University of Southampton

Faculty of Environmental and Life Sciences

School of Psychology

The Psychological Benefits of Yoga Practice

Volume 1 of 1

by

Nadine Fox

Thesis for the degree of

Doctorate in Clinical Psychology

September 2024

Orcid ID: 0000-0003-4152-6642

Word Counts
Systematic review: 8582
Empirical paper: 7721
Full word count: 16,303
(Excluding abstracts, references and appendices)

University of Southampton

Abstract

Faculty of Environmental and Life Sciences

School of psychology

Thesis for the degree of Doctorate in Clinical Psychology

The Psychological Benefits of Yoga Practice

by

Nadine Fox

Interest in yoga as an intervention to support mental health is growing. Understanding how yoga yields psychological benefit and for whom is needed to position it as a treatment for mental health. Currently, little is known about the psychological mechanisms of change through which yoga improves psychological wellbeing. This is in part due to a lack of mediational research and the heterogeneity and poor reporting of interventions within existing yoga research.

Chapter 1 presents a systematic review and narrative synthesis exploring mediation studies investigating potential mechanisms of change for yoga. 16 studies were included in the analysis and assessed for quality of methodology and mediation. Evidence was found to suggest mindfulness, self-compassion and interoception mediated the relationship between practising yoga and both mental health and wellbeing. Further high-quality research is needed. Limitations include the heterogenous nature of yoga research and the inclusion of poor quality and cross-sectional mediation studies.. Further research is needed to draw clinical implications, however tentative conclusions suggest that yoga could share transdiagnostic mechanisms of change with third wave therapies. It is suggested that future studies looking at mediators of yoga and psychological benefit should include randomised longitudinal design which is designed well to assess mediation. Studies would benefit from looking at the eight limbs of yoga and clearly conceptualising psychological outcomes.

Chapter 2 presents a quantitative study exploring the difference between yoga practisers and non-yoga practisers on measures of psychological wellbeing, psychological flexibility, and psychological inflexibility. The study looked at whether components of yoga (the eight limbs) were related to or predicted wellbeing, flexibility, and inflexibility. The study recruited 463 participants (227 yoga practisers and 236 non-yoga practisers) who completed an online cross-sectional survey. Results showed yoga practisers had significantly higher levels of wellbeing and psychological flexibility, and lower levels of psychological inflexibility. All eight limbs of yoga correlated with wellbeing, flexibility, and inflexibility. Most of the individual yamas and niyamas correlated with wellbeing, flexibility, and inflexibility, except for isvara pranidhana for wellbeing and isvara pranidhana, savadhaya and saucha for inflexibility. Each of the eight limbs predicted wellbeing, flexibility, and inflexibility. Ahimsa significantly predicted psychological flexibility. While, satya significantly predicted psychological inflexibility. Limitations include the cross-sectional design and use of author design measure which is yet to be validated. While conclusions are tentative, a potential clinical implication is that yoga which focused on ahimsa and satya could influence psychological flexibility and inflexibility. Further research would benefit from well designed intervention studies which considers whether the eight limbs mediates psychological outcomes.

Table of Contents

Table of Tables 7
Table of Figures 8
Research Thesis: Declaration of Authorship 9
Acknowledgements 10
Definitions and Abbreviations 11
Chapter 1 Literature Review Paper 13
1.1 Introduction 15
1.1.1 Proposed Mechanisms of Change 15
1.1.2 Methods of Studying Mechanisms of Change 17
1.1.3 Aims for current study 19
1.2 Methods 19
1.2.1 Identification and selection of studies 19
1.2.2 Inclusion and exclusion criteria 20
1.2.2.1 Wellbeing and mental health definition 20
1.2.3 Quality assessment 21
1.3 Results 22
1.3.1 Study flow and characteristics 22
1.3.2 Population characteristics 23
1.3.3 Mediation characteristics 30
1.3.4 Quality Assessment 39
1.3.4.1 Mediation quality assessment 39
1.3.4.2 Study quality assessment 40
1.3.5 Summaries of identified mechanisms 40
1.3.5.1 Mechanism 1: Mindfulness (*n* = 9) 40
1.3.5.2 Mechanism 2: Self-compassion *(n = 6)* 42
1.3.5.3 Mechanism 3: Interoceptive awareness (n = 5*)* 43
1.3.5.4 Mechanism 4: Spirituality *(n = 2)* 45
1.3.5.5 Mechanism 5: Rumination (n = 2) 45
1.3.5.6 Other mechanisms 46
1.3.5.6.1 Emotional regulation (n = 1) 46

1.3.5.6.2 Distress tolerance (n = 1) 46
1.3.5.6.3 Perceived stress (n = 1) 47
1.3.5.6.4 Psychological flexibility (n = 1). 47
1.4 Discussion 47
1.4.1 Summary of Evidence 47
1.4.2 Theoretical implications 49
1.4.3 Clinical Implications 50
1.4.4 Critique of the literature 50
1.4.5 Strengths and limitations of the current review 52
1.4.6 Future Research 53
1.5 Conclusion 54
1.6 References 55
Chapter 2 Empirical Paper 69
2.1 Introduction 71
2.1.1 Yoga 72
2.1.2 Yoga: psychological mechanisms of change 73
2.1.3 Acceptance and Commitment Therapy 75
2.1.4 ACT: psychological mechanisms of change 77
2.1.5 Yoga and ACT: shared mechanisms 77
2.1.6 Yoga and ACT: empirical evidence for shared mechanisms 78
2.1.7 Rationale for study 79
2.2 Method 80
2.2.1 Ethical considerations 80
2.2.2 Design 80
2.2.3 Power Analysis 80
2.2.4 Participants 81
2.2.5 Measures 83
2.2.5.1 Part 1 (completed by all participants) 83
2.2.5.2 Part 2 (completed by yoga practisers only) 84
2.2.6 Procedure 84
2.2.7 Statistical analyses 85

2.3 Results 85

2.3.1 Participant characteristics 85

2.3.2 Hypothesis one: 88

2.3.3 Hypothesis two: 89

2.3.4 Hypothesis three: 91

2.3.4.1 Predicting psychological wellbeing 91

2.3.4.2 Predicting psychological flexibility 92

2.3.4.3 Predicting psychological inflexibility 93

2.3.5 Hypothesis four: 94

2.3.5.1 Predicting psychological flexibility 94

2.3.5.2 Predicting psychological inflexibility 95

2.4 Discussion 96

2.4.1 Summary of findings 96

2.4.2 Clinical implications 99

2.4.3 Strengths and limitations 99

2.4.4 Future research 101

2.5 Conclusions 102

2.6 Reference 103

Appendix A Complementary Therapies in Clinical Practice Guide for Authors 115

Appendix B Search Strategy 138

Appendix C Inclusion and Exclusion Screening tool 139

Appendix D The Mediation Quality Checklist Tool 141

Appendix E The Checklist for Measuring Quality 142

Appendix F Quality Assessment Ratings for each study 147

Appendix G ERGO Ethics Approval 154

Appendix H Participant Information sheet and consent 166

Appendix I Bot Criteria 171

Appendix J Demographic Information Questionnaire 172

Appendix K Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS-7; Stewart-Brown et al., 2009) 178

Appendix L Multidimensional Psychological Flexibility Inventory – 24 (MPFI-24; Rolffs et al., 2018) 179

Appendix M Measure of the 8-limbs of yoga 189

Appendix N Cronbach Alpha for measures 194
Appendix O Recrutement Poster 195
Appendix P Debrief Statement 196
Appendix Q Analytic strategy including tests of assumptions 199
Appendix R Detailed characteristics of yoga practitioners 200

Table of Tables

Table 1 Theoretical psychological mechanisms of change 17

Table 2 Summary of study characteristics 25

Table 3 Summary of mediation test, mediation variables and results 31

Table 4 Definitions of the eight Limbs of yoga 72

Table 5 Definitions of the core ACT processes 75

Table 6 Analysis of participant demographics by group.....86

Table 7 Means, standard deviations and correlations between variables 90

Table 8 Multiple regression results for the eight limbs and psychological wellbeing 92

Table 9 Multiple regression results for the eight limbs and psychological flexibility93

Table 10 Multiple regression results for the eight limbs and psychological inflexibility 94

Table 11 Multiple regression results for the yamas and psychological flexibility...95

Table 12 Multiple regression results for the yamas and niyamas psychological inflexibility 96

Table of Figures

Figure 1 Flow diagram of study review process 24

Figure 2 Consort diagram showing reason for excluding data sets 82

Research Thesis: Declaration of Authorship

Print name: Nadine Fox

Title of thesis: The psychological benefits of yoga practice

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: .....

Acknowledgements

Thank you to all the people who gave up their time, shared and completed our questionnaires. To my yoga teacher Helen, thank you for sharing your knowledge and helping us develop the eight limbs measure. Also, for keeping me sane with your weekly yoga class!

Next, I would like to thank my supervisors Dr Ali Bennetts and Dr Andrew Merwood, for all your guidance and support. It has been a pleasure to work with you both. Ali, I feel incredibly lucky to have had such a kind and passionate supervisor. Your love for yoga and research is infectious.

To Halina Willis, I am not sure I would have got through this project without you! Thank you for your help in screening papers and conducting quality assessments, but mostly always being on the other end of teams with advice and reassurance.

Finally, I would like to express my gratitude to my family. Thank you Mum for your support, love, and your unwavering belief that I can achieve anything I can put my mind to. To Mark, my absolute rock throughout the last 3 years. Thank you for always listening to me and supporting my dreams. I could not have reached the finish line without you.

Definitions and Abbreviations

AAQ-II ..... Acceptance and Action Questionnaire 2

ACT ..... Acceptance and Commitment Therapy

ANOVA ..... Analysis of Variance

BAI ..... Beck Anxiety Inventory

BAS ..... Body Appreciation Scale

BAQ ..... Body Awareness Questionnaire

BCS ..... Body Compassion Scale

BDI ..... The Beck Depression Inventory

BIQ ..... Body Image Questionnaire

BSL-23 ..... Borderline Symptom List

CAPS-5 ..... Clinical Administered PTSD Scale

CAI ..... Clinical Activity Index

CBT..... Cognitive Behavioural Therapy

DASS ..... Depression Anxiety Stress Scale

DBT..... Dialectical Behavioural Therapy

DEBQ ..... Dutch Eating Behaviour Questionnaire

DERS ..... The Difficulties in Emotional Regulation Scale

DTS ..... Distress Tolerance Scale

DV ..... Dependent Variable

ERGO ..... Southampton Ethics and Research Governance Committee

FACIT-SP ..... Functional Assessment of Chronic Illness Therapy-Spirituality subscale

FFMQ..... Five Facet Mindfulness Questionnaire

HADS ..... Hospital Anxiety Depression Scale

HAM-D ..... Hamilton Rating Scale for Depression

IBDQ ..... Inflammatory Bowel Disease Questionnaire

ISAS ..... The Inventory of Statements about Self-Injury

Definitions and Abbreviations

MAIA ..... The Multidimensional Assessment of Interoceptive Awareness

MAAS..... The Mindful Attention and Awareness Scale

MANOVA ..... Multivariate Analysis of Variance

mDES ..... Differential Emotions Scale

MPFI ..... Multidimensional Psychological Flexibility Inventory

NSSI ..... Non-Suicidal Self-Injury

PBE ..... Physical Body Expériences Questionnaire

PCL ..... The PTSD Checklist for DSM-5

PCL-C ..... PTSD checklist – Civilian version

PCS ..... Pain Catastrophizing scale

PHLMS ..... Philadelphia Mindfulness Scale

PRISMA..... Preferred Reporting Items for Systematic Reviews and Meta-Analysis

PSS ..... Perceived Stress Scale

PSQ ..... Perceived Stress Questionnaire

PTSD..... Post Traumatic Stress Disorder

RCT ..... Randomised Control Trial

RRS ..... The Ruminative Responses Scale

RRQ ..... Rumination and Reflection Questionnaire

SCS-SF ..... Self- Compassion Scale-Short Form

SEM ..... Structural equation modelling

SPSS..... Statistical Package for Social Sciences

SISRI-24 ..... The Spiritual Intelligence Self-Report Inventory

SWEMWBS-7..... Warwick-Edinburgh Mental Wellbeing Scale

WHO ..... World Health Organisation

QQLI ..... Quality of Life Inventory

Chapter 1 Literature Review Paper

How Does Yoga Improve Mental Health and Psychological Wellbeing? A Systematic Review of Mediation Studies

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: 8582 (excluding abstract, tables and references)

Chapter 1

Abstract

Background and Purpose

Little is known about how yoga yields psychological benefits. This paper aims to systematically review mediation studies, looking at the relationship between yoga and mental health and wellbeing. This is important as increasingly yoga is being positioned as a holistic treatment for mental health difficulties and a possible adjunct to talking therapies.

Methods

A systematic search of databases was conducted (CINAHL, EMBASE, Scopus, PsychINFO and Web of Science). The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. The methodological quality of the studies were reviewed using the Checklist for Measuring Quality and the Mediation Quality Checklist. A narrative synthesis of each mechanism identified is provided.

Results

16 studies of mixed quality were included in the review. Overall, there is some evidence to suggest mindfulness, self-compassion and interoception mediate the relationship between practising yoga and mental health and wellbeing outcomes.

Conclusion

Mindfulness, self-compassion and interoception may play a role in mediating the relationship between practising yoga and psychological benefit. However, results should be treated with caution due to lack of heterogeneity and methodological concerns across yoga research.

Keywords: Yoga, Mental health, Wellbeing, Psychology, Mediator, Mechanisms of change

Chapter 1

1.1 Introduction

Yoga has grown in popularity in western societies as a holistic approach to mental and physical health (Cartwright et al., 2020; Zhang et al., 2021). Originating over 4000 years ago in India, yoga aims to unify the mind and spirit through mental and physical practices, while following ethical principles in one's daily life (Iyengar, 2005). This is achieved by engaging with the "eight limbs" which include: ethical considerations *(yama)*, guidance for ways of living *(niyama)*, 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;* Iyengar, 2005). Western yoga tends to focus primarily on physical postures (asana), breath work (pranayama) and meditation (dhyana) (Ivtzan, & Jegatheeswaran, 2015).

Yoga is beneficial for a variety of mental health conditions and symptoms including; anxiety (Cramer et al., 2018; Hofman et al., 2016), depression (Cramer et al., 2017; Brinsley et al., 2021; Zoogman et al., 2019), PTSD (Niles et al., 2018), work-related stress (Della Valle et al., 2020), and psychological wellbeing (Kelley et al., 2020). This has led to yoga being positioned as an alternative approach to talking therapies (Bennetts, 2022). Yoga could potentially address barriers to accessing talking therapies such as stigmatising beliefs, finances and difficulties verbally expressing concerns (Salaheddin, & Mason., 2016).

While the beneficial effects of yoga are well established, little is known about the mechanisms through which psychological benefit is obtained (Field, 2016). Systematic reviews have found a lack of empirical research, concluding there is insufficient evidence to make conclusions about psychological mechanisms (McCall, 2013; Riley, & Park, 2015). One potential mechanism found was self-compassion, but further research is needed to substantiate this (Gard et al., 2012; McCall, 2013). This study aims to provide a current review of yoga research exploring psychological mechanisms of change.

1.1.1 Proposed Mechanisms of Change

Historically, research has focused on yoga's efficacy rather than how it yields psychological benefit. Several theoretical models exist which aim to provide this explanation, these are summarised below and in Table 1. Gard et al., (2014) proposes a self-regulatory model of yoga and psychological wellbeing. Self-regulation is defined as the *"efforts of monitoring, willpower and motivation to manage or alter one's incipient responses and*

impulses, so as to pursue or maintain explicit goals or standards" (Gard et al., 2014, pg. 1). The model simplifies the eight limbs of yoga into four facets (ethical principles, breath regulation, postures and meditation) and suggests each of these improve regulation of cognition, emotions, behaviours and physiology. This occurs as a result of yoga's effect on several processes; attentional control, response inhibition, self-awareness, emotional regulation, the ability to reappraise/observe without judgement, behavioural regulation and integration of viscero-somatic information. Yoga is thought to promote integration and bi-directional feedback between low and high-level networks within the brain. Therefore, inhibiting cognitive, emotional, behavioural and physiological processes that contribute to stress, while promoting more adaptive responses. Adaptive responses are thought to become progressively more automatic with increased yoga practice.

Gard et al's., (2014) model has been criticised for being overly complex, offering few measurable psychological constructs and not communicating cognitive mechanisms well (Gust, 2023). In response, a simpler model of self-regulatory mechanisms has been produced by Gust (2023). Five psychological mechanisms of change are proposed: emotional regulation, self-control, parasympathetic nervous system function, distress tolerance and mindfulness. These factors are said to mediate the four facets of yoga (used by Gard et al., 2014) and improved self-regulation. Empirical evidence offers support for the theory (Gust, 2023), however conclusions are limited as only a single yoga class was delivered and participants were psychology students therefore generalisability is limited.

Alternatively, it has been suggested that yoga increases psychological wellbeing through intrapersonal and interpersonal mechanisms (Kishida et al., 2018). Drawing on empirical research it is hypothesised that yoga increases; compassion (to the self and others), social connectedness and mindfulness, with individual and social factors moderating the impact on wellbeing. This theory is the first to integrate the role of social factors however ignores physiological mechanisms. Like Gard et al., (2014) and Gust (2023), Kishida reduces the eight limbs to four components. This is particularly problematic in the case of the yamas and niyamas, which are combined into a single component despite being a set of ten different principles. All three models discussed therefore fail to understand how each of the eight limbs may relate to specific processes.

Addressing this criticism, Bennetts' (2022) links each limb to psychological transdiagnostic processes. It is suggested that engaging in individual limbs of yoga may impact transdiagnostic processes (interoception, compassion, self-criticism, emotional regulation,

attention, cognitive fusion, imagery, motivation, spirituality), which mediate psychological wellbeing. These transdiagnostic processes were selected as they are conceptually similar to the eight limbs of yoga. Links are made between the yamas and niyamas and processes targeted in third wave approaches, concluding that improved wellbeing occurs through shared processes. The model provides clear testable hypotheses allowing yoga to be compared to talking therapies. While Bennetts focuses primarily on psychological mechanisms, the complex interaction between physiological, psychological, interpersonal processes and psychological wellbeing is acknowledged.

There is little empirical support for any of the theoretical models. This is in part due to the limitations of existing yoga research including; poor study design, heterogeneity of yoga practices studied and poor reporting of interventions (Field, 2016).

Table 1

Theoretical psychological mechanisms of change

Gard et al., (2014)	**Kishida et al., (2018)**	**Bennetts (2022)**	**Gust (2023)**
Self-regulation: Attentional control Self-awareness Emotional regulation Reappraise and observe without judgement Behavioural regulation	Self-compassion Compassion to others Social connectedness Mindfulness	Interoception Compassion Self-criticism Emotional regulation Attention (mindfulness) Cognitive fusion Imagery Motivation Spirituality	Emotional Regulation Self-control Distress tolerance Mindfulness

1.1.2 Methods of Studying Mechanisms of Change

To test existing theories and explore potential mechanisms of change, research must conduct mediation analysis. For a comprehensive overview of mediation methods see Kazdin

(2007). Mediation is an important step in testing theoretical models, which works to help us understand *how* changes occur during an intervention. Mediation looks at the indirect influence of an intervention (X) on an outcome (Y) through a mediator (M) (Kazdin, 2007). This allows for an understanding of which therapeutic components are effective, therefore providing insight into possible mechanisms of change (Maric et al., 2012).

The most commonly used method to assess mediation is sequence of linear regression modelling, also known as the causal steps-approach (Baron, & Kenny, 1986). This method has come under scrutiny for its low statistical power and high error rates (Hayes, 2009, Mackinnon et al., 2002). Alternative methods include linear regression analysis (Hayes, & Rockwood, 2017) Structural Equation Modelling (SEM; Lacobucci et al., 2007). SEM is currently considered the gold standard. This method assesses both the direct and indirect relationships amongst constructs represented by multiple items (Lacobucci et al., 2007). SEM is also referred to as path analysis when conducted using observed variables (MacKinnon, 2008).

Methods to assess the strength of mediation include the Sobel test, also known as the product of coefficient approach (Sobel, 1982), distribution of the product (MacKinnon, 2002) and bootstrapping (Preacher, & Hayes, 2004). These methods have been criticised, particularly when used in addition to the already criticised causal steps-approach, rather than instead of it due to the limitation discussed above (Hayes, 2009). Even when used independently these tests are not without their criticisms. The distribution of the product approach has been referred to as “cumbersome” and requiring multiple assumption tests (Hayes, 2009, p.412). The Sobel test is flawed in so far that it assumes indirect effects are normally distributed however these tend to be asymmetric (Hayes, 2009). Therefore, bootstrapping is recommended due to greater statistical power, more accurate type 1 error rates and no assumptions of normality (Hayes, 2009; MacKinnon et al., 2002).In addition to statistical methods, Kazdin (2007, 2009) recommends five principles which needs to be fulfilled for mediation. Firstly, mediators must have a strong theoretical base, secondly interventions should be compared to a control group, thirdly studies should provide evidence for the temporal sequence of change, fourth results should be robustly reproduced and lastly only data where participants have received a sufficient dose of intervention should be analysed. Studies that fail to meet these criteria can only provide tentative conclusions.

The study of mediators is particularly important in light of calls to move away from syndrome-specific treatment protocols, toward a process-based approach (Hayes et all., 2020). Process-based therapies aim to offer an idiosyncratic treatment approach which targets

empirically established biopsychological processes of change (Ong et al., 2024). This approach would support the integration of psychological therapies and yoga, should there be clear shared mechanisms of change which are philosophically compatible (Ong et al., 2024).

1.1.3 Aims for current study

The current study aims to answer the research question, what are the potential mediators of yoga practice and psychological outcomes? A systematic review of existing studies will be conducted to provide narrative summaries for each mediator identified. Meta-analysis, coefficients and confidence intervals are not looked at due to the heterogeous nature of the studies found.. Understanding moderators will provide information about how yoga could be used as a psychological intervention. Insight into mechanisms could potentially allow for yoga to be tailored to specific mental health conditions. Understanding the existing research will help to inform and provide direction for future research.

1.2 Methods

The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA; Moher et al., 2015), and pre-registered with PROSPERO (Page et al., 2021; registration no.: CRD42023409038). Two changes were made after registering. Firstly, the databases searched were updated to exclude Cochrane Library and include Web of Science as this database yielded more relevant results. Secondly, once studies were identified, the quality assessment tools were changed to provide a more rigorous assessment and reflect similar systematic reviews.

1.2.1 Identification and selection of studies

A comprehensive search of published studies up to April 2023 was conducted using the following databases: CINAHL, EMBASE, Scopus, PsychINFO and Web of Science. The search items consisted of terms pertaining to yoga (yoga OR yogic) and mediation analysis (mechanis* OR mediat*) (Appendix B). Search terms were kept broad to capture as many

relevant studies as possible. Reference lists of selected articles were hand-searched by the primary researcher to identify any additional studies not identified by electronic search.

Studies were screened against predetermined inclusion and exclusion criteria (Appendix C). This included an initial title and abstract screen, followed by a full text screen both carried out by the lead researcher (NF). 50% of the studies were reviewed at random by an independent reviewer (HG). Any disparities were discussed. In the case of uncertainty, there was a discussion with another member of the research team (AB) until agreement was sought.

Data extraction for eligible studies was completed by the primary researcher (NF). This included collecting information of the study authors, year, title, journal, sample characteristics, design, intervention, outcome measures, mediator(s), and type of mediation analysis. See Table 2 for a summary of the papers, missing data is indicated.

1.2.2 Inclusion and exclusion criteria

Inclusion criteria included; any study of yoga published in English which used 1) an adult sample (>18 years), 2) wellbeing and mental health outcomes as a dependent variable (defined below), 3) a formal mediation analysis (e.g. Baron and Kenny's causal steps of mediation, structural equation modelling, multi-level mediation, path analysis) or significance tests of mediation (e.g. Sobel test, bootstrapping). The exclusion criteria included 1) reviews, 2) studies which tested mediators without a strong theoretical basis. A summary of those mechanisms included in existing theory is shown in Table 1 (Kazdin, 2007).

1.2.2.1 Wellbeing and mental health definition

The distinction between mental health and psychological wellbeing differs across disciplines (Camfield et al., 2009) and cultures (Helliwell, & Putnam, 2004; Kishan, 2020). The review hopes to capture a range of articles, therefore terms were kept broad. The term 'mental health' will encompass mental health disorders e.g. depression, post-traumatic stress etc (World Health Organisation, 2019) and mental health problems e.g. issues that are not sufficiently severe to be formally diagnosed as disorders for example; stress, anxiety, worry, body image, negative affect (Bremberg, & Dalman, 2015; Keyes, 2005). Psychological wellbeing is defined as both hedonic (enjoyment, pleasure) and eudemonic (meaning, fulfilment)

happiness, as well as resilience (coping, emotional regulation, healthy problem solving) (Boniwell et al., 2007; National Institute of Health, 2018; Tang et al., 2019). This review will include both hedonic and eudemonic wellbeing, this could include measures of life satisfaction including general terms (life as a whole) and domain terms e.g relationships, work, quality of life and positive affect.

1.2.3 Quality assessment

Mediation studies meeting the inclusion criteria were assessed for methodological quality and potential bias in line with PRISMA guidance (Moher et al., 2015). Despite calls for a consensus-based quality assessment tool for mediation studies, no such tool exists (Vo et al., 2022). This review will follow the precedent set in previous systematic reviews and use both mediation and methodological quality measures (Argyriou et al., 2021; Cha et al., 2022).

The Mediation Quality Checklist Tool was initially developed by Lubans et al., (2008) and later adapted by Cerin et al., (2009), Rhodes and Pfaeffli (2010) and Mansell et al., (2013). The Mansell version of the tool was selected as it accounts for biases including; temporal order bias and mediator-outcome confounding bias (Vo et al's., 2022). The measure consists of 12 items and assesses; study design and analysis, supporting theoretical framework, measurement properties, study power, assessment of temporality (exposure-mediator and mediator-outcome), appropriateness of analysis, and consideration of confounding factors. Answers are scored yes (1) or no (0).

The Checklist for Measuring Quality has high internal consistency, good inter-rater and test-retest reliability and was chosen because it can be used across study design (Downs & Black, 1998). The 27-item version was used to assess intervention studies and the adapted 16-item version was used for cross-sectional and observational designs (Irving et al., 2006). The measure includes questions relating to reporting, external validity, internal validity and confounding variables. Answers are scored yes (1), no (0) or unable to determine (0).

Total scores are not calculated on either quality assessment measure, instead descriptive summaries are provided as these are more reliable and easily interpreted than the use of scores (Higgens, & Green., 2011).

Two researchers (NF, HG) independently rated quality of all eligible studies. Inter-rater reliability was 'substantial' for both the mediation quality checklist ($\kappa = .79$) and the checklist

for measuring quality (κ = .79) (Cohen, 1968). Disagreements were discussed and any decisions not agreed upon were discussed with a third independent reviewer (AB) until agreement was met.

1.3 Results

1.3.1 Study flow and characteristics

A total of 1850 articles were identified. Figure 1 shows the flow of studies through the review. Table 2 shows a summary of study characteristics for all studies. Six studies were RCTs which compared yoga to; waitlist (*n* = 3; Alleva et al., 2020; Medina et al., 2015; Shallit., 2018), waitlist and aerobic exercise (*n* = 1; La Rocque et al., 2021), a wellness program (*n* = 1; Davis et al., 2023) and self-care (*n* = 1; Koch et al., 2020). Four studies were quasi-experimental, three of these looked at a yoga intervention without a comparison (Boni et al., 2018; Curtis et al., 2011; Drapkin, 2019) and one compared to a waitlist control (Gard et al., 2012). Intervention studies looked at a variety of styles of yoga including; hatha (*n* = 4; Alleva et al., 2020; Curtis et al., 2011; Davis et al., 2023; Koch et al., 2020), bikram (*n* = 3; La Rocque et al., 2021; Medina et al., 2015; Shallit, 2018), kripalu (*n* = 1; Gard et al., 2012) and chakra focused yoga (*n* = 1; Drapkin, 2019). Interventions ranged from 5 to 16 weeks. Seven studies were cross-sectional surveys looking at a vast range of different yoga practices (Daubenmier, 2005; Kishida et al., 2019; Muehlenkamp et al., 2022; Parkinson & Smith., 2023; Rasoulzadeh, 2019; Tihanyi et al., 2016).

Studies most commonly looked at the impact of yoga on mental health outcomes (depression, anxiety, PTSD, borderline symptoms, stress) (*n* = 8; Boni et al., 2018; Davis et al., 2023; Drapkin., 2019; Gard et al., 2012; La Rocque et al., 2021; Parkinson & Smith., 2023; Rasoulzadeh, 2019; Shallit., 2018). Other outcomes included; body image (*n* = 2; Alleva et al., 2020; Daubenmier, 2005), eating behaviours (*n* = 2; Medina et al., 2015), quality of life (*n* = 1; Gard et al., 2012), pain catastrophising (*n* = 1; Curtis et al., 2011), wellbeing (*n* = 1; Tihanyi et al., 2016), physical health coping (*n* = 1; Koch et al., 2020), non-suicidal self-injury (*n* = 1; Muehlenkamp et al., 2022) and emotional regulation (*n* = 1; Parkinson & Smith., 2023).

1.3.2 Population characteristics

The majority of studies were conducted in United States of America (*n* = 7; Daubenmier., 2005; Davis et al., 2023; Gard et al., 2012; Kishida et al., 2019; Medina et al., 2015; Muehlenkamp et al., 2022; Shallit., 2018). Study sample sizes ranged from 22 to 676 participants and ages ranged from 18-87 years old. Studies looked at a range of different sample populations with six studies including only women (Alleva et al., 2020; Curtis et al., 2011; Daubenmier, 2005; La Rocque et al., 2021; Medina et al, 2015; Shallit., 2018) and nine looking at the general population (Alleva et al., 2020; Boni et al., 2018; Daubenmier, 2005; Gard et al., 2012; Kishida et al., 2019; Muehlenkamp et al., 2022; Parkinson & Smith., 2023; Rasoulzadeh., 2019; Tihanyi et al., 2016).

Figure 1

Flow diagram of study review process

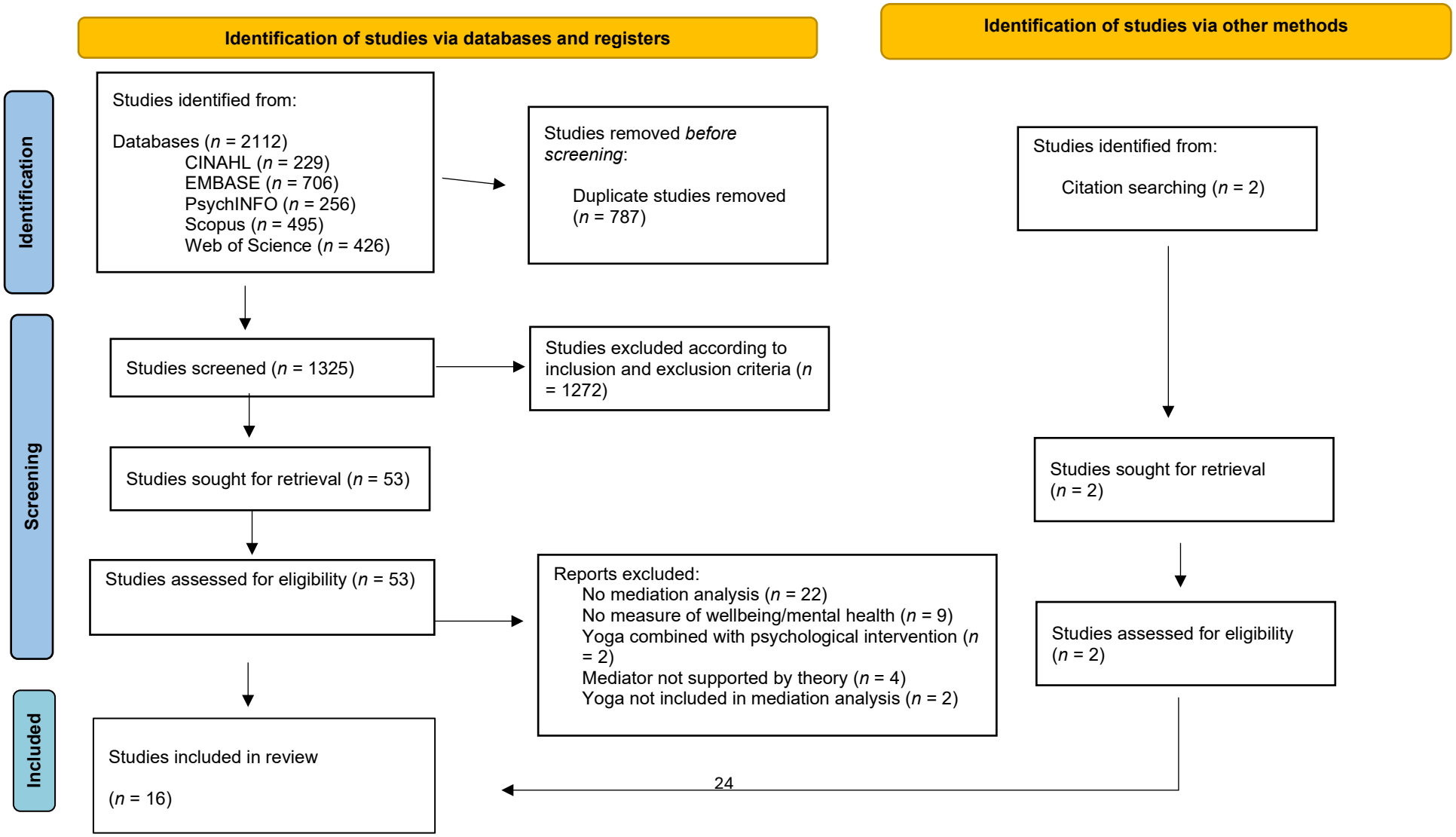


Table 2

Summary of study characteristics

Study	Design	Country	Sample	Ethnicity/Race	Type of yoga studied (Intervention/dosage)	Comparator
Alleva et al. (2020)	RCT	Netherlands	114 females, 18–30 years old (*M* = 22.2, *SD* = 2.4)	German (*n* = 37, 32.5%), Dutch (*n* = 12, 10.5%), other Western European (*n* = 15, 13.2%), Eastern European (*n* = 14, 12.3%), Southern European (*n* = 14, 12.3%), North American (*n* = 7, 6.1%), Mixed (*n* = 4, 3.5%), South American (*n* = 3, 2.6%), Asian (*n* = 2, 1.8%), Northern European (*n* = 2, 1.8%), African (*n* = 1, 0.9%), Australian (*n* = 1, 0.9%), Caribbean (*n* = 1, 0.9%), Central American (*n* = 1, 0.9%)	10-week Hatha Yoga	Waitlist
Boni et al.(2018)	Cross-sectional	Australia	308 females and 59 males, 19–66 years old (*M* = 35.27, *SD* = 8.33)	No demographic information provided	Ashtanga (47.2%), Yin (3%), Vinyasa (27.9%), Iyengar (1.7%), and Other (20.3%).	None

Curtis et al. (2011)	Quasi experimental	Canada	22 women with Fibromyalgia, 17–71 years old (*M* = 47.4, *SD* = 13.7)	African Canadian (*n* = 1, 4.5%), South Asian (*n* = 1, 4.5%), East Asian (*n* = 1, 4.5%), Middle Eastern/north (*n* = 1, 4.5%), Caucasian (*n* = 16, 72.7%), Hispanic (*n* = 1, 4.5%),West Indian (*n* = 1, 4.5%)	8-week Restorative yoga	None
Dauben mier.(2005)	Cross-sectional	United States of America	139 females, 18–87 years old (*M* = 37.16, *SD* = 14.29)	Asian American (52%), White (26%), Hispanic/Latina (8%), African American (4%), Other (8%), No Response (2%)	Iyengar and Ashtanga	Aerobic classes and baseline
Davis et al., (2023)	RCT	United States of America	132 veterans and 9 civilians, 44 females and 97 males with PTSD, 43-64 years old (*M* =51.7, *SD* = 13.1)	White (62.4%), Black/African American (30.5%), Other (7.1%)	16-week holistic yoga program	16-week wellness program
Drapkin. (2019)	Quasi experimental	Columbia	102 students with anxiety, depression, PTSD or borderline symptoms, 89 females and 11 males, 20–55 years old	Hispanic (*n* = 8, 7.8%), White(*n* = 27, 26.5%), Black (*n* = 11, 10.8%), Middle Eastern (*n* = 2, 2.0%), East Asian (*n* = 39, 38.2%), South Asian (Indian) (*n* = 9, 8.8%)	8 weekly classes each one focused on a different chakra	none
Gard et al. (2012)	Quasi experimental	United States of America	Yoga condition: 39 females and 14 males, 18–26 years old (*M* = 22.06, SD= 1.67)	Caucasian (88% yoga group/79% control group)	16-week Kripalu Semester Intensive Program	Waitlist

			Control condition: 36 females and 12 males, 18–26 years old (*M* = 21.33, SD= 2.58)			
Kishida et al. (2019)	Observation	United States of America	96 females and 8 males, 18-76 years old (*M* = 41.7, *SD* = 16.1)	Caucasian (88.5%)	Hatha yoga (39.4%), Iyengar (8.4%), Bikram (6.6%), Triyoga (5%), Power (4.2%), Ashtanga (3.8%), Kripalu (3.4%), Kundalini (3.4%), Vinyasa (3.3%), Other (22.5%)	none
Koch et al. (2020)	RCT	Germany	77 individuals with ulcerative colitis Yoga condition: 27 females and 11 males, no age range given (*M* = 45, *SD* = 13.3) Self-care condition: 30 females and 9 males, no age range given (*M* = 46.1, *SD* = 10.4)	No demographic information provided	12-week Hatha yoga	Self-care
La Rocque et al. (2021)	RCT	Canada	56 females with depressive symptoms, 18–60 years (*M* = 33.1, *SD* = 14.7)	White (*n* = 39, 73.6%), Asian (*n* = 8, 15.1%), Mixed (*n* = 2, 3.8%), Other (*n* = 2, 7.5%)	8-week Bikram yoga	Aerobic exercise classes or waitlist

Medina et al . (2015)	RCT	United States of America	52 females at risk of obesity or emotional eating, no age range given Yoga condition: 27 females, no age range given (*M*= 31.52, *SD* = 5.47) Waitlist control: 25 females, no age range given (*M* =35.68, *SD* = 6.80)	Non-Hispanic white (75%), Hispanic (19.2%)	5-week Bikram yoga	Waitlist
Muehlenkamp et al. (2022)	Cross-sectional	United States of America	676 students, 406 females and 270 males, 18–24 years old (*M* = 19.98, *SD* = 2.2)	White (92%)	Power Yoga (29.9 %), Vinyasa (26.8 %), Hot Yoga (23.2 %), Other (20.1%)	None
Parkinson & Smith. (2023)	Cross-Sectional	Canada	454 participants, Gender not reported due to missing for 35% of participants. No experience of yoga group: no age range given (*M* = 44.5. *SD* = 8.7) Intermittent experience of yoga group: no age range (*M* = 46.9, *SD* = 17.4)	Ethnicity reported per condition: White (82.9-85.3%), Black (7-7.5%), Latin American (2.3–3.7%), Pilipino (0-1.2%), Indigenous (0–1.6%), Chinese (0-0.8%), Korean (0-0.6%), Japanese (0-0.6%), Arab/West Indian (0-0.6%), Southeast Asian (0-0.6%), Other (0-3%)	Ashtanga (21.3%), Bikram (30.1%), Hot non-Bikram (20.8%), Integral (17.8%), Iyengar (13.5%), Kripalu (7.8%), Kundalini (19%), Power (36.3%), Restorative (48.4%), Vinyasa (43.2%), Yin (22.9%),	none

			Long term experience of yoga group: no age range given (*M* = 48, *SD* = 16)		Other (11.8%), Unsure (70.5%)	
Rasoulzadeh. (2019)	Cross-sectional	India	185 females and 128 males, 19–62 years old Yoga group: 101 females and 57 males, 16-62 years old (*M* = 31, *SD* = 8.6) Non-yoga group: 84 females and 71 men, 19–51 years old (*M* =30, *SD* = 7.1)	No ethnicity information given	Hatha (*n* = 95), Ashtanga (*n* = 20), Raja (*n* = 15), Yin (*n* = 8) and other types (*n* = 11).	Non-yoga practitioners
Shallit. (2018)	RCT	United States of America	52 females with elevated levels of perceived stress and pathological eating behaviours, 24-46 years old (*M* = 33.5, *SD* = 6.4)	Caucasian (*n* = 39, 75%), African American/Black (*n* = 11, 21.2%), Asian (*n* = 2, 3.8%), Hispanic/Latina (*n* = 10, 19.2%)	8-week Bikram yoga	Waitlist
Tihanyi et al. (2016)	Cross-sectional	Hungary	203 people who practice yoga, 183 females and 20 males, 19–68 years old (*M* = 35.8, *SD* = 10.03)	No ethnicity information given	Not stated	None

1.3.3 Mediation characteristics

Mediation characteristics and study findings are summarised in Table 3. Studies tended to look at more than one mediator. Mechanisms tested included; mindfulness (*n* = 9; Boni et al., 2018; Curtis et al., 2011; Gard et al., 2012; Kishida et al., 2019; La Rocque et al., 2021; Muehlenkamp et al., 2022; Parkinson & Smith., 2023; Shallit., 2018; Tihanyi et al., 2016), self-compassion (*n* = 6; Davis et al., 2023; Gard et al., 2012; Kishida et al., 2019; Muehlenkamp et al., 2022; Parkinson & Smith., 2023; Shallit., 2018), interoception (*n* = 5; Alleva et al., 2020; Daubenmier., 2005; Davis et al., 2023; Parkinson & Smith., 2023; Tihanyi et al., 2016), spirituality (*n* = 2; Davis et al., 2023; Parkinson & Smith., 2023), rumination (*n* = 2; La Rocque et al., 2021; Rasoulzadeh., 2019), emotional regulation (*n* = 1; Rasoulzadeh., 2019), distress tolerance (*n* = 1; Medina et al., 2015), perceived stress (*n* = 1; Koch et al., 2020) and psychological flexibility (*n* = 1; Drapkin., 2019).

