University of Southampton

Faculty of Environmental and Life Sciences

School of Psychology

An investigation of the psychological benefits of yoga practice across cultures and in neurodevelopmental populations

Volume 1 of 1

By

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Abstract

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Yoga has grown in popularity globally as an intervention for wellbeing and mental health. Little research has explored the individual components of yoga and if yoga benefits are universal. Exploration of how features and components of yoga practice are related to wellbeing across populations is needed to understand if interventions may benefit from tailoring to optimize the effect of yoga.

Chapter one presents a systematic review of yoga on psychosocial outcomes in neurodevelopmental conditions (NDCs). 21 studies were included in the review. The main findings suggest yoga may have a positive impact on some cognitive and behavioural outcomes in NDCs. However, there was inconclusive evidence for social outcomes and limited evidence for emotional outcomes. Findings were limited by heterogeneity in interventions and outcome measures. Directions for future research and clinical implications are discussed.

Chapter two presents a quantitative cross-sectional study. The study explores features of yoga practice across the UK and India as well as looking at whether components of yoga (the eight limbs) were related to wellbeing across cultures. The study recruited 435 participants (275 UK and 160 Indian practitioners) who completed an online survey. The findings provide preliminary support that features of yoga practice differ across cultures and that specific limbs of yoga are differentially associated with psychological wellbeing across cultures. Due to methodological limitations the findings should be interpreted tentatively. Further research using intervention RCT designs are needed to investigate the impact of different features of yoga practice and individual limbs on health-related outcomes across populations.

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Research Thesis: Declaration of Authorship

Print name: Natasha Wing

Title of thesis: An investigation of the psychological benefits of yoga practice across cultures and in neurodevelopmental populations

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

Signature: ..... Date: 25.09.2025

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Lastly, I dedicate this to my dad, who passed away at the start of my third year. I love and miss you every day. Thank you for always pushing me to keep going and instilling in me drive and motivation in life.

Abbreviations

ACT	Acceptance and Commitment Therapy
ADHD	Attention-Deficit/Hyperactivity Disorder
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
ASD	Autism Spectrum Disorder / Autism
AUC	Area Under the Curve
CBT	Cognitive Behavioural Therapy
CLARIFY	Checklist Standardising the Reporting of Interventions for Yoga
DBT	Dialectical Behaviour Therapy
DSM-5	The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
ERGO	Ethics and Research Governance Online
IAYT	Integrated Approach of Yoga Therapy
ID / IDD	Intellectual Disability / Intellectual and Developmental Disabilities
LD	Learning Disability
M	Mean
MANOVA	Multivariate Analysis of Variance
NDCs	Neurodevelopmental Conditions
NDDs	Neurodevelopmental Disorders
NICE	The National Institute for Health and Care Excellence
N.S.	Non-Significant
N/A	Not Applicable
NHS	National Health Service
ODD	Oppositional Defiant Disorder

PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
PROSPERO	International Prospective Register of Systematic Reviews
RCT	Randomised Controlled Trial
SES	Socioeconomic Status
SD	Standard Deviation
Sig.	Significant
SPSS	Statistical Package for the Social Sciences
SQAC	Standard Quality Assessment Criteria
TAU	Treatment as Usual
QOL	Quality of Life

Chapter 1 Systematic Review Paper

The Impact of Yoga in Neurodevelopmental Populations: A Systematic Review

Journal Specification: The following paper has been prepared for submission to the journal Complementary Therapies in Clinical Practice. The guidelines for authors are provided in Appendix A.

Word Count: 10,246 (excluding abstract, tables and references)

Chapter 1 Abstract

Background and Purpose

Neurodevelopmental conditions (NDCs) cover a group of conditions associated with difficulties across cognitive, behavioural, social and emotional domains. Due to high rates of co-occurring conditions, there is a growing debate that NDCs could be better treated using a transdiagnostic approach. Theory suggests yoga may have a positive effect on NDCs due to its effect on core areas of difficulties experienced in these populations. This paper aimed to systematically review the existing literature to investigate the impact of yoga on psychosocial outcomes in NDCs.

Methods

A systematic search of four databases was completed (PsycInfo, Web of Science Core Collection, EMBASE and CINAHL), following PRISMA guidelines. The primary author reviewed all articles, with a secondary reviewer reviewing 10% of articles during the screening process and 100% of included texts and quality assessment. Risk of bias was assessed using the SQAC. A narrative synthesis was completed on the outcomes identified.

Results

21 studies from various countries were identified through the inclusion and exclusion criteria. The main findings suggest yoga may have a positive impact on some cognitive and behavioural outcomes in NDCs. However, there was inconclusive evidence for social outcomes and limited evidence for emotional outcomes. A risk of bias assessment indicated a wide range of included study quality, varying from adequate to strong.

Conclusion

The findings, limitations and clinical implications are discussed. Results should be treated with caution due to heterogeneity and methodological concerns across the included research. The need for further high-quality research exploring the impact of yoga in NDCs using more robust, longitudinal methods is highlighted.

Keywords: Yoga, Neurodevelopmental, Neurodivergence, Wellbeing, Psychology.

1.1 Introduction

1.1.1 Neurodivergence

Neurodevelopmental conditions (NDCs) comprise a group of conditions characterised by difficulties in developmental functioning in the following domains: cognition, adaptive behaviour, language/communication, motor skills (Jeste, 2015; Mullin et al., 2013; Villagomez et al., 2019). Individuals with NDCs are often referred to as being neurodivergent; for the purpose of this review neurodivergent or neurodivergence refers to variations in mental or neurological functioning from what is considered neurotypical (Oxford University Press, 2025).

The current medical model often refers to diagnostic conditions such as autism and ADHD as "disorders" or "deficits". However, a shift towards transdiagnostic and neuro-affirmative approaches focus on individuals' strengths and supporting individuals to manage difficulties associated with their neurodivergence while understanding that neurodivergence is a natural variation of human neurology and experiences. It also highlights that society itself may contribute to these experiences by not being fully accommodating to non-neurotypical individuals.

It is acknowledged that preferred language is subjective to individuals. The current review aims to use neuro-affirmative language, for example referring to "treatment" as "support"; "neurodevelopmental disorders" as "neurodevelopmental conditions" and "comorbidities" as "co-occurring conditions". However, some terminology language is kept consistent with the original source for transparency.

Based on the current medical model the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013) classifies the following conditions under 'Neurodevelopmental Disorders' (NDDs): Autism Spectrum Disorder (ASD; Autism), Intellectual Disorders (ID), Attention-Deficit/Hyperactivity Disorder (ADHD), Specific Learning Disorders, Motor Disorders, Tic Disorders, Communication Disorders, and Other

NDDs. The impact of these conditions is often pervasive throughout an individual's lifetime (Alexander et al., 2021; Antolini & Colizzi, 2023).

The reported global prevalence of NDCs varies in research (Francés et al., 2022; Olusanya et al., 2022; 2023) with prevalence of single NDCs ranging from 4.7-88.5% across cultures (Francés et al., 2022). Estimates of childhood prevalence in the UK are between 0.6-3.5% for autism, 0.5-2.2% for ADHD and 0.3-10.6% for ID (varying by severity) with mild ID being most prevalent (Cleaton & Kirby, 2018). It has been suggested that the variance in prevalence rates may be due to different diagnostic tools, data collection methods and samples used (Cleaton & Kirby, 2018; Francés et al., 2022). Additionally, Roman-Urrestarazu et al. (2021) found significant differences in autism prevalence across England depending on the geographic areas, local authorities and racial and ethnic groups.

Although clear operationalisation of NDCs exist, the collective literature is limited by variance in methodological approaches such as measurements, sources of information and other confounding factors including inconsistency in terminology or co-occurring conditions (comorbidities).

1.1.1.1 Co-occurring Conditions

Research estimates the majority of individuals with NDCs have co-occurring conditions (the same person having two or more conditions) (Cleaton & Kirby, 2018; Francés et al., 2022). This includes high rates of both homotypic co-occurrences (having more than one condition from the same diagnostic group e.g. more than one neurodevelopmental condition) and heterotypic co-occurrences (having more than one condition from different diagnostic groups). Heterotypic co-occurrences include psychiatric disorders such as anxiety and mood disorders (Bonti et al., 2024; Cleaton, & Kirby, 2018; Hansen et al., 2018; Mannion & Leader, 2013), and physical disorders such as gastrointestinal disorders, sleep disorders and epilepsy (Bonti et al., 2024; Cleaton, & Kirby, 2018; Hansen et al., 2018; Mannion & Leader, 2013).

Homotypic co-occurrences have been found to be common with research suggesting 16.5-55% of children with NDCs having two or more and some NDCs such as autism having higher rates of homotypic co-occurrences up to 80% (Cleaton & Kirby, 2018; Francés et al., 2022). As homotypic co-occurrences are common, this might indicate diagnostic overlap and can lead to challenges in accessing help, particularly where services are established to support specific conditions or 'formal diagnosis' and can exclude people that have co-occurring conditions, difficulties that fall below diagnostic thresholds, or no formal diagnosis (Astle et al., 2022; Azim et al., 2025; Male et al., 2020).

There is a growing debate that due to the significant overlap of NDC traits that these would be better treated as a 'neurodevelopmental spectrum' rather than distinct conditions. Increasingly models are proposing a transdiagnostic strength-based approach (Astle et al., 2022; Bonti et al., 2024; Mareva et al., 2021). A critique of this approach is that although there may be significant overlap in presentations there may be nuanced characteristics of each distinct condition which may be overlooked or missed. Alternatively, a strength of grouping different neurodevelopmental presentations as a 'neurodevelopmental spectrum' is that it allows consideration of approaches across overlapping difficulties (e.g., attention difficulties, social challenges, executive function difficulties) and frequent high rates of co-occurrence (comorbidity). This allows research to explore possible transdiagnostic approaches which could support co-occurring conditions simultaneously, leading to more coordinated and effective care (Bonti et al., 2024). However, there has been limited research exploring the effect of interventions across neurodevelopmental presentations. Therefore, for the purpose of this review NDCs associated with difficulties in cognitive, behavioural, and social domains were grouped together.

1.1.1.2 Support for Difficulties Associated with Neurodevelopmental Conditions

The current guidance on the management of NDCs focusses on 'treating' the difficulties directly related to the individual's neurodivergence. National Institute for Health and Care

Excellence (NICE, 2012; 2013; 2018) guidelines outline psychosocial and pharmacological interventions including medication and CBT to support individuals with difficulties associated with ADHD and autism, as well as teaching life skills and education to support individuals with ID and autism. NICE guidelines also highlight the need to adapt support to NDCs and consider coexisting neurodevelopmental or mental health conditions (NICE, 2012; 2013; 2018). It could be argued that due to overlaps in recommended support as well as diagnoses and co-occurrences, interventions may be targeting common processes across NDCs.

Although recommended pharmacological and therapeutic approaches have shown some efficacy in supporting difficulties experienced by individuals with neurodevelopmental conditions (Chan et al., 2016; Peterson et al., 2024; Perihan et al., 2020), individuals with NDCs face barriers to accessing help including misdiagnosis, long wait times, and underdiagnosis (Cleaton & Kirby, 2018; Heady et al., 2022; Shearer, 2024). Additionally, evidence suggests individuals with neurodivergence and NDCs are more likely to explore using Complementary and Alternative Medicines (CAM) than 'neurotypical' individuals, either alongside other Western medical approaches or as an alternative approach (Levy & Hyman, 2008; Sinha & Efron, 2005; Zisman et al., 2020).

These findings suggest there is a particular need for alternative approaches in these populations such as a transdiagnostic approach that could be easily accessed e.g. without prescription or help from professionals. One alternative approach that may be helpful for individuals and families of neurodevelopmental populations is yoga as this has been found to be a safe, inexpensive and accessible approach (Cagas et al., 2023; Meyer et al., 2012; Singh, 2021).

1.1.2 Yoga

Yoga has grown in popularity in Western societies as a holistic approach (Zhang et al., 2021). Yoga aims to develop unity between the body, mind, and spirit through a mind-body practice (Sarbacker, 2021). Traditional yoga offers practical steps for holistic personal

development by following Patanjali's eight limbed pathway which includes: ethical considerations (yamas), guidance for ways of living (niyamas), physical postures (asana), breathwork (pranayama), meditation practices including; inward attention (pratyahara), focused attention on one subject (dharana), connection with the object of dharana rather than just observing (dhyana) and lastly, reaching a bliss state (Samadhi) (Bryant, 2015).

Yoga has been shown to have a positive impact on a variety of physiological and psychological conditions including stress (Wang & Szabo, 2020), mental health (Khunti et al., 2023; Martínez-Calderon et al., 2023), physical health (Bussing et al., 2012; Kamraju, 2023), wellbeing / Quality of Life (QOL; Kelley & Kelley, 2020), cognitive functioning (Bhattacharyya et al., 2021), social functioning and communication (Artchoudane et al., 2019). Yoga benefits have also been explored across a variety of populations including children (Khunti et al., 2023), healthy adults (Wang & Szabo, 2020), older adults (Bhattacharyya et al., 2021), as well as a variety of medical conditions including neurological populations (Acabchuk et al., 2021; Legault et al., 2021; Suarez-Iglesias et al., 2022) and cancer (Gonzalez et al., 2021; Yi et al., 2021). However, yoga research to date has been heterogeneous, with a lot of research not clearly defining yoga interventions, a lack of manualised approaches, and a breadth of outcomes being investigated using a wide range of conceptualisations and measures (Bennetts, 2022). Consequently, the CLARIFY (CheckList stAndardising the Reporting of Interventions For Yoga) guidelines have been developed (Ward et al., 2022). These aim to address the lack of standardization in how yoga interventions are reported in research to allow for improved quality, reliability, comparability and transparency of research. This may help facilitate comparison of studies and help guide further research.

1.1.2.1 Mechanisms of Change

While research has suggested a variety of benefits of yoga, limited research has looked into understanding the mechanisms through which these psychological benefits are achieved (Field, 2016). Recently there has been an increased focus on theoretical models and research exploring the mechanisms of change from yoga. Yoga has been suggested to work through

physiological, psychological and interpersonal processes (Bennetts, 2022; Kishida et al., 2018; Gard et al., 2014; Gust, 2023; Voss et al., 2023).

Voss et al. (2023) review aimed to explore the impact of yoga on cognition. This review suggested two primary mechanisms contributing to the cognitive benefits of yoga: improved stress regulation and improved neurocognitive resource efficiency. The model proposed by Voss et al. (2023) suggests that yoga practice leads to improved stress regulation by reducing stress reactivity, chronic stress, inflammation and emotional reactivity. The model also suggests yoga increases neurocognitive resource efficiency via increased network flexibility, engagement in attentional and emotion regulation networks, and structural changes including reduction of grey matter volume loss. The improved stress regulation and neurocognitive resource efficiency leads to more adaptive stress responses and more flexible processing, promoting cognitive benefits. However, this review only focused on research in healthy older adults, included heterogeneous yoga styles and simplified the eight limbs of yoga into broader constructs limiting how specific elements of yoga practice may produce changes.

On the other hand, Kishida et al (2019) model suggests practicing yoga can promote psychological benefits through enhancing intrapersonal (e.g., mindfulness/ self-awareness, emotional regulation and self-compassion) and interpersonal outcomes (e.g., compassion toward others, social connectedness).

However, each of these models (Kishida et al., 2019; Voss et al., 2023) only explore specific outcomes and have been criticised for not being holistic in the mechanisms they explore (e.g. no model includes physiological, social and psychological processes together), oversimplifying the limbs of yoga into fewer core areas (e.g. ethical principles, breathwork, postures and meditation), and having limited empirical support to date (Bennetts, 2022; Fox et al., 2024).

Bennetts (2022) proposes a model for the impact of yoga on psychological wellbeing. The model suggests that each individual limb of yoga (distinguishing all eight limbs) may elicit

psychological change through specific transdiagnostic processes. These processes work through psychological (e.g. interoception, compassion, emotional regulation, attention), physiological (e.g. respiratory system, autonomic nervous system, sleep), or social (e.g. compassionate interaction, expression of inner experiences) mechanisms to elicit change and promote psychological wellbeing. Although Bennetts model mainly focuses on psychological mechanisms, the complex interaction between physiological, psychological, interpersonal processes on psychological wellbeing is acknowledged. A strength of this model is that it provides clear hypotheses allowing yoga to be compared to talking therapies which has found preliminary support (Fox et al., 2024; Wallis et al., 2024).

Bennetts (2022) also suggests that the transdiagnostic processes proposed in the model may work through similar mechanism of change to talking therapies such as CBT and third wave therapies, leading to similar psychological outcomes. Therefore, yoga may be a complementary and alternative approach to promote psychological wellbeing. Additionally, yoga could help people who find it difficult to verbally express their difficulties or find it difficult to access mainstream treatments such as neurodevelopmental populations (Adams & Young., 2021; Beauchamp et al., 2022; Bennetts, 2022; Salaheddin, & Mason., 2016).

1.1.2.2 Yoga and Neurodevelopmental Populations

It has been theorised that yoga may have a positive effect on neurodevelopmental populations due to its effect on physiological, emotional, and cognitive functioning which could directly relate to the core areas of difficulties experienced in NDCs such as autism, ADHD and ID (Singh, 2021). However, it has also been argued that intentionally focusing awareness on body sensations, which is common in yoga practices, may increase physical discomfort and agitation for some individuals in neurodevelopmental populations if not managed with sensitivity (Semple & Madni, 2014; Semple, 2019).

A number of previous reviews have looked at yoga and mindfulness practices in ADHD and autism populations (Gonzalez et al., 2023; Shanker & Pradhan 2022). Gonzalez et al., (2023)

review found that yoga and meditation positively affect various characteristics in children with ADHD, including attention, hyperactivity, and impulsive behaviour. However, the review only included studies since 2002 and only two of the included studies explored a yoga intervention. Shanker & Pradhan (2022) conducted a descriptive review of research on yoga in autism. The review suggests yoga is an effective intervention for children with autism. However, this review did not use a systematic approach.

These previous reviews (Gonzalez et al., 2023; Shanker & Pradhan 2022) only explored distinct neurodevelopmental presentations/conditions and often did not consider or report co-occurring conditions. Additionally, they did not distinguish yoga from other mindfulness or meditative approaches and did not clearly define the inclusion criteria for the construct of yoga such as the specific components or limbs of yoga practiced during the interventions. Another limitation is that all previous reviews only included children and did not explore research conducted with adults. Due to these critiques, there is a need for a systematic review to explore the impact of yoga across NDC populations which accounts for co-occurring conditions and clear definitions of yoga interventions.

1.1.3 The Current Review

Understanding the psychosocial impact of yoga in neurodevelopmental populations could inform how yoga interventions may be used or tailored to support with specific difficulties experienced in these populations. The current systematic review aims to synthesise and evaluate the evidence exploring the psychosocial impact of yoga across neurodevelopmental populations in both children and adults. The current review groups NDCs which are associated with difficulties in cognitive, behavioural, and social domains (e.g. autism, ID, ADHD), due to yoga's theorised effect on physiological, emotional, social and cognitive processes.

1.2 Method

1.2.1 Registration

The current systematic review follows evidence-based Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021a; 2021b). The protocol for this review was registered on PROSPERO international prospective register of systematic reviews (registration number: CRD42024512885; date of registration: 15th February 2024).

1.2.2 Search Strategy

The search strategy was informed by the review aims and early scoping searches. Search terms 'A' were designed to target a breadth of yogic practices, and search terms 'B' were designed to target neurodevelopmental populations (see Table 1). Search terms were kept broad to capture as many relevant studies as possible.

Table 1

Final Search Terms

Topic	Search terms
Search terms A (Yoga search terms)	yoga OR yogi OR yamas OR niyama OR asana OR pranayama OR pratyahara OR dharana OR dhyana OR samadhi OR meditation
Search terms B (Neurodivergent search terms)	Neurodiver* OR Autis* OR asperger* OR "Attention Deficit Hyperactivity Disorder" OR ADHD OR ADD OR "attention deficit disorder" OR "Learning dis*" OR "Intellectual Dis*" OR ASD OR ASC or neurodevelopmental or neuro-developmental

Note. Due to the limited research in this area no further filters or exclusions (i.e. language or date of publications) were made at this stage to ensure relevant studies were not excluded. Boolean operator 'AND' was used to combine search terms A and search terms B in each database.

1.2.3 Eligibility Criteria

The current review focussed on quantitative studies examining the psychosocial impact of yoga in NDCs. Psychosocial outcomes included cognitive, behavioural, emotional and social factors. Studies which met the eligibility criteria were included. See Table 2 for the full inclusion and exclusion criteria and Table 3 for definitions of psychological outcomes.

Table 2

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
The entire article is written in English.	The article is written in any language other than English.
Empirical study designs.	Reviews including systematic reviews, meta-analyses, conference papers, books, book chapters were excluded.
Research studies using or including quantitative analysis	Research that uses qualitative only or case study and case series designs.
Participants from the neurodivergent and/or learning disability population in the following domains: cognition, adaptive behaviour, language/ communication.	Non-neurodivergent populations or Neurodevelopmental Motor Disorders, including Tic Disorders or learning difficulties (such as dyslexia or dyscalculia) were excluded.
Must include a yoga intervention. Yoga interventions must include a minimum of two of the eight limbs of yoga. One of these must be physical postures (asana). Plus at least one of the following: • ethical considerations (yamas) • guidance for ways of living (niyamas) • breathwork (pranayama) • meditation practices including inward attention (pratyahara); focused attention on one subject (dharana); connection with the object of dharana rather than just observing (dhyana) • bliss state (Samadhi)	Interventions that were similar to but not explicitly yoga or studies focusing only on one element of yoga only (e.g. 'stretching' or 'mindfulness') were excluded. Integrated approaches where the effects of the yoga intervention cannot be separated from alternative approaches e.g. yoga and horse-riding or yoga and other therapy.
Studies must measure psychological or social outcomes as dependent variables (as defined).	Studies that did not include psychological or social outcome measures as dependent variables, such as physiological only outcomes were removed.

Note. There were no restrictions on age, gender, nationality, or other demographics of the samples used in the studies.

Table 3

Definition of Outcomes Used in the Current Review

Outcome Variable	Definition
Psychological outcomes	Emotional, cognitive or behavioural factors (Jordans et al., 2010; Psychosocial Working Group, 2003).
Emotional outcomes	Emotional outcomes include mental wellbeing, emotions and mood states including feelings such as happiness and anxiety.
Cognitive outcomes	Cognitive outcomes include cognitive processes including thoughts, self-control, memory, attention or learning.
Behavioural outcomes	Behavioural outcomes include overt behaviours such as adaptive behaviour, repetitive behaviours and functional behaviours (e.g., hyperactivity, aggression, or challenging behaviour).
Social outcomes	Social outcomes include social interactions such as communication skills and social skills.

1.2.4 Selection Process

Searches took place on the 9th February 2024 with all articles imported on the same day. The papers searched were from the earliest date available in each database until the date of the search. Searches were rerun on 25th January 2025 from previous search date, and all articles were imported on the same day. The databases used to identify articles to be included in this systematic review were Web of Science Core Collection, CINAHL, EMBASE and PsycINFO. Rayyan software was used to screen the articles in this review (Ouzzani et al., 2016). During screening the primary authors of a number of articles were contacted to request further details of their yoga intervention or if full text were available when abstracts appeared appropriate. The reference lists of the journal articles selected for inclusion were searched for any additional articles that were not identified in the online search.

Full texts were screened against a screening tool (Appendix B) consisting of the predetermined inclusion and exclusion criteria. The main researcher (NW) reviewed all studies. Duplicates were first removed before an initial title and abstract screen, followed by a full text screen. The titles and abstracts were categorized as Included/Maybe/Excluded based on eligibility. Full texts were obtained and reviewed for articles where it was unclear whether they were relevant and those that appeared to be eligible (Maybe/Included). To reduce bias, a second reviewer (TM) independently screened 10% of the 'titles and abstracts' and 'full text' reviews of randomly selected studies to reach consensus regarding the study eligibility criteria. Any discrepancies between the main author and second reviewer were discussed. If a decision could not be reached, a further discussion was had with another member of the research team (AB) to find a consensus.

The initial Kappa coefficient of title and abstract review was moderate agreement (k = 0.54) with 88% agreement between the reviewers. The main reason for disagreement reflected differences in the assignment of "Include" versus "Maybe" due to main researcher being more cautious although all "Included" and "Maybe" articles continued to the next stage of full text review. There was only one conflict that did not continue to the next stage, this discrepancy was due to second reviewer misreading the population of the study. The Kappa coefficient for full text review was substantial agreement (k = 0.654) with 97% agreement between the reviewers.

1.2.5 Data Extraction

The main researcher (NW) completed data extraction into a MS Excel spreadsheet for all studies included in the analysis. Data extracted included the study title, authors, year of publication, journal, design, location of study, study aim, sample size, sample characteristics, inclusion and exclusion criteria, intervention (definition, controls/comparators, duration/ frequency), study outcomes, analysis and key findings. For any missing data or unclear findings, the researcher contacted main authors for clarity.

A meta-analysis was not considered to be appropriate in this review due to heterogeneity of population diagnosis, ages, settings, measures, outcome variables as well as a lack of reported effect sizes (Boland et al., 2017; Campbell et al., 2020), therefore a narrative synthesis was conducted.

1.2.6 Quality Assessment

Kmet et al.'s (2004) Standard Quality Assessment Criteria (SQAC) tool for evaluating primary research papers, was used to assess the quality of the studies included in this review (Appendix C). This tool was chosen as it allowed the researcher to assess research across a variety of designs, while ensuring consistency without the need to compare across different assessment tools.

The tool is made up of 14 items which assess the quality of a study based on: clarity of the research question, study design, methodology, sample size, data analysis, results and conclusions and implications. The items are scored on a 3-point scale (2 = "yes", 1 = "partial", 0 = "no"). Items not applicable to a particular study design were marked "N/A". The tool was used to calculate a quantitative summary score, then scores of included studies were interpreted based on descriptors in line with previous research (Bjerrum et al., 2024; Cordier et al., 2021; Lee et al., 2020). Scores higher than 0.80 are rated as 'strong'; 0.70-0.79 rated as 'good'; 0.50-0.69 rated as 'adequate', and scores lower than 0.50 are rated 'limited'. To reduce potential bias, all included studies were assessed with the SQAC tool by two reviewers independently (NW & TM) as per recommendations for systematic reviews (Boland et al., 2017). Prior to discussing discrepancies, Cohen's Kappa coefficient was used to measure inter-rater reliability (Cohen, 1968). Inter-rater reliability was slight agreement (k = 0.101) with 28.57% agreement between the reviewers. This initial kappa coefficient was low due to the reviewers interpreting some items in the quality assessment tool differently. Most discrepancies reflected differences in N/A being applicable for specific items and differences in the assignment of "yes" versus "partial" on certain items, which is consistent with findings in the development of the tool (Kmet

et al., 2004). The two reviewers then met to discuss and compared scores. Any further disagreements or concerns were discussed with a third independent reviewer (AB) until agreement was met. Following this a consensus of 100% was achieved and a final summary score was calculated for each study (see Table 6).

1.3 Results

The initial search found a total of 2663 results and the rerun search found an additional 202 results from the four databases (CINAHL, PsycINFO, Web of Science Core Collection, EMBASE). Figure 1 shows a PRISMA flowchart outlining how publications were identified and eliminated during the selection process.

The reasons for exclusion at full text stage were as follows: not written in English language (n = seven); did not meet publication inclusion criteria (n=75); used the wrong design (n=73); the wrong population (non-neurodivergent populations; n=47); did not include an appropriate yoga intervention (n=117) and due to wrong outcomes as defined by the inclusion/exclusion criteria (n=13).

No additional studies were found for inclusion in the re-run search following full text review. The screening resulted in 21 full texts that met the criteria and were included in the quality assessment. Two articles were removed due to 'limited' quality and inconsistencies in the results making them difficult to interpret. Two additional studies for inclusion were found through back referencing. This left a final 21 studies included in the analysis.

