

Title: Psychedelics and mindfulness: A systematic review and meta-analysis

Short running title: Psychedelics & Mindfulness

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Conflict of Interest

The authors report no conflict of interest.

Abstract

Background and Aims: The benefits of classic serotonergic psychedelics (e.g. psilocybin, LSD, DMT, ayahuasca) are becoming more widely known with the resurgence in research in the past decade. Furthermore, the benefits of mindfulness are well documented. However, no systematic reviews have examined linkage of mindfulness and psychedelics use. The aim of this systematic review is to explore the link between psychedelics and characteristics of mindfulness. **Methods:** We conducted a systematic search across multiple databases, inclusive of grey literature and backwards/forward-citation tracking, on the 18 January 2021. The search strategy included terms relating to mindfulness and psychedelics, with no restriction on clinical or non-clinical conditions. Study quality was assessed. An exploratory random-effects meta-analysis was conducted on pre-post mindfulness data relative to psychedelic ingestion. **Results:** Of 1805 studies screened, 13 were included in the systematic review. There was substantial variability in participant characteristics, psychedelic administration method and measurement of mindfulness. The ingestion of psychedelics is associated with an increase in mindfulness, specifically relating to domains of acceptance, which encompasses non-judgement of inner experience and non-reactivity. The meta-analysis of a subset of studies (N=6) showed small effects overall relative to ayahuasca ingestion, increasing mindfulness facets of non-judgement of inner experience and non-reactivity, as well as acting with awareness. **Conclusions:** Further methodologically robust research is needed to elucidate the relationship between psychedelics and mindfulness. However, mindfulness and specific facets relating to acceptance have been shown to increase following ingestion of psychedelics in a number of studies.

Keywords: Psychedelics, ayahuasca, mindfulness, systematic review, meta-analysis

INTRODUCTION

The term psychedelic was coined by Humphrey Osmond in 1957 in order to describe their mind-manifesting capabilities, using a combination of the Greek words *psyche* (mind) and *delos* (manifest) (Osmond, 1957). Classic psychedelic substances include N,N-Dimethyltryptamine (DMT), found in the Amazonian brew ayahuasca; psilocybin, found in many species of mushrooms; mescaline, found in the peyote cactus; and lysergic acid diethylamide (LSD), which is synthesized. These psychedelics produce a variety of subjective experiences: changes in perception, volition, cognition, thinking and mood, along with visual and auditory hallucinations, and dissociative phenomena are all possible effects of these psychedelics (Isbell, 1959; Riba et al., 2001; Wolbach, Miner, & Isbell, 1962).

Psychedelics are in the midst of a revival of research and understanding (Carhart-Harris & Goodwin, 2017). Psychedelics' beneficial role in healthcare and well-being is historically well established (Nichols, 2016), and their positive effects on clinical populations are increasingly highlighted (Bogenschutz et al., 2015; Carhart-Harris et al., 2018; Griffiths et al., 2016; Sanches et al., 2016; Thomas et al., 2013). Further, the importance of set (e.g. mindset, beliefs, attitudes, expectations, motivation) and setting (e.g. physical, social, cultural context) have been identified as essential components of therapeutic use of psychedelics. They can minimise adverse reactions and support beneficial therapy (Eisner, 1997). Currently, there are more controlled trials than ever before (Doblin, Christiansen, Jerome, & Burge, 2019). The potentially beneficial role of psychedelics is now being more broadly considered in response to current research highlighting positive effects on, for example, cancer-related anxiety and depression (Griffiths et al., 2016), addiction (Bogenschutz et al. 2015; Thomas et al. 2013), and major depressive disorder (Carhart-Harris et al., 2018; Sanches et al., 2016). These studies have laid the groundwork for psychedelics to become a serious option in

the treatment of a variety of clinical populations and for increased wellbeing in healthy individuals (Nicholas et al., 2018; Schmid & Liechti, 2018).

Existing research has explored whether psychedelics enhance well-being in healthy populations and examined reported experiences of phenomena such as mindfulness (Else, 2017). Mindfulness is defined as “awareness that arises through paying attention, on purpose, in the present moment, non-judgmentally” (Kabat-Zinn, 1994, p. 4) and has its roots in contemplative traditions, specifically Buddhism (Shapiro, Carlson, Astin, & Freedman, 2006). Mindfulness is an umbrella term that includes many practices and processes, relating to attention, awareness, acceptance, attitude and memory (Shapiro et al., 2006; Van Dam et al., 2018). Measuring mindfulness constructs can be done using a variety of psychometric outcome measures (Park, Reilly-Spong, & Gross, 2013) such as the Five Facets of Mindfulness Questionnaire (FFMQ; Baer et al. 2006) or the Philadelphia Mindfulness Scale (PHLMS; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008). For example, the FFMQ measures observation (seeing, feeling and perception of internal or external experiences), description (labelling and expression of experiences), acting with awareness (attention to present moment experiences), non-judgemental inner experience (acceptance of self and empathy to others) and non-reactivity (emotional resilience and detachment from negativity). There are a number of psychological interventions integrating mindfulness principles for therapeutic use including Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990), Dialectical Behavioural Therapy (DBT; Linehan, 1993), and Acceptance and Commitment Therapy (ACT; Hayes et al. 2006). Further, there have been studies showing the wide-ranging benefits of mindfulness for the treatment of conditions ranging from chronic pain and substance abuse to general well-being (Bowen et al., 2009; Jon Kabat-Zinn, Lipworth, & Burney, 1985; Kingston, Chadwick, Meron, & Skinner, 2007; Ramírez-Barrantes et al., 2019).

A review by Jungaberle, et al. (2018) found that psychedelics may be able to sustain and enhance aspects such as mood, wellbeing, openness and flexibility, as well as mindfulness-related capabilities. While a state of mindfulness can be cultivated through dedicated practice or psychological therapy, this may be further facilitated through use of psychedelic substances. A more recent review and meta-analysis by Goldberg et al. (2020) also supports the hypothesis that psychedelics increase mindfulness, however, there are currently no systematic reviews examining the link between psychedelic use and its effect on facets or characteristics of mindfulness. Previous narrative reviews have emphasised the importance of integration of mindfulness interventions and psychedelics (Payne, Chambers, & Liknaitzky, 2021; Walsh & Thiessen, 2018).

Therefore, the aims of this systematic review were to investigate the relationship between psychedelic use and an increase in mindfulness in clinical and non-clinical populations, and to explore the effects of psychedelic use on facets or characteristics of mindfulness. Further, the aim was to conduct a meta-analysis to investigate if there might be any consistent effect relative to use of psychedelics and different facets of mindfulness.

METHODS

The systematic review protocol was registered with PROSPERO and published online: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42019160973. This review was conducted according to PRISMA guidelines (Moher, Liberati, Tetzlaff, Altman, & Grp, 2009).

Eligibility Criteria

Eligibility criteria for inclusion in the systematic review were primary and secondary studies (including grey literature) written in the English language, that measured mindfulness in the context

of psychedelic substance use for people above the age of 18. All study designs, except systematic reviews, were eligible. There were no restrictions relating to participant population, with studies recruiting healthy and clinical populations being eligible. Exclusion criteria were systematic reviews, editorials and conference proceedings.