Most studies performed more than one mediation analysis. Methods used include: Preacher and Hayes method (*n* = 8; Curtis et al., 2011; Daubenmier., 2005; Gard et al., 2012; Koch et al., 2020; Muehlenkamp et al., 2022; Parkinson & Smith., 2023; Rasoulzadeh., 2019; Tihanyi et al., 2016), multi-level modelling (*n* = 4; Kishida et al., 2019; La Rocque et al., 2021; Medina et al., 2015; Shallit., 2018), structural equation modelling (*n* = 1; Alleva et al., 2020), path analysis (*n* = 1; Drapkin., 2019), ANCOVA (*n* = 1; Davis et al., 2023) and non-parametric multiple regression (*n* = 1; Boni et al., 2018). Nine studies used bootstrapping (Curtis et al., 2011; Davis et al., 2023; Gard et al., 2012; Kishida et al., 2019; Koch et al., 2020; La Rocque et al., 2021; Muehlenkamp et al., 2022; Parkinson & Smith., 2023; Tihanyi et al., 2016) and two studies used a Sobel test (Boni et al., 2018; Daubenmier., 2005).

Table 3

Summary of mediation test, mediation variables and results

Study	Test of mediation	Predictor (X)	Mediator variable (M)	Dependent Variable (Y)	Mediation results
Alleva et al. (2020)	Structural equation modelling; simple mediation	Group (yoga intervention vs control)	Embodiment – Physical Body Expériences Questionnaire (PBE; Menzel, 2010)	Body Appreciation Scale-2 (BAS-2; Tylka & Wood-Barcalow, 2015) Body Compassion Scale (BCS; Altman et al., 2017) Multidimensional Body-Self Relations Questionnaire – Appearance Evaluation Subscale (Brown et al., 1990)	○ Embodiment mediated the relationship between yoga practice and body appreciation ○ Embodiment mediated the relationship between yoga practice and body compassion ○ Embodiment mediated the relationship between yoga practice and appearance evaluation
Boni et al. (2018)	Sobel Test; Non-parametric Simultaneous Multiple Regression Analysis (NPSMRA);	Length of yoga (months and years)	Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006)	Depression Anxiety Stress Scale-21 (DASS 36; Lovibond, 1995)	○ Mindfulness non-judging subscale mediated length of time practicing yoga and anxiety ○ The other mindfulness subscales (describe, awareness and non-reacting) did not mediate length of time practicing yoga and anxiety

	multiple mediation				
Curtis et al. (2011)	Bootstrapping; Preacher and Hayes method; simple mediation	Pain Catastrophizing scale (PCS; Sullivan et al., 1995) at time 1	Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) at time 2	PCS at time 3	○ Mid-intervention mindfulness scores partially mediated pre and post-intervention pain catastrophizing scores
Daubenmier.(2005)	Sobel Test; Preacher and Hayes method; simple mediation	Group (yoga and aerobic group/ yoga and baseline)	Body Awareness Questionnaire (BAQ; Shields et al., 1989)	Body Area Satisfaction Scale (Brown et al., 1990)	○ Body awareness did not mediate group (yoga vs aerobic) and body satisfaction. ○ Body awareness mediated group (yoga vs baseline) and body satisfaction.
Davis et al., (2023)	Bootstrapping; ANCOVA Method; simple and multiple mediation	Group (yoga program vs wellness program)	The Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012) Functional Assessment of Chronic Illness Therapy-Spirituality subscale (FACIT-SP; Peterson et al., 2002)	Clinical Administered PTSD Scale (CAPS-5; Weathers et al., 2016) The PTSD Checklist for DSM-5 (PCL; Blevins et al., 2015)	○ Interoceptive awareness and self-compassion at mid-treatment did not mediate yoga and PTSD symptoms at treatment end ○ Emotional awareness subscale (at mid-treatment) was found to suppress the effect of the yoga intervention on PTSD symptoms at treatment end

			Self-Compassion Scale-Short Form (SCS-SF; Raes et al., 2011)		○ Mid-treatment spirituality mediated yoga and PTSD (CAPS but not PCL) ○ Interoceptive awareness, self-regulation, spirituality all separately mediated PTSD (CAPs-5 and PCL) at the end of treatment ○ Self-compassion did not mediate PTSD (CAPs-5 and PCL). ○ Interoceptive awareness subscales - body listening, emotional awareness and trusting did not mediate PTSD (CAPs-5 and PCL). ○ Interoceptive awareness subscales - attention regulation and self-regulation were no longer found to be significant mediators when examined jointly
Drapkin. (2019)	Path Analysis; simple mediation	PCL-C – pre-test BSL-23 - pre-test	Acceptance and Action Questionnaire 2 (AAQ-II; Bond et al., 2011) – change from pre to post test	PTSD checklist – Civilian version (PCL-C; Blanchard et al., 1996) at 3 month follow up Borderline symptom list (BSL-23; Bohus et al., 2007) at 3 month follow up	○ Increases in psychological flexibility from pretest to post-test mediated yoga and reduction in PTSD from pretest to follow-up ○ Increases in psychological flexibility from pretest to post-test mediated yoga and reduction in borderline symptoms from pretest to follow-up

Gard et al. (2012)	Bootstrapping; Preacher and Hayes Method; simple and multiple mediator models	Group (yoga vs control)	Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) Self- Compassion Scale-Short Form (SCS-SF; Raes et al., 2011)	Quality of life inventory (QQLI; Frisch et al., 1992) Perceived Stress Scale (PSS; Cohen et al., 1983)	○ Mindfulness mediated yoga and quality of life ○ Mindfulness mediated yoga and perceived stress. ○ Self-compassion mediated yoga and quality of life ○ Self-compassion mediated yoga and perceived stress. ○ Mindfulness and self-compassion combined mediated quality of life. ○ Only self-compassion not mindfulness mediated perceived stress in the multiple mediator model.
Kishida et al. (2019)	Bootstrapping; Multilevel Mediation; simple mediation	Daily yoga practice Between vs within person level yoga practice	Mindfulness (created by authors) Two items from the Self- Compassion Scale-Short Form (SCS-SF; Raes et al., 2011)	Daily compassion - Two items from the Differential Emotions Scale (mDES; Fredrickson et al., 2001) Two items from the social connectedness Scale (Lee, & Robbins., 1995)	○ Mindfulness mediated yoga practice and daily compassion ○ Mindfulness mediated yoga practice and daily social connectedness ○ Self-compassion mediated yoga practice and daily compassion at the within person levels not at the between person level.

Koch et al. (2020)	Bootstrapping; Preacher and Hayes Method; simple mediation	Group (yoga or self-care)	Perceived Stress Questionnaire (PSQ; Levenstein & Robbins, 1995) – taken at 12 weeks	Inflammatory Bowel Disease Questionnaire (IBDQ; Guyatt et al., 1989) – taken at 24 weeks Disease activity - Clinical Activity Index (CAI; Rachmilewitz, 1989) – taken at 24 weeks	○ Perceived stress at week 12 mediated yoga and health-related quality of life at week 24 ○ Perceived stress at week 12 mediated yoga and disease activity at week 24
La Rocque et al. (2021)	Bootstrapping; Multilevel Mediation; simple mediation	Group (yoga vs waitlist	The Ruminative Responses Scale (RRS) from the Response Styles Questionnaire (Nolen-Hoeksema, & Morrow, 1991) Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008)	The Beck Depression Inventory – II (BDI; Beck et al., 1996) Hamilton Rating Scale for Depression (HAM-D; Hamilton, 1960)	○ Rumination mediated yoga and depression ○ Mindfulness-acceptance subscale mediated yoga and depression ○ Mindfulness-awareness subscale did not mediate yoga and depression
Medina et al . (2015)	Multilevel Mediation; simple mediation	Group (yoga vs waitlist)	Distress Tolerance Scale (DTS; Simons, & Gaher, 2005)	Emotional eating subscale (DEES) of the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien et al., 1986)	○ Distress tolerance did not mediate yoga and emotional eating ○ Distress tolerance-absorption mediates yoga and emotional eating

Muehlenkamp et al. (2022)	Bootstrapping; Preacher and Hayes Method; simple and serial mediation	Frequency of yoga practice	The Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003) Self Compassion (SCS-SF; Raes et al., 2011) Body Appreciation Scale (BAS; Avalos et al., 2005)	The Inventory of Statements about Self-Injury (ISAS; Klonsky & Glenn, 2009)	○ Body appreciation mediated yoga and NSSI ○ Self-compassion did not mediate yoga and NSSI. ○ Mindfulness did not mediate yoga and NSSI ○ Self-compassion followed by body appreciation mediated yoga and Non-Suicidal Self-Injury (NSSI) frequency
Parkinson & Smith. (2023)	Bootstrapping; Preacher and Hayes Method; simple and multiple mediation	Yoga group (individuals who have some experience of yoga)	The Multidimensional Assessment of Interoceptive Awareness (MAIA: Mehling et al., 2012) Self-Compassion Scale (SCS; Neff., 2003a) Five Facet Mindfulness questionnaire (FFMQ; Baer et al., 2006) The Spiritual Intelligence Self-Report Inventory (SISRI-24; King., 2009)	The Difficulties in Emotional Regulation Scale (DERS; Gratz, & Roemer, 2004) Depression, Anxiety, and Stress Scale (DASS-42; Lovibond, & Lovibond, 1995)	○ Interoceptive awareness mediated yoga experience and emotion dysregulation ○ Spiritual intelligence mediated yoga experience and emotion dysregulation. ○ Mindfulness mediated yoga experience and emotion dysregulation. ○ Self-compassion mediated yoga experience and emotion dysregulation ○ Emotion dysregulation mediated yoga experience for both anxiety and depression ○ Emotion dysregulation mediated yoga experience and stress

					○ Self-compassion and mindfulness concurrently mediated yoga experience and emotional dysregulation
Rasoulzadeh.(2019)	Preacher and Hayes Method; simple mediation	Frequency of yoga practice (frequency in weeks, months and years)	The Difficulties in Emotional Regulation Scale (DERS; Gratz, & Roemer, 2004) Rumination and Reflection Questionnaire (RRQ ; Trapnell, & Campbell, 1999)	Hospital Anxiety Depression Scale (HADS; Zigmond, & Snaith, 1983)	○ Emotion regulation mediated yoga experience and both anxiety and depression ○ Rumination mediated yoga experience and both anxiety and depression
Shallit. (2018)	Multilevel Modelling; single and multiple mediation	Group (yoga v waitlist)	Self-Compassion Scale (SCS; Neff., 2003a) Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006)	Beck Depression Inventory-II (BDI-II; Beck et al.,1996) Beck Anxiety Inventory (BAI; Beck et al., 1988)	○ Mindfulness–non judging subscale mediated both anxiety and depression. ○ Self-compassion - self judgement subscale mediated both anxiety and depression. ○ When combined self-compassion -self judgement, but not mindfulness – non judging, mediated both anxiety and depression
Tihanyi et al. (2016)	Bootstrapping and Sobel Test; Preacher and Hayes Method;	Frequency of yoga practice	Body Awareness Questionnaire (BAQ; Shields et al., 1989)	WHO-Five scale (Bech 1990).	○ Body awareness mediated the effects of yoga on wellbeing ○ Body image dissatisfaction mediated yoga and wellbeing

simple and multiple mediation	Body Image Questionnaire (BIQ; Cash, & Szymanski, 1995) The Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003)	○ Mindfulness mediated yoga and wellbeing ○ Body awareness, body image dissatisfaction and mindfulness mediated wellbeing within a multiple mediation model. Mindfulness was not significant

1.3.4 Quality Assessment

See Appendix E and F for a full break down of quality assessment scores for each study.

1.3.4.1 Mediation quality assessment

All studies cited a theoretical framework. Seven out of the 16 studies were cross-sectional (43%) therefore were not experimental or designed to influence mediating variables (Boni et al., 2018; Daubenmier 2005; Kishida et al., 2019; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Rasoulzadeh; Tihanyi et al., 2016). Common flaws include:

(a) Fourteen studies did not complete a pilot study to test mediation (95%) (Alleva et al., 2020; Boni et al., 2018; Curtis et al., 2011; Daubenmier 2005; Davis et al., 2023; Gard et al., 2012; Kishida et al., 2019; Koch et al., 2020; La Rocque et al., 2021; Medina et al., 2015; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Rasoulzadeh; Shalit, 2018; Tihanyi et al., 2016).

(b) Twelve studies were unable to ascertain whether changes in mediator preceded changes in outcome (75%) (Alleva et al., 2020; Boni et al., 2018; Daubenmier 2005; Davis et al., 2023; Gard et al., 2012; Kishida et al., 2019; La Rocque et al., 2021; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Rasoulzadeh; Shalit, 2018; Tihanyi et al., 2016),=.

(c) Twelve studies did not demonstrate that a change in mediator correlated with a change in outcomes (75%) (Alleva et al., 2020; Boni et al., 2018; Daubenmier 2005; Davis et al., 2023; Gard et al., 2012; Kishida et al., 2019; Medina et al., 2015; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Rasoulzadeh; Shalit, 2018; Tihanyi et al., 2016).

(d) Ten studies did not control for possible confounding factors (56%) (Alleva et al., 2020; Curtis et al., 2011; Drapkin, 2019; Gard et al., 2012; Koch et al., 2020; Medina et al., 2015; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Rasoulzadeh; Tihanyi et al., 2016).

(e) Eight studies failed to report a change between baseline and follow up for each mediator tested (50%) (Boni et al., 2018; Daubenmier 2005; Davis et al., 2023; Kishida et al., 2019; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Rasoulzadeh; Tihanyi et al., 2016).

1.3.4.2 Study quality assessment

All studies were unable to recruit samples representative of the entire population they were studying . Other common flaws include:

(a) Thirteen studies did not report a-priori power calculations (81%) (Curtis et al., 2011; Daubenmier 2005; Davis et al., 2023; Drapkin, 2019; Gard et al., 2012; Kishida et al., 2019; Koch et al., 2020; La Rocque et al., 2021; Medina et al., 2015; Muehlenkamp et al., 2022; Rasoulzadeh; Shalit, 2018; Tihanyi et al., 2016).

(b) Eleven studies did not adjust for confounding variables (69%)(Alleva et al., 2020; Curtis et al., 2011; Daubenmier 2005; Drapkin, 2019; Gard et al., 2012; Koch et al., 2020; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Rasoulzadeh; Shalit, 2018; Tihanyi et al., 2016).

(c) Seven studies did not seek to understand adverse impacts of yoga (44%) (Alleva et al., 2020; Curtis et al., 2011; Davis et al., 2023; Drapkin, 2019; Gard et al., 2012; Koch et al., 2020; Medina et al., 2015).

(d) Six studies did not include adequate information to make a decision about compliance with the intervention (38%)(Davis et al., 2023; Drapkin, 2019; Koch et al., 2020; La Rocque et al., 2021; Medina et al., 2015; Shalit, 2018).

1.3.5 Summaries of identified mechanisms

This section aims to provide narrative summaries of each identified mechanism. This will include a summary of the study designs, outcome variables used, statistical analysis and key findings. Mechanisms only assessed in single studies are discussed collectively within a separate section.

1.3.5.1 Mechanism 1: Mindfulness (*n* = 9)

There are many definitions of mindfulness (Nilsson, & Kazemi, 2016). Bennetts (2022), Kishida et al., (2018) and Gust (2023) all define mindfulness as an *"awareness that arises through paying attention, on purpose, in the present moment, non-judgmentally*" (Hayes, & Hofmann, 2017, p.4).

1.3.6.1 Study Design

Of nine studies exploring mindfulness as a potential mechanism, four studies were cross-sectional surveys (Boni et al., 2018; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Tihanyi

et al., 2016), two were quasi-experimental (Curtis et al., 2011; Gard et al., 2012), two were RCT (ranging from 8 to 16 weeks) (La Rocque et al., 2021; Shalit, 2018) and one was observational (Kishida et al., 2019). Cross-sectional and observational studies asked participants to self-report the type of yoga they practiced. Intervention studies looked at; bikram (*n* = 2; La Rocque et al., 2021; Shalit, 2018), hatha (*n* = 1; Curtis et al., 2011) and kripalu (*n* = 1; Gard et al., 2012).

Mindfulness was measured using; FFMQ (*n* = 5; Boni et al., 2018; Curtis et al., 2011; Gard et al., 2012; Parkinson & Smith, 2023; Shalit, 2018), MAAS (*n* = 2; Muehlenkamp et al., 2022; Tihanyi et al., 2016), PHLMS (*n* = 1; La Rocque et al., 2021) and a bespoke measure created by the authors (*n* = 1; Kishida et al., 2019).

1.3.6.2 Outcome Variables

A variety of psychological outcomes were looked at, with some studies looking at multiple outcomes which included; depression (*n* = 4; Boni et al., 2018; La Rocque et al., 2021; Parkinson & Smith, 2023; Shalit, 2018), anxiety (*n* = 3; Boni et al., 2018; Parkinson & Smith, 2023; Shalit, 2018), stress (*n* = 2; Gard et al., 2012), pain catastrophising (*n* = 1; Curtis et al., 2011), quality of life (*n* = 1; Gard et al., 2012), compassion (*n* = 1; Kishida et al., 2019), social connectedness (*n* = 1; Kishida et al., 2019), non-suicidal self-harm (*n* = 1; Muehlenkamp et al., 2022), emotional regulation (*n* = 1; Parkinson & Smith, 2023) and wellbeing (*n* = 1; Tihanyi et al., 2016).

1.3.6.3 Analysis

Three studies looked at mindfulness as a single mediator (Curtis et al., 2011; Kishida et al., 2019; La Rocque et al., 2021), one study tested a multiple mediator model (Boni et al., 2018) and four reported both simple and multiple models (Gard et al., 2012; Parkinson & Smith, 2023; Shalit, 2018; Tihanyi et al., 2016). One study dropped mindfulness from their multiple mediation as it did not correlate with the independent variable (frequency of yoga practice) (Muehlenkamp et al, 2022).

1.3.6.4 Key Findings

Most studies found that mindfulness mediated the effect of yoga on psychological outcomes despite heterogeneity in measures of mindfulness, sample characteristics and outcomes. In cross-sectional and observational studies, mindfulness was shown to mediate the relationship between daily yoga practice for both daily compassion and social connectedness (Kishida, 2019), frequency of yoga practice and wellbeing (Tihanyi et al., 2016) and practising yoga and emotional dysregulation (Parkinson, & Smith, 2023). Intervention studies showed mindfulness mediated engaging in a yoga intervention and both quality of life

and stress (Gard et al, 2018), and partially mediated the relationship between pain catastrophising pre and post intervention (Curtis et al., 2011).

Studies that looked at subscales of mindfulness found mindfulness non-judging mediated the relationship between yoga practice and both anxiety and depression (Shallit, 2018). As well as length of yoga practice and anxiety (Boni et al., 2018). However, the other subscales on the FFMQ did not (Boni et al., 2018; Shallit, 2018). Using the PHLMS scale mindfulness – acceptance mediated the effect of 8 weeks of Bikram yoga on depression, mindfulness – awareness did not (La Rocque et al., 2021).

Three studies looked at mindfulness in a multiple mediation model with self-compassion. Mindfulness and self-compassion were found to mediate the relationship between practicing yoga and both emotional dysregulation (Parkinson, & Smith, 2023) and quality of life (Gard et al., 2012). Self-compassion only mediated perceived stress (Gard et al., 2012), anxiety and depression (Shalit et al., 2018).

1.3.5.2 Mechanism 2: Self-compassion *(n = 6)*

Bennetts (2022) draws upon Gilbert's (2010) definition of compassion: *"a sensitivity to suffering in the self and others, with a commitment to try to alleviate and prevent it'* (p. 19). Kishida et al., (2018) does not define compassion but talks about compassion being kindness to oneself.

1.3.7.1 Study Design

Of six studies exploring self-compassion as a potential mechanism, two studies were cross-sectional surveys (Muehlenkamp et al., 2022; Parkinson & Smith, 2023), two were RCTs (Davis et al., 2023; Shalit, 2018), one was observational (Kishida et al., 2019) and one was quasi-experimental (Gard et al., 2012). Cross-sectional and observational studies asked participants to self-report the types of yoga they practiced. Intervention studies looked at; bikram (*n* = 1; Shalit, 2018), hatha (*n* = 1; Davis et al., 2023) and kripalu (*n* = 1; Gard et al., 2012).Self-compassion was measured using SCS-SF (*n* = 4) and SCS (*n* = 2).

1.3.7.2 Outcome Variable

A variety of psychological outcomes were looked at with some studies looking at multiple outcomes including; depression (*n* = 2; Parkinson & Smith, 2023; Shalit, 2018), anxiety (*n* = 2; Parkinson & Smith, 2023; Shalit, 2018), stress (*n* = 2; Gard et al., 2012), quality of life (*n* = 1; Gard et al., 2012), daily compassion (*n* = 1; Kishida et al., 2019), connectedness (*n* = 1; Kishida et al., 2019), non-suicidal self-harm (*n* = 1; Muehlenkamp et al., 2022), emotional regulation (*n* = 1; Parkinson & Smith, 2023) and PTSD (*n* = 1; Davis et al., 2023).

1.3.7.3 Analysis

Three studies looked at self-compassion as a single mediator (Gard et al., 2012; Kishida et al., 2019; Shalit, 2018), four studies as part of a multiple mediator model (Davis et al., 2023; Gard et al., 2012; Parkinson & Smith, 2023; Shalit, 2018) and one as a serial multiple mediator model (Muehlenkamp et al., 2022).

1.3.7.4 Key Findings

In general studies found that self-compassion mediated the effect of practicing yoga on psychological outcomes despite heterogeneity, sample characteristics and outcomes. In simple mediation models', self-compassion was shown to mediate engaging in a yoga intervention and; anxiety (Shalit et al., 2018), depression (Shalit et al., 2018), quality of life and stress (Gard et al, 2018). Self-compassion also mediated daily yoga practice and daily compassion (Kishida, 2019). Self-compassion did not mediate the effect of engaging in a 16-week holistic yoga program on PTSD (Davis et al, 2023).

Studies that combined self-compassion with mindfulness are summarised within section 3.5.1. A serial mediation model found self-compassion followed by body-appreciation mediated frequency of yoga practice and frequency of non-suicidal self-injury (Muehlenkamp et al., 2022). In this study, self-compassion did not mediate frequency of yoga practice and frequency of non-suicidal self-injury as a single mediator.

1.3.5.3 Mechanism 3: Interoceptive awareness (n = 5*)*

Bennetts (2022) and Gard et al., (2014) link yoga to interoception and define this as the ability to perceive sensations within the body i.e., internal physiological sensations such as heartbeat, hunger and sensations that relate to emotions. For the purposes of the review, body awareness and embodiment, were considered part of interoceptive awareness as they are conceptually similar (Ferentzi et al., 2018).

1.3.8.1 Study Design

Of five studies exploring interoceptive awareness, three studies were cross-sectional surveys (Daubenmier 2005; Parkinson & Smith, 2023; Tihanyi et al., 2016) and two were RCTs (Alleva et al., 2020; Davis et al., 2023). One cross-sectional study looked at iyengar and ashtanga (Daubenmier 2005) and two studies asked participants to self-report the types of yoga they practiced (Parkinson & Smith, 2023; Tihanyi et al., 2016). Intervention studies looked at a 10-week hatha yoga intervention compared to waitlist (Alleva et al., 2020) and 16-week holistic yoga program compared to a 16-week wellness program (Davis et al., 2023).

Interoceptive awareness was measured using: MAIA (*n* = 2; Davis et al., 2023; Parkinson & Smith), BAQ (*n* = 2; Daubenmier 2005; Tihanyi et al., 2016) and PBE (*n* = 1; Alleva et al., 2020).

1.3.8.2 Outcome Variable

A variety of psychological outcomes were looked at with some studies looking at multiple outcomes including; body appreciation (*n* = 1; Alleva et al., 2020), body compassion (*n* = 1; Alleva et al., 2020), body self-relations (*n* = 1; Alleva et al., 2020), eating attitudes (*n* = 1; Daubenmier 2005), PTSD (*n* = 1; Davis et al., 2023), emotional regulation (*n* = 1; Parkinson & Smith), anxiety, depression, stress (*n* = 1; Parkinson & Smith), and wellbeing (*n* = 1; Tihanyi et al., 2016).

1.3.8.3 Analysis

All studies examined interoceptive awareness using simple mediation analysis (Alleva et al., 2020; Daubenmier, 2005; Davis et al., 2023; Parkinson & Smith, 2023; Tihanyi et al., 2016). In addition, two studies also used interoception within a multiple mediator model (Parkinson & Smith, 2023; Tihanyi et al., 2016).

1.3.8.4 Key Findings

Most studies found interoceptive awareness mediated the relationship between yoga and both mental health and wellbeing outcomes. Simple mediation models showed interoception mediated the relationship between engaging in 10-weeks of hatha yoga and body appreciation, body compassion, and appearance evaluation (Alleva et al., 2020), practising yoga and emotional dysregulation (Parkinson, & Smith, 2023), frequency of yoga practice and wellbeing (Tihanyi et al., 2016) and practicing Iyengar and ashtanga yoga and body satisfaction (Daubenmeir, 2005). In Duabenmeir's (2005) study, body awareness was a mediator for the yoga vs no exercise group condition but not for yoga vs aerobic exercise condition.

Davis et al., (2023) found that interoceptive awareness (scores at mid-treatment), did not mediate the relationship between the engaging in a 16-week holistic yoga program and PTSD symptoms (end of treatment scores). Closer inspection of the interoception subscales found that only attention regulation and self-regulation subscales mediated the relationship.

A serial mediation model showed a significant mediation effect for interoception, body image dissatisfaction and mindfulness on the relationship between frequency of yoga practice and wellbeing (Tihanyi et al., 2016).

1.3.5.4 Mechanism 4: Spirituality *(n = 2)*

The only theoretical model to discuss the role of spirituality is Bennetts (2022). Bennetts acknowledges the ongoing debate as to the boundaries between spirituality, religion and mental health (Cook, 2020). Bennetts (2022) does not define spirituality but refers to it as a broad concept.

1.3.9.1 Study Design

The two studies exploring spirituality as a potential mechanism of change included one RCT (Davis et al., 2023) and one cross-sectional survey (Parkinson, & Smith, 2023). Davis et al., (2023) looked at the effects of a 16-week holistic yoga program compared with a 16 week wellness program for PTSD symptoms. Parkinson and Smith (2023) assessed whether spirituality mediated the relationship between experience of practising yoga and emotional regulation, depression, anxiety and stress.

Spirituality was measured using: FACIT-SP (Davis et al., 2023) and SISRI-24 (Parkinson, and Smith, 2023).

1.3.9.3 Analysis

Both studies looked at spirituality using simple mediation.

1.3.9.4 Key Findings

Davis et al., (2023) found that spirituality (scores at mid-treatment) mediated the effect of the yoga intervention on PTSD symptoms (end of treatment scores) when measured by the CAPS, but not the PCL. Parkinson and Smith (2023) found that spirituality mediated the relationship between practising yoga and emotional dysregulation.

1.3.5.5 Mechanism 5: Rumination (n = 2)

Bennett's (2022) paper considers rumination as an emotional regulation strategy and defines it according to the American psychological association dictionary definition (2020); *"thinking which involves excessive, repetitive thoughts or themes that interfere with other forms of mental activity"*.

1.3.10.1 Study Design

Two studies explored rumination as a potential mechanism; one RCT (La Rocque et al., 2021) and one cross-sectional survey (Rasoulzadeh, 2019). La Rocque et al., (2021) looked at

the effects of an 8-week bikram program on individuals with depression, comparing yoga with an aerobic exercise and waitlist control. Rasoulzadeh (2019) looked at whether rumination mediated the relationship between experience of practising yoga and both anxiety and depression.

Rumination was measured using: RRS (La Rocque et al., 2021) and RRQ (Rasoulzadeh, 2019).

1.3.10.2 Analysis

Both studies looked at spirituality in using simple mediation.

1.3.10.2 Key Findings

Rumination mediated the relationship between the frequency of practicing yoga and both anxiety and depression (Rasoulzadeh, 2019), and engaging in an 8-week Bikram program and depression (La Rocque et al., 2021).

1.3.5.6 Other mechanisms

1.3.5.6.1 Emotional regulation (n = 1)

Gard et al., (2014), Bennetts (2022) and Gust (2023) identify emotional regulation as a key mechanism of change in yoga. Bennetts (2022) recognises that emotion regulation is subject to multiple definitions and considers the common factors in those definitions to come up with the definition*: "awareness, acceptance, understanding and response to emotional experience" (p. 3),* this includes rumination and experiential avoidance. In contrast, Gard et al., (2014) and Gust (2023) consider emotional regulation as an individual's propensity to regulate their emotions through cognitive appraisal and expressive suppression. The current review found Rasoulzadeh's (2019) study looked at emotional regulation (DERS) using a cross-sectional design. Using simple mediation, they found that emotional regulation mediated the relationship between practising yoga and both depression and anxiety (HADs).

1.3.5.6.2 Distress tolerance (n = 1)

The role of distress tolerance is discussed by Gust (2023) who defines the concept as the ability to endure negative psychological states, produced by physical or emotional stressors (Simons & Gaher, 2005). Medina et al., (2015) conducted a RCT comparing a 5-week Bikram

intervention to a waitlist control. Distress tolerance (DTS) did not mediate the effect of engaging in a yoga intervention and emotional eating (DEES). However, the subscale “absorption”, which refers to how much an individual becomes absorbed in their distress and as a result cannot complete other goals, was shown to mediate the relationship.

1.3.5.6.3 Perceived stress (n = 1)

Gard et al., (2014) proposes that yoga impacts the stress response which is linked with negative appraisal. Koch et al., (2020) studied individuals with ulcerative colitis and examined perceived stress as a potential mediator of the relationship between engaging in 12 weeks of hatha yoga and both health-related quality of life (IBDQ) and disease activity (CAI). Using simple mediation, they found perceived stress (PSQ) at week 12 fully mediated the effects of engaging in a yoga intervention on health-related quality of life and disease activity at week 24.

1.3.5.6.4 Psychological flexibility (n = 1).

Psychological flexibility refers to the ability to be fully conscious, open to your experiences and act guided by your values and is a concept referred to in acceptance commitment therapy (Harris, 2019). Bennetts (2022) makes theoretical links between psychological flexibility and yoga. Drapkin (2019) used a quasi-experimental design and ran an 8-week yoga class. They found psychological flexibility (AAQ-II) had a mediating effect on PTSD (PCL-C) and borderline symptoms (BSL-23).

1.4 Discussion

1.4.1 Summary of Evidence

This paper aimed to systematically review mediation studies to answer the research question, what are the mediators of yoga practice and mental health and wellbeing outcomes?. . Mediation studies identify the mechanisms through which interventions provide clinical benefit and are key in developing the evidence base for any intervention (MacKinnon et al., 2007). The review found 16 studies exploring this relationship. Narrative synthesis showed evidence that mindfulness, self-compassion and interoception may mediate yoga practice and psychological benefit. Preliminary but insufficient evidence was found for spirituality, rumination, emotional regulation, distress tolerance, perceived stress and psychological

flexibility. Coefficients and confidence intervals were not looked at because of the heterogeneity across studies, looking at these statistics could result in misleading conclusions.

Mindfulness mediated practising yoga and; social connectedness (Kishida, 2019), wellbeing (Tihanyi et al., 2016), emotional dysregulation (Parkinson, & Smith, 2023), quality of life, stress (Gard et al, 2018) and partially mediated pain catastrophising (Curtis et al., 2011). This finding is consistent with qualitative research. Yoga teachers and therapists have anecdotally highlighted the ability of yoga to increase one's awareness and connection with the present moment (Harvey et al., 2020). These claims are backed by empirical research which shows that engaging in yoga increases mindfulness (Butterfield et al., 2017; Erkin, & Aykar, 2020; Gaiswinkler, & Unterrainer, 2016). It has been argued that mindfulness and yoga are conceptually similar, with Salmon et al., (2009) referring to yoga as "mindfulness in motion". Taken together these findings suggest that yoga may produce psychological benefit by increasing mindfulness. Butterfield et al., (2017) suggest that yoga may be a more appealing activity over seated mindfulness meditations because increasing sensory awareness through movement is potentially more engaging.

