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Yoga for hypertension management in the UK – what is the evidence?

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Abstract

Yoga is an ancient Indian philosophy and way of life that is being used as a means to improve health and well-being. Numerous studies have shown that yoga has positive effects on managing many non-communicable diseases. Moreover, growing evidence suggests that yoga could be used to improve the management of hypertension in addition to current management strategies. Yoga has also become increasingly popular in the world and the UK for improving health and well-being, and previous cross-sectional studies have reported that hypertension is one of the most commonly disclosed health conditions in yoga sessions in the UK. The popularity of yoga has surged globally, including in the UK. However, the term "yoga" encompasses a broad range of concepts and previous systematic reviews included studies from across the world including places where yoga could mean different things. Despite the increasing body of evidence supporting yoga's benefits for hypertension and overall well-being, research specifically focusing on yoga in the UK remains limited. This thesis aimed to bridge this gap by exploring the current landscape of yoga practice in the UK and its potential for managing hypertension. Three studies were conducted for this purpose, aiming to gain a comprehensive understanding of the provision of yoga in the country.

The aim of the first study was to synthesise the content, structure and delivery characteristics of effective yoga interventions used for managing hypertension, and to compare these characteristics with interventions that were not found to

be effective. Randomised controlled trials (RCTs) conducted among people with hypertension reporting at least one of the major components of yoga (i.e., asana, pranayama and dhyana and relaxation practices) and comparing them with no intervention, sham intervention, any non-pharmaceutical intervention (such as diet, exercise, or yoga) or pharmaceutical intervention (such as antihypertensive drugs) were eligible. Sixteen databases were searched for published and unpublished studies without any date and language restrictions till March 15, 2021. The literature search yielded 13,130 records. Thirty-four RCTs (evaluating 38 yoga interventions) met the inclusion criteria. Overall, the included studies had low quality mostly due to inadequate reporting of the methodology. Yoga reduced systolic blood pressure (SBP) and diastolic blood pressure (DBP) compared to a control intervention (mean difference (MD −6.49 and −2.78; 95% confidence interval (CI) −8.94 to −4.04 and −4.11 to −1.45, respectively). Eighteen, 14 and 20 interventions were effective in improving SBP, DBP, or either, respectively. 13 out of 20 effective interventions incorporated all the 3 major components of yoga (i.e., asana (yogic poses), pranayama (breathing practices) and dhyana (meditation) and relaxation practices) and allocated similar durations to each component whereas interventions that were not found to be effective were more focused on the asana and duration of asana practice was longer. The most common duration and frequency of effective interventions were 45 min/session (in 5 interventions), 7 days/week (in 5 interventions), and 12 weeks (in 11 interventions) whereas the most common session frequency was 2 days a week (in 7 interventions) in ineffective interventions. Effective interventions were

mostly centre-based (in 15 interventions) and supervised (in 16 interventions), and this was similar to interventions that were not found to be effective.

The second study aimed to explore who is providing yoga; what sessions are available, where and at what cost; who attends these sessions in the UK, and whether yoga providers were aware of health conditions in their sessions. A cross-sectional survey was undertaken among yoga providers in the UK. They were approached through four major UK yoga associations. 407 yoga providers participated. Most providers were aged 45-64 years (69%), female (93%), and white (93%). The median number of group sessions and one-to-one sessions delivered per week was four and two, respectively. The most common styles were Hatha (28%), Iyengar (26%), and Vinyasa (15%). Sessions had a varying emphasis on different yogic practices, but 59% of providers allocated most time to yogic poses (asana), 18% to breathing practices (pranayama), and 12% to meditation (dhyana) and relaxation practices. Most (73%) reported that their attendees disclosed their health conditions to them most commonly; mental health issues (41%), hypertension (25%), and heart diseases (9%).

The third study aimed to explore yoga providers' knowledge, experiences, and attitudes toward delivering yoga to people with hypertension. Semi-structured qualitative interviews were conducted with yoga providers in the UK (n=19). Interviews were audio-recorded, transcribed verbatim, and analysed thematically. Eight themes were identified. Yoga providers were generally aware of the health conditions of their attendees, and they had a reasonable knowledge of the causes, signs and symptoms, and management of

hypertension. Whilst most had received some information about hypertension as part of their initial yoga teaching training, this was generally felt to be limited. They mentioned the biopsychosocial benefits of yoga on hypertension but also expressed their concerns about the lack of regulation, the wide disparity in what is being delivered under the label of yoga, and the competency of some yoga providers.

In conclusion, despite some mismatches between yoga sessions in the UK and effective yoga interventions, yoga holds promise for hypertension management in the UK as it was an available and accessible practice in the UK, practised by people with hypertension and yoga providers showed willingness to deliver yoga to people with hypertension. Though the current evidence lacks strength in terms of both quality and quantity, it does indicate some consistency in the characteristics of effective yoga interventions. An important implication from this thesis is that the characteristics of potentially effective yoga interventions were in line with the lifestyle recommendations in the hypertension guideline by the ISH. In addition, considering that yoga is an affordable practice and yoga providers were willing to deliver yoga to people with hypertension, yoga could be of some help with managing hypertension in the UK. However, to establish stronger evidence before recommending the integration of yoga into the NHS for managing hypertension, comprehensive investigations involving different study populations, with a focus on validating and improving the identified intervention characteristics, are needed. Therefore, to carry the work done in this review to the next stage, with inspiration from the findings of this systematic review and meta-analysis, a funding application has been submitted

to NIHR to develop a yoga intervention that is likely to lead to maximum benefits for people with high blood pressure and to explore the acceptability and accessibility to people with different physical abilities in the UK.

*All the three empirical chapters of this thesis have already been published therefore there is some duplication in the thesis, especially in the introduction of these chapters.

Published Papers

1. Nalbant G, Hassanein Zeinab M, Lewis S, Chattopadhyay K. Delivering yoga to people with hypertension in the UK: A qualitative study to explore yoga providers' knowledge, experiences, and attitudes. *Health Sci Rep*. 2023;6(5):e1260.
2. Nalbant G, Hassanein ZM, Lewis S, Chattopadhyay K. Content, Structure, and Delivery Characteristics of Yoga Interventions for Managing Hypertension: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Front Public Health*. 2022; 10:846231.
3. Nalbant G, Lewis S, Chattopadhyay K. Characteristics of Yoga Providers and Their Sessions and Attendees in the UK: A Cross-Sectional Survey. *Int J Environ Res Public Health*. 2022;19(4):2212.
4. Nalbant G, Lewis S, Chattopadhyay K. Content, Structure, and Delivery Characteristics of Yoga Interventions for Managing Hypertension: A Systematic Review Protocol. *Int J Yoga*. 2020;13(2):111-114.

Conference Presentations

1- Nalbant G, Lewis S, Chattopadhyay K. Content, structure and delivery characteristics of yoga interventions for managing hypertension: a systematic review and meta-analysis of randomised controlled trials. School of Health and Related Research, University of Sheffield. August 8, 2023. Oral presentation.

2- Nalbant G, Lewis S, Chattopadhyay K. Content, structure and delivery characteristics of yoga interventions for managing hypertension: a systematic review and meta-analysis of randomised controlled trials. Academic Unit of Lifespan and Population Health Festival, University of Nottingham, July 2022. Oral presentation.

3- Nalbant G, Lewis S, Chattopadhyay K. Content, structure and delivery characteristics of yoga interventions for managing hypertension: a systematic review and meta-analysis of randomised controlled trials. Sue Watson Event, May 31, 2022. Oral presentation. (Student Choice Award)

4- Public Health Science Conference, 2021 (Oral presentation)

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5- European Society of Hypertension-International Society of Hypertension (ESH-ISH) Joint Meeting Committee, 2021 (Poster presentation)

Nalbant G, Lewis S, Chattopadhyay K. Content, structure and delivery characteristics of yoga interventions for managing hypertension: a

systematic review and meta-analysis of randomised controlled trials. *J Hypertens*, 2021; 39 (Supp 1).

6- **The International Association of Yoga Therapists Symposium on Yoga Research, 2021 (Oral presentations) - Student Research Abstract Award**

Nalbant, G., Lewis, S. and Chattopadhyay, K. Content, structure and delivery characteristics of yoga interventions for managing hypertension: A systematic review and meta-analysis of RCTs [abstract]. *International Journal of Yoga Therapy*, 2021; 31(Suppl. 1). ePub.

Nalbant G, Lewis, S., & Chattopadhyay, K. (2021). Characteristics of yoga providers and their sessions and students in the UK: A cross-sectional survey [abstract]. *International Journal of Yoga Therapy*, 2021; 31(Suppl. 1). ePub.

7- Nalbant G, Lewis S, Chattopadhyay K. Content, structure and delivery characteristics of yoga interventions for managing hypertension: a systematic review and meta-analysis of randomised controlled trials. Academic Unit 4 Postgraduate Research Conference, July 30, 2021. Oral presentation. (3rd best presenter)

8- Nalbant G, Lewis S, Chattopadhyay K. Yoga for managing hypertension? EMDoc, University of Derby, September 11, 2020. Oral presentation. (3rd best presenter)

9- Nalbant G, Lewis S, Chattopadhyay K. Yoga for the management of hypertension. School of Medicine Faculty Forum, University of Nottingham, June 25, 2019. Oral presentation.

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List of abbreviations

ABPM	Ambulatory Blood Pressure Measurement
ASH	American Society of Hypertension
BHF	British Heart Foundation
BMI	Body Mass Index
BP	Blood Pressure
BWY	British Wheel of Yoga
CAM	Complementary and Alternative Medicine
CI	Confidence Interval
CNHC	Complementary and Natural Healthcare Council
COREQ-32	Consolidated Criteria for Reporting Qualitative Research
CrI	Credible Intervals
CVD	Cardiovascular Disease
DALYS	Disability Adjusted Life Years
DBP	Diastolic Blood Pressure
DOR	Diagnostic Odds Ratio
ESC/ESH	European Society of Cardiology/European Society of Hypertension
ES	Effect Size
GIS	Geographical Information Systems
HBPM	Home Blood Pressure Measurement
HPA	Hypothalamic–Pituitary–Adrenal
ISH	International Society of Hypertension

JNC	Joint National Committee
LMIC	Low- and Middle-Income Countries
METs	Metabolic Equivalents
NHS	National Health Services
NICE	National Institute for Health and Care Excellence
OR	Odds Ratio
QOF	Quality and Outcomes Framework
RR	Relative Risk
SBP	Systolic Blood Pressure
UI	Uncertainty Interval
UK	United Kingdom
WHO	World Health Organization

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Chapter 1: Background

1.1. Abstract

The number of people with hypertension in the world has significantly increased in the last four decades and reached 1 billion 278 million people in 2019. In addition, hypertension is the leading attributable risk factor for death globally, accounting for 10.8 million deaths in 2019. In the UK, it has been estimated that around 1 in 4 people had hypertension in 2019 and around 65 thousand people died because of an SBP of 140 mmHg or higher in the UK in 2015. The current hypertension management strategies achieved a substantial improvement in the awareness, diagnosis, and management of hypertension. Despite these improvements, hypertension management remains poor worldwide and it is still a priority.

Growing evidence suggests that yoga, which is an ancient Indian philosophy and way of life, has positive effects on blood pressure and could be used to improve the management of hypertension in addition to current management strategies. Yoga has also become increasingly popular in the world and the UK for improving health and well-being, and previous cross-sectional studies have reported that hypertension is one of the most commonly disclosed health conditions in yoga sessions in the UK. If yoga is to be recommended for people with hypertension in the UK, it is crucial to understand the current landscape of yoga practice in the country, and the potential of yoga to be used in the management of hypertension.

1.2. The definition of hypertension

Hypertension is a chronic condition in which the force of blood pushing against the walls of blood vessels persistently increases and is characterised by a permanent increase in blood pressure where SBP is ≥140 mmHg and DBP is ≥90 mmHg.[1] Hypertension was classified into three stages in the American Society of Hypertension and the International Society of Hypertension (ASH/ISH) 2014 hypertension guideline as prehypertension (SBP 120-139 mmHg, DBP 80-89 mmHg), stage 1 hypertension (SBP 140-159 mmHg, DBP 90-99 mmHg), and stage 2 hypertension (SBP≥160, DBP≥100 mmHg).[2] However, in the 2020 ISH hypertension guideline, this classification was modified, and prehypertension has now been defined as high-normal blood pressure with SBP of 130-139 mmHg and DBP of 85-89 mmHg but stage 2 and stage 3 classification remained the same.[1] The National Institute for Health and Care Excellence (NICE) 2019 guideline on hypertension aligns with the definitions of stage 1 and 2 hypertension in 2020 ISH guideline.[3] However, it differs in that it excludes high-normal blood pressure (BP) and includes stage 3 or severe hypertension. In the NICE guideline, stage 3 or severe hypertension is defined as a clinic SBP of 180 mmHg or higher or a clinic DBP of 120 mmHg or higher. The Intercollegiate Guidelines Network (SIGN) guideline specifically addressing the management of hypertension could not be located. Although hypertension is discussed in the SIGN guideline for cardiovascular disease, it does not include a classification for hypertension in this particular guideline.[4]

Table 1 Classification of hypertension

	(ASH/ISH) 2014	ISH 2020	NICE 2019
Prehypertension/ high-normal blood pressure	SBP 120-139 mmHg, DBP 80-89 mmHg	SBP 130-139 mmHg, DBP 85-89 mmHg	_
Stage 1 hypertension	SBP 140-159 mmHg, DBP 90-99 mmHg	SBP 140-159 mmHg, DBP 90-99 mmHg	SBP 140-159 mmHg, DBP 90-99 mmHg
Stage 2 hypertension	SBP≥160, BP≥100 mmHg	SBP≥160, BP≥100 mmHg	SBP≥160, BP≥100 mmHg
Stage 3 or severe hypertension	_	_	SBP≥180 mmHg or higher, DBP≥ 120 mmHg

1.3. Risk factors for hypertension

There are two categories of hypertension: primary (essential) and secondary hypertension.[5] Primary hypertension develops over time with no identifiable cause. However, some factors might affect its development, which are divided into two categories as non-modifiable and modifiable risk factors.[6] Secondary hypertension, on the other hand, is caused by a specific and potentially treatable condition. Examples of such conditions include obstructive sleep apnoea, renal diseases, endocrinal causes (like primary aldosteronism), some medications (e.g., oral contraceptives), and other substances (e.g., stimulant drugs).[7] This thesis is focused on primary (essential) hypertension.

1.3.1 Non-modifiable risk factors

The non-modifiable risk factors for hypertension are the characteristics of an individual that cannot be changed and include age, ethnicity, family history, and genetics.[8] As people get older their likelihood of developing hypertension increases.[7] The Framingham study, which conducted a 30-year follow-up on normotensive individuals and those with untreated hypertension, observed a consistent rise in both mean SBP and DBP as individuals aged, regardless of gender.[9] Specifically, there was a linear increase in SBP from age 30 to 84 years, accompanied by concurrent increases in DBP.[9] People from certain ethnic backgrounds also have a higher risk of hypertension than the general population such as African American, African-Caribbean and South Asian people.[10, 11] In addition, family history and genetics play a role in hypertension, and a systematic review found that hazard ratios (HR) of hypertension were 2.0 (95% CI 1.2 to 3.5) and 3.5 (95% CI 1.9 to 6.1) in participants with one and both parents with early onset hypertension.[12]

1.3.2 Modifiable risk factors

The modifiable risk factors for hypertension are linked with the lifestyle of an individual which can be changed and include unhealthy diet, physical inactivity, overweight and obesity, excessive alcohol consumption, smoking, and persistent exposure to stress.[1] First, an unhealthy diet, which is specifically rich in excess dietary salt (>5 g salt per day), brings about an increase in blood pressure and increases the risk of hypertension.[13] In addition, a recent systematic review showed that high consumption of sugar-sweetened

beverages such as sugar sodas and juices was significantly associated with an increased risk of hypertension (relative risk (RR) 1.08; 95 % CI 1.04, 1.12).[14] Second, physical inactivity, which is commonly defined as a metabolic equivalent (MET) of 1.5 or less and corresponds to activities undertaken while sitting, accounts for 5–13% of the risk for the development of hypertension.[15, 16] Third, being overweight or obese has been related to an increased risk for hypertension.[17] For White, Hispanic and Black people, overweight is defined as a body mass index (BMI) of 25-29.9 kg/m^2 or obesity as a BMI of 30 kg/m^2 or over.[18] For Asian and South Asian people, overweight is defined as a BMI of 23-24.9 kg/m^2 and obesity as a BMI greater than 25 kg/m^2.[18] The Framingham study showed that multivariable-adjusted RR for development of hypertension was highly associated with being overweight (RR of 1.48 and 1.75 for overweight men and women, respectively) and obese (RR of 2.23 and 2.63 for obese men and women, respectively).[19]

Excessive alcohol consumption is another modifiable risk factor. It has been identified that there is a positive linear association between excessive alcohol consumption and hypertension.[20] In the 2018 European Society of Cardiology/European Society of Hypertension (ESC/ESH) guidelines for the management of arterial hypertension, it is recommended to restrict alcohol consumption to less than 14 units per week for men and 8 units for women (1 unit is equal to 125 mL of wine or 250 mL of beer).[21] The effects of smoking on blood pressure are still controversial.[22] A systematic review showed that acute smoking has a moderate negative effect on arterial stiffness (Effect size

(ES) 0.68; 95% CI 0.39 to 0.98), which is a contributing factor to hypertension.[23, 24] However, a Mendelian randomisation meta-analysis showed that smoking is causally related to a higher level of resting heart rate, but not to changes in blood pressure and risk of hypertension (beta coefficient −0.20; 95% CI −0.46 to 0.06 and beta coefficient 0.01; 95% CI −0.12 to 0.14 for SBP and DBP, respectively).[25] Finally, persistent exposure to stress has a role in the development and exacerbation of hypertension.[26, 27] Evidence indicates that chronic stress is likely a cause of sustained elevation of blood pressure.[26] A systematic review showed that psychosocial stress was associated with an increased risk of hypertension (odds ratio (OR) 2.40; 95% CI 1.65 to 3.49), and people with hypertension had a higher incidence of psychosocial stress compared to normotensive patients (OR 2.69; 95% CI 2.32 to 3.11).[27] In addition, a meta-analysis of cross-sectional and prospective studies reported the association between anxiety and hypertension (OR 1.18; 95% CI 1.02 to 1.37).[28]

1.4. Diagnosis of hypertension

The ISH and NICE hypertension guidelines recommend the same procedures for diagnosing hypertension.[1, 29] Blood pressure is measured in both arms in the clinic setting and if the measurement is 140/90 mmHg or higher, second and third measurements are taken, with the lower of the last two readings recorded as the clinic blood pressure. If clinic blood pressure is between 140/90 mmHg and 180/120 mmHg, people are asked to monitor their blood pressure outside the clinic using either home or ambulatory blood pressure measurement

(HBPM/ABPM) to identify white-coat or masked hypertension.[29] White-coat hypertension refers to a condition in which blood pressure is elevated in the clinic due to the presence of the clinician possibly because of increased stress but is normal out-of-clinic while masked hypertension is the opposite.[7]

In HBPM, blood pressure is recorded by patients themselves for around a week before the clinic visit.[7] ABPM records blood pressure between 15 and 30-minute intervals and also gives the average reading of blood pressure for a period of time, which is usually twenty-four hours.[7] Although ABPM is more representative of daily life and can identify white-coat or masked hypertension, it is more expensive than clinic blood pressure measurement (CBPM) and HBPM[7] therefore it is not commonly used to diagnose hypertension in clinical practice. However, a recent systematic review found that both ABPM and HBPM were cost-saving compared with CBPM, but ABPM was associated with lower costs than both CBPM and HBPM.[30] In addition, another systematic review found that the diagnostic performance of HBPM was higher than CBPM.[31] When using the 24-h ABPM with the cut-off of ≥ 130/80 mmHg as the reference standard, the diagnostic odds ratio (DOR) of HBPM was 11.11 (95% CI 6.44 to 19.16) and that of HBPM was 11.60 (95% CI 8.98 to 15.13), respectively. Therefore, HBPM remains the best alternative method for diagnosing hypertension where ABPM is not available.