Information Sources and Search Strategies

A systematic search was initially conducted including studies available up to 10 December 2019. A second search was completed on 18 January 2021 to update search results. This systematic review used primary databases (MEDLINE and Embase via OVID), specialised databases (PsycINFO and AMED via EBSCO). Forward citation tracking from key relevant articles (Scopus), backward citation tracking using references of included articles, the MAPS (Multidisciplinary Association of Psychedelic Studies) Bibliography, websites of known research organisations and retreats who provide guided use of psychedelics with a research link (e.g. Temple of the Way of the Light), and contact with study authors.

Search terms included medical subject headings (MeSH) and keywords. The first search terms were descriptive of the intervention, relating to psychedelic substances terms ('hallucinogens' OR 'psychedelic*' OR 'psychotomimetic' OR 'psychotogenic' OR 'psilocybin' OR 'mescaline' OR 'peyote' OR 'magic mushroom*' OR 'LSD' OR 'lysergic acid diethylamide' OR 'DMT' OR 'N,N-Dimethyltryptamine' OR 'ayahuasca'). The AND operator was used for the second set of terms, which were descriptive of outcome, relating to mindfulness ('mindfulness' OR 'meditation' OR 'attention' OR 'consciousness' OR 'vipassana').

Study Screening

Initial searches in databases were performed and duplicate results were removed. Following this, two reviewers independently screened titles and abstracts based on eligibility and exclusion criteria. Any disagreements were resolved through discussion between the two reviewers. Following this, full text articles were then screened and assessed for eligibility independently by two reviewers and any disagreements on inclusion resolved through discussion between the two reviewers.

Data Collection

The data extracted from the included articles were study design, clinical condition (if any), intervention(s) in study, sub-groups/control group, population size, demographics, aims of study, mindfulness measure used, and results. Quantitative data extracted included means of pre and post intervention groups, standard deviations of pre and post intervention groups, population size, effect size, and p-values.

Quality Appraisal

Quality of individual studies was assessed using the National Heart, Lung, and Blood Institute Study Quality Assessment Tools (National Heart Lung and Blood Institute, 2018). Study quality was assessed by two reviewers independently and any disagreements were resolved through discussion. If a resolution could not be reached, the study was sent to a third reviewer for adjudication.

Statistical Analysis

Extracted data and quality assessment ratings underwent data synthesis and descriptive comparison. R Software (RStudio Team, 2020) using the meta package, was utilised to perform an exploratory random-effect meta-analysis (Anello & Fleiss, 1995) on pre-post psychedelic intervention data in relation to mindfulness construct measures. Standardised mean difference, 95% confidence

intervals, and percent weight were calculated for studies eligible for meta-analysis. For studies without numerical data provided, authors were contacted on two occasions. We were unable to obtain numerical data from these attempts so mean and standard error data were extracted from graphs (Rohatgi, 2021), following which standard deviation was estimated (Higgins & Thomas, 2019). This was done by plotting the available graphs (without detailed x or y axes) onto graphs with more detailed axes in order to estimate the numerical data. Where studies had more than one intervention group, standard deviations and means were pooled (Higgins & Thomas, 2019).

Heterogeneity between studies was assessed prior to choosing a fixed or random effects model using Q (or χ^2) statistic, I^2 and prediction intervals. Q represents the presence of heterogeneity while I^2 describes the variability in effect estimates due to heterogeneity as opposed to sampling error (Higgins & Thomas, 2019). A significant Q value ($p < 0.0035$) represented the presence of heterogeneity in the studies while a high I^2 value 74.5% indicated the extent of heterogeneity. I^2 values between 0-25 were classified as absent, 25-50 as low, 50-75 as medium, and 75-100 as high heterogeneity (Borenstein, Hedges, Higgins, & Rothstein, 2010). Prediction intervals were also used to help with clinical interpretation of the heterogeneity through estimation of what true treatment effects can be expected in future settings (IntHout, Ioannidis, Rovers, & Goeman, 2016).

RESULTS

Search Results

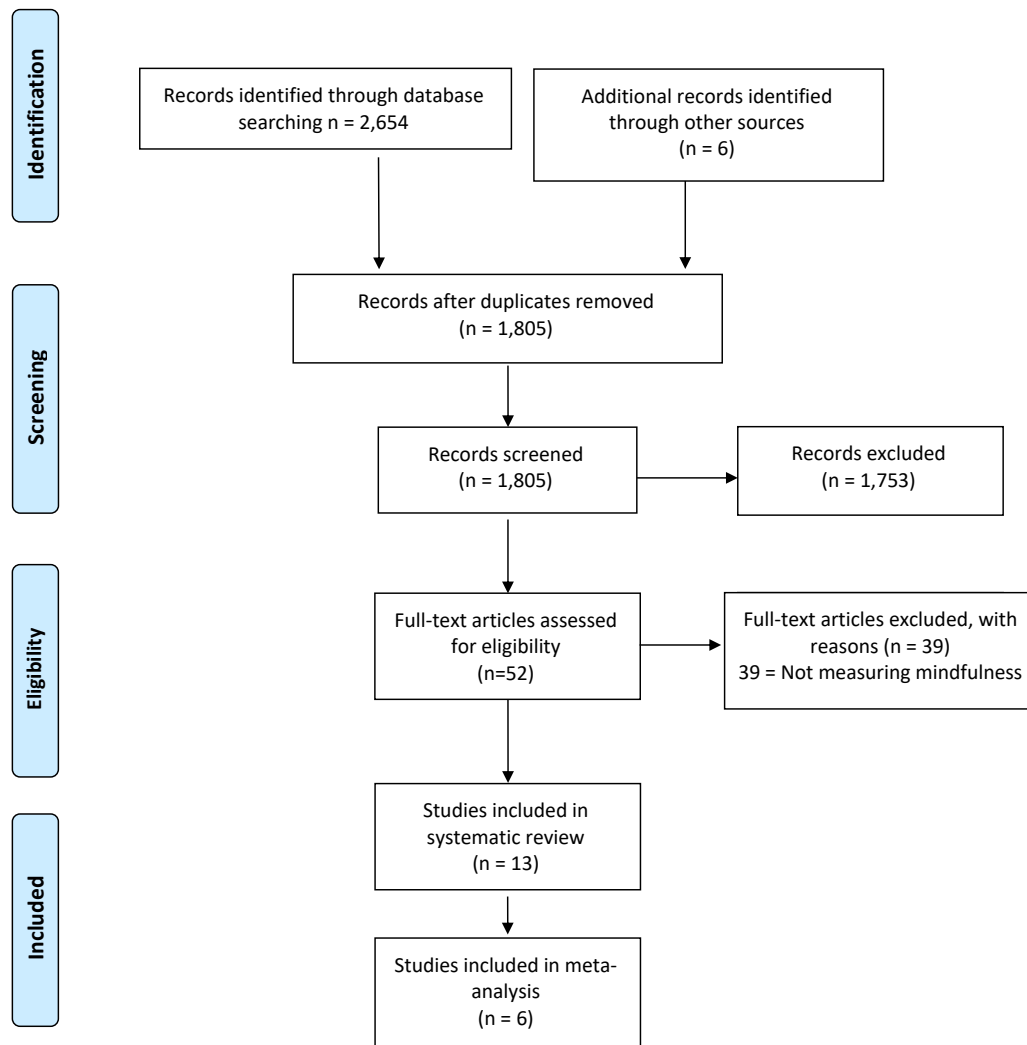


Figure 1: PRISMA Flow diagram (adapted from Moher et al. 2009)

The searches identified a total of 1805 records from databases and other sources with a total of 13 studies meeting inclusion criteria (Domínguez-Clavé et al., 2019; Madsen et al., 2020; Mian, Altman, & Earleywine, 2019; Murphy-Beiner & Soar, 2020; Polito & Stevenson, 2019; Sampedro et al., 2017; Smigielski et al., 2019; Soler et al., 2018, 2016; Thomas et al., 2013; Uthaug et al., 2020, 2019, 2018). Figure 1 shows the full screening process including reasons for exclusion of articles.

