist psilocybin in the treatment of tobacco addiction. *Journal of Psychopharmacology* **28**(11):983-92. https://doi.org/10.1177/0269881114548296

Johnson MW, Garcia-Romeu A, Griffiths RR (2017) Long-term follow-up of psilocybin-facilitated smoking cessation. *American Journal of Drug and Alcohol Abuse* **43**(1):55-60. https://doi.org/10.3109/00952990.2016.1170135

Johnson MW, Griffiths RR, Hendricks PS, Henningfield JE (2018) The abuse potential of medical psilocybin according to the 8 factors of the Controlled Substances Act. *Neuropharmacology* **142**:143-166. https://doi.org/10.1016/j.neuropharm.2018.05.012

Johnson MW, Hendricks PS, Barrett FS, Griffiths RR (2019) Classic psychedelics: An integrative review of epidemiology, therapeutics, mystical experience, and brain network function. *Pharmacology & Therapeutics* **197**:83-102. https://doi.org/10.1016/j.pharmthera.2018.11.010

Kamilar-Britt P, Bedi G (2015) The prosocial effects of 3,4-methylenedioxymethamphetamine (MDMA): Controlled studies in humans and laboratory animals. *Neuroscience & Biobehavioral Reviews* **57**:433-46. https://doi.org/10.1016/j.neubiorev.2015.08.016

Kim K, Che T, Panova O, DiBerto JF, Lyu J, Krumm BE, Wacker D, Robertson MJ, Seven AB, Nichols DE, Shoichet BK, Skiniotis G, Roth BL (2020) Structure of a Hallucinogen-Activated Gq-Coupled 5-HT_{2A} Serotonin Receptor. *Cell* **182**(6):1574-1588.e19. https://doi.org/10.1016/j.cell.2020.08.024

Klaiber A, Humbert-Droz M, Ley L, Schmid Y, Liechti ME (2024) Safety pharmacology of acute mescaline administration in healthy participants. *British Journal of Clinical Pharmacology*. https://doi.org/10.1111/bcp.16345

Knudsen GM (2023) Sustained effects of single doses of classical psychedelics in humans. *Neuropsychopharmacology* **48**(1):145-150. https://doi.org/10.1038/s41386-022-01361-x

Kopra EI, Penttinen J, Rucker JJ, Copeland CS (2024) Psychedelic-related deaths in England, Wales and Northern Ireland (1997-2022). *Progress in Neuro-Psychopharmacology & Biological Psychiatry* **136**:111177. https://doi.org/10.1016/j.pnpbp.2024.111177

Korthuis PT, Hoffman K, Wilson-Poe AR, Luoma JB, Bazinet A, Pertl K, Morgan DL, Cook RR, Bielavitz S, Myers R, Wolf RC, McCarty D, Stauffer CS (2024) Developing the Open Psychedelic Evaluation Nexus consensus measures for assessment of supervised psilocybin services: An e-Delphi study. *Journal of Psychopharmacology* **38**(8):761-768. https://doi.org/10.1177/02698811241257839

Kraehenmann R, Preller KH, Scheidegger M, Pokorny T, Bosch OG, Seifritz E, Vollenweider FX (2015) Psilocybin-Induced Decrease in Amygdala Reactivity Correlates with Enhanced Positive Mood in Healthy Volunteers. *Biological Psychiatry* **78**(8):572-81. https://doi.org/10.1016/j.biopsych.2014.04.010

Laabi S, LeMmon C, Vogel C, Chacon M, Jimenez VM Jr (2024) Deciphering psilocybin: Cytotoxicity, anti-inflammatory effects, and mechanistic insights. *International Immunopharmacology* **130**:111753. https://doi.org/10.1016/j.intimp.2024.111753

Lake S, Lucas P (2024) Co-use of psychedelics with other substances: Findings from the global psychedelic survey. *Journal of Psychopharmacology* **28**:2698811241292956. https://doi.org/10.1177/02698811241292956

Lebedev AV, Kaelen M, Lövdén M, Nilsson J, Feilding A, Nutt DJ, Carhart-Harris RL (2016) LSD-induced entropic brain activity predicts subsequent personality change. *Human Brain Mapping* **37**(9):3203-13. https://doi.org/10.1002/hbm.23234

Lehmann ED, Thom CH, Croft DN (1995) Delayed severe rhabdomyolysis after taking 'ecstasy'. *Postgraduate Medical Journal* **71**(833):186-7. https://doi.org/10.1136/pgmj.71.833.186-a

Lewis EC, Jaeger A, Girn M, Omene E, Brendle M, Argento E (2024) Exploring psychedelic-assisted therapy in the treatment of functional seizures: A review of underlying mechanisms and associated brain networks. Journal of Psychopharmacology **38**(5):407-416. https://doi.org/10.1177/02698811241248395

Liao C, Dua AN, Wojtasiewicz C, Liston C, Kwan AC (2025) Structural neural plasticity evoked by rapid-acting antidepressant interventions. *Nature Reviews Neurosciences* **26**(2):101-114. https://doi.org/10.1038/s41583-024-00876-0

Lima da Cruz RV, Moulin TC, Petiz LL, Leão RN (2018) A Single Dose of 5-MeO-DMT Stimulates Cell Proliferation, Neuronal Survivability, Morphological and Functional Changes in Adult Mice Ventral Dentate Gyrus. *Frontiers in Molecular Neuroscience* **11**:312. https://doi.org/10.3389/fnmol.2018.00312

Liu F, Wu J, Gong Y, Wang P, Zhu L, Tong L, Chen X, Ling Y, Huang C (2017) Harmine produces antidepressant-like effects via restoration of astrocytic functions. *Progress in Neuro-Psychopharmacology & Biological Psychiatry* **79**(Pt B):258-267. https://doi.org/10.1016/j.pnpbp.2017.06.012

Liu X, Li M, Tan S, Wang C, Fan S, Huang C (2017) Harmine is an inflammatory inhibitor through the suppression of NF-κB signaling. *Biochemical and Biophysical Research Communications* **489**(3):332-338. https://doi.org/10.1016/j.bbrc.2017.05.126

Low ZXB, Ng WS, Lim ESY, Goh BH, Kumari Y (2025) The immunomodulatory effects of classical psychedelics: A systematic review of preclinical studies. *Progress in Neuro-Psychopharmacology & Biological Psychiatry* **36**:111139. https://doi.org/10.1016/j.pnpbp.2024.111139

Lukasiewicz K, Baker JJ, Zuo Y, Lu J (2021) Serotonergic Psychedelics in Neural Plasticity. *Frontiers in Molecular Neuroscience* **14**:748359. https://doi.org/10.3389/fnmol.2021.748359

Luoma JB, Chwyl C, Bathje GJ, Davis AK, Lancelotta R (2020). A Meta-Analysis of Placebo-Controlled Trials of Psychedelic-Assisted Therapy. *Journal of Psychoactive Drugs* **52**(4):289-299. https://doi.org/10.1080/02791072.2020.1769878