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only

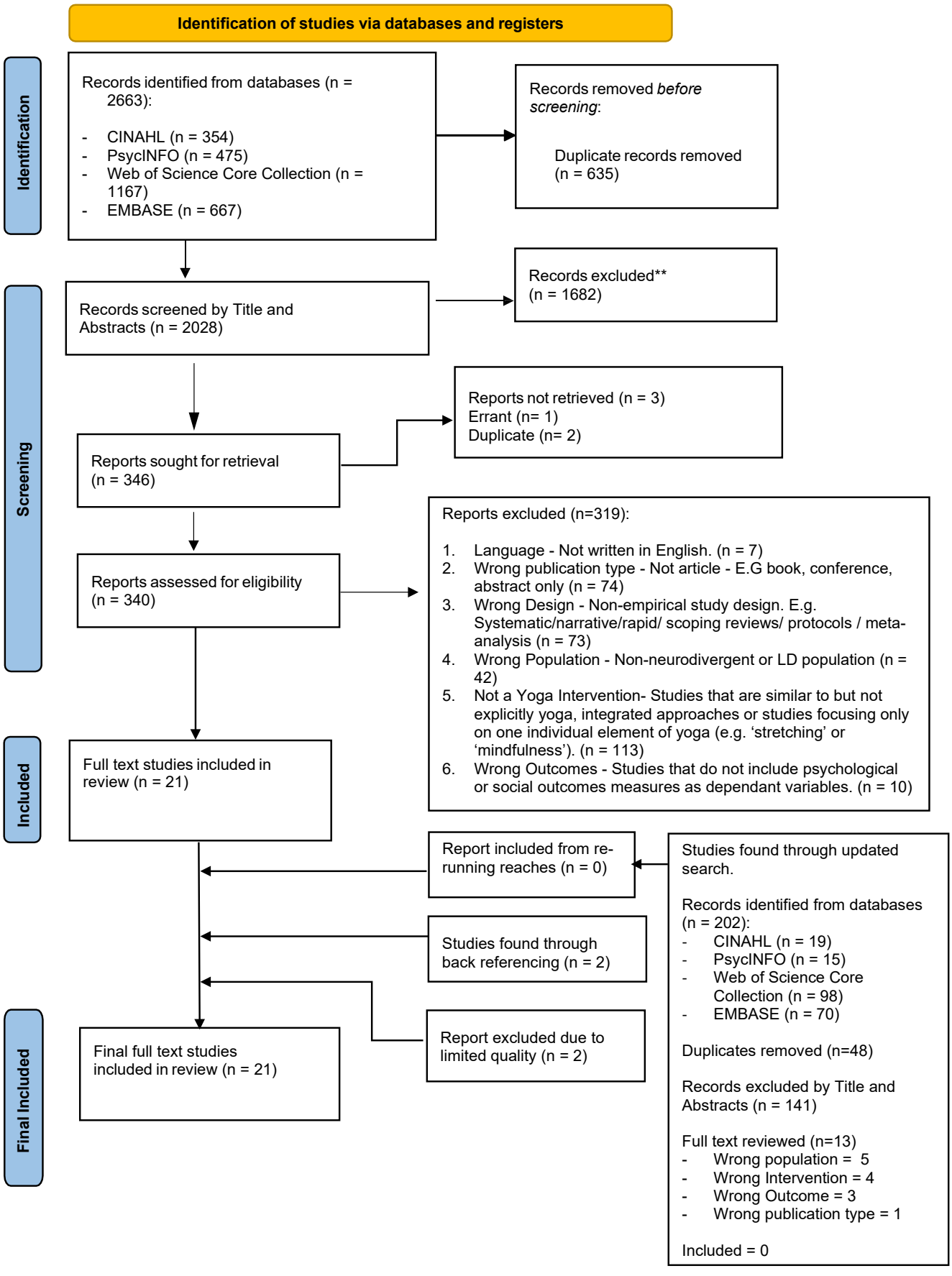

Figure 1

Flow Diagram of Study Review Processes

1.3.1 Study flow and characteristics

A summary of the study characteristics is shown in Table 5. The included studies were all published in peer-reviewed journals between 1989 and 2024.

The majority of studies were conducted in India (n = 7; Deorari & Bhardwaj, 2014; Joshi & Rathi, 2019; Narasingharao et al., 2017a; 2017b; Shanker & Pradhan, 2023; Sharma & Sharma, 2016; Uma et al., 1989) or the USA (n = 6; Crowe et al., 2019; Fritz & O'Connor, 2022; Kaur et al., 2021; Koenig et al., 2012; Litchke et al., 2018; 2021). Two studies were conducted in Iran (Abadi et al., 2008; Rezaei et al., 2018). Single studies were conducted in China (Luo et al., 2023), South Korea (Kim & Hong, 2019), Taiwan (Chou & Huang, 2017), Australia (Jensen & Kenny, 2004) and the UK (Dinu et al., 2023). One study was conducted across two cities: Mumbai in India and Pretoria in Africa (Pandya, 2020).

The total sample included in analysis across all studies was 851 participants. Studies sample sizes ranged from 5 participants (Litchke et al., 2018) to 159 participants (Dinu et al., 2023).

Interventions ranged from one ten-minute session (Dinu et al., 2023) to six sessions a week for 90 weeks (Sharma & Sharma, 2016). The yoga interventions included in the studies ranged from including two limbs of yoga such as breathing (pranayama) and postures (asanas) to four of the eight-limbs as outlined by Patanjali (Shearer, 2002). However, some limbs were combined for clarity due to studies using non-Sanskrit terms. Table 4 shows the percentage of studies that included different limbs of yoga in their intervention.

Table 4

Percentage of Limbs incorporated in interventions within included studies'

Limbs of Yoga	Number of Studies	%
Yama (ethical restraints)	0	0%
Niyama (observances)[a]	2	9.5%
Asana (postures)	21	100%
Pranayama (breath control)	21	100%
Meditative Limbs[b] Pratyahara (sense withdrawal) Dharana (concentration) Dhyana (meditation)	19	90.5%
Samadhi (absorption)[c]	0	0%

Note. [a] Yama and niyama were not explicitly reported by studies however practices of reflection and affirmations were defined under niyama. [b] Due to heterogeneity in the standardisation and lack of detailed reporting of interventions meditative limbs were grouped together to reduce the risk of misclassification. Practices of relaxation, concentration, chanting and mantras were also defined under meditation. [c] Samadhi is described as deep state of bliss that develops over a progressive journey of consistent practice, so it was deemed unable to ascertain given the information in the included studies.

1.3.1.1 Design

Four studies used one arm designs (Crowe et al., 2019; Deorari & Bhardwaj, 2014; Litchke et al., 2018; Narasingharao et al., 2017a). 17 studies used a pre-test post-test control group design.

1.3.1.2 Randomisation

Of the 17 studies using a control group design, 11 studies were RCTs; five of which reported randomisations but did not define the method of randomisation (Kim & Hong, 2019; Litchke et al., 2021; Joshi & Rathi, 2019; Rezaei et al., 2018; Uma et al. 1989); five studies

reported the method of randomisation (Dinu et al., 2023; Fritz & O'Connor, 2022; Luo et al., 2023; Pandya, 2020; Shanker & Pradhan, 2023) and one study was a randomized crossover design (Jensen & Kenny, 2004).

Three studies did not use randomisation (Chou & Huang, 2017; Kaur et al., 2021; Koenig et al., 2012) and three did not report whether randomisation had occurred (Abadi et al., 2008; Narasingharao et al., 2017b; Sharma & Sharma, 2016).

1.3.1.3 Interventions and control groups

12 studies compared yoga to a single control group, which included: an undefined control (Joshi & Rathi, 2019), no intervention or "standard morning activity" (Abadi et al., 2008; Chou & Huang, 2017; Koenig et al., 2012); Rhythmic movement (yoga was control group; Kim & Hong, 2019); Academic Intervention (Kaur et al., 2021; Narasingharao et al., 2017b; Shanker & Pradhan, 2023); waitlist control group (Fritz & O'Connor., 2022; Pandya, 2020); matched control group that was 'not exposed to yogic practices' (Uma et al. 1989); and cooperative games and activities (cross over design; Jensen & Kenny, 2004). Five further studies compared yoga to an alternative active intervention and a control group. One study compared yoga to a recreation intervention, combined Yogic-Recreational intervention and a no intervention control group (Sharma & Sharma, 2016). One study compared Kid Yoga Rocks to Drumtastic intervention and a classroom control group (Litchke et al., 2021). One study compared yoga only to a combined yoga and music group, music only group and a control group who did not receive any intervention (Luo et al., 2023). One study compared yoga intervention to a neuro-feedback intervention and a control group (Rezaei et al., 2018). One study compared four groups: Cycling versus Hatha Yoga in ADHD versus 'healthy controls' (Dinu et al., 2023).

1.3.1.4 Sampling

The majority of studies used convenience sampling (n=16; Chou & Huang, 2017; Deorari & Bhardwaj, 2014; Dinu et al., 2023; Fritz & O'Connor, 2022; Jensen & Kenny, 2004; Joshi & Rathi, 2019; Kaur et al., 2021; Kim & Hong, 2019; Koenig et al., 2012; Litchke et al., 2018; 2021;

Narasingharao et al., 2017b; Rezaei et al., 2018; Shanker & Pradhan, 2023; Sharma & Sharma, 2016; Uma et al.,1989;). One study used stagewise recruitment (Pandya, 2020), one used stratified whole group sampling (Luo et al., 2023) and one reported using cluster sampling (Abadi et al., 2008). Two did not report sampling method (Crowe et al., 2019; Narasingharao et al., 2017a).

1.3.2 Sample Characteristics

1.3.2.1 Diagnosis

Studies recruited participants with diagnosis of NDCs. Nine studies included individuals with autism (Deorari & Bhardwaj, 2014; Joshi & Rathi, 2019; Kaur et al., 2021; Koenig et al., 2012; Litchke et al., 2018; Narasingharao et al., 2017a; 2017b; Shanker & Pradhan, 2023; Sharma & Sharma, 2016). Litchke et al., (2021) “diagnosed with ASD or with symptoms and behaviours consistent with a potential future diagnosis of ASD” (p. 63). Five included individuals with ADHD (Abadi et al., 2008; Chou & Huang, 2017; Fritz & O'Connor, 2022; Pandya, 2020; Rezaei et al., 2018). One included individuals with co-occurring ADHD and ODD (Luo et al., 2023). One included ADHD with co-occurring ODD and LD (Jensen & Kenny, 2004). One study included ADHD with co-occurring anxiety and depression, but all other co-occurrences were excluded (Dinu et al., 2023). One study reported recruiting individuals consistent with diagnosis of mild, moderate and severe intellectual disabilities (Uma et al., 1989). One study included individuals with intellectual or autistic disability (Kim & Hong, 2019). One study included participants with Intellectual and Developmental Disabilities (IDD) including Fragile X syndrome; intellectual disability; autism, Down Syndrome; learning disability; and 1p36 deletion syndrome (Crowe et al. 2019).

1.3.2.2 Age

Ages ranged from 3-4 years (Litchke et al., 2021) to 22-39 years (Crowe et al. 2019). Seventeen studies recruited children and four recruited adults (Crowe et al. 2019; Dinu et al., 2023; Fritz & O'Connor, 2022; Kim & Hong, 2019).

1.3.2.3 Gender

12 studies included both male and female participants. One study recruited women only (Fritz & O'Connor, 2022) and two recruited males only (Jensen & Kenny, 2004; Litchke et al., 2018). Two studies did not report any mention of gender (Deorari & Bhardwaj, 2014; Sharma & Sharma, 2016). Four studies mention screening or including both genders without any figures (Abadi et al., 2008; Joshi & Rathi, 2019; Narasingharao et al., 2017b; Rezaei et al., 2018).

1.3.2.4 Ethnicity

Only four studies reported on ethnicity (Crowe et al. 2019; Jensen & Kenny, 2004; Kaur et al., 2021; Koenig et al., 2012). The majority of these studies categorised ethnicity into Hispanic/Latin, African American, Caucasian/White, Asian. While Jensen and Kenny (2004) reported ethnicity as “All but one participant, who was Chinese, were Caucasian (92.85%)” p.206.

Table 5

Study Characteristics

Study	Country	Design / Randomisation / Sampling	Study Population	Sample Characteristics	Yoga Intervention	Yoga duration and frequency	Comparator
Abadi et al., 2008	Iran	**Design:** Pretest-Posttest experimental design **Randomisation** Not reported **Sampling:** Cluster sampling - method not described.	ADHD	40 children 20 in experimental; 20 in control. **Age:** 9-12 years Mean age of 10.1 years (SD = .99) **Gender:** "boys and girls" **Ethnicity:** Not reported.	Pranayama Asanas Relaxation	Twice a week (2 sessions 45 minutes each) for eight weeks (total 16 sessions)	Intervention V Control Experimental group – yoga Control group - did not receive intervention. No treatment group.
Chou & Huang, 2017	Taiwan	**Design:** Experimental Pretest-Posttest control group design. **Randomisation:** Randomisation was not used - participants	ADHD	49 included in analysis. 50 allocated and 1 drop out: The yoga exercise group (24) and the control group (25). **Age:**	Asanas Meditation Concentration/ Body awareness attention Breathing	Each lesson for yoga activity lasted for 40 min, twice a week for eight weeks	Yoga exercise V Control group. The participants in the control group were simply instructed to maintain their normal life without

		grouped based on school districts. **Sampling:** Convenience sample recruited via flyers posted in relevant locations, referrals given to the children's parents by their elementary schools, and a number of orientations conducted to introduce the project.		Between 8-12 years Mean age = 10.50 years (SD = 1.05) Mean age: yoga 10.71 years (SD = 1.00); control 10.30 years (SD = 1.07) **Gender:** (male: female) yoga 19:5; control 19:6; total 38:11. **Ethnicity:** Not reported.	Relaxation		participating in regular physical activity programs.
Crowe et al. 2019	USA	**Design:** Multimethod research (Quant and Qual). One Arm Pretest-Posttest design. **Sampling:** Not reported.	Intellectual and Developmental Disabilities (IDD) "Participants had the following IDD related health conditions: Fragile X syndrome; intellectual disability; autism; Down Syndrome (DS); learning disability; and 1p36	9/12 participants completed all pre and post quantitative assessments. **Age:** 22-39 years. Single Adults **Gender:** 5 males; 4 females **Ethnicity:**	Guided meditation; 5 mins breathwork; 5 mins, Asanas (postures); 30 mins Relaxation; 5 mins	12, 60-minute yoga sessions over the course of 7 weeks.	No control group - yoga only

			deletion syndrome. Additional health conditions LARs reported participants having included celiac disease, scoliosis, and involuntary muscle twitches" (p. 43)	Hispanic/Latinx 2; African-American 2; Caucasian 5.			
Deorari & Bhardwaj, 2014	India	**Design** Single group Pretest-Posttest design **Sampling** Purposive sampling selected from Abhiprerna Foundation, Haridwar.	Autism No exclusion criteria reported.	Sample size 30 children with autism **Age** 5-16 years. **Gender** Not reported **Ethnicity** Not reported	Breathing (Pranayama) Asanas (poses) OM Chanting	One hour in the morning over 3 month period.	Yoga only. Single arm design.
Dinu et al., 2023	UK	**Design:** Experimental Randomised control trial (RCT) with Pretest-Posttest measures **Randomisation:** reported method used	ADHD V control without ADHD Depression or anxiety comorbidities included. All other comorbidities were excluded.	A total of 159 adults. ADHD (n = 82) and controls (n = 77). **Age:** 18–35 years old	Asanas Breathing	One ten-minute intervention	Cycling v Hatha Yoga ADHD V controls

		web based random number generator **Sampling:** Convenience sample recruited from the community through posters across university campuses, social media, institutional recruitment emails and advertisements on support groups' websites and newsletters		Age M (SD): Controls 23.01 (SD = 4.29); ADHD 26.62 (SD = 5.26) **Gender:** Male and female included. Female N (%): Controls 41 (53); ADHD 68 (83). **Ethnicity:** Not reported **Other:** Education (years) M (SD) 5.36 (3.24) 5.32 (3.06)			
Fritz & O'Connor, 2022	USA	**Design:** Randomized controlled trial with waitlist control **Randomisation:** Randomised using a tool available at randomizer.org. **Sampling:** Convenience sampling recruited via flyers posted on local campus bulletin	ADHD Screened using Adult ADHD Self-Report Scale for DSM-5	32 participants recruited 27 completed the study. 16 were assigned to the control condition and 16 to the yoga condition. 5 participants dropped out of the yoga intervention. No-one dropped out of the control group.	Breathing Postures (Asanas)	180min of yoga per week for 6 weeks.	Intervention V Control 6-week yoga training program V waitlist control.

		boards, email listservs, announcements in lecture classes and word-of mouth.		**Age:** 18-24 years. Mean 20.16 SD 1.46 **Gender:** All women **Ethnicity:** Not reported			
Jensen & Kenny, 2004	Australia	**Design:** A randomized crossover design **Randomisation:** Randomisation mentioned but method not described. **Sampling:** Convenience sample recruited from letters sent to 80 parents with eligible sons	ADHD Diagnosed according to DSM-IV criteria by experienced paediatricians specializing in ADHD. Comorbid Anxiety Disorder and Learning Disability were included. Diagnosed ODD and Conduct Disorder were excluded except three boys with ODD (with mild expression) (p. 207).	25 responded, 16 began and 14 completed the trials. Of the 14 who completed the trials: six participated in the yoga group only; five were originally in the control group—crossed over; and three were in the control group only. **Age:** Aged 8–13 years. The mean age in the yoga group was 10.63 years (SD = 1.78) and in the control group was 9.35 years (SD = 1.70).	Breathing techniques Asanas (postures) Relaxation Concentration (meditation)	Twenty weekly one hour sessions.	Intervention V control Crossover design. Yoga only Control/ Yoga (Crossover) Control only The control group engaged in cooperative games and activities that involved the skills of talking and listening, turn-taking, sharing equipment, and talk time. These groups were conducted for 1 hour, once a month, and at the same location as the yoga groups.

				Gender: All boys **Ethnicity:** All were Caucasian (92.85%) except one participant, who was Chinese. **Other:** All participants were from middle to lower-middle socioeconomic status and were assessed as having average or higher intelligence.			
Joshi & Rathi, 2019	India	**Design:** Pretest-Posttest control group design. **Randomisation:** "Randomly divided into two groups" (p.169) – method not described. **Sampling:** Convenience sampling by examining admissions and medical records of children enrolling in 2017-2018 academic	Autism	45 children with established autism profiles screened. 30 children included in the study. yoga group (15) and control group (15). **Age:** 6-14 years **Gender:**	Breathing (Pranayama) Chanting Asanas (poses)	One-hour Integrated Approach of Yoga Therapy (IAYT) module based on authentic and modern texts of yoga was conducted with a yoga group for 5 days a week for 12 weeks.	Yoga Intervention V Control (undefined control group)

		year in Sheeshyaa Acadamy.		Reports 'both genders included' **Ethnicity**: Not reported. **Other:** Middle socioeconomic backgrounds of parents			
Kaur et al. (2021)	USA	**Design:** Pretest-Posttest control group design. **Randomisation**: Randomisation not done due to recruiting 12 individuals from previous trial for control group. **Sampling:** Convenience sample recruited for intervention by "distributing fliers at the local schools, clinical services, and through online postings with the local parent and family advocacy groups" (p.5)	Autism	12 academic group; 11 yoga group. **Age:** Overall, 5-13 years. Mean (SD): Yoga = 7.84 (± 0.54) Academic = 7.80 (± 0.70) **Gender:** Yoga group: 10 males; 1 female. Academic group: 11 males; 1 female. **Ethnicity:** Yoga Group: White 6; Asian 5; African American 0; Hispanic 0	Breathing Asanas (poses and partner poses) Relaxation As well as activities focused on the needs of children with autism	4 sessions a week for 8 weeks. Two expert-led (~45 mins) and two parent-led (~30 mins) sessions each week (for a total of 16 expert and 16 parent-led sessions).	Creative Yoga v Academic The "academic intervention" involved therapeutic activities that are often offered to children with autism in standard special education settings including activities to promote fine-motor and communication skills through reading, building, art-craft, etc. (p4).

				Academic group: White 9; Asian 1; African American 1; Hispanic 1. **Other:** Yoga group: Socioeconomic Status (SES) upper 2; upper middle 8; middle 1; Lower-middle 0. Academic group: SES upper 1; upper middle 8; middle 2; Lower-middle 1.			
Kim & Hong, (2019)	Seoul, South Korea	**Design:** Experimental Pretest-Posttest control group design **Randomisation:** "Randomly arranged them into experiment group and control group" - method not described. **Sampling:** Convenience sample from Social Welfare Protection Centre	Autism or Intellectual Disabilities	30 participants. Rhythmic Movement (n=15) V Yoga (n=15). **Age:** 20's-30's **Gender:** 13 males; 17 females. (Rhythmic Movement 6 males & 9 females; Yoga control 7 males & 8 females) **Ethnicity**: Not reported.	Liz Lark's children yoga. Relaxation; 16 mins (intro 10mins and finish 6 mins) Asanas (postures) ; 40 mins Meditation ; 4 mins	60 minutes per session, once a week for 12 weeks. (June 12 to August 28 2015)	Experimental (creative movement) v Control (yoga)

Koenig et al., 2012	USA	**Design:** Experimental Pretest-Posttest control group design. **Randomisation:** No randomisation. **Sampling:** Convenience sample drawn from a large urban public school. "Convenience sample of an intact group (classrooms) from a large urban school and did not use random sampling or sample size estimation" (p.544).	Autism	Initially recruited 49 (7 classes of 6 and one of 7). 3 dropouts. Total included 46. 24 participants in the intervention group and 22 participants in the control group. **Age (mean):** Intervention: 9 yr, 7 mo; Control: 8 yr, 7 mo **Gender:** Intervention: male 19; female 5. Control: male 18; Female 4. **Ethnicity (%):** African American: Intervention 50; Control 41 Hispanic: Intervention 37.5; Control 32 White: Intervention 12.5; Control 9 Asian: Intervention 0; Control 18	Breathing (pranayamas) Asanas (physical postures) Relaxation (yoga nidra) Chanting (kirtan).	This routine was done every morning for approximately 15–20 min. Every school day for a period of 16 wk.	Intervention v Control Yoga v no intervetion. The control group participated in the standard morning activity

Litchke et al., 2018	USA	**Design** Single Arm Pretest-Posttest design **Sampling** Convenience sampling. The inclusion criteria were (1) the youth participated in the autism camp for 4 weeks, (2) they were able to follow instructions, and (3) they were willing to participate in yoga activities (p. 60).	Males with autism recruited from a 4-week autism summer camp. Two participants had Asperger Syndrome and Three had Pervasive developmental disorder not otherwise specified (PDD-NOS)	N = 5 **Age** 8-13 years **Gender** 5 Male **Ethnicity** Not reported.	Mandala style yoga program called Teen Yoga Warriors including: Breathing (Pranayama) Asanas (poses) Positive Affirmations (Adaption for children)	One-hour sessions, twice a week for four weeks.	Yoga only. Single arm design.
Litchke et al., 2021	USA	**Design:** Quasi-experimental design with Pretest-Posttest. **Randomisation:** Random allocation reported – method not described. **Sampling:** Convenience Sample	Autism “diagnosed with autism or with symptoms and behaviours consistent with a potential future diagnosis of autism” (p. 63).	29 total. (31 students that met the inclusion criteria, only 29 students met the minimum attendance of 7/10 sessions) Drumtastic (DR; experimental group; n=11); Kid Yoga Rocks (KYR; experimental group; n=10); control	Chanting Breathing Asanas Relaxation Mantra	Twice a week for one hour over a 5-week period (10 sessions) during the fall school semester.	Two Interventions V Control group. DR = Drumtastic; KYR = Kid yoga rocks; CR = Classroom recess/physical education;

				group (regular classroom/recess/physical education) (CR; n = 8). **Age:** 3-4 years. **Gender:** 25 males;4 female. Yoga group was male only. **Ethnicity**: Not reported			
Luo et al., 2023	China	**Design:** Randomized controlled design (RCT) **Randomisation:** Randomisation method reported using computer assignment software. **Sampling:** Children from music company and the yoga company by distributing flyers in Wenjiang district, Chengdu. stratified whole-group random	Co-occurring ADHD and ODD	67 recruited, after screening, 60 children. 15 participants in each group. **Age (mean):** 4.98 years (SD = 0.77). **Gender:** 29 females, 31 males **Ethnicity**: Not reported	Breathing Meditation Asanas	16-week intervention of two sessions a week. Each intervention totalled 10 minutes.	Yoga-only group (10 min per yoga intervention, twice a week) Music only group (10 min per music intervention, twice a week) Yoga and music group (10 min per yoga intervention and 10 min per music intervention, twice a week)

		sampling method to divide children's consumer of yoga company and the music company into three levels: small, middle, and large classes.		**Other (mean):** Height 109.33 cm (SD, 6.67 cm) Weight 20.9 kg (SD, 3.02 kg).			Control group did not receive any intervention
Narasingharao et al., 2017a	India	**Design:** Pretest-Posttest single group design **Sampling**: Not reported	Autism "Diagnosed as autistic under the International Classification for Diseases 10th edition (ICD-10)" P56	7 children **Age:** 5-16 years **Gender:** 4 male; 3 female **Ethnicity:** Not reported.	Breathing Relaxation Postures (Asanas) Mantras.	Two-week yoga intervention for 75 minutes every day along with parents. The session was held every evening between 5.45 pm to 7.00 pm for 75 minutes.	Yoga only
Narasingharao et al., 2017b	India	**Design:** Pretest-Posttest control design. **Randomisation:** Not reported **Sampling:** Convenience sample of children from Academy for Severe Handicap and	Autism -diagnosis in line with ICD-10	32 yoga group and 29 control group 68 participants recruited 4 excluded due to ADHD 3 dropped out the control group before completion.	Yoga program including: Breathing Relaxation Postures (Asanas) Mantras.	90 days. 75-minute duration held between 9.30 am and 10.45 am just before the school opening.	Yoga v Academic

		Autism (ASHA) special school.		**Age:** 5-16 years **Gender:** "Males and females were considered" (p. 2). **Ethnicity**: Not reported.			
Pandya, 2020	Multi City: Mumbai in India and Pretoria in Africa	**Design:** A waitlist-control pretest-posttest design study **Randomisation:** Random allocation mentioned, with participants randomized using random number tables. **Sampling:** Stage-wise recruitment.	ADHD	84 grandchildren with ADHD paired with their grandparent carer included in analysis. **(Grandchildren characteristics only extracted)** Pretest: intervention =55; control group= 55 Post test: Intervention= 46; Control group = 38. **Age:** Pretest: control 8.23 (1.65); Intervention 8.56 (1.78). Posttest: control 9.33 (1.01); Intervention 9.78 (1.89)	Concentration / Meditation Breathing Postures (Asanas) Relaxation	40-min once a week joint lesson for grandchild-grandparent dyads over a year. 2017-2018.	Meditation Intervention V Control Group Meditation group - respiratory, postural, relaxation concentration training. Control group - waitlist control group were advised to listen to soft instrumental music together every week but this was not monitored.

				Gender (%): Pretest control: male 36 (65.45); female 19 (34.54). Pretest intervention: male 39 (70.91); female 16 (29.09). Posttest control: male 26 (68.42); female 12 (31.58) Posttest Intervention: male 34 (73.91); female 12 (26.08). **Ethnicity:** Not reported **Other:** *City* Pretest (per group): India 29; South Africa 26 Post test: Control India 22; South Africa 16 Intervention India 24; South Africa 22.			
Rezaei et al., 2018	Iran	**Design:** Multicentre three-way parallel group	ADHD	21 students were selected as statistical sample and randomly	Relaxation Meditation	Three sessions a week and totally, for 24	Neuro-feedback intervention V Yoga

		randomized controlled trial (RCT) design. **Randomisation:** Randomisation mentioned but method not. **Sampling:** Convenience sample of students with "ADHD disorder symptoms" (p. 19) who were studying in primary schools of Mashhad	"After screening the patients in terms of the severity of symptoms and equalizing the dosage of medicines based on expertise physician, 21 students were selected as statistical sample" (p. 19).	classified into three sample groups of neurofeedback, yoga and control group. NFB (n = 7), yoga (n = 7) or control (n = 7). **Age:** 7-11 years were screened. *No demographic information reported on the final participants' pool.* **Gender:** 'Girls and boys were screened' p 19. **Ethnicity:** Not reported	Breathing Postures (asanas) Reflection.	sessions of 45 min over 8 weeks.	Intervention V control group
Shanker & Pradhan, 2023	India	**Design:** A randomized control trial design (RCT) **Randomisation:** Randomisation method reported as coin toss. **Sampling:**	Autism	Yoga group = 23 children Control group = 20 children **Age:** 5–15 years Yoga group: mean age 9.77 (SD = 2.63).	Chanting Breathing (pranayama) Yoga poses (asanas) Relaxation.	Daily on all school days for 12 weeks. One school period of 45 min was assigned to the yoga sessions.	Yoga V Control Integrated Approach of Yoga Therapy (IAYT) The control group did not participate in the yoga program and followed regular

		Convenience sampling from 4 special schools		Control group: mean age 9.16 (SD = 1.93). **Gender:** Male and females included. Yoga group: male=19:4. Control group: male = 16:4 **Ethnicity**: Not reported.			school routines of basic academics, functional skills training, and physical activity.
Sharma & Sharma, 2016	India	**Design:** Pretest-Posttest control design. **Randomisation:** Not reported. **Sampling:** Convenience sample of autistic children from Mini Bright Future Mentally Challenged School Gosianpur, Punjab,	Autism	20 total **Age**: 8-14 years **Gender**: Not reported **Ethnicity**: Not reported	Asanas Breathing Meditation	Six days in a week for ninety (90) weeks. There were two sessions in a day i.e. morning (7 to 9 am approx.) and evening (5:30 to 7:30 approx.).	Three intervention groups and a control group. Recreational V Yoga V Combined Yoga and Recreation V Control (no-intervention) No experimental treatment was given to control group.
Uma et al. (1989)	India	**Design:** Controlled study design with a matched control group	Intellectual Disabilities	90 participants. Yoga (n=45) V Control (n=45)	Breathing; 10 mins	1-hour sessions; 5 times a week; for one year.	Yoga v Control

	Randomisation: Randomly selected to intervention v control - method not described. **Sampling:** Convenience sample from four special schools in Bangalore	Mild, moderate and severe "Mentally retarded" (p. 415). Severe behavioural problems, cerebral palsy, gross neurological problems, physical handicaps, autism, mutism and sensory deficiencies were excluded from the study. (p416)	**Age:** 6-15 years; Yoga = 10.73 (SD = ±2.70) Control = 10.79 (SD = ±2.46) **Gender:** 58 boys; 32 girls (29 boys & 16 girls per group) **Ethnicity**: Not reported.	Asanas (postures); 45 mins Meditation; 5 mins	The control group was not exposed to yogic practices.

Note. This table uses some terminology used in the papers for transparency.

1.3.3 Quality Assessment

The quality of the included studies ranged from 0.5 – 0.86 as assessed by the SQAC (Kmet et al., 2004). This indicated the studies in this review varied from adequate to strong in the quality of their methodology (Adequate = 57%; Good = 29%; Strong = 14%; see Table 6 for details).

Most studies scored highly (majority scoring Yes) on: the study design being evident and appropriate (yes, n = 20); sufficiently describing their research question and objective (yes, n = 16; partial, n = 5); sufficiently reporting the results (yes, n = 15; partial, n = 6); describing subject characteristics (yes, n = 11; partial, n = 10); defining outcome measures (yes, n = 11; partial, n = 9).