Table 1. Characteristics of included studies (N = 13)

Reference	Study Design	Condition	Control/ Subgroups	Sample size	Participants	Aims of study	Intervention/ Additional Interventions in study	How many doses/ administered by whom?	Mindfulness Outcome Measure	Mindfulness Results	Quality rating
Dominguez- Clave <i>et al.</i> (2019)	Observational study Pre/post intervention measurements Uncontrolled, exploratory	BPD-like	BPD and non-BPD	n=45 (BPD=12, non-BPD=33)	Recruited through three groups planning to have ayahuasca ceremonies in Barcelona. Sex: F=27, M=18 Age: m=40 One-third of the participants were ayahuasca- naïve.	To assess the effects of ayahuasca on emotion regulation. BPD status assessed by researchers.	Ayahuasca	Hourly doses, total number not specified, during one evening session. Administered within pre- planned ayahuasca ceremonies, not by researchers.	FFMQ – Short Form (24) FFQM-SF subscales: <u>Non- judgemental inner experience</u> ($\eta^2 = 0.28$) <u>Non- reactivity</u> ($\eta^2 = 0.20$) <u>Observing</u> ($\eta^2 = 0.63$)	*Statistically significant differences pre/post with large effect sizes in the FFQM-SF subscales: <u>Non- judgemental inner experience</u> ($\eta^2 = 0.28$) <u>Non- reactivity</u> ($\eta^2 = 0.20$) <u>Observing</u> ($\eta^2 = 0.63$)	Poor

										<u>Acting with</u> <u>awareness</u> (η^2 = 0.24)	
										*Results were considered significant for P values < 0.05	
Madsen et al. (2020)	Pre/3 months post intervention	Non- clinical	None	n=10	Recruited from list of interested volunteers. Sex: M=6 F=4 Age: m=28 (SD 3.4) All psychedelic- naïve.	To evaluate underlying mechanisms for long-term effects of psilocybin, and investigate the effects of psilocybin on mindfulness and personality three months	Psilocybin	A single oral dose of psilocybin (0.2– 0.3mg/kg) was administered by a familiar member of staff.	MAAS	Mindfulness significantly increased at follow-up ($p = 0.023$)	Fair

						following psilocybin intake.					
Mian, Altman, Earleywine (2019)	Cross-sectional survey	Depression	None	n=152	Recruited via Facebook. Sex: M=50.7% Age: r=40-49 Ethnicity: 86.2% white Level of education: >50% completed Bachelors or graduate degree Lifetime ayahuasca use: m=40.2	To investigate whether both mindfulness and behavioural activation might contribute to the anti- depressant effects of ayahuasca	Ayahuasca (Retrospective survey)	Not reported – not administered by researchers.	FFMQ	<u>An increase in</u> <u>mindfulness</u> <u>(overall)</u> was strongly associated (<i>P</i> < 0.001) with reduced depression severity. Changes in depressive symptoms covaried with subscales from the FFMQ.	<u>Poor</u>
Murphy- Beiner and Soar (2020)	Observational Pre/post intervention.	Non- clinical	None	n=48	Self-selected sample. Recruited	To assess changes in mindfulness,	Ayahuasca	Administered within two pre-planned,	FFMQ – Short Form (24)	Significant post- ayahuasca	Fair

					through psychedelics mailing list.	decentering, and cognitive flexibility both at baseline and 24 hours following ayahuasca use.		secular ayahuasca ceremonies.		increase in overall mindfulness ($p=0.003$)	
					Sex: M=22 F=26			unknown.		Significant increase in scores on:	
					Age: m=38.48 (SD 7.21)					<u>Observing</u> ($p<0.001$)	
					Highly educated: n=40					<u>Describe</u> ($p=0.03$)	
										<u>Acting with Awareness</u> ($p=0.005$)	
					Psychedelics-naïve: n=6					<u>Non-reactivity</u> ($p=0.015$)	
Polito and Stevenson (2019)	Observational pre/post intervention	Non-clinical	None	n=63 completed psychometric measures at	Recruited through Reddit and Facebook.	To assess the effects of micro-dosing psychedelics	Serotonergic psychedelics (LSD-48.1%, Psilocybin-	Doses were taken every 3 days and were	MAAS	No significant increase in mindfulness scores.	Fair

	Uncontrolled				baseline and completion	Sex: M=49 F=14 Age: (18-25)=13, (26-35)=31, (36-45)=11, (46-55)=7, (55+)=1 Postgraduate education = 71.4%	with the expectations of micro-dosing psychedelics.	47.1%, Mescaline-2.1%, other synthetic research chemicals-2.7%)	self-administered. LSD- m=13.5µg (SD 8.5 µg) Psilocybin- m=0.3g (SD 0.3g) Mescaline- m=2.6g (SD 2.7g)		Expectation was for an increase in mindfulness.
Sampedro et al. (2017)	Pre/post/follow-up intervention measurements	Non-clinical	None	n=16	Volunteers with prior experience of ayahuasca in Barcelona area.	To improve understanding of the neural mechanisms potentially involved in the rapid and sustained therapeutic	Ayahuasca	One dose administered within lay context by researchers.	FFMQ	Statistically significant increases in scores on: <u>non-judgemental</u> <u>inner</u> <u>experience</u>	Good

	Follow-up two					effects				($P = 0.011$)	
	months post					observed in				<u>non-reactivity</u>	
	baseline					patients.				($P = 0.020$)	
										Follow up:	
										Statistically	
										significant	
										increases in	
										scores on:	
										<u>Non-</u>	
										<u>judgemental</u>	
										<u>inner</u>	
										<u>experience</u>	
										($P=0.045$)	
Soler et al.	Exploratory	Non-	Comparison	n=20	Recruited by	To	Ayahuasca	4 weekly	FFMQ	Ayahuasca	Fair
(2018)	comparison	clinical	groups:	(n=10 per	word of	understand	group, MBSR	doses		led to	
	study		Ayahuasca	group)	mouth after	the	group	(alkaloids		statistically	
			and MBSR		initial contact	therapeutic		measured)		significant	
	Pre/post				in Barcelona	mechanisms		administered		increases in	
	measurements				area.	by which		in a non-		scores on:	
					Sex: M=3,	Ayahuasca		religious		<u>Non-</u>	
	Uncontrolled				F=7	works by		setting with		<u>judgemental</u>	
					Age: m=50	studying its		experimenters			

						impact on		present		<u>inner</u>	
						mindfulness-		throughout		<u>experience</u>	
						related		session.		($P < 0.05$)	
						capacities.					
						Comparing					
						the effects of					
						a standard					
						mindfulness					
						training					
						course with					
						four					
						consecutive					
						ayahuasca					
						sessions.					
Soler <i>et al.</i>	Pre/post	Non-	None	n=25	Recruited by	To	Ayahuasca	1 dose	FFMQ	Statistically	Fair
(2016)	intervention	clinical			word of	understand		(alkaloids		significant	
	measurements				mouth in	the		measured)		increases in	
					Barcelona	psychological		administered		scores on:	
	Uncontrolled				area.	mechanisms		in a non-		<u>Non-</u>	
					Sex: M=11,	underlying		religious		<u>judgemental</u>	
					F=14	the		setting with		<u>inner</u>	
					Age: m=43.6	therapeutic		experimenters		<u>experience</u>	
					Years of	potential of		present			