Those studies looking at mindfulness subscales found mindful acceptance and non-judgement mediated yoga and both anxiety or depression but other subscales such as; observing, describe, awareness and non-reactivity did not (Boni et al., 2018; La Rocque et al., 2021; Shalit, 2018). This suggests that different elements of mindfulness may mediate yoga practice and psychological outcomes. The current review offers some empirical evidence to suggest mindfulness may be a mechanism through which yoga yields psychological benefit. However, different components of mindfulness may be related to different limbs of yoga (Bennetts, 2022).

Self-compassion was shown to mediate the relationship between practicing yoga and; anxiety (Shalit et al., 2018), depression (Shalit et al., 2018), quality of life, stress (Gard et al, 2018) and daily compassion (Kishida, 2019). This finding is consistent with Riley and Park's (2015) systematic review that found self-compassion to be a potential mediator for yoga and stress reduction. Qualitative research that explored the views of experienced yogis found that yoga was reported to improve one's relationship with oneself through increased self-compassion (Harvey et al., 2020). Further supporting the relationship between yoga and self-compassion, empirical research shows engaging in yoga increases self-compassion (Erkin, & Aykar, 2020). This review found one study that contradicted these findings, Davis et al., (2023) found that self-compassion did not mediate the relationship between yoga practice and PTSD. However, these results lack generalisability as the sample consisted of majority male veterans

diagnosed with PTSD. The review offers preliminary support that self-compassion could be a mechanism of change for yoga practice.

There was mixed evidence to support an interaction effect for mindfulness and self-compassion. Two studies found mindfulness and self-compassion jointly mediated yoga and; emotional dysregulation (Parkinson, & Smith, 2023) and quality of life (Gard et al., 2012). This is consistent with Neff's (2003b) postulation that there is a relationship between self-compassion and mindfulness, whereby they increase and enhance each other. In contrast, two studies have shown when combined with mindfulness, only self-compassion mediated perceived stress (Gard et al., 2012), anxiety and depression (Shalit et al., 2018). This could be because self-compassion is a stronger predictor than mindfulness for anxiety and depression (Van Dam et el., 2011). Further research looking at self-compassion and mindfulness as joint mediators is needed.

Interoception mediated yoga practice and; body appreciation, body compassion, appearance evaluation (Alleva et al., 2020), emotional dysregulation (Parkinson, & Smith, 2023), wellbeing (Tihanyi et al., 2016) and body satisfaction (Daubenmeir, 2005). This finding is consistent with reports from yoga teachers and yoga therapists who highlight yoga's ability to increase awareness of somatic experiences, breath and the self (Harvey et al., 2020). McCall's (2013) review of the underlying mechanisms of yoga found one study which showed yoga increased awareness of physical and mental states. Conceptually interoception has been linked to body awareness (Ferentzi et al., 2018). Daubenmeir (2005) found that body awareness mediated yoga practice and body satisfaction when compared to no exercise group, but not when compared to an aerobic exercise group. Other factors in instructor led exercise classes may have impacted wellbeing. One study found interoception did not mediate yoga practice and PTSD (Davis et al., 2023). However, on closer inspection some of the subscales, "attention regulation" and "self-regulation" were mediators. There is some evidence to suggest interoception may be a psychological mechanism through which yoga yields psychological benefits however, components of interoception may be related to different limbs which supports Bennetts' theory (2022).

1.4.2 Theoretical implications

Existing theories of how yoga yields psychological benefits are complex. Gard et al., (2014), Gust (2023) and Bennetts (2022) consider the interaction between yoga, psychological and physiological factors, whereas Bennett's (2022) and Kishida et al., (2018) also consider the impact of interpersonal factors. As the review focused on psychological mechanisms of change,

we were unable to conclude whether there is support for each model as a whole. Despite this, the review offers some support for individual psychological mediators including interoception, as discussed in Gard et al's (2014) model, self-compassion as discussed by Kishida et al., (2018) and mindfulness as discussed in both Kishida et al., (2018) and Gust (2023). However, all three of these models fail to account for the role of all three mechanisms found to be important in this review.

In contrast, these findings provide support for Bennett's (2022) theory that specifically refers to mindfulness, self-compassion and interoception as potential psychological mechanisms of change in yoga practice. The findings provide preliminary support for Bennett's (2022) postulation that yoga targets the same processes as those implicated in third-wave therapies. Bennetts (2022) goes on to state that engaging in the yamas, niyamas, meditation and samadhi could lead to improvements in these psychological factors. All studies in the review looked at yoga as a homogenous concept, therefore the review was unable to conclude what parts of yoga may specifically be linked to mindfulness, self-compassion and interoception.

1.4.3 Clinical Implications

The key mediators for yoga and psychological benefit found in this review (mindfulness, self-compassion and interoception) are transdiagnostic mechanisms shared with third-wave approaches including; Compassion Focused Therapy (CFT), Dialectical Behavioural Therapy (DBT) and Acceptance and Commitment Therapy (ACT) (Bennetts, 2022). These third-wave approaches are explicit in drawing on eastern philosophies (Bennetts, 2022) therefore the results suggest there could be a potential conceptual overlap. Further research is needed to explore the relationship between the component parts of yoga and these transdiagnostic processes (Makto et al., 2021). If yoga were to target the same processes as third-wave therapies, this would allow for comparisons to be made between the approaches. Yoga could then potentially be offered for mental health difficulties, as an alternative or adjunct to talking therapies. Yoga interventions could even be designed to target specific transdiagnostic processes (Bennetts, 2022).

1.4.4 Critique of the literature

The current review adds to the understanding of causal pathways and hopes to act as a guide to future research. However, the results of the quality assessment suggest that conclusions should be considered in light of their limitations (Appendix D). Generally, study design to assess mediation was poor. A large proportion of studies failed to report whether

assumptions necessary for mediation were met. 43% of studies were cross-sectional, therefore limiting the ability to make inferences about causal relationships (Boni et al., 2018; Daubenmier 2005; Kishida et al., 2019; Muehlenkamp et al., 2022; Parkinson & Smith, 2023; Rasoulzadeh; Tihanyi et al., 2016). Mediator changes were collected at only one or concurrent time points in the majority of studies, therefore temporal precedence could not be establish and only preliminary proof for proposed mechanisms can be concluded (Kazdin, 2007). Furthermore, the majority of studies used Preacher and Hayes causal steps approach to assess mediation (Curtis et al., 2011; Daubenmier, 2005; Gard et al., 2012; Koch et al., 2020; Muehlenkamp et al., 2022; Parkinson, & Smith, 2023; Rasoulzadeh, 2019; Tihanyi et al., 2016). This method has been criticised for its low statistical power (Mackinnon et al., 2002). The poor design of some studies in assessing mediation means conclusions from this review must interpreted with caution.

Within intervention studies there was a general lack of information or measurement regarding compliance with interventions. This information is necessary to understand whether yoga can account for changes in outcomes. The literature lacked transparency when reporting demographic information of participants. Three studies reported only how many participants were caucasian or white (Gard et al., 2012; Kishida et al., 2019; Muehlenkamp et al., 2022), three studies did not report an age range only means and standard deviations (Koch et al., 2020; Medina et al., 2015; Parkinson, & Smith, 2023). A further three studies reported no information about race and ethnicity (Boni et al., 2018; Rasoulzadeh, 2019; Tihanyi et al., 2016). Where studies are looking at multiple groups, providing a breakdown of demographics per group and considering group differences using chi-square or fisher analysis is needed to aid transparency. The majority of studies looked at American populations, mainly white female populations, further indicating that results may not be generalisable. All studies used convenience sampling, which impacts external validity.

Furthermore, the conceptualisation of “yoga practitioner” varied across studies. Some studies asked participants to self-report (Boni et al., 2018; Daubenmier), others required a minimum of six months of experience (Rasoulzadeh, 2019; Tihanyi et al., 2016), or required someone to practice once per week (Kishida et al., 2019) and others did not state how yoga practitioners were classified at all (Muehlenkamp et al., 2022). Six studies failed to report on any information regarding a person’s current or previous yoga practice (i.e., lengths of practice, frequency, location and engagement in different components) (Curtis et al., 2011; Drapkin, 2019; Gard et al., 2012; Koch et al., 2020; La Rocque et al., 2021; Medina et al., 2015). This is problematic as this information is essential in understanding what results can be generalised to what population and which studies are comparable.

Lastly, a variety of measures for mindfulness and interoception were used, which makes drawing conclusions across studies difficult. An evaluation of mindfulness measures, which included those used in this review (FFMQ, MAAS, PHLMS), found that measures covered different aspects of mindfulness and therefore did not measure the same latent constructs (Bergomi et al., 2013). Similar results have been found for interoception measures including the MAIA and BAQ which were found to measure different constructs (Desmedt et al., 2022). This limits the ability to draw inferences across studies and could lead to inaccurate conclusions (Chess, & Gagnier, 2016). Concepts measured may be distinct processes that have differing influences. The measurement of self-compassion was more consistent across studies, as the SCS or the short form version was used in all studies. This is advantageous when drawing conclusions however becomes an issue when comparing to theory. The SCS is based on Neff's (2003a) conceptualisation of compassion, but Bennetts (2022) uses Gilbert (2010) conceptualisation.

1.4.5 Strengths and limitations of the current review

The current review is the first systematic review looking at mediation studies of yoga. The paper used replicable robust methods including the use of an independent reviewer to review relevant articles and conduct quality assessments. Despite this, the review was subject to several limitations. The researchers did not confine the review to a specific sample or outcomes. This reflects the movement towards looking at mental health from a transdiagnostic perspective, but consequently conclusions cannot be generalised to specific mental health conditions or symptoms. Mechanisms could be unique to specific populations however this was not considered as part of the review. The studies included varied widely in the type of yoga practice looked at, length of practice, population studied, outcome and mediator measures used. This meant a meta-analysis was not feasible and provided challenges when synthesising the data. Styles of yoga might impact mental health and wellbeing differently or through different mechanisms. All studies have looked at yoga as a homogenous practice rather than considering its component parts, this is a key limitation of the literature as theory suggests that components of yoga may yield different psychological benefits (Gard et al., 2014; Gust, 2023; Kashia et al., 2018; Bennetts, 2022).

In line with advice from Kazdin (2007) and previous systematic reviews looking at mediation studies (Gu et al., 2015), only mechanisms with a theoretical basis were included. This means that additional potential mediators were not reviewed. Due to the lack of research, the reviewers chose to include all study designs, meaning that both cross-sectional and RCT

designs were reviewed. Cross-sectional mediation analysis has been criticised as it is unable to assess causal processes and therefore conclusions can be considered misleading (Maxwell, & Cole, 2007). As the number of studies in this area increase reviews may benefit from focusing on RCTs involving longitudinal designs.

1.4.6 Future Research

Future research should use mediation methods to explore mechanisms of change and ensure that they are well designed. This includes considering the theoretical justification for mediators (Kazdin, 2007) and making sure mediators are identified and decided upon before the commencement of studies (Mascha et al., 2013). Well-designed experiments will include randomisation of participants and show changes in the independent variable occur before the dependent variable to assess temporal precedence (Pirlott, & MacKinnon, 2016). Studies could compare yoga to other instructor led exercise classes, to investigate whether therapeutic effects are due to factors specific to yoga. Studies should consider and account for covariates (Kazdin, 2007). Future studies must be adequately powered and use appropriate statistical tests for mediation tests such as SEM (Kazdin, 2007).

Future research may benefit from looking at the component parts of yoga, as suggested by Bennetts (2022). Understanding what mediates the relationship between the eight limbs and psychological benefits will help us to consider what types of yoga interventions could be used clinically and what might be helpful for whom. Future studies could look at the relationship between the component parts of yoga and transdiagnostic mechanisms which will allow for comparisons between yoga and third-wave therapies (Bennetts, 2022).

Future theories and studies should be clear about the conceptualisation of the concepts studied and consider the conceptual overlap between constructs. For example, mindfulness and interoception are considered conceptually similar which has implications for both theory and future research (Gibson, 2019). Mediators must be rooted in theory however future reviews could include this as a quality criterion rather than an exclusion criterion so that all potential mediators are reviewed. Once single mediators have been established, studies could look at potential relationships between mechanisms such as mindfulness and self-compassion, as well as any potential dose effects for yoga interventions.

1.5 Conclusion

The review has shown that there is little literature looking at mechanisms of psychological change in yoga. The majority of studies looked at mindfulness, self-compassion and interoception. These studies provide some evidence to suggest that these could be potential mediators of the relationship between practicing yoga and mental health and wellbeing. These results should be treated with caution due to the methodological limitations in the existing literature. Future research should address these limitations and consider looking at the component parts of yoga.

1.6 References

Alleva, J. M., Tylka, T. L., van Oorsouw, K., Montanaro, E., Perey, I., Bolle, C., ... & Webb, J. B. (2020). The effects of yoga on functionality appreciation and additional facets of positive body image. *Body Image*, 34, 184-195. https://doi.org/10.1016/j.bodyim.2020.06.003

Altman, J. K., Linfield, K., Salmon, P. G., & Beacham, A. O. (2017). The Body Compassion Scale: Development and initial validation. *Journal of Health Psychology*, 1–11. http://dx.doi.org/10.1177/1359105317718924

American Psychological Association (2020) *Dictionary of Psychology: Rumination*, https://dictionary.apa.org/rumination. Accessed on: 23rd Jan 2024

Argyriou, A., Goldsmith, K. A., & Rimes, K. A. (2021). Mediators of the disparities in depression between sexual minority and heterosexual individuals: A systematic review. *Archives of Sexual Behaviour*, 50, 925-959. https://doi.org/10.1007/s10508-020-01862-0

Avalos, L., Tylka, T. L., & Wood-Barcalow, N. (2005). The body appreciation scale: Development and psychometric evaluation. *Body image*, 2(3), 285-297. https://doi.org/10.1016/j.bodyim.2005.06.002

Baer, R., Smith, G.,. Hpokins, J., Krietemeyer, J. & Toney, L., (2006) Using self-report assessment methods to explore facets of mindfulness. *Assesment*, 13, 27-45. https://doi.org/10.1177/1073191105283504

Balaji, P. A., Varne, S. R., & Ali, S. S. (2012). Physiological effects of yogic practices and transcendental meditation in health and disease. *North American journal of medical sciences*, 4(10), 442. Doi: 10.4103/1947-2714.101980

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173. https://doi.org/10.1037// 0022-3514.51.6.1173

Bech, P. (1990). Measurement of psychological distress and well-being. *Psychotherapy and Psychosomatics*, *54*(2-3), 77-89. https://doi.org/10.1159/000288382

Beck, A. T., Steer, R. A. & Brown, G. (1996). *Manual for the beck depression inventory II*. San Antonio: The Psychological Corporation.

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: psychometric properties. *Journal of consulting and clinical psychology*, *56*(6), 893. https://doi.org/10.1037/0022-006X.56.6.893

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. https://doi.org/10.1016/j.ctcp.2021.101514

Bergomi, C., Tschacher, W., & Kupper, Z. (2013). The assessment of mindfulness with self-report measures: Existing scales and open issues. *Mindfulness*, *4*, 191-202. https://doi.org/10.1007/s12671-012-0110-9

Bremberg, S., & Dalman, C. (2015). Constructs, Assessment Methods and Prevalence, Mental Health, *Mental Illness and Mental Health Disorders*. Forte.

Brinsley, J., Schuch, F., Lederman, O., Girard, D., Smout, M., Immink, M. A., ... & Rosenbaum, S. (2021). Effects of yoga on depressive symptoms in people with mental disorders: a systematic review and meta-analysis. *British Journal of Sports Medicine*, *55*(17), 992-1000.

Brotto, L. A., Mehak, L., & Kit, C. (2009). Yoga and sexual functioning: a review. *Journal of sex & marital therapy*, *35*(5), 378-390. https://doi.org/10.1080/00926230903065955

Blanchard, E. B., Jones-Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD Checklist (PCL). *Behaviour research and therapy*, 34(8), 669-673.

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The posttraumatic stress disorder checklist for DSM-5 (PCL-5): Development and initial psychometric evaluation. *Journal of traumatic stress*, 28(6), 489-498. https://doi.org/10.1002/jts.22059

Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K., ... & Zettle, R. D. (2011). Preliminary psychometric properties of the Acceptance and Action Questionnaire–II: A revised measure of psychological inflexibility and experiential avoidance. *Behavior therapy*, 42(4), 676-688. https://doi.org/10.1016/j.beth.2011.03.007

Boni, M., Schütze, R., Kane, R. T., Morgan-Lowes, K. L., Byrne, J., & Egan, S. J. (2018). Mindfulness and avoidance mediate the relationship between yoga practice and anxiety. *Complementary therapies in medicine*, *40*, 89-94. https://doi.org/10.3389/fpsyg.2022.999130

Boniwell, I., & Henry, J. (2007). Developing conceptions of well-being: Advancing subjective, hedonic and eudaimonic theories. *Social Psychology Review*, *9*(1), 3-18. DOI:10.53841/bpsspr.2007.9.1.3

Bohus, M., Limberger, M. F., Frank, U., Chapman, A. L., Kühler, T., & Stieglitz, R. D. (2007). Psychometric properties of the borderline symptom list (BSL). *Psychopathology*, 40(2), 126-132.

Brown, T. A., Cash, T. F., & Mikulka, P. J. (1990). Attitudinal body-image assessment: Factor analysis of the Body-Self Relations Questionnaire. *Journal of Personality Assessment*, 55, 135–144. http://dx.doi.org/10.1207/s15327752jpa5501&2 13

Butterfield, N., Schultz, T., Rasmussen, P., & Proeve, M. (2017). Yoga and mindfulness for anxiety and depression and the role of mental health professionals: a literature review. *The Journal of Mental Health Training, Education and Practice*, *12*(1), 44-54. DOI 10.1108/JMHTEP-01-2016-0002

Camfield, L., Streuli, N., & Woodhead, M. (2009). What's the Use of Well-Being in Contexts of Child Poverty-Approaches to Research, *Monitoring and Children's Participation*. *Int'l J. Child. Rts.*, *17*, 65.

Cardaciotto, L., Herbert, J. D., Forman, E. M., Moitra, E., & Victoria, F. (2008). The assessment of present-moment awareness and acceptance. *Assessment, 15*, 204-223.

Cash, T. F., & Szymanski, M. L. (1995). The development and validation of the Body-Image Ideals Questionnaire. *Journal of personality assessment*, *64*(3), 466-477. https://doi.org/10.1207/s15327752jpa6403_6

Cartwright, T., Mason, H., Porter, A., & Pilkington, K. (2020). Yoga practice in the UK: A cross-sectional survey of motivation, health benefits and behaviours. *BMJ open*, *10*(1), e031848.

Cha, J. E., Boggiss, A. L., Serlachius, A. S., Cavadino, A., Kirby, J. N., & Consedine, N. S. (2022). A systematic review on mediation studies of self-compassion and physical health outcomes in non-clinical adult populations. *Mindfulness*, 13(8), 1876-1900. https://doi.org/10.1007/s12671-022-01935-2

Cohen, J. (1968). Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. *Psychological bulletin*, 70(4), 213. https://doi.org/10.1037/h0026256

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24, 385–396.

Cook, C. C. (2020). Spirituality, religion & mental health: exploring the boundaries. *Mental Health, Religion & Culture*, 23(5), 363-374. https://doi.org/10.1080/13674676.2020.1774525

Cramer, H., Anheyer, D., Lauche, R., & Dobos, G. (2017). A systematic review of yoga for major depressive disorder. *Journal of Affective Disorders*, *213*, 70-77. https://doi.org/10.1016/j.jad.2017.02.006

Cramer, H., Lauche, R., Anheyer, D., Pilkington, K., de Manincor, M., Dobos, G., & Ward, L. (2018). Yoga for anxiety: A systematic review and meta-analysis of randomized controlled trials. *Depression and anxiety*, *35*(9), 830-843. **https://doi.org/10.1002/da.22762**

Cerin, E., Barnett, A., & Baranowski, T. (2009). Testing theories of dietary behavior change in youth using the mediating variable model with intervention programs. *Journal of nutrition education and behavior*, 41(5), 309-318. https://doi.org/10.1016/j.jneb.2009.03.129

Curtis, K., Osadchuk, A., & Katz, J. (2011). An eight-week yoga intervention is associated with improvements in pain, psychological functioning and mindfulness, and changes in cortisol levels in women with fibromyalgia. *Journal of pain research*, 189-201. https://doi.org/10.2147/JPR.S22761

Drapkin, J. (2019). *Integrating Yoga and Self-Psychology: An Open-Trial Pilot Study*. Columbia University.

Daubenmier, J. J. (2005). The relationship of yoga, body awareness, and body responsiveness to self-objectification and disordered eating. *Psychology of women quarterly*, 29(2), 207-219. https://doi.org/10.1111/j.1471-6402.2005.00183.x

Davis, L. W., Schmid, A. A., Daggy, J. K., & Yang, Z. (2023). Mediators of improved PTSD symptoms in veterans and civilians following a yoga program. *Acta Neuropsychiatrica*, 1-9. https://doi.org/10.1017/neu.2023.5

Della Valle, E., Palermi, S., Aloe, I., Marcantonio, R., Spera, R., Montagnani, S., & Sirico, F. (2020). Effectiveness of workplace yoga interventions to reduce perceived stress in employees: A systematic review and meta-analysis. *Journal of functional morphology and kinesiology*, *5*(2), 33. **https://doi.org/10.3390/jfmk5020033**

Desmedt, O., Heeren, A., Corneille, O., & Luminet, O. (2022). What do measures of self-report interoception measure? Insights from a systematic review, latent factor analysis, and

network approach. *Biological Psychology*, *169*, 108289. https://doi.org/10.1016/j.biopsycho.2022.108289

Downs, S. H., & Black, N. (1998). The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *Journal of epidemiology & community health*, 52(6), 377-384. http://dx.doi.org/10.1136/jech.52.6.377

Erkin, Ö., & Şenuzun Aykar, F. (2021). The effect of the yoga course on mindfulness and self-compassion among nursing students. *Perspectives in Psychiatric Care*, *57*(2), 875-882. https://doi.org/10.1111/ppc.12630

Ferentzi, E., Drew, R., Tihanyi, B. T., & Köteles, F. (2018). Interoceptive accuracy and body awareness–Temporal and longitudinal associations in a non-clinical sample. *Physiology & behavior*, *184*, 100-107. https://doi.org/10.1016/j.physbeh.2017.11.015

Field, T. (2016). Yoga research review. *Complementary therapies in clinical practice*, *24*, 145-161. https://doi.org/10.1016/j.ctcp.2016.06.005

Fredrickson, B. L., Tugade, M. M., Waugh, C. E., & Larkin, G. R. (2003). What good are positive emotions in crisis? A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. *Journal of personality and social psychology*, 84(2), 365.

Frisch, M.B., Cornell, J., Villanueva, M., & Retzlaff, P.J. (1992). Clinical validation of the quality of life inventory: A measure of life satisfaction for use in treatment planning and outcome assessment. *Psychological Assessment*, 4, 92–101.

Gaiswinkler, L., & Unterrainer, H. F. (2016). The relationship between yoga involvement, mindfulness and psychological well-being. *Complementary therapies in medicine*, *26*, 123-127. https://doi.org/10.1016/j.ctim.2016.03.011

Gard, T., Brach, N., Hölzel, B. K., Noggle, J. J., Conboy, L. A., & Lazar, S. W. (2012). Effects of a yoga-based intervention for young adults on quality of life and perceived stress: the potential mediating roles of mindfulness and self-compassion. *The Journal of Positive Psychology*, *7*(3), 165-175. https://doi.org/10.1080/17439760.2012.667144

Gard, T., Noggle, J. J., Park, C. L., Vago, D. R., & Wilson, A. (2014). Potential self-regulatory mechanisms of yoga for psychological health. *Frontiers in human neuroscience*, 770. https://doi.org/10.3389/fnhum.2014.00770

Gibson, J. (2019). Mindfulness, interoception, and the body: A contemporary perspective. *Frontiers in psychology*, *10*, 2012 https://doi.org/10.3389/fpsyg.2019.02012

Gilbert, P. (2010). An introduction to compassion focused therapy in cognitive behavior therapy. *International Journal of Cognitive Therapy*, *3*(2), 97-112. https://doi.org/10.1521/ijct.2010.3.2.97

Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of psychopathology and behavioural assessment*, 26(1), 41-54.

Gu, J., Strauss, C., Bond, R., & Cavanagh, K. (2015). How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clinical psychology review*, *37*, 1-12. https://doi.org/10.1016/j.cpr.2015.01.006

Gust, C. J. (2023). *Yoga for Improved Physical and Psychological Health: Understanding Potential Self-regulatory and Neurophysiological Mechanisms of an Ancient Practice*, Doctoral dissertation, University of Colorado at Boulder.

Guyatt, G., Mitchell, A., Irvine, E. J., Singer, J., Williams, N., Goodacre, R., & Tompkins, C. (1989). A new measure of health status for clinical trials in inflammatory bowel disease. *Gastroenterology*, *96*(2), 804-810.

Hamilton, M. (1960). A rating scale for depression. *Journal of Neurology, Neurosurgery, and Psychiatry, 25*, 56–62. Doi: 10.1136/jnnp.23.1.56

Harris, R. (2019). *ACT made simple: An easy-to-read primer on acceptance and commitment therapy*. New Harbinger Publications.

Harvey, R., Andriopoulou, P., & Grogan, S. (2020). Perceived mechanisms of change in therapeutic yoga targeting psychological distress. *Journal of Bodywork and Movement Therapies*, *24*(1), 274-280. https://doi.org/10.1016/j.jbmt.2019.06.014

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication monographs*, *76*(4), 408-420. https://doi.org/10.1080/03637750903310360

Hayes, S. C., & Hofmann, S. G. (2017). The third wave of cognitive behavioral therapy and the rise of process-based care. *World psychiatry*, *16*(3), 245. doi: 10.1002/wps.20442

Hayes, A. F., & Rockwood, N. J. (2017). Regression-based statistical mediation and moderation analysis in clinical research: Observations, recommendations, and

implementation. *Behaviour research and therapy*, *98*, 39-57. https://doi.org/10.1016/j.brat.2016.11.001

Hayes, S. C., Hofmann, S. G., & Ciarrochi, J. (2020). A process-based approach to psychological diagnosis and treatment:The conceptual and treatment utility of an extended evolutionary meta model. *Clinical Psychology Review*, 82, Article 101908. https://doi.org/10.1016/j.cpr.2020.101908

Helliwell, J. F., & Putnam, R. D. (2004). The social context of well–being. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *359*(1449), 1435-1446. https://doi.org/10.1098/rstb.2004.1522

Higgins J,P,T., & Green, S., (eds) (2011). *Cochrane Handbook for systematic reviews of interventions version 5.1. 0.* Cochrane Collaboration

Hofmann, S. G., Andreoli, G., Carpenter, J. K., & Curtiss, J. (2016). Effect of Hatha yoga on anxiety: a meta-analysis. *Journal of Evidence-Based Medicine*, *9*(3), 116-124. **https://doi.org/10.1111/jebm.12204**

Innes, K. E., Bourguignon, C., & Taylor, A. G. (2005). Risk indices associated with the insulin resistance syndrome, cardiovascular disease, and possible protection with yoga: a systematic review. *The Journal of the American Board of Family Practice,* 18(6), 491-519. https://doi.org/10.3122/jabfm.18.6.491

Irving, D. B., Cook, J. L., & Menz, H. B. (2006). Factors associated with chronic plantar heel pain: a systematic review. *Journal of science and medicine in sport*, *9*(1-2), 11-22. https://doi.org/10.1016/j.jsams.2006.02.004

Iyengar, B. K. S. (2005). *Light on yoga: the definitive guide to yoga practice*. Harper Collins

Ivtzan I, Jegatheeswaran S. (2015) The Yoga Boom in Western Society: practitioners' spiritual vs. physical intentions and their impact on psychological wellbeing. *J Yoga Phys Therapy*. https://doi.org/10.4172/2157-7595.1000204.

Kazdin, A. E. (2007). Mediators and mechanisms of change in psychotherapy research. Annual Review of Clinical Psychology, 3, 1–27. https://doi.org/10.1146/annurev.clinpsy.3.022806.091432

Kazdin, A. E. (2009). Understanding how and why psychotherapy leads to change. *Psychotherapy Research*, 19, 418–428. https://doi.org/10.1080/10503300802448899.

Kelley, G. A., & Kelley, K. S. (2020). Yoga, health-related quality of life and mental well-being: a re-analysis of a meta-analysis using the quality effects model. *The Journals of Gerontology: Series A*, *75*(9), 1732-1736. https://doi.org/10.1093/gerona/glz284

Keyes, C. L. (2005). Mental illness and/or mental health? Investigating axioms of the complete state model of health. *Journal of consulting and clinical psychology*, *73*(3), 539. https://doi.org/10.1037/0022-006X.73.3.539

King, D. B. (2009). Rethinking claims of spiritual intelligence: A definition, model, and measure. *Unpublished Master's Thesis, Trent University, Peterborough, Ontario, Canada*.

Kishan, P. (2020). Yoga and spirituality in mental health: Illness to wellness. *Indian journal of psychological medicine*, *42*(5), 411-420. https://doi.org/10.1177/025371762094699

Kishida, M., Mogle, J., & Elavsky, S. (2019). The daily influences of yoga on relational outcomes off of the mat. *International Journal of Yoga*, *12*(2), 103. Doi: 10.4103/ijoy.IJOY_46_18

Kishida, M., Mama, S. K., Larkey, L. K., & Elavsky, S. (2018). "Yoga resets my inner peace barometer": A qualitative study illuminating the pathways of how yoga impacts one's relationship to oneself and to others. *Complementary therapies in medicine*, *40*, 215-221. https://doi.org/10.1016/j.ctim.2017.10.002

Klonsky, E. D., & Glenn, C. R. (2009). Assessing the functions of non-suicidal self injury: Psychometric properties of the Inventory of Statements About Self-Injury (ISAS). *Journal of psychopathology and behavioral assessment, 3*, 215–219. https://doi.org/10.1007/s10862-008-9107-z

Koch, A. K., Schöls, M., Langhorst, J., Dobos, G., & Cramer, H. (2020). Perceived stress mediates the effect of yoga on quality of life and disease activity in ulcerative colitis. Secondary analysis of a randomized controlled trial. *Journal of psychosomatic research*, *130*, 109917. https://doi.org/10.1016/j.jpsychores.2019.109917

Iacobucci, D., Saldanha, N., & Deng, X. (2007). A meditation on mediation: Evidence that structural equations models perform better than regressions. *Journal of consumer psychology*, *17*(2), 139-153. https://doi.org/10.1016/S1057-7408(07)70020-7

La Rocque, C. L., Mazurka, R., Stuckless, T. J., Pyke, K., & Harkness, K. L. (2021). Randomized controlled trial of bikram yoga and aerobic exercise for depression in women: Efficacy and stress-based mechanisms. *Journal of Affective Disorders*, *280*, 457-466. https://doi.org/10.1016/j.jad.2020.10.067

Lee, R. M., & Robbins, S. B. (1995). Measuring belongingness: The social connectedness and the social assurance scales. *Journal of counselling psychology*, 42(2), 232.

Levenstein, S., Prantera, C., Varvo, V., Scribano, M. L., Berto, E., Luzi, C., & Andreoli, A. (1993). Development of the Perceived Stress Questionnaire: a new tool for psychosomatic research. *Journal of psychosomatic research*, 37(1), 19-32.

Lovibond, S. H. (1995). Manual for the depression anxiety stress scales. Sydney psychology foundation.

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

Lubans, D. R., Foster, C., & Biddle, S. J. (2008). A review of mediators of behavior in interventions to promote physical activity among children and adolescents. *Preventive medicine*, 47(5), 463-470. https://doi.org/10.1016/j.ypmed.2008.07.011

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological methods*, *7*(1), 83. Doi: 10.1037/1082-989x.7.1.83

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate behavioural research*, *39*(1), 99-128.

MacKinnon, D. P., Fairchild, A. J., & Fritz, M. S. (2007). Mediation analysis. *Annual Review of Psychology, 58*, 593–614. https://doi.org/10.1146/annurev.psych.58.110405.085542

MacKinnon, D. (2008). *Introduction to statistical mediation analysis*. New York, NY: Routledge

Mansell, G., Kamper, S. J., & Kent, P. (2013). Why and how back pain interventions work: what can we do to find out?. *Best practice & research Clinical rheumatology*, 27(5), 685-697. https://doi.org/10.1016/j.berh.2013.10.001

Maric, M., Wiers, R. W., & Prins, P. J. (2012). Ten ways to improve the use of statistical mediation analysis in the practice of child and adolescent treatment research. *Clinical Child and Family Psychology Review, 15*, 177–191. https://doi.org/10.1007/ s10567-012-0114-y

Mascha, E. J., Dalton, J. E., Kurz, A., & Saager, L. (2013). Understanding the mechanism: Mediation analysis in randomized and nonrandomized studies. *Anaesthesia & Analgesia*, *117*(4), 980-994. DOI: 10.1213/ANE.0b013e3182a44cb9

Maxwell, S. E., & Cole, D. A. (2007). Bias in cross-sectional analyses of longitudinal mediation. *Psychological methods*, *12*(1), 23. https://doi.org/10.1037/1082-989X.12.1.23

Medina, J., Hopkins, L., Powers, M., Baird, S. O., & Smits, J. (2015). The effects of a hatha yoga intervention on facets of distress tolerance. *Cognitive Behaviour Therapy*, *44*(4), 288-300. https://doi.org/10.1080/16506073.2015.1028433

Mehling, W. E., Price, C., Daubenmier, J. J., Acree, M., Bartmess, E., & Stewart, A. (2012). The multidimensional assessment of interoceptive awareness (MAIA). *PloS one*, 7(11), e48230. https://doi.org/10.1371/journal.pone.0048230

Menzel, J. E. (2010). The psychometric validation of the Physical Body Experiences Questionnaire Retrieved from. http://scholarcommons.usf.edu/etd/1710

McCall, M. C. (2013). How might yoga work? An overview of potential underlying mechanisms. *Journal of Yoga & Physical Therapy*, *3*(1), 1. http://dx.doi.org/10.4172/2157-7595.1000130

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., ... Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: Elaboration and explanation. *Systematic Reviews, 4*(1). https://doi.org/10.1136/bmj.g7647

Muehlenkamp, J. J., & Wagner, E. M. (2022). Yoga and non suicidal self-injury: Mediational effects of self-compassion and body appreciation. *Body image*, *43*, 17-24. https://doi.org/10.1016/j.bodyim.2022.08.001

Neff, K. D. (2003)a. The development and validation of a scale to measure self-compassion. *Self and identity*, *2*(3), 223-250. https://doi.org/10.1080/15298860309027

Neff, K. (2003)b. Self-compassion: An alternative conceptualization of a healthy attitude toward oneself. *Self and identity*, *2*(2), 85-101. https://doi.org/10.1080/15298860309032

Niles, B. L., Mori, D. L., Polizzi, C., Pless Kaiser, A., Weinstein, E. S., Gershkovich, M., & Wang, C. (2018). A systematic review of randomized trials of mind-body interventions for PTSD. *Journal of clinical psychology*, *74*(9), 1485-1508. **https://doi.org/10.1002/jclp.22634**

Nilsson, H., & Kazemi, A. (2016). Reconciling and thematizing definitions of mindfulness: The big five of mindfulness. *Review of General Psychology*, *20*(2), 183-193. https://doi.org/10.1037/gpr0000074

Nolen-Hoeksema, S., & Morrow, J. (1991). A prospective study of depression and posttraumatic stress symptoms after a natural disaster: the 1989 Loma Prieta earthquake. *Journal of Personality and Social Psychology, 61*, 115-121.

Ong, C. W., Ciarrochi, J., Hofmann, S. G., Karekla, M., & Hayes, S. C. (2024). Through the extended evolutionary meta-model, and what ACT found there: ACT as a process-based therapy. *Journal of Contextual Behavioral Science*, 100734. https://doi.org/10.1016/j.jcbs.2024.100734

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Systematic reviews*, *10*(1), 1-11.

Parkinson, T. D., & Smith, S. D. (2023). A cross-sectional analysis of yoga experience on variables associated with psychological well-being. *Frontiers in Psychology*, *13*, 999130. https://doi.org/10.3389/fpsyg.2022.999130

Pirlott, A. G., & MacKinnon, D. P. (2016). Design approaches to experimental mediation. *Journal of experimental social psychology*, *66*, 29-38. https://doi.org/10.1016/j.jesp.2015.09.012

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. Behavior Research Methods, Instruments, & Computers: *A Journal of the Psychonomic Society*, 36(4), 717–731, Retrieved from http://search.proquest.com/docview/67232339?accountid=14182.

Rachmilewitz, D. (1989). Coated mesalazine (5-aminosalicylic acid) versus sulphasalazine in the treatment of active ulcerative colitis: a randomised trial. *British Medical Journal*, 298(6666), 82-86.