1.5. The burden of hypertension in the world and the UK

The number of people with hypertension in the world has significantly increased in the last four decades.[32] A recent systematic review with a pooled

analysis from 184 countries (104 million participants) showed that the number of people with hypertension doubled from 648 million in 1990 to 1 billion 278 million people in 2019.[33] The global age-standardised prevalence of hypertension in adults aged 30–79 years was 32% (95% Credible Intervals (CrI) 30 to 34) in women and 34% (95% CrI 32 to 37) in men in 2019.[33] Interestingly, despite the increasing numbers, these figures were similar to those reported in 1990. This was attributed to several factors, including the impact of a growing and ageing population, a flattening or decreasing trend in the prevalence of hypertension in high-income countries and increasing prevalence of hypertension in low- and middle-income countries (LMICs) as illustrated in Figure 1.[33, 34] The reason for an increasing trend in hypertension prevalence in LMICs is possibly because of lower levels of awareness, diagnosis, and management of hypertension in LMICs compared to high-income countries.[34]

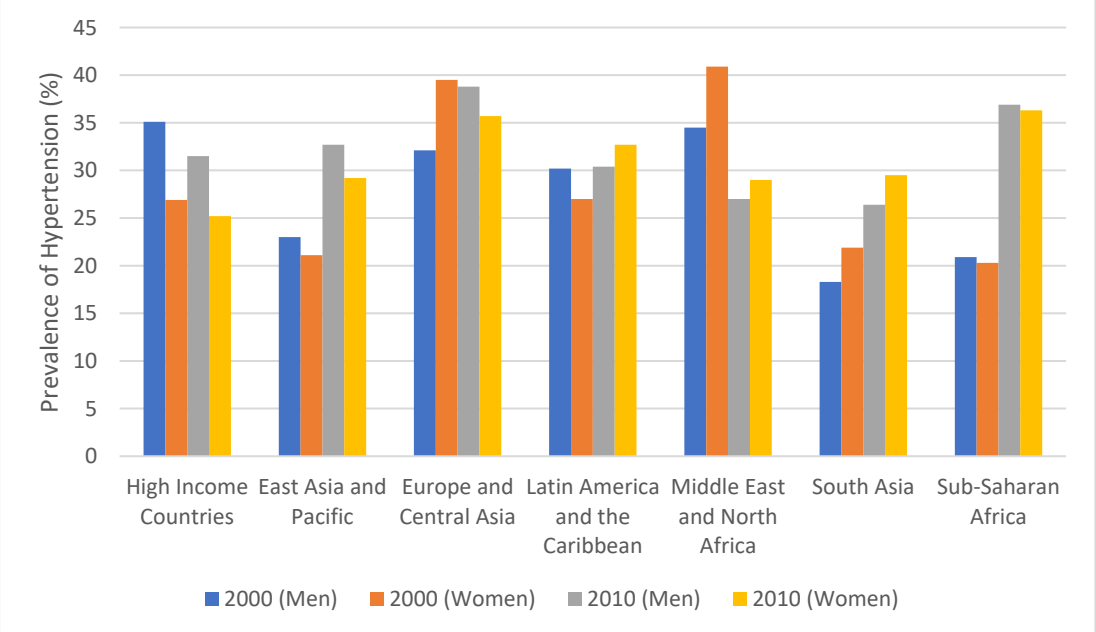

Figure 1 The change in prevalence of hypertension in the world between 2000 and 2010

*This table was reproduced from Mills, 2016.[34] Disparities of Hypertension Prevalence and Control: A Systematic Analysis of Population-Based Studies From 90 Countries. Circulation. 2016;134(6):441-50.

A systematic review showed that people with hypertension had a worse health-related quality of life than people without hypertension.[35] Furthermore, hypertension has a close link with serious health problems such as cardiovascular disease (CVD), e.g., myocardial infarction, cerebrovascular disease, e.g., stroke and kidney disease; therefore, it is considered a significant global threat.[36] The risk for such diseases begins at 115/75 mmHg and with each incremental increase of 20/10 mmHg, the risk for cerebrovascular and kidney disease substantially increases, and for CVD doubles.[37, 38] It is also estimated that hypertension accounts for around 10% of chronic kidney disease.[39] In addition, hypertension is the leading attributable risk factor for death globally, accounting for 10.8 million deaths in 2019.[40] According to the World Health Organization (WHO), at least 45% of deaths from CVD and 51% of deaths from stroke are attributable to hypertension.[36] High SBP was found to be the leading risk factor for the risk-attributable Disability Adjusted Life Years (DALYs), accounting for 10.4 million deaths (95% uncertainty interval (UI) 9.39 to11.5 million) and 218 million DALYs (95% UI 198 to 237 million).[41]

In addition to the health burden, hypertension imposes a great economic burden on health systems.[42] The economic costs of hypertension involve both direct medical costs for hypertension treatment, including the costs of comorbidities attributable to hypertension (e.g., stroke), and indirect costs such as productivity loss due to absence from work.[43] The global financial burden of high BP was around 370 billion US dollars in 2001 and it was estimated to reach

up to 1 trillion US dollars in 2019.[44] More recent assessments of the global economic impact of hypertension could not be found.

According to the WHO Noncommunicable Disease Country Profiles data, in the UK, the prevalence of hypertension was around 30% in 2000.[45] This is in line with the hypertension data from the England census and Scottish health survey (Figure 2).[46, 47] According to the data based on the Global Monitoring Framework, in 2015, hypertension prevalence declined to around 20% and the UK has become one of the countries with the lowest prevalence in the world[32] and the prevalence of hypertension is expected to decline to around 15% in 2025.[45] However, data from the Health Survey for England, Scottish, Welsh Health Survey and Quality and Outcomes Framework (QOF) suggest that around 28%, 29%, 16% and 14% of people had hypertension in England, Scotland, Wales and Northern Ireland in 2019, respectively.[46-49] In addition, the data from the British Heart Foundation's (BHF) analysis of UK surveys and the Office for National Statistics suggest that many cases are not diagnosed.[50] According to data from NHS Digital, in 2019, 30% of men and 25% of women had high blood pressure, highlighting a slightly higher prevalence among men.[51] Moreover, according to the BHF analysis of the QOF, Quality Assurance and Improvement Framework and GP prevalence data, it has been estimated that around 6-8 million people were living with undiagnosed or uncontrolled hypertension in the UK between 2021 and 2022.[52] Hence, the actual prevalence may be higher than the currently estimated prevalence. Therefore, there is a

significant rationale for conducting further research on hypertension and discovering improved management methods in the UK.

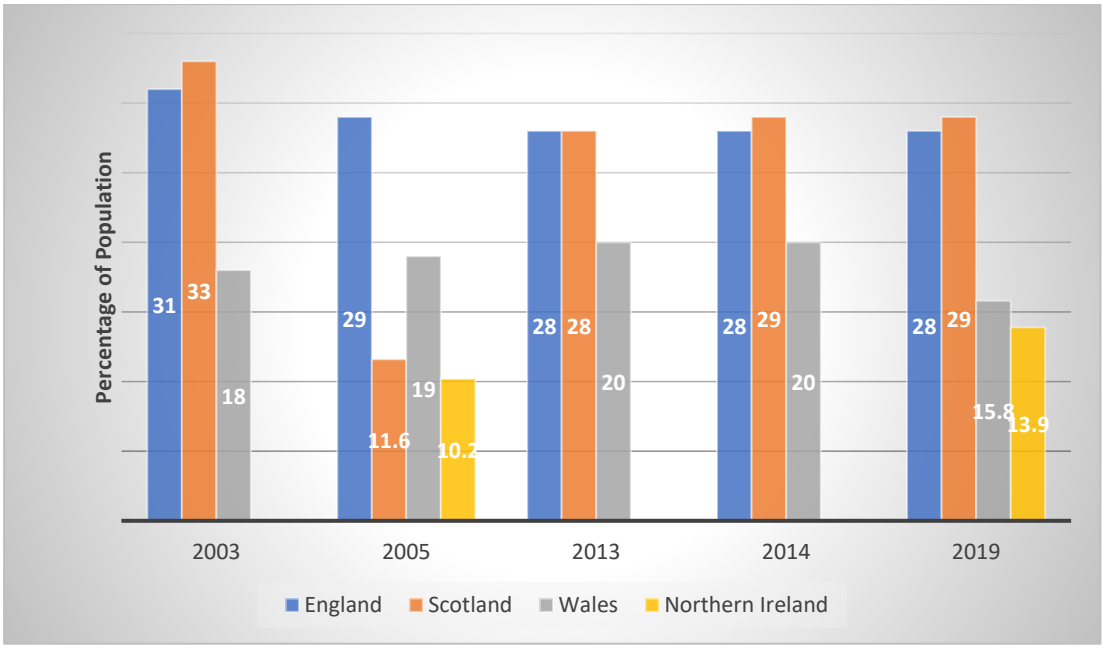

Figure 2 Change of hypertension prevalence in England, Scotland and Wales between 2003 and 2019

Hypertension also poses a burden on the UK's health system despite its decreasing prevalence.[53] It has been estimated that having an SBP of 110-115 mmHg was associated with around 1 million DALYs and an SBP of 140 mmHg or higher was associated with about 900 thousand DALYs in the UK in 2015.[54] In addition, it has been projected that around 93 thousand people died because of an SBP of 110-115 mmHg and around 65 thousand people died because of an SBP of 140 mmHg or higher in the UK in 2015.[54] Data from Public Health England showed that hypertension and hypertension-related complications cost over £2.1 billion every year to the UK's National Health Service (NHS).[55] While £850 million of the total cost is caused by hypertension-related stroke, £750 million is caused by hypertension-related coronary heart disease.[56]

1.6. Importance of hypertension management

Hypertension incurs a massive burden on health systems; however, it has been estimated that improved management of hypertension could substantially reduce this burden.[36] A recent meta-analysis authored by the Blood Pressure Lowering Treatment Trialists' Collaboration showed that a 5mmHg reduction of SBP decreases the risk of major cardiovascular events by 10%.[57] Interestingly, the risk reduction was observed across individuals with varying levels of cardiovascular risk, including those with blood pressure levels that are currently not considered for treatment.[57] Another meta-analysis showed that 10 mmHg reduction in SBP has been associated with a reduction in the risk of major cardiovascular disease events by 20%, in coronary heart disease by 17%, in stroke by 27%, in heart failure by 28%, and all-cause mortality by 13%.[58] This means that adequate hypertension management has a significant role in reducing premature death and disability, and economic burden.

1.7. Current approaches for hypertension management

Hypertension management strategies include lifestyle change and pharmacotherapy. These strategies aim to improve blood pressure and bring it below 140/90 mmHg.[37] Clinical management of hypertension is generally initiated with lifestyle changes for people with prehypertension.[7] Lifestyle changes are also recommended for people with stage 1 and 2 hypertension. These lifestyle changes aim to manage modifiable risk factors for hypertension and include a restriction on salt consumption, weight reduction, increased physical activity, smoking cessation, moderate alcohol consumption, and stress

management.[1] Several systematic reviews showed that addressing these risk factors can help control blood pressure.[59-62] A recent systematic review showed that the implementation of dietary sodium reduction resulted in a mean reduction (reduced sodium vs usual sodium) of 4.26 mmHg (95% CI 3.62 to 4.89) and 2.07 mm Hg (95% CI 1.67 to 2.48) in SBP and DBP, respectively.[59] In addition, moderate certainty evidence based on the GRADE approach was found that the DASH diet, which emphasises a diet rich in fruit, vegetables, low-fat dairy products, and reduced saturated and total fat, was associated with larger reductions in SBP and DBP than a usual diet (4.7 mmHg and 2.9 mm Hg, respectively).[60] Compared to the usual diet, low carbohydrate diets had resulted in a median reduction of 5.14 mmHg in SBP (3.01 to 7.32; moderate certainty) and 3.21 mmHg in DBP (95% CI 1.89 to 4.53; low certainty).[60] Furthermore, a systematic review showed that exercise significantly reduced ambulatory SBP (−5.4 mmHg; 95% CI −9.2 to −1.6) and DBP (−3.0 mmHg; 95% CI −5.4 to −0.6).[61] In addition, the clinic SBP and DBP were significantly reduced by 5.79 mmHg (95% CI 3.54 to 8.05) and 3.36 mmHg (95% CI 1.93 to 4.75) after a mean BMI reduction of 2.27 kg/m^2.[62]

The second clinical management approach is pharmacotherapy. The mainstay of pharmacotherapy for hypertension management is antihypertensive drugs. These include calcium channel blockers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and diuretics.[63] In the 2020 ISH guideline, pharmacotherapy is not recommended for prehypertensive people. However, for those with stage 1 hypertension, medication is recommended

after 3-6 months of lifestyle changes if their blood pressure remains uncontrolled. On the other hand, individuals with stage 2 hypertension are advised to begin pharmacotherapy immediately along with receiving lifestyle advice.[1] However, people with stage 2 hypertension are recommended to directly start pharmacotherapy as well as lifestyle advice. It usually starts with monotherapy and then other medicines are added with time to better manage blood pressure.[64] The SPRINT trial found that among patients at high risk for cardiovascular events without diabetes, aiming for a SBP below 120 mm Hg (compared to below 140 mm Hg) led to reduced rates of major cardiovascular events, both fatal and nonfatal, as well as lower overall mortality but also to higher rates of certain adverse events.[65] Conversely, a systematic review showed that administering treatment to reduce blood pressure was associated with a lower risk of death and cardiovascular disease if the SBP was 140 mm Hg or higher.[66] However, for individuals with a baseline SBP below 140 mm Hg, the treatment's effectiveness in preventing primary cardiovascular events was not significant.

In the UK, management strategies for hypertension largely mirror global management strategies. The NICE and SIGN guidelines recommend lifestyle changes and pharmacotherapy for the management of hypertension.[4, 29] However, unlike other hypertension guidelines, NICE guidelines do not recommend the routine use of antihypertensive treatment for those with stage 1 hypertension as well as those with prehypertension unless such people have

diabetes, renal disease, target organ damage, established CVD and estimated 10-year cardiovascular risk of >20%.[67]

The UK government has also undertaken several health policy initiatives aiming to increase awareness and diagnosis rates. In 2006, the UK's Food Standards Agency started a programme encouraging the food industry to reduce the salt used in processed food and to label packaged food based on fat, sugar, and salt content.[56, 68] In addition, in 2014, the Quality and Outcomes Framework (QOF) which is a pay-for-performance programme that aims to promote better care and outcomes in long-term conditions including hypertension was introduced.[69]

1.8. Limitations of current treatments in hypertension management

The current hypertension management strategies achieved a substantial improvement in the awareness and diagnosis of hypertension in high-income countries.[70] Despite these improvements, hypertension management remains poor worldwide, especially in LMICs. Globally, only 40% of people with hypertension are treated and of those, only around 35% achieve the recommended blood pressure level (<140/90 mmHg).[7]

According to a large multinational cross-sectional study conducted in 2017, it was found that 35% of individuals (around 1.2 million in total) had hypertension and 58% of those with hypertension were receiving antihypertensive treatment.[71] However, among individuals receiving treatment, 46% did not achieve sufficient control of their blood pressure.[71] In addition, in the UK,

although the prevalence of adults with untreated hypertension decreased over the years, the hypertension management rate is still far from optimal and significant numbers of people with hypertension remain inadequately treated.[50] According to a population-based survey (n=500.000), almost half of the hypertensives aged 40-69 years (46.9%) were unaware of their condition, 27% of those who were aware were untreated, and only 38.1% (n=37,925) of treated hypertensives were controlled, which means that around 62% of hypertensives were suboptimally treated.[72]

Globally, the main cause of suboptimal blood pressure management is seen as the poor adherence of patients to treatment.[64, 73, 74] Suboptimal adherence includes failure to initiate pharmacotherapy, to take medications as often as prescribed, and to persist in long-term therapy.[74] The high cost of such drugs, the difficulty of patients in using combination medications, and the perceptions of patients that medications are ineffective in controlling hypertension or are likely to have major adverse effects contribute to poor adherence and therefore suboptimal results in hypertension management.[75-77]

Hypertension management remains suboptimal in the world and the UK, and therefore, managing hypertension is still a priority. Thus, effective strategies to achieve better outcomes are needed to benefit individuals, improve healthcare, and promote national health. WHO 2013 report emphasises the value of 'thinking outside the box' for creative ways to tackle hypertension.[78] This creates an opportunity to explore non-pharmacological interventions for hypertension management. In this respect, yoga, covering physical poses and

meditation and relaxation practices, might be an effective way to further improve hypertension management.