Common areas where studies scored poorly (majority scoring No and Partial) were blinding of investigators (no, n = 14; N/A, n = 5; yes, n = 2); use of and adequate description of randomisation (no, n = 5; partial, n = 7; N/A, n = 4); Appropriate sample size (no, n = 4; partial, n = 14) and controlling for confounding (no, n = 5; partial, n = 13).

Out of the 17 studies comparing yoga to another intervention, 14 studies used an external person to administer the intervention separate from the research team making it possible to use blinding of investigators to reduce observer/ experimenter bias. However, blinding of investigators was only reported in two cases (Kaur et al., 2021; Uma et al.,1989).

All analyses appeared appropriate to the aims of the study however ten studies did not include a justification of the analysis used such as normal distribution checks prior to inferential statistical analysis (Abadi et al., 2008; Deorari & Bhardwaj, 2014; Fritz & O'Connor, 2022; Jensen & Kenny, 2004; Kim & Hong, 2019; Koenig et al., 2012; Rezaei et al., 2018; Shanker & Pradhan., 2023; Sharma & Sharma, 2016; Uma et al., 1989). Additionally, only three studies included a power analysis (Dinu et al., 2023; Lou et al., 2023; Shanker & Pradhan, 2023) to be able to ascertain if the results were based on a sufficient level of statistical power.

Table 6

Quality Assessment Scores for Included Studies.

Study	Quality Assessment														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	1. Question / objective sufficiently described?	2. Study design evident and appropriate?	3. Method of subject/comparison group selection or source of information/input variables described and appropriate?	4. Subject (and comparison group, if applicable) characteristics sufficiently described?	5. If interventional and random allocation was possible, was it described?	6. If interventional and blinding of investigators was possible, was it reported?	7. If interventional and blinding of subjects was possible, was it reported?	8. Outcome and (if applicable) exposure measure(s) well defined and robust to measurement / misclassification bias? Means of assessment reported?	9. Sample size appropriate?	10. Analytic methods described / justified and appropriate?	11. Some estimate of variance is reported for the main results?	12. Controlled for confounding?	13. Results reported in sufficient detail?	14. Conclusions supported by the results?	
Abadi et al., 2008	P	Y	P	P	P	N	N/A	Y	P	P	P	P	P	P	0.54 Adequate
Chou & Huang, 2017	Y	Y	P	Y	N	N	N/A	Y	P	Y	P	P	Y	Y	0.69 Adequate
Crowe et al., 2019	Y	Y	Y	Y	N/A	N/A	N/A	Y	P	Y	P	P	Y	Y	0.86 Strong
Deorari & Bhardwaj, 2014	Y	Y	P	P	N/A	N/A	N/A	Y	P	P	P	N	Y	P	0.64 Adequate
Dinu et al., 2023	Y	Y	Y	Y	Y	N	N/A	Y	P	Y	P	Y	Y	Y	0.85 Strong
Fritz & O'Connor, 2022	Y	Y	P	Y	Y	N	N/A	Y	N	P	Y	Y	Y	P	0.73 Good
Jensen & Kenny, 2004	P	Y	P	P	P	N	N/A	P	N	P	P	N	Y	Y	0.5 Adequate
Joshi & Rathi, 2019	Y	Y	P	P	P	N	N/A	P	P	Y	P	P	Y	P	0.62 Adequate
Kaur et al., 2021	Y	Y	Y	Y	N	Y	N/A	P	P	Y	P	P	Y	Y	0.77 Good

Study	Quality Assessment														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	1. Question / objective sufficiently described?	2. Study design evident and appropriate?	3. Method of subject/comparison group selection or source of information/input variables described and appropriate?	4. Subject (and comparison group, if applicable) characteristics sufficiently described?	5. If interventional and random allocation was possible, was it described?	6. If interventional and blinding of investigators was possible, was it reported?	7. If interventional and blinding of subjects was possible, was it reported?	8. Outcome and (if applicable) exposure measure(s) well defined and robust to measurement / misclassification bias? Means of assessment reported?	9. Sample size appropriate?	10. Analytic methods described / justified and appropriate?	11. Some estimate of variance is reported for the main results?	12. Controlled for confounding?	13. Results reported in sufficient detail?	14. Conclusions supported by the results?	
Kim & Hong, 2019	P	Y	P	P	P	N	N/A	Y	P	P	P	P	Y	P	0.58 Adequate
Koenig et al., 2012	Y	Y	P	Y	N	N	N/A	P	P	P	P	P	P	P	0.54 Adequate
Litchke et al., 2018	Y	P	P	Y	N/A	N/A	N/A	P	N	P	P	N	Y	P	0.55 Adequate
Litchke et al., 2021	Y	Y	Y	Y	P	N/A	N/A	Y	N	Y	P	P	P	Y	0.75 Good
Luo et al., 2023	Y	Y	Y	P	Y	N	N/A	Y	Y	Y	Y	P	P	P	0.77 Good
Narasingharao et al., 2017a	P	Y	Y	P	N/A	N/A	N/A	P	P	Y	Y	N	P	P	0.64 Adequate
Narasingharao et al., 2017b	Y	Y	P	P	N	N	N/A	P	Y	Y	P	N	Y	Y	0.62 Adequate
Pandya, 2020	Y	Y	Y	Y	Y	N	P	Y	P	Y	P	P	Y	Y	0.79 Good
Rezaei et al., 2018	P	Y	P	P	P	N	N/A	P	P	P	P	P	P	P	0.5 Adequate
Shanker & Pradhan, 2023	Y	Y	Y	Y	Y	N	N/A	Y	Y	P	P	P	Y	Y	0.81 Strong
Sharma & Sharma, 2016	Y	Y	P	P	N	N	N/A	N	P	P	P	P	Y	P	0.5 Adequate

Study	Quality Assessment														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	1. Question / objective sufficiently described?	2. Study design evident and appropriate?	3. Method of subject/comparison group selection or source of information/input variables described and appropriate?	4. Subject (and comparison group, if applicable) characteristics sufficiently described?	5. If interventional and random allocation was possible, was it described?	6. If interventional and blinding of investigators was possible, was it reported?	7. If interventional and blinding of subjects was possible, was it reported?	8. Outcome and (if applicable) exposure measure(s) well defined and robust to measurement / misclassification bias? Means of assessment reported?	9. Sample size appropriate?	10. Analytic methods described / justified and appropriate?	11. Some estimate of variance is reported for the main results?	12. Controlled for confounding?	13. Results reported in sufficient detail?	14. Conclusions supported by the results?	
Uma et al., 1989	Y	Y	Y	Y	P	Y	N/A	P	P	P	P	Y	Y	P	0.77 Good

Note. Y=Yes; P=Partial; N=No; N/A= Not Applicable. Total descriptive scores: Adequate (n = 12); Good (n = 6); Strong (n = 3).

1.3.4 Study Findings

This synthesis reviewed the impact of yoga on Cognitive, Behavioural, Emotional and Social outcomes in separate sections to explore the impact of yoga across neurodevelopmental populations. These sections explore the impact of yoga pre and post intervention as well as any significant differences post intervention comparing yoga to control groups or alternative approaches. Constructs were grouped broadly due to heterogeneity in outcome variables and measures used. Study findings are summarised in Table 7 (pp. 71-83).

1.3.4.1 Cognitive Outcomes

Eight studies looked into the impact of yoga on cognitive outcomes (Chou & Huang, 2017; Dinu et al., 2023; Fritz & O'Connor, 2022; Jensen & Kenny, 2004; Kaur et al., 2021; Pandya, 2020; Rezaei et al., 2018; Uma et al.,1989).

1.3.4.1.1 Outcome Variables

A variety of cognitive outcomes were looked at, with some studies looking at multiple outcomes including the impact on: attention (n=5; Chou & Huang, 2017; Dinu et al., 2023; Jensen & Kenny, 2004; Kaur et al., 2021; Rezaei et al., 2018), working memory (n=2; Fritz & O'Connor, 2022; Rezaei et al., 2018), self-control (n=1; Pandya, 2020), Intelligence Quotient (IQ; variety of cognitive processes measuring general cognitive ability) (n=1; Uma et al.,1989), temporal impulsivity and cognitive impulsivity (n=1; Dinu et al., 2023), inhibitory control and cognitive flexibility (n=1; Fritz & O'Connor, 2022) and determination ability (n=1; Chou & Huang, 2017).

1.3.4.1.2 Outcome Measures

There was heterogeneity of measures with most studies using different measures to assess cognitive outcomes (see Figure 2 for visual representation of variables and measures). All studies used standardised psychometric tests of cognitive processes except one which used

standardised self-reported measures of the Self-Control Rating Scale completed by teacher, parent and child (Pandya, 2020).

1.3.4.1.3 Findings

Most studies found that yoga had a positive impact on cognitive processes. All eight studies included within group analysis. Four studies found yoga had a significant positive impact pre to post intervention, two found mixed results (positive impacts on some outcomes, and no impact on others; Dinu et al., 2023; Rezaei et al., 2018) and two found non-significant results (Fritz & O'Connor, 2022; Jensen & Kenny, 2004).

Six studies found a positive effect of yoga on cognitive variables including: IQ (Uma et al.,1989); responsive joint attention skills (Kaur et al., 2021); selective and sustained attention skills (Chou & Huang, 2017); determination ability (Chou & Huang, 2017); perceptions of self-control (teacher, parent and child measures; Pandya, 2020); temporal impulsivity (Dinu et al., 2023) and some areas of working memory and sustained attention (Rezaei et al., 2018).

On the other hand, four studies found no significant effect of yoga on: inattention, cognitive impulsivity, motor impulsivity (Dinu et al., 2023), arithmetic and reaction times (Rezaei et al., 2018), attention (TOVA; Jensen & Kenny, 2004), and executive function skills (inhibitory control, cognitive flexibility and working memory; Fritz & O'Connor, 2022).

Seven studies reported between group analysis (one study did not explore differences between groups due to insufficient power and an invalid measure; Jensen & Kenny, 2004). Five studies found the yoga group were significantly improved post intervention compared to the control groups on cognitive outcomes (Chou & Huang, 2017; Dinu et al., 2023; Pandya, 2020; Rezaei et al., 2018; Uma et al.,1989). One study (Kaur et al., 2021) found a significant main effect only, showing responsive joint attention skills significantly improved following both the yoga intervention and the academic intervention control. One study found no significant effect between groups on executive functioning (Fritz & O'Connor, 2022).

Overall, the majority of studies found a significant positive impact of yoga on some cognitive outcomes both pre-to-post yoga intervention and when compared to control groups. However, some studies also found non-significant results for the effect of yoga on cognitive outcomes, particularly impulsivity and executive function skills.

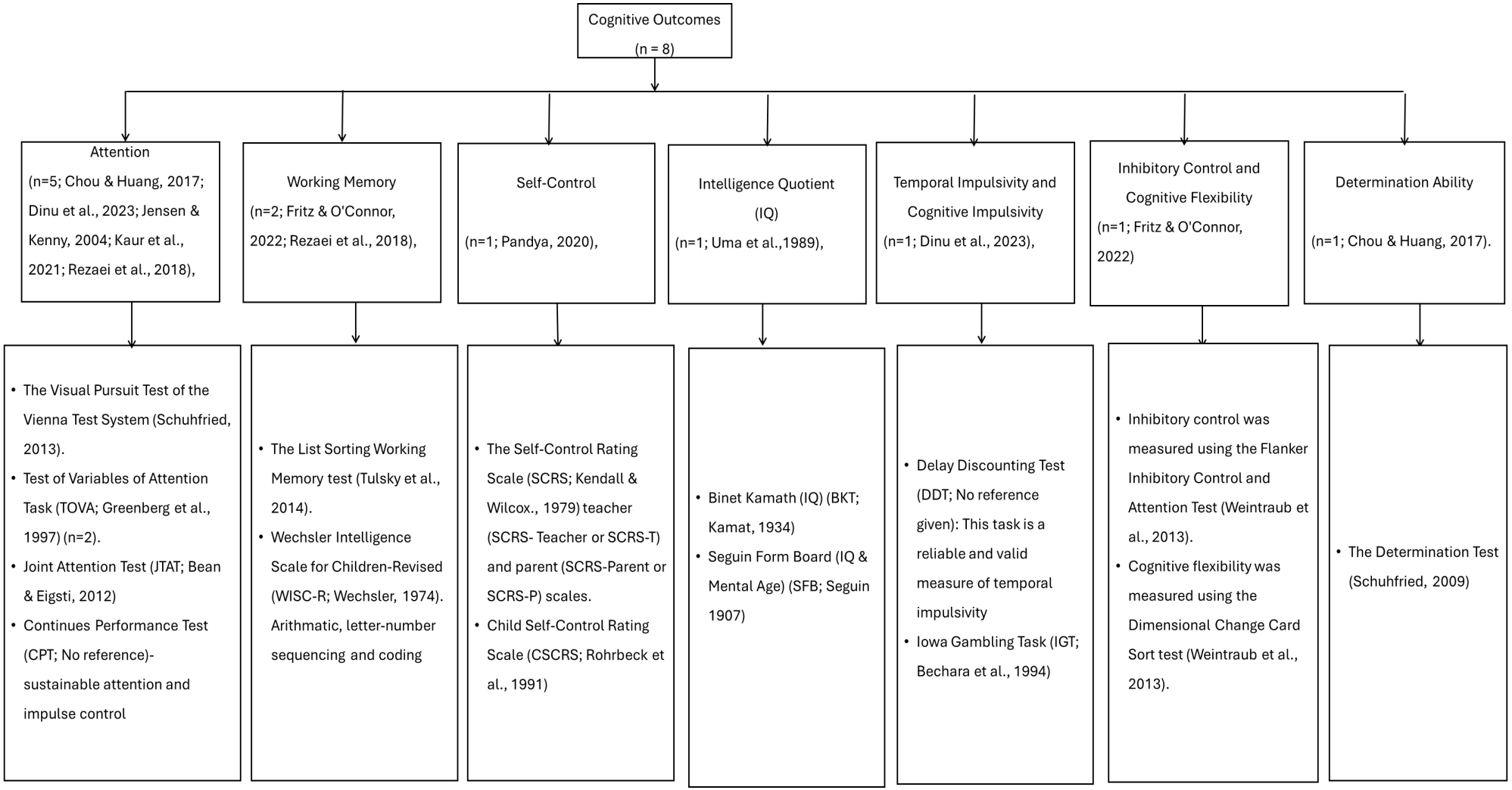

Figure 2

Visual Representation of Cognitive Variables and Measures Used in Included Studies

1.3.4.2 Behavioural Outcomes

Ten studies investigated the impact of yoga on behavioural outcomes (Abadi et al., 2008; Deorari & Bhardwaj, 2014; Jensen & Kenny, 2004; Joshi & Rathi, 2019; Koenig et al., 2012; Luo et al., 2023; Narasingharao et al., 2017a; 2017b; Shanker & Pradhan, 2023; Sharma & Sharma, 2016).

1.3.4.2.1 Outcome Variables

Several studies measured behavioural traits common in neurodevelopmental conditions. Rather than measuring internal states or processes, studies often used proxy reported measures of observable behaviours as a way of understanding neurodevelopmental differences.

Some measures included a combination of subscales or items about behavioural, cognitive and social 'symptomology' which could not be analysed separately. Where measures were exploring a combination of observed behavioural manifestations, these were grouped under behavioural outcomes: such as 'socially withdrawn', 'getting distracted' and 'impulsiveness' which are behavioural manifestations of social and cognitive processes (Yip et al., 2023). However, where measures only explored individual constructs, these were grouped under the specific outcomes, for example measures of social only constructs (e.g. social skills or socially directed verbal communication) were grouped under social outcomes.

A variety of behavioural outcomes were looked at, with some studies looking at multiple outcomes and subscales including the impact on: aggression and self-harm (n = 1; Sharma & Sharma, 2016); neurodevelopmental behavioural differences (n = 7; Abadi et al., 2008; Deorari & Bhardwaj, 2014; Jensen & Kenny, 2004; Joshi & Rathi, 2019; Luo et al., 2023; Narasingharao et al. 2017a; 2017b); Aberrant behaviours (n = 3; Joshi & Rathi, 2019; Koenig et al., 2012; Shanker & Pradhan, 2023).

1.3.4.2.2 Outcome Measures

There was heterogeneity of measures with most studies using different measures to assess behavioural outcomes (see Figure 3 for visual representation of variables and measures). Three studies used unstandardised measures developed by the authors (Narasingharao et al., 2017a; 2017b; Sharma & Sharma, 2016) and seven studies used standardised assessments which measured neurodevelopmental traits and behavioural differences (Abadi et al., 2008; Deorari & Bhardwaj, 2014; Jensen & Kenny, 2004; Joshi & Rathi, 2019; Koenig et al., 2012; Luo et al., 2023; Shanker & Pradhan, 2023). Studies varied in whether they reported subscales-only, total scores or a combination of both.

1.3.4.2.3 Findings

Most studies found that yoga had a significant positive impact on some behavioural processes despite heterogeneity. Seven studies included within group analysis. Two studies found yoga had a significant positive impact pre to post intervention (Abadi et al., 2008; Deorari & Bhardwaj, 2014) and five found mixed results (positive impacts on some outcomes, and no impact on others).

Three studies did not report significance values for within group analysis (Koenig et al., 2012; Lou et al., 2023; Sharma & Sharma, 2016). Seven studies found yoga had a positive impact post intervention on behavioural outcomes including: autism behavioural characteristics (Deorari & Bhardwaj, 2014; Joshi & Rathi, 2019), behavioural outcomes in children with autism (10/30 items, Narasingharao et al., 2017a; 29/30 items, Narasingharao et al., 2017b), ADHD behavioural characteristics (Abadi et al., 2008), four out of five aberrant behaviour subscales including social withdrawal, stereotypic behaviour, hyperactivity/ noncompliance, and inappropriate speech (Shanker & Pradhan, 2023) and eight out of 14 subscales of the CPRS–R:L including oppositional, perfectionism, ADHD Index, Conners' Global Index - Restless/Impulsive, Conners' Global Index-Emotional Lability, Conners' Global Index–Total, DSM–IV - Hyperactive/Impulsive, and DSM–IV-Total (Jensen & Kenny, 2004).

On the other hand, five studies showed no significant improvement in behavioural outcomes post intervention including: some autistic behavioural characteristics (20/30 items NS; Narasingharao et al., 2017a), savant abilities (1 item NS; Narasingharao et al., 2017b), total aberrant behaviour (Joshi & Rathi, 2019), irritability (Shanker & Pradhan, 2023), all subscales of the teacher rated CTRS–R:L (Jensen & Kenny, 2004) and six out of 14 parent rated subscales of the CPRS–R:L including cognitive problems- inattention, Hyperactivity, anxious/Shy, psychosomatic, social problems, and DSM-IV inattentive (Jensen & Kenny, 2004).

Seven studies conducted between group analysis. Three studies did not include between group analysis due to using a single arm design (Deorari & Bhardwaj, 2014; Narasingharao et al., 2017a) or due to being underpowered (Jensen & Kenny, 2004). Out of the seven studies, five studies found significant positive effect of yoga in comparison to a control group on: aggressive and self-injurious behaviours (Sharma & Sharma, 2016), irritability and social withdrawal (Shanker & Pradhan, 2023), total aberrant behaviour and irritability (Koenig et al., 2012), inattention, hyperactivity/impulsivity and ODD (Luo et al., 2023). Luo et al. (2023) also found yoga had significant improvements in inattention and hyperactivity/impulsivity subscales compared to a music only intervention. Abadi et al., (2008) found a significant reduction in behavioural characteristics irrespective of group. However, group-wise comparison revealed yoga had a significantly greater reduction (Abadi et al., 2008).

Two studies found no significant difference between yoga and control groups on: social withdrawal, stereotypic behaviour, hyperactivity and inappropriate speech subscales (Koenig et al., 2012), autism behavioural characteristics, and aberrant behaviours (Joshi & Rathi, 2019).

Overall, there are mixed results with preliminary evidence suggesting engagement in yoga practice may positively impact some behavioural outcomes across neurodevelopmental populations, both post intervention and between groups.

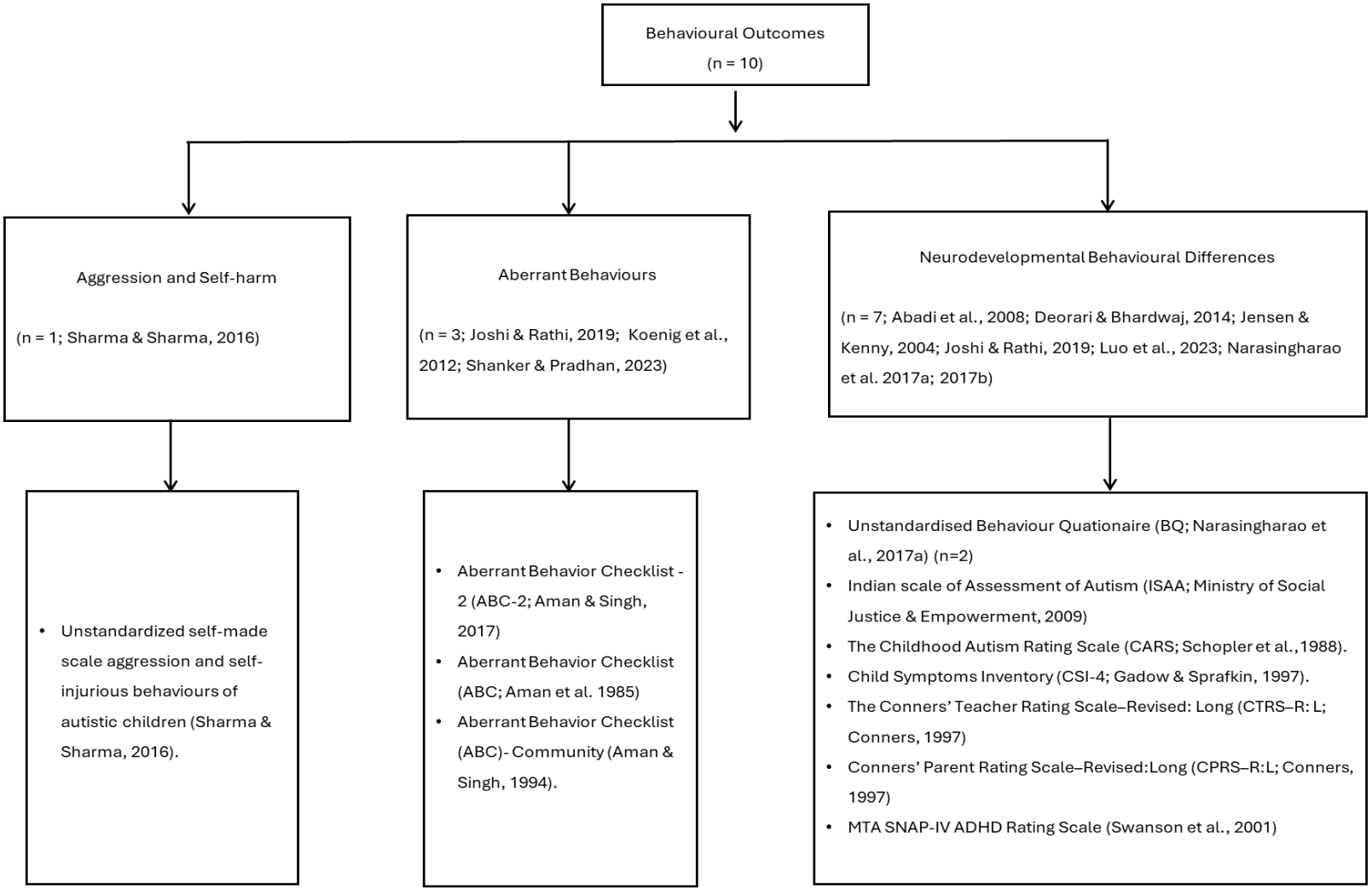

Figure 3

Visual Representation of Behavioural Variables and Measures Used in Included Studies

1.3.4.3 Social Outcomes

Six studies investigated the impact of yoga on social outcomes (Joshi & Rathi, 2019; Kaur et al., 2021; Litchke et al., 2018; 2021; Shanker & Pradhan, 2023; Uma et al.,1989).

1.3.4.3.1 Outcome Variables

A number of social outcomes were looked at including the impact on: social skills (n=3; Joshi & Rathi, 2019; Litchke et al., 2018; Shanker & Pradhan, 2023); social maturity (n=1; Uma et al.,1989); socially directed verbal communication (n=1; Kaur et al., 2021); socialisation with others and personal relationship skills (n=1; Litchke et al., 2021).

1.3.4.3.2 Outcome Measures

There was heterogeneity of measures with most studies using different measures to assess social outcomes (see Figure 4 for visual representation of variables and measures). Five studies used standardised measures, and one used an unstandardised measure created by the authors for observational coding (Kaur et al., 2021).

1.3.4.3.3 Findings

All six studies included within group analysis. Two studies found yoga had a significant positive impact pre to post intervention (Litchke et al., 2018; Uma et al.,1989), two found mixed results (positive impacts on some outcomes, and no impact on others; Kaur et al., 2021; Shanker & Pradhan, 2023) and two found non-significant results (Joshi & Rathi, 2019; Litchke et al., 2021).

Yoga showed significant improvement post intervention on social outcomes including social maturity (Uma et al.,1989), social skills (Litchke et al., 2018), spontaneous social verbalization (Kaur et al., 2021), social responsiveness and four out of five subscales of the SRS-2 including social cognition, social communication, social motivation, and restricted interests and repetitive behaviours (RRB) (Shanker & Pradhan, 2023).

There was no significant difference post intervention in: social awareness scores (Shanker & Pradhan, 2023), SPRS socialization (Litchke et al., 2021), responsive social verbalization (Bonferroni adjusted; Kaur et al., 2021) and social communication skills (Joshi & Rathi, 2019).

Five studies conducted between group analysis (one study did not include between group analysis due to using a single arm design; Litchke et al., 2018). Of the five studies, three studies found significant difference between groups on: social maturity (Uma et al.,1989), social communication subscale (SRS-2; Shanker & Pradhan, 2023), spontaneous social verbalization (Kaur et al., 2021). Although Joshi & Rathi (2019) found non-significant reduction in social communication difficulties in both groups, results found the reduction was significantly more in the yoga group than in the control group.

However, no significant difference was found between groups on: SPRS socialization (Litchke et al., 2021), responsive social verbalization (Kaur et al., 2021), and on four out of five subscales of the Social Responsiveness Scale-2 including social awareness, social cognition, social motivation and RRB (Shanker & Pradhan, 2023).

Overall, findings showed yoga had a positive impact on some aspects of social outcomes but non-significant effects on other aspects. However, mixed findings across the small number of studies make the results inconclusive.

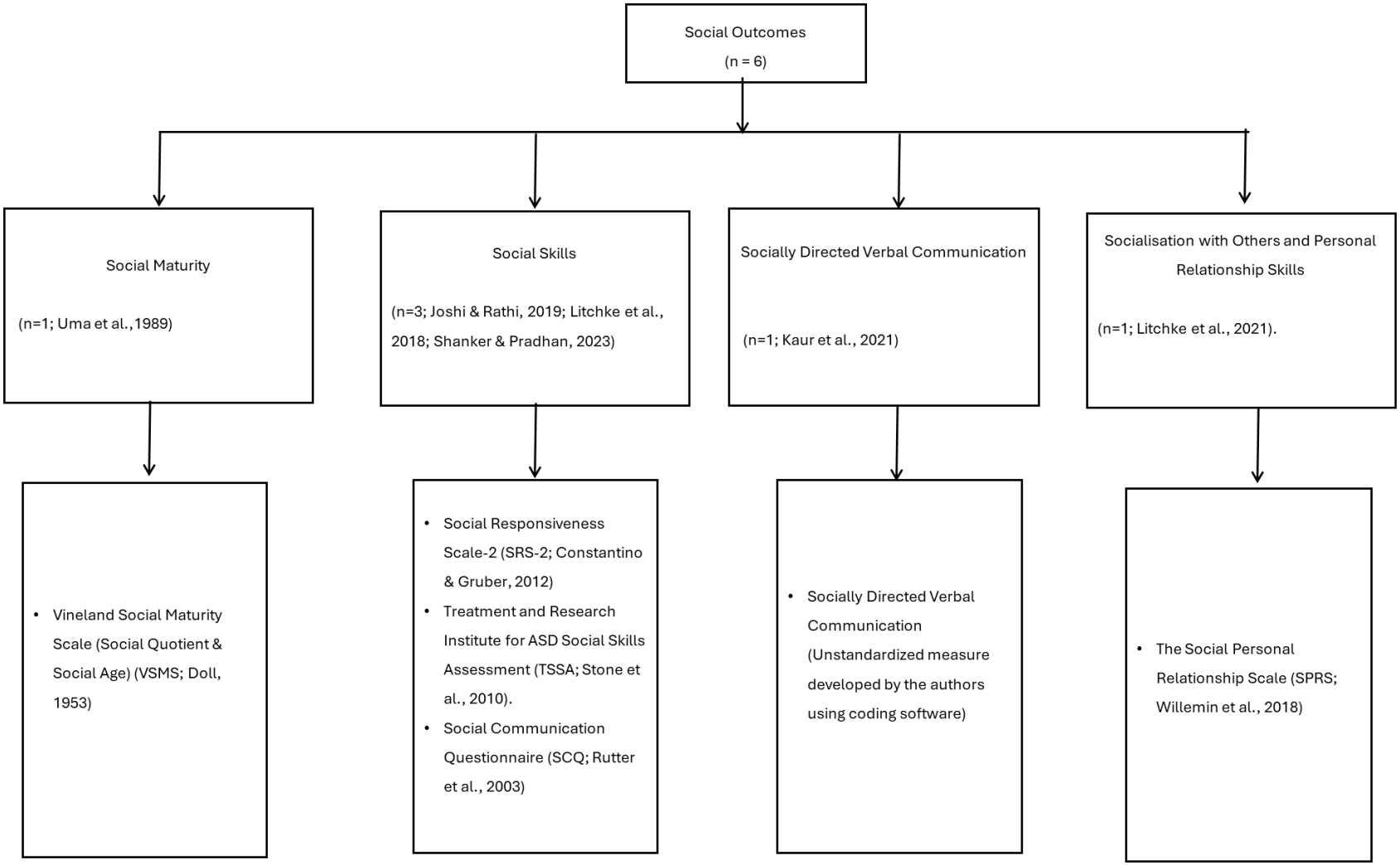

Figure 4

Visual Representation of Social Variables and Measures Used in Included Studies

1.3.4.4 Emotional Outcomes

Five studies looked into the impact of yoga on emotional outcomes (Crowe et al., 2019; Kaur et al. 2021; Kim & Hong, 2019; Litchke et al., 2018; 2021).