Ly C, Greb AC, Cameron LP, Wong JM, Barragan EV, Wilson PC, Burbach KF, Soltanzadeh Zarandi S, Sood A, Paddy MR, Duim WC, Dennis MY, McAllister AK, Ori-McKenney KM, Gray JA, Olson DE (2018) Psychedelics Promote Structural and Functional Neural Plasticity. *Cell Reports* **23**(11):3170-3182. https://doi.org/10.1016/j.celrep.2018.05.022

Ma Y, Li W, Yao Q, Liu Y, Yu J, Zang L, Wang S, Zhou L, Wen S, Luo Y, Li W, Niu X (2024) Harmine ameliorates CCl_4-induced acute liver injury through suppression of autophagy and inflammation. *International Immunopharmacology* **129**:111538. https://doi.org/10.1016/j.intimp.2024.111538

Madsen MK, Fisher PM, Burmester D, Dyssegaard A, Stenbæk DS, Kristiansen S, Johansen SS, Lehel S, Linnet K, Svarer C, Erritzoe D, Ozenne B, Knudsen GM (2019) Psychedelic effects of psilocybin correlate with serotonin 2A receptor occupancy and plasma psilocin levels. *Neuropsychopharmacology* **44**(7):1328-1334. https://doi.org/10.1038/s41386-019-0324-9

Marí-Sanchis A, Burgos-Barbaseda J, Hidalgo-Borrajo R (2022) Eating disorders in sport. Update and proposal for an integrated approach. *Endocrinology, Diabetes and Nutrition (Engl Ed)* **69**(2):131-143. https://doi.org/10.1016/j.endien.2022.02.016

Marton S, Gonzalez B, Rodríguez-Bottero S, Miquel E, Martínez-Palma L, Pazos M, Prieto JP, Rodriguez P, Sames D, Seoane G, Scorza C, Cassina P, Carrera I (2019) Ibogaine Administration Modifies GDNF and BDNF Expression in Brain Regions Involved in Mesocorticolimbic and Nigral Dopaminergic Circuits. *Frontiers in Pharmacology* **10**:193. https://doi.org/10.3389/fphar.2019.00193

Mason NL, Kuypers KPC, Müller F, Reckweg J, Tse DHY, Toennes SW, Hutten NRPW, Jansen JFA, Stiers P, Feilding A, Ramaekers JG (2020) Me, myself, bye: regional alterations in glutamate and the experience of ego dissolution with psilocybin. *Neuropsychopharmacology* **45**(12):2003-2011. https://doi.org/10.1038/s41386-020-0718-8

Mason NL, Kuypers KPC, Reckweg JT, Müller F, Tse DHY, Da Rios B, Toennes SW, Stiers P, Feilding A, Ramaekers JG (2021) Spontaneous and deliberate creative

cognition during and after psilocybin exposure. *Translational Psychiatry* **11**(1):209. https://doi.org/10.1038/s41398-021-01335-5

Mason NL, Szabo A, Kuypers KPC, Mallaroni PA, de la Torre Fornell R, Reckweg JT, Tse DHY, Hutten NRPW, Feilding A, Ramaekers JG (2023) Psilocybin induces acute and persisting alterations in immune status in healthy volunteers: An experimental, placebo-controlled study. *Brain, Behavior, and Immunity* **114**:299-310. https://doi.org/10.1016/j.bbi.2023.09.004

McClure-Begley TD, Roth BL (2022) The promises and perils of psychedelic pharmacology for psychiatry. *Nature Reviews Drug Discovery* **21**(6):463-473. https://doi.org/10.1038/s41573-022-00421-7

McDonald C, Losty C, MacCarthy R (2023) An Investigation of the Psychological Status of Amateur Athletes Before and After a Triathlon Competition. *European Journal of Sport Sciences* **2**(3)14–20. https://doi.org/10.24018/ejsport.2023.2.3.83

McIntyre RS, Alsuwaidan M, Baune BT, Berk M, Demyttenaere K, Goldberg JF, Gorwood P, Ho R, Kasper S, Kennedy SH, Ly-Uson J, Mansur RB, McAllister-Williams RH, Murrough JW, Nemeroff CB, Nierenberg AA, Rosenblat JD, Sanacora G, Schatzberg AF, Shelton R, Stahl SM, Trivedi MH, Vieta E, Vinberg M, Williams N, Young AH, Maj M (2023) Treatment-resistant depression: definition, prevalence, detection, management, and investigational interventions. *World Psychiatry* **22**(3):394-412. https://doi.org/10.1002/wps.21120

Melani A, Bonaso M, Biso L, Zucchini B, Conversano C, Scarselli M (2025) Uncovering Psychedelics: From Neural Circuits to Therapeutic Applications. *Pharmaceuticals (Basel)* **18**(1):130. https://doi.org/10.3390/ph18010130

Mendes FR, Costa CDS, Wiltenburg VD, Morales-Lima G, Fernandes JB, Filev R (2022) Classic and non-classic psychedelics for substance use disorder: a review of their historic, past and current research. *Addiction Neuroscience* **3**:100025. https://doi.org/10.1016/j.addicn.2022.100025

Mertens LJ, Wall MB, Roseman L, Demetriou L, Nutt DJ, Carhart-Harris RL (2020) Therapeutic mechanisms of psilocybin: Changes in amygdala and prefrontal functional connectivity during emotional processing after psilocybin for treatment-resistant depression. *Journal of Psychopharmacology* **34**(2):167-180. https://doi.org/10.1177/0269881119895520

Mitchell JM, Anderson BT (2024) Psychedelic therapies reconsidered: compounds, clinical indications, and cautious optimism. *Neuropsychopharmacology* **49**(1):96-103.

https://doi.org/10.1038/s41386-023-01656-7

Mitchell JM, Bogenschutz M, Lilienstein A, Harrison C, Kleiman S, Parker-Guilbert K, Ot'alora G M, Garas W, Paleos C, Gorman I, Nicholas C, Mithoefer M, Carlin S, Poulter B, Mithoefer A, Quevedo S, Wells G, Klaire SS, van der Kolk B, Tzarfaty K, Amiaz R, Worthy R, Shannon S, Woolley JD, Marta C, Gelfand Y, Hapke E, Amar S, Wallach Y, Brown R, Hamilton S, Wang JB, Coker A, Matthews R, de Boer A, Yazar-Klosinski B, Emerson A, Doblin R (2021) MDMA-assisted therapy for severe PTSD: a randomized, double-blind, placebo-controlled phase 3 study. *Nature Medicine* **27**(6):1025-1033. https://doi.org/10.1038/s41591-021-01336-3

Mitchell JM, Ot'alora G M, van der Kolk B, Shannon S, Bogenschutz M, Gelfand Y, Paleos C, Nicholas CR, Quevedo S, Balliett B, Hamilton S, Mithoefer M, Kleiman S, Parker-Guilbert K, Tzarfaty K, Harrison C, de Boer A, Doblin R, Yazar-Klosinski B, MAPP2 Study Collaborator Group (2023) MDMA-assisted therapy for moderate to severe PTSD: a randomized, placebo-controlled phase 3 trial. *Nature Medicine* **29**(10):2473-2480. https://doi.org/10.1038/s41591-023-02565-4