1.8. Yoga: a potential solution

1.8.1 The origin of yoga

Yoga, an ancient system of health and way of life, originated in the Indian subcontinent around 5000 years ago.[77] The word yoga originates from the Sanskrit (an ancient Indian language) root "yuji" which means to bring together or to unite.[79] It is based on the unity of the body, mind and spirit.[80] There are six main branches of yoga: Bhakti yoga, Hatha yoga, Jnana yoga, Karma yoga, Mantra yoga and Raja yoga.[81] Hatha yoga is the most commonly practised style and it is an overarching term for physically based yoga styles such as Iyengar, Ashtanga and Bikram.[82]

Yoga, as defined by Patanjali, has eight limbs and these are Yama (moral codes), Niyama (personal conduct), Asana (yogic poses), Pranayama (breathing practices), Pratyahara (internalisation of the senses), Dharana (concentration), Dhyana (meditation), and Samadhi (self-realisation).[83, 84] These limbs are explained as follows:[83, 85]

1. **Yama (moral codes)** refers to ethical guidelines or moral restraints regarding the outside world and therefore are of particular importance in social context. This comprises principles such as non-violence (ahimsa), truthfulness (satya), non-stealing (asteya), non-waste of vital energies (brahmacharya) and non-possessiveness (aparigraha).

2. **Niyama (personal conduct)** refers to ethical guidelines or moral restraints regarding the inner world. Niyama applies five principles to the individual's life: purity (sauca), contentment (santosa), self-discipline (tapas), self-study (svadhyaya) and surrender (ishvara pranidhana).
3. **Asana (yogic poses)** consists of several physical poses that are used for attention training, increasing awareness and preparation for controlling the mind in meditation for extended periods of time. Asana is one of the most commonly utilised yoga practices in modern interpretations that have been acquired from Hatha yoga.
4. **Pranayama (breathing practices)** is a Sanskrit word constructed of two separate words, prana meaning breath, respiration, life, vitality and energy, while ayama can be translated as restraint, control manifestation and regulation. Hence, Pranayama is a series of specific techniques to control the breath in order to allow the breath and life force to flow freely.
5. **Pratyahara (internalisation of the senses)** refers to the withdrawal or redirection of the senses inwardly. It is a way to minimise external distractions from sensory information, allowing for a calm mind and turning attention inwardly. A typical contemporary yoga practice, which includes the supine rest pose (Shavasana) and emphasises relaxation with closed eyes, is a form of pratyahara. This technique also incorporates guided relaxation such as Yoga Nidra, which serves as an invitation for the practitioner to direct their attention to their inner being.
6. **Dharana (concentration)** means focusing the mind on a particular place, object or experience. The practitioner aims to focus the mind on a single

object of meditation such as a breath, a point of the body, or an external object and attempt to maintain focus on that object. At this stage, focused attention requires effort as the mind repeatedly wanders. The important goal of dharana is to minimise mind wandering.

7. **Dhyana (meditation)** is the process of the mind's activity becoming increasingly refined and subtler. Dhyana occurs when the mind ceases to wander. This advanced stage of meditation occurs with time and practice, and as wandering decreases, so does the effort to maintain focus, and an unbroken chain of awareness rests on the object of meditation. The mind begins to become completely absorbed in the object of attention and a sense of union with the object of attention begins to occur.
8. **Samadhi (self-realisation)**, a state of profound meditative absorption, lacks an equivalent concept in Western cultures and remains uncommon even in Eastern cultures due to its challenging nature. Attaining samadhi requires extensive and dedicated practice, involving silencing all levels of the mind. This commitment necessitates a life dedicated to the practice.

Figure 3 Utthita balasana (extended child pose)[86]

Figure 4 Bhujangasana (cobra pose)[87]

Figure 5 Adho mukha svanasana (downward-facing dog pose)[88]

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1.8.2 The effectiveness of yoga on hypertension

In recent years, yoga has become increasingly popular for dealing with stress, improving health-related quality of life and managing several health conditions. With its growing popularity, the number of studies assessing its effects on health conditions increased. Several systematic reviews indicated that yoga has positive impacts on several health conditions, including anxiety, depression, diabetes, obesity, hypertension and CVD.[82, 89-92]

Of the benefits attributed to yoga practice, hypertension management is among the most studied.[77] To date, several systematic reviews have assessed the effectiveness of yoga interventions for managing hypertension.[77, 92-100] Reviews generally compared yoga with no treatment, usual care/conventional therapy, physical activity and dietary modifications. All these reviews noted that yoga practices produced significant changes in blood pressure. It was also found that yoga might be more effective in reducing SBP than DBP. Five such reviews conducted a meta-analysis.[77, 92, 97, 99, 100] The results of the meta-analysis showed that yoga had a significant effect on SBP and DBP compared to no intervention or usual care,[77, 97] but did not have a significant effect when compared to exercise or other types of interventions.[77, 92]

Table 2 Findings of the previous systematic reviews

	Number of trials	Number of participants	Effect size (MD (95% CI))	
			SBP	DBP
Hagins et al., 2013				
Yoga vs No intervention or usual care	13	656	−7.96 (−10.65, −5.27)	−5.52 (−7.92, −3.11)
Yoga vs Exercise or exercise+ additional intervention	3	97	2.87 (1.42, 4.31)	−0.30 (−1.47, 0.87)
Yoga vs Non-exercise intervention	6	190	1.14 (−3.37, 5.66)	−0.35 (−3.56, 2.86)
Cramer et al., 2014				
Yoga vs Usual Care	6	278	-9.65 (−17.23, −2.06)	−7.22 (−12.83, −1.62)
Yoga vs Exercise	2	126	1.20 (-3.52, 5.93)	0.06 (-4.85, 4.97)
Park et al., 2017				
Meditation vs Control	7	355	-7.37 (-8.28, -6.46)	-5.43 (-5.98, -4.89)
Yoga vs No intervention or usual care	6	343	-4.59 (-5.54, -3.64)	-3.65 (-4.26, -3.03)

Wu et al.., 2019* Yoga vs Control	49	3517	-0.47 (-0.62, -0.32)	-0.47 (-0.61, -0.32)
Khandekar, 2021 Yoga vs Control	5	376	−0.62 (−0.83 −0.41)	−0.81 (−1.39 to −0.23)

*SMD

1.8.3 The limitations of previous systematic reviews and RCTs

Six of the previous reviews included studies where not all the participants were hypertensive,[77, 93, 94, 99] yoga interventions were part of multimodal interventions[77, 93, 98] or interventions other than yoga were combined with studies looking at yoga.[94, 97] For example, Tyagi et al. included studies assessing interventions other than yoga such as biofeedback and the RESPeRATE device, which promotes to achieve slow and deep breathing.[52] Similarly, Park et al. included studies involving the use of meditation in combination with yoga and Posadzki et al. included some studies involving the use of relaxation methods in combination with yoga.[60,67] In addition, previous systematic reviews were limited in their search strategies with the inclusion of a few databases and a limited number of studies.

These systematic reviews suggested that yoga might be effective in hypertension management, but they were inconclusive. This is because most of the trials included in the previous systematic reviews were of poor methodological quality with small sample sizes, resulting in a lack of statistical power for outcome assessment. In addition, yoga interventions were highly heterogeneous in terms of the content, structure and delivery characteristics. Therefore, it is difficult to select one effective intervention over the other and replicate successful interventions.

1.8.4 Potential mechanisms for effects of yoga on hypertension

The beneficial effects of yoga on hypertension result from its direct and indirect effects. Its direct effects involve improving blood pressure, whereas indirect

effects involve improvements in mental health, physical activity, dietary choices and weight reduction.[61, 101] These lifestyle factors have been associated with improved management of high blood pressure, and making changes in these factors can lead to reductions in blood pressure levels.[1] Consequently, practising yoga can contribute to lowering blood pressure and reducing the risk of hypertension.

The exact mechanism for yoga's blood-pressure-lowering effect is not clearly known yet.[102] However, it is hypothesised that the potential blood pressure-lowering effects of yoga occur in two pathways. The first potential pathway is an increase in parasympathetic activity, possibly due to vagal stimulation, and the second one is the suppression of the hypothalamic-pituitary-adrenal (HPA) axis and the activation and reactivity of the sympathetic nervous system.[96, 103, 104] Stress prompts the release of hormones that physiologically regulate multiple processes within the nervous system. The HPA axis responds to stress by elevating cortisol levels in the blood, thereby impacting sympathetic nervous system reactions.[105] The response process begins in the hypothalamus, a brain region which impacts many aspects of life, including energy levels, sleep patterns, and blood pressure regulation. Yoga has been proposed as a method to downregulate the HPA axis by inducing a relaxation response, thereby reducing cortisol levels and decreasing sympathetic nervous system activity.[106]

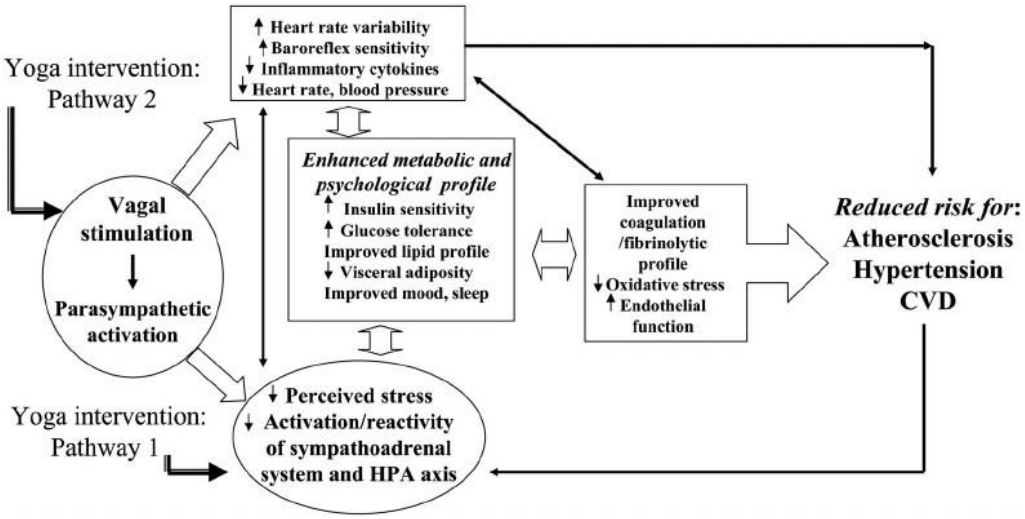

Figure 6 Hypothesized pathways by which yoga can regulate blood pressure[103]

Yoga promotes an improvement in mental health issues, including stress, anxiety and depression, which are partly caused by constant stimulation from the external world.[101] Yoga can help people to be more in contact with their inner world, i.e., their breath, body and mind, and therefore, to feel stiller and more relaxed.[101] There are several systematic reviews, suggesting that yoga can be beneficial in dealing with stress, anxiety and depression.[89, 91, 107, 108] Evidence also suggests that yoga has positive effects on well-being (emotional, psychological and social) by providing opportunities for personal transformation and social interaction.[27] People who practise yoga had more positive psychological traits such as calmness, peacefulness, happiness, kindness, tolerance, respect and compassion.[109] In addition, the community aspect of yoga practice may be beneficial for those who are at risk for social isolation such as older people, bereaved and depressed people by fostering social interaction.[109-112] As mentioned in the previous sections, stress management is one of the lifestyle approaches that are needed to achieve better hypertension management and therefore improvements in mental

health facilitated by yoga can indirectly contribute to the management of hypertension.

Two recent systematic reviews showed that there was a dose-response relationship between exercise and blood pressure reduction.[61, 113] One of these reviews suggested that a moderate-intensity exercise practised at least 3 sessions/week and 30 min/session is an effective lifestyle intervention for reducing ambulatory blood pressure.[61] Another systematic review showed that leisure time walking also reduced SBP (MD −8.36 mmHg; 95% CI −13.39 to −3.32) and DBP (MD −5.03 mm Hg; 95% CI −8.23 to −1.84).[114] Yoga also involves physical poses and improves physical fitness.[115] A systematic review showed that yoga met the light intensity of physical activity but with the inclusion of Surya Namaskar (Sun Salutation) achieved a moderate intensity of physical activity.[116] Another systematic review suggested that there are differences in intensity classifications observed between different styles of yoga.[117] While there is not complete uniformity in the evidence regarding the intensity of yoga practice, regular engagement in yoga, even if it falls under the category of low-intensity physical activity, can still meet the physical activity needed to achieve a reduction in blood pressure.

Lifestyle aspect of yoga encourages a vegetarian diet and motivates to make healthier choices and mindful eating.[118, 119] Therefore, individuals practising yoga may make choices that promote weight management and overall health.[120] Furthermore, the physical activity involved in yoga practice and the dietary approaches it encompasses may also contribute to weight reduction

and the prevention of obesity. Additionally, the positive effects of yoga on reducing stress, anxiety, and depression can indirectly support weight management by reducing emotional eating tendencies.[121] Considering that weight loss and healthy eating habits are important aspects of lifestyle change required for hypertension management, yoga can indirectly reduce blood pressure through its potential effects on dietary choices and weight reduction.

Yoga can encourage people to abstain from tobacco products, which is one of the principles (purity) imposed by Niyama.[120] Yoga may prompt reductions in tobacco consumption through a number of pathways. For example, yoga may reduce cigarette cravings by enhanced coping with stress and improvements in mood.[122] In addition, practising pranayama may make practitioners more mindful of their limited lung capacity and invoke a desire to quit. Nationally representative surveys of the US also found that yoga practice has been linked with lower rates of smoking.[122-124] By abstaining from tobacco products, individuals can significantly improve their cardiovascular health.[125] Therefore, yoga's potential influence on reducing tobacco consumption can contribute to overall cardiovascular well-being.

1.9. Differences between the concept of yoga in Eastern and Western countries

Although yoga is getting increasingly popular and acceptable by many people, yoga does not mean the same thing to everyone. Attitudes towards yoga vary across countries due to cultural, social and historical influences. In Eastern countries such as India, Nepal and Thailand, it carries a profound significance

as it represents the union with the ultimate reality embedded within their spiritual and religious convictions.[126] Contrary to Eastern countries, yoga is primarily viewed as a physical exercise aimed at enhancing health and well-being in Western countries.[126] Yoga started to be popularised in the late 19th and early 20th centuries by Indian teachers such as Swami Vivekananda, who was also a spiritual leader, and Yogini Sunita in Western countries, such as the US and the UK.[127] Yoga has been particularly embraced by women in Western countries as it provided a space to refresh physically and mentally, and it had much in common with exercise methods such as Swedish and Danish gymnastics that were popular for women in the late 19th and early 20th centuries.[128] Women in the UK started engaging in yoga for a range of motives, yet enhancing their physical health and mental wellness was a primary concern.[126] In addition, it provided a break from the housewife syndrome, encompassing feelings of monotony and underappreciation while also allowing them to do family commitments as well as earn more in shorter periods of time compared to alternative work options accessible to women at that time.[126]

1.10. Yoga practice in the world and the UK

Yoga has gained popularity in many countries, with a notable increase in the number of people who practise yoga.[129] In the United States (US), the percentage of people practising yoga increased from 9.2% (around 21 million individuals) in 2012 to 13.7% (around 33 million individuals) in 2017.[130] Similarly, in Germany, the prevalence of yoga practice was 16% in 2018 whereas it was 15.1% in 2014.[131] The prevalence of yoga practice increased by 12.5%

points over a nine-year period and reached 19.3% in Iceland in 2015.[132] In Australia, a survey of Australian women showed prevalence of yoga practice to be 20.7% among women aged 62–67 years, 21.7% among those aged 31–36 years and 29% among those aged 19–25 years.[133] A study conducted in India, involving 162,330 respondents, revealed that 11.8% of the population practised yoga.[134]

In Western countries such as Germany, Iceland and the US, yoga was predominantly practised by women.[130-132] On the contrary, in India, the prevalence of yoga practice among males and females was almost equal and another survey showed that yoga practitioners were mostly male.[135] In these countries, the commonly cited reasons for engaging in yoga were relaxation and health promotion.[130, 136] In a cross-sectional study, it was found that musculoskeletal conditions and injuries (62.8%) were one of the most common reasons for participants to attend a yoga therapy session in the US and this was followed by pregnancy (13.2%) and hypertension (5.2%).[137]

The prevalence of yoga practice in the UK was analysed using the Health Survey for England data.[138] It was found that the proportion of respondents who practised yoga in the last four weeks was 1.11% (0.95%-1.28%) in 2006/2008 and yoga practitioners in England were more likely to be female, degree-educated and from non-manual social class.[138] In addition, around 14% of those doing yoga were diagnosed with hypertension. In other words, almost 1 in 7 people who practised yoga had hypertension in England between 2006 and 2008. There is a need to highlight that the results of the research might

underestimate the real prevalence of yoga. This is because the research was originally a sports and exercise survey, and it is possible that people might not classify yoga as a form of physical activity and thus may not report their practice. Another cross-sectional study involving 1,106 people in the UK found that around 10% of participants practised yoga while approximately 13% engaged in meditation.[139] In addition, another cross-sectional study showed that 16% of the respondents (n=2434) began practising yoga to address specific physical or mental health issues.[140] These individuals found yoga to be beneficial for a variety of health conditions, with particular emphasis on musculoskeletal and mental health conditions. Moreover, among the respondents, 7% had hypertension, and 73% of them reported that yoga had a positive impact on their condition.[140] However, these studies did not provide information on the styles and content of yoga sessions and the availability and accessibility of these sessions in the UK.

Yoga sessions are available through leisure centres, health clubs, yoga associations, gyms and private yoga studios and sessions are delivered by yoga providers, i.e., yoga teachers or therapists in the UK.[141] Yoga therapists are yoga teachers with additional training and experience in the therapeutic adaptation and application of yoga to those with health problems including hypertension.[142] It is estimated that more than 10,000 yoga teachers,[143] whereas it is estimated that there are around 150 yoga therapists who practise in the UK. Most people with hypertension who practise yoga are likely to attend sessions led by yoga teachers who may not be well-informed about

hypertension. This is possibly because of the very low number of yoga therapists in the UK; a lack of public awareness about the difference between yoga teachers and therapists; and the higher cost of yoga therapy sessions delivered by therapists compared to regular yoga sessions delivered by yoga teachers.

Yoga appears as a part of healthcare in some countries such as India and Sweden.[144-149] It is also covered by US Medicare for those with or at risk of CVD and in Australia by private health insurance companies.[145] Although the UK's NHS provides yoga sessions for the staff in some settings and supports yoga as a safe and beneficial practice for those with hypertension, it does not feature as a first or even second-line management strategy for patients including hypertensives in the UK.[145-148] The lack of understanding of yoga practice and the paucity of research in the UK might be a potential reason for this situation.

1.11. Rationale for thesis

There has been a surge of research related to the health benefits of yoga for hypertension including systematic reviews and meta-analyses. Several systematic reviews suggested yoga might be effective in improving blood pressure in hypertension.[77, 82, 92-97] There is also evidence that yoga can help manage hypertension through its indirect impacts on stress, physical activity, weight and mental health.[121, 150] Therefore, yoga, as a non-pharmacological intervention, holds promise to improve the management of hypertension. However, the term "yoga" encompasses a broad range of concepts and previous systematic reviews included studies from across the world including

places where yoga could mean different things. These reviews have not synthesised what the yoga components are for those which seem to show effectiveness on hypertension. Therefore, there is a need to synthesise the content, structure and delivery characteristics of yoga interventions to understand which aspects of yoga have more potential to be effective in managing hypertension.