Raes, F., Pommier, E., Neff, K. D., & Van Gucht, D. (2011). Construction and factorial validation of a short form of the self-compassion scale. *Clinical psychology & psychotherapy*, 18(3), 250-255. https://doi.org/10.1002/cpp.702

Rasoulzadeh, H. Q. (2019). *Emotion regulation and rumination mediate the relation between yoga experience and psychological health in a non-clinical Indian population*. Halmstad University

Riley, K. E., & Park, C. L. (2015). How does yoga reduce stress? A systematic review of mechanisms of change and guide to future inquiry. *Health psychology review*, *9*(3), 379-396. https://doi.org/10.1080/17437199.2014.981778

Rhodes, R. E., & Pfaeffli, L. A. (2010). Mediators of physical activity behaviour change among adult non-clinical populations: a review update. *International Journal of Behavioral Nutrition and Physical Activity*, 7, 1-11. https://doi.org/10.1186/1479-5868-7-37

Salaheddin, K., & Mason, B. (2016). Identifying barriers to mental health help-seeking among young adults in the UK: a cross-sectional survey. *British Journal of General Practice*, *66*(651), e686-e692. https://doi.org/10.3399/bjgp16X687313

Salmon, P., Lush, E., Jablonski, M., & Sephton, S. E. (2009). Yoga and mindfulness: Clinical aspects of an ancient mind/body practice. *Cognitive and behavioural practice*, *16*(1), 59-72. https://doi.org/10.1016/j.cbpra.2008.07.002

Shallit, S. (2018). *Yoga for depression and anxiety among women with eating pathology: Roles of mindfulness and self-compassion* Doctoral dissertation, Alliant International University

Shields, S., Mallory, M., & Simon, A. (1989). The body awareness questionnaire: Reliability and validity. *Journal of Personality Assessment*, 53, 802–815. https://doi.org/10.1207/s15327752jpa5304_16

Simons, J.S., & Gaher, R.M. (2005). The Distress Tolerance Scale: Development and validation of a self-report measure. *Motivation and Emotion*, 29, 83–102. doi:10.1007/s11031-005-7955-3

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological methodology*, *13*, 290-312. https://doi.org/10.2307/270723

Sullivan, M. J., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: development and validation. *Psychological assessment*, 7(4), 524. https://doi.org/10.1037/1040-3590.7.4.524

Tang, Y. Y., Tang, R., & Gross, J. J. (2019). Promoting psychological well-being through an evidence-based mindfulness training program. *Frontiers in human neuroscience*, *13*, 237. https://doi.org/10.3389/fnhum.2019.00237

Tihanyi, B., Böőr, P., Emanuelsen, L., & Köteles, F. (2016). Mediators between yoga practice and psychological well-being: Mindfulness, body awareness and satisfaction with body image. *European Journal of Mental Health*, *11*(1-2), 112-127.

Trapnell, P. D., & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. *Journal of personality and social psychology*, *76*(2), 284.

Tylka, T. L., & Wood-Barcalow, N. L. (2015). The Body Appreciation Scale-2: Item refinement and psychometric evaluation. *Body Image*, 12, 53–67. http://dx.doi.org/10.1016/j.bodyim.2014.09.006

Van Dam, N. T., Sheppard, S. C., Forsyth, J. P., & Earleywine, M. (2011). Self-compassion is a better predictor than mindfulness of symptom severity and quality of life in mixed anxiety and depression. *Journal of anxiety disorders*, *25*(1), 123-130. https://doi.org/10.1016/j.janxdis.2010.08.011

Van Strien, T., Frijters, J.E.R., van Staveren, W.A., Defares, P.B., & Deurenberg, P. (1986). The predictive validity of the Dutch Restrained Eating Scale. *International Journal of Eating Disorders*, 5, 747–755. doi:10.1002/1098-108X(198605)5:4,747:AID-EAT2260050413.3.0.CO;2-6

Vo, T. T., Cashin, A., Superchi, C., Tu, P. H. T., Nguyen, T. B., Boutron, I., ... & Vansteelandt, S. (2022). Quality assessment practice in systematic reviews of mediation studies: results from an overview of systematic reviews. *Journal of Clinical Epidemiology*, 143, 137-148. https://doi.org/10.1016/j.jclinepi.2021.12.013

Weathers, F. W., Blake, D. D., Schnurr, P. P., Kaloupek, D. G., Marx, B. P., & Keane, T. M. (2016). The clinician-administered PTSD scale for DSM-5 (CAPS-5). 2013. *Interview available from the National Center for PTSD*

West, J., Otte, C., Geher, K., Johnson, J., & Mohr, D. C. (2004). Effects of hatha yoga and African dance on perceived stress, affect, and salivary cortisol. *Annals of Behavioral Medicine*, 28(2), 114–118. doi:10.1207/s15324796abm2802_6

World Health Organization (2019). *International Statistical Classification of Diseases and Related Health Problems (11th ed.)*. https://icd.who.int

Zhang, Y., Lauche, R., Cramer, H., Munk, N., & Denniw, J. A. (2021). Increasing trend of yoga practice among U.S. adults from 2002 to 2017. *The Journal of Alternative and Complementary Medicine, 27*(9), 778-785.

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta psychiatrica scandinavica*, *67*(6), 361-370.

Zoogman, S., Goldberg, S. B., Vousoura, E., Diamond, M. C., & Miller, L. (2019). Effect of yoga-based interventions for anxiety symptoms: A meta-analysis of randomized controlled trials. *Spirituality in Clinical Practice*, *6*(4), 256. https://doi.org/10.1037/scp0000202

Chapter 2 Empirical Paper

Could yoga improve psychological flexibility? A cross-sectional study exploring the limbs of yoga, psychological wellbeing and psychological flexibility.

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: 7721 (excluding abstract, tables and references)

Abstract

Background and Purpose

Current therapies for mental health difficulties may not be acceptable or work for everyone. Yoga has gained attention as a possible alternative treatment for mental health difficulties. Recent theory has suggested that yoga may share mechanisms of change with third-wave therapies. The current study aims to understand if those who practice yoga have higher levels of psychological wellbeing and psychological flexibility, and lower levels of psychological inflexibility. Further exploring the relationship between engaging with the eight limbs of yoga during yoga practice and psychological wellbeing, flexibility and inflexibility.

Methods

Using a questionnaire, this cross-sectional study recruited yoga practisers (*n* = 227) and non-yoga practisers (*n* = 236) from the general public between August to November 2023. Participants were required to complete demographic details and measures of psychological wellbeing, flexibility and inflexibility. The yoga group completed additional questions about their practice including a questionnaire designed by the research team to establish how much their practice encouraged the eight limbs of yoga. A MANOVA was used for group comparisons. Correlation and regression analysis looked at the relationship between wellbeing, flexibility, inflexibility and the eight limbs of yoga.

Results

Results showed that yoga practisers had significantly higher levels of wellbeing and psychological flexibility, and significantly lower levels of psychological inflexibility compared to non-yoga practisers. All eight limbs correlated with psychological wellbeing, flexibility and inflexibility. All individual yamas and niyamas correlated with psychological flexibility. The majority of yamas and niyamas correlated with wellbeing except for isvara pranidhana. Isvara pranidhana, savadhaya and saucha did not correlate with psychological inflexibility. Regression models showed that each of the eight limbs predicted wellbeing, flexibility and inflexibility. Ahimsa was shown to significantly predict psychological flexibility. Satya was shown to significantly predict psychological inflexibility.

Conclusion

The findings provide preliminary evidence for the psychological benefits of the eight limbs of yoga. More research is needed to draw conclusions about whether yoga and ACT share mechanisms of change. Much of the current research reduces yoga to movement, breathwork and meditation at expense of looking at the yamas and niyamas. This study suggests that these

ethical teachings are an important part of how yoga improves psychological wellbeing, flexibility and inflexibility.

Keywords: Yoga, Psychological Flexibility, ACT, Mental health, Wellbeing, Psychology,

2.1 Introduction

The most common treatments for mental health problems in the UK are psychotropic medication and talking therapies (Huhn et al., 2014). Medications such as anti-depressants, anti-psychotics, benzodiazepines and mood stabilisers are beneficial for anxiety and depression (Baldwin et al., 2005; Newcomer, 2007). However, individuals can have difficulties with adherence, unwanted side effects, acceptability and overprescribing (Julius et al., 2009; Kendrick & Pilling, 2012). Alternatively, talking therapies such as Cognitive Behavioural Therapy (CBT) is effective for a wide range of mental health problems (Cuijpers et al, 2019; Hofmann et al, 2012) and has higher levels of acceptability than medication (Deacon, & Abramowitz, 2005). However, CBT also has high levels of remission and relapse (Springer et al., 2018) and is not effective for everyone (Santoft et al., 2019). Research suggests that many of those with mental health difficulties do not engage in psychological treatment, due to difficulties talking about their problems and stigmatising beliefs about mental health and accessing therapy (Salaheddin, & Mason., 2016). Consequently, there is a need to explore alternative or adjunct approaches.

Psychologists have shown an interest in complementary therapies i.e., practices that are not part of conventional medicine and often not integrated into a country's healthcare system (Thomson-Casey et al., 2023). These include supplements, herbal medicines, yoga, aromatherapy, meditation and massage (De Jonge et al, 2018). Mind-body approaches are one type of complementary therapy, these are designed to impact the mind's capacity to affect bodily functions and symptoms and include yoga, relaxation and meditation (The National Centre for Complementary and Alternative Medicine, 2012). There is growing evidence that mind-body approaches may be an effective and favourable treatment for mental health difficulties (Brosnan et al., 2021; Elkins et al., 2005; Hansen, & Kristofferson, 2016). It has even been suggested complementary therapies should be integrated into psychological practice (Barnett, & Shale, 2012; Capon et al., 2019; Park, & Slattery, 2021). Yoga is now recommended as part of a holistic approach to trauma care due to the importance of treating the mind and body (Van der Kolk, 2014).

2.1.1 Yoga

Yoga is an ancient practice from India that originated to improve physical and mental health (Singleton, 2010). It is growing in popularity as a holistic approach to health and wellbeing in the West (Cramer et al., 2016; Cramer et al., 2017, Cramer et al., 2019). Yoga includes physical postures (asana), levels of meditation (pratyahara, dharana, dhyana), breathing (pranayama), enlightenment (samadhi) and ethical principles (yamas and niyamas); combined these are known as the eight limbs of yoga (Bryant, 2015; Satchidananda, 2012). Definitions of each limb can be found in Table 4.

Table 4

Definitions of the eight *limbs of yoga (Satchidananda, 2012; Schmid 2021)*

Limb	Sub-Limb	Definition
Yama		Guidance for how we should engage in everyday life or our personal conduct
	Ahimsa	Ahimsa is related to non-violence and compassion to oneself, this includes avoiding physical violence and violent words or thoughts towards oneself and others
	Satya	Satya is living with honesty and truthfulness
	Asteya	Asteya is related to non-stealing, this can be physical objects or our own or others time or happiness. '*If focused on the past or future the individual is potentially stealing from their time in the present*.' (Schmid et al, 2021, p.129)
	Brahmacharya	Brahmacharya refers to both celibacy and moderation in regulating one's energy and managing excessive energy and feelings
	Aparigraha	Aparigraha refers to non-hording and non-greediness and not being attached to material items
Niyama		Ethical teachings which provide guidance for everyday life
	Saucha	Saucha is related to purity and cleanliness of both the environment but also one's mind and body
	Santosha	Santosha is being content and happy with life as it is
	Tapas	Tapas refers to focused effort and self-discipline therefore being willing to do the work and learn

	Svadhyaya	Svadhyaya refers to self-study and includes awareness of one's habits, thoughts and behaviours
	Isvara Pranidhana	Isvara Pranidhana is surrendering to the divine or higher power
Asana		Asana is the physical postures, poses and movements in yoga
Pranayama		Pranayama refers to control of the breath, breath practices can be pared with asana or used on its own
Pratyahara		Pratyahara is a meditation practice which translates to withdrawal of the senses, therefore drawing the attention inwards
Dharana		Dharana means focused attention, concentrating on a single point of attention or an object
Dhyana		Dhyana is meditative absorption, connecting with rather than just observing the object of dharana
Samadhi		Samadhi refers to connecting to the divine to achieve oneness or a bliss state

There is good evidence supporting the psychological benefits of yoga for anxiety (Hofmann et al., 2016; Park, & Slattery, 2021; Zoogman, 2019), depression (Brinsley et al., 2021; Park, & Slattery, 2021), post-traumatic stress disorder (Niles et al., 2018; Park, & Slattery, 2021), eating disorders (Park, & Slattery, 2021), wellbeing (Hendriks et al., 2017) and work related stress (Della Valle et al., 2020). Furthermore, individuals with anxiety, depression and PTSD are reported to find yoga as acceptable and feasible as an adjunct to psychological therapies (Capon et al., 2019). Yoga offers an alternative to talking about one's experiences (Salaheddin & Mason, 2016). However, due to high levels of heterogeneity among yoga practices, poor standardisation and reporting of yoga interventions within research, it is difficult to establish what aspects of yoga may be beneficial for whom (Field, 2016; Jeter et al., 2013).

2.1.2 Yoga: psychological mechanisms of change

Despite yoga's efficacy, little is known about the potential psychological mechanisms. A few review papers have aimed to bring together existing research looking at yoga and

psychological mechanisms of change within a health context (Brotto et al., 2009; Innes et al., 2005; McCall, 2013) and for stress (Riley, & Park., 2016). However, these reviews concluded there is a lack of empirical evidence looking at psychological mechanisms of change, therefore evidence was insufficient to draw conclusions about specific mechanisms. The systematic review outlined in chapter one provides an up-to-date review of studies exploring mediators of yoga practice and psychological wellbeing and mental health outcomes (Fox et al., 2024). Potential mediators identified included mindfulness, self-compassion and interoception.

Existing empirical research has tended to look at yoga as a homogenous practice, failing to look at the impact of the different limbs (Matko et al., 2021). Only 37% of yoga intervention studies detailed the components utilised in the study, those studies that did focus on postures, breath work and meditation while other limbs were ignored (Elwy et al., 2014). In particular, the philosophical and ethical teaching of yoga (yamas and niyamas) have been neglected in research (Govindaraj et al., 2016). To the researcher's knowledge only one study exists which looks at the yamas and niyamas and psychological concepts (Schmid et al., 2021). In this study, veterans were interviewed after completing a 16-week yoga program, it was found that despite the intervention not explicitly teaching yama and niyama principles, those attending classes had taken away elements of the philosophical teachings through their practice. Studying the limbs of yoga has been a challenge due to the lack of validated measures (Bennetts, 2022; Matko et al., 2021; Schmid et al., 2015).

Theoretical models have contemplated how yoga yields psychological wellbeing. The self-regulatory model suggests that yoga improves the regulation of cognition, emotions, behaviours and physiology (Gard et al., 2014; Gust, 2023). Alternatively, Kishida et al., (2018) theorise that yoga increases self-compassion, compassion to others, social connectedness and mindfulness while acknowledging that individual and social factors may moderate the impact of yoga on wellbeing. However, these theories have been criticised for simplifying the eight limbs of yoga into four facets: ethical principles, breath regulation, postures and meditation. Understanding the differences between and the impact of each limb is important for the design of interventions for mental health, as interventions could be designed to target specific psychological symptoms (Bennetts, 2022; Matko et al., 2021; Sullivan et al., 2018).

Addressing these criticisms, Bennetts' (2022) theoretical model considers how each limb, including each ethical component (yamas and niyamas), may target transdiagnostic processes that maintain mental health problems. It is suggested that psychological factors responsible for the therapeutic effects of yoga may be the same as those targeted in talking therapies for common mental health disorders (Bennetts, 2022; O'Shea, 2022). Exploring this idea, Pick et al., (in prep) looked at the relationship between specific limbs of yoga (ahimsa,

pranayama, dharana) and the three flows of compassion. Ahimsa was shown to predict wellbeing and all three flows of compassion (Gilbert et al., 2017). This suggests that the inclusion of ahimsa may target processes involved with compassion-focused therapy as predicted by Bennetts (2022). Bennetts' (2022) model predicts that there is a conceptual overlap between each of the eight limbs of yoga and Acceptance and Commitment Therapy (ACT), however further research is needed to substantiate this claim.

2.1.3 Acceptance and Commitment Therapy

The theoretical roots of ACT lie within functional contextualism (Hayes, & Greg, 2001) and relational frame theory (Hayes et al., 2001). ACT is a trans-diagnostic approach that combines mindfulness, acceptance strategies, and behavioural change interventions to reduce experiential avoidance, increase psychological flexibility and decrease psychological inflexibility (Harris, 2019). Several definitions of psychological flexibility exist in the literature but it is generally agreed that psychological flexibility is being open to our inner experiences in the moment and adjusting our behaviour to act in alignment with our values (Harris, 2019). Conversely, psychological inflexibility is a rigid response to internal experiences that interfere with living according to one's values (Hayes et al., 2011). Psychological flexibility is a transdiagnostic process known to be relevant across psychological disorders (Levin et al, 2014). ACT conceptualises psychological flexibility and inflexibility as umbrella terms made up of six processes each, see Table 5 (Hayes et al., 2006).

Table 5

Definitions of the core ACT processes (Harris, 2019; Ong et al., 2024; Rolffs et al., 2018)

Core ACT Processes	Definition
	Psychological Flexibility
Present moment awareness	The ability to make full conscious contact with one's inner and outer world and to narrow, broaden, shift or sustain focus depending on what is most useful
Values	Staying connected to areas of life that are important, giving direction to behaviours

Acceptance	Openness to emotions, sensations, images, memories and other internal experiences or private events
Defusion	Being able to step back from unwanted experiences without getting stuck in them
Self as context	Keeping perspective of oneself by understanding thoughts occur in a context and therefore one is not the content of their thoughts
Committed action	Maintaining behaviours that move toward important aspects of life
	Psychological Inflexibility
Lack of contact with the present moment	The inability to pay attention to what is going on both internally or externally in any given moment
Lack of contact with values	Being disconnected or unable to identify one's meaningful values so they do not guide one's actions
Experiential avoidance	The ongoing attempt to get rid of, avoid, or escape from unwanted experiences such as thoughts, feelings and memories
Fusion	Attachment to or excessive control of thoughts, thoughts dominate physical actions and awareness to a problematic extent
Self as content	A storied self-narrative or making judgements about experiences resulting in a narrower view of self
Inaction	Patterns of behaviours which pull people away from mindful values-based living

Psychological flexibility and inflexibility are seen as distinct but interconnected concepts (Cherry et al., 2021; Chiarrochi et al., 2014; Morris, & Mansell, 2018). Consistent with this distinction, research has found that the 12 dimensions of flexibility and inflexibility are correlated but separate (Rolff et al., 2018). This suggests that flexibility is not simply the absence of inflexibility, therefore individuals could show both across a range of contexts and situations.

ACT is effective for anxiety, depression, addiction, quality of life, chronic pain and somatic health complaints in both clinical and non-clinical populations (A-tjak et al., 2015; Bai et al., 2020; Gloster et al., 2020; Han, & Kim, 2022; Smout et al., 2012; Stenhoff et al., 2020). Psychological flexibility is positively associated with psychological wellbeing and mental health

(Bluett et al., 2014; Dawson, & Golijani-Moghaddam, 2020; Kashdan, & Rottenberg, 2010), whereas psychological inflexibility has been associated with anxiety, depression, stress, disordered eating and substance abuse (Bluett et al., 2016; De Boer et al., 2014; Gilbert et al., 2019; Luoma et al., 2011; Tavakoli et al., 2019).

2.1.4 ACT: psychological mechanisms of change

There is substantial evidence that psychological flexibility is a key mechanism through which ACT yields psychological benefit. A recent systematic review of mediation studies found empirical support that psychological flexibility mediates ACT and psychological wellbeing (Stockton et al., 2019). However, a major criticism of the psychological flexibility literature is the wide use of the AAQ-II measure (Bond et al., 2011). The AAQ-II has received criticism for reducing psychological flexibility to a single dimension despite theory stating it is made up of 12 distinct dimensions (Rolffs et al., 2018). Furthermore, the construct validity of the AAQ-II has been questioned, as it appears to measure negative affect rather than psychological flexibility (Rochefort et al., 2018; Wolgast, 2014).

There is limited research into the core processes underlying psychological flexibility. Some evidence supports acceptance and cognitive defusion as possible mediators between ACT and both quality of life and mental health symptoms (Stockton et al., 2019). More research is needed to understand whether specific facets of psychological flexibility are distinct psychological mechanisms of change within ACT.

2.1.5 Yoga and ACT: shared mechanisms

Focusing on the relationship between yoga and ACT is timely due to the recent calls for psychological therapies to move away from syndrome-specific treatment protocols towards a process-based approach (Hayes et al., 2020). Process-based therapies aim to offer an individualised treatment approach which targets empirically established biopsychological processes of change (Ong et al., 2024). This has clinical and research implications. If philosophically and theoretically justified, any techniques (including yoga) that work through the same transdiagnostic mechanisms as ACT, could be considered consistent with a psychological flexibility approach. Engagement in yoga and psychological therapies could

result in enhanced therapeutic outcomes, compared to either intervention alone (Capon et al., 2019).

Consistent with this ethos, Gordon & Boroshuk (2019) present a protocol for the integration of yoga and ACT, however, there is little empirical evidence for the protocol to date. A recent review of qualitative studies by Capon et al., (2019) found benefits reported from practicing yoga replicated outcomes achieved through psychotherapeutic techniques consistent with CBT (Capon et al., 2019). For example, yoga was seen to have a positive impact on negative thought patterns through shifts in perspectives, greater mental clarity and increased calm and coping abilities. This provides evidence for the overlap between yoga and third-wave therapies, as well as indicating yoga's potential to be an adjunct to therapy (Bennetts, 2022).

It could be argued that there is a conceptual overlap between yoga and ACT: both emphasise acceptance, being open to experiences, values, committed intentional action, non-attachment, cognitive defusion, reducing experiential avoidance, mindfulness, connecting to one's true self, stilling the mind, developing an understanding of the self while being committed to reducing suffering and bringing about change (See Bennetts for a comprehensive overview, 2022; Briggs, 2016; Dick et al., 2014; Lundgren, 2008). In addition, both approaches view distress as an inevitable part of the human experience, which should not be ignored but used as a source of information (Gorden, & Broushok, 2019). Furthermore, Stahl and Drake (2014) add that yoga and ACT have complementary goals in connecting people flexibly to their experiences. Though they use different ways to do this, each approach encourages acceptance of experiences, acknowledging thoughts and feelings with curiosity and observing without changing them. Both approaches encourage individuals to recognise how they can take care of themselves both physically and psychologically.

2.1.6 Yoga and ACT: empirical evidence for shared mechanisms

In support of potential shared mechanisms, empirical evidence suggests that yoga may increase psychological flexibility. Despite finding no significant difference between yoga and control conditions in the reduction of PTSD symptoms, this reduction was associated with increased psychological flexibility for the yoga condition (Dick et al., 2014). Neither group were given information about PTSD symptoms, but the yoga instructor did talk about unwanted emotions and sensations which was not included in the control group. They concluded that the yoga participants were able to apply what they had learned through yoga to increase psychological flexibility, which resulted in a reduction of PTSD symptoms. Further yoga intervention studies have found higher levels of psychological flexibility to be significantly

associated with lower PTSD and perceived stress (Avery et al., 2018). For students with PTSD and symptoms of borderline personality disorder, psychological flexibility mediated a reduction in symptoms and yoga practice (Drapkin, 2019). A limitation of these studies is the use of the AAQ-II to measure psychological flexibility (Bond et al., 2011).

When yoga has been used as an adjunct to CBT, enhanced engagement and outcomes, and reduced dropouts were found compared to CBT alone (Capon et al., 2021; O'Shea et al., 2022; Vorkapic, & Range, 2014). Two studies that looked at the efficacy of delivering combined yoga and ACT interventions found yoga did not add to the effectiveness of ACT (Briggs, 2016; Mullen et al., 2021). However, Briggs (2016) study was underpowered. Whereas Mullen's et al., (2021) study looked only at one session, students were not randomised and the interventions had poor attrition rates. Although not significant, slightly greater improvements in depression, mindfulness, acceptance and quality of life were observed for the group that received ACT with yoga (Mullins et al., 2021). Further research that is adequately powered and looks at those who regularly practice yoga is needed to understand whether there is a relationship between yoga and psychological flexibility.

2.1.7 Rationale for study

The heterogeneity of yoga research has led to difficulties drawing conclusions about what is helpful for whom (Riley, & Park, 2015). One solution is to look at the eight limbs of yoga which could allow for comparisons to be made across different types of yoga, with transdiagnostic mechanisms and talking therapies (Bennetts, 2022; Matko et al., 2021). Yoga may work through the same transdiagnostic mechanisms as third-wave approaches however empirical research is needed to substantiate this (Bennetts, 2022). Particular interest has been shown in the overlap between yoga and ACT (Bennetts, 2022; Gorden, & Broushok, 2019; Stah, & Drake, 2014). As such this study will look at the relationship between the eight limbs and psychological wellbeing, flexibility and inflexibility. The study will aim to address criticisms of existing literature by using the Multidimensional Psychological Flexibility Inventory (Rolffs et al., 2018) rather than the AAQ-II (Bond et al., 2011), and constructing a new self-report measure to assess the inclusion of the individual eight limbs of yoga via self-report. In line with Bennetts (2022) transdiagnostic model of yoga this study hypothesises that:

1. Those who practice yoga will have higher levels of psychological wellbeing and psychological flexibility and lower levels of psychological inflexibility compared to those who do not practice.

2. The eight limbs will positively correlate with psychological wellbeing and psychological flexibility and negatively correlate with psychological inflexibility.
3. The eight limbs will predict scores of psychological wellbeing, psychological flexibility and psychological inflexibility.
4. Each of the ethical components of yamas and niyamas will predict psychological flexibility and psychological inflexibility.

No specific hypothesis are made about which of the limbs will relate to what psychological outcomes, as each of the limbs are conceptually linked with ACT and therefore each would be expected to related to psychological flexibility and inflexibility.

2.2 Method

2.2.1 Ethical considerations

The current study was approved by University of Southampton Ethics and Research Governance Committee (ERGO ethics number: 81567; Appendix G). Informed consent was obtained from all participants via an online consent statement (Appendix H).

2.2.2 Design

The study utilised a cross-sectional design looking at the relationship between yoga practice and wellbeing , psychological flexibility and inflexibility. For hypothesis one, a between-subjects design was used comparing two levels: yoga practisers vs non yoga practisers. For hypothesis two, three and four a within-subjects design were used comparing the limbs of yoga to the psychological wellbeing, flexibility and inflexibility.

2.2.3 Power Analysis

Power analyses were conducted a priori using G*Power (version 3.1.9.2; Faul et al, 2013). Assuming a medium effect size and a power .80, in line with Pick et al (in prep) who used the same methods, a minimum of 118 participants (per group) was suggested for multiple regression with ten predictors. The maximum predictors used in the analysis was 10 which was the individual yamas (n = 5) and niyamas (n = 5)

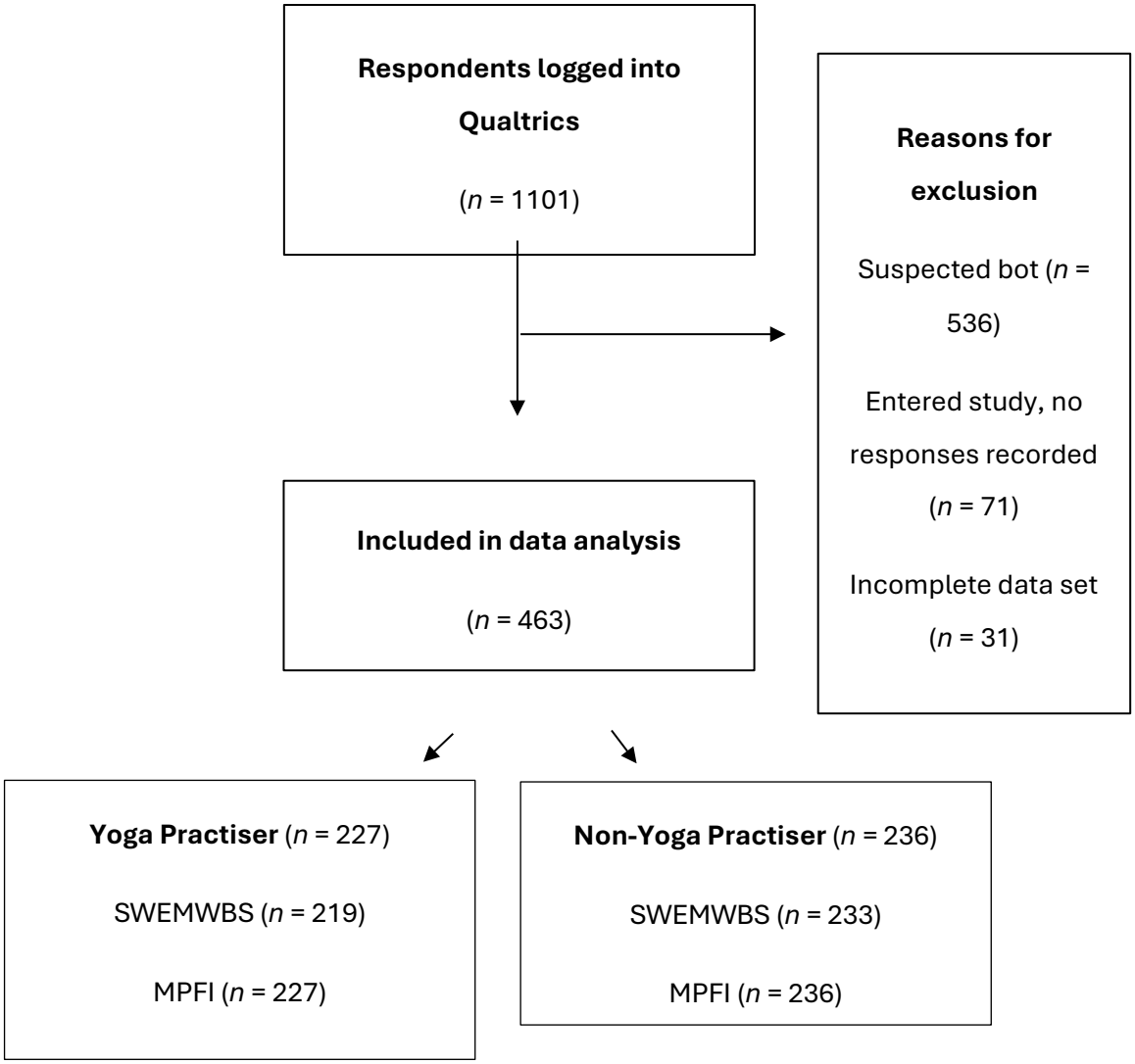
2.2.4 Participants

Participants were eligible for the study if they were over 18 years old and fluent in English. Consistent with previous research (Pick et al., in prep), participants were included in the yoga practisers group if they had reported practising yoga at least twice a month. A total of 1101 responses were received. 463 responses were included in the analysis (227 yoga practisers/236 non-yoga practisers). Figure 2 displays a consort diagram of participant movement through the study.

As a result of high and quick response rates in the first seven days, the researchers suspected a number of responses were bots. Bots are automated form fillers produced by computer programs to complete online forms randomly and systematically (Rauchfleisch, & Kasier, 2020). In response, a bot criterion was developed and applied to the dataset (see Appendix I). This resulted in excluding responses with a Qualtrics ReCAPTCHA score of under .5 and responses completed and finished within quick succession of each other (Lawrence et al., 2023). After this, data was frequently monitored, but no further bots were identified (Yarrish et al., 2019). The implications of this are considered further in the discussion.

Figure 2

Consort diagram showing reason for excluding data sets.



2.2.5 Measures

2.2.5.1 Part 1 (completed by all participants)

2.2.5.1.1 Demographic Information Questionnaire

Participants completed a demographic questionnaire (Appendix J) which asked about; age, gender, ethnicity, mental health difficulties, psychological treatment, previous ACT or DBT and physical activity including; type of exercise and frequency. Yoga practisers were asked about their yoga practice including; yoga style, frequency of practice, years practicing, whether they were a yoga teacher or yoga therapist and their previous knowledge of the eight limbs.

2.2.5.1.2 Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS-7; Stewart-Brown et al., 2009)

The SWEMWBS-7 (Appendix K) is a 7-item scale which asked about wellbeing over the last two weeks. It was selected due to good; internal consistency (Cronbach $\alpha = 0.86$; Stewart-Brown et al., 2009) and test-retest reliability (Shah et al., 2021; Stewart-Brown et al., 2009). Respondents were required to answer on a 5-point Likert scale ranging from 1 (none of the time) to 5 (all of the time). Items include "I've been feeling relaxed" and "I've been thinking clearly". Scores ranged from 7 to 35 with a higher score reflecting a higher level of mental wellbeing. The scale was found to have good internal consistency in the current study (Cronbach $\alpha = .86$).

2.2.5.1.3 Multidimensional Psychological Flexibility Inventory – 24 (MPFI-24; Rolffs et al., 2018)

The MPFI (Appendix L) is a 24-item measure which asks about psychological flexibility and psychological inflexibility over the last two weeks. The questionnaire was chosen because it has good validity, interval consistency, test-retest reliability (Gregoire et al., 2020; Seidler et al., 2020). Internal consistency has been shown to be excellent (Cronbach $\alpha = 0.91$; Seidler et al., 2020). The MPFI produces global scores of psychological flexibility and inflexibility and 12 subscale scores; acceptance, contact with the present moment, self as context, defusion, committed action values, experiential avoidance, of contact with the present moment, self as content, fusion, inaction and lack of contact with values. The current study analysed global scores only. Respondents were able to answer on a six-point Likert scale from 0 (never true) to 5 (always true). Items assessing psychological flexibility include "I was attentive and aware of my emotions" and psychological inflexibility include "negative feelings often leave me trapped in inaction". Scores ranged from 0 to 30, where higher scores reflect greater levels of the

psychological flexibility or psychological inflexibility. Both psychological flexibility (Cronbach α = .89) and psychological inflexibility (Cronbach α =.87) were found to have good internal consistency in the current study.

2.2.5.2 Part 2 (completed by yoga practisers only)

2.2.5.2.1 Measure of the eight limbs of yoga

Currently no fit for purpose measure of yoga practisers engagement with the 8-limbs of yoga exists. The essential properties of yoga measure has been used in previous studies (Park et al., 2018; Pick et al., In prep). However, this does not capture all eight limbs and was designed primarily as a tool to observe yoga sessions. A recent advancement is the ashtanga yoga Hindi scale (Raina, & Singh, 2018), however this has not been translated and validated in English. Therefore, a bespoke measure was created by the research team in line with Tsang et al., (2017) development criteria for creating questionnaires. Two focus groups were attended; one by yoga instructors and another with beginner yogis to gather feedback and assess face and content validity. The 8-limbs questionnaire (Appendix M) asks 30 questions and aims to determine the extent yoga practisers engage with the eight limbs during and outside their yoga practice. Participants could select a response on a 7-point Likert scale, ranging for 0 (never) to 6 (always). Global scores for each limb can be calculated as well as individual scores for individual yamas and niyamas. Internal consistency for global scores of the eight limbs ranged from .64 to .93. Subscales relating to individual yamas and niyamas ranged from .50 to .79 (see Appendix N for full breakdown).

2.2.6 Procedure

Recruitment was joint with another project looking at yoga and Dialectical Behavioural Therapy (DBT) (Willis et al., 2024). A small pilot was completed prior to recruitment to gather feedback about the process and provide information on timings. For the full study, participants were recruited using online advertisements distributed on social media platforms (Appendix O). Independent yoga teachers and studios were approached to advertise the study to their colleagues and students. The study was advertised to undergraduate students at the University of Southampton through SONA.

The study was accessed through a hyperlink which took the participant to an anonymous online Qualtrics survey. Each participant had to read the information sheet, which

asked for consent and gave information about the study and the right to withdraw (Appendix G). Participants completed the questionnaires in a random order, with those who practice yoga completing additional questions about their practice and the eight limbs questionnaire. Following a debrief statement (Appendix P), participants that accessed the study through SONA could obtain research credits and all others were given the option to enter into a prize draw by accessing a separate link to maintain anonymity.

2.2.7 Statistical analyses

Data analysis was completed using SPSS (Statistical Package for Social Science v.29, 2023). Total scores and subscales scores were calculated for each variable. Prior to analysis, preliminary checks were conducted (Appendix Q). All assumptions were met unless otherwise stated (Field, 2018). Group differences between demographic variables were analysed using Chi-squared. For hypothesis one, a between-subjects MANOVA was used with wellbeing, psychological flexibility and psychological inflexibility as dependent variables. Differences in demographic variables were explored across yoga practisers and non-yoga practisers. Variables shown to be associated with the dependent variables were considered as possible co-variates. However, these did not meet the assumptions to be included in the analysis (Field, 2018). In addition, guidelines suggest co-variates should be set a priori (European Medicines Agency, 2015). For hypothesis two, Pearsons bivariate correlational coefficients were used to assess the correlation between the eight limbs and dependent variables for those who practice yoga. The strength of the relationship was assessed according to Cohen et al (2003) where correlations less than .3 are considered small, .3 to .49 are moderate and greater than .5 are strong. For hypothesis three, multiple regressions were produced to explore whether practice of the eight limbs predicted the dependent variables. Additional multiple regressions were produced for hypothesis four which assessed whether the individual yamas and niyamas predicted psychological flexibility and psychological inflexibility.