Mithoefer MC, Feduccia AA, Jerome L, Mithoefer A, Wagner M, Walsh Z, Hamilton S, Yazar-Klosinski B, Emerson A, Doblin R (2019) MDMA-assisted psychotherapy for treatment of PTSD: study design and rationale for phase 3 trials based on pooled analysis of six phase 2 randomized controlled trials. *Psychopharmacology (Berl)* **236**(9):2735-2745. https://doi.org/10.1007/s00213-019-05249-5

Mithoefer MC, Mithoefer AT, Feduccia AA, Jerome L, Wagner M, Wymer J, Holland J, Hamilton S, Yazar-Klosinski B, Emerson A, Doblin R (2018) 3,4-methylenedioxymethamphetamine (MDMA)-assisted psychotherapy for post-traumatic stress disorder in military veterans, firefighters, and police officers: a randomised, double-blind, dose-response, phase 2 clinical trial. *Lancet Psychiatry* **5**(6):486-497. https://doi.org/10.1016/S2215-0366(18)30135-4

Mithoefer MC, Wagner MT, Mithoefer AT, Jerome L, Doblin R (2011) The safety and efficacy of {+/-}3,4-methylenedioxymethamphetamine-assisted psychotherapy in subjects with chronic, treatment-resistant posttraumatic stress disorder: the first randomized controlled pilot study. *Journal of Psychopharmacology* **25**(4):439-52. https://doi.org/10.1177/0269881110378371

Mithoefer MC, Wagner MT, Mithoefer AT, Jerome L, Martin SF, Yazar-Klosinski B, Michel Y, Brewerton TD, Doblin R (2013) Durability of improvement in post-traumatic stress disorder symptoms and absence of harmful effects or drug dependency after 3,4-

methylenedioxymethamphetamine-assisted psychotherapy: a prospective long-term follow-up study. *Journal of Psychopharmacology* **27**(1):28-39. https://doi.org/10.1177/0269881112456611

Moliner R, Girych M, Brunello CA, Kovaleva V, Biojone C, Enkavi G, Antenucci L, Kot EF, Goncharuk SA, Kaurinkoski K, Kuutti M, Fred SM, Elsilä LV, Sakson S, Cannarozzo C, Diniz CRAF, Seiffert N, Rubiolo A, Haapaniemi H, Meshi E, Nagaeva E, Öhman T, Róg T, Kankuri E, Vilar M, Varjosalo M, Korpi ER, Permi P, Mineev KS, Saarma M, Vattulainen I, Casarotto PC, Castrén E (2023) Psychedelics promote plasticity by directly binding to BDNF receptor TrkB. *Nature Neuroscience* **26**(6):1032-1041. https://doi.org/10.1038/s41593-023-01316-5

Morales-Garcia JA, Calleja-Conde J, Lopez-Moreno JA, Alonso-Gil S, Sanz-SanCristobal M, Riba J, Perez-Castillo A (2020) *N,N*-dimethyltryptamine compound found in the hallucinogenic tea ayahuasca, regulates adult neurogenesis in vitro and in vivo. *Translational Psychiatry* **10**(1):331. https://doi.org/10.1038/s41398-020-01011-0

Morris AD (2015) Improving pharmaceutical care for athletes: A proposed assessment tool and useful resources. *Canadian Pharmacists Journal* **148**(6):305-7. https://doi.org/10.1177/1715163515607309

Munier JJ, Pank JT, Severino A, Wang H, Zhang P, Vergnes L, Reue K (2022) Simultaneous monitoring of mouse grip strength, force profile, and cumulative force profile distinguishes muscle physiology following surgical, pharmacologic and diet interventions. Scientific Reports. **12**(1):16428. https://doi.org/10.1038/s41598-022-20665-y

Murphy RJ, Muthukumaraswamy S, de Wit H (2024) Microdosing Psychedelics: Current Evidence From Controlled Studies. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging* **9**(5):500-511. https://doi.org/10.1016/j.bpsc.2024.01.002

Nardai S, Laszlo M, Szabó A, Alpár A, Hanics J, Zahola P, Merkely B, Frecska E, Nagy Z (2020) *N,N*-dimethyltryptamine reduces infarct size and improves functional recovery following transient focal brain ischemia in rats. *Experimental Neurology* May;**327**:113245. https://doi.org/10.1016/j.expneurol.2020.113245

Nau F Jr, Miller J, Saravia J, Ahlert T, Yu B, Happel KI, Cormier SA, Nichols CD (2015) Serotonin 5-HT_2 receptor activation prevents allergic asthma in a mouse model. *American Journal of Physiology-Lung Cellular and Molecular Physiology* **308**(2):L191-8. https://doi.org/10.1152/ajplung.00138.2013

Nau F Jr, Yu B, Martin D, Nichols CD (2013) Serotonin 5-HT2A receptor activation

blocks TNF-α mediated inflammation in vivo. *PLoS One* **8**(10):e75426. https://doi.org/10.1371/journal.pone.0075426

Neumann J, Dhein S, Kirchhefer U, Hofmann B, Gergs U (2024) Effects of hallucinogenic drugs on the human heart. *Frontiers in Pharmacology* **15**:1334218. https://doi.org/10.3389/fphar.2024.1334218

Nicholas CR, Wang JB, Coker A, Mitchell JM, Klaire SS, Yazar-Klosinski B, Emerson A, Brown RT, Doblin R (2022) The effects of MDMA-assisted therapy on alcohol and substance use in a phase 3 trial for treatment of severe PTSD. *Drug and Alcohol Dependence* **233**:109356. https://doi.org/10.1016/j.drugalcdep.2022.109356

Nichols DE (2016). Psychedelics. *Pharmacological Reviews* **68**(2):264-355. https://doi.org/10.1124/pr.115.011478

Niu X, Yao Q, Li W, Zang L, Li W, Zhao J, Liu F, Zhi W (2019) Harmine mitigates LPS-induced acute kidney injury through inhibition of the TLR4-NF-κB/NLRP3 inflammasome signalling pathway in mice. *European Journal of Pharmacology* **849**:160-169. https://doi.org/10.1016/j.ejphar.2019.01.062

Nkadimeng SM, Steinmann CML, Eloff JN (2021) Anti-Inflammatory Effects of Four Psilocybin-Containing Magic Mushroom Water Extracts in vitro on 15-Lipoxygenase Activity and on Lipopolysaccharide-Induced Cyclooxygenase-2 and Inflammatory Cytokines in Human U937 Macrophage Cells. *Journal of Inflammation Research* **14**:3729-3738. https://doi.org/10.2147/JIR.S317182

Nutt D, Carhart-Harris R (2021) The Current Status of Psychedelics in Psychiatry. *JAMA Psychiatry* **78**(2):121-122. https://doi.org/10.1001/jamapsychiatry.2020.2171