If yoga is to be recommended for people with hypertension in the UK, it is crucial to understand the current landscape of yoga practice in the country, and how this compares to the interventions that have shown effectiveness in the trials. Furthermore, the views of yoga providers as service providers would be helpful for decision-makers to understand potential problems with using yoga for the management of hypertension in the UK and how to overcome these problems. Therefore, a systematic review, a cross-sectional survey and a qualitative study were conducted. These three studies were combined and compared to explore if and how yoga can be used to manage hypertension in the UK by presenting an overall picture of the yoga practice and how yoga sessions align with the effective yoga interventions; and to contribute to the development of a yoga intervention for hypertension management by synthesising the characteristics of effective yoga interventions and exploring the perspectives of yoga providers on yoga practices that are beneficial or non-beneficial for people with hypertension.

1.12. Thesis aims and objectives

The overall aim of this thesis was to gain a better understanding of the current provision of yoga and its potential in managing hypertension in the UK.

The specific objectives were:

1. To synthesise the content, structure and delivery characteristics of effective yoga interventions used for managing hypertension.
2. To map the characteristics of yoga providers and their sessions and attendees in the UK.
3. To explore the knowledge, experiences and attitudes of yoga providers in delivering yoga to people with hypertension in the UK.

Chapter 2: Content, structure and delivery characteristics of yoga interventions for managing hypertension: A systematic review and meta-analysis of randomised controlled trials

2.1 Abstract

Objectives: This systematic review aimed to synthesize the content, structure, and delivery characteristics of effective yoga interventions used for managing hypertension and to compare these characteristics with interventions that were not found to be effective.

Design and Method: The JBI and the PRISMA guidelines were followed in this systematic review. RCTs conducted among hypertensive adults were included. RCTs reporting at least one of the major components of yoga (i.e., asana, pranayama, and dhyana and relaxation practices) and comparing them with no intervention or any intervention were eligible. Sixteen databases were searched for published and unpublished studies without any date and language restrictions till March 15, 2021.

Results: The literature search yielded 13,130 records. 34 RCTs (evaluating 38 yoga interventions) met the inclusion criteria. Overall, included studies had low methodological quality mostly due to inadequate reporting. Yoga reduced SBP and DBP compared to a control intervention (MD −6.49 and −2.78; 95CI% −8.94-−4.04 and −4.11-−1.45, respectively). Eighteen, 14 and 20 interventions were effective in improving SBP, DBP, or either, respectively. 13 out of 20 effective interventions incorporated all the 3 major components of yoga and allocated similar durations to each component whereas interventions that were not found to be effective were more focused on the asana and duration of asana practice was longer. The most common duration and frequency of effective interventions were 45 min/session (in 5 interventions), 7 days/week (in 5

interventions), and 12 weeks (in 11 interventions) whereas the most common session frequency was 2 days a week (in 7 interventions) in interventions that were not found to be effective. Effective interventions were mostly centre-based (in 15 interventions) and supervised (in 16 interventions) and this was similar with interventions that were not found to be effective.

Conclusion: Despite the low quality and heterogeneity of included studies, our findings suggest yoga interventions may effectively manage hypertension. The differences between the effective and interventions that were not found to be effective suggest that effective yoga interventions for managing hypertension yoga interventions mostly incorporated asana, pranayama, and dhyana and relaxation practices and they had a balance between these three components and included regular practice. They were mostly delivered in a centre and under supervision. Future studies should consider developing and evaluating an intervention for managing hypertension using the synthesized findings of the effective interventions in this review.

2.2 Introduction

The number of people with hypertension in the world has significantly increased in the last four decades.[32] Current estimates suggest that the global prevalence of hypertension is around one billion.[32] If this trend continues, by 2025, approximately 1.56 billion people aged over 20 years are expected to have hypertension.[151, 152] Hypertension has a close link with serious health problems such as cardiovascular disease, cerebrovascular disease, and kidney disease; therefore, it is considered a significant global threat.[153] Hypertension also imposes a great economic burden;[42] including both direct medical costs for hypertension treatment and the costs of comorbidities attributable to hypertension and indirect costs such as productivity loss due to absence from work.[43]

Hypertension is characterised by consistently high arterial blood pressure, and the ISH/ASH classifies hypertension into three stages as prehypertension (SBP: 120–139 mmHg, DBP: 80–89 mmHg), stage 1 hypertension (SBP: 140–59 mmHg, DBP: 90–99 mmHg) and stage 2 hypertension (SBP ≥160, DBP ≥100 mmHg).[2] Current hypertension management strategies aim to reduce blood pressure and include lifestyle modification, mainly dietary changes, physical activity, and stress reduction, in addition to pharmacological treatment.[1] The current hypertension management strategies achieved a substantial improvement in the awareness, diagnosis, and management of hypertension.[32] However, the WHO 2013 report emphasised the importance of 'thinking outside the box' for creative ways to further improve the management of

hypertension.[36] Yoga, as a non-pharmacological intervention, could be one such additional way to further improve the management of hypertension.

Yoga, an ancient Indian philosophy and way of life, originated in the Indian subcontinent over 5000 years ago and is being used as a method of improving health and well-being.[77] There are different branches of yoga, each with a different emphasis on and approach to practice; Hatha yoga, an overarching term for physically-based yoga styles such as Iyengar, Asthanga, and Vinyasa, is the most commonly practised style.[154-156] Yoga, as explained by Patanjali, has eight components which are ethical standards (yama), self-discipline (niyama), yogic poses (asana), breathing practices (pranayama), withdrawal of the senses (pratyahara), concentration (dharana), meditation (dhyana) and relaxation practices, and transcendence (samadhi).[83, 157]

The beneficial effects of yoga on hypertension may occur through its blood pressure-lowering effect,[154] as well as its effects on physical activity, stress reduction, and lifestyle.[89, 150, 158, 159] The exact mechanism of yoga for lowering blood pressure is not known yet but proposed physiological mechanisms include an increase in parasympathetic activity, possibly due to vagal stimulation, the suppression of the hypothalamic-pituitary-adrenal axis, and reduction in the activity and reactivity of the sympathetic nervous system.[96, 160-162] Yoga, as physical activity, can satisfy the recommended levels of physical activity for people with hypertension. For example, one study found that an hour of Ashtanga yoga satisfies the moderate levels of physical intensity[150] and another study found that 1.5 hours of Vinyasa yoga is higher than moderate

physical activity requirements.[163] 2020 ISH Global Hypertension Practice Guidelines also suggest yoga as an aerobic form of physical activity under lifestyle modification.[1] Yoga has been shown to improve stress levels,[89, 164] which is associated with high blood pressure.[1] In addition, yoga focuses on a healthier and mindful lifestyle, which supports people for a healthier diet, and abstinence from smoking and alcohol.[122, 165, 166]

Several systematic reviews have evaluated and synthesised evidence on the effectiveness of yoga interventions for managing hypertension.[77, 92-96, 98, 167, 168] Previous reviews showed that yoga interventions significantly reduced SBP and DBP.[77, 92, 167] Six of these reviews, despite claiming to include studies conducted on patients with hypertension and yoga interventions, included studies where not all the participants were hypertensive,[77, 93, 94, 168] yoga interventions were part of multimodal interventions[77, 93, 98] or interventions other than yoga were assessed.[94, 167] In addition, though these systematic reviews suggested that yoga might be effective in hypertension management, they were inconclusive. It is also hard to select one yoga intervention over the other because of its heterogeneous content, structure, and delivery characteristics, which are important aspects of yoga interventions. To evaluate yoga's effectiveness, there is a need to summarise and synthesise potentially effective aspects of yoga interventions. Only one systematic review,[93] described the content and structure of yoga interventions used in each study; however, this review did not synthesise these aspects of effective interventions. Thus, the objective of this systematic review was to synthesise the content, structure, and delivery

characteristics of effective yoga interventions used for managing hypertension and to compare these characteristics with interventions that were not found to be effective.

2.3 Materials and methods

This systematic review was conducted in accordance with the JBI methodology for systematic reviews of effectiveness and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[169, 170] The systematic review protocol has been published elsewhere[171] and it was registered with PROSPERO (CRD42019139404). Two independent reviewers were involved throughout the process and any disagreements arising between reviewers were resolved through discussion. If consensus was not reached, a third reviewer was involved.

2.4 Inclusion criteria

Population: This systematic review included studies conducted among adults (≥18 years) diagnosed with hypertension. The International Society of Hypertension and the American Society of Hypertension (ISH/ASH) classifies hypertension into three stages: prehypertension (SBP: 120–139 mmHg, DBP: 80–89 mmHg), stage 1 hypertension (SBP: 140–59 mmHg, DBP: 90–99 mmHg) and stage 2 hypertension (SBP ≥160, DBP ≥100 mmHg).[2] Studies in line with this classification were eligible. In accordance with the ISH/ASH guideline, studies conducted among participants with isolated systolic or diastolic hypertension were also eligible. A study that included adults and non-adults was included if

the participants' mean age was ≥18 and results were stratified by age so that relevant data could be extracted.

Intervention: Studies reporting at least one of the major components of yoga (i.e., asana, pranayama, and dhyana and relaxation practice) were included. Studies on multimodal interventions that included yoga among others were excluded if the relevant data were not possible to extract. Studies were excluded if they did not explicitly label the intervention as yoga. Studies examining the acute effects of yoga interventions on SBP and/or DBP following a single session were included as well as long-term studies.

Comparator: Studies comparing yoga interventions with no intervention, sham intervention, any non-pharmaceutical intervention (such as diet, exercise, or yoga), or pharmaceutical intervention (such as antihypertensive drugs) were included in this systematic review. Studies allowing co-interventions were included (i.e., studies allowing participants to continue their individual treatment were included as long as all the eligible study groups were allowed to do so).

Outcome: This systematic review included studies that assessed SBP and DBP as outcomes.

Study design: Only RCTs were included in this systematic review.

2.5 Data sources and search strategy

Studies were identified using a three-step search strategy. First, an initial limited search was conducted in the MEDLINE database using keywords such as yoga, hypertension, and RCT. The search results were inspected to ensure that

the relevant articles were identified. The text words contained in the titles and abstracts of relevant articles and the index terms used to describe the articles were used to develop a search strategy for MEDLINE in consultation with an information specialist/librarian. Second, the search strategy was adapted for other databases in consultation with the information specialist/librarian, and a systematic search across all included databases was undertaken to identify published and unpublished studies. Third, the reference list of previous systematic reviews and studies included in the systematic review were screened for additional studies. The search strategies are reported in Appendix 1.

The following 16 databases were searched, without date and language restrictions, till March 15, 2021: MEDLINE (from 1946, Ovid), Embase (from 1947, Ovid), CINAHL (from 1937, EBSCO), PsycINFO (from 1806, Ovid), Allied and Complementary Medicine (AMED, from 1985, Ovid), Web of Science (from 1900), Cochrane Central Register of Controlled Trials (CENTRAL, from 1996), Turning Research Into Practice (TRIP, from 1997), AYUSH Research Portal, A Bibliography of Indian Medicine (ABIM), Digital Helpline for Ayurveda Research Articles (DHARA), CAM-QUEST and Directory of Open Access Journals (DOAJ). The search for unpublished studies included OpenGrey (from 1997), EthOS (from 1925), and ProQuest Dissertations and Theses (from 1980, ProQuest).

2.6 Screening and full-text reading

Following the search, all identified citations were collated and uploaded into Endnote X8.2 (Clarivate Analytics, PA, USA)[172] and duplicates were removed.

The remaining records were then imported into Rayyan (Qatar Computing Research Institute [Data Analytics], Doha, Qatar),[173] a web application, to facilitate the title and abstract screening process. Titles and abstracts were independently screened for eligibility using the inclusion criteria by two reviewers. Studies identified as potentially eligible or those without an abstract were retrieved in full. The full text of these studies was assessed in detail against the inclusion criteria by the two independent reviewers. Full-text studies that did not meet the inclusion criteria were excluded and the reasons for exclusion were reported. Any disagreements that arose between the reviewers were resolved through discussion. If consensus was not reached, then a third reviewer was involved.

2.7 Methodological quality assessment

The included studies were critically assessed using the standardized JBI critical appraisal tool for RCTs.[170] This tool has 13 criteria that can be scored as being met (yes), not met (no), unclear, or not applicable (n/a). One of the criteria was about the blinding of intervention deliverers, which was not possible with yoga interventions and was accepted as not applicable. The quality of the individual studies was determined as high quality if 8 or more of the criteria scored yes, moderate quality if 5 to 7 of the criteria scored yes, and low quality if 4 or less of the criteria scored yes. Two independent reviewers were involved throughout the process and any disagreements arising between reviewers were resolved through discussion. If consensus was not reached, a third

reviewer was involved. All studies, regardless of their methodological quality, were included in the review.

2.8 Data extraction

Data were extracted using a predeveloped and piloted data extraction form, specifically developed for this purpose, by two independent reviewers (GN and ZMN). If consensus is not reached, then a third reviewer was involved (SL/KC). The data extracted included the characteristics of the studies: author, year of publication, country, final follow-up, participant characteristics (e.g., age, sex, stage of hypertension, medication use, comorbidities, and previous experience with yoga), sample size, intervention and comparator, study outcomes (e.g., blood pressure and adverse events), final follow-up (in weeks), lost to follow-up, and SBP and DBP data extraction time-point (in weeks). In addition, the characteristics of yoga interventions were extracted: intervention development, structure (e.g., session duration, frequency, and intervention duration), delivery characteristics (e.g., the context of the intervention, strategies used to enhance intervention uptake and adherence, and characteristics of yoga instructors), and content (e.g., asana, pranayama, and dhyana and relaxation practices).

The beneficial effects of treatment for most patients with hypertension would be reached within 8 weeks.[2, 64] Therefore, the authors extracted the 8-week time point data. Where this time point data was not reported or multiple time points were reported, data from the time point closest to eight weeks from the start of the intervention were extracted. Intention-to-treat (ITT) data were

preferred compared to per-protocol data and post-intervention data were preferred over the change from baseline data (i.e., post-intervention score – baseline score). Mean change from baseline was used if only change scores were reported and if there was a significant difference between groups at baseline (≥5 mmHg). However, if studies with a significant difference at baseline did not report change scores, post-intervention data were used, and the imbalance was noted in the risk of bias assessment.

SBP and DBP are continuous data, so mean and SD were extracted. Where no SDs were available, they were calculated from SE, CI, or interquartile ranges, and where no mean scores were available; the mean was assumed to be equal to the median. In case of missing or unclear data, authors were contacted by e-mail (two times per author).

2.9 Data synthesis

A tabular and narrative format was used to synthesise the results. Some yoga interventions included only one component whereas others incorporated two or three components; therefore, yoga interventions were divided into those incorporating three components of yoga (i.e., yoga interventions incorporating asana, pranayama and dhyana, and relaxation practices), those combining any two components of yoga (e.g., asana and pranayama) and only pranayama interventions. To determine the effectiveness of the studies, a meta-analysis using Review Manager 5.4.1[174] was conducted as many included RCTs used inappropriate analysis methods to decide the effectiveness of the intervention such as making within-group comparisons but not between-group

comparisons. First, all yoga interventions were compared with all control groups to show the overall effectiveness of yoga interventions. Then, subgroup analyses were done according to the type of yoga interventions and the type of comparators separately for SBP and DBP. Yoga interventions were divided into those incorporating three components of yoga (i.e., yoga interventions incorporating asana, pranayama, and dhyana and relaxation practices), those combining any two components of yoga (e.g., asana and pranayama), and only pranayama interventions. The plan was to divide comparator groups into three no-intervention, non-pharmaceutical intervention, and pharmaceutical intervention. However, only one study had pharmaceutical intervention as a comparator group. Therefore, comparator groups were divided into two subgroups no-intervention and non-pharmaceutical intervention. Studies allowing co-medication for both intervention and comparator groups, with no additional intervention, comparator groups were evaluated as no-intervention. All active comparator groups were evaluated as non-pharmaceutical interventions. If yoga interventions were compared with both no intervention and non-pharmaceutical intervention groups within the same study, they were considered separately. Yoga interventions shorter than eight weeks were separated from the long-term studies in the meta-analysis.

In the meta-analysis, random effects were used due to the heterogeneous nature of the interventions. Statistical heterogeneity was assessed in the meta-analysis using the I2 and heterogeneity was considered substantial if I2>50%.

Where there was a sufficient number of studies included in the meta-analysis (at least 10), funnel plots were generated to assess for publication bias.

2.10 Results

2.10.1 Study Selection

13,130 records were identified through the literature search. After the removal of duplicate records and title and abstract screening, 82 studies were retrieved for full-text screening. Thirty-six RCTs met the inclusion criteria and were included in this systematic review.[175-208] (See Figure 1 for PRISMA flowchart)[169] The list of studies found ineligible following full-text review and ongoing RCTs identified from trial registries are presented in Appendix 2.