1.3.4.4.1 Outcome Variables

A variety of emotional outcomes were explored including; affective states (n=2; Kaur et al., 2021; Litchke et al., 2021), individuals' emotional experience (n=3; Kim & Hong, 2019; Litchke et al., 2018; 2021), flourishing (n=1; Crowe et al., 2019) and self-esteem (n=1; Crowe et al., 2019).

1.3.4.4.2 Outcomes Measures

There was heterogeneity of measures with all studies using different measures to assess emotional outcomes (see Figure 5 for visual representation of variables and measures).

1.3.4.4.3 Findings

Five studies included within group analysis. One study found a significant positive impact of yoga post intervention on emotional outcomes and four found non-significant results.

One study found support for yoga on individuals' positive affect and emotional experience (fun/mood) (Litchke et al., 2021).

Alternatively, there was no significant effect of yoga following the intervention on: emotional experience (Kim & Hong, 2019), facial emotional mood (Litchke et al. 2018), children's affective states (interest, positive and negative affect; Kaur et al., 2021), negative affect (Litchke et al., 2021) and self-esteem or flourishing (Crowe et al., 2019).

Three studies conducted between group analysis. Two studies did not include between group analysis due to using a single arm design (Crowe et al., 2019; Litchke et al., 2018). One study found significant difference between yoga than control group in positive effect post intervention but no significant difference between yoga and alternative interventions

(Drumtastic) (Litchke et al., 2021). One study found the yoga intervention evoked more interest and less negative affect compared to the academic group throughout the study (Kaur et al. 2021). On the other hand, yoga was not significantly different post intervention compared to a control or alternative intervention on positive affect (Kaur et al. 2021), negative affect and emotional experience (Litchke et al., 2021). One study found that a creative rhythmic movement program was significantly more effective at improving children's emotional experience than yoga (Kim & Hong, 2019).

Overall, there is limited evidence to support the impact of yoga on emotional outcomes either pre to post intervention or between groups.

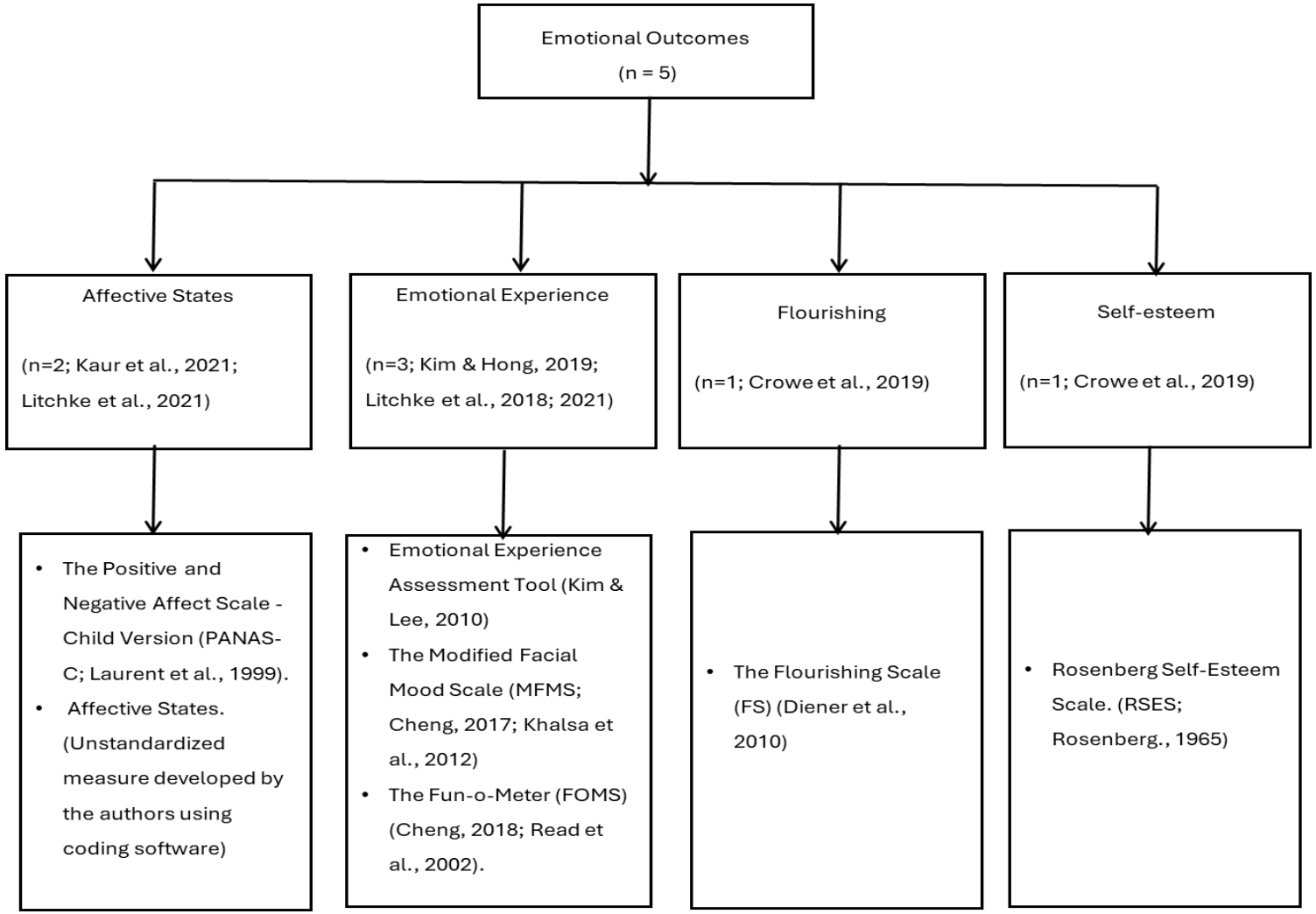

Figure 5

Visual Representation of Emotional Variables and Measures Used in Included Studies

Table 7

Key Findings of Included Studies.

Study	Outcome Variables	Measures	Analytic Strategy	Key Findings	Summary
Abadi et al., 2008	Behavioural	Child Symptoms Inventory (CSI-4; Gadow & Sprafkin, 1997). For this study the measure consisted of nine inattention and nine hyperactivity/impulsivity questions.	Repeated measures ANOVA	**Child Symptoms Inventory -** There was an overall reduction in symptoms in both yoga and control groups (F (1,32) = 47.15, p<.00). There was a significant difference between groups - Yoga had a greater reduction in symptoms than the control group. (F (1, 32) = 28.40 p < .00).	Results showed a significant decrease in symptoms post yoga intervention.
Chou & Huang, 2017	Cognitive	The Visual Pursuit Test of the Vienna Test System (Schuhfried GmbH, Austria). Measure of selective and sustained attention.	ANOVA	**The visual pursuit test -** *Correct Answers* - There was a significant interaction of Group by Time (F (1, 47) = 4.26, p = .045, *partial* η^2 = 0.08). The yoga group had a higher accuracy rate at posttest than the control group, (t (47) = 2:70, p = .010, d = 0.78), with no group differences observed at pretest. The yoga group had a higher accuracy rate after the yoga intervention, (t (23) = -2.12, p = .045, d =-0.69), while no change in the accuracy rate was found for the control group, (p = 397). *Reaction Time* – There was a significant interaction of Group by Time (F (1,47) = 8.20, p = .006, *partial* η^2 = 0.15). The yoga group had faster reaction time at the posttest than the control group, (t (47) = -4.18, p < .001, d = -1.20), with no group differences observed at the pretest. The yoga group reported a decreased reaction time after the yoga intervention, (t (23) =	The results showed that the yoga exercise program had a significant improvement in accuracy and reaction time (Visual Pursuit Test), response accuracy and response time (Determination Test). No significant change was found for the control group.

				4.12, $p < .001$, $d = 1.29$), while no reaction time change was found for the control group ($p = .597$). **The determination test -** *Correct trails* – There was a significant interaction of Group by Time (F (1, 47) = 17.48, $p < .05$, *partial* $\eta^2 = 0.27$). The yoga group had higher response accuracy at the posttest than the control group (t (47) = 3.74, $p < .001$, $d = 1.09$), with no group differences observed at the pretest. The yoga group had increased response accuracy after the yoga intervention (t (23) = -5:78, $p < .001$, $d = 1.22$), while no change in the response accuracy was found for the control group ($p = .263$). *Response Time* –There was a significant interaction of Group by Time (F (1, 47) = 4.79, $p = .034$, *partial* $\eta^2 = 0.09$). Yoga group had faster response time at the posttest than the control group (t (47) = -4.26, $p < .001$, $d = -1.25$), with no group differences observed at the pretest. The yoga group had a decreased response time after the yoga intervention (t (23) = 4.78, $p < .001$, $d = 1.26$), while no response time change was found for the control group ($p = 964$).	
Crowe et al., 2019	Emotional	The Flourishing Scale (FS) (Diener et al., 2010) Rosenberg Self-Esteem Scale. (RSES; Rosenberg., 1965)	Wilcoxon Signed Rank Test.	**The Flourishing Scale -** Psychological health scores showed no significant improvement ($Z = –1.83$, $p = .068$). **Rosenberg Self-Esteem Scale -** Self-esteem scores were not significantly improved ($Z = –0.68$, $p = .498$).	Yoga had no significant impact on participants' self-esteem or psychological health (flourishing).
Deorari & Bhardwaj, 2014	Behavioural	The Childhood Autism Rating Scale (CARS; Schopler et al.,1988).	T-test	**CARS -** Significant decrease post intervention in total CARS scores indicating a reduction in symptoms of autism ($t = 3.172$, $p = .01$).	Yoga significantly reduced behavioural characteristics/

					difficulties associated with autism post 3-month yoga intervention.
Dinu et al., 2023	Cognitive	Test of Variables of Attention Task (TOVA; Greenberg et al., 1997). Delay Discounting Test (DDT; No reference): This task is a measure of temporal impulsivity Iowa Gambling Task (IGT; Bechara et al., 1994) One of the most frequently used and ecologically valid assessments of cognitive impulsivity	ANCOVA 2x2x2 design (Group - Control; ADHD. Time – Pretest; Posttest. Exercise – Cycling; Hatha Yoga) Controlling for gender, age and pre-exercise heart rate.	**Inattention -** *Hit reaction time* - There was, a significant time x group interaction (F (1, 150) = 4.11, p = .044, hp^2 = .027). The ADHD group had significantly longer reaction times at pretest than those without ADHD (t (135.52) = 2.33, p = .021). However, the groups were comparable at posttest (t (157) = 0.07, p = .472). There was no significant change in the ADHD group reaction times pretest to posttest (p = .396). However, there was a significant increase in reaction time in the Control group (t(76) = 3.15, p = .002). *Omission errors*- there were no significant main effects or any two or three-way interactions (p > .05). *d prime (response sensitivity)* – There were no significant main effects or any two or three-way interactions (p > .05). **Temporal Impulsivity -** there was a significant time x exercise x group interaction (F (1, 142) = 4.79, p = .03, hp^2 = .033). Yoga increased Area Under the Curve (AUC; higher AUC value indicates reduced impulsivity) in those with ADHD (t (41) = 3.03, p = .004) but not for Controls (p = .824). Higher AUC is suggestive of reduced impulsivity. **Motor Impulsivity -** There was no significant main effect or two or three-way interactions (p > .05).	The results showed yoga reduced temporal impulsivity within the ADHD group. There were no effects of yoga on any measure of attention, cognitive impulsivity, or motor impulsivity in those with ADHD.

				Cognitive Impulsivity – For the percentage of risky decisions in the last 40 trials, there was no significant main effect or two or three-way interactions ($p > .05$). The Net Score for the last 40 trials revealed there was no significant main effect and no significant interactions ($p > .05$).	
Fritz & O'Connor, 2022	Cognitive	Flanker Inhibitory Control and Attention Test (Weintraub et al., 2013). Dimensional Change Card Sort test (Weintraub et al., 2013). List Sorting Working Memory test (Tulsky et al., 2014).	R statistical software.	**Executive functioning -** There were no significant group-by-time interactions for any of outcome variables for: The Flanker Inhibitory Control and Attention test ($p > .153$) The Dimensional Change Card Sort test ($p > .216$) The List Sorting Working Memory test ($p > .305$).	Results showed no effect of 6-weeks yoga intervention on any of the measures of executive function.
Jensen & Kenny, 2004	Behavioural Cognitive	The Conners' Parent Rating Scale–Revised:Long (CPRS–R:L; Conners, 1997) The Conners' Teacher Rating Scale–Revised: Long (CTRS–R: L; Conners, 1997) Test of Variables of Attention (TOVA ; Greenberg et al., 1997)	One-way repeated measures analyses of variance ANOVA	**Conners' Parent Rating Scale –** There were significant effects for the yoga group on five subscales of the CPRS: Oppositional ($p = .003$, $d = .77$); Global Index Emotional Lability ($p = .001$, $d = .79$); Global Index Total ($p = .001$; $d = .73$); Global Index Restless/Impulsive ($p = .008$, $d = .73$); ADHD Index ($p = .019$, $d = .29$). Both groups demonstrated significant improvements on three subscales: Perfectionism (yoga, $p = .032$; control, $p = .028$; $d = .58$); DSM–IV Hyperactive/Impulsive (yoga, $p = .036$; control, $p = .016$; $d = .17$); DSM-IV Total (yoga, $p = .024$; control, $p = .016$; $d = .1$) Significant effects for the control group were only found on three subscales of the CPRS: Hyperactivity; Anxious/Shy; Social ($p < .05$).	Results found significant positive effects for yoga on some behavioural outcomes (8/14) based on parent ratings in boys with ADHD. There was no significant impact of yoga based on Teacher ratings (0/13). Authors deemed *TOVA was not a valid or reliable instrument for this sample*.

				The Conners' Teacher Rating Scale–There were no significant differences observed for either the yoga or control groups by teachers (CTRS-R:L; $p > .05$), although there was a trend favouring the yoga group on Global Index Total ($p = .056$). **TOVA –** There was no significant effects for either the yoga group or the control group on the TOVA (*no statistics given*). Authors deemed *TOVA was not a valid or reliable instrument for this sample*.	
Joshi & Rathi, 2019	Behavioural Social	Indian scale of Assessment of Autism (ISAA; Ministry of Social Justice & Empowerment, Government of India, 2009) Aberrant Behavior Checklist (ABC; Aman et al. 1985) Social Communication Questionnaire (SCQ; Rutter et al., 2003)	ANOVA for between groups analysis. Paired sample t-test and Wilcox was used for yoga group SCQ analysis.	**Indian scale of assessment of autism** – There was significant decrease in autism severity for the yoga group with significance ($p = 0.01$) but no significant difference in the control group. **Aberrant Behaviour Checklist** – There was no significant decreased in aberrant behaviour in the yoga group but there was significant increase in the control group (0.27%; $p = 0.03$). **Social communication questionnaire** - No significant difference in SCQ within groups (N/S, $p > .05$). There was significant difference between groups post intervention with SCQ scores improving more in the yoga group than the control group ($p = 0.02$). *There is no baseline analysis between the groups for any measures*.	The study suggests yoga improves autism severity (ISAA) post intervention. There was no significant difference in aberrant behaviours in the yoga group. However, there was a significant increase in aberrant behaviours in the control group. There was significant difference between SCQ post intervention between groups. but within groups SCQ scores were not significantly improved.

Kaur et al., 2021	Cognitive	Joint Attention Test (JTAT; Bean & Eigsti, 2012)	Repeated measures Analysis of Variance (ANOVA)	**JTAT –** Joint attention showed a significant main effect of pretest to posttest session, with no group interaction (F (1,20) = 16.61, p < 0.05, partial $\eta 2$ = 0.45).	Results found both groups significantly improved in responsive joint attention skills at posttest compared to pretest.
	Social	Socially Directed Verbal Communication (unstandardised measure developed by the authors using coding software)		**Socially directed verbal communication –** There was a significant three-way interaction of session by verbalization type by group (F (2,88) = 3.76, p = .03, partial $\eta 2$ = 0.15). The improvement in spontaneous social verbalization from early to late intervention session was significantly greater in the yoga compared to the academic group (p < .008 after Bonferroni corrections for 6 comparisons, d = 1.23). After Bonferroni corrections for six comparisons, there was no significant difference in responsive social verbalization between any intervention sessions (p > .008).	The yoga group showed a significantly greater increase in their spontaneous social verbalizations compared to the academic group from early to late intervention sessions. Responsive social verbalization did not reach significance after Bonferroni corrections.
	Emotional	Affective States. (unstandardised measure developed by the authors using coding software)		**Affective State –** There was a significant affective state x group interaction (F (2,44) = 3.67, p = 0.03, partial $\eta 2$ = 0.14) Children in the yoga group showed less negative affect (Bonferroni adjusted p < 0.02, d = 0.70) and greater interested affect (Bonferroni adjusted p < 0.02, d = 0.72) compared to the academic group throughout the intervention, with no significant differences in positive affect (p > .05).	There was no change in affective states over time, however the yoga group showed significantly greater interest and lower negative affect compared to the academic group. There were no significant differences in positive affect.

Kim & Hong, 2019	Emotional	Emotional experience assessment tool (Kim & Lee, 2010)	T-test / ANOVA	**Emotional Experience -** Yoga did not show significant difference in their emotional experience ($p > .05$). Creative rhythmical movement program showed significant improvement post intervention ($p < .001$) There was significant difference between creative rhythmical movement program and yoga post intervention ($p < .001$) with creative rhythmical movement program showing significantly greater emotional experience.	The yoga group did not significantly improve in emotional experience. Post intervention showed significant difference between the creative rhythmic movement program and yoga. Creative rhythmic movement program was significantly more effective than yoga.
Koenig et al., 2012	Behavioural	Aberrant Behaviour Checklist (ABC)- Community (Aman & Singh, 1994). The checklist has five subscales: Irritability, Lethargy/Social Withdrawal, Stereotypic Behaviour, Hyperactivity/Noncompliance, and Inappropriate Speech (outcomes completed by parents and teachers).	ANOVA	**Aberrant Behaviour Checklist -** The Get Ready to Learn (GRTL) yoga program showed significant reduction in teacher rated total ABC–Community score (F (1, 44) = 5.079, p = .029, d = 1.19) and the Irritability subscale (F (1, 44) = 3.89, p = .05, d = 0.59) compared to the control group. There was no significant difference between groups on the Lethargy/Social Withdrawal; Hyperactivity/Noncompliance; Stereotypic Behaviour; Inappropriate Speech subscales ($p > .05$). There were no significant differences in any parent ratings of behaviour on the ABC–Community ($p > .05$).	The yoga intervention showed improved total ABC–Community and irritability (Teachers' ratings) compared with the control group. There were no significant changes in any other subscales. There were no significant changes in any parent ratings of behaviours on the ABC–Community for either group.
Litchke et al., 2018	Social	Treatment and Research Institute for ASD Social Skills Assessment (TSSA; Stone et al.,	T-test	**TSSA -** There was a significant increase from pretest to posttest in TSSA scores ($t(4) = -5.744$, p = .005).	Results showed social skills of the sample were

		2010). Higher scores indicate better social skills.		The paired sample *t*-tests were assessed four TSSA subscales. A significant increase was found from pretest to posttest on response to initiation ($t(4) = -3.73$, $p = .020$), initiating interaction ($t(4) = -8.5$, $p = .039$), and affective understanding and perspective taking ($t(4) = -5.17$, $p = .007$).	improved after yoga intervention.
	Emotional	The Modified Facial Mood Scale (MFMS; Cheng, 2017; Khalsa et al., 2012) was used to observe mood changes. Higher scores indicating more positive emotions and engagement.		**MFMS -** MFMS indicated that 80% youth with autism were in the pleasant or positive mood before the yoga training. There was no significant change on mood variables from pretest to posttest including self ($t(4) = 0.66$, $P = .548$), college buddy ($t(4) = 0.59$, $P = .586$), and RTGS ($t(4) = -1.56$, $P = .194$).	No significant difference was found in mood following the intervention across all measures of MFMS.
Litchke et al., 2021	Emotional,	The fun-o-meter (FOMS) (adapted from Cheng, 2018; Read et al., 2002).	An Analysis of Covariance (ANCOVA) / Repeated measures ANOVA	**Fun O Meter -** there was significant positive change within groups from pretest to posttest for DR and KYR ($p = .003$). No significant difference between the two intervention groups at posttest ($p = .535$).	DR and KYR groups experienced significantly higher positive emotional behaviours and personal relationships than the control group.
		The Positive and Negative Affect Scale - child version (PANAS-C; Laurent et al., 1999). Divided into two affect scales measuring positive and negative emotional behaviours.		**Positive and Negative Affect Scale-Children (PANAS-C) -** There was a significant positive change for both DR and KYR vs. control ($p < .001$) in positive affect. There was no significant difference between DR vs. KYR. Overall, a significant change was revealed within both groups (DR & KYR) from pretest to posttest $p < .001$).	There was a significant change in fun/mood experienced in both the DR and KYR groups. However, there was no significant different between KYR or DR groups.
	Social	The social personal relationship scale (SPRS; Willemin et al., 2018) measures socialisation with others and personal relationship skills.		There was no significant change in negative scale behaviours on PANAS-C pretest to posttest between or within each of the three groups. *No statistic values reported for PANAS-C analysis.*	
				Social Personal Relationship Scale (SPRS) – There was no significant difference between any of the three	

				groups at posttest. There was no significant change on SPRS socialization with others or personal relationship skills on pretest to posttest.	
Luo et al., 2023	Behavioural	MTA SNAP-IV ADHD Rating Scale (Swanson et al., 2001)	Repeated measures ANOVA	**MTA SNAP-IV ADHD Rating Scale -** There were no significant differences posttest between the yoga and music group in terms of ODD (p = .064). There were significant differences between inattention, hyperactivity/impulsivity, and ODD between all remaining groups (p < .05). There was a significant interaction effect for time and groups for inattention (F = 80.81; p = <.05), Hyperactivity/impulsivity (F = 87.03; p = <.05) and ODD (F = 94.79; p = <.05). The yoga and music combined was most effective followed by yoga only intervention then music only with large effect sizes.	Results found yoga and music combined was most effective followed by yoga only intervention then music only.
Narasingharao et al. (2017a)	Behavioural	Questionnaire developed by researchers based on the problematic areas of autism in children. Questions included sleep disorder 15 questions (SQ1-SQ15) GI disorder (food and digestion) 16 question (FQ1-FQ16) and behaviour problems 30 questions (BQ1-BQ30). Only BQ used in this review.	Wilcoxon test	**Behavioural Questionnaire –** Items BQ-1, BQ-3, BQ-5, BQ-11, BQ-21, BQ-22, BQ-23, BQ-27, BQ-28, and BQ-30 show significance (p < .05). The majority of items (20/30) in the behavioural questionnaire show non-significant improvement (p > .05). *No item details included in this report to interpret further. Report interprets non-significant results approaching significance as 'moderately' significant. Does not account for multiple testing.*	Although there was significant improvement on some behavioural items the majority of items in the behavioural questionnaire show non-significant improvement.
Narasingharao et al. (2017b)	Behavioural	Questionnaire developed by researchers Questions included sleep disorder 15 questions (SQ1-SQ15) GI disorder (food	Wilcoxon signed rank test	**Behavioural Questionnaire -** All behavioural items significantly improved except one (BQ-26 measuring 'savant abilities'; Z = -.659, p = .510). All other items showed a significant decrease in means post yoga	The majority of items on BQ questionnaire (29/30) related to behaviour problems associated

		and digestion) 16 question (FQ1-FQ16) and behaviour problems 30 questions (BQ1-BQ30). Only BQ used in this review.		intervention with z scores ranging from Z = -4.019 to Z = -5.000, p = .001. No significant differences were found in the control group (p > .05).	with autism shows significant improvement post yoga intervention. One Item found non-significant effect of yoga (BQ-26) referring to savant ability (extraordinary intelligent in specific area). No significant differences were found in the control group.
Pandya, 2020	Cognitive	The Self-Control Rating Scale (SCRS; Kendall & Wilcox., 1979) assesses teacher (SCRS-Teacher or SCRS-T) and parent (SCRS-Parent or SCRS-P) perceptions of self-control in elementary school children. Child Self-Control Rating Scale (CSCRS; Rohrbeck et al., 1991)	Two-way ANOVA MANOVA with Kruskal-Wallis	**Self-Control -** There were significant interaction between pretest and posttest scores of the intervention group on all measures of perceived self-control: SCRS-T (F (1, 99) = 18.03, p = .01, ηp^2 = .64); SCRS-P (F (1, 99) = 13.46, p = .01, ηp^2 = .63); CSCRS (F (1,99) = 17.33, p = .01, ηp^2 = .68). Intervention group showed significantly greater self-control. There were significant interaction effects between posttest scores of the intervention and control group in all measures of perceived self-control with intervention group showing significant improvements in self-control compared to the control group: SCRS-T (F (1, 82) = 18.18, p = .02, ηp^2 = .64); SCRS-P (F (1, 82) = 19.32, p = .03, ηp^2 = .62); CSCRS (F (1, 82) = 16.78, p = .02, ηp^2 = .68) There was no significant effect between the pretest scores of the control and intervention groups or	ADHD diagnosed grandchildren exhibited greater self-control after undergoing the joint meditation (yoga) lessons compared to the control group dyads.

				between the pretest and posttest scores of the control group ($p > .05$).	
Rezaei et al., 2018	Cognitive	Wechsler Intelligence Scale for Children-Revised (WISC-R; Wechsler, 1974). Arithmetic, letter-number sequencing and coding Continues Performance Test (CPT; No reference) - sustainable attention and impulse control	ANCOVA	**Sustained attention and memory -** There was a significant positive effect of yoga intervention on attention variables for ADHD children between pretest and posttest compared to the control group ($F = 4.28$, $p = .009$). There was a significant positive effect between pretest and posttest of the yoga group compared to the control group in: Response error ($F = 43.32$, $p = .001$); Response omission ($F = 15.52$, $p = .008$); Correct response ($F = 47.69$, $p < .001$); Digit memory ($F = 0.06$, $p = .004$); and Coding ($F = 11.24$, $p = .015$). There was no significant difference between yoga and control groups in the variables: Response time ($F = 0.06$, $p = .816$); and Mathematics ($F = 1.61$, $p = .252$).	The results showed the yoga group significantly improved compared to the control group in a number of sustained attention and memory measures including response error, response omission, correct response, digit memory and coding. There was no significant difference between groups on response time and Mathematics.
Shanker & Pradhan, 2023	Social Behavioural	Social Responsiveness Scale-2 (SRS-2; Constantino & Gruber, 2012) Consists of five subscales: Social Awareness, Social Cognition, Social Communication, Social Motivation, Restricted Interests, and Repetitive Behaviour (RRB). (lower scores indicate more social responsiveness)	Independent sample t-tests - group differences Paired t-tests – pretest-posttest	**SRS-2 -** Yoga group had a significant decrease in posttest scores of social responsiveness for: The Total SRS-2 scores (t (22) = 3.86, $p = .001$); Social Cognition (t (22) = 2.92, $p = .008$); Social Communication (t (22) = 3.82, $p = .001$); Social Motivation subscale (t (22) = 2.16, $p = .042$); RRB (t (22) =3.87, $p = .016$). There was no significant difference in social awareness ($p > .05$) There was a significant difference when post scores were compared between groups on social communication only (t (41) = 2.40, $p = .021$) with yoga showing greater improvement. **ABC-2 -** The yoga group had a significant decrease in ABC-Community posttest scores for: Stereotypic	Yoga showed improved scores post intervention on all areas of social responsiveness except social awareness. Yoga showed improved scores post intervention on all subscales of ABC-2 except Irritability. Yoga showed significant improvement compared to the control group on social communication

		Aberrant Behaviour Checklist -2 (ABC-2; Aman & Singh, 2017) Comprises five subscales: Irritability, Social Withdrawal, Stereotypic Behaviour, Hyperactivity/ Noncompliance, and Inappropriate Speech.		Behaviour (t (22) = 2.55, p = .018); Hyperactivity/Noncompliance (t (22) = 2.95, p = .007); Inappropriate Speech (t (22) = 2.27, p = .033); Social Withdrawal (F (1,41) = 4.19, p = 0.047). There was no significant difference in Irritability scores (p > .05). There was a significant difference between yoga and control post intervention in Irritability (t (41) = 2.11, p = .041). Social Withdrawal showed an overall statistically significant difference at post intervention between groups (F (1,41) = 4.19, p = 0.047) after their means were adjusted for pre intervention values.	(SRS-2); irritability and social withdrawal (ABC-2).
Sharma & Sharma, 2016	Behavioural	Self-made scale was prepared by the researchers to measure aggression and self-injurious behaviours of autistic children (Sharma & Sharma, 2016).	Analysis of covariance (ANCOVA)	**Aggression and Self Injurious Behaviour Questionnaire -** Means show a decrease in aggressive and self-injurious behaviour pre and post yoga intervention - no statistical analysis reported within groups. There was a statistically significant difference in self-injurious behaviour between yoga and control groups as reported by Mothers (F (1,7) = 277.54, p < .001); Fathers (F (1,7) = 243.53, p < .001); Teachers (F (1,7) = 280.09, p < .001). There was a statistically significant difference in aggressive behaviour between yoga and control groups as reported by Mothers (F (1,7) = 101.13, p < .001); Fathers (F (1,7) = 163.69, p < .001); Teachers (F (1,7) = 101.13, p < .001).	The yoga group had significantly less self-injurious and aggressive behaviour post treatment compared to a no intervention control group.
Uma et al. (1989)	Cognitive	Binet Kamath (IQ) (BKT; Kamat, 1934)	Paired t-test	**Binet Kamath (IQ) –** Yoga group IQ significantly increased (46.6 ± 13.1 to 57.5 ± 17.0, t = 6.7, p < 0.01).	Yoga led to significant improvements in all

Social	Seguin Form Board (IQ & Mental Age) (SFB; Seguin 1907) Vineland Social Maturity Scale (Social Quotient & Social Age) (VSMS; Doll, 1953)	**Seguin Form Board (Mental Age) -** Yoga group mental age significantly increased (4.47 ± 1.76 to 5.68 ± 2.26, $t = 5.56$, $p < 0.01$). **Vineland Social Maturity Scale (Social Age) –** Yoga group social maturity significantly increased (7.1 ± 2.7 to 7.6 ± 3.0, $t = 5.11$, $p < 0.01$). Yoga showed significant improvement compared to the control group across all measures ($p < 0.01$).	cognitive domains (IQ, Mental age and Social Maturity) post intervention and compared to the control group.