Nutt D, Crome I, Young AH (2024) Is it now time to prepare psychiatry for a psychedelic future? *British Journal of Psychiatry* **225**(2):308-310. https://doi.org/10.1192/bjp.2024.76

Nutt DJ, King LA, Phillips LD (2020) Independent Scientific Committee on Drugs. Drug harms in the UK: a multicriteria decision analysis. *Lancet* **376**(9752):1558-65. https://doi.org/10.1016/S0140-6736(10)61462-6

Odland AU, Kristensen JL, Andreasen JT (2022) Animal Behavior in Psychedelic Research. *Pharmacological Reviews* **74**(4):1176-1205. https://doi.org/10.1124/pharmrev.122.000590

Oehen P, Traber R, Widmer V, Schnyder U (2013) A randomized, controlled pilot study of MDMA (± 3,4-Methylenedioxymethamphetamine)-assisted psychotherapy for treatment of resistant, chronic Post-Traumatic Stress Disorder (PTSD). *Journal of*

Psychopharmacology **27**(1):40-52. https://doi.org/10.1177/0269881112464827

Olson DE (2022) Biochemical Mechanisms Underlying Psychedelic-Induced Neuroplasticity. *Biochemistry* **61**(3):127-136. https://doi.org/10.1021/acs.biochem.1c00812

Osmond H (1957). A review of the clinical effects of psychotomimetic agents. *Annals of the New York Academy of Sciences* **66**(3):418-34. https://doi.org/10.1111/j.1749-6632.1957.tb40738.x

Ot'alora G M, Grigsby J, Poulter B, Van Derveer JW 3rd, Giron SG, Jerome L, Feduccia AA, Hamilton S, Yazar-Klosinski B, Emerson A, Mithoefer MC, Doblin R (2018) 3,4-Methylenedioxymethamphetamine-assisted psychotherapy for treatment of chronic posttraumatic stress disorder: A randomized phase 2 controlled trial. *Journal of Psychopharmacology* **32**(12):1295-1307. https://doi.org/10.1177/0269881118806297

Pagni BA, Petridis PD, Podrebarac SK, Grinband J, Claus ED, Rogenschutz MP (2024) Psilocybin-induced changes in neural reactivity to alcohol and emotional cues in patients with alcohol use disorder: an fMRI pilot study. *Scientific Reports* **14**(1):3159. https://doi.org/10.1038/s41598-024-52967-8

Palhano-Fontes F, Andrade KC, Tofoli LF, Santos AC, Crippa JA, Hallak JE, Ribeiro S, de Araujo DB (2015) The psychedelic state induced by ayahuasca modulates the activity and connectivity of the default mode network. *PLoS One* **10**(2):e0118143. https://doi.org/10.1371/journal.pone.0118143

Palhano-Fontes F, Barreto D, Onias H, Andrade KC, Novaes MM, Pessoa JA, Mota-Rolim SA, Osório FL, Sanches R, Dos Santos RG, Tófoli LF, de Oliveira Silveira G, Yonamine M, Riba J, Santos FR, Silva-Junior AA, Alchieri JC, Galvão-Coelho NL, Lobão-Soares B, Hallak JEC, Arcoverde E, Maia-de-Oliveira JP, Araújo DB (2019) Rapid antidepressant effects of the psychedelic ayahuasca in treatment-resistant depression: a randomized placebo-controlled trial. *Psychological Medicine* **49**(4):655-663. https://doi.org/10.1017/S0033291718001356

Peck SK, Shao S, Gruen T, Yang K, Babakanian A, Trim J, Finn DM, Kaye WH (2023) Psilocybin therapy for females with anorexia nervosa: a phase 1, open-label feasibility study. *Nature Medicine* **29**(8):1947-1953. https://doi.org/10.1038/s41591-023-02455-9

Peill J, Marguilho M, Erritzoe D, Barba T, Greenway KT, Rosas F, Timmermann C, Carhart-Harris R (2024) Psychedelics and the 'inner healer': Myth or mechanism? Journal of Psychopharmacology **38**(5):417-424. https://doi.org/10.1177/02698811241239206

Perkins D, Pagni BA, Sarris J, Barbosa PCR, Chenhall R (2022) Changes in mental health, wellbeing and personality following ayahuasca consumption: Results of a naturalistic longitudinal study. *Frontiers in Pharmacology* **13**:884703. https://doi.org/10.3389/fphar.2022.884703

Pokorny T, Preller KH, Kometer M, Dziobek I, Vollenweider FX (2017) Effect of Psilocybin on Empathy and Moral Decision-Making. *International Journal of Neuropsychopharmacology* **20**(9):747-757. https://doi.org/10.1093/ijnp/pyx047

Polito V, Stevenson RJ (2019) A systematic study of microdosing psychedelics. *PLoS One* **14**(2):e0211023. https://doi.org/10.1371/journal.pone.0211023

Ponte L, Jerome L, Hamilton S, Mithoefer MC, Yazar-Klosinski BB, Vermetten E, Feduccia AA (2021) Sleep Quality Improvements After MDMA-Assisted Psychotherapy for the Treatment of Posttraumatic Stress Disorder. *Journal of Traumatic Stress* **34**(4):851-863. https://doi.org/10.1002/jts.22696

Preller KH, Burt JB, Ji JL, Schleifer CH, Adkinson BD, Stämpfli P, Seifritz E, Repovs G, Krystal JH, Murray JD, Vollenweider FX, Anticevic A (2018) Changes in global and thalamic brain connectivity in LSD-induced altered states of consciousness are attributable to the 5-HT2A receptor. *Elife* **7**:e35082. https://doi.org/10.7554/eLife.35082

Preller KH, Duerler P, Burt JB, Ji JL, Adkinson B, Stämpfli P, Seifritz E, Repovš G, Krystal JH, Murray JD, Anticevic A, Vollenweider FX (2020) Psilocybin Induces Time-Dependent Changes in Global Functional Connectivity. *Biological Psychiatry* **88**(2):197-207. https://doi.org/10.1016/j.biopsych.2019.12.027

Rakoczy RJ, Runge GN, Sen AK, Sandoval O, Wells HG, Nguyen Q, Roberts BR, Sciortino JH, Gibbons VJ Jr, Friedberg LM, Jones JA, McMurray MS (2024) Pharmacological and behavioural effects of tryptamines present in psilocybin-containing mushrooms. *British Journal of Pharmacology* **181**(19):3627-3641. https://doi.org/10.1111/bph.16466

Ramaekers JG, Hutten N, Mason NL, Dolder P, Theunissen EL, Holze F, Liechti ME, Feilding A, Kuypers KP (2021) A low dose of lysergic acid diethylamide decreases pain perception in healthy volunteers. *Journal of Psychopharmacology* **35**(4):398-405. https://doi.org/10.1177/0269881120940937