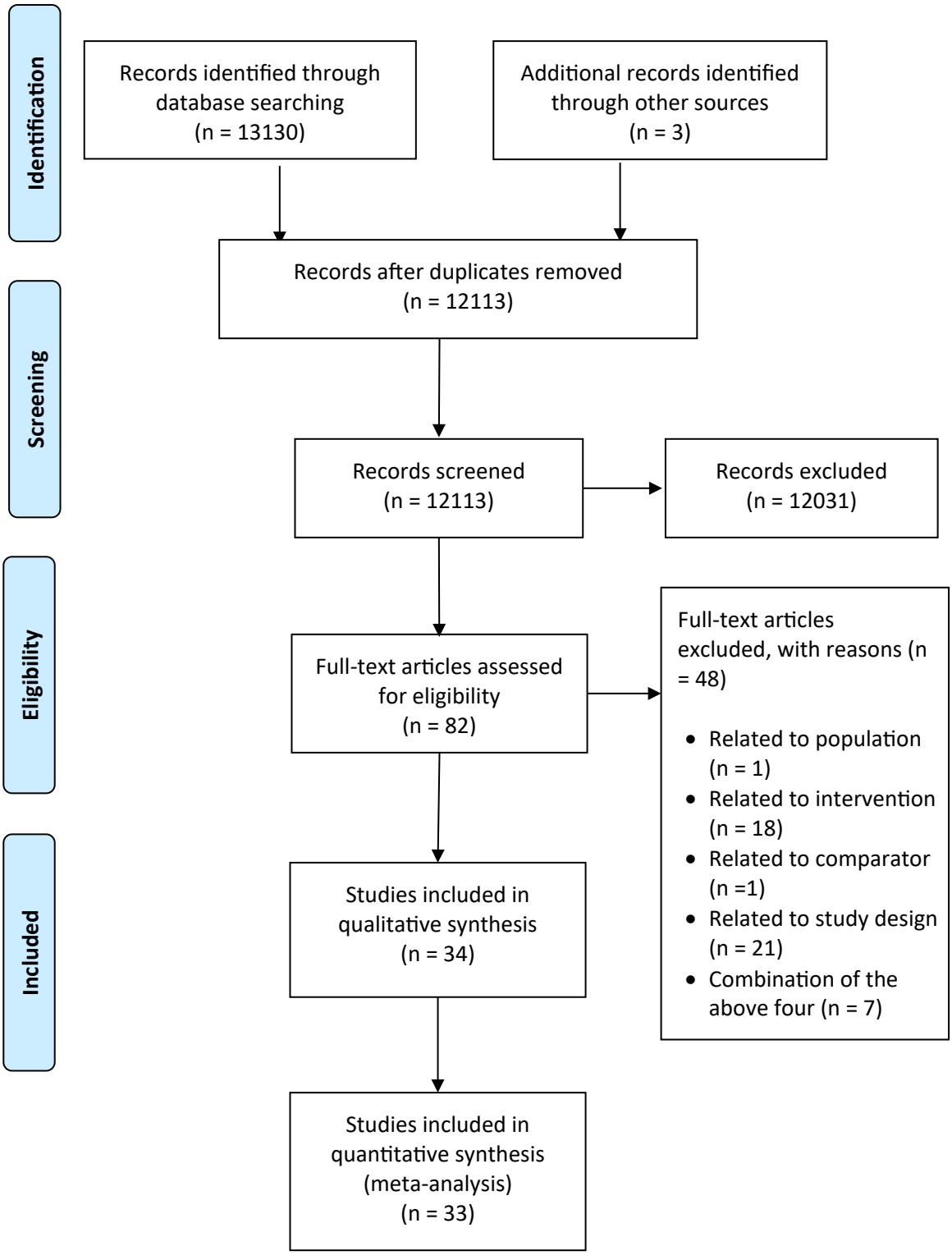

Figure 7 PRISMA Flow Diagram

2.10.2 Description of the included studies

See Table 1 for the characteristics of the included studies. Thirty-four RCTs met the inclusion criteria. Fifteen studies reported the number of people invited and participated. In total, 5,083 people were invited and 3,125 participated in these studies. Twenty-one RCTs were conducted in India (n=1,694 participants), 4 in the USA (n=382),[176, 178, 184, 190] 2 in Germany (n=415),[177, 198] 2 in Nepal (n=135)[192, 208] and 1 each in Sweden (n=191),[180] Thailand (n=61),[194] Spain (n=100),[195] Hong-Kong (n=97)[199] and Brazil (n=50).[203] Studies recruited participants who were between 18 and 70 years old. Four RCTs recruited only male participants.[181, 185, 198, 201] 2 recruited only female participants[203, 205] and the sex of the participants was unclear in 3 RCTs.[175, 182, 200] Nineteen out of 34 studies did not specify the stages of hypertension. Four studies included only participants with prehypertension, 4 included only participants with stage I hypertension, 5 included participants with prehypertension and stage I hypertension, 1 included participants with stage I and II hypertension and 1 included participants at any stage of hypertension. All the participants were on antihypertensive medication in 12 RCTs, some of the participants were on antihypertensive medication in 5 RCTs and none of the participants was on antihypertensive medication in 7 RCTs. Ten studies did not provide information on participants who were on antihypertensive medication. Additional health conditions of the participants included postmenopause (n=2),[203, 205] type 2 diabetes mellitus (T2DM) (n=2)[189, 202] and metabolic syndrome (MetS) (n=1).[199] Previous experience of yoga practice among participants varied across the RCTs

and 17 studies recruited yoga-naïve participants whereas 2 studies recruited participants with experience of practising yoga.

Table 3 Study characteristics of included RCTs

Author and year	Country	Population characteristics	Sample size	Intervention	Comparator	SBP (mmHg)	DBP (mmHg)	Adverse events	Final follow-up (in weeks)	Loss to follow-up	SBP and DBP data extraction time-point (in weeks)
						Baseline	Baseline				
Murugesan, 2000	India	Both sexes, HTN	33 (I1=11, C1=11, C2=11)	I=Yoga	C1=No intervention C2=Antihypertensive treatment	I=156.45±9.21 C1=155.45±10.34 C2=158.63±11.52	I=108.63±9.92 C1=109.09±9.60 C2=106.45±10.32	NR	11	NR	11
McCaffrey, 2005	Thailand	Age (mean): 56.45, both sexes (F:35), essential HTN, not on medication	61 (I= 32, C=29)	I=Yoga	C=Usual care	I=160.89±10.37 C=160±13.35	I=98.52±8.33 C=98.30±7.10	NR	8	No time/inability to get to the yoga centres: I=5 Started taking antihypertensive drugs: C=1 Moved out of the province: C=1	8
Kettner, 2009	Germany	Age (mean): 51.50, only male, HTN, on medication	340 (I=173, C=167)	I=Viniyoga	C=Progressive muscle relaxation	I=131.11±18.19 C=132.76±18.12	I=81.39±10.75 C=80.67±10.89	NR	24	Discharge from the clinic: I=27, C=9	3
Mourya, 2009	India	Both sexes (F:29), stage I essential HTN, on medication or not, yoga-naïve	60 (I1=20, I2=20, C=20)	I1=Slow yogic breathing I2=Fast yogic breathing	C=No intervention	I1=145.90±9.21 I2=146.80±9.25 C=146.93±8.67	I1=91.95+9.12 I2=91.09+8.13 C=91.01±8.49	NR	12	Did not practice regularly: 2 Could not learn the technique: 3 Started dieting:2	12

Saptharishi, 2009	India	Age (mean): 22.50, both sexes (F:34), prehypertension and HTN	113 (I=30, C=30, C2=30, C3=30)	I=Yoga	C=No intervention C2=Salt intake reduction C3=Physical exercise	I=127.60± 9.90 C1=123.80±10.80 C2=123.10±8.10 C3=128.40±7.60	I=85.80±6.70 C1=83.20±7.20 C2=83.70±6.80 C3=87.40±4.80	NR	8	Did not give consent: I1=3, C2=2, C3=2 Drop-out: I= 6, C1=1, C2=3, C3=1	8
Khadka, 2010	Nepal	Age (mean): 43.53, both sexes, essential HTN, on medication and salt reduction, yoga-naïve	14 (I=7, C=7)	I=Yoga	C=No intervention	I=143±14.07 C=140±19.25	I=98±5.18 C=86±7.40	NR	6	NR	6
Cohen, 2011	USA	Age (mean): 48.24 both sexes (F:39), prehypertension and stage 1 HTN, not on medication yoga-naïve	78 (I=46, C=32)	I=Iyengar yoga	C=Enhanced usual care	I=132±15.29 C=135±16.70	I=83±10.19 C=82±11.13	NS (n=3)	12	Protocol criteria: I=4 Personal decision: I=7	6
Bhavanani, 2012	India	Age (mean): 56.66, both sexes (F:14), essential HTN, on medication, T2DM, attending regular therapy sessions at ACYTER	29 (I=15, C=14)	I=Pranava pranayama	C=Sham relaxation	I=134.30±3.80 C=136.30±4.10	I=77.20±1.30 C=77.40±2.20	NR	Acute effect	None	-
Shantakumari, 2012	India	Age (mean): 44.98, both sexes (F:48), HTN, T2DM	100 (I=50, C=50)	I=Yoga+ Antidiabetic treatment	C=Only antidiabetic treatment (Sulfonylureas)	I=141.71±9.80 C=137.37±28.77	I=90.57±4.07 C=88.23±17.05	NR	12	None	12

Telles, 2013	India	Age (mean): 49.70, both sexes (F:30), uncomplicated essential HTN, on medication, familiar with the yoga for at least 6 months	90 (I1=30, I2=30, C=30)	I1=Anuloma-Viloma/ Nadi Shodhana (Alternate nostril breathing) I2=Breath awareness	C=Reading a magazine	I1=133.67±14.26 I2=130.67±16.39 C=140.83±14.22	I1=85.67±8.58 I2=84.33±10.73 C=81.20±9.42	None	Acute effect	None	-
Hagins, 2014	USA	Age (mean): 54.56, both sexes (F:58), prehypertension and stage I HTN	84 (I=45, C=39)	I=Ashtanga Yoga	C=Non-aerobic exercise	I=135.53±9.79 C=133.80±9.86	I=80.82±7.33 C=80.17±7.49	None	12	Lost to follow-up: I=9, C=7	12
Patil, 2014a	India	Age (mean): 68.92, male-only, stage I HTN, not on medication	57 (I=28, C=29)	I=Yoga	C=Walking	I=146.07±5.18 C=145.72±5.90	I=74.25±4.68 C=75.52±5.21	NR	12	Did not appear for the post-data due to domestic reasons: I=2, C=1	12
Patil, 2014b	India	Age (mean): 69.47, male only, stage I HTN, not on medication	42 (I=21, C=21)	I=Yoga	C=Lifestyle modification (stretching exercise and brisk walk)	I=147.23±5.62 C=147±5.82	I=74.95±3.80 C=75.52±5.43	NR	6	NR	6
Sujatha, 2014	India	Both sexes (F:128), stage 1 and 2 HTN, on medication, yoga-naïve	238 (I= 118, C=120	I=Hatha Yoga	C=Wait-list control group receiving no treatment	I=152.75±11.57 C=152.85±10.68	I=94.51±6.92 C=94.77±6.40	NR	12	None	12

Patil, 2015	India	Age (mean): 68.90, male-only, Isolated systolic HTN with increased PP=60 mmHg, not on medication, yoga-naïve	60 (I=30, C=30)	I=Yoga	C=Brisk walking	I=146.96±5.70 C=145.86±6.30	I=74.13±4.58 C=75.53±5.50	NR	12	None	12
Pushpanathan, 2015	India	Essential HTN	70 (I=34, C=36	I=Yoga + Antihypertensive treatment	C=Yoga+ Antihypertensive treatment	I=124.8±8.10 C=126.47±11.21	I=80.44±7.02 C=83.2±7.11	NR	12	Discontinued the intervention: I=4, Lost to follow-up: C=6	12
Prakash, 2015	India	Uncomplicated HTN, on medication	50 (I=25, C=25)	I=Yoga+ Antihypertensive	C=Only antihypertensive treatment	I=149±18.48 C=150±20.36	I=91±13.08 C=91±11.76	NR	8	NR	8
Sriloy, 2015	India	Age (mean): 48.84, both sexes (F:10), uncomplicated HTN	46 (I=23, C=23)	I=Yoga breathing	C= Acupuncture	I=139.50±17.50 C=143.70±19.70	I=81.15±11.30 C=80.50±10	NR	Acute effect	Refused to participate: I= 4, C=3 Did not turn for the post-data: C=1	-
Thiyagarajan, 2015	India	Age (mean):43.29, both sexes (F:38), prehypertensive, not on medication	192 (I=96, C=96)	I=Yoga + Lifestyle modification	C=Lifestyle modification	I=127±6 C=127±5	I=85±4 C=85±4	NR	12	Excluded based on biochemical results: I=4, C=4, Asymptomatic, lack of self-motivation, family commitments and no immediate health	12

										benefit: I=41, C=43	
Cohen, 2016	USA	Age (mean): 49.60, both sexes (F: 70), prehypertension and stage I HTN, not on medication, yoga-naïve	137 (I=43, C1= 48, C2= 46)	I=Forrest yoga	C1=BPEP program (health education classes and a walking program) C2=COMBO (Forrest yoga and BPEP)	I=132.60±16.10 C1=134.20±14.60 C2=132.80±15.20	I=80.60±13.60 C1=82.20±13.10 C2=81.10±13.20	None	24	Protocol criteria: I=8, C1=4, C2=7 Personal decision: I=5, C1=8, C2=6	12
Punita, 2016	India	Age (mean): 43.38, both sexes (F:11), HTN, on medication	80 (I=40, C=40)	I=Yoga+ antihypertensive drugs	C=Antihypertensive drugs	I=124.80±8.10 C=126.47±11.21	I=80.44±7.02 C=83.2 ± 7.11	NR	12	Continued to treatment in their native place: I=14, C=10 Attendance less than 60%: I=1	12
Wolff, 2016	Sweden	Age (mean): 64.70, both sexes (F:99), prehypertension and stage I HTN, on medication or not	191 (I=96, C=95)	I=Home-based Kundalini yoga	C=Usual care	I=148.80±11.60 C=150±10.60	I=88.30±6.10 C=88.10±5.70	None	12	No time/feeling stressed: I=4 No reason: I=4, C=2 Illness: I=3, C=5 Unable to attend follow-up: C=2	12
Roche, 2017	Spain	Age (mean): 57.69, both sexes, essential HTN, yoga-naïve	100 (I1= 25, I2=25, I3=25, C=25)	I1=Yoga I2=Pranayama I3=Himalayan Tradition Meditation	C=One time lecture on HTN and healthy lifestyle habits	_	_	NR	8	Did not consent: I1=3, I2=2, I3=4, C=6 Drop-out: I1=8, I2=4, I3= 9, C=9	8

					given after one month						
Shetty, 2017	India	Both sexes, prehypertension and stage I HTN, on medication, yoga-naïve	60 (I=30, C=30)	I=Pranayama	C=Wait-list control group	I=148.20±7.90 C=153.60±9.50	NR	NR	4	None	4
Supriya, 2017	Hong Kong	Age (mean): 57.57, both sexes (F:65), prehypertension, MetS	97 (I= 52, C=45)	I=Yoga	C=No intervention (monthly contact to monitor their health status)	I=140.27±13.46 C=141.71±13.85	I=84.52±7.80 C=85.78±8.50	NR	52	NR	52
Misra, 2018	USA	Age (mean): 60.80, both sexes (F:48), uncontrolled HTN, on medication or not	83 (I1=23, I2=38, C=22)	I1=In-class instruction yogic breathing I2=DVD/YouTube instruction yogic breathing	C=Usual care+ recording dinner time	I1=155.40±15.90 I2=152.50±15.50 C=149.20±23.70	I1=87.63±11.33 I2=84.70±5.96 C=89.86±9.52	NR	10	Did not show up: I1=15, I2=7, C=8 Dropped out: I1=6, I2=12, C=2	10
Cramer, 2018	Germany	Age (mean): 58.70, both sexes (F:54), primary arterial HTN, on medication	75 (I1=25, I2=25, C=25)	I1=Yoga with postures I2= yoga without postures	C=Wait-list control group receiving usual care	I1=135.40±11.60 I2=131.70±11.30 C=133.30±9.80	I1=82.50± 10.30 I2=81.10± 10.90 C=81.10±9.10	No severe adverse events occurred*	28	Acute Illness: I1=3, I2=2 Brake off contact: I2=1	12
Ankolekar, 2019	India	Prehypertension	102 (I= 51, C=51)	I=Yoga	NR	I=134±4.96 C=133.45±4.76	I=85.95±2.54 C=86.03±5.03	NR	24	NR	12
Gadgil, 2019	India	Female only, prehypertension, postmenopause	60 (I=30, C=30)	I=Fast pranayama	C=Slow pranayama	I=115.67±1.34 C=119.33±9.04	I=74.53±4.16 C=78.20±6.15	NR	Acute effect	NR	-

Fetter, 2020	Brazil	Age (mean): 59.08, female only, HTN, on medication or not, post-menopause, yoga-naïve	50 (I=10, C1=9, C2=14)	I=Yoga+ ujjayi pranayama	C1=Stretching + ujjayi pranayama C2=Stretching or Yoga alone	I=137.40±12.01 C1=141.20±14.10 C2=142.90±21.70	I=86.23±6.89 C1=87.15±8.94 C2=82.66±10.10	NR	12	Lost to follow-up:5 Declined to participate: 12	12
Ghati, 2020	India	Age (mean): 48.89, both sexes (F:31), essential HTN, on medication, yoga-naïve	70 (I=35, C=35)	I=Bhramari pranayama	C=Placebo slow breathing exercise	I=131.75±9.67 C=127.80±12.91	I=91.37±7.72 C=88.05±9.81	NR	Acute effect	Missing data: I=3	-
Sathe, 2020	India	Age (mean): 60.14, both sexes (F:21), HTN, on medication	42 (I=21, C=21)	I=Bhramari pranayama	C=Buteyko breathing	I=139.61±6.04 C=140.75±21.27	I=81.28±5.22 C=83.15±10.75	NR	Acute effect	None	-
Thanalakshmi, 2020	India	Age (mean):38.5, both sexes (F:23), primary HTN, on medication, yoga-naïve	100 (I=50, C=50)	I=Sheetali pranayama	C= No additional intervention	I=143.88±10.60 C=146.10±11.28	I=87.12±7.40 C=88.90±9.88	None	12	I=10 (health issues: 6, participated in other activities:2, missed more than 2 weeks of yoga:2) C=8 (health issues: 7, participated in other activities:1)	12

Dhungana, 2021	Nepal	Age (mean): 47.74, both sexes (F: 58), stage I HTN, on medication or not, yoga-naïve	121 (I=61, C=60)	I=Yoga + health education	C=Health education	I= 141.70±9.10 C= 136.90±9.00	I= 90.30±5.40 C= 89.40± 5.10	None	12	No stated reasons: I=2, C=1	12

Only yoga-related interventions were mentioned under intervention, and no intervention or any other active interventions were mentioned under comparator. Blood pressure results were reported as mean and SD.

* The adverse events registered in the yoga group with asana were: headache (n=3), shoulder pain (n=1), knee pain (n=1), tendinitis (n=1), meniscus rupture (n=1), prolapsed intervertebral disc (n=1), hypertensive emergency (n=1) and mental problems (n=1) and in the yoga intervention without asana were tinnitus (n=1) and knee pain (n=1). The adverse events registered in the control group were headache (n=1), neck pain (n=1) and sleep disturbances (n=1).

I: Intervention, C: Control, NR: Not reported, HTN: Hypertension, ACYTER: The Advanced Centre for Yoga Therapy Education and Research, JIPMER: Jawaharlal Institute of Postgraduate Medical Education & Research

2.10.3 Description of the included interventions and comparators

See Table 2 for the details of the yoga interventions (e.g., content, structure, and delivery characteristics). Six studies included more than one yoga group and these were considered separate interventions unless they used the same yogic practice with varying context and delivery characteristics. Consequently, 38 yoga interventions within 34 studies were identified. Of the 38 interventions, 21 incorporated all the three components of yoga (asana, pranayama, and dhyana and relaxation practice); 11 included only pranayama; 3 included pranayama and dhyana and relaxation practice; 2 included asana and pranayama and one included asana and dhyana and relaxation practice.