										Follow up:	
										Significant	
										overall	
										improvement	
										($P < 0.05$)	
Uthaug et al. (2018)	Observational	Non-	Colombian	n=57	Participants	To assess	Ayahuasca	One dose was	FFMQ	Statistically	Fair
	Pre/post/follow-	clinical	sample and	(Colombian=27,	in pre-	sub-acute and		administered		significant	
	up intervention		Dutch	Dutch n=30)	planned	long-term		by trained		increases in	
	measures		sample		ayahuasca	effects of		shaman or		scores on:	
				Follow up:	ceremonies	ayahuasca on		ayahuascero in		<u>Observing</u>	
	Uncontrolled			n=31	were invited	well-being		a ceremonial		($P = 0.018$)	
					to join the	and cognitive		setting. Four		<u>Non-</u>	
					study.	thinking style		samples were		<u>judgemental</u>	
					Dutch	and to assess		assessed for		<u>inner</u>	
					sample:	whether sub-		alkaloid		<u>experience</u>	
					Sex:	acute and		concentrations.		($P = 0.016$)	
					M=40%,	long-term				<u>act acting</u>	
					F=60%	effects of				<u>with</u>	
					43.3% had	ayahuasca				<u>awareness</u>	
					no previous	depend on the				($P = 0.006$)	
					experience	degree of ego				<u>Non-</u>	
					with	dissolution				<u>reactivity</u>	
						that was				($P = 0.038$)	

					ayahuasca	experienced					
						after				Follow up:	
					Colombian	consumption				Increases	
					sample: Sex:	of ayahuasca				remained but	
					M=33.3%					no facets met	
					40.7% had					statistical	
					no previous					significance.	
					experience						
					with						
					ayahuasca						
Uthaug <i>et al.</i> (2019)	Observational	Non-clinical	None	n=42 (Mixture of three settings: Czech Republic, Spain, The Netherlands)	Recruited from pre-planned sessions.	To assess whether inhaling vapor containing 5-MeO-DMT produces any sub-acute and/or long lasting improvements in measures of affect and	5-MeO-DMT from vapor of dried toad secretions	Doses were administered by facilitators in non-clinical setting. Precise doses unknown, estimated between 20-120mg dried toad secretion.	FFMQ-15	The main effects of session reached significance on two mindfulness parameters: <u>Non-judgemental</u> <u>inner experience</u> ($p = 0.008$)	Fair
	pre/post intervention.										
	Follow up 4 weeks post intervention.										
	Uncontrolled.										

cognition. If	<u>Act with</u>
so, whether	<u>Awareness</u>
these were	($p = 0.046$)
related to	
certain	Sub-acute
aspects of the	assessments
acute	of
psychedelic	mindfulness
state.	<u>did</u>
	<u>not</u>
	<u>significantly</u>
	<u>differ from</u>
	<u>baseline.</u>
	Follow up:
	Improvements
	compared to
	baseline in:
	<u>Non-</u>
	<u>judgemental</u>
	<u>inner</u>
	<u>experience</u>
	($p = 0.009$)

										<u>Act with</u>	
										<u>Awareness</u>	
										(p = 0.042)	
Smigielski	Prospective	Non-	Matched	n=39	Recruited	To quantify	Psilocybin	Standardised	TMS (State	Psilocybin did	Good
et al. (2019)	matched group	clinical	groups:	(Placebo n=19,	expert	the effects of		doses of	mindfulness)	not	
	study		Meditation	psilocybin	meditators	meditation		psilocybin,	FMI (trait	significantly	
			and	n=20)	through	alone and		according to	mindfulness)	increase state	
	Pre/post		meditation		meditation	meditation		body weight,		mindfulness	
	intervention.		with		communities	combined		and placebo		(p = 0.53)	
	Follow up 4		psilocybin		and	with		(lactose) were			
	months post				professional	psilocybin.		administered		Trait	
	intervention.				Buddhist	Meditation		in a double-		mindfulness	
					magazines.	depth,		blind setting.		was	
	Double blind					mindfulness		315 µg/kg of		significantly	
					Sex: M=23	(state and		body weight.		higher post-	
					F=16	trait),		Administered		retreat (day 6)	
						mystical		on day 4 of 5		than pre-	
					Age:	experience		during		retreat (day 0)	
					m=51.66	and altered		meditation		(p < 0.001)	
						states of		retreat.			
						consciousness					
						were					
						explored,					

						compared and analysed for their interactions and influence on one another.					
Uthaug et al. (2020)	Observational pre/post intervention Follow up 7 days post intervention.	Non- clinical	None	n=11 Follow up n=10	Recruited after signing up for a session. Sex: M=8 F=3 Age: m=33 (SD 8.59) All had previous psychedelic experience.	To assess the effects of 5-MeO- DMT on depression, anxiety, stress, mindfulness, and satisfaction with life.	Synthetic 5-MeO-DMT	Administered one-on-one by a facilitator in a non-clinical setting. Participants given between 1 and 4 doses varying from 17mg and 61mg total.	FFMQ	Main effects of session reached significance on <u>Non- judgemental inner experience</u> ($p = 0.001$) Baseline to post-session measures showed	Fair

significant

increase

in

Non-

judgemental

inner

experience

($p = 0.017$)

n = Number of participants, M = Male, F = Female, m = Mean, SD = Standard Deviation, r = Range, BPD = Borderline Personality Disorder, η^2

= Partial eta squared (effect size), FFMQ = Five Facets of Mindfulness Questionnaire, PHLMS = Philadelphia Mindfulness Scale, μg =

microgram, g = grams, MAAS = Mindful Attention Awareness Scale, TMS = Toronto Mindfulness Scale, FMI = Freiburg Mindfulness