1.4 Discussion

This review aimed to systematically review empirical research to answer the question: what are the psychological and social impacts of yoga in neurodevelopmental populations? The review found 21 studies exploring the impact of yoga on psychosocial outcomes in NDCs.

1.4.1 Summary of Main Findings and Theoretical Implications

The narrative synthesis showed preliminary evidence that suggested yoga may have a positive impact on some cognitive and behavioural outcomes in neurodevelopmental populations, although there was heterogeneity and mixed results across the included studies. This could suggest initial support for yoga as a transdiagnostic approach for NDCs and for transdiagnostic mechanisms of change from yoga (Bennetts, 2022; Gard et al., 2014; Gust, 2023; Kishida et al., 2019; Paramashiva et al., 2025; Voss et al., 2023). However, there was inconclusive evidence for social outcomes and limited evidence for yoga benefiting emotional outcomes in neurodevelopmental populations.

1.4.1.1 Cognitive Outcomes

Six out of eight studies found some support for yoga having a positive impact on cognitive outcomes, suggesting yoga may be a useful approach to enhance cognitive processes such as attention and perceived self-control in NDCs.

These findings are in line with previous theory and research in the general population and older adults that suggest yoga improves cognitive functioning (Paramashiva et al., 2025; Voss et al., 2023). Research has found yoga reduces stress and emotional reactivity, with long-term practice associated with positive changes in functional connectivity networks and structural changes in the brain (such as greater gray matter volume), which may collectively improve neurocognitive efficiency (Voss et al., 2023). Based on research Voss et al. (2023) proposed a model for mechanisms contributing to the cognitive benefits of yoga. The model suggests yoga

improves cognitive skills as a result of improved neurocognitive resource efficiency and stress regulation by providing the practitioner with more adaptive physiological responses to stressors along with more efficient and automatic cognitive processing.

There were some non-significant results on the effect of yoga on executive functioning processes such as cognitive flexibility, working memory and impulsivity. One explanation for this could be complex cognitive skills such as executive functioning skills including impulse control, working memory (Diamond, 2013) may require more time to have benefits in neurodevelopmental populations. Research has suggested that executive functioning skills improve more based on duration of training, dose (length of each session), and frequency (how often the sessions occur) indicating more time practicing could lead to more significant improvements in these cognitive processes (Diamond & Ling, 2016). Alternatively, these results may be due to methodological limitations including shorter yoga intervention (one 10-minute intervention; Dinu et al., 2023); small samples sizes (Fritz & O'Connor, 2022; Jensen & Kenny, 2004); high dropout rates (~31%; Fritz & O'Connor, 2022) or inappropriate measures (Jensen & Kenny, 2004; Rezaei et al., 2018). For instance, Rezaei et al. (2018) found no significant effect of yoga on tests of arithmetic and reaction times, however, the arithmetic sub-test measures a child's ability to perform mental math calculations and could be assessing numerical reasoning rather than the construct of working memory (Harrison et al., 2024).

1.4.1.2 Behavioural

The majority of studies found some support for yoga having a positive impact on behavioural outcomes suggesting yoga may have transdiagnostic potential to support individuals with behavioural difficulties across NDCs.

The findings that yoga positively impacts behaviour is supported by research in neurotypical populations that found yoga and meditation practice can increase pro-social behaviours (Kreplin et al., 2018; Pandey et al., 2025). It is suggested that by reducing stress and developing skills such as problem-solving, emotional and behavioural regulation, yoga can help

develop resilience, reduce distress and promote positive functioning (Pandey et al., 2025). This could provide support for the self-regulatory models of yoga (Gard et al., 2014; Gust, 2023) that suggest yoga can improve people's abilities to regulate their physical, emotional, cognitive and behavioural states by inhibiting processes that contribute towards stress, leading to more adaptive responses.

Some studies found non-significant findings of yoga on behavioural outcomes. Joshi & Rathi, (2019) found non-significant effect of yoga on aberrant behaviour, however the same study found a significant increase in aberrant behaviour in the control group, which may suggest that yoga could have a maintaining effect preventing behaviour from deteriorating/escalating. Jensen & Kenny (2004) found significant difference in a majority of subscales measured by parents (CPRS) but found no significant differences in the teachers' ratings (CTRS). The limited concordance across raters is widely acknowledged in literature where self-report measures have been found to vary between parent and teacher ratings (Dickson et al., 2018; Murray et al., 2021). Although no significant changes were found teachers rated children more favourably than parents, consistent with previous research that suggests parents rate children as more impaired (Dickson et al., 2018). This could highlight potential issues in the use of multi-informant measures that could introduce informant bias and impact the reliability of the findings.

1.4.1.3 Social Outcomes

Four out of six studies (Kaur et al., 2021; Litchke et al., 2018; Shanker & Pradhan, 2023; Uma et al., 1989) found yoga had significant positive impact on some social outcomes while four of the six found non-significant results on other aspects of social outcomes (Joshi & Rathi, 2019; Kaur et al., 2021; Litchke et al., 2021; Shanker & Pradhan, 2023). Although findings could suggest yoga may have an impact on social outcomes, mixed results and heterogeneity across a small number of studies suggest the evidence is inconclusive. Kishida et al's (2019) model suggests that practicing yoga can promote social connectedness through individual and

collective aspects of practice. On an individual level, yoga enhances self-awareness, emotional regulation, and empathy, which can improve interpersonal relationships. Whilst participating in group yoga practices (such as classes) creates opportunities for social interaction and bonding. Therefore, by developing self-compassion, compassion to others, social connectedness and mindfulness, yoga can enhance social connectedness and wellbeing (Kishida et al., 2019). Due to inconclusive findings the review does not provide support for this model and further research into social outcomes is needed.

1.4.1.4 Emotional Outcomes

Four out of five studies that looked at emotional outcomes reported a majority of non-significant results for the impact of yoga on emotional experience and wellbeing, Contrary to previous findings in neurotypical populations (Janjhua et al., 2020; Menezes et al., 2015), the current study did not find support for the impact of yoga on emotional outcomes in NDCs. However, a number of studies exploring emotional experience found individuals mood and interest were high throughout the intervention which may have an impact on findings resulting from a ceiling effect (Kaur et al 2021; Litche et al 2018).

It should be noted that none of the studies report using an intervention with all eight limbs of yoga, which has been argued to be important in having an effect on psychological functions such as emotion regulation and wellbeing (Bennetts, 2022; Bhide et al., 2022), particularly none of the studies included the yamas (ethical considerations) and few included niyamas (principles for ways of living) which have been postulated as the critical factor in promoting psychological wellbeing from yoga interventions (Bennetts, 2022; Fox et al., 2024). Furthermore, children with neurodevelopmental conditions including autism and ADHD often experience difficulties in social-emotional development, particularly in emotion recognition and regulation (Löytömäki et al., 2023). Therefore, for yoga to have a significant impact on emotional and social outcomes, interventions may need to explicitly include the yamas and niyamas in order to target emotion regulation (awareness of emotions and responding to emotions) and interpersonal factors

(Bennetts, 2022). Alternatively, emotional awareness and emotion recognition enhancing skills may need to be incorporated into interventions (England-Mason, 2020; England-Mason, & Gonzalez, 2020).

1.4.2 Strengths and limitations of included studies

A key limitation of the studies included in this review is the heterogeneity between the studies. Participants' characteristics, construct operationalisation, yoga interventions, outcome measures and analysis all varied significantly across the studies. This makes it difficult to draw firm conclusions across studies.

Across all the studies the only measures used in more than one paper was the TOVA (Dinu et al., 2023; Jensen & Kenny, 2004) and the Aberrant Behaviour Checklist (Joshi & Rathi, 2019; Koenig et al., 2012; Shanker & Pradhan, 2023). However, in one study the TOVA was determined to be an invalid measure for the study sample due to a third of participants returning invalid scores (Jensen & Kenny, 2004). All studies using the Aberrant Behaviour Checklist used different versions of the measure (ABC; ABC-Community; ABC-2) and reported on different aspects of the questionnaire, with one reporting sub-scales only (Shanker & Pradhan, 2023), one reporting total score only (Joshi & Rathi, 2019) and one reporting both total and sub-scale (Koenig et al., 2012) making possible comparisons between them limited. The remaining studies used different measures with some using self-made or unstandardised measures.

The majority of studies had small sample sizes and therefore are not representative of the desired population. The research tended to investigate one neurodevelopmental condition, and a number of studies either did not report co-occurring conditions or excluded them, which is not representative of the general population (Cleaton & Kirby, 2018; Francés et al., 2022). Screening out individuals with specific DSM diagnoses (e.g., autism or ADHD) may have unnecessarily reduced sample sizes and the generalizability of findings (Stanton et al., 2020).

The included studies were carried out across different cultures (both Eastern and Western), which is a strength of the literature overall. However, this means populations may have different narratives around wellbeing and the importance of psychosocial skills, making it difficult to form an overall conclusion about the outcomes.

A further limitation is that most research used purposive and convenience sampling from a particular service or geographical area, meaning the potential for self-selection bias and limited generalisability need to be considered when interpreting the results.

The current review only found four studies that recruited adult participants. Due to the heterogeneity of these studies, it is not possible to draw conclusions on the effect of yoga specific to the adult population. There is limited research in adults with neurodevelopmental conditions despite them having lifelong prevalence (Alexander et al., 2021; Antolini & Colizzi, 2023). This could mean that appropriate and effective evidence-based approaches for adults in this population are not being explored or are overlooked, particularly given the high rate of individuals being diagnosed in adulthood, especially females (Attoe & Climie, 2023; Da Silva et al., 2020; Dufour et al., 2025)

Despite some evidence supporting the effectiveness of yoga in this population, there was a lack of RCT which is deemed the gold-standard of research and none which compare yoga to the current recommended guidelines for intervention and best practice in NDCs (NICE, 2012; 2013; 2018). This highlights the need for more robust RCT to explore the clinical effectiveness of yoga against alternative recommended approaches (TAU).

Finally, no studies completed longitudinal follow-up to ascertain the dose and duration effect of yoga and whether the findings show temporary or persistent effects.

Considering these limitations, results should be interpreted with caution and further robust research is required to be able to draw more confident conclusions.

1.4.3 Clinical Implications

People with NDCs face barriers to accessing support (Cleaton & Kirby, 2018; Heady et al., 2022; Shearer, 2024) and may experience difficulties identifying or expressing concerns (Catania & Garzotto, 2023). These difficulties may act as a barrier to accessing NICE recommended support including talking therapies such as CBT. Bennetts (2022) proposed additional barriers to mental health support may be cultural differences and a lack of subscription to Western models on which talking therapies are based. Yoga offers an alternative approach for individuals unable to express their experiences verbally or for individuals that do not wish to engage in standard Western medical treatment e.g. talking therapies or pharmacological medication. The results of the current review suggest that yoga may benefit a number of psychosocial outcomes in individuals with NDCs, particularly improving cognitive and behavioural outcomes. This could suggest a non-clinical, easily accessible approach that is cheap to facilitate and focuses on strengths rather than 'deficits' (Cagas et al., 2023; Meyer et al., 2012; Singh, 2021). The findings of the current review could offer preliminary support for a transdiagnostic approach to supporting individuals with NDCs which may help to reduce waitlists and barriers to support.

1.4.4 Strengths and limitations of the current review

The current systematic review is the first to examine the impact of yoga interventions on cognitive, behavioural, social and emotional outcomes across NDCs.

A strength is that the review was pre-registered and conducted following established systematic review framework and reported using PRISMA guidelines (Page et al., 2021). The study also employed dual assessment of study quality and inclusion criteria, in line with recommendations (Boland et al., 2017). Another strength is that this review specifically examined yoga interventions that consisted of more than one limb of yoga, whilst excluding similar interventions that are not yoga. The review also included intervention studies to allow inferences regarding the impact of yoga on psychosocial outcomes.

The SQAC (Kmet et al., 2004) may not be the most robust quality assessment tool as its scoring system may leave room for interpretation making some items difficult to score. Additionally, the tool did not consider the quality of the interventions used in the studies. Previous research has shown reports of yoga interventions have been variable in detail and interventions are unable to be replicated (Ward et al., 2022). One way this review could have controlled for this is by adding an additional item into the SQAC tool that assesses the quality of the intervention similar to previous research (Bjerrum et al., 2024). Future reviews may benefit from using an alternative quality assessment tool with more rigorous guidelines or using the CLARIFY checklist to assess intervention reporting alongside the quality assessment (Ward et al., 2022).

The conceptualisation of outcomes included in this review was very broad as there is no single clear definition of the constructs, therefore there may be some overlap in how the constructs are conceptualised across the studies. Social, emotional and behavioural norms may vary across cultures, this may mean that different countries and measures may bring into question the construct validity of these outcomes. However, the current review chose to use a broad conceptualisation due to this being the first systematic review exploring the effect of multiple limbs of yoga across NDCs. Another limitation was the authors excluded articles that were not written in English and majority of grey literature except thesis which may have introduced bias into this systematic review.

A challenge in this review is that current research has been designed and developed using the medical model, which does not account for co-occurring conditions and transdiagnostic processes. A number of studies included in this review recruited specific conditions, using diagnostic specific measures. This is a challenge as research design and implementation in the included studies were heavily influenced by the ‘single-diagnostic’ approach of the medical model prominent in society. This makes it difficult to compare across studies and conditions/presentations to establish a reliable transdiagnostic effect (Dalgleish et al., 2020; Stanton et al., 2020).

1.4.5 Future Research

The duration, frequency and severity of interventions varied significantly in this review however research did not investigate the dose effect of yoga in this population. Guidelines and research recommend that interventions should be tailored to individuals with NDCs needs including adjusting the intensity, frequency, duration, or delivery of interventions (NICE, 2012; 2013; 2018), as some outcomes may take longer or more intense practice for mechanisms to have a positive impact in NDCs (Cooper et al., 2018; National Guideline Alliance, 2016). Additionally, none of the reviewed studies assessed outcomes at multiple follow-up time points; so, the long-term impact of yoga-based interventions are unknown. Therefore, future research needs to explore the dose (intensity, frequency and duration) of yoga and long-term effect of these outcomes specific to the needs of individuals with NDCs.

Due to small sample sizes of included studies, future research could recruit larger representative samples of neurodivergent participants from across wider areas. This could be useful in recruiting more diverse samples from different regions, which has been found to have significantly different prevalence rates of NDCs (Roman-Urrestarazu et al., 2021).

None of the studies in the current review reported the use of CLARIFY guidelines (Ward et al., 2022) developed to address reporting issues specific to yoga interventions. The reports of yoga interventions varied significantly making replication or analysis of the mechanisms of yoga difficult to compare, such as different limbs of yoga. This highlights the importance of future research using standardised reporting guidelines to enable high-quality yoga research that is replicable to promote evidence-based practice. Additionally, further research should explore the individual components of yoga and their effect to understand the mechanisms of change in neurodivergent populations. This could explore the proposed link between ethical limbs (yamas and niyamas) and emotional and social outcomes (Bennetts, 2022).

Finally, although results should be interpreted with caution there is preliminary support for a positive impact of yoga on some psychosocial outcomes in NDCs. Therefore, future

research may benefit from exploring the effect of yoga as a stand-alone intervention as well as an add-on intervention to current recommended support of neurodevelopmental conditions such as yoga versus CBT (TAU).

1.4.6 Conclusion

The current review adds to the understanding of yoga as an approach to support across neurodevelopmental populations. Results in this review offer preliminary support for yoga as a transdiagnostic approach in improving cognition and behaviour in NDCs, however this conclusion is limited by the overall quality and heterogeneity in research to date. Further high-quality research is needed to increase the quality of the evidence available, to provide a greater understanding of the dose-effect of yoga, and to understand the specificity of components of yoga that contribute to positive change in neurodevelopmental populations. These endeavours could support the development of the most effective yoga interventions for this population.

1.5 References

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Chapter 2 Empirical Paper

Title: A cross-cultural investigation of the psychological benefits of yoga practice.

Journal Specification: The following paper has been prepared for submission to the Journal Complementary Therapies in Clinical Practice. The guidelines for authors are provided in Appendix A.

Word Count: 7475 (excluding abstract, tables and references)

Chapter 2 Abstract

Background and Purpose

Yoga is a traditional Eastern practice that is growing in popularity globally. It is believed that Western yoga focuses predominately on physical postures, compared to other components' (limbs) of yoga from traditional Eastern practice. The current study aims to explore elements of yoga practice across Eastern and Western cultures and the relationship between engaging with different limbs of yoga and psychological wellbeing across cultures.

Methods

A cross-sectional study recruited yoga practitioners from the UK (*n* = 275) and India (*n* = 160). Participants completed an online survey measuring features of their yoga practice, motivations to practice yoga, engagement in the eight limbs of yoga, and psychological wellbeing.

Results

Results suggested that yoga practice differed across cultures. Indian practitioners had significantly more engagement in seven out of eight limbs of yoga. The regression models showed that different components of yoga were associated with psychological wellbeing across cultures.

Conclusion

These findings may have implications for the implementation of yoga as a treatment for psychological wellbeing. Yoga interventions for psychological wellbeing may require tailoring based on culture to maximize the effect in multicultural countries such as the UK. Future research is needed to assess these differences further.

Keywords: Yoga, Psychological Wellbeing, Cross-Cultural, Psychology.

2.1 Introduction

2.1.1 Yoga

Yoga is traditionally an Eastern practice involving the development of spiritual and physical wellness through enlightenment (Chaurasiya & Mishra, 2022), focusing on the union between the mind, body, spirit and environment (Sarbacker, 2021). The Yoga Sutras of Patanjali describe the eight limbs of yoga (Table 8) as a journey to live a meaningful life through awareness and enlightenment.

Table 8

Definitions of The Eight Limbs of Yoga

Limb	Sub-limb	English Translation	Definition (Bryant, 2015)
Yama		Ethical Restraints	Moral principles regulating one's behaviour toward others in everyday life. Essential for yoga practice.
	Ahimsa	Non-violence	Avoiding harm in thought, word, or action; the core principle for peace and compassion.
	Satya	Truthfulness	Living honestly and speaking truthfully. Aligned with non-harming - truth should not cause injury.
	Asteya	Non-stealing	Not taking what isn't freely given, includes honesty and not coveting.
	Brahmacarya	Moderation / Celibacy	Channelling energy wisely. Often interpreted as celibacy or moderation.
	Aparigraha	Non-possessiveness / non-greed	Letting go of material attachment, greed, or ownership.
Niyama		Personal Observances	Internal disciplines for personal and spiritual enhancement.
	Saucha	Cleanliness	Physical and mental purity and cleanliness including the environment, body and mind. Prepares for meditation and clarity.

	Santosha	Contentment	Acceptance of life as it is. Developing gratitude and peace.
	Tapas	Austerity / Discipline	Self-discipline and commitment to practice.
	Svadhyaya	Self-study	Study of sacred texts and self-reflection to deepen awareness.
	Isvara pranidhana	Surrender to God	Devotion and trust in a higher power.
Asana		Posture	Physical postures and movement in yoga to prepare the body for meditation - not merely physical exercise.
Pranayama		Breath Regulation	Conscious control of the breath to steady the mind and regulate vital energy.
Pratyahara		Withdrawal of the Senses	Turning the senses inward to draw attention away from external distractions.
Dharana		Concentration	Fixing the mind on and observing one object or point with focused attention.
Dhyana		Meditation	Meditative absorption. Continuous, uninterrupted concentration and connection with a single focus.
Samadhi		Absorption	Deep meditative absorption, leading toward spiritual liberation. Connection and unity with higher power achieving a ‘bliss state’.

2.1.2 Culture and Yoga

Yoga has become popular worldwide particularly in recent years across the Western world (Clarke et al., 2018; Ding & Stamatakis, 2014; Jakhmola, 2024).

It is suggested that traditional yoga has been assimilated and acculturated into urban and Western cultures. De Michelis (2007) refers to 'modern yoga' as what a Western or English speaker would understand as yoga, describing it as the performance of asanas (postures) including in a classroom or at home with self-help. De Michelis (2007) describes how Indic individuals have a deeper and varied interpretation of the word yoga beyond physical postures, including meditation, reflection, ethical behaviour, and spiritual and ritual practices. Therefore, it is important to consider the impact of culture on yoga practices and its effects.

It is argued that Western yoga focuses on physical, or posture-driven (asana) yoga in contrast to the traditional Eastern practice (Ivtzan & Jegatheeswaran, 2015; Nalbant et al., 2022; Singleton, 2010). Additionally, research has found that the reason people from Western cultures may begin practising yoga are more physical, whereas people from Eastern cultures would argue the aim of yoga is to gain spiritual enlightenment (Ivtzan & Jegatheeswaran, 2015). However, exploration of the cultural differences between traditional Eastern yoga and yoga adapted for Western cultures is limited. A cross-sectional study, exploring differences in yoga practice between United States of America (USA) and India, found US practitioners reported higher body awareness and postures in their practice whereas Indian practitioners reported more spiritual and social aspects to their yoga (Gupta et al., 2024). However, the components of yoga measured in this study did not include all eight limbs of traditional yoga and only recruited from USA and India and therefore cannot be generalised to other cultures. A further critique is that this study did not assess the relationship between differences in practice with any wellbeing measures.

Alternatively, research has suggested that although Western practice is predominately physically motivated initially, ongoing practice can cultivate more spiritual motivation (Ivtzan &

Jegatheeswaran, 2015). Gannon and Life (2002) argue that it is possible to practice traditional yoga in modern, urban and Western societies with the aim of experiencing enlightenment. Schmid et al. (2021) conducted a qualitative study exploring feedback on a 16-week yoga intervention for US individuals with PTSD. Although the interventions did not use traditional Sanskrit words or explicitly teach the eight limbs of yoga, the study concluded that all eight limbs were represented including the ethical principles (Yamas and Niyamas). However, the study grouped multiple limbs together to represent meditation in the analysis and conceptualised guided relaxation as meditation instead of including traditional meditation. Therefore, further research into all eight limbs individually need to be explored across Western cultures.

Overall, there are mixed findings on whether Eastern and Western practices differ significantly and if Western yoga integrates the eight limbs rather than just the physical component. Limited research has studied the effect of different components or individual limbs of yoga, and even fewer have explored these cross-culturally.

2.1.3 Yoga and Wellbeing

Emerging research suggests yoga has a therapeutic effect on a variety of mental health and psychological health conditions across cultures. Systematic reviews have shown yoga interventions improve mental health conditions including anxiety (Cramer et al., 2018a; Martínez-Calderon et al., 2023), depression (Brinsley et al., 2021; Martínez-Calderon et al., 2023) and post-traumatic stress disorder (PTSD) (Cramer et al., 2018b; Taylor et al., 2020). It also impacts psychological wellbeing including improving stress (Wang & Szabo, 2020), wellbeing (Pick et al., 2021) and quality of life and happiness (Auty et al., 2017). Frequently, research has investigated the impact of yoga on wellbeing without exploring the processes within yoga that affect these outcomes. This may be due to yoga being researched as a homogenous practice, heterogeneity of reporting interventions, as well as a lack of validated

measures (Bennetts, 2022; Matko et al., 2021). As a result, yoga interventions may not be using components that are most effective for psychological and therapeutic benefits.

2.1.3.1 Mechanisms of Change

There are several theoretical models suggesting yoga works though physiological, psychological and interpersonal processes (Gard et al., 2014; Gust, 2023; Kishida et al., 2018).

Gard et al., (2014) proposes a self-regulatory model of yoga which argues yoga can improve people's abilities to regulate their physical, emotional, cognitive and behavioural states. In this model Gard consolidates the eight limbs of yoga into four core features: ethical principles, breath regulation, postures and meditation. The model suggests that yoga works through a number of neurological networks to develop self-awareness, self-control, attentional control and emotional regulation and integration of viscero-somatic information. This in turn helps to inhibit cognitive, emotional, behavioural and physiological processes that contribute to stress, while promoting prosocial behaviour, physical and psychological wellbeing. The model proposes that these benefits are achieved through practicing the four core features of yoga which support the development of self-regulation over time. However, Gard et al's (2014) model has been criticised for being very complex.

More recently Gust (2023) proposed a simpler model of self-regulatory mechanisms. Gust argued practicing the four core features of yoga (used by Gard et al., 2014) significantly improves individuals' ability to apply self-control, mindfulness, distress tolerance, emotion regulation and to manage their parasympathetic nervous system leading to greater psychological wellbeing.

Additionally, Kishida et al's (2019) model suggests that practicing yoga can promote social connectedness through individual and collective aspects of practice. On an individual level, yoga enhances self-awareness, emotional regulation, and empathy, which can improve interpersonal relationships. Whilst participating in group yoga practices (such as classes) creates opportunities for social interaction and bonding. Therefore, by developing self-

compassion, compassion to others, social connectedness and mindfulness, yoga can enhance social connectedness and wellbeing (Kishida et al., 2019).

A critique of these models is that no single model includes physiological, psychological and interpersonal mechanisms of change and there is limited empirical support to date (Bennetts, 2022; Fox et al., 2024). Additionally, these models do not account for all aspects of yoga. Each of the models simplifies the eight limbs of yoga into four features (ethical considerations, breathwork, physical postures and meditation) and therefore may miss some of the processes that lead to change. Research suggests that yoga interventions which include more components of traditional yoga are more effective than interventions involving fewer components (Matko et al., 2021; Ross et al., 2012; Smith et al., 2011). Ross et al., (2012) found that different components of yoga predicted at least one health related outcome and that the non-physical components were more important in improving mindfulness and wellbeing. However, a critique of these studies is that similar to the previous models, they simplify the eight limbs of yoga into four components.

Bennetts (2022) builds on previous models and suggests that yoga works as a transdiagnostic approach to promote psychological change through psychological, physiological and interpersonal processes. This model suggests that each of the individual eight limbs of yoga illicit psychological change through specific transdiagnostic processes and argues that these mechanisms of change are similar to changes in talking therapies such as CBT and third wave therapies. A unique aspect of the theory is that it highlights that the yamas and niyamas are specifically relevant to targeting the psychological processes (e.g. compassion, self-criticism, emotion regulation) that are addressed within talking therapies.

Preliminary research has found support for the eight limbs of yoga having a positive effect on psychological outcomes in Western populations as well as potential shared transdiagnostic processes between limbs of yoga and third wave therapies including ACT and DBT (Fox et al., 2024; Pick et al. 2021; Willis et al., 2024). These suggest that all eight limbs may be individually

relevant for psychological wellbeing, and so previous theories and research are limited by grouping components of yoga together. Research exploring individual components of yoga to date supports the argument that specific limbs, particularly ethical limbs (yamas and niyamas), are critical for understanding the process of change in psychological outcomes in Western cultures (Fox et al., 2024; Pick et al., 2021; Willis et al., 2024).

2.1.4 Current Study

Increasing research has shown yoga benefits physical, mental and psychological health (Bussing et al., 2012; Kamraju, 2023; Kelley & Kelley, 2020; Khunti et al., 2023; Martínez-Calderon et al., 2023; Wang & Szabo, 2020). Despite a wealth of literature, there is limited cross-cultural research that explores specific features and components of yoga practice.

For yoga to be used therapeutically, we need to understand the motivations and features of yoga across cultures and how these factors relate to psychological wellbeing. This could have clinical implications for whether interventions could be tailored to improve the effectiveness of therapeutic yoga for those of different cultures. Understanding if these factors are similar or different across Eastern and Western cultures could be useful in understanding how yoga interventions may need to be tailored to specific populations for optimum effect.

The current study aimed to explore elements of yoga practice across Eastern and Western cultures and whether any differences in yoga practice are associated with psychological wellbeing.

2.1.5 Hypotheses

H1) There will be a significant difference in aspects of yoga practice (start age, frequency, who practice with, where they practice, motivation) between Indian (Eastern) and UK (Western) cultures.

H2) There will be significant differences between the extent practitioners from different cultures engage in the different limbs of yoga.

H3) Engagement with specific limbs of yoga may predict psychological wellbeing differently between Indian (Eastern) and UK (Western) cultures, particularly the non-physical limbs e.g. ethical components and meditation.

2.2 Method

2.2.1 Ethics

Study protocols were approved by the Research Ethics Committee of the University of Southampton, ERGO number: 88935 (Appendix D).

2.2.2 Design

The current study used a cross-sectional single time point online survey.