Raote I, Bhattacharya A, Panicker MM (2007) Serotonin 2A (5-HT_{2A}) Receptor Function: Ligand-Dependent Mechanisms and Pathways. In: Chattopadhyay A, editor. *Serotonin Receptors in Neurobiology*. Boca Raton (FL): CRC Press/Taylor & Francis; Chapter 6. https://www.ncbi.nlm.nih.gov/books/NBK1853/

Ray TS (2010) Psychedelics and the human receptorome. *PLoS One* **5**(2):e9019. https://doi.org/10.1371/journal.pone.0009019

Reardon CL, Creado S (2016) Psychiatric medication preferences of sports psychiatrists. *Physician and Sportsmedicine* **44**(4):397-402. https://doi.org/10.1080/00913847.2016.1216719

Reardon CL, Hainline B, Aron CM, Baron D, Baum AL, Bindra A, Budgett R, Campriani N, Castaldelli-Maia JM, Currie A, Derevensky JL, Glick ID, Gorczynski P, Gouttebarge V, Grandner MA, Han DH, McDuff D, Mountjoy M, Polat A, Purcell R, Putukian M, Rice S, Sills A, Stull T, Swartz L, Zhu LJ, Engebretsen L (2019) Mental health in elite athletes: International Olympic Committee consensus statement (2019). *British Journal of Sports Medicine* **53**(11):667-699. https://doi.org/10.1136/bjsports-2019-100715

Reardon CL (2016) The sports psychiatrist and psychiatric medication. *International Review of Psychiatry* **28**(6):606-613. https://doi.org/10.1080/09540261.2016.1190691

Reiff CM, Richman EE, Nemeroff CB, Carpenter LL, Widge AS, Rodriguez CI, Kalin NH, McDonald WM; the Work Group on Biomarkers and Novel Treatments, a Division of the American Psychiatric Association Council of Research (2020) Psychedelics and Psychedelic-Assisted Psychotherapy. *American Journal of Psychiatry* **177**(5):391-410. https://doi.org/10.1176/appi.ajp.2019.19010035

Rhee TG, Davoudian PA, Sanacora G, Wilkinson ST (2023) Psychedelic renaissance: Revitalized potential therapies for psychiatric disorders. *Drug Discovery Today* **28**(12):103818. https://doi.org/10.1016/j.drudis.2023.103818

Riba J, Valle M, Urbano G, Yritia M, Morte A, Barbanoj MJ (2003) Human pharmacology of ayahuasca: subjective and cardiovascular effects, monoamine metabolite excretion, and pharmacokinetics. *Journal of Pharmacology and Experimental Therapeutics* **306**(1):73-83. https://doi.org/10.1124/jpet.103.049882

Romeo B, Kervadec E, Fauvel B, Strika-Bruneau L, Amirouche A, Verroust V, Piolino P, Benyamina A (2024) Safety and risk assessment of psychedelic psychotherapy: A meta-analysis and systematic review. *Psychiatry Research* **335**:115880. https://doi.org/10.1016/j.psychres.2024.115880

Roseman L, Demetriou L, Wall MB, Nutt DJ, Carhart-Harris RL (2018) Increased amygdala responses to emotional faces after psilocybin for treatment-resistant depression. *Neuropharmacology* **142**:263-269. https://doi.org/10.1016/j.neuropharm.2017.12.041

Ross S, Bossis A, Guss J, Agin-Liebes G, Malone T, Cohen B, Mennenga SE, Belser A,

Kalliontzi K, Babb J, Su Z, Corby P, Schmidt BL (2016) Rapid and sustained symptom reduction following psilocybin treatment for anxiety and depression in patients with life-threatening cancer: a randomized controlled trial. *Journal of Psychopharmacology* **30**(12):1165-1180. https://doi.org/10.1177/0269881116675512

Rusyniak DE, Tandy SL, Hekmatyar SK, Mills E, Smith DJ, Bansal N, MacLellan D, Harper ME, Sprague JE (2005) The role of mitochondrial uncoupling in 3,4-methylenedioxymethamphetamine-mediated skeletal muscle hyperthermia and rhabdomyolysis. *Journal of Pharmacology and Experimental Therapeutics* **313**(2):[illegible]-39. https://doi.org/10.1124/jpet.104.079236

Sabé M, Sulstarova A, Glangetas A, De Pieri M, Mallet L, Curtis L, Richard-Lepouriel H, Penzenstadler L, Seragnoli F, Thorens G, Zullino D, Preller K, Böge K, Leucht S, Correll CU, Solmi M, Kaiser S, Kirschner M (2024) Reconsidering evidence for psychedelic-induced psychosis: an overview of reviews, a systematic review, and meta-analysis of human studies. *Molecular Psychiatry*. https://doi.org/10.1038/s41380-024-02800-5

Sanches RF, de Lima Osório F, Dos Santos RG, Macedo LR, Maia-de-Oliveira JP, Wichert-Ana L, de Araujo DB, Riba J, Crippa JA, Hallak JE (2016) Antidepressant Effects of a Single Dose of Ayahuasca in Patients With Recurrent Depression: A SPECT Study. *Journal of Clinical Psychopharmacology* **36(**1):77-81. https://doi.org/10.1097/JCP.0000000000000436

Sarparast A, Thomas K, Malcolm B, Stauffer CS (2022) Drug-drug interactions between psychiatric medications and MDMA or psilocybin: a systematic review. *Psychopharmacology (Berl)* **239**(6):1945-1976. https://doi.org/10.1007/s00213-022-06083-y

Schlag AK, Aday J, Salam I, Neill JC, Nutt DJ (2022) Adverse effects of psychedelics: From anecdotes and misinformation to systematic science. *Journal of Psychopharmacology* **36**(3):258-272. https://doi.org/10.1177/02698811211069100

Schmid Y, Hysek CM, Simmler LD, Crockett MJ, Quednow BB, Liechti ME (2014) Differential effects of MDMA and methylphenidate on social cognition. *Journal of Psychopharmacology* **28**(9):847-56. https://doi.org/10.1177/0269881114542454

Schmid Y, Liechti ME (2018) Long-lasting subjective effects of LSD in normal subjects. *Psychopharmacology (Berl)* **235**(2):535-545. https://doi.org/10.1007/s00213-017-4733-3

Schneier FR, Feusner J, Wheaton MG, Gomez GJ, Cornejo G, Naraindas AM, Hellerstein DJ (2023) Pilot study of single-dose psilocybin for serotonin reuptake

inhibitor-resistant body dysmorphic disorder. *Journal of Psychiatric Research* **161**:364-370. https://doi.org/10.1016/j.jpsychires.2023.03.031

Screaton GR, Singer M, Cairns HS, Thrasher A, Sarner M, Cohen SL (1992) Hyperpyrexia and rhabdomyolysis after MDMA ("ecstasy") abuse. *Lancet* **339**(8794):677-8. https://doi.org/10.1016/0140-6736(92)90834-p