Yoga interventions were compared with a variety of comparators such as no intervention, no additional intervention (where both intervention and control groups received the same intervention e.g., antihypertensive/antidiabetic treatment and lifestyle modification training), lifestyle modification training, exercise, acupuncture, Buteyko breathing, sham breathing, and sham relaxation. Four studies compared yoga intervention with more than one comparator and 38 comparators within 34 studies were identified.

Table 4 Intervention details of the included RCTs

Author/ Year	Intervention development	Yoga sessions: structure (duration and frequency)	Yoga sessions: delivery characteristics (context and instructor)	Yoga sessions: delivery characteristics (intervention uptake and adherence)	Asana	Pranayama	Dhyana and relaxation	Extra features
Murugesan, 2000	NR	I=30 min x 2/day x 6 days/ week x 11 weeks	NR	NR	Pawanamuktasana (Wind releasing pose), Ardha Halasana (Half plough pose), Viparita Karani (Legs up the wall), Ardha Matsyendrasana (Half lord of the fishes pose), Makarasana (Crocodile pose), Bhujangasana (Cobra pose), Ardha Salabhasana (Half locust pose), Vakrasana (Twisted pose), Vajrasana (Thunderbolt pose), Yoga Mudrasana (Psychic union/Yoga seal pose), Urdhva Dhanurasana/ Chakrasana (Wheel pose), Tadasana (Mountain pose)	Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing)	Om recitation and meditation, Shavasana (Corpse pose/ Deep relaxation)	_

McCaffrey, 2005	- Yoga for Health was modified by the researcher	I=63 min/day x 3 days/ week x 8 weeks	-In two temporary yoga training centres -Supervised by a trained research assistant	- Booklets and a cassette tape of yoga guidance were given - Self-reporting of home practice via a diary	Dhanurasana (Bow pose), Bhujangasana (Cobra pose), Makarasana (Crocodile pose), Matsyasana (Fish pose), Janu Sirsasana (Head-to-knee forward bend pose), joint exercise, Padmasana (Lotus pose), Tadasana (Mountain pose), Vajrasana (Thunderbolt pose), Urdhva Dhanurasana/ Chakrasana (Wheel pose), Yoga mudrasana (Psychic union/Yoga seal pose), Yoni mudra	Pranayama (NS)	Shavasana (Corpse pose/ Deep relaxation)	- Intervention included health information and group support in learning yogic principles and stress reduction techniques
Kettner, 2009	NR	I=45 min/ day x 5 days/week x3 weeks	-At a clinic -Supervised by a yoga teacher	NR	8 sets: Tadasana (Mountain pose), Urdhva hastasana (Upward salute) Ardha Uttanasana (Half forward bend), 4 times both sides: Virabhadrasana I (Warrior I), 8 sets: Paschimottanasana (Seated forward bend), 4 times both sides: Vakrasana (Spinal twist), 8 sets: Bharmanasana (Table top pose), Balasana (Child pose), 8 sets: Setu Bandha Sarvangasana (Bridge pose), 8 sets: Apanasana (Knees to chest pose), 4 sets: Chair Urdhva Hastasana (Chair Upward salute)	8 sets: Bhramari pranayama ((Bumblee) Bee breathing)	NR	-Modified if needed without changing the standardised basic concept and chair was used to do some of the practices
Mourya, 2009	NR	I1=15min x 2/day x 7 days/week x 12 weeks	-At research centre -Supervised by a yogic	-Cassettes were given -Flexible practice time was offered	I1 and I2= Padmasana (Lotus pose): 5 min	I1= Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing):15 min (5–6	NA	I1 and I2= -Pranayama was taught everyday for

		I2=15min x 2/day x 7 days/week x 12 weeks	instructor for the first few days until technique was learnt	- They were advised to time breathing rate -Accuracy of the practice was checked on visits to the department -A questionnaire was given every month to ensure motivation and compliance		breaths per min) I2= Bhastrika pranayama (Bellow breathing) (The procedure was repeated 4 to 5 times over a period of 15 min with 3 min of rest after one min of practice).		the first 2 weeks and then, themselves practised twice daily 10–12 hours apart -Classes had 4–6 participants and were held at 9 am
Saptharishi, 2009	NR	I=30-45 min/day x 5 days/ week x 8 weeks	-Supervised by a qualified yoga teacher of the institute (JIPMER)	NR	Talasana (Palm tree pose), Utkatasana (Chair pose), Trikonasan (Triangle pose), Ardha-matsyendrasan (Half lord of the fishes pose), Bakasana (Crow pose), Pawanmuktasan (Wind releasing pose), Navasana/ Naukasan (Boat pose), Matsyasana (Fish pose), Pashchimottanasana (Seated forward bend), Halasana (Plough pose), Bhujangasana (Cobra pose), Salabhasana (Locust pose), Sarvangasana (Shoulder stand)	Mukha Bhastrika (Downward facing bellow breath), Mahat-yoga pranayam (Complete deep breathing), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing), Savitri pranayam (Rhythmic breath)	Shavasana (Corpse pose/ Deep relaxation)	_

Khadka, 2010	NR	I= 30 min/day x 6 days/ weeks x 6 weeks	-At hospital -Supervised by a trained yoga instructor	NR	5 min (40 sec each): Suksha Vyayama (Loosening practices): Manibandha, Shakti Vikasaka, Ardha Bhuja Shakti Vikasaka, Purna Shakti Vikasaka (Arms rotation), Anguli Shakti Vikasaka, Kamar Chakrasana, Vakshasthal Shakti Vikasaka and Uder Shakti Vikasaka, 6-7 min (40 sec each): Tarasana (Star pose), Trikonasana (Triangle pose), Gomukhasana (Cow face pose), Shashankasana (Rabbit pose), Padmasana (Lotus pose), Bhujangasana (Cobra pose), Hardhayastambhasana, Navasana/Naukasana (Boat pose), Makarasana (Crocodile pose)	Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing): 4 min	Shavasana (Corpse pose/ Deep relaxation): 5 min, Meditation (NS): 5 min.	_

Cohen, 2011	-Developed by IY-certified instructor, Joan White, with input from B.K.S. Iyengar	I= 70 min/day x 2 days/ week x 6 weeks +70 min/day x 1 day/week x 6 weeks	- Supervised by two IY-certified instructors - Encouraged to practise at home	-DVD was given for home practice -Self-reporting of home practice via a diary	Cross bolsters: 5min, Supta Baddha Konasana (Reclining bound angle pose): 5min, Supta Swastikasana (Supine auspicious pose): 5min/side, Bharadvajasana (Torso stretch pose): 3 × 30 s/side, Pawanmuktasana (Wind releasing pose): 5 min, Adho Mukha Virasana (Downward facing hero pose): 5min, Adho Mukha Swastikasana (Downward facing auspicious pose):1min/side, Adho Mukha Svanasana (Downward facing dog): 1min, Uttanasana (Standing forward bend): 1min, Janu Sirsasana (Head to knee forward bend): 1min/side, Upavistha Konasana (Wide-angle seated forward bend): 3min, Paschimottanasana (Seated forward bend): 1min	Ujjayi pranayama (the conqueror): 5min	Shavasana (Corpse pose/ Deep relaxation): 10 min (5 min at the beginning and 5 min at the end)	-Classes were closed to the public -Classes had 2–10 participants -Props were used if needed
Bhavanani, 2012	NR	I= 10 min	-In the ACYTER, JIPMER	NA	NA	6 min in total: Pranav pranayama (Om meditation breathing in corpse pose): 3 rounds, Dirga/Mahat pranayama (Full yogic breath/ three-part breath):3 rounds	Shavasana (Corpse pose/ Deep relaxation): 4 min (2 min at the beginning and 2 min at the end)	_
Shantaku mari, 2012	-Based on literature	I=60 min/ day x 7	- In the holistic medicine clinic	-Personalised yoga program	Surya Namaskara (Sun salutation): 5 min, Yoga Mudrasana (Psychic	5 min: Ujjayi pranayama (Victorious	Shavasana (Corpse pose/	-Practice was adapted

	review done by yoga specialists	days/ week x 12 weeks	-Supervised by an experienced yoga teacher -Encouraged to practise at home	for home practice was given - Self-reporting of home practice -Contacted study centre every month for follow-up advice	union/ Yoga seal pose): 2 min, Vajrasana (Thunderbolt pose): 2 min, Vakrasana (Twisted pose): 2 min, Paschimottasana (Seated forward bend): 2 min, Pawanamuktasana (Wind releasing pose): 2 min, Sashankasana (Rabbit pose): 2 min, Ustrasana (Camel pose): 2 min, Bhujangasana (Cobra pose) 2 min, Dhanurasana (Bow pose): 2 min, Ardhakati Chakrasana (Latera arc pose): 2 min, Parivrtta Trikonasana (Revolved triangle pose): 2 min	breathing): 5 repeats, Anuloma-Viloma/ Nadi Shodhana (Alternate nostril breathing): 10-15 repeats, Alternate Kapalapathi pranayama (Alternate nostril rapid exhalations): 5 repeats, Suryabhedhana pranayama (Right nostril breathing): 5 repeats	Deep relaxation): 5 min, One–one meditation: 5 min, Anapanasati (Breath counting meditation): 10 min	according to abilities of the participants - Classes had 25 participants -At the end of 2 weeks, advice was given on ongoing medical treatment
Telles, 2013	NR	I1= 10 min I2= 10 min	NR	NA	NA	I1= 10 min: Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing) I2= 10 min: Breath awareness without manipulation of the nostrils	NA	-Purdue pegboard task was completed before and after intervention in all groups - I1 did not include breath retention
Hagins, 2014	-Based on the primary series of Ashtanga yoga and	I= 55 min/day x 2 days/ week x 12	-Supervised by yoga instructors, who had a	-$100 was given at the end of the study	35 min total: Urdva Hastasana (Upward salute): 3 times, Uttanasana (Standing forward bend): 3 times, Chakravakasana/	10 min total: Seated cross-legged, hands clasped behind back, head leaning forward,	5-7 min: Guided meditation focusing on	-Average intensity was 3 METs

	specifically designed for this study by Eddie Stern (Director of Ashtanga Yoga New York)	weeks + 20 min/day x 3 days/ week x 12 weeks (home practice)	minimum 200-hour training and completed a workshop specific to hypertension -Encouraged to practise at home	-Printed text, photos and a DVD were given for home practice	Marjaryasana-Bitilasana (Cat-cow pose): 3 times, Tiryaka Bhujangasana (Twisted cobra pose): 3 times, Surya Namaskara A: 5 sets, Surya Namaskara B: 3 sets, Virabhadrasana I-II (Warrior 1 and 2): 3 sets, Padahastasana (Hands to foot pose): 2-8 breaths, Trikonasana (Triangle pose): 4-16 breaths, Utthita Parsvakonasana (Extended side angle pose): 4-16 breaths, Prasarita Padottanasana A/B/C/D (Wide-legged standing forward bend): 2-8 breaths each type, Parsvottanasana (Side Stretch pose): 2-8 breaths, Bharmanasana (Table top pose): 2-8 breaths each, Janu Sirsasana (Head-to-knee forward bend): 2-8 breaths each, Baddha Konasana (Bound Angle/ Butterfly pose): 2-8 breaths, Shalabhasana (Locust pose): 2-8 breaths	flexed spine (10 breaths), Seated cross-legged, leaning backwards with hands on floor, arching spine, looking up and back with eyes (10 breaths), Ujjayi pranayama with Uddiyana Bandha (Victorious breath with Abdominal lock): 10 breaths, Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing): 10 breaths each side	the body and breath, nervous system and mind, 5 min: Shavasana (Corpse pose/ Deep relaxation)	-Modified if needed and chairs and the wall were used to support -Provided positive expectations regarding the potential for the class to lower blood pressure

Patil, 2014a	NR	I= 60 min/day x 6 days/ week x 12 weeks	-Supervised by a yoga instructor	NR	5 min: Sukshma Vyayama (Loosening practices), 15 min: Padahastasana (Hand to Foot Pose), Ardha chakrasana (Half wheel pose), Shashankasana (Rabbit pose), Ardha Ustrasana (Half camel pose), Bhujangasana (Cobra pose), Ardha Salabhasana (Half locust pose), Trikonasana (Triangle pose)	Breathing Practices Hands in and out breathing, Ankle stretch breathing, Straight leg raising breathing, Lumbar stretch breathing, 5 min: Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing), Brahmari ((Bumblee) Bee breathing)	Cyclic Meditation: 23 min, Bhajans (Devotional chanting): 5 min, Opening prayer (1 min), Closing prayer (1 min)	-Practised in the morning between 06:00 and 07.00
Patil, 2014b	NR	I=60 min/ day x 6 days/ week x 6 weeks	-Supervised by an authorised yoga instructor	NR	5 min: Sukshma Vyayama (Loosening practices), 15 min: Padahastasana (Hand to Foot Pose), Ardha chakrasana (Half wheel pose), Shashankasana (Rabbit pose), Ardha Ustrasana (Half camel pose), Bhujangasana (Cobra pose), Ardha Salabhasana (Half locust pose), Trikonasana (Triangle pose)	Breathing Practices Hands in and out breathing, Ankle stretch breathing, Straight leg raising breathing, Lumbar stretch breathing, 5 min: Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing), Brahmari ((Bumblee) Bee breathing)	Cyclic Meditation: 23 min, Bhajans (Devotional chanting): 5 min, Opening prayer (1 min), Closing prayer (1 min)	_
Sujatha, 2014	NR	I=45 min/ day x 5 days/week x 12 weeks	-Practised at home -Attended group sessions at a community centre -Supervised	-DVD was given for home practice -Attended group session once in two weeks	18 min (3 min each): Sukhasana (Easy pose), Vajrasana (Thunderbolt pose), Ardha Matsyendrasana (Half lord of the fishes pose), Bhujangasana (Cobra pose), Urdhva	12 min (3 min each): Bhastrika (Bellow breathing), Ujjayi (Victorious breathing), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing),	Shavasana (Corpse pose/ Deep relaxation), Mindfulness meditation	-Yoga practices were taught in the first week: 120 min/day x 5 days/week x

				-Attendance register was maintained	Dhanurasana/ Chakrasana (Wheel pose)	Kapalabhati (Rapid exhalations)		1 week and then they practised at home -Sessions were held at two time points for flexibility
Patil, 2015	NR	I= 60 min/day x 6 days/ week x 12 weeks	-Supervised by experienced authorised instructors	-Attendance register was maintained	5 min: Sukshma Vyayama (Loosening Practices): Loosening of Fingers, Loosening of Wrist, Shoulder rotation, Ankle stretch/ rotation, Drill walking, 15 min: Utkatasana (Chair pose), Padahastasana (Hand to foot pose), Ardha chakrasana (Half wheel pose), Shashankasana (Rabbit pose), Ardha Ustrasana (Half camel pose), Bhujangasana (Cobra pose), Ardha Salabhasana (Half locust pose), Trikonasana (Triangle pose)	Breathing Practices Hands in and out breathing, Ankle stretch breathing, Straight leg raising breathing, Lumbar stretch breathing, 5 min: Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing), Brahmari ((Bumblee) Bee breathing)	Cyclic Meditation: 23 min, Bhajans (Devotional chanting): 5 min, Opening prayer (1 min), Closing prayer (1 min)	-Practices were taught for the first 2 weeks and then complete module was practised for the last 10 weeks
Pushpanathan, 2015	Validated by ACYTER, JIPMER, according to the MDNIY guidelines	I=45 min/ day x 3 days/ week x 12 weeks	-At a research centre (JIPMER) -Supervised by yoga therapists -Encouraged to practise at home	-Attendance register was maintained	15 min of asanas; Talasana (Palm tree pose), Ardhakati Chakrasana (Lateral arc pose), Ardha Chakrasan (Half wheel pose), Uttanpadasan (Raised leg pose), Ardha Halasana (Half plough pose) Pawanamuktasana (Wind releasing pose), Makarasana (Crocodile	15 min of pranayamas; Chandranadi pranayama (Left nostril breathing), Pranav (Om meditation breathing), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing)	10 min: Kayakriya in Shavasan (Dynamic body relaxation), Shavasan with Savitri	-Sessions started with yogic counselling and preparatory practices (5 min)

					pose), Bhujangasana (Cobra pose), Vajrasana (Thunderbolt pose)		pranayam (Rhythmic breath in corpse pose)	
Prakash, 2015	NR	I= 30 min/day x 7 days/ week x 8 weeks	-At hospital -Under supervision	NR	Padmasana (Lotus pose), Makarasana (Crocodile pose)	Suryabhedana (Right nostril breathing), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing), Kapalbhati (Rapid Exhalations), Ujjayi (Victorious breathing), Sheetali (Cooling breath), Shitkari (Hissing breath), Bhastrika (Bellow breathing), Bhramari ((Bumblee) Bee breathing)	Shavasana (Corpse pose/Deep relaxation)	-Practised at early morning hours
Sriloy, 2015	NR	I=20 min	-At hospital -Supervised by a qualified yoga and naturopathy physician with 4 years of therapeutic yoga experience	NA	NA	20 min: Adhama pranayama (Abdominal breathing), Madhyama pranayama (Chest breathing), Adhyama pranayama (Clavicular breathing), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing)	NA	_

Thiyagarajan, 2015	-Designed in ACYTER, JIPMER	I= 45 min/day x 3 days/ week x 12 weeks	-In the ACYTER, JIPMER -By the qualified yoga teachers -Encouraged to practise at home	-Attendance register was maintained	10 min: Preparatory practices: Breath–body coordination practices, Sukshma Vyayama (Loosening practices), 14 min: Talasana (Palm tree pose), Ardhakati Chakrasana (Lateral arc pose), Ardha Chakrasana (Half wheel pose), Uttanpadasana (Raised leg pose), Ardha Halasana (Half plough pose), Pavanamuktasana (Wind releasing pose), Sarvangasana (Shoulder stand), Makarasana (Crocodile pose), Bhujangasana (Cobra pose), Dhanurasana (Bow pose), Vajrasana (Thunderbolt pose)	7 min: Chandranadi pranayama (Left nostril breathing), Pranav (Om meditation breathing), Anuloma-Viloma/Nadi Shodhana pranayama (Alternate nostril breathing)	14 min: Kayakriya in Shavasana (Dynamic body relaxation), Shavasan with Savitri pranayama (Rhythmic breath in corpse pose)	_
Cohen, 2016	Forrest Yoga (a form of Hatha yoga)	I1=90 min/ day x 2 days/week x 12 weeks + 90 min/ day x 3 days/week x 8 weeks	-At an offsite studio -Supervised by a certified yoga instructor at the studio -Practised at home	-A DVD of Ana Forrest was given for home practice -Logged in LIMBS study website weekly and recorded their practice -Attendance register was maintained by instructors	25 minutes: Seated side and forward bends, e.g. Parsva Sukhasana (Seated side bend), Janu Sirsasana (Head to knee forward bend), twists, e.g. Ardha Matsyendrasana (Half lord of the fishes pose), hip and shoulder openers, e.g. Baddha Konasana (Bound angle pose/Butterfly pose), Agnistambhasana (Firelog pose). 2-3 minutes: Setu Bandha Sarvangasana (Dynamic/static bridge pose), Adho Mukha Svanasana (Downward facing	5 – 7 min of pranayama (NS)	Shavasana (Corpse pose/Deep relaxation): 5-7 min	After 12 weeks of semi-private classes, participants attended 2 community classes and did one self-practice per week for the remaining 8 weeks of the program.