Inventory , 5-MeO-DMT = 5-methoxy-N,N-dimethyltryptamine

Table 1 shows the characteristics of all included studies. Substances studied were ayahuasca – 8 (Domínguez-Clavé et al., 2019; Mian et al., 2019; Murphy-Beiner & Soar, 2020; Sampedro et al., 2017; Soler et al., 2018, 2016; Thomas et al., 2013; Uthaug et al., 2018), psilocybin – 2 (Madsen et al., 2020; Smigielski et al., 2019), 5-MeO-DMT – 2 (Uthaug et al., 2020, 2019), and mixed serotonergic psychedelics (LSD, Psilocybin, Mescaline, other) – 1 (Polito & Stevenson, 2019). Eleven of the included studies were pre/post intervention design with no control group (Domínguez-Clavé et al., 2019; Madsen et al., 2020; Murphy-Beiner & Soar, 2020; Polito & Stevenson, 2019; Sampedro et al., 2017; Soler et al., 2018, 2016; Thomas et al., 2013; Uthaug et al., 2018, 2020, 2019). The two remaining studies were a cross-sectional survey (Mian et al., 2019) and a randomised controlled trial (Smigielski et al., 2019). The total number of participants included over all studies was 530 with an overall range from 10 to 152. The mean age of participants, calculated from 10 of 13 studies, as two reported ranges (Mian, Altman and Earleywine, 2019; Polito and Stevenson, 2019) and one did not report age (Uthaug et al., 2018), was 44.9 years with a standard deviation of 1.6 years. Mean percentage of males was 53.4% across twelve studies with a standard deviation of 14%. Three studies included participants with clinical conditions; depression (Mian et al., 2019), borderline personality disorder-like (Domínguez-Clavé et al., 2019), and addiction (Thomas et al. 2013), while the remaining ten studies included participants with no reported clinical condition (Madsen et al., 2020; Murphy-Beiner & Soar, 2020; Polito & Stevenson, 2019; Sampedro et al., 2017; Smigielski et al., 2019; Soler et al., 2018, 2016; Uthaug et al., 2020, 2019, 2018).

Quality Appraisal

See supplementary materials 1 full quality appraisal results. The overall quality of included studies was fair. All of the studies described their objectives well, used appropriate and valid outcome measures consistently, and statistical methods to analyse the results were reported clearly. The sample sizes in included studies were moderate, although sample size calculations were not made

clear in the majority of studies, somewhat restricting the generalisability of findings to a wider population. A primary issue in the majority of studies was consistency of intervention delivery across participants where numbers of doses and quantities per dose varied.

Methodological weaknesses included those inherent in the study designs while others were acquired through the research process. In some cases, weaknesses in the study were due to the nature and tradition of ayahuasca ingestion, which includes for example, variations in dose, setting, and consistency in the delivery of the intervention from participant to participant (Thomas et al. 2013; Uthaug et al. 2018; Dominguez-Clave et al. 2019; Mian, Altman and Earleywine, 2019). Measuring the dose and levels of alkaloids in ayahuasca samples, as done in (Soler et al., 2018, 2016; Uthaug et al., 2018), was valuable in helping to understand dose-related effects and ensuring a standardised intervention across study populations.

With no control groups, small sample sizes, and inconsistencies in delivery of interventions, it is difficult to apply certainty in the sum of these studies' findings. They provide a preliminary base for future research to further explore mindfulness with more methodological rigour, although it may not be possible to conform to some aspects of rigorous study design due to the way settings and interpersonal interactions are used to facilitate an individual's experience of ingesting psychedelics.

Description of mindfulness outcome measures used and psychedelic intervention

Nine of the thirteen studies used the FFMQ to measure mindfulness (Domínguez-Clavé et al., 2019; Mian et al., 2019; Sampedro et al., 2017; Soler et al., 2018, 2016; Uthaug et al., 2018), three of which used the FFMQ-Short Form (Baer et al., 2006). Two study used the Mindful Attention Awareness Scale (Polito and Stevenson, 2019; Madsen et al. 2020) and one used the PMA (Thomas

et al. 2013). One study utilised two mindfulness measures in the Freiburg Mindfulness Inventory and the Toronto Mindfulness Scale (Smigielski et al., 2019).

The psychedelic interventions across studies varied in substance, dose, frequency, and setting. Six studies observed the effects of ayahuasca and 5-MeO-DMT administered in a ceremonial setting by experienced facilitators (Thomas et al. 2013; Uthaug et al. 2018, 2019, 2020; Dominguez-Clave et al. 2019; Murphy-Beiner and Soar, 2020), five administered ayahuasca or psilocybin by researchers in a lay setting (Madsen et al., 2020; Sampedro et al., 2017; Smigielski et al., 2019; Soler et al., 2018, 2016), and one study observed the effects of self-administered serotonergic psychedelics (Polito and Stevenson, 2019). Mian et al. (2019) did not report ayahuasca ingestion method, setting or dose. Ten studies used a standardised number of doses per participant, whereas the number of doses per participant varied in Dominguez-Clave et al. (2019) and Uthaug et al. (2020). The quantity of each dose, however, was pre-planned only in Madsen et al. (2020) and Smigielski et al. (2019). Otherwise doses were given according to the facilitator or researcher's judgement taking into account the participant's characteristics and acute experience. Self-administered psychedelics (Polito and Stevenson, 2019) were taken in a dose considered to be sub-threshold (minimal identifiable acute effects).

Impact of Psychedelics on Mindfulness

All but one study (Polito and Stevenson, 2019) reported a significant level of improvement in one or more mindfulness domains either sub-acute, acute, or at follow-up. Interestingly, Smigielski et al. (2019) found that trait mindfulness was significantly higher post-retreat but that state mindfulness was not significantly increased. Three studies reported an overall increase in mindfulness following ayahuasca ingestion (Madsen et al. 2020; Mian et al. 2019; Thomas et al. 2013), measured using PHLMS, FFMQ, and Mindful Attention Awareness Scale (MAAS) respectively.

Thomas et al. (2013), using the PHLMS, reported an increase in mindfulness after a short retreat during which participants participated in a number of interventions alongside the ayahuasca ceremony (which was facilitated by an experienced ayahascero). One of the additional interventions during the retreat was group counselling sessions, part of the aim of which was to enhance present moment awareness and acceptance, the two outcomes measured by the PHLMS. This is a possible additional factor for increasing mindfulness in their study.

Seven studies showed a significant increase in scores on the FFMQ non-judgemental inner experience domain (Domínguez-Clavé et al., 2019; Sampedro et al., 2017; Soler et al., 2018, 2016; Uthaug et al., 2020, 2019, 2018). Four of these studies included participants with no previous experience of ayahuasca or 5-MeO-DMT. Sampedro et al. (2017) reported sustained significant increases on non-judgemental inner experience scores 24 hours post intervention and at follow up, two months later, Uthaug (2019) reported significant increases on non-judgemental inner experience scores at one month but not sub-acute (within 24 hours), and Uthaug (2020) reported sustained significant increases up to seven days post intervention.

The non-judgemental inner experience domain was found to be higher in individuals with meditation experience (Baer et al., 2006), potentially augmenting the perceived effects of psychedelics, however, (Soler et al., 2018) included a comparison group that underwent a mindfulness training course and found that scores in the non-judgemental inner experience domain increased after ayahuasca intake independent of mindfulness training.

Five studies found a statistically significant increase in scores on the non-reactivity domain (Domínguez-Clavé et al., 2019; Murphy-Beiner & Soar, 2020; Sampedro et al., 2017; Soler et al., 2016; Uthaug et al., 2018). The non-reactivity domain is related to the non-judgemental inner experience domain in that according to a bi-dimensional definition of mindfulness (Bishop et al., 2006), they measure the ‘acceptance’ dimension.