2.2.3 Patient and Public involvement (PPI)

PPI involvement included two individuals from the UK and two from India. PPI was used to consider how culture was conceptualized and measured, and the accessibility of the study for individuals from Eastern cultures (where English may not be their first language) or individuals with varying understanding of yoga. Feedback was gathered on the wording of questions and potential participant burden, and dissemination across cultures.

2.2.3.1 Power Analysis

An a-priori power analysis was conducted using G*Power for multiple regression (version 3.1.9.2; Faul et al., 2013). Assuming a small-to-medium effect size (Cohen, 1988) based on data from a previous study using similar methodology (Pick et al., 2021) and power of .80, the current study aimed to recruit a minimum number of 300 participants (150 per group).

2.2.3.2 Recruitment

Participants were recruited by distributing the research poster (Appendix E) and survey link via email and social media. Researchers emailed UK and Indian institutions (Appendix F) to advertise the study to their members e.g. universities, yoga institutions, and other events organisers in the UK and India. Additionally, individuals known to the research team were contacted to advertise the study online. Due to recruitment difficulties, a second wave of recruitment occurred where the study was advertised on SONA (University of Southampton

students) and Prolific platforms. These platforms offer university credit or payment for research participation in line with relevant policies.

2.2.4 Eligibility Criteria

Participants completed an eligibility screening questionnaire (contained in Appendix I Demographic Information Questionnaire), for the full inclusion criteria see Table 9.

Table 9

Inclusion Criteria

Inclusion Criteria	Definition
Aged 18 or over.	Participants must be legal adults, ensuring they can provide informed consent.
From the UK or India.	Participants must reside in either the UK or India for the majority of their life to ensure cultural relevance.
Cultural identification: identify most with the UK or Indian Culture	Participants were grouped based on the culture they self-identified with and were limited to UK or Indian culture. Individuals identifying most with another culture were excluded from the study.
Currently practicing yoga.	To be classified as practicing yoga, participants must practice yoga at least twice a month to ensure engagement with yoga is current.
Not currently receiving talking therapy for mental health.	Excludes those currently receiving talking therapy such as CBT or counselling to avoid confounding variables related to mental health support. It has been suggested that factors responsible for the therapeutic effects of yoga may be the same as those targeted in talking therapies (Bennetts, 2022)
No previous involvement in PPI (Patient and Public Involvement) for the current study.	Individuals who contributed to the development of the study were excluded to prevent bias or prior knowledge effects.

2.2.5 Participants

Overall, 435 participants took part in the study. 275 participants identified with UK culture and 160 participants identified with Indian culture (see Figure 6 for Consort Diagram; p.128).

2.2.6 Materials

Cronbach alphas for all measures are reported in Appendix H. Cronbach alphas were interpreted using George and Mallery (2003) cutoffs (< .50 = Unacceptable; .50-0.59 = Poor; .60–.69 = Questionable; .70–.79 = Acceptable; .80–.89 = Good; > .90 = Excellent).

Eligibility Screening: Participants were screened using a questionnaire based on the eligibility criteria (contained in Appendix I Demographic Information Questionnaire).

Demographic Information: A demographic questionnaire (Appendix I) collected information about participants' age, gender, ethnicity, country of origin and residence, religion and spirituality.

Features of Yoga Practice: Participants were asked about features of their yoga practice (Appendix J) including type of yoga, start age, duration, frequency of practice, who they practice with, and where they practice.

Motivation to Practice Yoga: Participants were asked about their motivations to start and continue practicing yoga (Appendix K). These measures were developed for the current study due to no known standardised motivation measure specific to yoga and other measures of motivation do not include a spiritual element. The first measure asked, 'How important were the following possible motivations when you FIRST began yoga?' while the second asked 'When considering why you CONTINUE to practice yoga, how important to you are the following aspects?'. Each measure had 23-items which were used to assess four subscales of motivations for practicing yoga including spiritual development, physical, psychological, and interpersonal. Responses were made on a 7-point Likert scale ranging from 1 (not at all important) to 7 (extremely important). In the current study, reliability ranged between acceptable-excellent for motivation to

start: Cronbach α = .74-.90 (UK = .72-.88; India =.74-.90), and the motivation to continue: Cronbach α = .78-.91 (UK = .72-.90; India = .83-.90).

Physical Activity and Leisure Motivation Scale (PALMS): PALMS (Appendix L) is a 40-item scale used to assess eight motives for participation in physical activity. These include mastery, enjoyment, psychological condition, physical condition, appearance, other's expectations, affiliation, competition/ego. Responses to the PALMS are made on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scores of each PALMS sub-scale ranges from 5 to 25 (Molanorouzi et al., 2014; Roychowdhury., 2012). The scale has shown good reliability and validity (Roychowdhury., 2018). For the current study the original questionnaire wording was amended from "I undertake physical activity…" to "I undertake Yoga…". In the current study, reliability ranged acceptable-excellent for the PALMS: Cronbach α = .76-.91 (UK = .69-.93; India = .75-.89).

The PALMS measure was used to evaluate the validity of the self-reported motivation to practice yoga questionnaires. The following subscales were considered conceptually akin; psychological condition subscale (PALMS) and psychological motivations to practice yoga; both physical condition subscale (PALMS) and appearance subscale (PALMS) and physical motivation to practice yoga; affiliation subscale (PALMS) and interpersonal motivations to practice.

Eight Limbs of Yoga: The Eight Limbs of Yoga Questionnaire (Appendix M) asks yoga practitioners to self-report the extent they engage with the eight limbs of yoga. Each item describes the concept of a limb of yoga in lay terms. Participants then rate their engagement on a 7-point Likert scale ranging from 1 (not at all) to 7 (All of the time). The eight limbs of yoga questionnaire was developed alongside two other research teams (Fox et al., 2024; Wallis et al., 2024). As part of PPI involvement, development of the questionnaire was discussed in a focus group of yoga practitioners and individually with three yoga teachers. Total scores for each limb can be calculated as well as total scores for individual yamas and niyamas. Reliability for the

overall questionnaire was excellent, Cronbach α = .971 (UK = .97; India = .96), and total scores of the eight limbs ranged from questionable-excellent, Cronbach α = .62-.94 (UK = .63-.93; India = .60-.90). Across the samples Cronbach's alpha for each of the individual yama and niyama subscales ranged from excellent to acceptable, however one subscale scored poor for Indian participants only, Cronbach α = .70-.85 (UK = .70-.86; India = .59-.81).

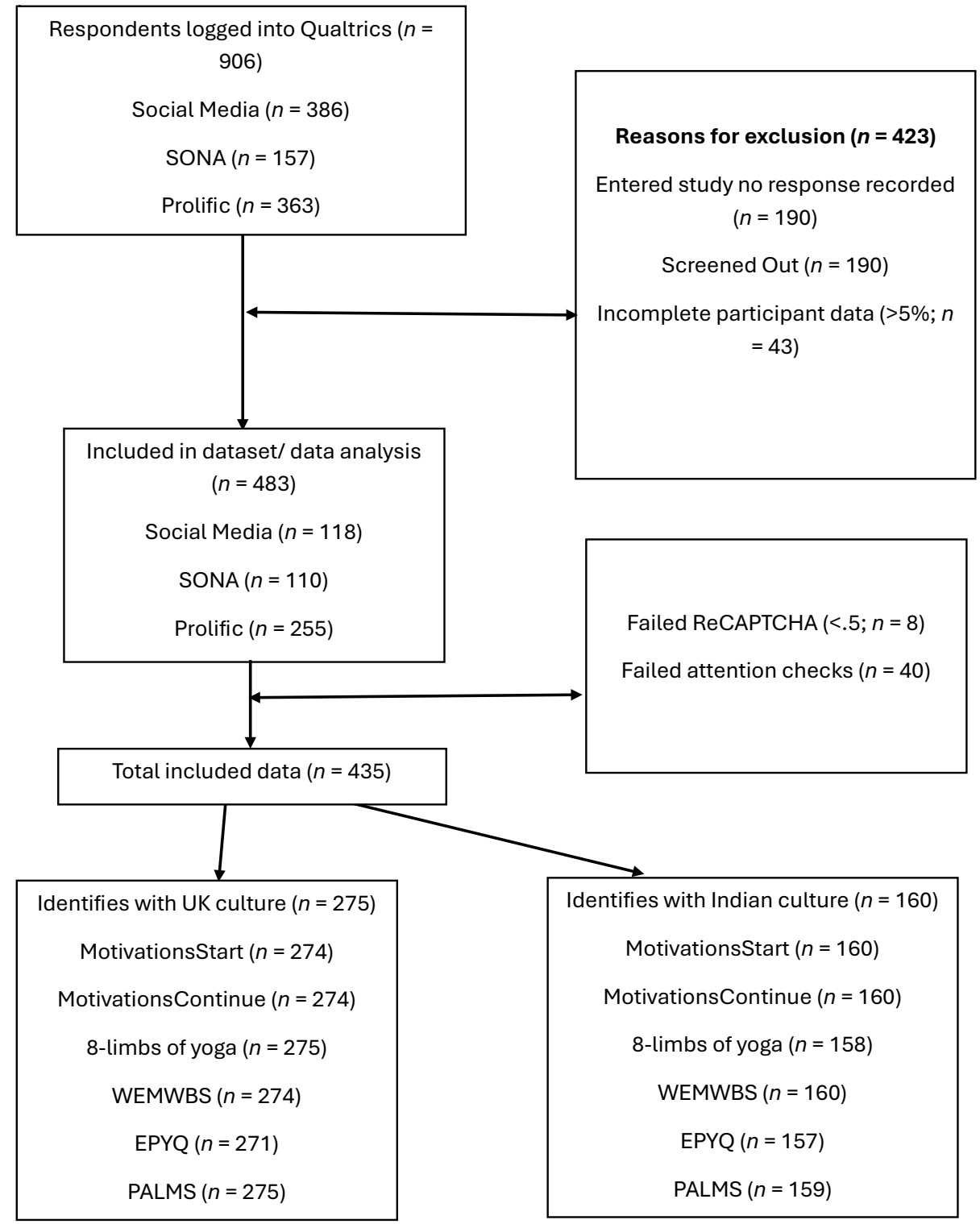
Essential Properties of Yoga Questionnaire (EPYQ; Park et al., 2018): The EPYQ (Appendix N) assesses fourteen key dimensions of yoga: Acceptance/compassion, breathwork, physicality, active postures (asanas), restorative postures (asanas), body locks (bandhas), body awareness, mental and emotional awareness/release, health benefits, individual attention, social aspects, spirituality, meditation and mindfulness and yoga philosophy. The EPYQ was originally designed for external, objective raters to score yoga interventions. However, it has been used as a self-report measure of individual yoga practice (Park et al., 2020; Pick et al., 2021). The instructions for the measure were adapted from "*How much did the instructor mention or include…?*" to "*How much does your practice include…?".* Participants rate how much of their yoga practice incorporates the different elements described on a 5-point Likert scale from 1 ('not at all') to 5 ('a very large amount'). Participants completed Part One of the EPYQ, which includes questions related to the components of yoga present in their practice.

The EPYQ has been shown to have good reliability and validity both as an external rating tool (Park et al., 2018) and as a self-report questionnaire in the UK, USA and India (Gupta et al., 2024; Park et al., 2020; Pick et al, 2021). The EPYQ reliability ranged from acceptable-excellent for all subscales: Cronbach α =.75-.90 (UK = .74-.89; India = .76-.91).

This scale was used to assess the validity of the newly developed Eight Limbs of Yoga Questionnaire. As previously suggested (Pick et al., 2021) the following subscales were conceptually akin; acceptance/compassion EPYQ subscale and ahimsa; the breathwork EPYQ subscale and pranayama; the meditation/mindfulness EPYQ subscale and both dharana and dhyana.

The Warwick-Edinburgh Mental Well-Being Scale (WEMWBS; Tennant et al., 2007):

The WEMWBS (Appendix O) is a 14-item scale that measures aspects of psychological functioning (optimism, autonomy, agency, curiosity, clarity of thought and positive relationships) and positive affect (confidence, feeling relaxed, cheerful, having energy to spare). Items are rated on a 5-point scale ranging from 1 (none of the time) to 5 (all of the time). The total score was determined by adding the score of all the 14 items. A higher score indicates higher positive wellbeing. The scale has shown good reliability and validity across cultures including in the UK and India (Singh & Raina, 2020; Stewart-Brown, 2012). In the current study, the WEMWBS reliability was excellent, Cronbach α = .92 (UK = .93; India = .90).



Participants with missing data less than 5% were included in the study but were excluded from analysis of questionnaires with missing data. These were excluded from the analysis due to majority of subscales being small and majority of missing data making up over 20% of subscales.

Figure 6

Consort Diagram Showing Reasons for Excluded Datasets

2.2.7 Demographics

Participants' demographic data is presented in Table 10. There was no significant difference in age between groups, with UK practitioners' ages ranging from 18-79 years old and Indian practitioners ranging from 18-72 years old. Overall, the majority of participants were female (84.7% UK; 50.6% Indian), however, significantly more males practiced yoga in the Indian group compared to the UK group. The majority of the Indian practitioners identified as Asian (93.1%) whereas the majority of UK practitioners identified as white (79.7%). In both groups, a majority of individuals identified as spiritual (UK = 61.1%; Indian = 85.0%), however, significantly more Indian practitioners identified as spiritual compared to UK practitioners. The UK practitioners identified more with no religion (61.1%) or Christianity (27.6%), whereas Indian practitioners identified more commonly with Hindu (65.0%) or Muslim (12.5%). See Appendix G for more detailed characteristics of yoga practitioners.

Table 10

Participants' Demographic Information by Group

Demographics	UK Culture		Indian Culture		T-Test		Chi-Squared Test			Significance
	N (%)	*M* (*SD*)	*N* (%)	*M* (*SD*)	*t*	*df*	X^2	*df*	*v*	*p*
Age					1.47	433				*p* = .128
M (SD)		34.36 (15.38)		32.32 (11.14)						
Gender							64.11[a]	3	.39	<.001**
Female	233 (84.7%)		81 (50.6%)							
Male	38 (13.8%)		79 (49.4%)							
Non-Binary	1 (0.4%)		0 (0%)							
Prefer not to say	3 (1.1%)		0 (0%)							
Ethnicity							316.11	4	.86	<.001**
White	216 (79.7%)		9 (5.7%)							

Demographics	UK Culture		Indian Culture		T-Test		Chi-Squared Test			Significance
	N (%)	*M* (*SD*)	*N* (%)	*M* (*SD*)	*t*	*df*	X^2	*df*	*v*	*p*
Asian or Asian British	18 (6.6%)		148 (93.1%)							
Black or Black British	11 (4.1%)		0 (0%)							
Mixed heritage background	11 (4.1%)		1 (0.6%)							
Other	15 (5.5%)		1 (0.6%)							
Religion							280.39	5	.80	<.001**
Hindu	3 (1.1%)		104 (65.0%)							
Muslim	7 (2.5%)		20 (12.5%)							
Christian	76 (27.6%)		11 (6.9%)							
Sikh	3 (1.1%)		6 (3.8%)							

Demographics	UK Culture		Indian Culture		T-Test		Chi-Squared Test			Significance
	N (%)	*M* (*SD*)	*N* (%)	*M* (*SD*)	*t*	*df*	X^2	*df*	*v*	*p*
No religion	168 (61.1%)		12 (7.5%)							
Other religion	18 (6.5%)		7 (4.4%)							
Spirituality							27.47	1	.25	<.001**
Yes	168 (61.1%)		136 (85.0%)							
No	107 (38.9%)		24 (15.0%)							
Are you a yoga teacher / therapist							6.54[a]	2	.12	*P = .034**
No	231 (84%)		148 (92.5%)							
Yoga Teacher	38 (13.8%)		11 (6.9%)							
Yoga Therapist	6 (2.2%)		1 (0.6%)							

Demographics	UK Culture		Indian Culture		T-Test		Chi-Squared Test			Significance
	N (%)	*M* (*SD*)	*N* (%)	*M* (*SD*)	*t*	*df*	X^2	*df*	*v*	*p*
Psychological Wellbeing		49.15 (9.08)		53.73 (7.90)	-5.31	432				<.001**

Note. Group differences analysed using t-test or Chi-square test; [a] = Fishers Exact; ** significant at $p<.001$; * significant at $p<.05$.

2.2.8 Procedure

All participants accessed the research by clicking on an online survey link. Participants read an online information sheet and consented by selecting a consent box that was mandatory to continue with the study (Appendix P). Participants then completed eligibility screening questions. If participants did not meet the inclusion criteria in the eligibility screening, they were directed to the debrief form (Appendix Q). If eligible, participants completed all measures and then had access to the online debrief form.

2.2.9 Data analytic strategy

The current research was an exploratory study to gain preliminary insights into cross cultural yoga practice and the impact on wellbeing. Data analysis was completed using IBM SPSS Statistics version 30.0.0.0 (IBM Corporation, 2024). Prior to analysis, the researcher conducted initial assumption checks for each of the hypotheses (Field, 2009) (Appendix R). Due to the presence of outliers and violations of normality, a bias-corrected accelerated (BCa) bootstrap procedure with 1,000 resamples was used to estimate the 95% confidence interval for the mean difference in all t-test and regression analyses (Efron, 1987; Hassan & Ali, 2022).

In order to meet the assumption of expected frequency to run the chi- square test (maximum of 20% cells having expected value less than five; Field, 2009; Howell, 2006), categories of some questions were collapsed. Fisher-Freeman-Halton Exact Test was used for interpretation of any questions that did not meet the assumption of expected frequencies, as this is more reliable when expected cell counts are low (Kim, 2017).

Pearson's bivariate correlations were conducted to assess the validity of the motivation and eight limbs of yoga questionnaires.

Hypothesis One explored group differences in features of participants' yoga practice using Chi-square. Chi-square effect sizes were measured using Cramer's V (< .3 = small; .3

to .49 = medium; > .5 = large). Standardized residuals were examined to determine the specific cells contributing most to this association. Motivation to practice and continue practicing yoga were explored using t-tests. T-test effect sizes were measured using Cohen's d (.2 = small; .5 = medium; > .8 = large).

Hypothesis Two explored practitioners' engagement with the limbs of yoga using a number of independent t-tests and effect sizes were measured using Cohen's d.

Hypothesis Three explored the relationship between the eight limbs of yoga and psychological wellbeing. Pearson's bivariate correlations were used to assess the relationship between the eight limbs and psychological wellbeing. Correlations were interpreted according to Cohen et al. (1988) (< .3 = small; .3 to .49 = moderate; > .5 = strong). Multiple regressions were used to explore whether engagement in the eight limbs of yoga were associated with wellbeing in each group.

2.3 Results

2.3.1 Validation Checks

The PALMS measure was used to evaluate the validity of the self-reported motivation to practice yoga questionnaires. Results found significant moderate to strong correlations between the theoretically related constructs for motivation to start practicing yoga, ranging from .36 to .65 for UK practitioners and from .43 to .67 in Indian practitioners. There were significant strong correlations between the theoretically related constructs for motivation to continue practicing yoga and PALMS subscales, ranging from .53 to .75 for UK practitioners and from .50 to .76 in Indian practitioners ($p < .001$; Table 11). This indicates support for the validity of the motivation to practice yoga questionnaire.

The EPYQ was used to assess the validity of the newly developed Eight Limbs of Yoga Questionnaire. Results found significant strong correlations between the theoretically related constructs between measures, ranging from .56 to .71 for UK practitioners and from .55 to .68 in Indian practitioners ($p < .001$; Table 12). This indicates support for the validity of the Eight Limbs of Yoga questionnaire.

Table 11

Correlations Between PALMS Variables and Motivation to Start and Continue Practicing Yoga.

	UK				India			
Scales	Physical Condition (PALMS)	Appearance (PALMS)	Psychological (PALMS)	Affiliation (PALMS)	Physical Condition (PALMS)	Appearance (PALMS)	Psychological (PALMS)	Affiliation (PALMS)
Motivation to start								
Physical	.37**	.49**			.44**	.67**		
Psychological			.36**				.43**	
Interpersonal				.65**				.63**
Motivation to continue								
Physical	.53**	.58**			.50**	.76**		
Psychological			.57**				.64**	
Interpersonal				.75**				.68**

Note. ** significant at $p<.001$; * significant at $p<.05$.

Table 12

Correlations Between EPYQ subscales and the Eight Limbs of Yoga Variables.

	UK			India		
Scales	Acceptance/ Compassion (EPYQ)	Breathwork (EPYQ)	Meditation/ Mindfulness (EPYQ)	Acceptance/ Compassion (EPYQ)	Breathwork (EPYQ)	Meditation/ Mindfulness (EPYQ)
Eight Limbs of Yoga						
Ahimsa	.71**			.55**		
Pranayama		.68**			.68**	
Dharana			.56**			.62**
Dhyana			.56**			.61**

Note. ** significant at $p<.001$; * significant at $p<.05$.

2.3.2 Hypothesis One - Features of Yoga Practice

See Table 13 for features of yoga practice by group and Appendix G for additional characteristics of yoga practitioners.

Various types of yoga were practiced by practitioners, the most common practiced by UK practitioners were Hatha Yoga (32.7%), Yogic Breathing (27.3%) and participants not knowing the type they practiced (25.5%). Whereas the Indian practitioners most common type of yoga practiced were Yogic Breathing (60%), Ashtanga Yoga (50%), Hatha Yoga (30%). The most common place to practice was at home (UK: 78.2%; India 94.4%) followed by the gym for UK practitioners (28.4%) and other for Indian practitioners (15%).

There were no significant group differences between practitioners' culture and start age or culture and the frequency of practitioner's practice. There were significant group differences in the duration practitioners have been practicing yoga for, where they learnt yoga and who they practice with ($p < .05$).

Results suggested Indian practitioners were less likely to be practicing yoga for under a year to three years and more likely to be practicing yoga for three to ten years. UK practitioners were more likely to practice for less than one year to 3 years and less likely to be practicing for three to ten years.

Indian practitioners were more likely to learn yoga in school or from family members. They were less likely to learn yoga at a leisure facility or online, which was more common for UK practitioners. UK practitioners were less likely to learn from immediate family or school.

Indian practitioners were more likely to practice with close friends and family and less likely to practice in a group, while UK practitioners were more likely than expected to practice in a group.

Table 13

Features of Participants' Yoga Practice by Group

Characteristics	UK Culture	Indian Culture		Chi Squared Test			Significance
Features of Yoga Practice	*N* (%)	*N* (%)	*df*	*n*	X^2	*v*	*p*
Start Age			*6*	434	7.06		*p* =.318
0-10years	3 (1.1%)	6 (3.8%)					
10-20years	115 (42.0%)	74 (46.3%)					
21-24years	36 (13.1%)	23 (14.4%)					
25-34years	70 (25.5%)	32 (20.0%)					
35-44years	31 (11.3%)	18 (11.3%)					
45-54years	13 (4.7%)	6 (3.8%)					
55+ years	6 (2.2%)	1 (0.6%)					
Where did you learn to practice yoga			5	435	113.73	.51	<.001**
From Immediate family	22 (8.0%)	36 (22.5%)					
School	17 (6.2%)	59 (36.9%)					
Workplace	1 (0.4%)	2 (1.3%)					

Leisure Facility	103 (37.5%)	12 (7.5%)				
Online	96 (34.9%)	32 (20.0%)				
Other	36 (13.1%)	19 (11.9%)				
Where do you practice?						MC
Home	215 (78.2%)	151 (94.4%)				
Work	12 (4.4%)	6 (3.8%)				
Gym	78 (28.4%)	18 (11.3%)				
Other	66 (24%)	24 (15%)				
On average how much do you practice yoga			5	435	10.91	*p* = *.053**
Twice per month	47 (17.1%)	18 (11.3%)				
Three times per month	38 (13.8%)	14 (8.8%)				
Once a week	85 (30.9%)	42 (26.3%)				
Twice per week	37 (13.5%)	29 (18.1%)				
Three to five times per week	50 (18.2%)	41 (25.6%)				
Daily	18 (6.5%)	16 (10.0%)				

How many years have you been practicing yoga?			6	435	25.77	.24	< .001**
Less than a year	58 (21.1%)	14 (8.8%)					
1-3 years	74 (26.9%)	29 (18.1%)					
3-5 years	46 (16.7%)	43 (26.9%)					
5-10 years	35 (12.7%)	37 (23.1%					
10-20 years	35 (12.7%)	25 (15.6%)					
20-30 years	18 (6.5%)	9 (5.6%)					
30+ years	9 (3.3%)	3 (1.9%)					
Who do you practice yoga with?			*4*	*435*	*9.41*	*.15*	*p = .044**
Alone	128 (46.5%)	87 (54.4%)					
With close friends and family	20 (7.3%)	19 (11.9%)					
With others in a group	41 (14.9)	13 (8.1%)					
Both alone and in a group	84 (30.5%)	41 (25.6%)					
Other	2 (0.7%)	0 (0%)					

Note. Group differences analysed using t-test or Chi-square test; MC = Multiple Choice (descriptive only); [a] = Fishers Exact; ** significant at $p<.001$; * significant at $p<.05$

2.3.2.1 Motivations to Practice Yoga

Indian practitioners had significantly higher motivation than UK practitioners in all areas of motivation to start practicing and motivation to continue practicing yoga. This included spiritual motivation, physical motivation, psychological motivation and interpersonal motivation. Results are shown in Table 14.

2.3.2.1.1 Differences in Motivation to Start and Continue Practicing Yoga

A paired samples t-test with bootstrapping was performed to evaluate whether there was a difference between the participants' motivation to start practicing yoga and their motivation to continue practicing yoga. For UK practitioners, spiritual and psychological motivation was reported as a significantly higher factor in continuing to practice yoga than for starting yoga. Whereas for Indian practitioners, psychological and physical motivation was reported as a significantly higher factor in continuing to practice yoga than for starting yoga. There was no significant difference in any other motivations to practice yoga ($p>.05$). Results are shown in Table 15.

Table 14

Differences Between UK and India in Motivations to Practice Yoga - Means, Standard Deviations and T-tests.

Measure	UK	India	*t*	*p*	Cohen's *d*	Bootstrap		
						BCa SE	BCa 95% Confidence Interval	
	M (*SD*)	*M* (*SD*)					Lower	Upper
Motivation at Start								
Spiritual [a]	14.01 (7.17)	22.37 (7.25)	-11.66	<.001**	-1.16	0.71	-9.81	-6.97
Physical [a]	28.42 (5.87)	30.73 (5.87)	-3.95	<.001**	-0.39	0.59	-3.47	-1.15
Psychological [a]	38.44 (9.15)	45.64 (8.40)	-8.15	<.001**	-0.81	0.89	-9.15	-5.47
Interpersonal [a]	11.28 (5.81)	14.68 (5.77)	-5.89	<.001**	-0.59	0.59	-4.66	-2.28
Motivation to continue								
Spiritual [a]	15.47 (8.08)	22.86 (7.64)	-9.37	<.001**	-0.93	0.78	-9.00	-5.80
Physical [a]	28.41 (5.98)	31.36 (6.52)	-4.81	<.001**	-0.48	0.62	-4.22	-1.67
Psychological	41.35 (8.26)	47.19 (6.69)	-8.03	<.001**	-0.76	0.76	-7.29	-4.36
Interpersonal [a]	11.39 (6.51)	14.93 (6.33)	-5.53	<.001**	-0.55	0.64	-4.82	-2.28

Note. Group differences analysed using t-tests; [a] = equal variance assumed; ** significant at $p<.001$; * significant at $p<.05$

Table 15

Differences Between Motivations to Start and Continue Yoga in UK and India - Means, Standard Deviations and T-tests.

Measure	Start	Continue	*t*	*p*	Cohen's *d*	Bootstrap		
						BCa SE	BCa 95% Confidence Interval	
	M (*SD*)	*M* (*SD*)					Lower	Upper
UK								
Spiritual	14.04 (7.17)	15.43 (8.06)	-3.83	<.001**	-0.23	0.36	-2.10	-0.70
Physical	28.45 (5.86)	28.41 (5.99)	0.15	.873	0.01	0.24	-0.43	0.50
Psychological	38.54 (9.02)	41.32 (8.27)	-5.58	<.001**	-0.34	0.49	-3.77	-1.82
Interpersonal	11.31 (5.81)	11.36 (6.49)	-0.18	.860	-0.01	0.26	-0.58	0.49
India								
Spiritual	22.37 (7.25)	22.86 (7.64)	-1.36	.157	-0.11	0.35	-1.19	0.26
Physical	30.73 (5.87)	31.36 (6.52)	-2.04	.038*	-0.16	0.30	-1.15	-0.08
Psychological	45.64 (8.40)	47.19 (6.69)	-3.17	.009*	-0.25	0.47	-2.53	-0.68
Interpersonal	14.68 (5.77)	14.93 (6.33)	-1.01	.317	-0.08	0.25	-0.78	0.23

Note. Group differences analysed using t-tests; ** significant at $p<.001$; * significant at $p<.05$

2.3.3 Hypothesis Two - Eight Limbs of Yoga

37.9 % of the UK practitioners and 57.5% of Indian practitioners were at least somewhat familiar with the eight limbs of yoga. There was no significant difference in engagement in asana (physical postures) between groups ($p > .05$). Indian practitioners reported engaging in the remaining limbs of yoga (yama, niyama, pranayama, pratyahara, dharana, dhyana and samadhi) to a greater extent than UK practitioners (see Table 16 for details).

A significant difference in engagement with ethical principles was found across all five yamas and all five niyamas ($p < .001$), with Indian practitioners engaging in all ethical principles significantly more than UK practitioners. Effect sizes ranged from -.47 to -1.00 (see Table 17 for details).