Shafiee A, Arabzadeh Bahri R, Rafiei MA, Esmaeilpur Abianeh F, Razmara P, Jafarabady K, Amini MJ (2024) The effect of psychedelics on the level of brain-derived neurotrophic factor: A systematic review and meta-analysis. *Journal of Psychopharmacology* **38**(5):425-431. https://doi.org/10.1177/02698811241234247

Shahraki MR, Irani M (2014). The effects of ecstasy on liver function tests, blood glucose, and lipids profile of male rats. *Journal of High Risk Behaviors and Addiction* **3**(4):e21076. https://doi.org/10.5812/ijhrba.21076

Shakir J, Pedicini M, Bullock BC, Hoen PW, Macias LK, Freeman J, Pletnikov MV, Tamashiro KLK, Cordner ZA (2024) Effects of psilocybin on body weight, body composition, and metabolites in male and female mice. *Physiology & Behavior* **284**:114627. https://doi.org/10.1016/j.physbeh.2024.114627

Shan J, Khelashvili G, Mondal S, Mehler EL, Weinstein H (2012) Ligand-dependent conformations and dynamics of the serotonin 5-HT(2A) receptor determine its activation and membrane-driven oligomerization properties. *PLoS Computational Biology* **8**(4):e1002473. https://doi.org/10.1371/journal.pcbi.1002473

Shao LX, Liao C, Gregg I, Davoudian PA, Savalia NK, Delagarza K, Kwan AC (2021) Psilocybin induces rapid and persistent growth of dendritic spines in frontal cortex in vivo. *Neuron* **109**(16):2535-2544 e4. https://doi.org/10.1016/j.neuron.2021.06.008

Shen L, Lv X, Yang X, Deng S, Liu L, Zhou J, Zhu Y, Ma H (2022) Bufotenines-loaded liposome exerts anti-inflammatory, analgesic effects and reduce gastrointestinal toxicity through altering lipid and bufotenines metabolism. *Biomedicine & Pharmacotherapy* **153**:113492. https://doi.org/10.1016/j.biopha.2022.113492

Siegel JS, Subramanian S, Perry D, Kay BP, Gordon EM, Laumann TO, Reneau TR, Metcalf NV, Chacko RV, Gratton C, Horan C, Krimmel SR, Shimony JS, Schweiger JA, Wong DF, Bender DA, Scheidter KM, Whiting FI, Padawer-Curry JA, Shinohara RT, Chen Y, Moser J, Yacoub E, Nelson SM, Vizioli L, Fair DA, Lenze EJ, Carhart-Harris R, Raison CL, Raichle ME, Snyder AZ, Nicol GE, Dosenbach NUF (2024) Psilocybin desynchronizes the human brain. *Nature* **632**(8023):131-138. https://doi.org/10.1038/s41586-024-07624-5

Simon MW, Olsen HA, Hoyte CO, Black JC, Reynolds KM, Dart RC, Monte AA (2012) Clinical Effects of Psychedelic Substances Reported to United States Poison Centers: 2012 to 2022. *Annals of Emergency Medicine* **84**(6):605-618. https://doi.org/10.1016/j.annemergmed.2024.06.025

Simonsson O, Osika W, Carhart-Harris R, Hendricks PS (2021) Associations between lifetime classic psychedelic use and cardiometabolic diseases. *Scientific Reports* **11**(1):14427. https://doi.org/10.1038/s41598-021-93787-4

Singleton SP, Wang JB, Mithoefer M, Hanlon C, George MS, Mithoefer A, Mithoefer O, Coker AR, Yazar-Klosinski B, Emerson A, Doblin R, Kuceyeski A (2023) Altered brain activity and functional connectivity after MDMA-assisted therapy for post-traumatic stress disorder. *Frontiers in Psychiatry* **13**:947622. https://doi.org/10.3389/fpsyt.2022.947622

Skosnik PD, Sloshower J, Safi-Aghdam H, Pathania S, Syed S, Pittman B, D'Souza DC (2023) Sub-acute effects of psilocybin on EEG correlates of neural plasticity in major depression: Relationship to symptoms. *Journal of Psychopharmacology* **37**(7):687-697. https://doi.org/10.1177/02698811231179800

Slattery DA, Cryan JF (2012) Using the rat forced swim test to assess antidepressant-like activity in rodents. *Nature Protocols* **7**(6):1009-14. https://doi.org/10.1038/nprot.2012.044

Sloshower J, Skosnik PD, Safi-Aghdam H, Pathania S, Syed S, Pittman B, D'Souza DC (2023) Psilocybin-assisted therapy for major depressive disorder: An exploratory placebo-controlled, fixed-order trial. *Journal of Psychopharmacology* **37**(7):698-706. https://doi.org/10.1177/02698811231154852

Sloshower J, Zeifman RJ, Guss J, Krause R, Safi-Aghdam H, Pathania S, Pittman B, D'Souza DC (2024) Psychological flexibility as a mechanism of change in psilocybin-assisted therapy for major depression: results from an exploratory placebo-controlled trial. *Scientific Reports* **14**(1):8833. https://doi.org/10.1038/s41598-024-58318-x

Smith A, Buadze A, Colangelo J, Liebrenz M (2023) A Review of Mental Health Issues in High-Performance and Elite-Level Cycling. *International Journal of Sports Medicine* **44**(14):1034-1042. https://doi.org/10.1055/a-2145-6355

Soto-Angona Ó, Fortea A, Fortea L, Martínez-Ramírez M, Santamarina E, López FJG, Knudsen GM, Ona G (2024) Do classic psychedelics increase the risk of seizures? A scoping review. *European Neuropsychopharmacology* **85**:35-42. https://doi.org/10.1016/j.euroneuro.2024.05.002

Soto-Montenegro ML, Vaquero JJ, Arango C, Ricaurte G, García-Barreno P, Desco M (2007) Effects of MDMA on blood glucose levels and brain glucose metabolism. *European Journal of Nuclear Medicine and Molecular Imaging* **34**(6):916-25. https://doi.org/10.1007/s00259-006-0262-8

Sprague JE, Brutcher RE, Mills EM, Caden D, Rusyniak DE (2004) Attenuation of 3,4-methylenedioxymethamphetamine (MDMA, Ecstasy)-induced rhabdomyolysis with alpha1- plus beta3-adrenoreceptor antagonists. *British Journal of Pharmacology* **142**(4):667-70. https://doi.org/10.1038/sj.bjp.0705823

Sprague JE, Moze P, Caden D, Rusyniak DE, Holmes C, Goldstein DS, Mills EM. (2005) Carvedilol reverses hyperthermia and attenuates rhabdomyolysis induced by 3,4-methylenedioxymethamphetamine (MDMA, Ecstasy) in an animal model. *Critical Care Medicine* **33**(6):1311-6. https://doi.org/10.1097/01.ccm.0000165969.29002.70

Stankevicius D, Ferraz-de-Paula V, Ribeiro A, Pinheiro ML, Ligeiro de Oliveira AP, Damazo AS, Lapachinske SF, Moreau RL, Tavares de Lima W, Palermo-Neto J (2012) 3,4-methylenedioxymethamphetamine (ecstasy) decreases inflammation and airway reactivity in a murine model of asthma. *Neuroimmunomodulation* **19**(4):209-19. https://doi.org/10.1159/000334098