2.3 Results

2.3.1 Participant characteristics

A breakdown of demographic information is provided in Table 3. The majority of participants were female (90.7% of yoga practisers and 76.7% of non-yoga practisers) and white (80.6% of yoga practisers and 78.4% of non-yoga practisers). Most yoga practisers were 25-34

years old (26.4%) and most non-yoga practisers were 19-20 years old (42.4%). 91.6% of yoga practisers exercised more than once a week compared to 79.7% of non-yoga practisers. Chi-square tests showed the yoga practisers and non-yoga practisers groups were significantly different in terms of age, gender and exercise frequency (Table 6). Participants in the yoga group were significantly more likely to have a history of mental health difficulties and reported higher rates of accessing therapies. The relationship between significant group differences (age, gender, exercise frequency, mental health and therapy) and each of the dependent variables were analysed. Gender was not significantly correlated with psychological wellbeing, flexibility and inflexibility. All other group differences were significantly correlated with the dependent variables.

For yoga practisers vinyasa (35.7%), hatha (30%), ashtanga (13.2%) and yin (16.3%) were the most commonly practiced styles of yoga. 81.1% reported practicing yoga at least once per week with 22.9% practising daily. 84.1% reported practising yoga for over a year, 43.6% had practised longer than 5 years. The majority practised at home (83.5%) and 25.1% at yoga studios. The sample included 57 yoga teachers and 1 yoga therapist. 39.3% of yoga practisers reported being at least somewhat familiar with the eight limbs. See Appendix R for detailed characteristics of yoga practisers.

Table 6

Analysis of participant demographics by group

Characteristics	Yoga Practisers	Non-Yoga Practisers	*P*
Demographics	n(%)	n(%)	
Total (n)	227 (49)	236 (51)	
Age			<.001**
18-20	34 (15)	100 (42.4)	
21-24	11 (4.8)	9 (3.8)	
25-34	60 (26.4)	72 (30.5)	
35-44	42 (19)	25 (10.6)	
45-54	29 (12.8)	11 (4.7)	
55-64	38 (16.7)	15 (6.4)	

65+	13 (5.7)	4 (1.7)	
Gender			<.001**
Female	206 (90.7)	181 (76.7)	
Male	20 (8.8)	52 (22)	
Non-binary	0	2 (8)	
Prefer not to say	1 (4)	1 (4)	
Ethnicity			.734
White	183 (80.6)	185 (78.4)	
Black	10 (4.4)	13 (5.5)	
Asian	21 (9.3)	24 (10.2)	
Arab	2 (.9)	0	
Mixed heritage	6 (2.6)	10 (4.2)	
Prefer not to say	1 (.4)	1 (.4)	
Other	4 (1.8)	3 (1.3)	
Mental Health/Psychological Therapy			
Previous mental health difficulties	151 (66.5)	128(54.2)	.007*
Treatment for mental health	66 (29.1)	46 (19.5)	.016*
ACT	27 (12)	27 (11.4)	.879
DBT	31 (13.7)	30 (12.7)	.764
Exercise Frequency			<.001**
Less than once per month	3 (1.3)	20 (8.5)	

Oncer per month	4 (1.8)	6 (2.6)
Twice per month	6 (2.6)	13 (5.5)
Three times per month	6 (2.6)	9 (3.8)
Once per week	18 (7.9)	34 (14.4)
Twice per week	49 (21.6)	55 (23.3)
Three times per week	87 (38.3)	67 (28.4)
Daily	54 (23.8)	32 (13.6)
Type of exercise		
Brisk Walking	150 (66.1)	149 (63.1)
Cycling	30 (13.2)	38 (16.1)
Dancing	33 (14.5)	26 (11)
Football	9 (4)	18 (7.6)
Gymnastics	11 (4.8)	8 (3.4)
HIIT (High Intensity)	48 (21.1)	37 (15.7)
Cardio	49 (21.6)	51 (21.6)
Pilates	48 (21.1)	24 (10.2)
Running	66 (29.1)	68 (28.8)
Tennis	12 (5.3)	9 (3.8)
Water sports	18 (7.9)	22 (9.3)
Weight training	67 (29.5)	64 (27.1)

Note. Group differences analysed using Chi-square test of homogeneity; CI= confidence interval; ** significant at $p<.001$, * significant at $p<.05$

2.3.2 Hypothesis one:

Those who practice yoga will have higher levels of psychological wellbeing and flexibility and lower levels of psychological inflexibility compared to those who do not practice yoga.

A one-way Multivariate Analysis of Variance (MANOVA) was run to determine the effect of group (yoga vs. non-yoga) on wellbeing, psychological flexibility and psychological inflexibility (*n* = 263). A Bonferroni correction was used to account for multiple dependent variables (Field, 2018). A significant medium group effect was found for psychological wellbeing, psychological flexibility and psychological inflexibility ($F(3, 448) = 10.21$, $p = <.001$, Wilks' = .94, $\eta_p^2 = .06$).

Separate univariate ANOVAs found a significant effect for each group on the dependent variables. A small effect for psychological wellbeing was found ($F(1,450) = 18.14$, $p = <.001$, $\eta_p^2 = .04$). Yoga practisers ($n = 219$, $M = 25.41$, $SD = 4.21$) scored significantly higher than non-yoga practitioners ($n = 233$, $M = 23.64$, $SD = 4.63$). A small effect for psychological flexibility was found ($F(1,450) = 20.74$, $p = <.001$, $\eta_p^2 = .04$). Yoga practisers ($n = 219$, $M = 49.61$, $SD = 9.05$) scored significantly higher compared to the non-yoga practisers ($n = 233$, $M = 45.79$, $SD = 8.75$). A small effect for psychological inflexibility was found ($F(1,450) = 26.63$, $p = <.001$, $\eta_p^2 = .06$). Yoga practisers ($n = 219$, $M = 32.37$, $SD = 8.66$) scored significantly lower compared to the non-yoga practisers ($n = 233$, $M = 36.70$, $SD = 9.16$).

2.3.3 Hypothesis two:

The eight limbs will positively correlate with psychological wellbeing and psychological flexibility and negatively correlate with psychological inflexibility.

A Pearsons correlation was run to assess the relationships between the eight limbs and psychological wellbeing (*n* = 210), psychological flexibility (*n* = 209-213) and psychological inflexibility (*n* = 209-213) for those who practiced yoga. All available data was analysed, there was a slightly lower completion rate for the measure of psychological wellbeing and four participants completed only half of the eight limbs measure therefore were only included in some subscales and not others.

Results are shown in Table 7. Psychological wellbeing was moderately correlated with total yama, asana and pratyahara and there was a small correlation with total niyama, pranayama, dharana, dhyana and samadhi. Looking at the subscales of the yamas and niyamas, psychological wellbeing was moderately positively correlated with ahimsa, satya, santosha, savadhyaya and there was a small positive correlation for asteya, brahmacharya, aparigraha, saucha and tapas. There was no correlation for isvara pranidhana.

Psychological flexibility was strongly positively correlated with total yama, moderately positively correlated with total niyama, asana, pranayama, pratyahara, and a small positive correlation with dharana, dhyana and samadhi. Looking at the subscales of the yamas and

niyamas, psychological flexibility was strongly positively correlated with ahimsa and moderately positively correlated with asteya, satya, brahmacharya, aparigraha, santosha, tapas, savadhyaya and there was a small positive correlation with saucha and isvara pranidhana.

Psychological inflexibility was moderately negatively correlated with total yama and asana, there was a small negative correlation with total niyama, pranayama, pratyahara, dharana, dhyana and samadhi. Looking at the subscales of the yamas and niyamas psychological inflexibility was moderately negatively correlated with ahimsa, satya and santosha, a small negative correlation with asteya, brahmacharya, aparigraha, and tapas. Psychological inflexibility was not correlated with savadhyaya, saucha, and isvara pranidhana.

Table 7

Means, standard deviations and correlations between variables

Variable	*M*	*SD*	1	2	3
1. Wellbeing	25.4	4.2	-	.	
2. Psychological Flexibility	49.4	9	.735**	-	
3. Psychological Inflexibility	32.4	8.5	-.624**	-.637**	-
Eight Limbs					
4. Total Yama	72.3	15.9	.356**	.541**	-.342**
5. Ahimsa	15.5	3.8	.429**	.510**	-.383**
6. Satya	15	3.7	.323**	.427**	-.312**
7. Asteya	14.1	4	.232**	.336**	-.190**
8. Brahmacharya	13.5	3.4	.264**	.371**	-.254**
9. Aparigraha	14.2	3.5	.286**	.401**	-.287**
10. Total Niyama	68.5	16.6	.265**	.375**	-.170**
11. Saucha	14.1	3.7	.211**	.278**	-.115
12. Santosha	14.9	3.6	.434**	.477**	-.302**
13. Tapas	14	3.7	.290**	.352**	-.175*
14. Svadhyaya	13.7	4.2	.167*	.335**	-.111

15. Isvara Pranidhana	11.8	4.5	.078	.189*	-.053
16. Asana	17	3.3	.439**	.386**	-.334**
17. Pranayama	16	3.6	.289**	.330**	-.267**
18. Pratyahara	15	3.6	.378**	.368**	-.267**
19. Dharana	14.2	3.8	.230**	.253**	-.179*
20. Dhyana	14.2	3.6	.207**	.246**	-.170*
21. Samadhi	12	3.9	.157*	.275**	-.182**

Note: M = Mean; *SD* = Standard deviation; ** significant at $p<.001$; * significant at $p<.05$.

2.3.4 Hypothesis three:

The eight limbs will predict psychological wellbeing, psychological flexibility and psychological inflexibility.

2.3.4.1 Predicting psychological wellbeing

A linear regression was carried out to see whether the eight limbs predicted psychological wellbeing. Results are shown in Table 8. The overall model was significant, total yama, total niyama, asana, pranayama, pratyahara, dharana, dhyana, samadhi predicted psychological wellbeing, $F(8,198)= 8.509$, $p <.001$, with greater practice of asana, significantly predicting higher scores on wellbeing. R^2 for the overall model was 25.6% and adjusted R^2 of 22.6%, indicating a medium effect size (Cohen, 1988).

Table 8

Multiple regression results for the eight limbs and psychological wellbeing

	B	*95% CI for B*		*SE B*	β	R^2	ΔR^2
		LL	*UL*				
Model						.256	.226***
Constant	14.439***	11.420	17.458	1.531			
Total Yama	.065	-.012	.142	.039	.248		
Total Niyama	-.007	-.079	.064	.036	-.029		
Asana	.322***	.130	.515	.098	.262***		
Pranayama	.060	-.130	.250	.096	.054		
Pratyahara	.244	-.007	.496	.128	.213		
Dharana	-.068	-.288	.151	.111	-.064		
Dhyana	-.157	-.387	.073	.117	-.139		
Samadhi	-.007	-.183	.169	.089	-.007		

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; β = standardized coefficient; R^2 = coefficient of determination; *ΔR2* = adjusted *R* ;*p<.05, **p<.0, ***p<.00.

2.3.4.2 Predicting psychological flexibility

Results are shown in Table 9 and show that the overall model was significant for psychological flexibility. Total yama, total niyama, asana, pranayama, pratyahara, dharana, dhyana, samadhi predicted psychological flexibility, $F(8,200) = 10.910$, $p<.001$, with greater practice of yamas and asana, significantly predicting higher scores of psychological flexibility. R^2 for the overall model was 30.4% and adjusted R^2 of 27.6%, indicating a large effect size (Cohen, 1988).

Table 9

Multiple regression results for the eight limbs and psychological flexibility

	B	*95% CI for B*		*SE B*	β	R^2	ΔR^2
		LL	*UL*				
Model						.304	.276***
Constant	24.213***	17.956	30.469	3.173			
Yama	.258**	.099	.417	.081	.458**		
Niyama	-.035	-.184	.113	.075	-.066		
Asana	.422*	.026	.818	.201	.160*		
Pranayama	.210	-.183	.602	.199	.087		
Pratyahara	.229	-.292	.750	.264	.092		
Dharana	-.108	-.562	.345	.230	-.047		
Dhyana	-.379	-.855	.097	.242	-.156		
Samadhi	.183	-.182	.548	.185	.081		

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; β = standardized coefficient; R^2 = coefficient of determination; *ΔR2* = adjusted *R* ;*p<.05, **p<.0, ***p<.00.

2.3.4.3 Predicting psychological inflexibility

Results are shown in Table 10 and show that the overall model was significant was psychological inflexibility. Total yama, total niyama, asana, pranayama, pratyahara, dharana, dhyana, samadhi predicted psychological inflexibility, $F(8,200)= 6.693$, $p<.001$, with greater practice of yamas and niyamas, significantly predicting lower scores of psychological inflexibility. R^2 for the overall model was 21.1% and adjusted R^2 of 18.9%, indicating a medium effect size (Cohen, 1988).

Table 10

Multiple regression results for *the eight limbs and* psychological inflexibility

	B	*95% CI for B*		*SE B*	β	R^2	ΔR^2
		LL	*UL*				
Model						.211	.189***
Constant	60.602***	44.131	57.073	3.282			
Total Yama	-.297***	-.462	-.133	.083	-.543***		
Total Niyama	.226**	.072	.379	.078	.430**		
Asana	-.392	-.801	.018	.208	-.153		
Pranayama	-.182	-.589	.224	.206	-.078		
Pratyahara	-.337	-.876	.201	.273	-.140		
Dharana	.133	-.337	.602	.238	.060		
Dhyana	.289	-.204	.781	.250	.122		
Samadhi	-.307	-684	.070	.191	-.140		

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; β = standardized coefficient; R^2 = coefficient of determination; *ΔR2* = adjusted *R* ;*p<.05, **p<.0, ***p<.00.

2.3.5 Hypothesis four:

Each of the ethical components of yamas and niyamas will predict the psychological flexibility and psychological inflexibility.

2.3.5.1 Predicting psychological flexibility

A linear regression was carried out to see whether the yama subscales predicted psychological flexibility. Results are shown in Table 11 and show that the overall model was significant. The yama subscales predicted psychological flexibility, $F(5,207) = 15.281$, $p<.001$, with greater practice of ahimsa, significantly predicting higher scores of psychological flexibility.

R^2 for the overall model was 27% and adjusted R^2 of 25.2%, indicating a strong effect size (Cohen, 1988).

Table 11

Multiple regression results for yamas and psychological flexibility

	B	*95% CI for B*		*SE B*	β	R^2	*ΔR2*
		LL	*UL*				
Model						.270	.252***
Constant	29.845***	24.952	34.737	2.482			
Ahimsa	.957***	.504	1.410	.230	.418***		
Satya	.014	-.517	.545	.269	.006		
Asteya	-.092	-.523	.339	.219	-.042		
Brahmacharya	.174	-.295	.644	.238	.067		
Aparigraha	.272	-.215	.759	.247	.108		

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; β = standardized coefficient; R^2 = coefficient of determination; *ΔR2* = adjusted *R* ;*p<.05, **p<.0, ***p<.00.

2.3.5.2 Predicting psychological inflexibility

A linear regression was carried out to see whether the yama and niyama subscales predicted psychological inflexibility. Results are shown in Table 12 and show that the overall model was significant. Yama and niyama subscales predicted psychological inflexibility, $F(10,202)= 5.008$, $p<.001$, with greater practice of satya, significantly predicting lower scores of psychological inflexibility. R^2 for the overall model was 19.9% and adjusted R^2 of 15.9%, indicating a medium effect size (Cohen, 1988).

Table 12

Multiple regression results for the yamas and niyamas psychological inflexibility

	B	*95% CI for B*		*SE B*	β	R^2	*ΔR2*
		LL	*UL*				
Model	45.786					.199	.159***
Constant	-.252***	40.561	51.012	2.650			
Ahimsa	-.252	-.775	.271	.265	-.113		
Satya	-.650**	-1.244	-.057	.301	-.282**		
Asteya	.040	-.439	.518	.243	.018		
Brahmacharya	-.445	-.963	.073	.263	-.174		
Aparigraha	-.398	-.927	.131	.268	-.162		
Saucha	.338	-.129	.806	.237	.145		
Santosha	-.385	-.980	.210	.302	-.159		
Tapas	.207	-.275	.690	.245	.088		
Svadhyaya	.448	-.024	.921	.240	.218		
Isvara Pranidhana	.267	-.110	.643	.191	.140		

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; β = standardized coefficient; R^2 = coefficient of determination; *ΔR2* = adjusted *R* ;*p<.05, **p<.0, ***p<.00.

2.4 Discussion

2.4.1 Summary of findings

Supporting hypothesis one, yoga practisers were found to have higher levels of wellbeing than non-yoga practisers. These findings support the evidence base, which shows yoga is associated with higher levels of wellbeing (Hendricks et al., 2017; Pick et al., in prep). Yoga

practisers had higher levels of psychological flexibility and lower levels of psychological inflexibility compared to non-yoga practisers. This is in line with previous studies that have found yoga to increase psychological flexibility (Avery et al., 2018; Drapkin, 2019). These findings contrast Dick et al's., (2014) study which found yoga did not significantly increase psychological flexibility. This is the first study to consider psychological inflexibility. Findings must be interpreted with caution as the study is cross-sectional and yoga practisers and non-yoga practisers groups differed in age, gender, exercise, previous mental health and current therapy. These limitations may have led to confounders biasing the results for hypothesis one.

The second part of the study looked solely at yoga practisers and whether the eight limbs of yoga are associated with psychological wellbeing, flexibility and inflexibility. Partial support was found for hypothesis two. All of the limbs positively correlated with psychological flexibility. All limbs except for isvara pranidhana positively correlated with wellbeing. For psychological inflexibility, all of the limbs negatively correlated except for isvara pranidhana, savadhyaya and saucha. The finding that the majority of the limbs correlated with psychological outcomes is consistent with theoretical models of yoga and psychological wellbeing (Bennetts, 2022; Gard et al., 2014; Kishida et al., 2018). These findings offer support that the limbs of yoga are related to transdiagnostic processes relevant to ACT (Bennetts, 2002).

Psychological flexibility was shown to be more strongly correlated with total yama compared to psychological inflexibility and wellbeing. This suggests that psychological flexibility may have a stronger relationship with the yamas than the other dependent variables. The yamas are a set of ethical codes that guide how individuals should interact with themselves and others to promote wellbeing (Shearer, 2002). Similarly, the facets of psychological flexibility are concerned with how individuals interact with themselves in ways that promote flexibility (Harris, 2019). As both psychological flexibility and the yamas are concerned with how individuals approach the self, it is intuitive that they were shown to be associated.

Isvara pranidhana was not significantly correlated with both wellbeing and psychological inflexibility. This niyama is associated with ideas of being connected to a higher power and could be conceptually linked to spirituality (Bennetts, 2022). It is surprising, that isvara pranidhana was not associated with wellbeing, considering yoga is positively associated with spirituality and increased wellbeing (Csala et al., 2021). In Western societies (which reflects the current study sample) yoga practisers are more likely to cite physical intentions to practice over spiritual intentions (Csala et al., 2021). The eight limbs questionnaire framed isvara pranidhana as surrendering to a higher power, believing in a power greater than yourself and acting for the greater good. These ideas may not be important for the population studied however other facets of spirituality might have been. Only the global score of flexibility and inflexibility were analysed,

therefore we may have missed whether isvara pranidhana may be more closely linked to a particular facet of flexibility. This is poignant because Bennetts (2022) theorises isvara pranidhana may link specifically with the self-is context facet, however, this was not explored.

The findings support hypothesis three, which stated the eight limbs would predict scores of psychological wellbeing, flexibility and inflexibility. All regression models were found to be significant. This provides evidence for the importance of considering all components of yoga including the yamas and niyamas in the practice and study of yoga (Makto et al., 2021; Bennetts, 2022). For psychological wellbeing, greater practice of asana significantly predicted higher wellbeing. The relationship between body movement and increased wellbeing is well established in the literature (Marquez et al., 2020, Schmalzl et al., 2018). Greater practice of yamas and asana, significantly predicted higher scores of psychological flexibility. The link between psychological flexibility and asana could be understood, in relation to, the relationship between physical movement and an increase in mindfulness or improved interoceptive abilities (Bennetts, 2022). The psychological inflexibility model showed greater practice of yamas and niyamas, significantly predicted lower scores of psychological inflexibility. These findings offer support for the theoretical models of yoga which include ethical teachings as important components (Bennetts, 2022; Gard et al., 2014; Kishida et al., 2018).

Hypothesis four stated that each of the yamas and niyamas would predict psychological flexibility and inflexibility. For psychological flexibility the total niyama did not significantly predict psychological flexibility therefore it was dropped from the model. Looking at the yamas only, greater practice of ahimsa was found to significantly predict higher scores of psychological flexibility. Ahimsa relates to compassion and self-criticism and has been conceptually linked to self-acceptance and opening up to one's own experiences in ACT (Bennetts, 2022). It might be that yoga practisers are more aware of or connected with values around self-compassion. Previous research has found ahimsa to be a predictor of wellbeing and the three flows of compassion (Pick et al., in prep). These findings suggest there may be a uniquely beneficial effect of the inclusion of ahimsa for predicting psychological benefit.

For psychological inflexibility, greater practice of satya significantly predicted lower scores of psychological inflexibility. Satya refers to truthfulness and has been conceptually linked to acceptance and acknowledging one's values in ACT (Bennetts, 2022). The practice of this yama has been explicitly postulated as being contrary to experiential avoidance (Bennetts, 2022), which is a key facet of psychological inflexibility and a treatment target in ACT. Thus, the finding that this yama specifically predicted levels of psychological inflexibility offers further support that yoga and ACT may share mechanisms of change that are targeted through related,

though different, practices (Bennetts, 2022). However, the individual facets of psychological inflexibility and psychological flexibility require further investigation.

The transdiagnostic model of yoga (Bennetts, 2022) postulates that each of the eight limbs can be conceptually related with ACT, however the current research suggests that some of the of the limbs may be more important than others in influencing psychological flexibility and inflexibility. The current research found asana, yamas (particularly ahimsa) and niyamas (particularly satya) could potentially be particularly important in influencing psychological flexibility and inflexibility. Combined with findings from Pick et al., (In prep) this supports considering ethical components in yoga practice and empirical research (Bennetts, 2022). This is an important finding as existing research has demonstrated that the inclusion of ethical principles in yoga or mindfulness interventions increases their effectiveness (Smith et al., 2011; Chen, & Jordan, 2020).

2.4.2 Clinical implications

The findings from this study support evidence that yoga is associated with positive psychological wellbeing (Hendriks et al., 2017; Pick et al., in prep). Findings provide support for the idea that yoga interventions could be used to improve psychological flexibility (Avery et al., 2018; Drapkin, 2019). A key finding is that specific limbs of yoga may predict different psychological outcomes. Asana was found to predict psychological wellbeing. Asana, yamas and specifically ahimsa predicted psychological flexibility. Whereas yamas, niyamas and specifically satya predicted psychological inflexibility. Further research is needed to explore causal relationships using intervention studies (see section 4.4). However, these tentative findings suggest ahimsa and satya could be most helpful for populations presenting with low levels of psychological flexibility and high levels of psychological inflexibility. This could have direct implications for the design of yoga interventions.

2.4.3 Strengths and limitations

The current study adds to the literature on understanding the psychological benefits of yoga and is the first to explore yoga and psychological flexibility and inflexibility using the MPFI (Roffs et al., 2018). The MPFI has good psychometric properties and has been developed to address the limitations of the AAQ-II (Bond et al., 2011), which is most commonly used in existing studies (Avery et al., 2018; Dick et al., 2014; Drapkin, 2019). However, only global

scores of the MPFI were analysed which could have led to nuances in the relationship between subscales and the eight limbs being missed. In addition, the current study does not look at the relationship between psychological wellbeing, flexibility and inflexibility. Therefore, we are unable to conclude how they may be related. Previous research has found psychological flexibility to be a mediator of the relationship between yoga and both PTSD and borderline personality disorder symptoms (Drapkin, 2019). It is possible, that psychological flexibility may be a mediator of the relationship between yoga practice and wellbeing.

A strength of this research is that it answers calls to look at the eight limbs of yoga (Bennetts, 2022; Makto et al., 2021; Riley, & Park, 2015). This led to the creation of the eight limbs questionnaire which may lead to a better understanding of how specific components of yoga may yield psychological benefits. However, while the overall score had excellent internal reliability some subscales were questionable. Total yama and total niyama were shown to be excellent. Asana, pranayama, pratyahara, dharana were acceptable and dhyana and samadhi were questionable. All individual yamas and niyamas were acceptable except for brahmacharya and asteya which were both poor. Scales with low internal consistency may be less reliable and valid (John et al., 2007). Therefore, conclusions for these scales should be interpreted with caution. It was beyond the scope of the study to carry out a large scale pilot on the measure or look at test-re-test reliability, assess construct validity or validate against another measure, consequently, results may lack validity (Tsang et al., 2017).

The cross-sectional design utilised limits the ability to make causal inferences and increases the likelihood of confounding bias (Kesmodel, 2018). Convenience sampling was used to obtain participants from general and student populations, this resulted in a narrow population of predominantly white females, limiting the ability to generalise findings (Emerson, 2015). In addition, as data was self-report the findings could have been subject to over-reporting and recall bias (Del Boca, & Nell, 2000).

Significant differences in demographics were found between the yoga practiser and non-yoga practisers. Yoga practisers were significantly older, exercised more and were more likely to be female. Yoga practisers were more likely to have had previous mental health difficulties and received therapy. Existing research suggests that individuals may seek out yoga due to its mental health benefits (Capon et al., 2019; Penman et al., 2012). It is therefore possible that people with mental health difficulties may be more drawn to yoga. Interesting that yoga practisers had higher instances of mental health difficulties, but higher psychological wellbeing, flexibility and lower inflexibility. While causality cannot be inferred due to the cross-sectional design, these findings are consistent with studies that show yoga is beneficial for mental health difficulties (Park, & Slattery, 2021). Group differences were not included as covariates as they

did not meet the assumptions for MANCOVA (Field, 2018). This may have impacted the results for hypothesis one, as these factors may have clouded the relationship between the independent and dependent variables.

A large number of bot responses were identified early in the study. Bot responses have become an increasing problem in research, this appears to be a particular problem when financial incentives are offered (Goodrich et al., 2023). In hindsight, more stringent bot detecting and deterrents would have been applied prior to research starting rather than a post-hoc criteria applied. Considerable time was spent removing bot data and responses may have impacted the validity of results.

2.4.4 Future research

Further research should aim to explore what ways yoga may improve psychological wellbeing and flexibility, and decrease inflexibility. Studies would benefit from looking at longitudinal yoga interventions and utilising control conditions to consider causality. Studies should measure the duration of and immersion into the limbs to understand any dose effect. Studies could look at general populations to consider proof of concept but studies looking at clinical samples are key to understanding the use of yoga for mental health difficulties. Future research could look at combining ACT and yoga, however interventions should be based on strong theoretical rationale. Addressing the limitations of the current research, future studies should aim to recruit similar samples to comparison groups, this could be achieved through randomisation and matched pair designs.

As discussed in chapter one, mediation studies are needed to identify mechanisms of change responsible for the psychological benefits of yoga practice. The current study offers preliminary support to Drapkin's (2019) study which found psychological flexibility could be a potential mechanism of change in yoga. Future longitudinal intervention studies are needed to support these findings and should use high-quality design to test mediation including testing the temporal precedence.

The current study and existing literature call for the limbs of yoga to be explored, perhaps most understudied are the yamas and niyamas. Understanding more about how the components of yoga improve psychological flexibility will help to support the design of yoga interventions. This is the second study to show ahimsa has a significant predictive effect on transdiagnostic mechanisms related to mental health presentations, therefore ahimsa specifically warrants further investigation in clinical trials.

The eight limbs questionnaire can be freely used in future yoga studies to understand the extent to which individuals incorporate the eight limbs in their practice. However further research is needed to validate this measure. This should include carrying out a large-scale pilot, assessing test-retest reliability and construct validity. Further work is needed to increase the internal validity of those scales with low reliability.

The study adds to evidence that psychological flexibility and psychological inflexibility are distinct concepts as each predicted and correlated with different limbs. If they were two ends of a continuum the study would have seen them correlate with the same variables. This provides further rationale for the importance of looking at these concepts separately and for further research to understand the relationship between them (Cherry et al., 2021; Chiarrochi et al., 2014; Morris, & Mansell, 2018).

2.5 Conclusions

Interest in yoga as a possible treatment for mental health is growing. Bennetts (2022) suggests that yoga and ACT may share transdiagnostic mechanisms of change. These findings provide support that practicing yoga is associated with psychological benefits and that the limbs of yoga may yield distinct psychological benefits (Bennetts, 2022). Specifically, the findings support the practice of asana in predicting wellbeing. Practicing asana and yamas (specifically ahimsa) in predicting flexibility and practicing the yamas (specifically satya) and niyamas in predicting inflexibility. Further intervention studies are required to understand whether yoga and ACT share mechanisms of change, but the current study suggests this could be an exciting avenue to explore. Lastly, much of the current research looks only at a few of the limbs; movement, breathwork and meditation. This is at the expense of looking at the yamas and niyamas. This study suggests they could be an important part of how yoga improves wellbeing, flexibility and inflexibility.

2.6 Reference

A-tjak, J. G., Davis, M. L., Morina, N., Powers, M. B., Smits, J. A., & Emmelkamp, P. M. (2015). A meta-analysis of the efficacy of acceptance and commitment therapy for clinically relevant mental and physical health problems. *Psychotherapy and Psychosomatics*, 84(1), 30-36. https://doi.org/10.1159/000365764

Avery, T., Blasey, C., Rosen, C., & Bayley, P. (2018). Psychological flexibility and set-shifting among veterans participating in a yoga program: a pilot study. *Military medicine*, 183(11-12), e359-e363. https://doi.org/10.1093/milmed/usy045

Bai, Z., Luo, S., Zhang, L., Wu, S., & Chi, I. (2020). Acceptance and commitment therapy (ACT) to reduce depression: A systematic review and meta-analysis. *Journal of affective disorders*, 260, 728-737. https://doi.org/10.1016/j.jad.2019.09.040

Baldwin, D. S., Anderson, I. M., Nutt, D. J., Bandelow, B., Bond, A., Davidson, J. R., den Boer, J. A., Fineberg, N. A., Knapp, M., Scott, J., Wittchen, H. U., & British Association for, P. (2005). Evidence-based guidelines for the pharmacological treatment of anxiety disorders: recommendations from the British Association for Psychopharmacology. *J Psychopharmacol*, *19*(6), 567-596. https://doi.org/10.1177/0269881105059253

Barnett, J. E., & Shale, A. J. (2012). The integration of Complementary and Alternative Medicine (CAM) into the practice of psychology: A vision for the future. *Professional Psychology: Research and Practice*, 43(6), 576. https://doi.org/10.1037/a0028919

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. https://doi.org/10.1016/j.ctcp.2021.101514

Bluett, E. J., Homan, K. J., Morrison, K. L., Levin, M. E., & Twohig, M. P. (2014). Acceptance and commitment therapy for anxiety and OCD spectrum disorders: An empirical review. *Journal of anxiety disorders*, *28*(6), 612-624. https://doi.org/10.1016/j.janxdis.2014.06.008

Bluett, E. J., Lee, E. B., Simone, M., Lockhart, G., Twohig, M. P., Lensegrav-Benson, T., & Quakenbush-Roberts, B. (2016). The role of body image psychological flexibility on the treatment of eating disorders in a residential facility. *Eating Behaviors*, *23*, 150-155. https://doi.org/10.1016/j.eatbeh.2016.10.002

Briggs, J. M. (2016). *Yoga as an ancillary treatment to acceptance and commitment therapy for depression*. Western Michigan University.

Brinsley, J., Schuch, F., Lederman, O., Girard, D., Smout, M., Immink, M. A., Stubbs, B., Firth, J., Davison, K., & Rosenbaum, S. (2021). Effects of yoga on depressive symptoms in people

with mental disorders: a systematic review and meta-analysis. *Br J Sports Med*, *55*(17), 992-1000. https://doi.org/10.1136/bjsports-2019-101242

Brosnan, P., Nauphal, M., & Tompson, M. C. (2021). Acceptability and feasibility of the online delivery of hatha yoga: A systematic review of the literature. *Complementary therapies in medicine*, 60, 102742. https://doi.org/10.1016/j.ctim.2021.102742

Brotto, L. A., Mehak, L., & Kit, C. (2009). Yoga and sexual functioning: a review. *Journal of sex & marital therapy*, *35*(5), 378-390. https://doi.org/10.1080/00926230903065955

Bryant, E. F. (2015). *The yoga sutras of Patanjali: A new edition, translation, and commentary*. . North Point Press.

Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K., ... & Zettle, R. D. (2011). Preliminary psychometric properties of the Acceptance and Action Questionnaire–II: A revised measure of psychological inflexibility and experiential avoidance. *Behavior therapy*, *42*(4), 676-688. https://doi.org/10.1016/j.beth.2014.07.002

Capon, H., O'Shea, M., & McIver, S. (2019). Yoga and mental health: A synthesis of qualitative findings. *Complementary Therapies in Clinical Practice,* 37, 122-132. https://doi.org/10.1016/j.ctcp.2019.101063

Capon, H., O'Shea, M., Evans, S., & McIver, S. (2021). Yoga complements cognitive behaviour therapy as an adjunct treatment for anxiety and depression: Qualitative findings from a mixed-methods study. *Psychology and Psychotherapy: Theory, Research and Practice*, *94*(4), 1015-1035. https://doi.org/10.1111/papt.12343

Chen, S., & Jordan, C. H. (2020). Incorporating ethics into brief mindfulness practice: effects on well-being and prosocial behavior. *Mindfulness* 11, 18–29.

Cherry, K. M., Vander Hoeven, E., Patterson, T. S., & Lumley, M. N. (2021). Defining and measuring "psychological flexibility": A narrative scoping review of diverse flexibility and rigidity constructs and perspectives. *Clinical psychology review*, *84*, 101973. https://doi.org/10.1016/j.cpr.2021.101973

Chess, L. E., & Gagnier, J. J. (2016). Applicable or non-applicable: investigations of clinical heterogeneity in systematic reviews. *BMC Medical Research Methodology*, 16, 1-7. https://doi.org/10.1186/s12874-016-0121-7

Ciarrochi, J., Sahdra, B., Marshall, S., Parker, P., & Horwath, C. (2014). Psychological flexibility is not a single dimension: The distinctive flexibility profiles of underweight, overweight, and obese people. *Journal of Contextual Behavioral Science*, 3(4), 236–247. https://doi.org/10.1016/j.jcbs.2014.07.002

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale,

NJ: Erlbaum

Csala, B., Springinsfeld, C. M., & Köteles, F. (2021). The relationship between yoga and spirituality: a systematic review of empirical research. *Frontiers in Psychology*, 12, 695939. https://doi.org/10.3389/fpsyg.2021.695939

Cramer, H., Ward, L., Steel, A., Lauche, R., Dobos, G., & Zhang, Y. (2016). Prevalence, patterns, and predictors of yoga use: results of a US nationally representative survey. *American journal of preventive medicine*, 50(2), 230-235. https://doi.org/10.1016/j.amepre.2015.07.037

Cramer, H., Sibbritt, D., Park, C. L., Adams, J., & Lauche, R. (2017). Is the practice of yoga or meditation associated with a healthy lifestyle? Results of a national cross-sectional survey of 28,695 Australian women. *Journal of psychosomatic research*, 101, 104-109. https://doi.org/10.1016/j.jpsychores.2017.07.013

Cramer, H., Quinker, D., Pilkington, K., Mason, H., Adams, J., & Dobos, G. (2019). Associations of yoga practice, health status, and health behavior among yoga practitioners in Germany—Results of a national cross-sectional survey. *Complementary therapies in medicine*, 42, 19-26. https://doi.org/10.1016/j.ctim.2018.10.026

Cuijpers, P., Noma, H., Karyotaki, E., Cipriani, A., & Furukawa, T. A. (2019). Effectiveness and acceptability of cognitive behavior therapy delivery formats in adults with depression: a network meta-analysis. *JAMA psychiatry*, *76*(7), 700-707. doi:10.1001/jamapsychiatry.2019.0268

Deacon, B. J., & Abramowitz, J. S. (2005). Patients' perceptions of pharmacological and cognitive-behavioral treatments for anxiety disorders. *Behavior therapy*, 36(2), 139-145. https://doi.org/10.1016/S0005-7894(05)80062-0

Dawson, D. L., & Golijani-Moghaddam, N. (2020). COVID-19: Psychological flexibility, coping, mental health, and wellbeing in the UK during the pandemic. *Journal of contextual behavioral science*, *17*, 126-134. https://doi.org/10.1016/j.jcbs.2020.07.010

De Boer, Levin, M. E., MacLane, C., Daflos, S., Seeley, J. R., Hayes, S. C., Biglan, A., & Pistorello, J. (2014). Examining psychological inflexibility as a transdiagnostic process across psychological disorders. J*ournal of Contextual Behavioral Science*, 3(3), 155–163. https://doi.org/10.1016/j.jcbs.2014.06.003

De Jonge, P., Wardenaar, K. J., Hoenders, H. R., Evans-Lacko, S., Kovess-Masfety, V., Aguilar-Gaxiola, S., ... & Thornicroft, G. (2018). Complementary and alternative medicine contacts by persons with mental disorders in 25 countries: results from the World Mental Health Surveys. *Epidemiology and psychiatric sciences*, 27(6), 552-567 . doi:10.1017/S2045796017000774

Del Boca, F. K., & Noll, J. A. (2000). Truth or consequences: the validity of self-report data in health services research on addictions. *Addiction*, *95*(11s3), 347-360. https://doi.org/10.1046/j.1360-0443.95.11s3.5.x

Della Valle, E., Palermi, S., Aloe, I., Marcantonio, R., Spera, R., Montagnani, S., & Sirico, F. (2020). Effectiveness of Workplace Yoga Interventions to Reduce Perceived Stress in Employees: A Systematic Review and Meta-Analysis. *J Funct Morphol Kinesiol*, *5*(2). https://doi.org/10.3390/jfmk5020033

Dick, A. M., Niles, B. L., Street, A. E., DiMartino, D. M., & Mitchell, K. S. (2014). Examining mechanisms of change in a yoga intervention for women: The influence of mindfulness, psychological flexibility, and emotion regulation on PTSD symptoms. *Journal of clinical psychology*, 70(12), 1170-1182. https://doi.org/10.1002/jclp.22104

Drapkin, J. (2019). *Integrating Yoga and Self-Psychology: An Open-Trial Pilot Study*. Columbia University.