Three studies showed a significant increase in scores on the FFMQ observation domain (Domínguez-Clavé et al., 2019; Murphy-Beiner & Soar, 2020; Uthaug et al., 2018), which measures an individual noticing internal and external experiences. These three studies also showed a significant increase in scores on the FFMQ acting with awareness domain, which measures one’s ability to focus on the present activity. All of these studies recruited participants from pre-planned ayahuasca ceremonies, facilitated by a trained ayahuascero or shaman. Dominguez-Clave’s participants received hourly doses while Uthaug’s received one dose. Both the observation and acting with awareness domains are measuring facets of the ‘attention’ dimension of mindfulness as opposed to ‘acceptance’.

The only study which reported an increase in the description facet of mindfulness, which relates to one’s ability to describe their inner experience, was Murphy-Beiner and Soar (2020). Baer et al. (2006) suggest that the description facet is helpful in understanding individual’s mindfulness in relation to emotional intelligence and understanding and describing one’s own emotions.

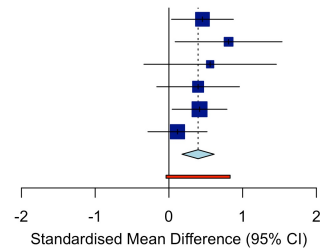
Meta-analysis Results

An exploratory meta-analysis (Anello & Fleiss, 1995) was completed for 6 of the studies (Domínguez-Clavé et al., 2019; Sampedro et al., 2017; Soler et al., 2018, 2016; Uthaug et al., 2018),

all of which used ayahuasca and the FFMQ as their mindfulness outcome measure. See supplementary materials 2 for extracted data for meta-analysis.

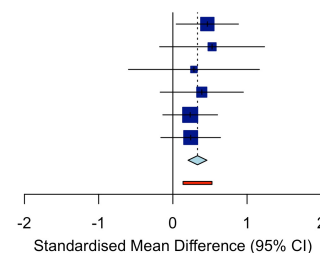
a) Non-Judgemental Inner Experience

Source	SMD (95% CI)
Dominguez-Clave et al. 2019	0.45 [0.04; 0.87]
Sampedro et al. 2017	0.81 [0.08; 1.53]
Soler et al. 2018	0.56 [-0.34; 1.46]
Soler et al. 2016	0.40 [-0.16; 0.96]
Uthaug et al. 2018	0.42 [0.04; 0.79]
Murphy-Beiner and Soar 2020	0.12 [-0.28; 0.52]
Total	0.40 [0.18; 0.61]
Prediction interval	[-0.04; 0.83]
Heterogeneity: $\chi^2_5 = 3.33$ ($P = .65$), $I^2 = 0\%$ [0%; 62%]	



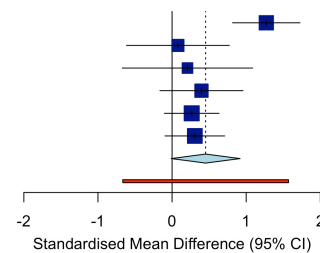
b) Non-Reactivity

Source	SMD (95% CI)
Dominguez-Clave et al. 2019	0.46 [0.05; 0.88]
Sampedro et al. 2017	0.53 [-0.18; 1.24]
Soler et al. 2018	0.28 [-0.60; 1.17]
Soler et al. 2016	0.39 [-0.17; 0.95]
Uthaug et al. 2018	0.23 [-0.13; 0.60]
Murphy-Beiner and Soar 2020	0.24 [-0.16; 0.64]
Total	0.33 [0.20; 0.46]
Prediction interval	[0.14; 0.53]
Heterogeneity: $\chi^2_5 = 1.21$ ($P = .94$), $I^2 = 0\%$ [0%; 0%]	



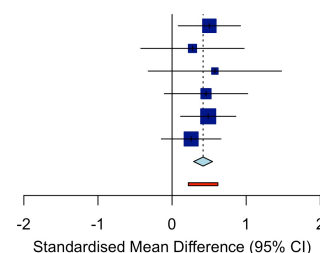
c) Observation

Source	SMD (95% CI)
Dominguez-Clave et al. 2019	1.27 [0.82; 1.73]
Sampedro et al. 2017	0.08 [-0.61; 0.77]
Soler et al. 2018	0.21 [-0.67; 1.09]
Soler et al. 2016	0.40 [-0.16; 0.96]
Uthaug et al. 2018	0.26 [-0.10; 0.63]
Murphy-Beiner and Soar 2020	0.31 [-0.10; 0.71]
Total	0.45 [-0.01; 0.92]
Prediction interval	[-0.67; 1.57]
Heterogeneity: $\chi^2_5 = 15.38$ ($P = .009$), $I^2 = 67\%$ [23%; 86%]	



d) Acting with Awareness

Source	SMD (95% CI)
Dominguez-Clave et al. 2019	0.50 [0.08; 0.92]
Sampedro et al. 2017	0.28 [-0.42; 0.97]
Soler et al. 2018	0.58 [-0.32; 1.48]
Soler et al. 2016	0.46 [-0.10; 1.02]
Uthaug et al. 2018	0.49 [0.11; 0.86]
Murphy-Beiner and Soar 2020	0.26 [-0.14; 0.66]
Total	0.42 [0.29; 0.55]
Prediction interval	[0.22; 0.62]
Heterogeneity: $\chi^2_5 = 1.21$ ($P = .94$), $I^2 = 0\%$ [0%; 0%]	



e) Description

Source	SMD (95% CI)
Dominguez-Clave et al. 2019	0.05 [-0.36; 0.46]
Sampedro et al. 2017	-0.23 [-0.93; 0.46]
Soler et al. 2018	0.28 [-0.60; 1.16]
Soler et al. 2016	-0.38 [-0.94; 0.18]
Uthaug et al. 2018	0.11 [-0.25; 0.48]
Murphy-Beiner and Soar 2020	0.26 [-0.14; 0.66]
Total	0.04 [-0.21; 0.29]
Prediction interval	[-0.50; 0.58]
Heterogeneity: $\chi^2_5 = 4.29$ ($P = .51$), $I^2 = 0\%$ [0%; 70%]	

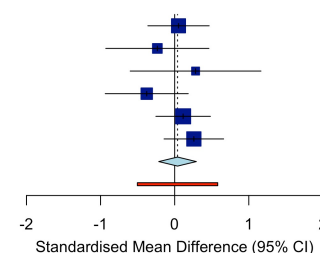


Figure 2: Forest Plot of pre and post ayahuasca ingestion in relation to 5 facets of mindfulness. 95% CI = 95% Confidence Intervals. I^2 = heterogeneity. SMD = Standardised Mean Difference

Figure 2 shows results of subgroup meta-analysis for mindfulness facets pre and post ayahuasca ingestion. The acting with awareness and non-reactivity facets showed no significant heterogeneity or varying effects. Both of these facets showed small but significant overall effect sizes in favour of a positive ayahuasca effect. Non-judgemental inner experience and description facets reported no significant heterogeneity but prediction intervals suggest that these facets showed varying effects. Only the non-judgemental inner experience facet also showed small but significant overall effect size in favour of a positive ayahuasca effect. Only the observation facet has a significant medium level of heterogeneity, displayed varying effects based on prediction intervals and no significant overall effect.

DISCUSSION

The results of this review indicate that psychedelics may be associated with an increase in scores on mindfulness outcome measures. The overall synthesis of evidence shows a tendency toward increases in mindfulness after psychedelic ingestion over all sub-domains of mindfulness as subdivided by the FFMQ (acting with awareness, non-judgemental inner experience, non-reactivity, observation), with the exception of the description domain, which was only found to increase in one study (Murphy-Beiner and Soar, 2020).