Strand NH, Whitney M, Johnson B, Duda T, Attanti S, Maloney J, Misra L, Gomez D, Viswanath O, Emami E, Leathem J (2025) Pain and Perception: Exploring Psychedelics as Novel Therapeutic Agents in Chronic Pain Management. *Current Pain and Headache Reports* **29**(1):15. https://doi.org/10.1007/s11916-024-01353-0

Stoliker D, Novelli L, Vollenweider FX, Egan GF, Preller KH, Razi A (2024) Neural Mechanisms of Resting-State Networks and the Amygdala Underlying the Cognitive and Emotional Effects of Psilocybin. *Biological Psychiatry* **96**(1):57-66. https://doi.org/10.1016/j.biopsych.2024.01.002

Stone MB, Yaseen ZS, Miller BJ, Richardville K, Kalaria SN, Kirsch I (2022) Response to acute monotherapy for major depressive disorder in randomized, placebo controlled trials submitted to the US Food and Drug Administration: individual participant data analysis. *British Medical Journal* **378**:e067606. https://doi.org/10.1136/bmj-2021-067606

Sue YM, Lee YL, Huang JJ (2002) Acute hyponatremia, seizure, and rhabdomyolysis after ecstasy use. *Journal of Toxicology: Clinical Toxicology* **40**(7):931-2. https://doi.org/10.1081/clt-120016964

Sun J, Yang X, Zhang Y, Zhang W, Lu J, Hu Q, Liu R, Zhou C, Chen C (2019) Salvinorin A attenuates early brain injury through PI3K/Akt pathway after subarachnoid hemorrhage in rat. *Brain Research* **1719**:64-70. https://doi.org/10.1016/j.brainres.2019.05.026

Tabaa MME, Tabaa MME, Rashad E, Elballal MS, Elazazy O (2024) Harmine alleviated STZ-induced rat diabetic nephropathy: A potential role via regulating AMPK/Nrf2 pathway and deactivating ataxia-telangiectasia mutated (ATM) signaling. *International Immunopharmacology* **132**:111954. https://doi.org/10.1016/j.intimp.2024.111954

Thomas K (2024) Toxicology and Pharmacological Interactions of Classic Psychedelics. *Current Topics in Behavioral Neurosciences.* https://doi.org/10.1007/7854_2024_508

Thompson C, Szabo A (2020) Psychedelics as a novel approach to treating autoimmune conditions. Immunology Letters **228**:45-54. https://doi.org/10.1016/j.imlet.2020.10.001

Thuany M, Viljoen C, Gomes TN, Knechtle B, Scheer V (2023) Mental Health in Ultra-Endurance Runners: A Systematic Review. *Sports Medicine* **53**(10):1891-1904. https://doi.org/10.1007/s40279-023-01890-5

Tso JV, Pelliccia A (2022) Psychiatric Medications and Cardiovascular Performance: Uncommon Depressing Side Effects. *Journals of the American College of Cardiology Case Reports* **4**(20):1341-1343. https://doi.org/10.1016/j.jaccas.2022.08.004

Vamvakopoulou IA, Nutt DJ (2024) Psychedelics: From Cave Art to 21st-Century Medicine for Addiction. *European Addiction Research* **30**(5):302-320. https://doi.org/10.1159/000540062

van der Kolk BA, Wang JB, Yehuda R, Bedrosian L, Coker AR, Harrison C, Mithoefer M, Yazar-Klosinki B, Emerson A, Doblin R (2024) Effects of MDMA-assisted therapy for PTSD on self-experience. *PLoS One* **19**(1):e0295926. https://doi.org/10.1371/journal.pone.0295926

van Oorsouw K, Toennes SW, Ramaekers JG (2022) Therapeutic effect of an ayahuasca analogue in clinically depressed patients: a longitudinal observational study. *Psychopharmacology (Berl)* **239**(6):1839-1852. https://doi.org/10.1007/s00213-021-06046-9

Vanden Eede H, Montenij LJ, Touw DJ, Norris EM (2012) Rhabdomyolysis in MDMA intoxication: a rapid and underestimated killer. "Clean" Ecstasy, a safe party drug? *Journal of Emergency Medicine* **42**(6):655-8. https://doi.org/10.1016/j.jemermed.2009.04.057

VanderZwaag B, Garcia-Romeu A, Garcia-Barrera MA (2024) Exploring psychedelic use in athletes and their attitudes toward psilocybin-assisted therapy in concussion recovery. *Therapeutic Advances in Psychopharmacology* **14**:20451253241264812. https://doi.org/10.1177/20451253241264812

Vargas MV, Dunlap LE, Dong C, Carter SJ, Tombari RJ, Jami SA, Cameron LP, Patel SD, Hennessey JJ, Saeger HN, McCorvy JD, Gray JA, Tian L, Olson DE (2023) Psychedelics promote neuroplasticity through the activation of intracellular 5-HT2A receptors. *Science* **379**(6633):700-706. https://doi.org/10.1126/science.adf0435

Vollenweider FX, Preller KH (2020) Psychedelic drugs: neurobiology and potential for treatment of psychiatric disorders. *Nature Reviews Neuroscience* **21**(11):611-624. https://doi.org/10.1038/s41583-020-0367-2

Wallach J, Cao AB, Calkins MM, Heim AJ, Lanham JK, Bonniwell EM, Hennessey JJ, Bock HA, Anderson EI, Sherwood AM, Morris H, de Klein R, Klein AK, Cuccurazzu B, Gamrat J, Fannana T, Zauhar R, Halberstadt AL, McCorvy JD (2023) Identification of 5-HT_{2A} receptor signaling pathways associated with psychedelic potential. *Nature Communications* **14**(1):8221. https://doi.org/10.1038/s41467-023-44016-1

Wang J, Xu D, Shen L, Zhou J, Lv X, Ma H, Li N, Wu Q, Duan J (2021) Anti-inflammatory and analgesic actions of bufotenine through inhibiting lipid metabolism pathway. *Biomedicine & Pharmacotherapy* **140**:111749. https://doi.org/10.1016/j.biopha.2021.111749

Wang L, Wang Q, Wang W, Ge G, Xu N, Zheng D, Jiang S, Zhao G, Xu Y, Wang Y, Zhu R, Geng D (2021) Harmine Alleviates Titanium Particle-Induced Inflammatory Bone Destruction by Immunomodulatory Effect on the Macrophage Polarization and Subsequent Osteogenic Differentiation. *Frontiers in Immunology* **12**:657687. https://doi.org/10.3389/fimmu.2021.657687

Werle I, Bertoglio LJ (2024) Psychedelics: A review of their effects on recalled aversive memories and fear/anxiety expression in rodents. *Neuroscience & Biobehavioral Reviews* **167**:105899. https://doi.org/10.1016/j.neubiorev.2024.105899