Elkins, G., Marcus, J., Rajab, M. H., & Durgam, S. (2005). Complementary and alternative therapy use by psychotherapy clients. *Psychotherapy: Theory, Research, Practice, Training*, 42(2), 232. https://doi.org/10.1037/str0000040

Elwy, A. R., Groessl, E. J., Eisen, S. V., Riley, K. E., Maiya, M., Lee, J. P., ... & Park, C. L. (2014). A systematic scoping review of yoga intervention components and study quality. *American journal of preventive medicine*, 47(2), 220-232. https://doi.org/10.1016/j.amepre.2014.03.012

Emerson, R. W. (2015). Convenience sampling, random sampling, and snowball sampling: How does sampling affect the validity of research?. *Journal of visual impairment & blindness*, *109*(2), 164-168. https://doi.org/10.1177/0145482X1510900215

European Medicines Agency. (2015). *Guideline on adjustment for baseline covariates in clinical trials*. London: European Medicines Agency.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2013). G*Power Version 3.1.7 [computer software]. Uiversität Kiel, Germany. Retrieved from http://www.psycho.uni duesseldorf.de/abteilungen/aap/gpower3/download-and-register

Field, T. (2016). Yoga research review. *Complementary therapies in clinical practice*, *24*, 145-161. https://doi.org/10.1016/j.ctcp.2016.06.005

Field, A. (2018). D*iscovering statistics using IBM SPSS statistics*. Sage publications limited.

Fox, N., Willis., H., Merwood, A., & Bennetts, A. (2024). Could yoga improve psychological flexibility? A cross-sectional study exploring the limbs of yoga, psychological wellbeing and psychological flexibility. [Unpublished doctoral thesis]. University of Southampton.

Gard, T., Noggle, J. J., Park, C. L., Vago, D. R., & Wilson, A. (2014). Potential self-regulatory mechanisms of yoga for psychological health. *Frontiers in human neuroscience*, *8*, 100258. https://doi.org/10.3389/fnhum.2014.00770

Gilbert, P., Catarino, F., Duarte, C., Matos, M., Kolts, R., Stubbs, J., ... & Basran, J. (2017). The development of compassionate engagement and action scales for self and others. *Journal of Compassionate Health Care, 4*, 1-24. https://doi.org/10.1186/s40639-017-0033-3

Gilbert, K. E., Tonge, N. A., & Thompson, R. J. (2019). Associations between depression, anxious arousal and manifestations of psychological inflexibility. *Journal of behavior therapy and experimental psychiatry*, *62*, 88-96.https://doi.org/10.1016/j.jbtep.2018.09.006

Gloster, A. T., Walder, N., Levin, M. E., Twohig, M. P., & Karekla, M. (2020). The empirical status of acceptance and commitment therapy: A review of meta-analyses. J*ournal of Contextual Behavioral Science*, 18, 181-192. https://doi.org/10.1016/j.jcbs.2020.09.009

Goodrich, B., Fenton, M., Penn, J., Bovay, J., & Mountain, T. (2023). Battling bots: Experiences and strategies to mitigate fraudulent responses in online surveys. A*pplied Economic Perspectives and Policy*, 45(2), 762-784. https://doi.org/10.1002/aepp.13353

Gordon, T., & Borushok, J. (2019). *Mindful Yoga-based Acceptance and Commitment Therapy: Simple Postures and Practices to Help Clients Achieve Emotional Balance*. New Harbinger Publications.

Govindaraj, R., Karmani, S., Varambally, S., & Gangadhar, B. N. (2016). Yoga and physical exercise–a review and comparison. *International Review of psychiatry*, *28*(3), 242-253. https://doi.org/10.3109/09540261.2016.1160878

Gregoire, S., Gagnon, J., Lachance, L., Shankland, R., Dionne, F., Kotsou, I., ... & Rogge, R. D. (2020). Validation of the English and French versions of the multidimensional psychological flexibility inventory short form (MPFI-24). *Journal of contextual behavioral science*, 18, 99-110. https://doi.org/10.1016/j.jcbs.2020.06.004

Gust, C. J. (2023). *Yoga for Improved Physical and Psychological Health: Understanding Potential Self-regulatory and Neurophysiological Mechanisms of an Ancient Practice*, Doctoral dissertation, University of Colorado at Boulder.

Han, A., & Kim, T. H. (2022). Efficacy of internet-based acceptance and commitment therapy for depressive symptoms, anxiety, stress, psychological distress, and quality of life:

Systematic review and meta-analysis. *Journal of Medical Internet Research*, 24(12), e39727. doi:10.2196/39727

Hansen, A. H., & Kristoffersen, A. E. (2016). The use of CAM providers and psychiatric outpatient services in people with anxiety/depression: A cross-sectional survey. *BMC Complementary and Alternative Medicine*, 16(1), 461. https://doi.org/10.1186/s12906-016-1446-9

Harris, R. (2019). *ACT made simple: An easy-to-read primer on acceptance and commitment therapy*. New Harbinger Publications.

Hayes, S. C., Barnes-Holmes, D., & Roche, B. (Eds.). (2001). Relational frame theory: A post-Skinnerian account of human language and cognition.

Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., & Lillis, J. (2006). Acceptance and commitment therapy: Model, processes and outcomes. *Behaviour Research and Therapy*, 44, 1–25. https://doi.org/10.1016/j.brat.2005.06.006.

Hayes, S. C., & Gregg, J. (2001). Functional contextualism and the self. In J. C. Muran (Ed.), Self-relations in the psychotherapy process (pp. 291–311). *American Psychological Association*. https://doi.org/10.1037/10391-012

Hayes, S. C., Hofmann, S. G., & Ciarrochi, J. (2020). A process-based approach to psychological diagnosis and treatment:The conceptual and treatment utility of an extended evolutionary meta model. *Clinical Psychology Review*, 82, Article 101908. https://doi.org/10.1016/j.cpr.2020.101908

Hendriks, T., De Jong, J., & Cramer, H. (2017). The effects of yoga on positive mental health among healthy adults: a systematic review and meta-analysis. *The Journal of Alternative and Complementary Medicine*, *23*(7), 505-517. https://doi.org/10.1089/acm.2016.0334

Hofmann, S. G., Asnaani, A., Vonk, I. J. J., Sawyer, A. T., & Fang, A. (2012). The efficacy of cognitive behavioral therapy: A review of meta-analyses. *Cognitive Therapy and Research*, 36(5), 427–440. https://doi.org/10.1007/s10608-012-9476-1

Hofmann, S. G., Andreoli, G., Carpenter, J. K., & Curtiss, J. (2016). Effect of Hatha Yoga on Anxiety: A Meta-Analysis. *J Evid Based Med*, *9*(3), 116-124. https://doi.org/10.1111/jebm.12204

Huhn, M., Tardy, M., Spineli, L. M., Kissling, W., Foerstl, H., Pitschel-Walz, G., ... & Leucht, S. (2014). Efficacy of pharmacotherapy and psychotherapy for adult psychiatric disorders: a systematic overview of meta-analyses. *JAMA psychiatry*, 71(6), 706-715. doi:10.1001/jamapsychiatry.2014.112

Innes, K. E., Bourguignon, C., & Taylor, A. G. (2005). Risk indices associated with the insulin resistance syndrome, cardiovascular disease, and possible protection with yoga: a

systematic review. *The Journal of the American Board of Family Practice,* 18(6), 491-519. https://doi.org/10.3122/jabfm.18.6.491

Jeter, P. E., Slutsky, J., Singh, N., & Khalsa, S. B. S. (2015). Yoga as a therapeutic intervention: a bibliometric analysis of published research studies from 1967 to 2013. *The journal of alternative and complementary medicine*, 21(10), 586-592. https://doi.org/10.1089/acm.2015.0057

John, O. P., Soto, C. J., Robins, R. W., Fraley, R. C., & Krueger, R. F. (2007). *Handbook of research methods in personality psychology*

Julius, R. J., Novitsky, M. A., Jr., & Dubin, W. R. (2009). Medication adherence: a review of the literature and implications for clinical practice. *J Psychiatr Pract*, *15*(1), 34-44. https://doi.org/10.1097/01.pra.0000344917.43780.77

Kashdan, T. B., & Rottenberg, J. (2010). Psychological flexibility as a fundamental aspect of health. *Clinical psychology review*, *30*(7), 865-878. https://doi.org/10.1016/j.cpr.2010.03.001

Kendrick, T., & Pilling, S. (2012). Common mental health disorders--identification and pathways to care: NICE clinical guideline. *Br J Gen Pract*, *62*(594), 47-49. https://doi.org/10.3399/bjgp12X616481

Kesmodel, U. S. (2018). Cross-sectional studies–what are they good for?. *Acta obstetricia et gynecologica Scandinavica*, *97*(4), 388-393. https://doi.org/10.1111/aogs.13331

Kishida, M., Mogle, J., & Elavsky, S. (2019). The daily influences of yoga on relational outcomes off of the mat. I*nternational Journal of Yoga*, 12(2), 103. Doi: 10.4103/ijoy.IJOY_46_18

Lawrence, P. R., Osborne, M. C., Sharma, D., Spratling, R., & Calamaro, C. J. (2023). Methodological challenge: addressing bots in online research. J*ournal of Pediatric Health Care,* 37(3), 328-332. https://doi.org/10.1016/j.pedhc.2022.12.006

Levin, M. E., MacLane, C., Daflos, S., Seeley, J. R., Hayes, S. C., Biglan, A., & Pistorello, J. (2014). Examining psychological inflexibility as a transdiagnostic process across psychological disorders. *Journal of contextual behavioral science*, *3*(3), 155-163. https://doi.org/10.1016/j.jcbs.2014.06.003

Lundgren, T., Dahl, J., Yardi, N., & Melin, L. (2008). Acceptance and commitment therapy and yoga for drug-refractory epilepsy: a randomized controlled trial. *Epilepsy & Behavior,* 13(1), 102-108. https://doi.org/10.1016/j.yebeh.2008.02.009

Luoma, J., Drake, C. E., Kohlenberg, B. S., & Hayes, S. C. (2011). Substance abuse and psychological flexibility: The development of a new measure. *Addiction Research & Theory*, *19*(1), 3-13. https://doi.org/10.3109/16066359.2010.524956

Marquez, D. X., Aguiñaga, S., Vásquez, P. M., Conroy, D. E., Erickson, K. I., Hillman, C., ... & Powell, K. E. (2020). A systematic review of physical activity and quality of life and well-being. *Translational behavioral medicine*, *10*(5), 1098-1109. https://doi.org/10.1093/tbm/ibz198

Matko, K., Bringmann, H. C., & Sedlmeier, P. (2021). Effects of different components of yoga: A meta-synthesis. *OBM Integrative and Complementary Medicine*, *6*(3), 1-27. doi:10.21926/obm.icm.2103030.

McCall, M. C. (2013). How might yoga work? An overview of potential underlying mechanisms. *Journal of Yoga & Physical Therapy*, *3*(1), 1. http://dx.doi.org/10.4172/2157-7595.1000130

Morris, L., & Mansell, W. (2018). A systematic review of the relationship between rigidity/flexibility and transdiagnostic cognitive and behavioral processes that maintain psychopathology. *Journal of Experimental Psychopathology*, 9(3), 1–40. https://doi.org/10.1177/2043808718779431.

Mullen, R. A., Protti, T., Block-Lerner, J., Marks, D. R., Sandoz, E. K., & Ricardo, P. (2021). Curriculum-based yoga and acceptance and commitment training intervention for undergraduate students: A mixed-methods investigation. *Journal of Contextual Behavioral Science*, 19, 92-99. https://doi.org/10.1016/j.jcbs.2020.12.00

National Center for Complementary and Alternative Medicine (2012), Mind-Body Practices. Accessed on: 22/04/24 https://www.nccih.nih.gov/health/mind-and-body-practices

National Institutes of Health. (2018). *Emotional well-being: Emerging insights and questions for future research*. Roundtable meeting report.

Newcomer, J. W. (2007). Metabolic considerations in the use of antipsychotic medications: a review of recent evidence. *J Clin Psychiatry*, *68 Suppl 1*, 20-27. https://www.ncbi.nlm.nih.gov/pubmed/17286524

Niles, B. L., Mori, D. L., Polizzi, C., Pless Kaiser, A., Weinstein, E. S., Gershkovich, M., & Wang, C. (2018). A systematic review of randomized trials of mind-body interventions for PTSD. *J Clin Psychol*, *74*(9), 1485-1508. https://doi.org/10.1002/jclp.22634

O'Shea, M., Capon, H., Evans, S., Agrawal, J., Melvin, G., O'Brien, J., & McIver, S. (2022). Integration of hatha yoga and evidence-based psychological treatments for common mental disorders: An evidence map. *Journal of Clinical Psychology*, *78*(9), 1671-1711. https://doi.org/10.1002/jclp.23338

Ong, C. W., Ciarrochi, J., Hofmann, S. G., Karekla, M., & Hayes, S. C. (2024). Through the extended evolutionary meta-model, and what ACT found there: ACT as a process-based therapy. *Journal of Contextual Behavioral Science*, 100734. https://doi.org/10.1016/j.jcbs.2024.100734

O'Shea, M., Capon, H., Evans, S., Agrawal, J., Melvin, G., O'Brien, J., & McIver, S. (2022). Integration of hatha yoga and evidence-based psychological treatments for common mental disorders: An evidence map. *Journal of Clinical Psychology*, *78*(9), 1671-1711. https://doi.org/10.1002/jclp.23338

Park, C. L., Elwy, A. R., Maiya, M., Sarkin, A. J., Riley, K. E., Eisen, S. V., ... & Groessl, E. J. (2018). The essential properties of yoga questionnaire (EPYQ): Psychometric properties. *International journal of yoga therapy*, 28(1), 23-38. https://doi.org/10.17761/2018-00016R2

Park, C. L., & Slattery, J. M. (2021). Yoga as an integrative therapy for mental health concerns: An overview of current research evidence. *Psychiatry International*, 2(4), 386-401. https://doi.org/10.3390/psychiatryint2040030

Paudel, D. (2023). Integrating the Eight Limbs of Yoga into Psychotherapeutic Practice: A Typology Conceptual Framework. https://doi.org/10.31219/osf.io/9feu7

Pick, L., Irons, C., Ononaiye, M., & Bennetts. (in prep). Are yoga practisers more mindful and compassionate? Exploring the limbs of yoga, wellbeing, self-criticism and the three flows of compassion.

Penman, S., Cohen, M., Stevens, P., & Jackson, S. (2012). Yoga in Australia: Results of a national survey. *International journal of yoga*, *5*(2), 92-101. DOI: 10.4103/0973-6131.98217

Raina, M., & Singh, K. (2018). The Ashtanga Yoga Hindi Scale: An assessment tool based on eastern philosophy of Yoga. *Journal of religion and health*, 57(1), 12-25. https://doi.org/10.1007/s10943-015-0096-4

Rauchfleisch, A., & Kaiser, J. (2020). The false positive problem of automatic bot detection in social science research. *PloS one*, 15(10), https://doi.org/10.1371/journal.pone.0241045

Riley, K. E., & Park, C. L. (2015). How does yoga reduce stress? A systematic review of mechanisms of change and guide to future inquiry. *Health psychology review*, *9*(3), 379-396. https://doi.org/10.1080/17437199.2014.981778

Rochefort, C., Baldwin, A. S., & Chmielewski, M. (2018). Experiential avoidance: An examination of the construct validity of the AAQ-II and MEAQ. *Behavior therapy*, *49*(3), 435-449. https://doi.org/10.1016/j.beth.2017.08.008

Rolffs, J. L., Rogge, R. D., & Wilson, K. G. (2018). Disentangling components of flexibility via the hexaflex model: Development and validation of the Multidimensional Psychological Flexibility Inventory (MPFI). *Assessment*, *25*(4), 458-482. https://doi.org/10.1177/1073191116645905

Salaheddin, K., & Mason, B. (2016). Identifying barriers to mental health help-seeking among young adults in the UK: a cross-sectional survey. *Br J Gen Pract*, *66*(651), e686-692. https://doi.org/10.3399/bjgp16X687313

Santoft, F., Axelsson, E., Öst, L. G., Hedman-Lagerlöf, M., Fust, J., & Hedman-Lagerlöf, E. (2019). Cognitive behaviour therapy for depression in primary care: systematic review and meta-analysis. *Psychological medicine*, *49*(8), 1266-1274. doi:10.1017/S0033291718004208

Satchidananda. S.S., (2012) *Yoga Sutra of Patanjali: New Edition*. Yoga Publications

Schmalzl, L., Powers, C., Zanesco, A. P., Yetz, N., Groessl, E. J., & Saron, C. D. (2018). The effect of movement-focused and breath-focused yoga practice on stress parameters and sustained attention: A randomized controlled pilot study. *Consciousness and Cognition*, *65*, 109-125. https://doi.org/10.1016/j.concog.2018.07.012

Schmid, A. A., DeBaun-Sprague, E., Gilles, A. M., Maguire, J. M., Mueller, A. L., Miller, K. K., ... & Schalk, N. (2015). Yoga influences recovery during inpatient rehabilitation: A pilot study. *International journal of yoga therapy*, 25(1), 141-152. https://doi.org/10.17761/1531-2054-25.1.141

Schmid, A. A., Sternke, E. A., Do, A. N. L., Conner, N. S., Starnino, V. R., & Davis, L. W. (2021). The eight limbs of yoga can be maintained in a veteran friendly yoga program. *International Journal of Yoga*, *14*(2), 127-132. DOI: 10.4103/ijoy.IJOY_106_20

Seidler, D., Stone, B., Clark, B. E., Koran, J., & Drake, C. E. (2020). Evaluating the factor structure of the Multidimensional Psychological Flexibility Inventory: An independent replication and extension. *Journal of Contextual Behavioral Science*, *17*, 23-31. https://doi.org/10.1016/j.jcbs.2020.04.007

Shah, N., Cader, M., Andrews, B., McCabe, R., & Stewart-Brown, S. L. (2021). Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS): performance in a clinical sample in relation to PHQ-9 and GAD-7. *Health and quality of life outcomes*, 19(1), 1-9. https://doi.org/10.1186/s12955-021-01882-x

Shearer, A. (2002). *The Yoga Sutras of Patanjali*. Rider.

Singleton, M. (2010). *Yoga body: The origins of modern posture practice*. Oxford University Press.

Smith, J. A., Greer, T., Sheets, T., & Watson, S. (2011). Is there more to yoga than exercise?

Alternative Therapies in Health & Medicine, 17(3), 22–29.

Smout, M. F., Hayes, L., Atkins, P. W., Klausen, J., & Duguid, J. E. (2012). The empirically supported status of acceptance and commitment therapy: An update. *Clinical Psychologist*, 16(3), 97-109. https://doi.org/10.1111/j.1742-9552.2012.00051.x

Springer, K. S., Levy, H. C., & Tolin, D. F. (2018). Remission in CBT for adult anxiety disorders: A meta-analysis. *Clin Psychol Rev*, *61*, 1-8. https://doi.org/10.1016/j.cpr.2018.03.002

Stahl, K.M., and Drake, C.E., (2014) Yoga and acceptance and commitment therapy for anxiety: A conceptual and applied integration. In Axel, G. and Caplan, M. (eds) *Proceedings of the yoga and psyche conference*. (pp. 71 - 87).

Statistical Package for Social Sciences (2023). *IBM* (SPSS 29) [Computer software]. https://www.ibm.com/uk-en/analytics/spss-statistics-software

Stenhoff, A., Steadman, L., Nevitt, S., Benson, L., & White, R. G. (2020). Acceptance and commitment therapy and subjective wellbeing: a systematic review and meta-analyses of randomised controlled trials in adults. *Journal of Contextual Behavioral Science*, 18, 256-272. https://doi.org/10.1016/j.jcbs.2020.08.008

Stewart-Brown, S., Tennant, A., Tennant, R., Platt, S., Parkinson, J., & Weich, S. (2009). Internal construct validity of the Warwick-Edinburgh mental well-being scale (WEMWBS): a Rasch analysis using data from the Scottish health education population survey. *Health and quality of life outcomes*, 7, 1-8. https://doi.org/10.1186/1477-7525-7-15

Stockton, D., Kellett, S., Berrios, R., Sirois, F., Wilkinson, N., & Miles, G. (2019). Identifying the underlying mechanisms of change during acceptance and commitment therapy (ACT): A systematic review of contemporary mediation studies. *Behavioural and cognitive psychotherapy*, 47(3), 332-362. doi:10.1017/S1352465818000553

Sullivan, M. B., Moonaz, S., Weber, K., Taylor, J. N., & Schmalzl, L. (2018). Toward an explanatory framework for yoga therapy informed by philosophical and ethical perspectives. A*ltern. Ther. Health Med,* 24, 38-47.

Tavakoli, N., Broyles, A., Reid, E. K., Sandoval, J. R., & Correa-Fernández, V. (2019). Psychological inflexibility as it relates to stress, worry, generalized anxiety, and somatization in an ethnically diverse sample of college students. *Journal of Contextual Behavioral Science*, 11, 1-5. https://doi.org/10.1016/j.jcbs.2018.11.001

Thomson-Casey, C., Adams, J., & McIntyre, E. (2023). The engagement of psychology with complementary medicine: A critical integrative review. Heliyon, 9(10).Varambally, S., & Gangadhar, B. N. (2016). Current status of yoga in mental health services. *Int Rev Psychiatry*, *28*(3), 233-235. https://doi.org/10.3109/09540261.2016.1159950

Tsang, S., Royse, C. F., & Terkawi, A. S. (2017). Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. *Saudi journal of anaesthesia*, 11(Suppl 1), S80-S89. DOI: 10.4103/sja.SJA_203_17

Van der Kolk, B. (2014). *The body keeps the score: Brain, mind, and body in the healing of trauma*. New York, Viking

Vorkapic, C.F., Rang´e, B., 2014. Reducing the symptomatology of panic disorder: the effects of a yoga program alone and in combination with cognitive-behavioral therapy. *Frontiers in Psychiatry*, 5, 177. https://doi.org/10.3389/fpsyt.2014.00177

Willis, H., Fox, N., Williams, J., & Bennetts., A (2024) Yoga and Dialectical Behaviour Therapy: Exploring the relationship between yoga practice, the four skills modules of DBT, and mental wellbeing. [Unpublished doctoral thesis]. University of Southampton.

Wolgast, M. (2014). What does the Acceptance and Action Questionnaire (AAQ-II) really measure?. *Behavior therapy*, *45*(6), 831-839. https://doi.org/10.1016/j.beth.2014.07.002

Yarrish, C., Groshon, L., Mitchell, J., Appelbaum, A., Klock, S., Winternitz, T., & Friedman-Wheeler, D. G. (2019). Finding the signal in the noise: Minimizing responses from bots and inattentive humans in online research. *The Behavior Therapist*, 42(7), 235-242.

Zoogman, S., Goldberg, S. B., Vousoura, E., Diamond, M. C., & Miller, L. (2019). Effect of yoga-based interventions for anxiety symptoms: A meta-analysis of randomized controlled trials. *Spirituality in Clinical Practice*, *6*(4), 256. https://doi.org/https://doi.org/10.1037/scp0000202

Appendix A Complementary Therapies in Clinical Practice 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.

To find out more, please visit the Preparation section below.

The Editor of *Complementary Therapies in Clinical Practice* invites authors to submit articles on all aspects of individual therapies, international news, book reviews, multimedia reports and correspondence.

As a service to the community, this journal makes available online the accepted manuscripts as soon as possible after acceptance. At this stage, the author's accepted manuscript (in both full-text and PDF) is given a Digital Object Identifier (DOI) and is fully citable, and searchable by title, author(s) name and the full-text. The article also carries a disclaimer noting that it is an unedited manuscript which has not yet been copyedited, typeset or proofread. When the fully copyedited version is ready for publication, it simply replaces the author accepted manuscript version.

Page charges

This journal has no page charges.

Submission checklist

You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:
• E-mail address
• Full postal address

All necessary files have been uploaded:
Manuscript:
• Include keywords
• All figures (include relevant captions)
• All tables (including titles, description, footnotes)
• Ensure all figure and table citations in the text match the files provided
• Indicate clearly if color should be used for any figures in print

Graphical Abstracts / Highlights files (where applicable)
Supplemental files (where applicable)

Further considerations
• Manuscript has been 'spell checked' and 'grammar checked'
• All references mentioned in the Reference List are cited in the text, and vice versa
• Permission has been obtained for use of copyrighted material from other sources (including the Internet)
• A competing interests statement is provided, even if the authors have no competing interests to declare
• Journal policies detailed in this guide have been reviewed
• Referee suggestions and contact details provided, based on journal requirements

For further information, visit our Support Center.

Before you begin

Ethics in publishing
Please see our information on Ethics in publishing.

Studies in humans and animals
If the work involves the use of human subjects, the author should ensure that the work

described has been carried out in accordance with The Code of Ethics of the World Medical Association(Declaration of Helsinki) for experiments involving humans. The manuscript should be in line with the Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals and aim for the inclusion of representative human populations (sex, age and ethnicity) as per those recommendations. The terms gender should be used correctly.

Authors should include a statement in the manuscript that informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects must always be observed.

Complementary Therapies in Clinical Practice does not accept studies using animal models for experimentation or investigation. Please note CTCP does, however, consider studies that involve animals as part of a therapeutic intervention. This may be described by terms including animal assisted intervention; animal assisted activities; animal assisted therapy and should comply with the ARRIVE guidelines and should be carried out in accordance with the U.K. Animals (Scientific Procedures) Act, 1986 and associated guidelines, EU Directive 2010/63/EU for animal experiments, or the National Research Council's Guide for the Care and Use of Laboratory Animals and the authors should clearly indicate in the manuscript that such guidelines have been followed. The sex of animals must be indicated, and where appropriate, the influence (or association) of sex on the results of the study.

Declaration of interest

All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential competing interests include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. Authors must disclose any interests in two places: 1. A summary declaration of interest statement in the title page file (if double anonymized) or the manuscript file (if single anonymized). If there are no interests to declare then please state this: 'Declarations of interest: none'. 2. Detailed disclosures as part of a separate Declaration of Interest form, which forms part of the journal's official records. It is important for potential interests to be declared in both places and that the information matches. More information.

Declaration of generative AI in scientific writing

The below guidance only refers to the writing process, and not to the use of AI tools to analyse and draw insights from data as part of the research process.

Where authors use generative artificial intelligence (AI) and AI-assisted technologies in the writing process, authors should only use these technologies to improve readability and language. Applying the technology should be done with human oversight and control, and authors should carefully review and edit the result, as AI can generate authoritative-sounding output that can be incorrect, incomplete or biased. AI and AI-assisted technologies should not be listed as an author or co-author, or be cited as an author. Authorship implies responsibilities and tasks that can only be attributed to and performed by humans, as outlined in Elsevier's AI policy for authors.

Authors should disclose in their manuscript the use of AI and AI-assisted technologies in the writing process by following the instructions below. A statement will appear in the published work. Please note that authors are ultimately responsible and accountable for the contents of the work.

Disclosure instructions

Authors must disclose the use of generative AI and AI-assisted technologies in the writing process by adding a statement at the end of their manuscript in the core manuscript file, before the References list. The statement should be placed in a new section entitled 'Declaration of Generative AI and AI-assisted technologies in the writing process'.

Statement: During the preparation of this work the author(s) used [NAME TOOL / SERVICE] in order to [REASON]. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

This declaration does not apply to the use of basic tools for checking grammar, spelling, references etc. If there is nothing to disclose, there is no need to add a statement.

Submission declaration and verification

Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or

explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. To verify compliance, your article may be checked by Crossref Similarity Check and other originality or duplicate checking software.

Preprints

Please note that preprints can be shared anywhere at any time, in line with Elsevier's sharing policy. Sharing your preprints e.g. on a preprint server will not count as prior publication (see 'Multiple, redundant or concurrent publication' for more information).

Preprint posting on SSRN

In support of Open Science, this journal offers its authors a free preprint posting service. Preprints provide early registration and dissemination of your research, which facilitates early citations and collaboration.

During submission to Editorial Manager, you can choose to release your manuscript publicly as a preprint on the preprint server SSRN once it enters peer-review with the journal. Your choice will have no effect on the editorial process or outcome with the journal. Please note that the corresponding author is expected to seek approval from all co-authors before agreeing to release the manuscript publicly on SSRN.

You will be notified via email when your preprint is posted online and a Digital Object Identifier (DOI) is assigned. Your preprint will remain globally available free to read whether the journal accepts or rejects your manuscript.

For more information about posting to SSRN, please consult the SSRN Terms of Use and FAQs.

Use of inclusive language

Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Content should make no assumptions about the beliefs or commitments of any reader; contain nothing which might imply that one individual is superior to another on the grounds of age, gender, race, ethnicity, culture, sexual orientation, disability or health condition; and use inclusive language throughout.

Authors should ensure that writing is free from bias, stereotypes, slang, reference to dominant culture and/or cultural assumptions. We advise to seek gender neutrality by using plural nouns ("clinicians, patients/clients") as default/wherever possible to avoid using "he, she," or "he/she." We recommend avoiding the use of descriptors that refer to personal attributes such as age, gender, race, ethnicity, culture, sexual orientation, disability or health condition unless they are relevant and valid. When coding terminology is used, we recommend to avoid offensive or exclusionary terms such as "master", "slave", "blacklist" and "whitelist". We suggest using alternatives that are more appropriate and (self-) explanatory such as "primary", "secondary", "blocklist" and "allowlist". These guidelines are meant as a point of reference to help identify appropriate language but are by no means exhaustive or definitive.

Reporting sex- and gender-based analyses

Reporting guidance

For research involving or pertaining to humans, animals or eukaryotic cells, investigators should integrate sex and gender-based analyses (SGBA) into their research design according to funder/sponsor requirements and best practices within a field. Authors should address the sex and/or gender dimensions of their research in their article. In cases where they cannot, they should discuss this as a limitation to their research's generalizability. Importantly, authors should explicitly state what definitions of sex and/or gender they are applying to enhance the precision, rigor and reproducibility of their research and to avoid ambiguity or conflation of terms and the constructs to which they refer (see Definitions section below). Authors can refer to the Sex and Gender Equity in Research (SAGER) guidelines and the SAGER guidelines checklist. These offer systematic approaches to the use and editorial review of sex and gender information in study design, data analysis, outcome reporting and research interpretation - however, please note there is no single, universally agreed-upon set of guidelines for defining sex and gender.

Definitions

Sex generally refers to a set of biological attributes that are associated with physical and physiological features (e.g., chromosomal genotype, hormonal levels, internal and external anatomy). A binary sex categorization (male/female) is usually designated at birth (""sex assigned at birth""), most often based solely on the visible external anatomy of a newborn. Gender generally refers to socially constructed roles, behaviours, and identities of women, men and gender-diverse people that occur in a historical and cultural context and may vary across societies and over time. Gender influences how people view themselves and each

other, how they behave and interact and how power is distributed in society. Sex and gender are often incorrectly portrayed as binary (female/male or woman/man) and unchanging whereas these constructs actually exist along a spectrum and include additional sex categorizations and gender identities such as people who are intersex/have differences of sex development (DSD) or identify as non-binary. Moreover, the terms ""sex"" and ""gender"" can be ambiguous—thus it is important for authors to define the manner in which they are used. In addition to this definition guidance and the SAGER guidelines, the resources on this page offer further insight around sex and gender in research studies.

Author contributions

For transparency, we require corresponding authors to provide co-author contributions to the manuscript using the relevant CRediT roles. The CRediT taxonomy includes 14 different roles describing each contributor's specific contribution to the scholarly output. The roles are: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; and Writing - review & editing. Note that not all roles may apply to every manuscript, and authors may have contributed through multiple roles. More details and an example.

Authorship

All authors should have made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted.

Clinical trial results

In line with the position of the International Committee of Medical Journal Editors, the journal will not consider results posted in the same clinical trials registry in which primary registration resides to be prior publication if the results posted are presented in the form of a brief structured (less than 500 words) abstract or table. However, divulging results in other circumstances (e.g., investors' meetings) is discouraged and may jeopardise consideration of the manuscript. Authors should fully disclose all posting in registries of results of the same or closely related work.

Systematic reviews and meta-analyses

Systematic reviews and meta-analyses should be registered in advance of the work being undertaken with an appropriate agency, e.g. PROSPERO, OSF or INPLASY, and the registration number should be given in the manuscript.

Reporting clinical trials

Randomized controlled trials should be presented according to the CONSORT guidelines. At manuscript submission, authors must provide the CONSORT checklist accompanied by a flow diagram that illustrates the progress of patients through the trial, including recruitment, enrolment, randomization, withdrawal and completion, and a detailed description of the randomization procedure. The CONSORT checklist and template flow diagram are available online.

Registration of clinical trials

Registration in a public trials registry is a condition for publication of clinical trials in this journal in accordance with International Committee of Medical Journal
Editors recommendations. Trials must register at or before the onset of patient enrolment. The clinical trial registration number should be included at the end of the abstract of the article. A clinical trial is defined as any research study that prospectively assigns human participants or groups of humans to one or more health-related interventions to evaluate the effects of health outcomes. Health-related interventions include any intervention used to modify a biomedical or health-related outcome (for example drugs, surgical procedures, devices, behavioural treatments, dietary interventions, and process-of-care changes). Health outcomes include any biomedical or health-related measures obtained in patients or participants, including pharmacokinetic measures and adverse events. Purely observational studies (those in which the assignment of the medical intervention is not at the discretion of the investigator) will not require registration.

Article transfer service

This journal uses the Elsevier Article Transfer Service to find the best home for your manuscript. This means that if an editor feels your manuscript is more suitable for an alternative journal, you might be asked to consider transferring the manuscript to such a journal. The recommendation might be provided by a Journal Editor, a dedicated Scientific Managing Editor, a tool assisted recommendation, or a combination. If you agree, your manuscript will be transferred, though you will have the opportunity to make changes to the manuscript before the submission is complete. Please note that your manuscript will be independently reviewed by the new journal. More information.

Copyright

Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see more information on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases.

For gold open access articles: Upon acceptance of an article, authors will be asked to complete a 'License Agreement' (more information). Permitted third party reuse of gold open access articles is determined by the author's choice of user license.

Author rights

As an author you (or your employer or institution) have certain rights to reuse your work. More information.

Elsevier supports responsible sharing

Find out how you can share your research published in Elsevier journals.

Role of the funding source

You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement, it is recommended to state this.

Open access

Please visit our Open Access page for more information about open access publishing in this journal.

Language (usage and editing services)

Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to

eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the Language Editing service available from Elsevier's Language Services.

Submission

Our online submission system guides you stepwise through the process of entering your article details and uploading your files. The system converts your article files to a single PDF file used in the peer-review process. Editable files (e.g., Word, LaTeX) are required to typeset your article for final publication. All correspondence, including notification of the Editor's decision and requests for revision, is sent by e-mail.

Submit your article

Please submit your article via https://www.editorialmanager.com/ctcp/default.aspx.

Suggesting reviewers

Please submit the names and institutional e-mail addresses of several potential reviewers.

You should not suggest reviewers who are colleagues, or who have co-authored or collaborated with you during the last three years. Editors do not invite reviewers who have potential competing interests with the authors. Further, in order to provide a broad and balanced assessment of the work, and ensure scientific rigor, please suggest diverse candidate reviewers who are located in different countries/regions from the author group. Also consider other diversity attributes e.g. gender, race and ethnicity, career stage, etc. Finally, you should not include existing members of the journal's editorial team, of whom the journal are already aware.

Note: the editor decides whether or not to invite your suggested reviewers.