Table 16

Engagement in the Eight Limbs of Yoga by Culture – Means, Standard Deviations and T-Tests

Measure	UK	India	*t*	*p*	Bootstrapping			
					Cohen's *d*	BCa SE	BCa 95% Confidence Interval	
	M (SD)	*M (SD)*					Lower	Upper
Eight Limbs of Yoga								
Yama (Ethical Restraints)	67.98 (17.89)	79.28 (12.89)	-7.59	<.001**	-0.70	1.44	-14.32	-8.37
Niyama (Personal Observances)	65.22 (17.67)	79.87 (13.41)	-9.72	<.001**	-0.90	1.48	-17.57	-11.65
Asana (Physical Postures) [a]	16.42 (3.38)	16.30 (3.30)	0.35	.720	0.04	0.33	-0.58	0.80
Pranayama (Breathwork) [a]	16.14 (3.54)	16.99 (3.26)	-2.49	.016*	-0.25	0.33	-1.51	-0.17
Pratyahara (Withdrawal of Senses) [a]	14.99 (3.68)	16.25 (3.20)	-3.58	<.001**	-0.36	0.33	-1.90	-0.55
Dharana (Concentration)	14.57 (3.72)	16.51 (3.04)	-5.88	<.001**	-0.56	0.32	-2.53	-1.31
Dhyana (Meditation)	14.24 (3.89)	16.20 (3.19)	-5.67	<.001**	-0.54	0.34	-2.63	-1.27
Samadhi (Absorption)	10.96 (4.60)	14.72 (3.64)	-9.35	<.001**	-0.88	0.40	-4.52	-3.03

Note. Group differences analysed using t-tests; [a] = equal variance assumed; ** significant at $p<.001$; * significant at $p<.05$

Table 17

Engagement in the Individual Yamas and Niyamas between Cultures – Means, Standard Deviations and T-Tests

Measure	UK	India	*t*	*p*	Bootstrap			
					Cohen's *d*	BCa SE	BCa 95% Confidence Interval	
	M (SD)	*M (SD)*					Lower	Upper
Eight Limbs of Yoga								
Yamas								
Ahimsa (Non-violence)	14.88 (3.93)	16.55 (2.92)	-5.03	< .001**	-0.47	0.32	-2.34	-1.04
Satya (Truthfulness)	14.20 (4.13)	16.59 (2.82)	-7.13	< .001**	-0.65	0.32	-3.03	-1.78
Asteya (Non-stealing)	12.32 (4.69)	15.85 (3.48)	-8.94	< .001**	-0.83	0.39	-4.28	-2.79
Brahmacharya (Moderation)[a]	13.13 (3.59)	14.96 (3.25)	-5.26	< .001**	-0.53	0.32	-2.46	-1.19
Aparigraha (Non-greed)	13.45 (3.73)	15.33 (3.17)	-5.57	< .001**	-0.53	0.34	-2.56	-1.24
Niyamas								
Saucha (Cleanliness)	13.92 (3.84)	16.41 (2.79)	-7.76	< .001**	-0.71	0.31	-3.12	-1.82
Santosha (Contentment)	14.06 (3.81)	15.94 (3.15)	-5.53	< .001**	-0.53	0.34	-2.57	-1.25
Tapas (Discipline)	13.93 (3.66)	16.77 (2.88)	-8.92	< .001**	-0.84	0.32	-3.45	-2.20
Svadhyaya (Self-study)	13.22 (4.15)	16.10 (3.29)	-7.95	< .001**	-0.75	0.36	-3.61	-2.13
Ishvarapranidhana (Surrender to Higher Power)	10.09 (4.86)	14.66 (4.02)	-10.52	< .001**	-1.00	0.43	-5.42	-3.70

Note. Group differences analysed using t-tests; [a] = equal variance assumed; ** significant at $p<.001$; * significant at $p<.05$.

2.3.4 Hypothesis Three: Psychological Wellbeing.

Pearson's correlations were run to assess the relationships between the eight limbs and psychological wellbeing. In UK practitioners, psychological wellbeing had a moderate positive correlation with yama and niyama (ethical restraint and personal observances). There was a small positive correlation with all other limbs. In Indian practitioners, psychological wellbeing was strongly correlated with niyama (personal observances) and dhyana (meditation). There was a moderate positive correlation with the remaining limbs. Examining the sub-limbs of the yamas and niyamas, UK practitioners' psychological wellbeing had a moderate positive correlation with all sub-limbs except saucha (cleanliness) for which there were small positive correlations. In the Indian practitioner group, psychological wellbeing was strongly correlated with savadhyaya (self-study) and had moderate positive correlations with all other sub-limbs. Results are shown in Table 18.

Table 18

Correlations Between Eight Limbs of Yoga Variables and Psychological Wellbeing by Culture.

Variable	UK		India	
	Psychological Wellbeing	**Strength**	**Psychological Wellbeing**	**Strength**
Eight Limbs				
Yama (Ethical Restraint)	.38**	Moderate	.48**	Moderate
Niyama (Personal Observances)	.36**	Moderate	.53**	Strong
Asana (Physical Postures)	.19**	Small	.31**	Moderate
Pranayama (Breathwork)	.15*	Small	.36**	Moderate
Pratyahara (Withdrawal of Senses)	.20**	Small	.48**	Moderate
Dharana (Concentration)	.21**	Small	.37**	Moderate
Dhyana (Meditation)	.18**	Small	.51**	Strong
Samadhi (Absorption)	.28**	Small	.45**	Moderate
Yama Sub-limbs				
Ahimsa (Non-violence)	.36**	Moderate	.36**	Moderate
Satya (Truthfulness)	.35**	Moderate	.39**	Moderate
Asteya (Non-stealing)	.32**	Moderate	.44**	Moderate
Brahmacharya (Moderation)	.40**	Moderate	.38**	Moderate
Aparigraha (Non-greed)	.30**	Moderate	.42**	Moderate
Niyama Sub-limbs				
Saucha (Cleanliness)	.27**	Small	.48**	Moderate
Santosha (Contentment)	.34**	Moderate	.31**	Moderate
Tapas (Dicipline)	.35**	Moderate	.49**	Moderate
Svadhyaya (Self-study)	.31**	Moderate	.52**	Strong
Ishvarapranidhana (Surrender to Higher Power)	.31**	Moderate	.41**	Moderate

Note. ** significant at $p<.001$; * significant at $p<.05$. Correlations interpreted according to Cohen et al. (1988): < .3 = small; .3 to .49 = moderate; > .5 = strong.

2.3.4.1 UK Practitioners

A linear regression with bootstrapping was conducted to assess if the eight limbs of yoga were associated with psychological wellbeing across cultures.

The regression model was statistically significant for UK group with yama, niyama, asana, pranayama, pratyahara, dharana, dhyana, samadhi being associated with psychological wellbeing, F (8, 265) = 6.69, p < .001. The final model accounted for 16.8% of the variance in psychological wellbeing (R^2 =.168) indicating a medium effect size (Cohen, 1988). Greater practice of yama (ethical restraint) was significantly associated with psychological wellbeing with a small effect size (Cohen, 1988). Inclusion of the other limbs of yoga in practitioners' yoga practice (niyama, asana, pranayama, pratyahara, dharana, dhyana and samadhi) were not significantly associated with psychological wellbeing. Results are shown in Table 19.

2.3.4.2 Indian Practitioners

The multiple regression model was statistically significant for the Indian group F (8, 149) = 10.08, p < .001. The final model accounted for 35.1% of the variance in psychological wellbeing (R^2 = .351) indicating a large effect size (Cohen, 1988). Greater practice of dharana (concentration) and dhyana (meditation) were significantly associated with psychological wellbeing with small effect sizes (Cohen, 1988). Inclusion of the other limbs of yoga in practitioners' yoga practice (yama, niyama, asana, pranayama, pratyahara, dharana, dhyana and samadhi) were not significantly associated with psychological wellbeing. Results are shown in Table 20.

Table 19

UK Practitioners' Engagement with Eight Limbs of Yoga and Psychological Wellbeing - Multiple Regression

UK Wellbeing					Bootstrap		
						BCa 95% Confidence Interval	
	B	*Beta*	*t*	*p*	*BCa SE*	Lower	Upper
Model							
Constant	33.87		11.20	<.001	3.34	27.04	41.04
Yama (Ethical Restraint)	0.17	.34	2.34	.022*	0.07	0.03	0.31
Niyama (Personal Observances)	0.05	.09	0.55	.568	0.08	-0.11	0.22
Asana (Physical Postures)	0.33	.12	1.84	.063	0.17	-0.03	0.67
Pranayama (Breathwork)	-0.04	-.02	-0.19	.868	0.23	-0.46	0.40
Pratyahara (Withdrawal of Senses)	-0.46	-.19	-1.73	.132	0.30	-1.02	0.21
Dharana (Concentration)	0.33	.13	1.32	.264	0.30	-0.28	0.86
Dhyana (Meditation)	-0.18	-.08	-0.74	.566	0.30	-0.77	0.41
Samadhi (Absorption)	0.04	.02	0.20	.845	0.21	-0.39	0.48

Note. ** significant at $p<.001$; * significant at $p<.05$.

Table 20

Indian Practitioners' Engagement with Eight Limbs of Yoga and Psychological Wellbeing - Multiple Regression

India					Bootstrap		
						BCa 95% Confidence Interval	
	B	*Beta*	*t*	*p*	*BCa SE*	Lower	Upper
Constant	26.50		7.14	<.001	4.49	17.18	35.76
Yama (Ethical Restraint)	0.02	.04	0.26	.828	0.11	-0.19	0.25
Niyama (Personal Observances)	0.19	.31	1.88	.086	0.11	-0.02	0.37
Asana (Physical Postures)	0.08	.03	0.35	.754	0.26	-0.42	0.66
Pranayama (Breathwork)	-0.04	-.02	-0.16	.880	0.30	-0.59	0.43
Pratyahara (Withdrawal of Senses)	0.46	.19	1.57	.110	0.30	-0.16	1.09
Dharana (Concentration)	-0.60	-.23	-1.97	.046*	0.31	-1.13	-0.05
Dhyana (Meditation)	0.86	.34	2.56	.011*	0.30	0.34	1.39
Samadhi (Absorption)	-0.08	-.04	-0.32	.766	0.28	-0.59	0.56

Note. ** significant at $p<.001$; * significant at $p<.05$

2.4 Discussion

2.4.1 Summary of findings

Hypothesis one is partially supported. Yoga practitioners differed in some of the features of their practice across cultures including where they learnt to practice, who they practice with, how long they have practiced for and motivations for practicing yoga.

Overall Indian practitioners had been practicing yoga for longer. This could reflect that yoga is long standing in Indian culture and the growing popularity of yoga in Western cultures (Bhargav et al., 2022; Clarke et al., 2018; Ding & Stamatakis, 2014).

There were differences in where yoga was learnt and who practitioners practiced with across cultures. Indian practitioners were more likely to learn yoga in school or from immediate family and friends whereas the UK were more likely to learn in a leisure facility or online. Results also found that the majority of practitioners' practice alone across both cultures. However, UK practitioners were more likely to practice in a group whereas the Indian practitioners were more likely to practice with close friends and family. This is consistent with research which suggests that in Eastern and collectivist cultures, family and community are the primary focus for social and cultural life with practices such as yoga being shared across generations at home or in ashrams (spiritual retreats); whereas individualistic Western cultures value autonomy and personal focus (Chadda & Deb, 2013; Chauhan & Bansal, 2024). Theories suggest yoga may increase social connectedness and that social factors may moderate the impact on wellbeing (Bennetts, 2022; Kishida et al., 2018). As social features of yoga differ across cultures, future research should explore the social impact and mechanisms of change to identify how interventions may be delivered to maximise any benefits. For example, future research could explore the suggested social mechanisms of yoga (including self-compassion, compassion to others, social connectedness and mindfulness) on psychological wellbeing across social

features of individuals' practice such as group versus individual practice or in-person versus online practice.

UK practitioners reported differences between their spiritual motivations to start and their motivations to continue practicing yoga, with their spiritual motivation to continue being higher compared to their motivations to start practicing. Additionally, both UK and Indian practitioners reported differences between their psychological motivation to start and their motivation to continue practicing yoga, with motivations to continue being higher compared to their motivations to start practicing. This is consistent with previous research that found yoga practice improves spiritual intent and growth, as well as greater perceived psychological benefits (Banerjee et al., 2024; Csala et al., 2021; Ivtzan & Jegatheeswaran, 2015).

Supporting hypothesis two, there were significant differences in engagement in some of the eight limbs of yoga across cultures. There was no significant difference in engagement in asana (physical postures) across cultures. However, Indian practitioners engaged significantly more with all other limbs of yoga (yama, niyama, pranayama, pratyahara, dharana, dhyana, and samadhi) compared to UK practitioners. This suggests Indian practitioners generally incorporate more limbs of yoga into their practice. This is compatible with previous assumptions and research that argues Western cultures primarily focus on physical postures and less on the psychological and ethical elements of yoga and could reflect the influence of asana focused yoga in Western cultures (De Michelis, 2007; Gupta et al., 2024; Singleton, 2010).

Finally, there was some support for hypothesis three. Engagement in specific limbs of yoga were significantly associated with psychological wellbeing in UK and Indian cultures. Although preliminary correlations indicate all limbs were positively associated with psychological wellbeing, the regression found only specific limbs were significant when accounting for the inclusion of all the limbs. As predicted, there were differences between Indian and UK practitioners on which limbs impact psychological wellbeing. Results found that practicing yama (ethical principles) was significantly associated with psychological wellbeing in

UK practitioners. This is in line with theory that proposes interventions need to explicitly include the ethical principles of yoga including the yamas (e.g. compassion, truthfulness, moderation) in order to target psychological factors (Bennetts, 2022). Therefore, there may be limited psychological benefit if yamas are not incorporated into asana (posture) practice (Bennetts, 2022). Consistent with the current findings Pick et al., (2021) found that ahimsa (non-violence), a yama sub-limb, to be associated with wellbeing while pranayama (breathwork) and dharana (concentration) was not associated with wellbeing in a UK population. However, recent research has found asanas (physical postures) to be a significant predictor of wellbeing in UK samples (Fox et al., 2024; Willis et al., 2024), although this appears to approach significance in the current study it was not statistically significant. Beta values indicate there may be small effect sizes which the current study may be underpowered to detect.

On the other hand, practicing dharana and dhyana (concentration and meditation) were significantly associated with psychological wellbeing for Indian practitioners. This supports theory and the hypothesis that these limbs influence psychological wellbeing (Bennetts, 2022; Fox et al., 2024; Gard et al., 2014). To date, research and theory has mostly explored meditation as a single isolated construct rather than the individual limbs of yoga related to varying meditative approaches (pratyahara, dharana, dhyana, samadhi). Patanjali's Yoga Sutras (Bryant, 2015) described these meditative approaches as independent but connected, with dharana (focus on one area or object) progressing to dhyana (a state of connection or meditation). Studies have found dharana and dhyana improve emotional intelligence and attention (Telles et al., 2016). These suggest dharana leads to better cognitive ability including selective attention while dhyana is associated with physiological benefits such as reduced sympathetic nervous system activity and increased parasympathetic activity leading to increased relaxation (Telles et al., 2016). Additionally, Bennetts (2022) suggests that depending on the focus and process of meditation, these practices may promote processes comparable to the yamas and niyamas (ethical components), for example, meditation may promote kindness, self-control, similar to the ethical yamas. These findings highlight the importance of studying

yoga as an integrative approach consisting of individual components or limbs. Future empirical research should explore how specific limbs of yoga may bring about psychological change and promote wellbeing as well as how these limbs may interact across cultures.

2.4.2 Clinical Implications

Consistent with previous cross-cultural research (Gupta et al., 2024), results found differences across cultures in the components and features of participants' yoga practice. Beyond this, the current study suggests specific limbs of yoga are associated with greater psychological wellbeing and that the effect of individual limbs differs across cultures.

This has potential clinical implications for the implementation of yoga as a treatment for psychological wellbeing. The findings highlight the need for caution of universal methods of yoga delivery, indicating that interventions across cultures may benefit from tailoring the extent each of the eight limbs are incorporated to maximise the psychological benefit of practice. Focusing on the yamas (ethical principles) may help maximise the impact of yoga on psychological wellbeing in the UK (Bennetts, 2022; Chen & Jordan, 2020; Smith et al., 2011) whereas including more focus on dharana and dhyana (meditative) limbs could maximise the benefit for individuals from Indian culture. However, these findings could also be result of cultural differences in practice such as years of practice, therefore further research should control for differences in features of yoga practice across cultures. This could include controlling for features such as motivations, limbs of yoga practiced, immersion in practice, duration, frequency, and start age of practice.

This has significant implications for the development of yoga interventions, particularly in Western cultures where there is currently more focus on physical postures and less focus on ethical limbs of yoga (Gard et al., 2014; Matko et al., 2021). These findings suggest that UK yoga practitioners may find greater psychological benefit in the incorporation of the yamas (ethical principles), alongside the physical (asana) practice. Future research could investigate why yamas in particular may be important for wellbeing by exploring how individual yama sub-limbs

impact wellbeing and the potential psychological mechanisms involved in these pathways – for example Bennetts (2022) suggested different yamas sub-limbs may work through different mechanisms such as compassion, self-criticism, emotion regulation.

Alternatively, with growing globalisation and multiculturalism results may highlight the need for a more holistic yoga practice (incorporating more limbs of yoga) to be effective across cultures within Western societies. Overall, results found Indian practitioners engaged more with six out of seven limbs of yoga and reported greater psychological wellbeing than UK participants. Western practice often focusses more on the physical components of yoga than the psychological, ethical and spiritual components. Additionally, it has been argued that advanced practices of traditional yoga may not be commonly used in Western practice for example Western practice often includes guided relaxation rather than incorporating traditional meditative limbs and often excludes yamas, niyamas and more advanced breathwork (Gard et al., 2014; Singleton, 2010).

As yoga is becoming more popular and integrated within NHS services both for staff and patients (Mason et al., 2017) it is important to understand the processes and how yoga can be most effective at promoting health and wellbeing across cultures and populations. Tailored yoga may be beneficial in NHS initiatives such as social prescribing of community activities, which help reduce sedentary behaviour and social isolation and promote spiritual and psychological wellbeing. Tailoring yoga to optimize its effect directly supports the preventative, community-oriented, and personalised holistic approach highlighted in the NHS 10 Year Health Plan (Department of Health and Social Care, 2025). This could offer low-cost, evidence-aligned ways to improve wellbeing, which may in turn reduce waitlists and demands on clinical services. Future yoga intervention studies and ongoing service evaluations are required to assess the impact of yoga in the NHS community services. These studies should follow the CLARIFY (CheckList stAndardising the Reporting of Interventions For Yoga) guidelines to allow robust replicable yoga research to help optimise yoga interventions and inform evidence-based practice (Ward et al., 2022).

2.4.3 Strengths and Limitations

To the author's awareness, the current study is one of the first of its kind to look at features of yoga practice and engagement with individual limbs of yoga across cultures, particularly including a UK population. A strength is that it responds to research that has highlighted the need to explore the individual components of yoga and their effect (Bennetts, 2022; Makto et al., 2021) as well as the recommendation for more cross-cultural yoga research due to globalisation and the commercialisation of yoga (Ivtzan & Jegatheeswaran, 2015).

Although there was significant difference between groups in some demographics, these appear to be representative of the country and culture of the group including gender, ethnicity and religion (ONS, 2021; Kramer, 2021). For instance, the UK group had significantly more females whereas the Indian group had a more comparable male to female ratio. This is consistent with previous research where men are more likely to practice yoga in India compared to Western cultures (Cartwright et al., 2020; Ding & Stamatakis, 2014; Telles et al., 2017). Further research could explore if features of yoga practice or mechanisms of change are similar or different across demographics (e.g. gender) as well as considering approaches to engage with wider/underrepresented populations such as men in the UK.

Although the current study looked at features of yoga practice across cultures it did not include an in-depth analysis of their impact. The current findings highlight the need for further research around features of practitioners' yoga practice and the effect on psychological outcomes. As well as a need to conduct longitudinal studies to understand impacts of features of practice over time. There is anecdotal evidence suggesting that features such as longer practice, frequency of practice and greater immersion in yoga is associated with greater wellbeing (Bennetts, 2022; Bilderbeck et al., 2015; Gaiswinkler & Unterrainer, 2016; Gard et al., 2014; Ross et al., 2012). Further exploration of the duration and frequency of yoga practitioners' practice should also be explored to determine a dose effect of yoga and longitudinal impact of interventions across cultures.

The current study was a cross-sectional design which may limit validity due to an increased risk of confounding bias and inability to establish causality (Wang & Cheng, 2020). Future research could use intervention studies to determine causality, such as randomised controlled trials to compare different tailored yoga interventions for specific cultural groups with control groups.

Another limitation of the current study is the use of self-report measures. Self-report measures could limit the reliability and validity of results by introducing biases such as misinterpretation of questions, social desirability, over-reporting, recall bias and low self-awareness (Del Boca & Noll, 2000; Podsakoff et al., 2003; Van de Vijver & Poortinga, 1997). These biases may be compounded by cross-cultural factors such as English as a second language which can lead to further bias and misinterpretations (Beins, 2019; Halder et al., 2016). Results may be influenced by practitioners from different cultures in this study having different conceptualisations of culture and measures that may be more valid and reliable in certain cultures over others e.g. using measures developed in the Western world (Beins, 2019). Additionally, only including English speaking practitioners may compromise the sample recruited and reduce generalisability. Future research should consider translation and validation of measures for different languages and cultures to reduce bias or misinterpretation.

The current study used the WEMWBS measure of psychological wellbeing which showed excellent internal consistency and has been validated in both UK and Indian populations (Singh & Raina, 2020; Stewart-Brown, 2012). Future research may benefit further from including a psychological wellbeing measure that considers both individualistic and collectivist priorities, for example differences in the dimensions of happiness they prioritize (e.g. personal achievement vs. social harmony) (Krys et al., 2023).

Previously there was no measure of the eight limbs of yoga in the English language. Consequently, the eight limbs of yoga questionnaire was developed alongside this project as a tool to understand practitioners' practices of individual limbs of yoga. The overall scale has

excellent internal reliability in the current study across cultural groups. However, reliability of subscales varied. When exploring reliability across sample groups only one item scored poorly (saucha/cleanliness for Indian practitioners). Scales with low internal consistency may be less reliable and valid, and results should be interpreted with caution (John & Soto, 2007). Further research should complete a large-scale validation of this measure. However, correlations with EPYQ subscales measuring similar constructs showed good concurrent/construct validity.

Culture is a complex multifaceted construct which is dynamic, making it difficult to universally define or measure. Conceptualising and reifying variables as culture can provide a stable representation, however these can be minimalistic and should be interpreted with caution. The current study recruited individuals who had spent the majority of their life in UK or India and grouped participants by the culture they most identified with (UK or India) based on feedback from PPI and a previous cross-cultural study. This allowed individuals to self-identify with their culture while considering the culture they had been exposed to. However, this meant individuals with multiculturism outside of these cultures were excluded which could reduce the representation of the UK or Indian populations and reduce the generalisability of results.

More cross-cultural research is needed to understand cultural nuances and the impact of globalization, particularly in highly culturally diverse countries such as the UK. Future research should replicate the current study and recruit across more cultures and multicultural participants to assess the impact this could have on tailoring yoga interventions to maximise their efficiency and improve patient care and treatments.

Finally, it is important to recognise the debate about cultural appropriation of yoga (Thompson-Ochoa, 2019) and highlight that the current study was conducted by a white female research team from a Western understanding of yoga. However, a primary member of the research team was a yoga teacher trained based on traditional teachings and the main researcher learnt yoga in India. Another approach the research team took to address these

concerns was through the use of PPI from both the UK and India in the conceptualization and development of the study.

2.4.4 Conclusions

The current research aimed to explore differences in features of yoga practice across cultures and how specific limbs of yoga are associated with psychological wellbeing across cultures. The findings provide support that features of yoga practice differ across cultures. Yoga practice was found to positively impact psychological wellbeing, although specific limbs of yoga may impact psychological wellbeing differently across cultures. This could suggest yoga should go beyond universal methods of delivery and instead may need to personalize the extent of each limb incorporated in yoga practice based on culture to maximize the effect. The findings suggest practicing yamas is associated with wellbeing in the UK culture, while practicing dharana and dhyana meditative limbs were associated with wellbeing in Indian culture. Due to methodological limitations findings should be interpreted with caution. Further research is needed to investigate the impact of different features of yoga practice and individual limbs on health-related outcomes across cultures.

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Appendix A Complementary Therapies in Clinical Practice Guide for Authors

Complementary Therapies in Clinical Practice Guide for Authors:
https://www.sciencedirect.com/journal/complementary-therapies-in-clinical-practice/publish/guide-for-authors

Your Paper Your Way We now differentiate between the requirements for new and revised submissions. You may choose to submit your manuscript as a single Word or PDF file to be used in the refereeing process. Only when your paper is at the revision stage, will you be requested to put your paper in to a 'correct format' for acceptance and provide the items required for the publication of your article.

NEW SUBMISSIONS Submission to this journal proceeds totally online and you will be guided stepwise through the creation and uploading of your files. The system automatically converts your files to a single PDF file, which is used in the peer-review process.

As part of the Your Paper Your Way service, you may choose to submit your manuscript as a single file to be used in the refereeing process. This can be a PDF file or a Word document, in any format or lay-out that can be used by referees to evaluate your manuscript. It should contain high enough quality figures for refereeing. If you prefer to do so, you may still provide all or some of the source files at the initial submission. Please note that individual figure files larger than 10 MB must be uploaded separately.

References There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

Formatting requirements There are no strict formatting requirements, but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions. If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes. Divide the article into clearly defined sections.

Figures and tables embedded in text Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file. The corresponding caption should be placed directly below the figure or table.

Peer review This journal operates a double anonymized review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of two independent expert reviewers to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. Editors are not involved in decisions about papers which they have written themselves or have been written by family members or colleagues or which relate to products or services in which the editor has an interest. Any such submission is subject to all of the journal's usual procedures, with peer review handled independently of the relevant editor and their research groups. More information on types of peer review.

Double anonymized review This journal uses double anonymized review, which means the identities of the authors are concealed from the reviewers, and vice versa. More information is available on our website. To facilitate this, please include the following separately: *Title page (with author details):* This should include the title, authors' names, affiliations, acknowledgements and any Declaration of Interest statement, and a complete address for the corresponding author including an e-mail address. *Anonymized manuscript (no author details):* The main body of the paper (including the references, figures, tables and any acknowledgements) should not include any identifying information, such as the authors' names or affiliations.

Appendix B Screening and Selection Tool

Reviewer Name:		**Date:**
Author Name/Study ID:		**Year:**
Title:		**Journal:**
Population	**Include:**	**Exclude:**
	☐ Participants have diagnosis of learning disability or neurodevelopmental diagnosis. Including but might not be limited to: • Autism • ADHD (attention-deficit hyperactivity disorder) • ADD (attention deficit disorder) • Learning disabilities	☐ Not neurodevelopmental populations. Including but not limited to individuals with learning difficulties (such as dyslexia or dyscalculia) ☐ Neurodevelopmental Motor Disorders, such as Tic Disorders.
Papers	**Include:**	**Exclude:**
	☐ Articles published in peer-reviewed articles, theses, and service evaluations	☐ Books and conference papers
	☐ Written in English throughout the whole paper	☐ The entire paper is written in any language but English
		☐ Grey and unpublished literature, excluding theses and service evaluations. E.g., opinion articles, websites, blogs etc.

Study Design:	**Include:**	**Exclude:**
	☐ Quantitative studies, observational studies, intervention studies, cohort studies, experimental studies including RCTs and longitudinal in design.	☐ Non-empirical study design (No intervention) ☐ Qualitative studies
		☐ Systematic/narrative/rapid/ scoping reviews/ protocols / meta-analysis
Intervention	**Include:**	**Exclude:**
	☐ Yoga intervention - Yoga interventions must include a minimum of two limbs of yoga, one of which must be physical postures (asana). ☐ Yoga studies that measure psychological and social outcomes (as defined above).	☐ Studies that are similar to but are not explicitly yoga. ☐ Studies focusing only on one individual element of yoga (i.e., stretching only, meditation only)
Outcomes	**Include:**	**Exclude:**
	☐ Studies that include an outcome measure of psychological or social factors. Psychological outcomes refer to emotion, cognitive or behavioural factors For this review: • Emotional outcomes include psychological and mental wellbeing including thoughts and feelings such as happiness, perceived quality of life, anxiety.	☐ Studies that do not include psychological or social outcomes measures as dependent variables such as physiological only, motor only or physical activity outcomes.

	• Cognitive outcomes include cognitive processes including memory, attention, or learning. • Behavioural outcomes include overt behaviours such as adaptive behaviour and repetitive behaviours. • Social outcomes include social interactions such as communication and social behaviours (e.g., hyperactivity, aggression, or challenging behaviour).	
Overall Decision:	**Include:** ☐	**Exclude:** ☐
Notes:		

Appendix C Quality Assessment of Reviewed Studies Using SQAC Tool (Kmet et al., 2004)

Table: Quality Assessment				
Study:				
Criteria	**Met – Yes**	**Met – Partially**	**Met – No**	**N/A**
1. Question / objective sufficiently described?				
2. Study design evident and appropriate?				
3. Method of subject/comparison group selection or source of information/input variables described and appropriate?				
4. Subject (and comparison group, if applicable) characteristics sufficiently described?				
5. If interventional and random allocation was possible, was it described?				
6. If interventional and blinding of investigators was possible, was it reported?				
7. If interventional and blinding of subjects was possible, was it reported?				
8. Outcome and (if applicable) exposure measure(s) well defined and robust to measurement / misclassification bias? Means of assessment reported?				
9. Sample size appropriate?				
10. Analytic methods described / justified and appropriate?				
11. Some estimate of variance is reported for the main results?				
12. Controlled for confounding?				
13. Results reported in sufficient detail?				
14. Conclusions supported by the results?				
Total summary quality score:				

Appendix D ERGO Ethical Approval

Approved by Faculty Ethics Committee - ERGO II 88935.A3

E ergo2@soton.ac.uk
To Natasha Wing

Reply | Reply All | Forward

Tue 12/11/2024 16:13

Approved by Faculty Ethics Committee - ERGO II 88935.A3

University of Southampton

ERGO II – Ethics and Research Governance Online https://www.ergo2.soton.ac.uk

Submission ID: 88935.A3
Submission Title: A cross-cultural investigation of the psychological benefits of yoga practice. (Amendment 3)
Submitter Name: Natasha Wing

Your submission has now been approved by the Faculty Ethics Committee. You can begin your research unless you are still awaiting any other reviews or conditions of your approval.