					dog), inversions, e.g. Adho Mukha Vrksasana (Handstand). 40 minutes: Sun salutations B series with standing poses, e.g. Virabhadrasana I (Warrior I pose), Virabhadrasana II (Warrior II pose), Utthita Trikonasana (Extended triangle pose), Backbends, e.g. Ustrasana (Camel ride/Spinal flex pose), Dhanurasanam (Bow pose), Natarajasana (Dancer pose), Urdhva Dhanurasana/Chakrasana (Wheel pose), Apex Poses. 5-7 minutes: Setu Bandha Sarvangasana (Bridge pose), Adho Mukha Svanasana (Downward facing dog), inversions, e.g. Adho Mukha Vrksasana (Handstand), deep twists, forward bends, e.g. Janu Sirsasana ((Seated) head to knee forward bend), Paschimottanasana (Seated forward bend), side bends, straddle, e.g. Upavistha Konasana (Wide-angle seated forward bend), Prasarita Padottanasana (Wide-legged forward bend), splits, e.g. Hanumanasana (Monkey pose)			

Punita, 2016	-Validated by ACYTER and JIPMER in accordance with MDNIY Guidelines	I= 45 min/day x 3 days/ week x 12 weeks	- At JIMPER research centre -Supervised by a trained ACYTER yoga teacher -Encouraged to practice at home	-Attendance register was maintained by instructors	10 min: Breath–body coordination practices and Sukshma Vyayama (Loosening practices), 10 min: Tadasana (Palm tree pose), Ardhakati Chakrasana (Lateral arc pose), Ardha Chakrasana (Half wheel pose), Uttanpadasana (Raised leg pose) Ardha Halasana (Half plough pose), Pavanmuktasana (Wind releasing pose), Makarasana (Crocodile pose), Bhujangasan (Cobra pose), Vajrasana (Thunderbolt pose)	10 min: Chandranadi pranayama (Left nostril breathing), Pranav (Om meditation breathing), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing)	15 min: Kayakriya in shavasan (dynamic body relaxation), Shavasan with Savitri pranayam (rhythmic breath in corpse pose)	-Session started with yogic counselling and brief prayer -About diet and lifestyle modification were talked
Wolff, 2016	-Kundalini yoga (Mediyoga) developed at the Institute for Medical Yoga	I= 15 min x 2/day x 7 days/week x 12 weeks	-Practised at home -Taught by the three doctors who conducted the study and were familiar/ trained mediyoga instructors	-A CD, a nose plug and a manual were given -Self-reporting of home practice via a diary -Access to sessions via a website which was specifically made for the study and allowed to download to phone	Ustrasana (Camel ride/Spinal flex pose): 4 min	Chandranadi pranayama (Left nostril breathing): 11 min	NA	-Practised just after getting out of bed in the morning and just before going to bed in the evening -Information about yoga practice was given by the doctor during a GP consultation -A common template was

								used during the GP consultations
Roche, 2017	-Based on the yoga practice program for the prevention and management of hypertension developed at the ACYTER	I1=95 min/day x 2 days/ week x 8 weeks	NR	-Attendance register was maintained -Participant experiences and perceptions about their health were taken up	45-50 min: Warm-up exercises, Tala Kriya, Hasta Kona Kriya, Trikonasana (Triangle pose), Meru Asana, Sukhasana (Easy pose), Vakrasana (Twisted pose), Chatush Padasana (Four footed pose), Bhujangasana (Cobra pose)	5 min: Adham pranayama (Belly/ abdominal breathing), Dirga/Mahat pranayama (full yogic breath/three-part breath), Savitri pranayama (Rhythmic breath), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing), Chandra pranayama, Bhramari pranayama ((Bumblee) Bee breathing), Pranava Pranayama (Om meditation breathing)	10 - 15 min: Shavasana (Corpse pose/ Deep relaxation), Body scan meditation	-Session ended with a talk about yoga and practical application of mindfulness to bring it into every day (10 min)
	-Based on the yoga practice program for the prevention and management of hypertension developed at the ACYTER	I2= 40 min/day x 2 days/ week x 8 weeks	NR	-Attendance register was maintained -Participant experiences and perceptions about their health were taken up	NA	30 min: Adham pranayama (Belly/ abdominal breathing), Dirga/Mahat pranayama (full yogic breath/three-part breath), Savitri pranayama (Rhythmic breath), Anuloma-Viloma/Nadi Shodhana (Alternate nostril	NA	-Session ended with a talk on practical application of pranayama techniques (10 min)

						breathing), Chandra pranayama, Bhramari pranayama ((Bumblee) Bee breathing), Pranava Pranayama (Om meditation breathing)		
	-Based on some of the techniques included in the "Exercise Without Movement" yoga method of the Himalayan Yoga Tradition	I3= 50 min/day x 2 days/ week x 8 weeks	NR	-Attendance register was maintained -Participant experiences and perceptions about their health were taken up	NA	Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing)	Shavasana (Corpse pose/Deep relaxation), Shavayatra (61-point relaxation), Body Scan meditation	-Session ended with a talk about yoga and practical application of mindfulness to bring it into every day (10 min)
Shetty, 2017	NR	I=20 min/ day x 7 days/ week x 4 weeks	-At a clinical research centre -Observed by the research team	-Attendance register maintained	NA	20 min (10 min each): Sheetali (Cooling breath), Sheetkari (Hissing breath)	NA	_

Supriya, 2017	NR	I= 60 min/day x 3 days/ week x 52 weeks	-Supervised by certified yoga instructors who had at least 5 years of teaching experience	-Supermarket coupon was given at the end of the study -Attendance register maintained	Chakravakasana/Marjaryasana-Bitilasana (Cat-cow pose), Adho Mukha Svanasana (Downward facing dog), Utthitaashwa Sanchalanasana (High lunge), Uttanasana (Standing forward bend), Matsyendrasana (Spinal twist), Urdhva Hastasana (Upward salute), Utkatasana (Chair pose), Virabhadrasana (Warrior pose), Utthita parsvakonasana (Extended side angle pose), Utthita Trikonasana (Extended triangle pose), Vrksasana (Tree pose), Malasana (Garland pose), Eka Pada Rajakapotasana (One-legged king pigeon pose), Salabhasana (Locust pose), Dandasana (Staff pose), Baddha Konasana (Bound angle pose/ Butterfly pose), Agnistambhasana (Fire log pose), Gomukhasana (Cow face pose), Balasana (Child pose), Setu Bandha Sarvangasana (Dynamic/static bridge pose), Supta padangusthasana (Reclining big toe pose), Ananda Balasana (Happy baby pose), Virasana (Hero pose), Centring in cross-legged position, Paripurna Navasana (Knees bend version of	Pranayama (NS)	10-min warm-up and 10-min cool-down that consisted of a breathing and relaxation exercise, Shavasana (Corpse pose/Deep relaxation)	- Classes had ~10 participants -Intensity of practices was determined by instructors and modified according to the needs of participants

					boat pose), Vajrasana (Thunderbolt pose), Sukhasana (Easy pose), Eka Pada Bhekasana (1-leg frog pose), Supta Baddha Konasana (Reclining bound angle pose), Uttitha Hasta Padangustasana (Extended big toe pose), Padangusthasana (Big toe pose), Salabhasana (Locust pose), Tadasana (Mountain pose)			
Misra, 2018	NR	I1= 15 min/day x 5 days/ week x 6 weeks I2= 15 min/day x 5 days/ week x 6 weeks	I1: -1 session at a clinic -By an instructor -At least 4 sessions a week at home I2: -At least 5 sessions a week at home -Two examiners checked the accuracy of practice	I1: -Self-reporting of home practice via a diary (date and time) -Turned in their logs each week at the clinic I2: -DVD/YouTube guidance for home practice -Self-reporting of home practice via a diary (date and time)	NA	I1 and I2: Bhastrika (Bellow breathing): 2 min/30 repetitions, Kapalabhati (Rapid exhalations): 5 min/20 cycles, Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing): 5 min/20 cycles, Bhramari ((Bumble) Bee breathing): 3 times, Om Singing: 3 times	NA	I1 and I2: -The DVD/YouTube contained a 15-minute guided practice

				-Turned in their logs each week at the clinic				
Cramer, 2018	Developed by an expert panel from various yoga traditions, based on earlier studies and classic yoga texts	I1= 90 min/ day x 1 day/ week x 12 weeks	-Supervised by two yoga instructors -Encouraged to practise every day at home	- No minimum duration was suggested for home practice -Audio recordings and training manuals were given for home practice -Self-reporting of home practice via a diary	45 minutes of asanas: Light mobilisation exercises and work on sitting upright: 10 min, Vyaghrasana (Tiger pose): 4 min, Tadasana Vinyasa (Mountain flow): 8 min, Ardha Surya Namaskar (Half sun salutation): 8 min, Paschimottanasana (Seated forward bend): 4 min, Setu Bandha Sarvangasana (Dynamic/static bridge pose) with intervening Apanasana (Knees to chest pose): 8 min, Supta Parivartanasana (Twist-stretch pose): 5 min	10-15 min: Perception exercise in supine position: 3 min, Deeper breathing and completion of breathing with feet flat on floor: 4 min, Setu Bandha Sarvangasana (dynamic/ static bridge pose) with intervening Apanasana (knees to chest pose):2 min, Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing): 6 min	Meditation-observe stillness: 3 min, Shavasana (Corpse pose/ Deep relaxation): 10 min	-Sessions started with contemplation (3 min) and philosophical/ theoretical topic (12 min) -Adapted to needs of patients and props were used if necessary -Home practice was explained at the end of the sessions
	Developed by an expert panel from various yoga traditions, based on earlier studies, classic yoga texts	I2= 90 min/day x 1 day/ week x 12 weeks	-Supervised by the same two yoga instructors -Encouraged to practise every day at home	- No minimum duration was suggested for home practice -Audio recordings and training	NA	60 min of pranayama and dhyana: Light mobilisation exercises and work on sitting upright:4 min, Perception exercise in supine position:5 min,	Meditation: 2 min, Shavasana (Corpse pose/ Deep relaxation): 8 min,	-Sessions started with contemplation (3 min) and philosophical/ theoretical

				manuals were given for home practice -Self-reporting of home practice via a diary		Deeper breathing with feet flat on floor:5 min, Completion of breathing with feet flat on floor:5 min, Setu Bandha Sarvangasana (Dynamic/static bridge pose) with intervening Apanasana (Knees to chest pose): 4 min, Work on sitting upright: 6 min, Dirga/Mahat pranayama (Full yogic breath):4 min, Ujjayi (Victorious breathing):11 min, Meditation:2 min, relaxation with appreciation of the effect in supine position:3 min, Supta Parivartanasana (Twist-stretch pose):5 min, Observe, deepen, and complete breathing (2 min)		topic (12 min) -Adapted to needs of patients and props were used if necessary -Home practice was explained at the end of the sessions

Ankolekar, 2019	NR	I= 60 min/day x 6 days/ week x 15 days	-At Manipal Academy of Higher Education -Monitored to do yoga except on duty off days	NR	Swastikasana (Auspicious pose), Vajrasana (Thunderbolt pose), Suptavajrasana (Supine thunderbolt pose), Tadasana (Mountain pose), Trikonasana (Triangle pose), Parshwa-konasana ((Extended) Side angle pose), Pawanmuktasana (Wind releasing pose), Bhujangasana (Cobra pose), Salabhasana (Locust pose), Dhanurasana (Bow pose), Prasarita Padottanasana (Wide-legged forward bend pose), Vakrasana (Twisted pose)	Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing), Suryabhedana (Right nostril breathing), Chandrabhedana (Single nostril breathing), Bhramari ((Bumblee) Bee breathing)	Shavasana (Corpse pose/Deep relaxation), Meditation (NS)	_
Gadgil, 2019	NR	I1=40 min	NR	NA	NA	30 min (5 sets): Kapalabhati (Rapid exhalations) (1 min), Kukriya (Panting dog breath) (1 min), Bhastrika (Bellow breathing) (1min) with one-minute rest in between each pranayama	10 min: Shavasana (Corpse pose/ Deep relaxation)	-Practised in a quiet room -Sitting in Vajrasana (Thunderbol t pose)
	NR	I=54 min	-At hospital	NA	NA	54 min (9 sets): Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing) (2 min), Pranav (Om meditation breathing) (2 min), Savitri	10 min: Shavasana (Corpse pose/ Deep relaxation): 10 min	-Practised in a quiet room -Sitting in Sukhasana (Easy pose)

						pranayam (Rhythmic breath) (2 min) with 1 min rest between each pranayama		
Ghati, 2020	NR	I= 5 min	-Supervised by a yoga instructor	NA	NA	Bhramari pranayama ((Bumblee) Bee breathing): 5 min, breath rate 4-6/min	NA	-Sitting on an easy pose (Sukhasana)
Fetter, 2020	-Developed by experienced yoga and stretching licensed instructor	I=75 min/ day x 2 days/ week x 12 weeks	-At the clinical research centre -Video classes supervised by the author, who worked in the area of Physical Education	NR	10 times: Chakravakasana/ Marjaryasana-Bitilasana (Cat-cow pose), 4 times: Adho Mukha Svanasana (Downward facing dog), Kumbhakasana/ Phalakasana/Adho Mukha Dandasana/ Santolasana (Plank pose), Urdhva Mukha Svanasana (Upward-facing dog pose), 3 times: Surya Namaskar (Sun salutations): Pranamasana (prayer pose), Urdhva hastasana (Upward salute), Padahastasana (Hand to Foot Pose), Ashwa Sanchalanasana (High lunge pose), Phalakasana/ Adho Mukha Dandasana/ Santolasana (Plank pose), Ashtangasana (Salutation with eight limbs pose), 1 min:Virabhadrasana II (Warrior II pose), 1 min:Parshwa-	NA	Shavasana (Corpse pose/ Deep relaxation): 15min, Anapanasati (Breath counting meditation)	-Classes were held in a room equipped with a 32-inch-screen TV between 2:00 and 6:00 pm

					konasana/ Utthita parsvakonasana (Extended side angle pose), 1 min:Prasarita Padottanasana (Wide-legged forward bend pose), 1 min:Parivrtta Trikonasana (Revolved triangle pose), Vrksasana (Tree pose), Dandayamna Bharmanasana (Balancing table pose), Janu Sirsasana (Head to knee forward bend), 1 min: Ardha Matsyendrasana (Half lord of the fishes pose), 1 min: Baddha Konasana (Bound angle/ Butterfly pose), 1 min: Setu Bandha Sarvangasana (Bridge pose), 1 min: Sarvangasana (Shoulder stand), 1 min: Halasana (Plough pose), 1 min: Matsyasana (Fish pose)			
Sathe, 2020	NR/NA	I=5 min	-Guided through video and audio cassettes	NA	NA	Bhramari pranayama ((Bumblee) Bee breathing): 5 min, breath rate 3/min	NA	-Practised in a relaxed position (Sukhasana) with eyes closed
Thanalakshmi, 2020	NR	I= 30 min/ day x 7 days/week x 12 weeks	-Supervised by a qualified yoga and	-Attendance register maintained	NA	30 min (20 sets): Sheetali pranayama (Cooling breath), 1 set included 2 min rest	NA	-Practised between 7:00 to 9:00 a.m. on

			naturopathy doctor			following 10 rounds of practice		empty stomach for 4 weeks
Dhungana, 2021	NR	I=30 min/ day x 5 days/ week x 12 weeks	-Supervised by health workers, trained by experienced yoga teachers -Received training at health centres -Encouraged to practise five days a week at home	-Participants visited health centre every month and were able to call yoga instructors if needed -Video recordings were given for home practice -Attendance register maintained	5 min: Sukshma Vyayama (Loosening practices in sitting position: Toe bending, ankle bending, knee bending, finger bending, wrist bending, elbow bending, shoulder rotation, neck bending up and down, Ardha Baddha Konasana (Half butterfly pose)), 2 min each: Ardhakati Chakrasan " (Lateral arc pose), Vakrasana (Twisted pose)	3min: Breath awareness breathing, 2 min each: Chandranadi pranayam (Left nostril breathing), Sheetali pranayama (Cooling breath), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing), Bhramari pranayama ((Bumblee) Bee breathing)	1 min: Om recitation, 9 min: Yoga Nidra (Yogic sleep)	-Participants attended two-hour yoga training sessions for 5 consecutive days

Effective yoga interventions were coloured in light blue. NR: Not reported, NS: Not specified, NA: Not applicable, MDNIY: Morarji Desai National Institute of Yoga, METs: Metabolic Equivalents

2.10.4 Methodological quality of the studies

Overall, the studies were assessed as being of low quality (See Table 3). The total number of "yes" answers was 7 or more in 6 studies, was 6 in 2 studies, was 5 in 8 studies, and was 4 or less in 18 studies. Even though the design and conduct of the studies appeared to be good enough, the methodology was not adequately reported, and this resulted in poor scoring. There were poor methodological quality studies as well. Some of the major issues in these studies were: (i) inadequate reporting of the randomisation process, of the allocation concealment process, of the blinding of participants and outcome assessors, of whether the study arms were treated identically other than the intervention of interest or not, of the measurement process of outcomes (including adverse events); (ii) imbalance between the treatment groups at baseline (e.g., weight); (iii) describing the differences between study arms in terms of their follow-up but not analysing these; (iv) not performing ITT analysis; (v) errors/issues in the sample size calculation and reporting; and (vi) errors/issues in data analysis and reporting (e.g., pre-post analysis and not between the groups).