Preparation

Queries

For questions about the editorial process (including the status of manuscripts under review) or for technical support on submissions, please visit our Support Center.

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.

REVISED SUBMISSIONS

Use of word processing software

Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

LaTeX

You are recommended to use the latest Elsevier article class to prepare your manuscript and BibTeX to generate your bibliography.

Our Guidelines has full details.

Article structure

Subdivision - numbered sections

Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods

Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

Theory/calculation

A Theory section should extend, not repeat, the background to the article already dealt with in the Introduction and lay the foundation for further work. In contrast, a Calculation section represents a practical development from a theoretical basis.

Results

Results should be clear and concise.

Discussion

This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions

The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices

If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Authors are encouraged to provide a short biography for each contributor. These should not exceed 75 words per person, and may each be accompanied by a small photograph.

Essential title page information

• ***Title.*** Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.

• ***Author names and affiliations.*** Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. You can add your name between parentheses in your own script behind the English transliteration. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
• ***Corresponding author.*** Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. This responsibility includes answering any future queries about Methodology and Materials. **Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.**
• ***Present/permanent address.*** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Highlights

Highlights are optional yet highly encouraged for this journal, as they increase the discoverability of your article via search engines. They consist of a short collection of bullet points that capture the novel results of your research as well as new methods that were used during the study (if any). Please have a look at the example Highlights.

Highlights should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point).

Abstract

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

Abstract

Abstract shoulde in structured format with distinct, labeled sections as follows:
Original Research: Background and Purpose; Materials and Methods; Results; Conclusion.
Reviews: Background and Purpose; Methods; Results; Conclusion.
Case Studies: Background; Patient Presentation; Conclusion.
Abstracts should not exceed 250 words.

Keywords

Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Acknowledgements

Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Formatting of funding sources

List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, it is recommended to include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Units

Follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI.

Math formulae

Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Footnotes

Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article.

Artwork

Electronic artwork

General points

• Make sure you use uniform lettering and sizing of your original artwork.
• Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier.
• Number the illustrations according to their sequence in the text.
• Use a logical naming convention for your artwork files.
• Indicate per figure if it is a single, 1.5 or 2-column fitting image.
• For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.
• Please note that individual figure files larger than 10 MB must be provided in separate source files.

A detailed guide on electronic artwork is available.

You are urged to visit this site; some excerpts from the detailed information are given here.

Formats

Regardless of the application used, when your electronic artwork is finalized, please 'save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):

EPS (or PDF): Vector drawings. Embed the font or save the text as 'graphics'.

TIFF (or JPG): Color or grayscale photographs (halftones): always use a minimum of 300 dpi.
TIFF (or JPG): Bitmapped line drawings: use a minimum of 1000 dpi.
TIFF (or JPG): Combinations bitmapped line/half-tone (color or grayscale): a minimum of 500 dpi is required.

Please do not:

• Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); the resolution is too low.
• Supply files that are too low in resolution.
• Submit graphics that are disproportionately large for the content.

Color artwork

Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. **For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article**. Please indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

Figure captions

Ensure that each illustration has a caption. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables

Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

References

Citation in text

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Reference links

Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, Crossref and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles, publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is highly encouraged.

A DOI is guaranteed never to change, so you can use it as a permanent link to any electronic article. An example of a citation using DOI for an article not yet in an issue is: VanDecar J.C., Russo R.M., James D.E., Ambeh W.B., Franke M. (2003). Aseismic continuation of the Lesser Antilles slab beneath northeastern Venezuela. Journal of Geophysical Research, https://doi.org/10.1029/2001JB000884. Please note the format of such citations should be in the same style as all other references in the paper.

Web references

As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

Data references

This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

Preprint references

Where a preprint has subsequently become available as a peer-reviewed publication, the formal publication should be used as the reference. If there are preprints that are central to your work or that cover crucial developments in the topic, but are not yet formally published, these may be referenced. Preprints should be clearly marked as such, for example by including the word preprint, or the name of the preprint server, as part of the reference. The preprint DOI should also be provided.

References in a special issue

Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software

Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley. Using citation plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide. If you use reference management software, please ensure that you remove all field codes before submitting the electronic manuscript. More information on how to remove field codes from different reference management software.

Reference formatting

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. If you do wish to format the references yourself they should be arranged according to the following examples:

Reference style

Text: Indicate references by number(s) in square brackets in line with the text. The actual authors can be referred to, but the reference number(s) must always be given.
Example: '..... as demonstrated [3,6]. Barnaby and Jones [8] obtained a different result ....'
List: Number the references (numbers in square brackets) in the list in the order in which they appear in the text.

Examples:

Reference to a journal publication:

[1] J. van der Geer, J.A.J. Hanraads, R.A. Lupton, The art of writing a scientific article, J. Sci. Commun. 163 (2010) 51–59. https://doi.org/10.1016/j.Sc.2010.00372.

Reference to a journal publication with an article number:

[2] J. van der Geer, J.A.J. Hanraads, R.A. Lupton, 2018. The art of writing a scientific article. Heliyon. 19, e00205. https://doi.org/10.1016/j.heliyon.2018.e00205.

Reference to a book:

[3] W. Strunk Jr., E.B. White, The Elements of Style, fourth ed., Longman, New York, 2000.

Reference to a chapter in an edited book:

[4] G.R. Mettam, L.B. Adams, How to prepare an electronic version of your article, in: B.S. Jones, R.Z. Smith (Eds.), Introduction to the Electronic Age, E-Publishing Inc., New York, 2009, pp. 281–304.

Reference to a website:

[5] Cancer Research UK, Cancer statistics reports for the UK. http://www.cancerresearchuk.org/aboutcancer/statistics/cancerstatsreport/, 2003 (accessed 13 March 2003).

Reference to a dataset:

[dataset] [6] M. Oguro, S. Imahiro, S. Saito, T. Nakashizuka, Mortality data for Japanese oak wilt disease and surrounding forest compositions, Mendeley Data, v1, 2015. https://doi.org/10.17632/xwj98nb39r.1.

Reference to software:

[7] E. Coon, M. Berndt, A. Jan, D. Svyatsky, A. Atchley, E. Kikinzon, D. Harp, G. Manzini, E. Shelef, K. Lipnikov, R. Garimella, C. Xu, D. Moulton, S. Karra, S. Painter, E. Jafarov, S. Molins, Advanced Terrestrial Simulator (ATS) v0.88 (Version 0.88), Zenodo, March 25, 2020. https://doi.org/10.5281/zenodo.3727209.

Video

Elsevier accepts video material and animation sequences to support and enhance your scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file's content. In order to ensure that your video or animation material is directly usable, please provide the file in one of our recommended file formats with a preferred maximum size of 150 MB per file, 1 GB in total.

Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including ScienceDirect. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead of standard icons and will personalize the link to your video data. For more detailed instructions please visit our video instruction pages. Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

Data visualization

Include interactive data visualizations in your publication and let your readers interact and engage more closely with your research. Follow the instructions here to find out about available data visualization options and how to include them with your article.

Supplementary material

Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

Research data

This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings, which may also include software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.

Data linking

If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the database linking page.

For supported data repositories a repository banner will automatically appear next to your published article on ScienceDirect.

In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

Research Elements

This journal enables you to publish research objects related to your original research – such as data, methods, protocols, software and hardware – as an additional paper in a Research Elements journal.

Research Elements is a suite of peer-reviewed, open access journals which make your research objects findable, accessible and reusable. Articles place research objects into context by providing detailed descriptions of objects and their application, and linking to the associated original research articles. Research Elements articles can be prepared by you, or by one of your collaborators.

During submission, you will be alerted to the opportunity to prepare and submit a manuscript to one of the Research Elements journals.

More information can be found on the Research Elements page.

Data statement

To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the Data Statement page.

After acceptance

Online proof correction

To ensure a fast publication process of the article, we kindly ask authors to provide us with their proof corrections within two days. Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors.

If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF.

We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

Offprints

The corresponding author will, at no cost, receive a customized Share Link providing 50 days free access to the final published version of the article on ScienceDirect. The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Corresponding authors who have published their article gold open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

Author inquiries

Visit the Elsevier Support Center to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch.

You can also check the status of your submitted article or find out when your accepted article will be published.

Appendix B Search Strategy

Database	Search Used
Scopus	TITLE-ABS ((yoga OR yogic) AND (mechanism* OR mediat*)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "english"))
PsycINFO	((Yoga OR Yogic) OR (DE: Yoga)) AND (Mechanism* OR mediat*))
CINAHL	((Yoga OR Yogic) OR (MH “Yoga+”)) AND (Mechanism* OR mediat*)
Web of science	((Yoga OR Yogic) OR (DE: Yoga)) AND (Mechanism* OR mediat*)) (abstract)
EMBASE	((Yoga OR Yogic) AND (Mechanism* OR mediat*))

Appendix C Inclusion and Exclusion Screening tool

Review Question: How does yoga improve mental health and wellbeing?

Inclusion	**Exclusion**
1. Written in English 2. Population: adults aged 18+ 3. Intervention: included at lease on of the following: Yoga - asana (physical postures), pranayama (breathwork) or meditation. 4. Outcome measures pertaining to wellbeing or mental health (definition below) 5. Uses formal mediation analysis (I,e Baron and Kenny's causal steps of mediation, structural equation modelling, significance tests of mediation e.g. Sobel test, bootstrapping) 6. Mediator must be grounded in theory (see list below)	1. Reviews 2. No theoretical base 3. Studies that are similar to, but are not explicitly yoga (i.e mindfulness) 4. Studies where yoga is an adjunct intervention to other treatments, and thus the effects could not be explored separately

Wellbeing and Mental Health Definition

wellbeing	(Psychological wellbeing will be defined as including both hedonic (enjoyment, pleasure) and eudemonic (meaning, fulfilment) happiness as well as resilience (coping, emotional regulation, healthy problem solving). This could include measures of life satisfaction including general terms (life as a whole) and domain terms (e.g relationships, work), quality of life, positive affect.)
mental health	(mental health conditions/disorders (ICD 11 [WHO, 2019] defined conditions e.g depression, post-traumatic stress etc) and mental health problems (i.e issues that are not sufficiently severe to be formally diagnosed as disorder) for example; stress, anxiety, worry, body image, negative affect)

Mechanisms of change stated in theory:

Theory	Self-regulation: Attentional control Response inhibition Self-awareness (ability to de-centre and interoception) Emotional regulation

	Reappraise and observe without judgement Behavioural regulation Frequency of thoughts Self-compassion Compassion to others Social connectedness Mindfulness Interception Compassion Self-criticism Emotional regulation Attention Cognitive fusion Imagery Motivation Spirituality Emotional Regulation (Cognitive re-appraisal and expressive suppression) Self-control Distress and discomfort tolerance Mindfulness

Appendix D The Mediation Quality Checklist Tool

Mansell Checklist Quality Assessment Table

1. Did the study cite a theoretical framework	
2. Were the study measures/ procedures designed to influence mediating variables?	
3. Were pilot studies conducted/ reported to test the effect of the intervention on mediators?	
4. Were the psychometric characteristics of mediator variables reported and were they within accepted ranges (Cronbach's alpha and test retest reliability >.60)?	
5. Did the study report a power calculation and was the study adequately powered to detect mediation?	
6. Did the study use an experimental design?	
7. Were the psychometric characteristics of the outcome measure reported, and were they within acceptable ranges (i.e., test-retest or Cronbach's alpha>.60?)	
8. Were statistically appropriate/ acceptable methods of data analysis used?	
9. Did the study ascertain whether changes in the mediating variables preceded changes in the outcome variables?	
10. Did the study report a change between baseline and follow-up for each mediator tested/reported?	
11. Was the change in the potential mediator correlated with change in outcome?	
12. Did the study control for possible confounding factors, e.g., baseline values?	

Appendix E The Checklist for Measuring Quality

Downs and Black		
The Checklist for Measuring Quality has high internal consistency, good inter-rater and test re-test reliability (Downs & Black, 1998), and can be applied across designs (Malik et al., 2015). Importantly for this review, Downs and Black's (1998) tool has been applied to both cross-sectional and longitudinal designs. Various adapted versions have been used from the original 27 items. For our review, we used the original, 27-item checklist for intervention studies and an adapted 15-item checklist (Irving et al., 2006) for non-intervention studies (e.g., cross-sectional and longitudinal). The additional 12 items asked for intervention studies were 4, 8, 9, 13, 14, 15, 17, 19, 23, 24, 26, and 27. Given the variation in the number of quality evaluation items relevant to different study types, a percentage score was used to present and compare the overall quality assessment results across intervention and non-intervention designs. Consistent with prior systematic review and meta-analysis using the Downs and Black tool (Munn et al., 2010), study quality was scored as follows: > 75% as high, 60–74% as moderate, and < 60% as low.		
1	Is the hypothesis/aim/objective of the study clearly described?	
2	Are the main outcomes to be measured clearly described in the Introduction or Methods section? If the main outcomes are first mentioned in the Results section, the question should be answered no	
3	Are the characteristics of the patients included in the study clearly described ? In cohort studies and trials, inclusion and/or exclusion criteria should be given. In case-control studies, a case-definition and the source for controls should be given.	
4	Are the interventions of interest clearly described? Treatments and placebo (where relevant) that are to be compared should be clearly described.	
5	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided.	
6	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions. (This question does not cover statistical tests which are considered below).	

7	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If the distribution of the data is not described, it must be assumed that the estimates used were appropriate and the question should be answered yes.	
8	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that there was a comprehensive attempt to measure adverse events. (A list of possible adverse events is provided).	
9	Have the characteristics of patients lost to follow-up been described? This should be answered yes where there were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered nowhere a study does not report the number of patients lost to follow-up.	
10	Have actual probability values been reported(e.g. 0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?	
11	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for patients and describe how the patients were selected. Patients would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the patients are derived, the question should be answered as unable to determine.	
12	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.	
13	Were the staff, places, and facilities where the patients were treated, representative of the treatment the majority of patients receive? For the question to be answered yes the study should demonstrate that the intervention was representative of that in use	

	in the source population. The question should be answered no if, for example, the intervention was undertaken in a specialist centre unrepresentative of the hospitals most of the source population would attend	
14	Was an attempt made to blind study subjects to the intervention they have received ? For studies where the patients would have no way of knowing which intervention they received, this should be answered yes.	
15	Was an attempt made to blind those measuring the main outcomes of the intervention?	
16	If any of the results of the study were based on “data dredging”, was this made clear? Any analyses that had not been planned at the outset of the study should be clearly indicated. If no retrospective unplanned subgroup analyses were reported, then answer yes.	
17	In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls ? Where follow-up was the same for all study patients the answer should yes. If different lengths of follow-up were adjusted for by, for example, survival analysis the answer should be yes. Studies where differences in follow-up are ignored should be answered no.	
18	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	
19	Was compliance with the intervention/s reliable? Where there was noncompliance with the allocated treatment or where there was contamination of one group, the question should be answered no. For studies where the effect of any misclassification was likely to bias any association to the null, the question should be answered yes.	

20	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes	
21	Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	
22	Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time? For a study which does not specify the time period over which patients were recruited, the question should be answered as unable to determine.	
23	Were study subjects randomised to intervention groups? Studies which state that subjects were randomised should be answered yes except where method of randomisation would not ensure random allocation. For example alternate allocation would score no because it is predictable	
24	Was the randomised intervention assignment concealed from both patients and health care staff until recruitment was complete and irrevocable? All non-randomised studies should be answered no. If assignment was concealed from patients but not from staff, it should be answered no.	
25	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomised studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.	

26	. Were losses of patients to follow-up taken into account? If the numbers of patients lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes	
27	Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance is less than 5%? Sample sizes have been calculated to detect a difference of x% and y%	

Appendix F **Quality Assessment Ratings for each study**

Mansell Checklist Quality Assessment Table

	Alleva et al	Boni et al	Curtis et al	Daubenmier	Davis et al	Drapkin	Gard et al	Kishida et	Koch et al	La Rocque	Medina et al	Muehlenka	Parkinson &	Rasoulzade	Shallit	Tihanyi et al
1. Did the study cite a theoretical framework	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Were the study measures/ procedures designed to influence mediating variables?	1	0	1	0	1	1	1	0	1	1	1	0	0	0	1	0
3. Were pilot studies conducted/ reported to test the effect of the intervention on mediators?	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
4. Were the psychometric characteristics of mediator variables reported and were they within accepted ranges (Cronbach's alpha and testretest reliability >.60)?	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1
5. Did the study report a power calculation and was the study adequately powered to detect mediation?	1	1	0	0	1	0	0	0	0	0	1	0	1	0	1	0
6. Did the study use an experimental design?	1	0	1	0	1	1	1	0	1	1	1	0	0	0	1	0

7. Were the psychometric characteristics of the outcome measure reported, and were they within acceptable ranges (i.e., test-retest or Cronbach's alpha>.60?)	1	1	1	0	1	0	0	0	0	1	1	1	1	1	1	1
8. Were statistically appropriate/ acceptable methods of data analysis used?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9. Did the study ascertain whether changes in the mediating variables preceded changes in the outcome variables?	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0
10. Did the study report a change between baseline and follow-up for each mediator tested/reported?	1	0	1	0	0	1	1	0	1	1	1	0	0	0	1	0
11. Was the change in the potential mediator correlated with change in outcome?	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
12. Did the study control for possible confounding factors, e.g., baseline values?	0	1	0	1	1	0	0	1	0	1	1	0	0	0	1	0

Notes: 0 = no; 1 = yes

Downs and Black – Intervention Study Checklist

	Alleva et al	Curtis et al	Davis et al	Drapkin	Gard et al	Koch et al	La Rocque et al	Medina et al	Shallit
1. Is the hypothesis/aim/objective of the study clearly described?	1	1	1	1	1	1	1	1	1
2. Are the main outcomes to be measured clearly described in the Introduction or Methods section?	1	1	1	1	1	1	1	1	1
3. Are the characteristics of the patients included in the study clearly described?	1	1	1	1	0	1	1	1	1
4. Are the interventions of interest clearly described?	1	1	1	1	1	1	1	1	1
5. Are the distributions of principal confounders in each group of subjects to be compared clearly described?	0	n/a	0	n/a	1	0	1	1	0
6. Are the main findings of the study clearly described?	1	1	1	1	1	1	1	1	1
7. Does the study provide estimates of the random variability in the data for the main outcomes?	1	1	1	1	1	1	1	1	1
8. Have all important adverse events that may be a consequence of the intervention been reported?	0	0	0	0	0	0	1	0	1
9. Have the characteristics of patients lost to follow-up been described?.	1	1	0	0	1	1	1	1	1

10. Have actual probability values been reported (e.g. 0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?	1	1	1	1	1	1	1	1	0
11. Were the subjects asked to participate in the study representative of the entire population from which they were recruited?	0	0	0	0	0	0	0	0	0
12. Were those subjects who were prepared to participate representative of the entire population from which they were recruited?	0	0	0	0	0	0	0	0	0
13. Were the staff, places, and facilities where the patients were treated, representative of the treatment the majority of patients receive?	1	1	U	1	1	1	1	1	1
14. Was an attempt made to blind study subjects to the intervention they have received?	0	n/a	U	n/a	n/a	1	0	0	0
15. Was an attempt made to blind those measuring the main outcomes of the intervention?	0	n/a	1	n/a	n/a	1	1	0	0
16. If any of the results of the study were based on “data dredging”, was this made clear?	1	1	0	1	1	1	1	1	1
17. In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls?	1	1	1	1	1	1	1	1	1
18. Were the statistical tests used to assess the main outcomes appropriate?	1	1	1	1	1	1	1	1	1

19. Was compliance with the intervention/s reliable?	1	1	U	U	1	U	U	U	U
20. Were the main outcome measures used accurate (valid and reliable)?	U	1	1	1	1	1	1	1	1
21. Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population?	1	n/a	1	n/a	1	1	1	1	1
22. Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time?	1	n/a	1	n/a	1	U	1	U	1
23. Were study subjects randomized to intervention groups?.	1	n/a	1	n/a	n/a	1	1	1	1
24. Was the randomized intervention assignment concealed from both patients and health care staff until recruitment was complete and irrevocable?	U	n/a	U	n/a	n/a	1	0	0	0
25. Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?	0	0	1	0	0	0	1	1	0
26. Were losses of patients to follow-up taken into account?	1	1	0	1	1	1	1	1	1
27. Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance is less than 5%?	1	0	1	0	0	0	0	1	1

Notes: 0 = no; 1 = yes; U = unable to determine; N/A = not applicable

Downs and Black – Cross-sectional Study Checklist

	Boni et al	Daubenmier	Kishida et al	Muehlenkamp et al	Parkinson & Smith	Rasoulzadeh	Tihanyi et al
1. Is the hypothesis/aim/objective of the study clearly described?	1	1	1	1	1	1	1
2. Are the main outcomes to be measured clearly described in the Introduction or Methods section?	1	1	1	1	1	1	1
3. Are the characteristics of the patients included in the study clearly described?	0	1	1	0	1	0	1
5. Are the distributions of principal confounders in each group of subjects to be compared clearly described?	n/a	0	0	n/a	n/a	0	n/a
6. Are the main findings of the study clearly described?	1	1	1	1	1	1	1
7. Does the study provide estimates of the random variability in the data for the main outcomes?	1	1	1	1	1	1	1
10. Have actual probability values been reported (e.g. 0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?	1	0	0	0	1	1	0
11. Were the subjects asked to participate in the study representative of the entire population from which they were recruited?	0	0	0	0	0	0	0

12. Were those subjects who were prepared to participate representative of the entire population from which they were recruited?	0	0	0	0	0	0	0
16. If any of the results of the study were based on “data dredging”, was this made clear?	1	1	1	1	1	1	1
18. Were the statistical tests used to assess the main outcomes appropriate	1	1	1	1	1	1	1
20. Were the main outcome measures used accurate (valid and reliable)?	1	1	U	1	1	1	1
21. Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population?	n/a	1	n/a	n/a	n/a	1	n/a
22. Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time?	n/a	1	n/a	n/a	n/a	1	n/a
25.Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?	1	0	1	0	0	0	0
27. Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance is less than 5%?	1	0	0	0	1	0	0

Notes: 0 = no; 1 = yes; U = unable to determine; N/A = not applicable

Appendix G ERGO Ethics Approval

ERGO II Ethics application form – Psychology Committee

1. **Applicant Details**

1.1 Applicant name	Nadine Fox Halina Willis (nee Gleeson)
1.2 Supervisor	Dr Ali Bennetts
1.3 Other researchers / collaborators (if applicable): *Name, address, email*	Dr Andrew Merwood (Portsmouth Hospitals University NHS Trust) Joanne Williams (States of Guernsey)

2. **Study Details**

2.1 Title of study	Yoga, talking therapies and psychological wellbeing: Exploring shared mechanisms
2.2 Type of project (e.g. undergraduate, Masters, Doctorate, staff)	Doctorate

2.3 Briefly describe the rationale for carrying out this project and its specific aims and objectives.

Currently, the 'gold' standard psychological treatments for mental health difficulties have relatively high levels of remission and relapse. Consequently, we need to consider alternative/adjunctive approaches. Research suggests that yoga may provide a valid adjunct or alternative to talking therapies (Bennetts, 2022). Yoga moves away from the need to talk about experiences which can be a barrier to help seeking. There is good evidence base for the psychological benefits of yoga for anxiety (Cramer et al, 2017), PTSD (Cramer et al, 2018), depression (Duan-Porter et al, 2016; Brinsley, 2020), and eating disorders (Borden, & Cook-Cottone, 2020), and it may reduce symptom severity in individuals experiencing mental health difficulties (Klatte et al, 2016). A review by Park and Slattery (2021) concluded that yoga can help to reduce symptoms of psychiatric diagnoses including depression, anxiety and PTSD. Yoga has been found to be beneficial for wellbeing (Sahni, 2021) and an effective intervention for stress reduction (Riley and Park, 2015). Despite this there is little empirical evidence supporting proposed mechanisms of change for the psychological benefits of yoga practice.

Bennetts (2022) presents a model of transdiagnostic processes as hypothesised mechanisms of change in yoga practice. The theory postulates that yoga targets transdiagnostic processes

which leads to a reduction in distress and increases in wellbeing. The paper postulates the processes targeted in yoga are the same as those targeted in third wave therapies, including DBT and ACT. The model explores how the eight limbs of yoga (Yamas, Niyamas, Asana, Pranayama, Pratyahara, Dharana, Dhyana, Samadhi) are comparable to the techniques rehearsed in DBT and ACT and thus target the same processes, resulting in positive effects in both mental health and psychological wellbeing. The paper calls for further research into the potential conceptual overlap between yoga and third wave approaches (Bennetts, 2022).

Bennetts' (2022) calls for further research to explore whether yoga interventions may be a viable treatment alternative to third wave therapies in the NHS. Aside from Bennetts' (2022) model, research has not explored the overlap in mechanisms which lead to psychological benefits in yoga and DBT and ACT. The aim of this empirical study is to further explore the overlap in potential mechanisms of change between yoga and DBT and ACT. It is hoped that results from this research could inform future intervention studies, which could evaluate the efficacy of yoga as an intervention, in comparison to other interventions currently being offered in the NHS. This could potentially support the use of yoga as a treatment intervention in the NHS, increasing patient choice in terms of the types of interventions that they are offered.

Yoga and Acceptance and Commitment Therapy

Research has started to explore the efficacy of delivering combined yoga and ACT based interventions (Briggs, 2016; Mullen et al, 2021), and books such as 'Mindful yoga-based acceptance and commitment therapy' (Gordon, & Borushok, 2019) provide a protocol for a combined approach. However, there is currently a lack of empirical research exploring why ACT and yoga may go well together.

Emerging evidence suggests that yoga may yield psychological benefits by increasing psychological flexibility. Psychological flexibility is the ability to 'be fully conscious, open to our experiences and act guided by our values' (Harris, 2019). The goal of ACT is to increase psychological flexibility. Avery et al., (2018) looked at veterans who engaged in yoga over a 16-week period and found higher levels of psychological flexibility was associated with lower PTSD and perceived stress. In addition, Dick et al., (2014) conducted RCT looking at yoga as a treatment for PTSD symptoms. They found that yoga may improve PTSD symptoms by increasing psychological flexibility.

Further research is needed to explore the relationship between yoga and psychological flexibility, to determine whether this could be a potential mechanism of change in yoga. If this were the case, yoga could be a potential beneficial adjunct to ACT treatment. Therefore, the current study will look at the relationship between yoga, wellbeing and the key ACT core process; psychological flexibility (PF) and psychological inflexibility (PI).

Yoga and Dialectical Behavioural Therapy

A core feature of DBT is the teaching and application of emotion regulation, core mindfulness, distress tolerance and interpersonal effectiveness skills (Linehan, 1993). Research has

suggested that yoga is associated with improved emotion regulation, but further research is needed to explore this relationship (Menezes, 2015). Tihanyi et al (2016) found yoga practisers to have greater mindfulness and postulated that mindfulness mediates a relationship between yoga and wellbeing. Medina et al (2015) found yoga to increase distress tolerance, although further research is needed to explore the mechanisms of this. Bennetts (2002) discusses a potential link between yoga and interpersonal factors and the need for this to empirically studied. Given that 'skill use' is proposed as a potential mechanism of change in DBT (Rudge et al, 2020), and that features of yoga practice are postulated to parallel with these skills (Bennetts, 2022), shared mechanisms between yoga and DBT could be further investigated by exploring these four skills domains in those who practice yoga.

The aim of this study is to explore differences between those who practice yoga and those who do not on a variety of mechanisms hypothesized to be shared between yoga, ACT and DBT. The study will use a single method to recruit participants, and the data will then be analysed as two separate doctoral thesis studies; one exploring differences in processes relevant to ACT, and the other in processes relevant to DBT.

2.4 Provide a brief outline of the basic study design. Outline what approach is being used and why.

A cross-sectional design will be utilised. The between-subjects independent variable will have two levels ('Yoga practiser'; YP, vs 'non-Yoga practiser'; NYP). For YP participants there will be a within subject's variable looking at which of the eight limbs of yoga are included in their practice. The dependent variables will be participants scores on outcome measures relating to the two separate research studies.

As per University of Southampton guidance, public and patient involvement will be sought around development of the 8-limbs questionnaire and thus the questionnaire may be subject to change (for which an ERGO amendment will be submitted). This will involve a two focus groups, one including people who practice yoga and another including yoga teachers. They will provide feedback on whether the questions make sense and whether they describe the relevant 8-limb. If we are unable to recruit yoga teachers to a focus group, we will ask yoga teachers for individual feedback on the 8-limbs questionnaire. This will involve a one-to-one discussion with a member of the research team about the questions, either face to face or via MS Teams.

2.5 What are the key research question(s)? Specify hypotheses if applicable.

Overarching research question:

Are there differences in wellbeing, psychological flexibility, mindfulness, emotion regulation, interpersonal effectiveness and distress tolerance between those who practice yoga and those that do not?

Study specific research questions

Study 1

RQ1: Do those who practice yoga have higher levels of psychological flexibility and psychological wellbeing and lower levels of psychological inflexibility compared to those who do not practice yoga?

RQ2: Are the eight limbs in yoga practice (yama, niyama, asana, pranayama, pratyahara, dharana, dhyana and samadhi) related to PF, PI and psychological wellbeing in YPs?

RQ3: Do the eight limbs in yoga practice (yama, niyama, asana, pranayama, pratyahara, dharana, dhyana and samadhi) predict levels of PF, PI and psychological wellbeing in YPs?

RQ4: If yamas and niyamas are found to be predictive of PF and PI, do specific ethical components predict PI/PF?

Study 2

RQ1: Do yoga practisers have greater emotion regulation, core mindfulness, distress tolerance, interpersonal effectiveness skills and mental wellbeing compared to non-yoga practisers?

RQ2: Do participant scores on the DBT skills measures correlate with each other?

RQ3: Do yoga practisers' scores on emotion regulation, core mindfulness, distress tolerance, interpersonal effectiveness, and wellbeing measures positively correlate with the eight limbs of yoga?

RQ4: Do the limbs of yoga predict scores on the four DBT skills measures and a wellbeing measure in YPs?

Study specific hypothesis:

Study 1

RQ1 hypotheses:

- Those who practice yoga will have higher levels of PF and lower levels of PI compared to those who do not practice.

- Results will replicate Pick et al's (under review) findings that YPs have significantly higher psychological wellbeing than non YPs.

RQ2 hypotheses:

- The eight limbs will positively correlate with psychological flexibility and psychological wellbeing and negatively correlate with psychological inflexibility.

RQ3 hypothesis:

- The eight limbs will predict scores of PF, PI and psychological wellbeing scores.

RQ4 hypothesis:

- Each of the specific ethical components that make up yamas and niyamas will predict PI/PF?

Study 2

RQ1 hypotheses:

- Yoga practisers will have greater emotion regulation, core mindfulness, distress tolerance, interpersonal effectiveness skills compared to non-yoga practisers.
- Results will replicate Pick et al's (under review) findings that YPs have significantly higher wellbeing than non YPs.

RQ2 hypothesis:

- Participant's scores on the DBT skills measures will correlate with each other.

RQ3 hypothesis:

- Yoga practisers' scores on emotion regulation, core mindfulness, distress tolerance, interpersonal effectiveness, and wellbeing measures will positively correlate with the eight limbs of yoga.

RQ4 hypothesis:

- At least one of the limbs of yoga will predict scores on the four DBT skills measures and a wellbeing measure.

3. **Sample and setting**

3.1 Who are the proposed participants and where are they from (e.g. fellow students, club members)? List inclusion / exclusion criteria if applicable.
Participants will be eligible for the study if they are over 18 years old and fluent in English. Those who have taken part in PPI will not be eligible to take part in the main study because they will have been involved in the development of the 8-limbs questionnaire. Participants will be included in the yoga practicing group if they self-reported to practice yoga at least twice per month.

3.2. How will the participants be identified and approached? Provide an indication of your sample size. If participants are under the responsibility of others (e.g., parents/carers, teachers) state if you have permission or how you will obtain permission from the third party).
We aim to recruit a general population sample. Participants will be recruited via online advertisements distributed on social media platforms, through university institutions (i.e SONA), word of mouth, and via yoga teachers and yoga organisations. The study will also be advertised at the Research Council for Complementary Medicine (RCCM) annual conference in August 2023. Power analysis were conducted using G*Power (version 3.1.9.2). Previous research with similar design was consulted to determine effect size. For the MANOVA, Sahni et al., (2021) indicate an effect size of d = .114, which calculates a minimum of 100 participants are required. For the correlation matrix, using a medium effect size of 0.05 a minimum of 29 participants are required. For the multiple linear regression, using a medium effect size of 0.15 a minimum of 143 participants are required. Consequently, a minimum of 143 yoga practisers and 143 non yoga practisers will be recruited.
3.3 Describe the relationship between researcher and sample. Describe any relationship e.g., teacher, friend, boss, clinician, etc.
There will be no relationship between the researcher and sample. Given the online recruitment method and the fact that the only eligibility criteria to be aged over 18 years and fluent in English, there is a possibility that some participants will know the researcher in some capacity.
3.4 How will you obtain the consent of participants? (*please upload a copy of the consent form if obtaining written consent***) NB A separate consent form is not needed for online surveys where consent can be indicated by ticking/checking a consent box (normally at the end of the PIS). Other online study designs may still require a consent form or alternative procedure (for example, recorded verbal consent for online interviews).**
Consent will be indicated by participants ticking/checking a consent box. An online participant information sheet will be displayed prior to the consent box which will detail the possible benefits and negative consequences of taking part (attached). If participants indicate that they give consent to participate, then they will then be directed to the demographic questions and additional measures. If consent is not indicated, then participants will not be able to proceed with the study.

3.5 Is there any reason to believe participants may not be able to give full informed consent? If yes, what steps do you propose to take to safeguard their interests?
No

4. **Research procedures, interventions and measurements**

4.1 Give a brief account of the procedure as experienced by the participant. Make it clear who does what, how many times and in what order. Make clear the role of all assistants and collaborators. Make clear the total demands made on participants, including time and travel. *Upload copies of questionnaires and interview schedules to ERGO.*
The study will be administered using Qualtrics XM online survey software which participants will access via a URL or QR code link. The study will be completed online at one time point. Each participant will be required to read an information sheet (attached) which will detail why the research is being conducted, what it entails and what information will be collected. As well as any risks involved, what will happen to information collected and what to do if a problem occurs. There will be a tick box which confirms that this has been read and the individual consents to taking part. Firstly, the participants will be asked to complete the demographic information (attached) which will include; age, gender, ethnicity, mental health difficulties, current and previous psychological treatment, as well as information about physical activity including type of exercise and frequency. Yoga practitioners will be required to provide more details about their yoga practice including; yoga style, frequency of practice, years practicing, where and with whom they practice and whether they are a yoga teacher or yoga therapist. They will then click through to the next web page. To measure inclusion of 8 limbs of yoga in participant's practice, only the YP group will complete this measure: 1. Measure of the 8-limbs of yoga Currently there is no fit for purpose tool which measures the extent to which yoga practitioners engage in the 8-limbs of yoga. Recently the essential properties of yoga measure (Park et al., 2018) has been used, however this does not capture all 8-limbs and was designed as a tool to observe yoga sessions. A recent advancement in this area is the ashtanga yoga hindi scale (Raina, & Singh, 2018) however there has not been translated and validated in English. Therefore, a questionnaire has been developed by the research team (attached) Participants can indicate their response on a 5-point Likert scale, ranging for 0 (‘not at all) to 4 (‘a very large amount’). Yoga instructors and beginner yogis will be consulted in the construction of these questions as part of PPI involvement in the project.

All participants then complete the outcome measures (listed below) in a random order. Researchers have received permissions to use these outcome measures in their research.

To measure wellbeing:

1. Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS-7; Stewart-Brown et al., 2009)

The SWEMWBS-7 is a 7-item scale designed to capture mental wellbeing over the past two weeks. Respondents answer on a 5-point Likert scale, ranging from 1 ('none of the time') to 5 ('all of the time). Items include "I've been feeling relaxed" and "I've been thinking clearly". Scores range from 7 to 35 and raw scores are transformed into metric scores. A higher score reflects a higher level of mental wellbeing. The scale is reliable (Cronbach $\alpha = 0.84$) and has been shown to have good validity, internal consistency and test-retest reliability (Shah et al., 2021; Stewart-Brown et al., 2009).

To measure psychological flexibility:

2. Multidimensional Psychological Flexibility Inventory – 24 (MPFI-24; Rolffs et al., 2018)

The MPFI is a 24-item measure of psychologocial flexability and psychological inflexability as well as the six facets of PF and six facets of PI over the last two weeks. The facets include PF/PI include acceptance/experiential avoidance, contact with the present moment/lack of contact with the present moment, self as context/self as content, defusion/fusion, committed action/inaction and values/lack of contact with values. It includes 2 items for each facet and respondents answer on a six-point Likert scale from 0 ('never true') to 5 ('always true'). Items assessing PF include ", I was attentive and aware of my emotions" and PI include "negative feelings often trapped in inaction". Items from each of the subscales are averaged to derive a dimensional score, where greater scores reflect greater levels of the dimension being assessed. Two composite scores can be derived by averaging the six scores on the PF and PI subscales. Internal consistency for both composites have been shown to be excellent (Cronbach $\alpha = 0.91$). The MPFI-24 has been shown to have good validity, interval consistency and test-retest reliability (Gregoire et al., 2020).