The meta-analysis (N=6) results indicated that in relation to ayahuasca ingestion there was an increase in scores on the acting with awareness domain, albeit with relatively wide confidence intervals across studies. Acting with awareness, along with the non-judgemental inner experience and non-reactivity domains, have previously been shown to have incremental validity in the detection of psychological symptoms (Baer et al., 2006). These three domains showed overall increases, which suggests that the increase in mindfulness after ayahuasca intake may be particularly

helpful with challenges relating to self-judgemental thoughts, impulsive reactivity, or mind-wandering/distractibility. Further, increased mindfulness may aid in the ability to maintain perspective when in heightened emotional states, expressed as forms of acceptance through non-reactivity and non-judgemental inner experience.

Dominguez-Clave et al. (2019) suggest that a more reflective approach to difficult thoughts, emotions, and situations, rather than an emotionally-driven approach, may account for increases on the non-reactivity and non-judgemental inner experience domains of mindfulness, potentially allowing an individual to have clearer perspective on a given situation. Baer et al. (2006), in the development of the FFMQ, suggested that non-judgemental inner experience (refraining from self-criticism) and non-reactivity (refraining from impulsive action) are ways of operationalising acceptance. Increasing acceptance is an established method of supporting clinical populations, notably used within Acceptance and Commitment Therapy (Hayes et al. 2006). The significant increase in non-judgemental inner experience and non-reactivity domains observed in this systematic review, indicate that psychedelics (particularly ayahuasca) could be an effective method of improving these acceptance domains.

Additionally, Sampedro et al. (2017), Uthaug et al. (2019), and Uthaug et al. (2020) reported significant increases on the non-judgemental inner experience domain two months, one month, and seven days, respectively, after baseline. Sampedro et al. (2017) noted that scores were higher than those reported for meditators (Soler et al., 2014), which gives credence to the findings that ingestion of ayahuasca could be as effective at achieving increases in nonjudging mindfulness than a targeted meditation practice, with lasting effect. Similarly, Smigielski et al. (2019) found that experienced meditators that received psilocybin showed significantly increased trait mindfulness post-retreat compared to those that received a placebo. It was also observed that there were significant increases

in scores on the non-judgemental inner experience and non-reactivity domains after ingesting ayahuasca; with greater increases compared to meditators (Soler et al., 2018, 2016). Characteristics of non-judgemental processes have been shown to associate with lower anxiety and depression symptoms (Brown, Bravo, Roos, & Pearson, 2015). Therefore future interventions utilising psychedelics interventions may benefit from targeting specific elements of mindfulness, such as those relating to acceptance.

Observation, acting with awareness, and description domains have been thought to measure more attentional components of mindfulness (Baer et al., 2006). Significant increases on scores on observation, acting with awareness, and description domains were found in only three of the nine studies that used the FFMQ, which utilised ayahuasca or 5-MeO-DMT from dried toad secretion vapour. This may show that the overall effects of psychedelics in these studies are more related to openness and attention (i.e. characteristics of the observation, acting with awareness, and description domains) than acceptance. However, further research would be important to explore the overlap and difference between openness, acceptance and attention. Dominguez-Clave et al. (2019), Uthaug et al. (2018), and Murphy-Beiner and Soar (2020) measured statistically significant increases on the observation domain. Dominguez-Clave et al. (2019) suggest that increases on this domain could lead to greater connectedness with the present moment, which is a strategy used in many mindfulness-based therapies such as ACT, DBT or MBSR (Hayes et al., 2006; J. Kabat-Zinn, 1990; Linehan, 1993).

Thomas et al. (2013) measured an overall increase in mindfulness using the PHLMS. They suggested that this increase in mindfulness, more specifically, self-acceptance, could contribute to the positive therapeutic effects of ayahuasca. Mian, Altman and Earleywine (2019) found that individuals report an overall increase in mindfulness after an ayahuasca session. The two included

studies to use psilocybin specifically, Smigielski et al. (2019) and Madsen et al. (2020), found an overall increase in mindfulness post-intervention. Both found an increase in trait mindfulness using the Freiburg Mindfulness Inventory (FMI), and MAAS, but Smigielski et al. (2019) found that changes in state mindfulness due to psilocybin, measured using the Toronto Mindfulness Scale (TMS), did not significantly increase.

The fair quality of included studies overall resulted in a reduced ability to generalise the results to a wider population. There are, however, a number of methodological improvements that could be made to future research. Using well characterised intervention and control group within the study design would help to minimise the effect of outside variables. Standardisation of mindfulness outcome measures or constructs measured would help in harmonising findings of future research and add evidence to this developing area of research.

Overall, an increase in randomised controlled studies and prospective cohort studies would be valuable in exploring causal relationships between psychedelics and mindfulness. Ayahuasca in particular presents a challenge to researchers in that the ceremony is often an integral part of the therapeutic process. However, controlling the environment will inevitably alter some individualised aspects of the session, thereby potentially reducing or changing the effect of the ayahuasca session. This further suggests that more research studying environmental factors may aid in understanding the fuller picture of an ayahuasca session and its therapeutic value. Pre-determined doses of the chosen psychedelic from a single batch would allow the possibility of controlling for dose-related differences (Riba et al. 2001).

Finally, the importance of set and setting (Eisner, 1997) and the resulting differences in experience highlights the need for detailed descriptions of the intervention including any pre-education, dose

and concentration of psychedelic, additional elements such as a shaman, music, dietary preparation, and post-session integration of the experience.

There are some limitations to this systematic review. By focusing on mindfulness outcome measures specifically, e.g. FFMQ, PHLMS, others were not discussed but may have been measuring an aspect of mindfulness, e.g. MINDSENS composite index (Soler et al., 2014) and Experience Questionnaire (Fresco et al. 2007). Further, there is possibility of publication bias, which has the potential to skew effect sizes and artificially favour positive outcomes (Jooper, Schmitz, Annable, & Boksa, 2012). In the sub-group meta-analysis, there were a relatively small number of studies with small sample sizes included. This could have affected the estimation of heterogeneity of studies, effect sizes, and confidence intervals. The heterogeneity of studies might be indicative of the variability in treatment non-specific (e.g. time, attention, expectations, placebo effects, facilitator experience) and specific (e.g. set/preparation, setting, dose) factors related to use of psychedelics in research. Future research should further examine these factors, so as to improve robustness of future psychedelics (and mindfulness) studies. As more controlled studies are conducted using psychedelics that also include mindfulness measures, it will provide opportunities to explore the interplay of these treatment factors, as well as if any effects are observed over long-term follow ups, across clinical and non-clinical populations.

Conclusion

This systematic review and meta-analysis showed an increase in mindfulness relative to ingestion of psychedelics. Mindfulness facets relating to acceptance (non-judgemental inner experience and non-reactivity) seem to be affected, along with certain elements relating to attention (acting with awareness). However, further high-quality research is needed to elucidate the relationship between mindfulness and its facets relative to psychedelic ingestion.