Comments:

Appendix E Research Poster

Participants Wanted

A cross-cultural investigation of the psychological benefits of yoga practice

What is this about?

My name is Natasha, I am a Trainee Clinical Psychologist at the University of Southampton. I am completing a research project exploring if there are cultural differences between how yoga is practiced in UK and India. The research is looking into the potential impact cultural differences may have on the psychological benefits from yoga.

Who can take part?

- **Are you from India or the United Kingdom?**
- **Are you aged over 18 years old?**
- **Do you practice Yoga (at least two times a month)?**

What will I be asked to do?

This is an online survey where you will be asked to answer questions about your yoga practice and psychological well-being.

Where can I get more information?

If you are interested in taking part, please click here:

https://southampton.qualtrics.com/jfe/form/SV_00zfWuxoLZnEnQi

Or scan the QR code to find out more information about taking part in the study.

Version History			
Ergo Number: 88935	**Version:** 2	16/10/2023	University of Southampton

Appendix F Research Recruitment Email

Language may vary slightly depending on the organisation being contacted.

Hello / Dear [insert name],

I hope this message finds you well.

My name is Natasha, and I am a Doctorate of Clinical Psychology student at the University of Southampton in the United Kingdom. I am conducting a research project exploring the cultural differences between how yoga is practiced in the UK and India. The research is looking into the potential impact cultural differences may have on the psychological benefits from yoga. This study was approved by the Faculty Research Ethics Committee (FREC) at the University of Southampton (ERGO number: 88935)

If you would be happy to participate in this research or would like to find out more information, please see attached a poster advert and Participant Information Sheet. Alternatively, please follow the link below:

https://southampton.qualtrics.com/jfe/form/SV_00zfWuxoLZnEnQi

If you have any difficulties with the link, please try to copy and paste the link or try to use an alternative web browser. Alternatively, you can use the QR code on the Poster.

Depending on your organization's policies, I would be grateful if you could share this e-mail / research with your students/suitable candidates/people involved in your organisation, as you deem appropriate. Additionally, I would appreciate it if you could share the research survey on your social media page. I have attached the poster as a jpg and the following can be used to introduce the research online via social media and adapt as appropriate:

Hello, I am currently recruiting participants for a research project exploring people's yoga practice in the UK and India and how these practices may impact on psychological wellbeing. If you are interested in taking part or know someone who is, please see attached a poster and link for more details. https://southampton.qualtrics.com/jfe/form/SV_00zfWuxoLZnEnQi

Finally, if you have a physical location and are willing to print out the poster and put this up or share it with yoga practitioners, I would be grateful.

Please let me know if you need any additional information.

Best wishes.

Yours Sincerely,

Natasha Wing
Trainee Clinical Psychologist
University of Southampton

Appendix G Additional Characteristics of Yoga Practitioners

Participants' Engagement in Tyes of Yoga (Multiple Choice)

	Type of yoga	UK	UK	India	India
1	Ashtanga Yoga	49	17.8%	80	50.0%
2	Bikram Yoga	21	7.6%	12	7.5%
3	Chair Yoga	21	7.6%	23	14.4%
4	Hatha Yoga	90	32.7%	48	30.0%
5	Integral Yoga	5	1.8%	9	5.6%
6	Iyengar Yoga	17	6.2%	17	10.6%
7	Jivamukti Yoga	3	1.1%	7	4.4%
8	Kundalini Yoga	12	4.4%	20	12.5%
9	Laughter Yoga	8	2.9%	40	25.0%
10	Power Yoga	19	6.9%	45	28.1%
11	Partner Yoga	6	2.2%	3	1.9%
12	Restorative Yoga	60	21.8%	27	16.9%
13	Sivananda Yoga	8	2.9%	10	6.3%
14	Tantric Yoga	9	3.3%	3	1.9%
15	Tibetan Yoga	3	1.1%	6	3.8%
16	Vinyasa	61	22.2%	24	15.0%
17	Yin Yoga	53	19.3%	13	8.1%

18	Yoga Nidra	35	12.7%	41	25.6%
19	Yogic Breathing	75	27.3%	96	60.0%
20	Other	14	5.1%	7	4.4%
21	Don't know	70	25.5%	8	5.0%

Additional Demographics

Characteristics	UK Culture	Indian Culture		
	N(%)	N(%)		Significance
What country did you learn to practice?				<.001**
UK	269 (97.8%)	12 (7.5%)		
India	2 (0.7%)	148 (92.5%)		
Other	4 (1.5%)	0 (0%)		
Where has most of your yoga practice been?				<.001**
UK	272 (98.9%)	15 (9.4%)		
India	1 (0.4%)	145 (90.6%)		
Other	2 (0.7%)	0 (0%)		
Where do you practice?			MC	< .001**
Home	215 (78.2%)	151 (94.4%)		
Work	12 (4.4%)	6 (3.8%)		
Gym	78 (28.4%)	18 (11.3%)		

Other	66 (24%)	24 (15%)	
Are you familiar with the 8 limbs?			< .001**
Completely unfamiliar	53 (19.3%)	7 (4.4%)	
Quite familiar	57 (20.7%)	14 (8.8%)	
Somewhat unfamiliar	36 (13.1%)	17 (10.6%)	
Neutral	25 (9.1%)	30 (18.8%)	
Somewhat familiar	45 (16.4%)	45 (28.1%)	
Quite familiar	23 (8.4%)	35 (21.9%)	
Very much familiar	36 (13.1%)	12 (7.5%)	

Appendix H Cronbach Alpha for Measures

Measure	Outcome	Cronbachs Alpha Overall	Cronbachs Alpha UK	Cronbachs Alpha India
WEMWBS	WEMWBS Total	.923	.932	.899
8 Limbs of Yoga	8 Limbs Total	.971	.970	.962
	Yama Total	.925	.930	.886
	Sub-limbs			
	Ahimsa	.760	.786	.669
	Satya	.762	.783	.643
	Asteya	.731	.721	.607
	Brahmacharya	.618	.625	.602
	Aparigraha	.661	.661	.625
	Niyama Total	.935	.933	.901
	Sub-limbs			
	Saucha	.736	.743	.590
	Santosha	.695	.700	.649
	Tapas	.775	.745	.720
	Svadhyaya	.789	.776	.737
	Isvara Pranidhana	.851	.856	.727
	Asana	.800	.799	.808
	Pranayama	.839	.850	.813
	Pratyahara	.790	.784	.788
	Dharana	.808	.808	.772
	Dhyana	.797	.796	.752
	Samadhi	.806	.818	.670
Motivation to start	Spiritual	.901	.882	.852
	Physical	.735	.724	.734
	Psychological	.887	.862	.904
	Interpersonal	.861	.850	.851
Motivation to Continue	Spiritual	.908	.892	.886

	Physical	.777	.724	.832
	Psychological	.877	.860	.879
	Interpersonal	.909	.904	.899
EPYQ	AcceptanceComp_Total1	.842	.853	.777
	Breathwork_Total1	.847	.861	.822
	Physicality_Total1	.889	.879	.906
	ActivePostures_Total1	.780	.775	.790
	RestorativePostures_Total1	.758	.738	.791
	BodyLocks_Total1	.808	.801	.820
	BodyAwareness_Total1	.747	.737	.759
	MentalEmotionalAwareness_Total1	.826	.845	.782
	HealthBenefits_Total1	.819	.833	.758
	SocialAspects_Total1	.797	.782	.798
	Spirituality_Total1	.893	.874	.853
	MeditationMindfulness_Total1	.899	.892	.895
	YogaPhilosophy_Total1	.880	.867	.810
PALMS	Mastery_Total1	.796	.785	.808
	Enjoyment_Total1	.808	.837	.745
	PsychologicalCondition_Total1	.833	.849	.794
	PhysicalCondition_Total1	.815	.826	.775
	Appearance_Total1	.897	.901	.886
	OthersExpectations_Total1	.761	.686	.789
	Affiliation_Total1	.913	.926	.883
	CompetitionEgo_Total1	.903	.866	.888

Note. Cronbach's alpha cutoffs (George & Mallery, 2003) are: ≤ 0.50 (Unacceptable), 0.50-0.59 (poor), 0.60–0.69 (Questionable), 0.70–0.79 (Acceptable), 0.80–0.89 (Good), and ≥ 0.90 (Excellent).

Appendix I Demographic Information Questionnaire

Screening Questions:

How old are you?

Age (drop down)	

Do you practise yoga at least twice a month?

Yes	
No	

Which country have you spent majority of your life in?

United Kingdom	
India	
Other	

Which country's culture do you relate to most with?

United Kingdom	
India	
Other	

Are you currently receiving any talking therapy treatment for mental health issues or having private talking therapy?

No	
Yes	

Have you taken part in PPI (Patient and Public involvement) in the form of a focus group or interview as part of the current study:

No	
Yes	

If eligible the survey will continue:

What country were you born?

United Kingdom	
India	

Other	

What gender do you best identify with?

Female	
Male	
Non-binary	
Transgender	
Prefer not to say	
Other (Please state)	

How would you describe your ethnicity?

White	1. English / Welsh / Scottish / Northern Irish / British	
	2. Irish	
	3. Gypsy or Irish Traveller	
	4. Any other White background, please describe	
Mixed / Multiple ethnic groups	1. White and Black Caribbean	
	2. White and Black African	
	3. White and Asian	
	4. Any other Mixed / Multiple ethnic background, please describe	
Asian / Asian British	1. Indian	
	2. Pakistani	
	3. Bangladeshi	
	4. Chinese	
	5. Any other Asian background, please describe	
Black / African / Caribbean / Black British	1. African	
	2. Caribbean	
	3. Any other Black / African / Caribbean background, please describe	
Other ethnic group	1. Arab	
Any other ethnic group, please describe:_____		

Where is your current country of residence?

How long have you lived in your current country of residence?

What is your religion?

Hindu	
Muslim	
Christian	
Jewish	
Sikh	
Buddhist	
Jain	
Other religion (please specify)	
No religion	

Do you consider yourself to have spiritual beliefs?

No	
Yes	

Appendix J Features of Yoga Practice

What country did you learn to practice yoga?

United Kingdom	
India	
Other	

Where has most of your yoga practice been?

United Kingdom	
India	
Other	

Where did you learn to practice yoga?

From immediate family e.g. home	
School	
Workplace	
Leisure facility	
Online	
Other (please state)	

What type/s of yoga do you practise?

Ashtanga Yoga	
Bikram Yoga	
Chair Yoga	
Hatha Yoga	
Integral Yoga	
Iyengar Yoga	
Jivamukti Yoga	
Kundalini Yoga	
Laughter Yoga	
Power Yoga	
Partner Yoga	
Restorative Yoga	
Sivananda Yoga	
Tantric Yoga	
Tibetan Yoga	
Vinyasa	
Yin Yoga	
Yoga Nidra	
Yogic Breathing	

Other	
Don’t know	

On average, how much do you practise yoga?

Twice per month	
Three times per month	
Once a week	
Twice per week	
Three to five times per week	
Daily	

How many years have you been practising yoga?

Less than 1 year	
1-3 years	
3-5 years	
5-10 years	
10-20 years	
20-30 years	
30+ years	

What age did you start practicing yoga?

0-10	
10-20	
21-24	
25-34	
35-44	
45-54	
55-64	
65 and over	

Who do you practice yoga with

Alone	
With close friends / family	
With others in a group	
Both alone and in a group	
Other (please state)	

Where do you practice yoga?

Home	
Work	
Gym	
Other (please state)	

Are you a yoga teacher or yoga therapist?

No	
Yes, a yoga teacher	
Yes, a yoga therapist	

Appendix K Motivation to Practice

How important were the following possible motivations when you **FIRST** began yoga?

Statements scored on a 7-point scale, from one (definitely not important) to seven (definitely very important)

1	2	3	4	5	6	7
Not at all important	Low importance	Slightly important	Neutral	Moderately important	Very important	Extremely important

Spiritual development:

- Spiritual development
- To connect with a higher power
- An added sense of meaning in my life
- To gain enlightenment
- As part of my religious practice

Physical

- Physical exercise
- Better appearance
- Dissatisfaction with weight
- To be able to do postures
- To gain body control
- Stretching / flexibility

Psychological

- To reduce stress
- To feel better- wellbeing
- To improve mental health
- Meditation / self focus
- Improve my self-awareness
- Improve self confidence
- Improve self efficacy (self-efficacy is an individual's belief in their capacity to act in the ways necessary to reach specific goals)
- Improve self-control

Interpersonal

- To socialise
- For social support
- To feel part of a community
- Sense of connection with the instructor

When considering why you **CONTINUE** to practice yoga, how important to you is the following aspects?

Statements scored on a 7-point scale, from one (Not at all important) to seven (Extremely important)

1	2	3	4	5	6	7
Not at all important	Low importance	Slightly important	Neutral	Moderately important	Very important	Extremely important

Spiritual development:

- Spiritual development
- To connect with a higher power or something greater than yourself
- An added sense of meaning in my life
- To gain enlightenment
- As part of my religious practice

Physical

- Physical exercise
- Better appearance
- Dissatisfaction with weight
- To be able to do postures
- To gain body control
- Stretching / flexibility

Psychological

- To socialise / social support
- To reduce stress
- To feel better- wellbeing
- To improve mental health
- Meditation / self focus

- Improve my self-awareness
- Improve self- confidence
- Improve self efficacy (self-efficacy is an individual's belief in their capacity to act in the ways necessary to reach specific goals)
- Improve self-control

Interpersonal

- To socialise
- For social support
- To feel part of a community
- Sense of connection with the instructor

Appendix L The Physical Activity and Leisure Motivation Scale (PALMS)

REDACTED

Appendix M 8 limbs of Yoga Questionnaire

Responses:

Never (0% of the time)

Rarely (about 10% of the time)

Occasionally (about 30% of the time)

Sometimes (about 50% of the time)

Frequently (about 70% of the time)

Usually (about 90% of the time)

Always (about 100% of the time)

Please think about your current yoga practice when answering the following questions.

How much does your current yoga practice encourage the following principles?

Note. Subscale items in brackets are for reference only and are not included in the items as they appear to participants online

Yama's (general ethical principles which can guide your behaviour in daily life)

- Kindness, compassion and non-harming towards others (Ahimsa)
- Being kind and compassionate towards your body and in the way you respond to yourself, regardless of your internal and external experiences (Ahimsa)
- Being non-judgemental and kind towards your body (Ahimsa)

- Being truthful to yourself and others (Satya)
- Acting in line with your true values and intentions (Satya)
- Listening to what your body needs in the moment and taking rest or variations accordingly (Satya)

- Not taking the belongings of others without permission (Asteya)
- Respecting your own and other's resources, including time, energy, emotions, and ideas (Asteya)
- Connecting with your internal experiences as they occur (Asteya)

- Balancing energy; ensuring you are not exerting too much or not doing enough (Brahmacharya)

- Restraint or moderation; for some people this could include sexual restraint or not drinking alcohol to excess (Brahmacharya)
- Balancing strengthening with stretching, or speed with slowness (Brahmacharya)

- Only taking and giving what is necessary and not excessive (Aparigraha)
- Detaching yourself and 'letting go' of things, including objects, situations, thoughts and feelings (Aparigraha)
- Letting go of the idea of a 'perfect' posture and moving in a way that is right for your individual body (Aparigraha)

How much does your current yoga practice include the following?:

Niyama (self-discipline which can be strengthened over time through yoga practice, and guide your behaviour in daily life)

- Working towards a clean and calm body (Saucha)
- Doing what you can to keep your surrounding environment clean and uncluttered (whether this is your home, yoga studio or the natural world etc.) (Saucha)
- Making steps towards a pure and calm state of mind (Saucha)

- Accepting and being content with life as it is (Santosha)
- Letting go of the desire for things that we don't have, whilst accepting what you do have (Santosha)
- Recognising that your practice may feel different on different days and that being okay (Santosha)

- Practising self-discipline (Tapas)
- Having motivation, willingness, and dedication in all that you do (Tapas)
- Approaching challenges with courage (Tapas)

- Studying yourself and reflecting on your thoughts, emotions, habits and intentions (Svadhyaya)
- Working to understand yourself better (this could include learning from books, scriptures or other sources) (Svadhyaya)
- Reflecting on your actions and what they mean about you as a person (Svadhyaya)

- The principle of completely surrendering or devoting yourself to a higher power (this may be any spiritual belief or any religion, but does not have to be) (Isvara Pranidhana)

- Believing in a power that is bigger or greater than yourself (Isvara Pranidhana)
- Acting in a way that is for the greater good rather than for selfish means (Isvara Pranidhana)

How much does your current yoga practice include the following?:

- Practising the physical postures of yoga to increase flexibility, practice balance, or strengthen your body (Asana)
- Practising the postures of yoga to encourage calmness and stillness (Asana)
- Moving in your body into certain postures (Asana)

- Focusing on your breath (Pranayama)
- Engaging in breathing exercises (Pranayama)
- Changing the ratio of your inhale, exhale or the pause between breaths (Pranayama)

- Directing your attention inwards (Pratyahara)
- Withdrawing from the senses and reducing external stimuli (e.g. sitting in silence, closing eyes etc.) (Pratyahara)
- Becoming focused on the present moment and not distracted by sounds, sights, sensations, smells or taste (Pratyahara)

- Bringing your attention to focus on one thing (Dharana)
- Concentrating on one thing without distraction (Dharana)
- Focusing your attention solely on a mantra, mental image or the breath (Dharana)

- Experiencing a sense of connection with the focus of our attention (Dhyana)
- Maintaining your focus on one thing (e.g. breath, mantra) for a prolonged period of time (Dhyana)
- Becoming entirely absorbed with the focus of your meditation (Dhyana)

- A feeling of 'bliss' or 'enlightenment' which comes from an awareness of the connection between your mind, body and spirit (Samadhi)
- Being connected to a higher power or something more than yourself (Samadhi)
- Experiencing life exactly as it is, without seeing it through the lens of our likes, dislikes, biases or sensations (Samadhi)

To what extent are you familiar with the eight limbs of yoga

1- Completely unfamiliar

2- Quite unfamiliar

3- Somewhat unfamiliar

4- Neutral

5- Somewhat familiar

6- Quite familiar

7- Very much familiar

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Appendix N The Essential Properties of Yoga Questionnaire (Part A)

REDACTED

Appendix O Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS)

REDACTED

Appendix P Participant Information Sheet and Consent Form

Study Title: A cross-cultural investigation of the psychological benefits of yoga practice.
Researcher(s): Natasha Wing, Dr Katy Sivyer, Dr Emel Atuk, Dr Ali Bennetts.
University email: nw1n21@soton.ac.uk
Ethics/ERGO no: 88935
Version and date: Version 3 [20/10/2023]

What is the research about?
My name is Natasha, and I am a Doctorate of Clinical Psychology student at the University of Southampton in the United Kingdom.

You have been invited to participate in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done and what it will involve. Please read the information below carefully and contact me if anything is not clear or you would like more information before you decide to take part in this research. You may like to discuss it with others, but it is up to you to decide whether or not to take part. If you are happy to participate you will be asked to select a consent box that will be mandatory to continue with the study.

This study was approved by the Faculty Research Ethics Committee (FREC) at the University of Southampton (ERGO Number: 88935).

A bit of background information
I am inviting you to participate in a study exploring how yoga is practiced in India (Eastern) and UK (Western) cultures and how these practices may impact on psychological wellbeing. A lot of assumptions are made that Eastern and Western yoga practices are different. However, there is limited research into the specific elements of yoga practices and none which have explored these cross-culturally. Furthermore, there has been no exploration of whether differences in yoga practices may relate to differences in the psychological benefits of yoga between cultures.

What will happen to me if I take part?
If you decide to take part, then this study involves completing an online anonymous survey. The survey should take about 15 minutes of your time. If you are happy to complete this survey, you will need to tick (check) the box below to show your consent. As this survey is anonymous, the researcher will not be able to know whether you have participated, or what answers you provided.

You will be asked to complete an online survey which will ask about your demographic information (age etc.), your yoga practice and your psychological wellbeing.

Why have I been asked to participate?

Anyone who is currently practicing yoga, are aged 18 or over, and not receiving talking therapy treatment can participate in this study. The survey is in English therefore being fluent in English is required to take part.
To be classified as practicing yoga practitioners must be doing yoga at least twice a month. Anyone practicing less than twice a month will be excluded from the study.

I am aiming to recruit around 300 participants for this study.

What information will be collected?
The questions in this survey ask for demographic information (age, ethnicity etc.), whether you are receiving talking therapy for a mental health condition, and about features of your yoga practice. We will also ask you about your psychological wellbeing.

Data will be collected and stored securely inline with the UK GDPR and the Data Protection Act 2018. The survey is anonymous, the researcher will not be able to know whether you have participated, or what answers you provided. The data will be stored electronically on a password protected computer.

Once questionnaire data has been submitted anonymously, you will be unable to withdraw from the study.

What are the possible benefits of taking part?
If you decide to take part in this study, you may not receive any direct benefits; however, your participation will contribute to knowledge in this area of research. The current study aims to improve our current understanding of yoga practices across cultures. The study will inform if there are cultural differences in yoga practices that may relate to psychological wellbeing. This information could then help tailor therapeutic yoga interventions.

Are there any risks involved?
It is expected that taking part in this study will not cause you any psychological discomfort and/or distress. However, should you feel uncomfortable you can leave the survey at any time or contact the following resources for support:

In the UK:

- Mind
  Website: https://www.mind.org.uk

- NHS Improving Access to Psychological Therapies
  Website: https://www.nhs.uk/service-search/other-services/Psychological-therapies-%28IAPT%29/LocationSearch/10008

- The Samaritans helpline
  Website: https://www.samaritans.org/

In India:

- Vandrevala Foundation (India)
  Website: https://www.vandrevalafoundation.com/

- The secret ingredient to mental health and well-being

Website: https://www.tsimentalhealth.com/

- NIMHANS (India)

Website - https://nimhans.ac.in/pssmhs-helpline/
Phone: 080-46110007
Email: ms@nimhans.ac.in

What will happen to the information collected?

All information collected for this study will be held within the online survey host website (Qualtrics; www. Qualtrics.com) and, once downloaded, stored securely on a password protected computer and backed up on a secure server. In addition, all data will be pooled and only compiled into data summaries or summary reports. Only the researcher and their supervisor will have access to this information whilst the project is ongoing.

The information collected will be analysed and written up as part of the researcher's doctoral thesis. The data and research materials may also to be shared with publishing bodies for journal publication or presented at conferences etc. As all data is anonymous any research findings made available in any reports or publications will not directly identify you.

Your anonymous data will be made available to other researchers via online repositories (e.g. Open Science Framework (https://osf/io) and the University of Southampton repository), and may be accessed for use in future research and/or teaching. This is to increase transparency and sharing in science. You will not be identified as having taken part and no identifiable information will be shared.

The University of Southampton conducts research to the highest standards of ethics and research integrity. In accordance with our Research Data Management Policy, the anonymous data will be uploaded to the university repository (see *Welcome to ePrints Soton - ePrints Soton* for full details) where it will be stored for 10 years and may be accessed on request for future research studies, subject to suitable ethical approval.

What happens if there is a problem?

If you are unhappy about any aspect of this study and would like to make a formal complaint, you can contact the Head of Research Integrity and Governance, University of Southampton, on the following contact details: Email: rgoinfo@soton.ac.uk, phone: + 44 2380 595058.
Please quote the Ethics/ERGO number above. Please note that by making a complaint you might be no longer anonymous.

More information on your rights as a study participant is available via this link:
https://www.southampton.ac.uk/about/governance/participant-information.page

Thank you for reading this information sheet and considering taking part in this research.

☐ Please tick (check) this box to indicate that you have read and understood information on this form, are aged 18 or over and agree to take part in this survey

Appendix Q Debrief Form

Debriefing Form

Study Title: A cross-cultural investigation of the psychological benefits of yoga practice.

Researcher(s): Natasha Wing, Dr Katy Sivyer, Dr Emel Atuk, Dr Ali Bennetts.

University email: nw1n21@soton.ac.uk

Ethics/ERGO no: 88935

Version and date: Version 1 [18/09/2023]

Thank you for taking part in our research project. Your contribution is very valuable and greatly appreciated.

Purpose of the study

The aim of this research was to compare how people practice yoga, motivations for engaging in yoga and the extent to which yogis follow specific limbs of yoga practice across Indian (Eastern) and UK (Western) cultures. Additionally, the research will investigate if there are cultural differences in which aspects of yoga may relate to psychological wellbeing. This information could help inform how therapeutic yoga interventions could be tailored effectively.

Your data will help our understanding of yoga across cultures and the relationship to psychological wellbeing. This can help to understand how yoga could be adapted for people from different cultural backgrounds to promote the beneficial effects. This may lead to future research into yoga as a person-centered treatment for increasing psychological wellbeing.

Confidentiality

This study is anonymous. Results of this study will not include your name or any other identifying characteristics.

Study results

If you would like to receive a copy of the final doctoral thesis when it is completed, please contact us on the contact details above. It is up to you whether you would like to receive study results. Please note that by providing your contact details, your participation in the study might be no longer anonymous, but researcher will not know what information you provided.

Further support

If taking part in this study has caused you discomfort or distress, you can contact the following organisations for support:

In the UK:

- Mind
  Website: https://www.mind.org.uk

- NHS Improving Access to Psychological Therapies
  Website:https://www.nhs.uk/service-search/other-services/Psychological-therapies-%28IAPT%29/LocationSearch/10008

- The Samaritans helpline
  Website: https://www.samaritans.org/

In India:

- Vandrevala Foundation (India)

Website: https://www.vandrevalafoundation.com/

- The secret ingredient to mental health and well-being

Website: https://www.tsimentalhealth.com

- NIMHANS (India)

Website - https://nimhans.ac.in/pssmhs-helpline/
Phone: 080-46110007
Email: ms@nimhans.ac.in

Further reading

If you would like to learn more about this area of research, you can refer to the following resources:

Bennetts, A. (2022). How does yoga practice and therapy yield psychological benefits? A review and model of transdiagnostic processes. *Complementary Therapies in Clinical Practice*, *46*, 101514.

Ivtzan, I., & Jegatheeswaran, S. (2015). The yoga boom in Western society: practitioners' spiritual vs. physical intentions and their impact on psychological wellbeing. *Journal of Yoga & Physical Therapy*, *5*(03).

Further information

If you have any concerns or questions about this study, please contact Natasha Wing at nw1n21@soton.ac.uk who will do their best to help.

If you remain unhappy or would like to make a formal complaint, please contact the Head of Research Integrity and Governance, University of Southampton, by emailing: rgoinfo@soton.ac.uk, or calling: + 44 2380 595058. Please quote the Ethics/ERGO number which can be found at the top of this form. Please note that if you participated in an anonymous survey, by making a complaint, you might be no longer anonymous.

Thank you again for your participation in this research.

Appendix R Assumption Checks

Hypothesis One: t-tests and Chi-square

In order to meet the assumption of expected frequency to run the chi- squared test (maximum of 20% cells having expected value less than five; Field, 2009; Howell, 2006), it was deemed appropriate to collapse categories of some questions. Some variables did not meet the assumptions for expected values and therefore these should be interpreted with caution.

Gender did not meet the assumption of expected frequency as 50% of cells had an expected count less than 5. This was due to the inclusion of 'non-binary' and 'prefer not to say'. It was deemed not suitable to collapse these categories, therefore the chi-squared test for gender was run with caution and Fisher-Freeman-Halton Exact Test was used for interpretation as this is more reliable when expected cell counts are low (Kim, 2017).

For motivation to practice and continue practice the assumption checked were completed for t-test (see hypothesis two).

Hypothesis Two: t-tests

Normality was assessed using Histograms, P-P plots, Q-Q plots and Boxplots. Some variables appeared skewed or had a non-normal distribution. Skewness and kurtosis scores were reviewed. Some items skewness and kurtosis scores exceeded two confirming the assumption of non-normal distribution. Boxplots found a number of outliers. However, these did not appear to be due to an error therefore should not be removed (Field, 2009).

Bootstrapping in SPSS was used for analyzing non-normal data because it provides a more robust way to estimate standard errors and confidence intervals compared to traditional methods that assume normality. Bias-corrected bootstrapping was used as it offers more accurate confidence intervals and robust estimates compared to percentages alone, especially when dealing with skewed data or small sample sizes (Efron, 1987).

Equal variance not assumed were used to interpret the analysis when Levene's test for equality of variances was non-significant.

Hypothesis Three: Regression

Independence of observations was assessed using the Durbin-Watson statistic (Field, 2009). A value close to 2 indicates no autocorrelation. All values appeared close to 2. Variance inflation factors (VIFs) showed that the assumptions multicollinearity was met. VIFs above 10 (or tolerance below 0.1) indicate significant multicollinearity, which may need to be addressed. No values exceeded 10.

Linearity was assessed by inspecting that scatter plot.

Due to the presence of outliers and violations of normality (non-normal distribution of data), a bias-corrected accelerated (BCa) bootstrap procedure with 1,000 resamples was used to estimate the 95% confidence interval for the mean difference (Efron, 1987; Hassan & Ali, 2022).

Other: Correlations and Validity Checks

Preliminary analysis showed a linear relationship, as assessed by visual inspection of scatterplots. Due to non-normal distribution of data Bias-corrected Bootstrapping was used (as described in hypothesis two and three).