To measure the four skills modules in DBT:

3. Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004)

Difficulties in Emotion Regulation Scale (DERS) is a 36 item self-report questionnaire developed as a measure of emotion regulation (Gratz & Roemer, 2004) who found the questionnaire to have high internal consistency, good test–retest reliability, and adequate validity ($\alpha = .93$). Dan-Glauser & Scherer (2012) concluded that the DERS can be used as a measure of emotion regulation in clinical and research settings.

4. 15-item Five-Facet Mindfulness Questionnaire (FFMQ-15) (Baer et al., 2008)

The 15-item Five-Facet Mindfulness Questionnaire (FFMQ-15) (Baer et al., 2006; 2012) is a self-report questionnaire. The five facets are observing, describing, acting with awareness, non- judging of inner experience, and non-reactivity to inner experience. Baer et al (2006) developed the 39 items (FFMQ-39). The short form, 15 item, version (FFMQ-15) was developed by Baer et al. (2012) in order to reduce participant burden. Research has shown the FFMQ to have good reliability and validity, adequate internal consistency and sensitivity to change (α = .64 to .80) (Gu et al., 2016). The 39 item and 15 item versions of the questionnaire were found to have good convergent validity and findings supported the use of the FFMQ-15 as an alternative to the FFMQ-39.

5. Distress Tolerance Scale (DTS) (Simons & Gaher, 2005)

The Distress Tolerance Scale (DTS) (Simons & Gaher, 2005) is a 15 item self-report questionnaire. Research has shown the DTS to be a useful measure of distress tolerance (Sandín et al, 2017), to have good validity (Leyro et al., 2011; Brown et al., 2022) and internal consistency (Brown et al., 2022; Sandín et al, 2017) (α = .92 for the total scale and α = .76–.86 for the subscales).

6. Interpersonal Relationships Questionnaire (Darrow et al., 2014)

The FIAT–Q-SF (Functional Idiographic Assessment Template-Questionnaire-Short Form) (Darrow et al., 2014) is a 32 item self-report questionnaire which prompts respondents to indicate how strongly they agree with statements related to interpersonal interactions. The questionnaire has six subscales: interpersonal intimacy, disagreement, connection, conflict, emotional experience, and expressing emotions. Research has shown the FIAT-Q-SF to have moderate internal consistency and test-retest reliability (Darrow et al., 2014) (α = .72 to .82). The study will be looking at participants' total score on the questionnaire, rather than scores on a particular subscale.

All participants will complete the demographic information first. Those who are indicated as a 'YP' (as indicated by self-report of yoga practice at least twice per month) will complete information about their practice and the 8-limbs questionnaire. They will then filter back to the main survey to complete the randomized questionnaires presented. All participants will then be directed to the debrief statement.

Once the questionnaires have been completed the participant will be provided with a debrief statement (attached). This will include an embedded link for those who wish to be entered into the prize draw for a £25 voucher that will be a token of appreciation (in line with University of Southampton guidance). This prize draw will be a separate survey to maintain participant anonymity. If participants do 'opt-in' to the draw, then their contact details will not be connected to their demographic information and questionnaire responses. University students who are recruited through SONA will receive up to 8 university credits (1 credit x 7.5 minutes) (in line with University of Southampton guidance). University credits will be given

instead of entry into the prize draw. This will be informed by the pilot which will indicate how long the questionnaires take to complete.

As there is no perfect strategy for preventing and detecting invalid respondents for online surveys (Zhang et al., 2022) we consulted the existing literature (Lawrence et al., 2023, Yarrish et al., 2019). The following criteria will be used to exclude bot responses:

1. ReCAPTCHA score of under .5 (Qualtrics recommend)
2. Three or more responses started at the same time and ended the same time (within 1 minute)

Lawrence, P. R., Osborne, M. C., Sharma, D., Spratling, R., & Calamaro, C. J. (2023). Methodological Challenge: Addressing Bots in Online Research. *Journal of Pediatric Health Care*, *37*(3), 328-332.

Yarrish, C., Groshon, L., Mitchell, J., Appelbaum, A., Klock, S., Winternitz, T., & Friedman-Wheeler, D. G. (2019). Finding the signal in the noise: Minimizing responses from bots and inattentive humans in online research. *The Behavior Therapist*, *42*(7), 235-242.

Zhang, Z., S. Zhu, J. Mink, A. Xiong, L. Song, and G. Wang. 2022. " Beyond Bot Detection: Combating Fraudulent Online Survey Takers." In *Proceedings of the ACM Web Conference 2022*, 699–709. New York, NY: Association for Computing Machinery.

4.2 Will the procedure involve deception of any sort? If yes, what is your justification?

No

4.3. Detail any possible (psychological or physical) discomfort, inconvenience, or distress that participants may experience, including after the study, and what precautions will be taken to minimise these risks.

It is not expected that the study will cause participants to experience any psychological or physical discomfort, inconvenience, or distress. The number of questionnaires used have been kept to a minimum to reduce participant burden. In case distress is caused, the information sheet and debrief statement will include the following resources should participants need to access them. The information sheet and debrief statement will also include contact details of the two primary researchers should participants wish to contact them with any questions or concerns after the study.

- Mind – the mental health charity (https://www.mind.org.uk/)
- The Samaritans – emergency helpline (https://www.samaritans.org/)
- NHS Improving Access to Psychological Therapies (https://www.nhs.uk/service-search/other-services/Psychological-therapies-%28IAPT%29/LocationSearch/10008)

4.4 Detail any possible (psychological or physical) discomfort, inconvenience, or distress that YOU as a researcher may experience, including after the study, and what precautions will be taken to minimise these risks. If the study involves lone working please state the risks and the procedures put in place to minimise these risks (please refer to the lone working policy).
It is not expected that the researcher(s) will experience any psychological or physical discomfort, inconvenience, or distress. However, if this does occur then each researcher has access to two research supervisors and a personal clinical tutor who they can discuss any concerns with if necessary. The researchers are trainee clinical psychologists with experience of working with people with mental health problems. Therefore, if participants contact researchers, they would be able to manage this without distress and signpost to support.
4.5 Explain how you will care for any participants in 'special groups' e.g., those in a dependent relationship, are vulnerable or are lacking mental capacity), if applicable:
The study is not aiming to recruit specifically from any 'special groups' however if this happens key sources of support will be provided on the debrief form.
4.6 Please give details of any payments or incentives being used to recruit participants, if applicable:
For those who wish to they can provide their email address to be entered into a prize draw to win one of 10 £25 gift vouchers. University students who are recruited through SONA will receive up to 8 university credits (1 credit x 7.5 minutes) (in line with University of Southampton guidance). This will be informed by the pilot which will indicate how long the questionnaires take to complete. University credits will be given instead of entry into the prize draw.

5. Access and storage of data

5.1 How will participant confidentiality be maintained? Confidentiality is defined as non-disclosure of research information except to another authorised person. Confidential information can be shared with those already party to it and may also be disclosed where the person providing the information provides explicit consent. Consider whether it is truly possible to maintain a participant's involvement in the study confidential, e.g. can people observe the participant taking part in the study? How will data be anonymised to ensure participants' confidentiality?
Data will be collected and stored in a way that is consistent with the Data Protection Act 2018 and the GDPR. Participants will complete the questionnaires anonymously on Qualtrics XM, therefore the researcher team will not know who has completed each questionnaire. If a

participant opts to enter the prize draw at the end of the study, they will need to provide their name and email address. This will be kept separate from their survey responses. This data will be encrypted and stored in a password-protected database only accessible to the research team and will be destroyed immediately after the draw has taken place. If participants wish to receive a copy of the results, they are given the option to contact the researchers, their details will be destroyed once sent out.
5.2 How will personal data and study results be stored securely during and after the study. Who will have access to these data?
In line with the University of Southampton 'Research Data Management Policy' the project will adhere to a data management plan. All data collected will be digital survey responses using Qualtrics. In line with GDPR and data protection Act 2018, study data will be anonymised, and personal information collected for the prize draw will be stored separately and destroyed once the draw has taken place. The data will be stored on a password protected computer and backed up regularly. Only the research team will have access to the data whilst the project is underway. Data from the questionnaires will be entered into SPSS for statistical analysis. All data with be stored securely on a password protected computer and backed up on a secure server. On completion of the project, anonymous data will be deposited and made publicly available in the University's institutional repository in line with the 'Open Access Policy'. Consistent with the University of Southampton 'Research Data Management Policy' data will be kept for 10 years at which point data will be destroyed in accordance with the universities recommended practice for 'destruction of data' policy.
5.3 How will it be made clear to participants that they may withdraw consent to participate? Please note that anonymous data (e.g. anonymous questionnaires) cannot be withdrawn after they have been submitted. If there is a point up to which data can be withdrawn/destroyed e.g., up to interview data being transcribed please state this here.
Participants will be made aware that they can withdraw any time before completing the survey by closing the browser. The data will be anonymized and therefore cannot be withdrawn after submission. This will be clarified on the patient information sheet shown prior to obtaining consent.

6. Additional Ethical considerations

6.1 Are there any additional ethical considerations or other information you feel may be relevant to this study?
No

Appendix H Participant Information sheet and consent

Study Title: Yoga, talking therapies and psychological wellbeing: Exploring shared mechanisms
Researcher(s): Halina Willis (nee Gleeson), Nadine Fox, Dr Ali Bennetts, Dr Andrew Merwood and Joanne Williams
University email: hsdg1n21@soton.ac.uk, njm1v16@soton.ac.uk
Ethics/ERGO no: 81567
Version and date: Version 3 [21/06/23]

You have been invited to participate in the above research study. To help you decide whether you would like to take part or not, the information below will help you understand why the research is being done and what it will involve. Please read the information below carefully. Please don't hesitate to email us with any questions if anything is unclear or you would like more information before you decide to take part in this research. If you are happy to participate you will be asked for your consent online.

What is the research about?
The research is being conducted as part of a three-year doctoral qualification in Clinical Psychology at the University of Southampton. This is a research study about yoga and whether there are any differences between those who do regularly practice yoga and those who do not. For those who practice yoga, there will be additional questions about what yoga you practice and the different elements you include in your practice to consider if these elements might yield psychological benefit.

This study was approved by the Faculty Research Ethics Committee (FREC) at the University of Southampton (Ethics/ERGO Number: 81567).

What will happen to me if I take part?
If you decide to take part then you will be asked to complete an online survey. The survey takes approximately 30 minutes to complete. You will be asked to complete an online survey which will ask about your demographic information (age etc), physical activity and a number of psychological constructs. Once you have completed all of the questionnaires then you will be shown a debrief statement and given the option to follow a link to enter a prize draw for one of

ten available £25 gift vouchers. You will not be given the option to enter the prize draw if you are participating via SONA and receiving university credits.

Why have I been asked to participate?

Anyone who is over the age of 18 and fluent in English can participate in this study, unless they have been involved in the development of the study.

What information will be collected?

You will be asked to complete an online survey which will ask about your demographic information (age etc), if you have had any previous contact with mental health services, physical activity and a number of psychological constructs. Data will be collected and stored in a way that is consistent with the Data Protection Act 2018 and the GDPR. The survey is anonymous so your data and questionnaire responses cannot be connected to you. This data will be handled carefully during collection and analysis. It will be stored electronically encrypted and password protected.

You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights being affected. You can withdraw at any point by exiting the survey. If you withdraw from the study, we cannot remove the data you have already provided as we will not be able to identify it as belonging to you.

The prize draw will be a separate survey so if you do 'opt-in' to the draw then your contact details will not be connected to your demographic information and questionnaire responses. We will delete this data after the prize draw is completed.

What are the possible benefits of taking part?

By completing this research you would be helping the researchers gain a better understanding of the potential benefits of yoga which could lead to future research about the use of yoga as a possible treatment intervention. You will be given the option to provide your email address to be entered into a prize draw where you could win one of ten £25 vouchers as a token of appreciation.

Are there any risks involved?

There should not be any risks to you taking part. You will be asked to complete some questionnaires about yourself; it is hoped that these are not too sensitive and are unlikely to cause any distress however if you do experience any distress then please visit the following websites and resources for information and support:

Mind – the mental health charity: http://www.mind.org.uk
The Samaritans – emergency helpline: http://www.samaritans.org
NHS Improving Access to Psychological Therapies http://www.nhs.uk/mental-health/talking-therapies-medicine-treatments/talking-therapies-and-counselling/nhs-talking-therapies/

You will find the contact details of the researchers at the top of this sheet and again at the end of the survey. You can contact them after you have taken part if you have any concerns or questions.

What will happen to the information collected?
All information collected for this study will be 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.

The data from the study will be analyzed and written up as part of a doctoral thesis where it is hoped that this will be disseminated at conferences and submitted for publication in a peer-reviewed journal. Research findings made available in any reports or publications will not include information that can directly identify you. Only members of the research team will have access to the data whilst the study is underway. As all data will be anonymous, any research findings that are used for reports or published will not be linked to you.

The University of Southampton conducts research to the highest standards of ethics and research integrity. In accordance with our Research Data Management Policy, data will be held for 10 years after the study has finished when it will be securely destroyed. As a publicly funded organisation, the University has to ensure that it is in the public interest when we use personally-identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research

project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal data by the University can be found on its website: http://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page .

Once the study is finished, the anonymous data will be deposited and made publicly available in the University of Southampton's institutional repository. Research findings made available in any reports or publications will not include information that can directly identify you without your specific consent. Your 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 for future research studies, subject to suitable ethical approval.

Will my participation be confidential?

Your participation and the information we collect will be kept strictly anonymous. All data will be encrypted and stored in a password-protected database only accessible to the research team. Only members of the research team and responsible members of the University of Southampton may be given access to data about you for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All of these people have a duty to keep your information, as a research participant, strictly confidential.

If you choose to enter the prize draw at the end of the study, you will need to provide your name and email address. This will be kept separate from your survey responses. This data will also be encrypted and stored in a password-protected database accessible only to the research team, and deleted after the prize draw has taken place.

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: ergoinfo@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

Where can I get more information?

If you have any more queries or would like to know more about this study, please do not hesitate to get in touch , details of the research team are provided below:

Chief Investigators: Nadine Fox (njm1v16@soton.ac.uk) and Halina Willis (nee Gleeson) (hsdg1n21@soton.ac.uk)
Research supervisor: Dr Alison Bennetts (a.bennetts@soton.ac.uk)

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

Appendix I Bot Criteria

The research team relied on Qualtrics bot detection software, however within the first 7 days of the survey going live, 749 responses were obtained surpassing the target of 309 participants. On two separate days a suspicious number of responses were collected; on the 19th of August 435 response were received and on 21st August 161 responses were received despite minimal advertising. This is consistent with previous research which identified fraudulent responses (Lawrence et al., 2023). While Qualtrics flagged 100 of these responses as fraudulent, most of the responses bypassed the security set up, which has been seen is other studies (Belliveau, & Yakovenko, 2022; Lawrence et al., 2023). Consequently the research team reviewed the data which revealed clusters of questionnaires completed and finished at similar times. In line with research recommendations a two-part data cleaning plan was established to retrospectively inspect the data and exclude bot responses (Goodrich et al., 2023; Lawrence et al., 2023). This included firstly excluding any responses with a Qualtrics ReCAPTCHA score of under .5 (Qualtrics recommended) and responses where three or more responses started within 1 minute and ended within 1 minute of each other (within 1 minute).

Belliveau, J., & Yakovenko, I. (2022). Evaluating and improving the quality of survey data from panel and crowd-sourced samples: A practical guide for psychological research. *Experimental and Clinical Psychopharmacology*, *30*(4), 400. https://doi.org/10.1037/pha0000564

Goodrich, B., Fenton, M., Penn, J., Bovay, J., & Mountain, T. (2023). Battling bots: Experiences and strategies to mitigate fraudulent responses in online surveys. *Applied Economic Perspectives and Policy*, *45*(2), 762-784. https://doi.org/10.1002/aepp.13353

Lawrence, P. R., Osborne, M. C., Sharma, D., Spratling, R., & Calamaro, C. J. (2023). Methodological challenge: addressing bots in online research. *Journal of Pediatric Health Care*, *37*(3), 328-332. https://doi.org/10.1016/j.pedhc.2022.12.006

Appendix J **Demographic Information Questionnaire**

- How old are you?

18-21	
21-24	
25-34	
35-44	
45-54	
55-64	
65 and over	

- 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: White British, White Irish, Any other white background	
Asian or Asian British: Indian, Pakistani, Bangladeshi, Chinese, Any other Asian background	
Black or Black British: African, Caribbean, Any other Black background	
Mixed heritage background	
Arab	

Prefer not to say	
Other (please specify)	

Do you consider yourself to have ever had any mental health difficulties?

No	
Yes	

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

No	
Yes	

- Have you ever engaged in Dialectical Behaviour Therapy (DBT)?

No	
Yes	

- Have you ever engaged in Acceptance and Commitment Therapy (ACT)?

No	
Yes	

- Which of the following forms of exercise do you participate in?

Brisk walking	
Cycling	
Dancing	
Football	

Gymnastics	
HIIT (high intensity) workouts	
Other cardio	
Pilates	
Running	
Tennis	
Water sports	
Weight training	
Other (please state)	
None of the above	

- How many times per week do you exercise?

Less than once per month	
Once per month	
Twice per month	
Three times per month	
Once a week	
Twice per week	
Three to five times per week	
Daily	

- Do you practise yoga?

Yes	
No	

- 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?

Less than once per month	

Once per month	
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	

Where do you practice yoga (please select all that apply)?

Yoga studio	
Gym	
With a private instructor	
At home (self-directed)	
At home (online class)	
Outdoors	
Other (please specify)	

- Are you a yoga teacher or yoga therapist?

No	
Yes, a yoga teacher	
Yes, a yoga therapist	

Appendix K **Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS-7; Stewart-Brown et al., 2009)**

The Short Warwick–Edinburgh Mental Well-being Scale (SWEMWBS)

Below are some statements about feelings and thoughts.
Please tick the box that best describes your experience of each over the last 2 weeks

STATEMENTS	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future	1	2	3	4	5
I've been feeling useful	1	2	3	4	5
I've been feeling relaxed	1	2	3	4	5
I've been dealing with problems well	1	2	3	4	5
I've been thinking clearly	1	2	3	4	5
I've been feeling close to other people	1	2	3	4	5
I've been able to make up my own mind about things	1	2	3	4	5

Appendix L **Multidimensional Psychological Flexibility Inventory – 24 (MPFI-24; Rolffs et al., 2018)**

FLEXIBILITY SUBSCALES

ACCEPTANCE

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE
I was receptive to observing unpleasant thoughts and feelings without interfering with them.	O	O	O	O	O	O
I tried to make peace with my negative thoughts and feelings rather than resisting them	O	O	O	O	O	O
I made room to fully experience negative thoughts and emotions, breathing them in rather than pushing them away	O	O	O	O	O	O
When I had an upsetting thought or emotion, I tried to give it space rather than ignoring it	O	O	O	O	O	O
I opened myself to all of my feelings, the good and the bad	O	O	O	O	O	O

PRESENT MOMENT AWARENESS

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE
I was attentive and aware of my emotions	O	O	O	O	O	O

I was in tune with my thoughts and feelings from moment to moment	O	O	O	O	O	O
I paid close attention to what I was thinking and feeling	O	O	O	O	O	O
I was in touch with the ebb and flow of my thoughts and feelings	O	O	O	O	O	O
I strived to remain mindful and aware of my own thoughts and emotions	O	O	O	O	O	O

SELF AS CONTEXT

IN THE LAST TWO WEEKS…	**Never TRUE**	**Rarely TRUE**	**Occasionally TRUE**	**Often TRUE**	**Very Often TRUE**	**Always TRUE**
Even when I felt hurt or upset, I tried to maintain a broader perspective	O	O	O	O	O	O
I carried myself through tough moments by seeing my life from a larger viewpoint	O	O	O	O	O	O
I tried to keep perspective even when life knocked me down	O	O	O	O	O	O
When I was scared or afraid, I still tried to see the larger picture	O	O	O	O	O	O
When something painful happened, I tried to take a balanced view of the situation	O	O	O	O	O	O

DEFUSION

IN THE LAST TWO WEEKS…	**Never TRUE**	**Rarely TRUE**	**Occasionally TRUE**	**Often TRUE**	**Very Often TRUE**	**Always TRUE**

I was able to let negative feelings come and go without getting caught up in them	O	O	O	O	O	O
When I was upset, I was able to let those negative feelings pass through me without clinging to them	O	O	O	O	O	O
When I was scared or afraid, I was able to gently experience those feelings, allowing them to pass	O	O	O	O	O	O
I was able to step back and notice negative thoughts and feelings without reacting to them	O	O	O	O	O	O
In tough situations, I was able to notice my thoughts and feelings without getting overwhelmed by them	O	O	O	O	O	O

VALUES

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE
I was very in-touch with what is important to me and my life	O	O	O	O	O	O
I stuck to my deeper priorities in life	O	O	O	O	O	O
I tried to connect with what is truly important to me on a daily basis	O	O	O	O	O	O
Even when it meant making tough choices, I still tried to prioritize the things that were important to me	O	O	O	O	O	O
My deeper values consistently gave direction to my life	O	O	O	O	O	O

COMMITTED ACTION

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE
Even when I stumbled in my efforts, I didn't quit working toward what is important	O	O	O	O	O	O
Even when times got tough, I was still able to take steps toward what I value in life	O	O	O	O	O	O
Even when life got stressful and hectic, I still worked toward things that were important to me	O	O	O	O	O	O
I didn't let set-backs slow me down in taking action toward what I really want in life	O	O	O	O	O	O
I didn't let my own fears and doubts get in the way of taking action toward my goals	O	O	O	O	O	O

INFLEXIBILITY SUBSCALES

EXPERIENTIAL AVOIDANCE

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE
When I had a bad memory, I tried to distract myself to make it go away	O	O	O	O	O	O
I tried to distract myself when I felt unpleasant emotions	O	O	O	O	O	O
When unpleasant memories came to me, I tried to put them out of my mind	O	O	O	O	O	O
When something upsetting came up, I tried very hard to stop thinking about it	O	O	O	O	O	O
If there was something I didn't want to think about, I would try many things to get it out of my mind	O	O	O	O	O	O

LACK OF CONTACT WITH THE PRESENT MOMENT

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE
I did most things on "automatic" with little awareness of what I was doing.	O	O	O	O	O	O
I did most things mindlessly without paying much attention.	O	O	O	O	O	O
I went through most days on auto-pilot without paying much attention to what I was thinking or feeling	O	O	O	O	O	O
I floated through most days without paying much attention.	O	O	O	O	O	O

Most of the time I was just going through the motions without paying much attention	O	O	O	O	O	O

SELF AS CONTENT

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE
I thought some of my emotions were bad or inappropriate and I shouldn't feel them	O	O	O	O	O	O
I criticized myself for having irrational or inappropriate emotions	O	O	O	O	O	O
I believed some of my thoughts are abnormal or bad and I shouldn't think that way	O	O	O	O	O	O
I told myself that I shouldn't be feeling the way I'm feeling	O	O	O	O	O	O
I told myself I shouldn't be thinking the way I was thinking	O	O	O	O	O	O

FUSION

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE
Negative thoughts and feelings tended to stick with me for a long time.	O	O	O	O	O	O
Distressing thoughts tended to spin around in my mind like a broken record.	O	O	O	O	O	O
It was very easy to get trapped into unwanted thoughts and feelings.	O	O	O	O	O	O
When I had negative thoughts or feelings it was very hard to see past them.	O	O	O	O	O	O
When something bad happened it was hard for me to stop thinking about it.	O	O	O	O	O	O

LACK OF CONTACT WITH VALUES

IN THE LAST TWO WEEKS…	Never TRUE	Rarely TRUE	Occasionally TRUE	Often TRUE	Very Often TRUE	Always TRUE

My priorities and values often fell by the wayside in my day to day life	O	O	O	O	O	O
When life got hectic, I often lost touch with the things I value	O	O	O	O	O	O
The things that I value the most often fell off my priority list completely	O	O	O	O	O	O
I didn't usually have time to focus on the things that are really important to me	O	O	O	O	O	O
When times got tough, it was easy to forget about what I truly value	O	O	O	O	O	O

INACTION

IN THE LAST TWO WEEKS…	**Never TRUE**	**Rarely TRUE**	**Occasionally TRUE**	**Often TRUE**	**Very Often TRUE**	**Always TRUE**
Negative feelings often trapped me in inaction	O	O	O	O	O	O
Negative feelings easily stalled out my plans	O	O	O	O	O	O
Getting upset left me stuck and inactive	O	O	O	O	O	O
Negative experiences derailed me from what's really important	O	O	O	O	O	O
Unpleasant thoughts and feelings easily overwhelmed my efforts to deepen my life	O	O	O	O	O	O

PERMISSION FOR USE: We developed the MPFI scales to be freely available for research and clinical use. No further permission is required beyond this form and the authors will not generate study-specific permission letters.

SCORING:

Subscales – To score the MPFI subscales, you assign responses point values from 1 to 6 (left to right as presented above) and then average the responses across the items of each scale so that higher scores reflect higher levels of the dimension being assessed by each set of items.

Global Composites – The averages of the 6 flexibility subscales can be averaged to create a composite representing global flexibility. Similarly, the averages of the 6 inflexibility subscales can be averaged to create a global inflexibility composite.

Shorter Global Composites – The first two items of each of the flexibility subscales can be averaged to create a shorter 12-item global flexibility composite. Similarly, the first 2 items of each of the inflexibility subscales can be averaged to create a shorter 12-item global inflexibility composite.

NOTE – When we present the scale to participants, we do not show them the titles of the subscales. Those were included above in the interest of clarity.

INTERPRETATION:

Normative Information – The research article developing the MPFI (Rolffs, Rogge, & Wilson, 2016; see citation below) presents basic normative data on its subscales (e.g., means and standard deviations by gender). That information will help to place individual scores into a larger context.

Reliable Change – The article also presents Minimal Detectible Change (MDC_{95}; Stratford, Finch, et al., 1996) estimates for each subscale and for the global composites. These MDC_{95} estimates tell researchers and clinicians how many points an individual would need to change on each scale between assessments for that change to be statistically significant. Thus, these MDC_{95} estimates allow ACT researchers and clinicians to identify clinically significant (i.e., reliable) change groups as suggested by Jacobson and Truax (1991).

Online Interpretative Profiles – The research team is currently working on developing algorithms to create standardized flexibility/inflexibility profiles for use in clinical settings. Although use of the MPFI will remain open and free of any charges, these profiles will be available for small fees from a secure website (to cover the costs of their development and ongoing validation). Please email Dr. Rogge at rogge@psych.rochester.edu if you wish to be informed when those additional online clinical tools become available.

CITATION: If you are using this scale, then you should cite the research article validating it as follows:

Rolffs, J. L., Rogge, R. D., & Wilson, K. G. (2016). Disentangling Components of Flexibility via the Hexaflex Model Development and Validation of the Multidimensional Psychological Flexibility Inventory (MPFI). *Assessment*, 1073191116645905.

Appendix M Measure of the 8-limbs of yoga

8 limbs of Yoga Questionnaire

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

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)

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

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)

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

References

Adele, D. (2009). *The yamas and niyamas: Exploring yoga's ethical practise*. On-Word

Bound Books LLC.

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.

Büssing, A., Bretz, S. V., & Beerenbrock, Y. (2021). Ethical principles of yoga philosophy in western yoga practitioners: validation of the yama/niyama questionnaire. *Complementary Medicine Research*, *28*(4), 325-335.

Park, C. L., Elwy, A. R., Maiya, M., Sarkin, A. J., Riley, K. E., Eisen, S. V., ... & Groessl, E. J. (2018). The essential properties of yoga questionnaire (EPYQ): Psychometric properties. *International journal of yoga therapy*, *28*(1), 23-38.

Raina, M., & Singh, K. (2018). The Ashtanga Yoga Hindi Scale: An assessment tool based on eastern philosophy of Yoga. *Journal of religion and health*, *57*, 12-25.

Schmid, A. A., Sternke, E. A., Do, A. N. L., Conner, N. S., Starnino, V. R., & Davis, L. W. (2021). The eight limbs of yoga can be maintained in a veteran friendly yoga program. *International Journal of Yoga*, *14*(2), 127.

Appendix N **Cronbach Alpha for measures**

Outcome	Cronbachs alpha
SWEMWBS	.862
Psychological flexibility	.890
Psychological inflexibility	.866
Yama Total	.904
Ahimsa	.793
Satya	.720
Asteya	.496
Brahmacharya	.505
Aparigraha	.602
Niyama Total	.923
Saucha	.686
Santosha	.708
Tapas	.766
Svadhyaya	.786
Isvara Pranidhana	.791
Asana	.744
Pranayama	.780
Pratyahara	.710
Dharana	.793
Dhyana	.681
Samadhi	.640
8 Limbs total	.960

Appendix O **Recrutement Poster**

University of Southampton

YOGA AND PSYCHOLOGICAL WELLBEING

WHETHER YOU PRACTICE YOGA OR NOT, WE NEED YOU!

WE WANT TO BETTER UNDERSTAND THE PSYCHOLOGICAL BENEFITS OF YOGA

QUESTIONS?

PLEASE FEEL FREE TO CONTACT THE RESEARCH TEAM:

NADINE
NJM1V16@SOTON.AC.UK

HALINA
HSDG1N21@SOTON.AC.UK

DR ALISON BENNETTS (PRIMARY SUPERVISOR)
A.BENNETTS@SOTON.AC.UK

WHAT DOES IT INVOLVE?

AN ONLINE SURVEY WHICH TAKES APPROXIMATELY 30 MINUTES TO COMPLETE

PRIZE DRAW

WIN ONE OF TEN £25 VOUCHERS

UNIVERSITY OF SOUTHAMPTON STUDENTS CAN PARTICIPATE VIA SONA TO RECEIVE CREDITS IF PREFERRED

YOU CAN TAKE PART IF YOU ARE AGED 18+ AND SPEAK ENGLISH

IF YOU WOULD LIKE TO PARTICIPATE, PLEASE FOLLOW THIS LINK OR SCAN THE QR CODE :

HTTPS://SOUTHAMPTON.QUALTRICS.COM/JFE/FORM/SV_BRSFI1NRY8AAGWE

This study has been approved by The University of Southampton Research Ethics Committee (ERGO Number 81567). *Version 1 27.04.23*

Appendix P Debrief Statement

Study Title: Yoga, talking therapies and psychological wellbeing: Exploring shared mechanisms
Ethics/ERGO number: 81567
Researcher(s): Halina Willis (nee Gleeson), Nadine Fox, Dr Ali Bennetts, Dr Andrew Merwood and Joanne Williams
University email(s): hsdg1n21@soton.ac.uk, njm1v16@soton.ac.uk
Version and date: Version 1 [24/02/23]

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 is to explore whether there are any differences in the wellbeing of those who practice yoga and those who do not. Additionally we are looking at, whether there are any elements of a person's yoga practice which relate to psychological benefit. The data is being collected for two separate thesis projects which will be analysed and written up as two separate papers.

Study one

This study will be exploring the relationship between yoga practice, wellbeing and psychological flexibility. Psychological flexibility involves acceptance and willingness to experience unwanted private events in order to pursue one's values and goals (Hayes, 2006).

It is expected that the researchers will find:

· Those who practice yoga will have higher levels of wellbeing and psychological flexibility than those who do not practice yoga.

· We are also looking at the different elements included in participants yoga practice and predict that inclusion of certain limbs of yoga practice will predict scores of psychological flexibility and wellbeing.

Study two

This study is exploring the relationship between yoga practice, the four skills modules of DBT, and mental wellbeing. Dialectical Behaviour Therapy (DBT) is an evidence based mental health

intervention. In the survey there were questions looking at the four skills areas that are taught in DBT. These are emotion regulation, mindfulness, distress tolerance and interpersonal effectiveness. There was also a questionnaire about wellbeing.

Based on previous research the follow outcomes are predicted:

· Yoga practisers will have greater emotion regulation, core mindfulness, distress tolerance, interpersonal effectiveness skills and mental wellbeing compared to non-yoga practisers.

· Yoga practisers' scores on emotion regulation, core mindfulness, distress tolerance, interpersonal effectiveness, and wellbeing measures will positively correlate with the eight limbs of yoga. Each of the four DBT outcomes will correlate with at least one of the eight limbs.

· The inclusion of certain limbs of yoga in someone's yoga practice will predict their scores on the four DBT skills measures and a wellbeing measure.

· Participant's scores on the DBT skills measures correlate with each other.

Your data will help our understanding of yoga as an intervention, which may lead to further research into whether yoga could be offered as a treatment intervention for common mental health difficulties.

Confidentiality

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 thesis when it is completed, please let us know by using the contact details provided on this form. Please note, by doing this, you will be self-identifying as having participated in the project, however we will still not be able to identify your individual responses to questions.

Further support

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

Mind – the mental health charity: http://www.mind.org.uk
The Samaritans – emergency helpline: http://www.samaritans.org

NHS Improving Access to Psychological Therapies http://www.nhs.uk/mental-health/talking-therapies-medicine-treatments/talking-therapies-and-counselling/nhs-talking-therapies/

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.

Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., and Lillis, J. (2006). Acceptance and commitment therapy: model, processes and outcomes. Behav. Res. Ther. 44, 1–25. doi: 10.1016/j.brat.2005.06.006

Linehan, M. (2015). DBT Skills training manual. Guilford Publications.

Linehan, M. (1993). Cognitive-behavioral treatment of borderline personality disorder. Guildford Press.

Further information

If you have any concerns or questions about this study, please contact Halina Willis (nee Gleeson) hsdg1n21@soton.ac.uk or Nadine Fox at or njm1v16@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 Q Analytic strategy including tests of assumptions

Hypothesis one:

Normality was assessed using histograms, boxplots and Q-Q plots. Scatterplots were inspected to assess for skewness, kurtosis and linearity. Boxplots revealed 10 outliers, the one-way MANOVA was run with and without these and no difference was made to the results therefore the outliers were kept in the dataset. Pearson's correlation coefficient were inspected and *r* ranged from -.62 to .69, therefore the assumptions of multicollinearity were met (Tabachnick, & Fidell, 2012). Homogeneity of variance-covariance matrices was met, as shown by Box's M test (p = .008). Assumptions of homogeneity of variance were considered, all measures were significant on the Levene's test.

Hypothesis two:

Preliminary analysis showed a linear relationship, as assessed by visual inspection of scatterplots. 31 outliers were identified, the correlation was run with and without these however there was no appreciable difference in results therefore they were kept in the dataset.

Hypothesis three and four:

For each regression model the independence of observations was assessed using the Durbin-Watson statistic. Linearity was assessed by inspecting that scatter plot. Standardized residuals were plotted against standardized predicted values on scatterplots to asses linearity and homoscedasticity. Variance inflation factors showed that the assumption multicollinearity was met. Each regression model showed 1 to 3 outliers however as leverage values were all below .2 and no influential points were above 1 (Field, 2018) they were kept in the analysis. All studentized deleted residuals were less than 3 standard deviations (Field, 2018).

Reference

Tabachnick, B. G., & Fidell, l. S.(2012) *Using multivariate statistics*. New york: harper collins.

Appendix R **Detailed characteristics of yoga practitioners**

Characteristics of Yoga Practisers

Demographics	**n(%)**
Types of Yoga Practice	
Ashtanga	30 (13.2)
Bikram	4 (1.8)
Chair	14 (6.2)
Hatha	68 (30)
Integral	1 (.4)
Iyengar	10 (4.4)
Jivamukti	2 (.9)
Kundalini	8 (3.5)
Laughter	3 (1.3)
Power	20 (8.8)
Partner	2 (.9)
Restorative	32 (14.1)
Sivananda	6 (2.6)
Tantric	2 (.9)
Tibetan	2 (.9)
Vinyasa	81 (35.7)
Yin	37 (16.3)
Yoga Nidra	13 (5.7)
Yoga Breathing	11 (4.8)
Frequency of practice	
Twice per month	24 (10.6)
Three times per month	20 (8.8)

Once per week	39 (17.2)
Twice per week	41(18.1)
Three times per week	51 (22.5)
Daily	52 (22.9)
Location of practice	
Yoga studio	57 (25.1)
Gym	27 (11.9)
Private instructor	11 (4.8)
At home (self-directed)	93 (41)
At home (online class)	96 (42.3)
Outdoors	21 (9.3)
Other	30 (13.2)
Total years practising	
< 1 year	36 (15.9)
1-3 years	55 (24.2)
3-5 years	37 (16.3)
5-10 years	48 (21.1)
10-20 years	31 (13.7)
20 -30 years	11 (4.8)
30+ years	9 (4)
Yoga teacher or therapist	
No	169 (74.4)
Yoga teacher	57 (25.1)
Yoga therapist	1 (.4)
Both	
Are you familiar with the 8 limbs?	
Completely unfamiliar	42 (18.5)

Quite familiar	40 (17.6)
Somewhat unfamiliar	21 (9.3)
Nuetral	17 (7.5)
Somewhat familiar	49 (21.6)
Quite familiar	26 (11.5)
Very much familiar	14 (6.2)

Note: 8 limbs question missing 4 yogis due to incomplete data