Werle I, Nascimento LMM, Dos Santos ALA, Soares LA, Dos Santos RG, Hallak JEC, Bertoglio LJ (2024) Ayahuasca-enhanced extinction of fear behaviour: Role of infralimbic cortex 5-HT_{2A} and 5-HT_{1A} receptors. *British Journal of Pharmacology*

181(11):1671-1689. https://doi.org/10.1111/bph.16315

White SR, Obradovic T, Imel KM, Wheaton MJ (1996) The effects of methylenedioxymethamphetamine (MDMA, "Ecstasy") on monoaminergic neurotransmission in the central nervous system. *Progress in Neurobiology* **49**(5):455-79. https://doi.org/10.1016/0301-0082(96)00027-5

Wießner I, Falchi M, Maia LO, Daldegan-Bueno D, Palhano-Fontes F, Mason NL, Ramaekers JG, Gross ME, Schooler JW, Feilding A, Ribeiro S, Araujo DB, Tófoli LF (2022) LSD and creativity: Increased novelty and symbolic thinking, decreased utility and convergent thinking. *Journal of Psychopharmacology* **36**(3):348-359. https://doi.org/10.1177/02698811211069113

Wittmann M, Carter O, Hasler F, Cahn BR, Grimberg U, Spring P, Hell D, Flohr H, Vollenweider FX (2007) Effects of psilocybin on time perception and temporal control of behaviour in humans. *Journal of Psychopharmacology* **21**(1):50-64. https://doi.org/10.1177/0269881106065859

Wolfson PE, Andries J, Feduccia AA, Jerome L, Wang JB, Williams E, Carlin SC, Sola E, Hamilton S, Yazar-Klosinski B, Emerson A, Mithoefer MC, Doblin R (2020) MDMA-assisted psychotherapy for treatment of anxiety and other psychological distress related to life-threatening illnesses: a randomized pilot study. *Scientific Reports* **10**(1):20442. https://doi.org/10.1038/s41598-020-75706-1

Wsół A (2023) Cardiovascular safety of psychedelic medicine: current status and future directions. *Pharmacological Reports* **75**(6):1362-1380. https://doi.org/10.1007/s43440-023-00539-4

Xin J, Ma X, Chen W, Zhou W, Dong H, Wang Z, Ji F (2021) Regulation of blood-brain barrier permeability by Salvinorin A via alleviating endoplasmic reticulum stress in brain endothelial cell after ischemia stroke. *Neurochemistry International* **149**:105093. https://doi.org/10.1016/j.neuint.2021.105093

Yanakieva S, Polychroni N, Family N, Williams LTJ, Luke DP, Terhune DB (2019) The effects of microdose LSD on time perception: a randomized, double-blind, placebo-controlled trial. *Psychopharmacology (Berl)* **236**(4):1159-1170. https://doi.org/10.1007/s00213-018-5119-x

Yao Y, Guo D, Lu TS, Liu FL, Huang SH, Diao MQ, Li SX, Zhang XJ, Kosten TR, Shi J, Bao YP, Lu L, Han Y. Efficacy and safety of psychedelics for the treatment of mental disorders: A systematic review and meta-analysis. *Psychiatry Research* **335**:115886. https://doi.org/10.1016/j.psychres.2024.115886

Yerubandi A, Thomas JE, Bhuiya NMMA, Harrington C, Villa Zapata L, Caballero J (2024) Acute Adverse Effects of Therapeutic Doses of Psilocybin: A Systematic Review and Meta-Analysis. *JAMA Network Open* **7**(4):e245960. https://doi.org/10.1001/jamanetworkopen.2024.5960

Yousefi P, Lietz MP, O'Higgins FJ, Rippe RCA, Hasler G, van Elk M, Enriquez-Geppert S (2025) Acute effects of psilocybin on attention and executive functioning in healthy volunteers: a systematic review and multilevel meta-analysis. *Psychopharmacology*. https://doi.org/10.1007/s00213-024-06742-2

Yu B, Becnel J, Zerfaoui M, Rohatgi R, Boulares AH, Nichols CD (2008) Serotonin 5-hydroxytryptamine(2A) receptor activation suppresses tumor necrosis factor-alpha-induced inflammation with extraordinary potency. *Journal of Pharmacology and Experimental Therapeutics* **327**(2):316-23. https://doi.org/10.1124/jpet.108.143461

Zanikov T, Gerasymchuk M, Ghasemi Gojani E, Robinson GI, Asghari S, Groves A, Haselhorst L, Nandakumar S, Stahl C, Cameron M, Li D, Rodriguez-Juarez R, Snelling A, Hudson D, Fiselier A, Kovalchuk O, Kovalchuk I (2023) The Effect of Combined Treatment of Psilocybin and Eugenol on Lipopolysaccharide-Induced Brain Inflammation in Mice. *Molecules* **28**(6):2624. https://doi.org/10.3390/molecules28062624

Zaretsky TG, Jagodnik KM, Barsic R, Antonio JH, Bonanno PA, MacLeod C, Pierce C, Carney H, Morrison MT, Saylor C, Danias G, Lepow L, Yehuda R (2024) The Psychedelic Future of Post-Traumatic Stress Disorder Treatment. *Current Neuropharmacology* **22**(4):636-735. https://doi.org/10.2174/1570159X22666231027111147

Zeifman RJ, Singhal N, Dos Santos RG, Sanches RF, de Lima Osório F, Hallak JEC, Weissman CR (2021) Rapid and sustained decreases in suicidality following a single dose of ayahuasca among individuals with recurrent major depressive disorder: results from an open-label trial. *Psychopharmacology (Berl)* **238**(2):453-459. https://doi.org/10.1007/s00213-020-05692-9

Zeifman RJ, Wagner AC, Monson CM, Carhart-Harris RL (2023) How does psilocybin therapy work? An exploration of experiential avoidance as a putative mechanism of change. *Journal of Affective Disorders Reports* **334**:100-112. https://doi.org/10.1016/j.jad.2023.04.105

Zeng Y, Chourpiliadis C, Hammar N, Seitz C, Valdimarsdóttir UA, Fang F, Song H, Wei D (2024) Inflammatory Biomarkers and Risk of Psychiatric Disorders. *JAMA Psychiatry* **81**(11):1118-1129. https://doi.org/10.1001/jamapsychiatry.2024.2185

Zheng ZH, Lin XC, Lu Y, Cao SR, Liu XK, Lin D, Yang FH, Zhang YB, Tu JL, Pan BX, Hu P, Zhang WH (2023) Harmine exerts anxiolytic effects by regulating neuroinflammation and neuronal plasticity in the basolateral amygdala. *International Immunopharmacology* **119**:110208. https://doi.org/10.1016/j.intimp.2023.110208

Zhong Z, Tao Y, Yang H (2015) Treatment with harmine ameliorates functional impairment and neuronal death following traumatic brain injury. *Molecular Medicine Reports* **12**(6):7985-91. https://doi.org/10.3892/mmr.2015.4437