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Supplementary Material 1. Quality ratings for all included studies (N = 13)

Study	Quality Assessment Tool	Quality	Objective clearly stated?	Eligibility criteria described?	Representative participants?	All eligible participants enrolled?	Sample size sufficiently large?	Intervention clearly described and delivered?	Outcome measures prespecified/consistent?	Blinded assessors?	Loss to follow-up <20%?	Statistical tests for pre/post intervention?	Interrupted time series design?	Individual data utilised for group level stats?
Polito and Stevenson (2019)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	CD	CD	CD	Yes	No	Yes	NA	Yes	Yes	No	NA
Uthaug <i>et al.</i> (2019)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	NR	Yes	CD	Yes	No	Yes	NA	No	Yes	No	Yes
Uthaug <i>et al.</i> (2020)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	NR	Yes	CD	No	No	Yes	NA	Yes	Yes	No	NA
Uthaug <i>et al.</i> (2018)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	Yes	Yes	Yes	No	Yes	Yes	NA	No	Yes	Yes	No
Murphy-Beiner and Soar (2020)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	Yes	No	NA
Madsen <i>et al.</i> (2020)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	Yes	Yes	Yes	No	Yes	Yes	NA	Yes	Yes	No	NA
Sampedro <i>et al.</i> (2017)	Before-After (Pre-Post) Studies With No Control Group	Good	Yes	Yes	Yes	Yes	No	Yes	Yes	NA	Yes	Yes	Yes	Yes
Dominguez-Clave <i>et al.</i> (2019)	Before-After (Pre-Post) Studies With No Control Group	Poor	Yes	No	Yes	No	No	No	Yes	NA	NR	Yes	No	No
Thomas <i>et al.</i> (2013)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	Yes	Yes	Yes	No	No	Yes	NA	No	Yes	Yes	No

Soler <i>et al.</i> (2016)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	Yes	Yes	Yes	No	No	Yes	NA	NR	Yes	No	No		
Soler <i>et al.</i> (2018)	Before-After (Pre-Post) Studies With No Control Group	Fair	Yes	Yes	Yes	Yes	No	No	Yes	NA	Yes	Yes	No	No		
Quality			Objective clearly stated?	Study populations clearly described?	>50% of eligible participants enrolled?	Inclusion/exclusion criteria described?	Sample size justified?	Exposure measured prior to outcome?	Sufficient time between exposure and outcome?	Categories of exposure measured?	Exposure clearly defined?	Exposure measured more than once?	Outcomes measures clearly defined?	Blinded assessors?	Loss to follow-up <20%?	Confounding variables measured?
Mian, Altman, Earleywine (2019)	Observational Cohort and Cross-Sectional Studies	Poor	Yes	No	NR	No	No	No	No	Yes	Yes	NA	Yes	NA	NA	Yes
			Described as randomised?	Adequate method of randomisation?	Concealed treatment allocation?	Blinding to treatment group?	Blinding of participants' group assignment?	Groups similar at baseline?	Dropout rate <20%?	Differential dropout rate <15%?	High adherence to treatment protocols?	Similar/avoided background treatments?	Consistent/valid/reliable outcome measures?	Sufficient sample size reported?	Prespecified outcomes/subgroups?	Intention to treat analysis used?
Smigielski <i>et al.</i> (2019)	Controlled Intervention Studies	Good	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes	Yes

NA = Not applicable, NR = Not reported, CD = Cannot determine

Supplementary Material 2. Quantitative data extracted from studies for meta-analysis

Reference	Mindfulness Measure/Subgroup	Mean (pre)	SD (pre)	Mean (post)	SD (post)	n
Dominguez-Clave <i>et al.</i> (2019)	Observe – BPD/Non-BPD Pooled	14.43	1.98	17.21	2.34	45
Sampedro <i>et al.</i> (2017)	Observe	28.90	6.90	29.50	7.90	16
Soler <i>et al.</i> (2018)	Observe	25.70	8.08	27.60	9.38	10
Soler <i>et al.</i> (2016)	Observe - Estimated data extracted from graph	27.50	2.75	28.67	3.05	25
Uthaug <i>et al.</i> (2018)	Observe - Estimated data extracted from graph	27.59	5.51	29.09	5.74	57
Murphy-Beiner and Soar, 2020 [†]	Observe	3.99	0.76	4.23	0.79	48
Dominguez-Clave <i>et al.</i> (2019)	Describe - BPD/Non-BPD Pooled	19.14	3.41	19.33	3.86	45
Sampedro <i>et al.</i> (2017)	Describe	30.00	5.10	28.80	4.90	16
Soler <i>et al.</i> (2018)	Describe	29.00	9.36	31.40	6.73	10
Soler <i>et al.</i> (2016)	Describe – Estimated data extracted from graph	29.35	2.60	28.41	2.30	25
Uthaug <i>et al.</i> (2018)	Describe - Estimated data extracted from graph	29.56	7.70	30.44	7.63	57
Murphy-Beiner and Soar, 2020 [†]	Describe	4.76	0.89	5.00	0.95	48
Dominguez-Clave <i>et al.</i> (2019)	Act with Awareness - BPD/Non-BPD Pooled	16.56	3.67	18.43	3.70	45
Sampedro <i>et al.</i> (2017)	Act with Awareness	29.60	4.60	30.90	4.60	16
Soler <i>et al.</i> (2018)	Act with Awareness	30.70	6.36	34.10	4.81	10
Soler <i>et al.</i> (2016)	Act with Awareness - Estimated data extracted from graph	29.85	2.30	30.92	2.30	25
Uthaug <i>et al.</i> (2018)	Act with Awareness - Estimated data extracted from graph	26.73	5.59	29.21	4.45	57
Murphy-Beiner and Soar, 2020 [†]	Act with Awareness	3.55	0.67	3.74	0.79	48
Dominguez-Clave <i>et al.</i> (2019)	Nonjudge - BPD/Non-BPD Pooled	17.79	3.66	19.49	3.75	45
Sampedro <i>et al.</i> (2017)	Nonjudge	28.50	7.30	34.20	6.40	16
Soler <i>et al.</i> (2018)	Nonjudge	30.00	9.32	34.50	5.66	10
Soler <i>et al.</i> (2016)	Nonjudge - Estimated data extracted from graph	23.71	4.60	25.56	4.60	25
Uthaug <i>et al.</i> (2018)	Nonjudge - Estimated data extracted from graph	27.50	5.89	29.87	5.43	57
Murphy-Beiner and Soar, 2020 [†]	Nonjudge	3.23	0.78	3.33	0.92	48
Dominguez-Clave <i>et al.</i> (2019)	Nonreact - BPD/Non-BPD Pooled	17.00	3.07	18.55	3.53	45
Sampedro <i>et al.</i> (2017)	Nonreact	24.60	5.40	27.20	4.10	16
Soler <i>et al.</i> (2018)	Nonreact	22.00	8.39	24.20	6.30	10
Soler <i>et al.</i> (2016)	Nonreact - Estimated data extracted from graph	28.84	11.30	33.16	10.50	25
Uthaug <i>et al.</i> (2018)	Nonreact - Estimated data extracted from graph	22.49	6.95	24.08	6.57	57
Murphy-Beiner and Soar, 2020 [†]	Nonreact	3.36	0.76	3.55	0.81	48

SD = standard deviation, n = number of participants, BPD = Borderline Personality Disorder, FFMQ = Five Facets of Mindfulness Questionnaire.

[†] Different scoring criteria used.