Table 5 Critical appraisal of included studies

Authors	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Total %
Murugesan, 2000	U	U	N	U	NA	U	U	U	U	U	U	U	Y	8
McCaffrey, 2005	N	U	N	U	NA	U	Y	N	N	U	U	U	Y	17
Kettner, 2009	U	U	U	Y	NA	Y	Y	N	N	U	U	Y	Y	42
Mourya, 2009	U	U	N	U	NA	Y	Y	N	N	Y	U	U	Y	33
Saptharishi, 2009	Y	U	N	U	NA	U	U	N	U	U	U	U	Y	17
Khadka, 2010	N	U	N	U	NA	U	Y	U	U	U	U	U	Y	17
Cohen, 2011	U	U	N	N	NA	U	Y	N	N	Y	Y	U	Y	33
Bhavanani, 2012	U	U	U	U	NA	U	U	Y	Y	Y	Y	U	Y	42
Shantakumari, 2012	N	U	N	U	NA	U	Y	Y	Y	U	U	Y	Y	42
Telles, 2013	Y	U	N	U	NA	Y	U	Y	Y	U	U	N	Y	42
Sujatha, 2014	U	U	N	U	NA	U	U	Y	Y	Y	U	U	Y	33
Hagins, 2014	Y	Y	N	N	NA	Y	Y	N	N	Y	Y	Y	Y	67
Patil, 2014a	Y	U	N	N	NA	U	U	N	N	Y	U	U	Y	25
Patil, 2014b	Y	U	Y	N	NA	U	U	U	U	Y	U	U	Y	33
Patil, 2015	Y	U	N	N	NA	U	Y	Y	Y	Y	Y	U	Y	58
Sriloy, 2015	U	U	U	U	NA	Y	U	N	N	Y	Y	U	Y	33
Prakash, 2015	U	U	U	U	NA	U	U	U	U	U	U	U	Y	8
Pushpanathan, 2015	U	Y	U	U	NA	U	Y	N	N	U	U	U	Y	25
Thiyagarajan, 2015	U	Y	Y	N	NA	U	U	N	N	Y	U	U	Y	33
Cohen, 2016	U	U	N	N	NA	N	U	N	Y	Y	Y	Y	Y	42
Punita, 2016	U	Y	N	U	NA	U	Y	N	N	Y	Y	U	Y	42
Wolff, 2016	Y	U	N	U	NA	Y	Y	N	N	Y	Y	Y	Y	58
Roche, 2017	N	U	N	U	NA	U	U	N	N	U	U	U	Y	8
Shetty, 2017	Y	U	N	N	NA	Y	Y	Y	Y	Y	U	U	Y	58
Supriya, 2017	Y	U	U	U	NA	U	Y	N	N	Y	Y	Y	Y	50
Misra, 2018	Y	U	N	U	NA	Y	Y	N	N	U	U	Y	Y	42
Cramer, 2018	Y	Y	N	N	NA	Y	Y	N	Y	U	U	Y	Y	58
Ankolekar, 2019	N	U	U	U	NA	U	U	U	U	Y	U	U	Y	17
Gadgil, 2019	U	U	U	U	NA	U	U	U	U	U	U	U	Y	8

Fetter, 2020	U	U	N	Y	NA	Y	U	N	N	U	U	U	Y	25
Ghati, 2020	Y	U	N	N	NA	U	U	N	N	Y	Y	Y	Y	42
Sathe, 2020	U	U	Y	U	NA	U	U	Y	Y	U	U	U	Y	33
Thanalakshmi, 2020	Y	Y	N	N	NA	Y	U	N	Y	Y	Y	Y	Y	67
Dhungana, 2021	Y	U	N	N	NA	N	U	N	Y	Y	Y	Y	Y	50
Total %	41	18	9	6	0	32	44	21	32	56	35	26	100	

*Question 5 was excluded from the denominator and row percentage was calculated out of 12 questions.
Y=yes; N=no; U=unclear; NA=not applicable.
JBI critical appraisal checklist for randomised controlled trials: Q1. Was true randomisation used for assignment of participants to treatment groups? Q2. Was allocation to treatment groups concealed? Q3. Were treatment groups similar at baseline? Q4. Were participants blind to treatment assignment? Q5. Were those delivering treatment blind to treatment assignment? Q6. Were outcomes assessors blind to treatment assignment? Q7. Were treatment groups treated identically other than the intervention of interest? Q8. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed? Q9. Were participants analysed in the groups to which they were randomised? Q10. Were outcomes measured in the same way for treatment groups? Q11. Were outcomes measured in a reliable way? Q12. Was appropriate statistical analysis used? Q13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomisation, parallel groups) accounted for in the conduct and analysis of the trial?

2.10.5 Adverse events

Adverse events were not reported in 26 RCTs and 6 RCTs reported that no adverse events occurred. 2 RCTs reported adverse events but only one of these studies provided details.[177, 190] The study[177] reported that adverse events occurred in yoga and comparator groups but none of these adverse events was judged to be directly related to the yoga intervention.

2.10.6 Publication bias

Funnel plots were generated for yoga intervention versus control (Figure 4 and 5) and asana, pranayama, and dhyana and relaxation practice versus no intervention (Figure 6 and 7). Funnel plots showed little evidence of publication bias.

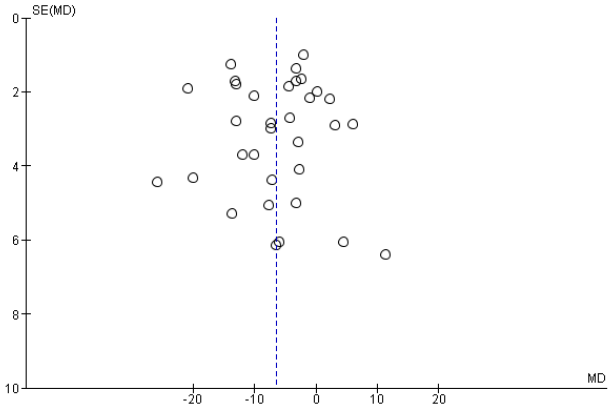

Figure 8 Yoga versus control (SBP)

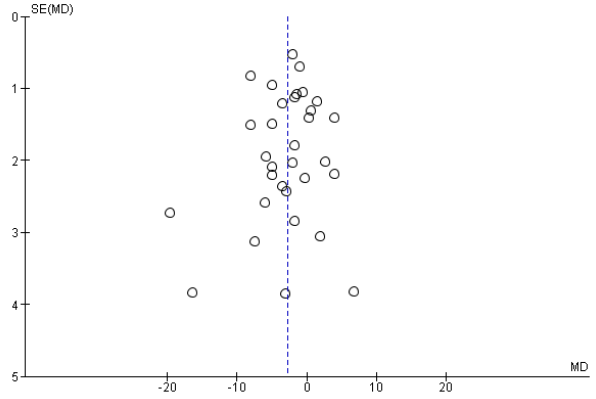

Figure 9 Yoga versus control (SBP)

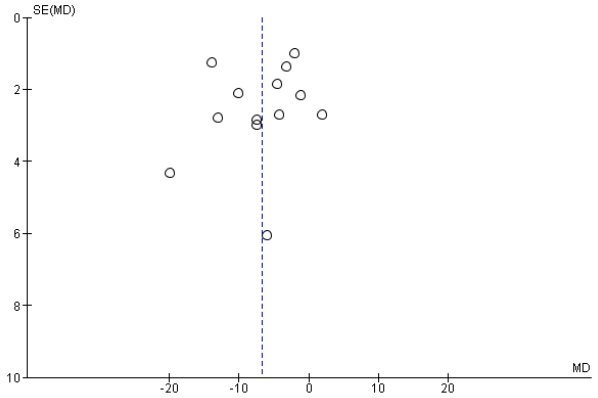

Figure 10 Asana, pranayama and dhyana and relaxation practice versus No intervention (SBP)

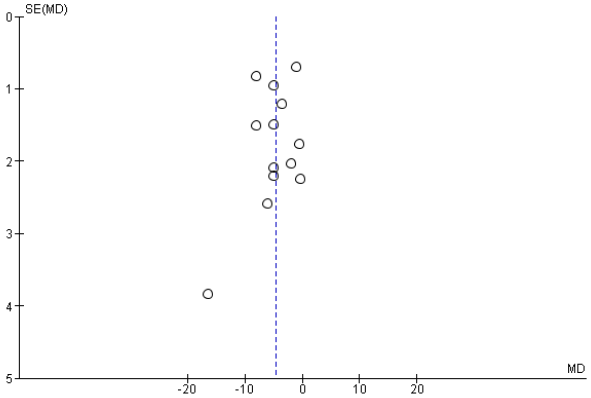

Figure 11 Asana, pranayama and dhyana and relaxation practice versus No intervention (DBP)

2.10.7 Meta-analysis to determine study effectiveness

Thirty-three out of 34 studies were included in the meta-analysis, comparing yoga with any type of comparator. One of the studies[205] was not included in the meta-analysis as it compared a yoga intervention with another yoga intervention but was included in the narrative synthesis. The overall effect on SBP and DBP favoured yoga interventions compared to comparators (MD -6.49 mmHg; 95% CI -8.94 to -4.04, MD -2.78 mmHg; 95% CI -4.11 to -1.45, respectively) (Figure 8 and 9). Of the studies included in the meta-analysis, 16, 13, and 18 interventions were effective in improving SBP, DBP, or either, respectively.

Thirty-eight comparisons were made in subgroup analyses, in total. In subgroup analyses, 18, 14, and 20 out of 38 yoga interventions showed effectiveness in reducing SBP, DBP, or either, respectively. All subgroup comparisons favoured yoga interventions except for pranayama vs non-pharmaceutical intervention in reducing SBP. Asana, pranayama, and dhyana and relaxation practice was more effective in reducing SBP compared to no intervention (-6.71 mmHg; -9.87 to -3.55) and non-pharmaceutical interventions (-6.36 mmHg; -11.64 to -1.09) (Figure 10 and 12). Pranayama was more effective in reducing SBP compared to no intervention (-12.01 mmHg; -20.25 to -3.77) but not compared to non-pharmaceutical intervention (-2.39 mmHg; -12.19 to 7.41) (Figure 14 and 16).

All subgroups favoured yoga interventions in reducing DBP when compared to no intervention but not when compared to non-pharmaceutical intervention. Asana, pranayama, and dhyana and relaxation practice was more effective in

reducing DBP compared to no intervention (-4.67 mmHg; -6.56 to -2.77) but not compared to non-pharmaceutical interventions (-2.34 mmHg; -5.42 to 0.74) (Figure 11 and 13). Pranayama was more effective in reducing DBP compared to no intervention (-5.38 mmHg; -8.03 to -2.73) but not compared to non-pharmaceutical interventions (1.49 mmHg; -1.28 to 4.26) (Figure 15 and 17). Interventions combining any two components of yoga could not be included in the meta-analysis as no two studies met the criteria to be pooled.[177, 180, 189, 195, 198, 203]

The meta-analysis including all the yoga interventions showed substantial heterogeneity for SBP (I^2=88%) and DBP (I^2=85%). Subgroup analyses could not reduce heterogeneity substantially. Only two subgroup analyses comparing pranayama with no intervention and non-pharmaceutical interventions for DBP showed no heterogeneity.

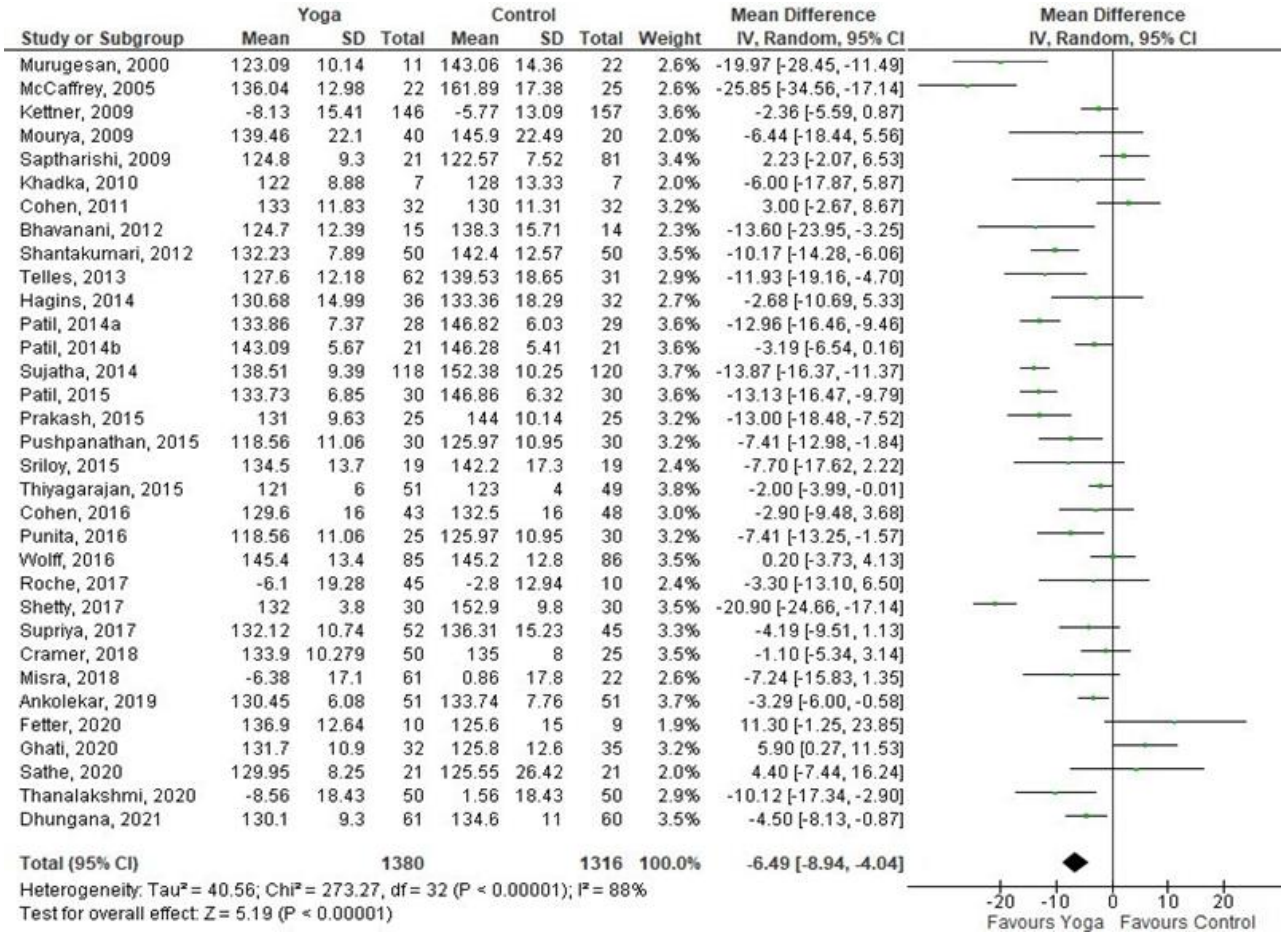

Figure 12 Yoga versus control (SBP)

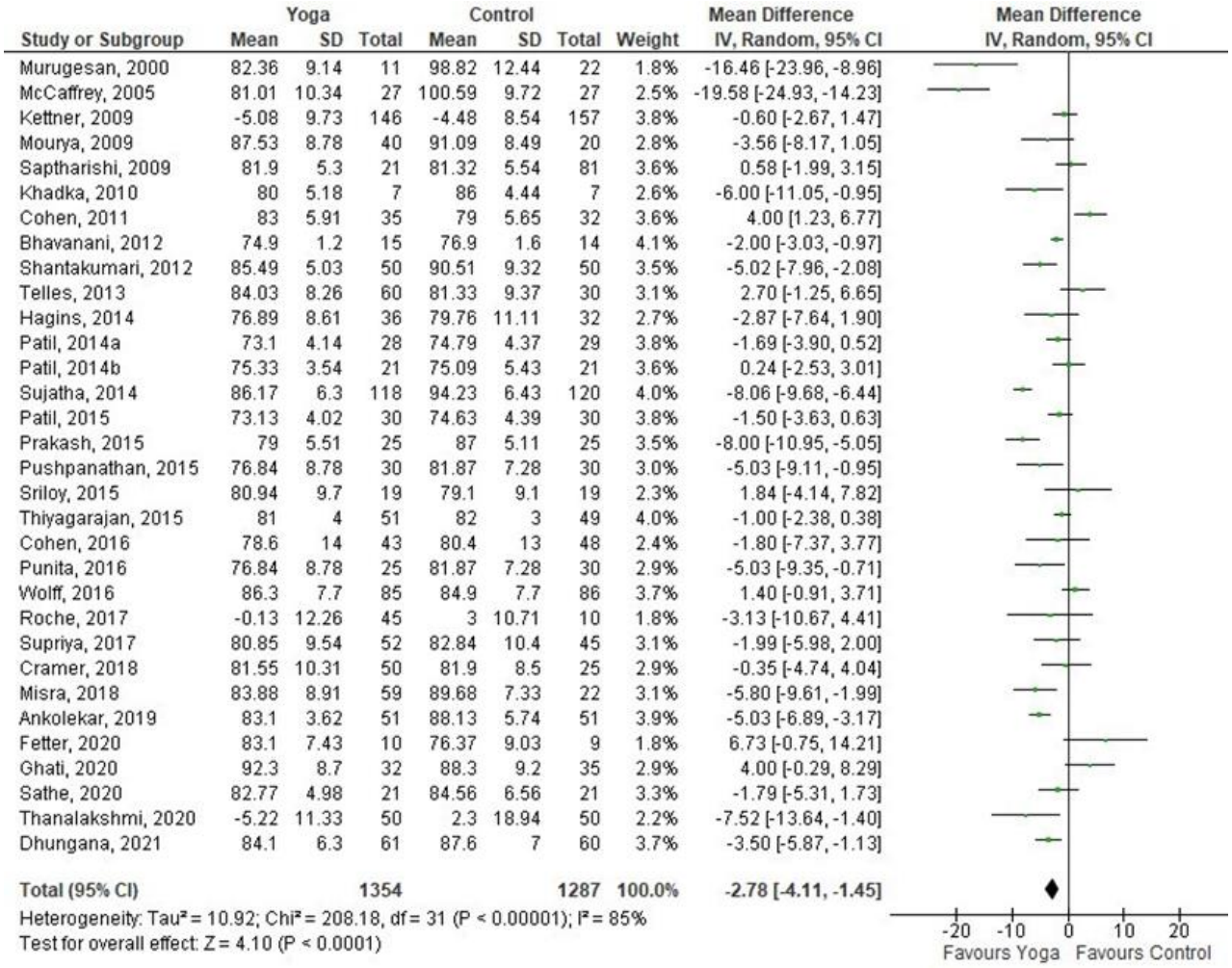

Figure 13 Yoga versus control (DBP)

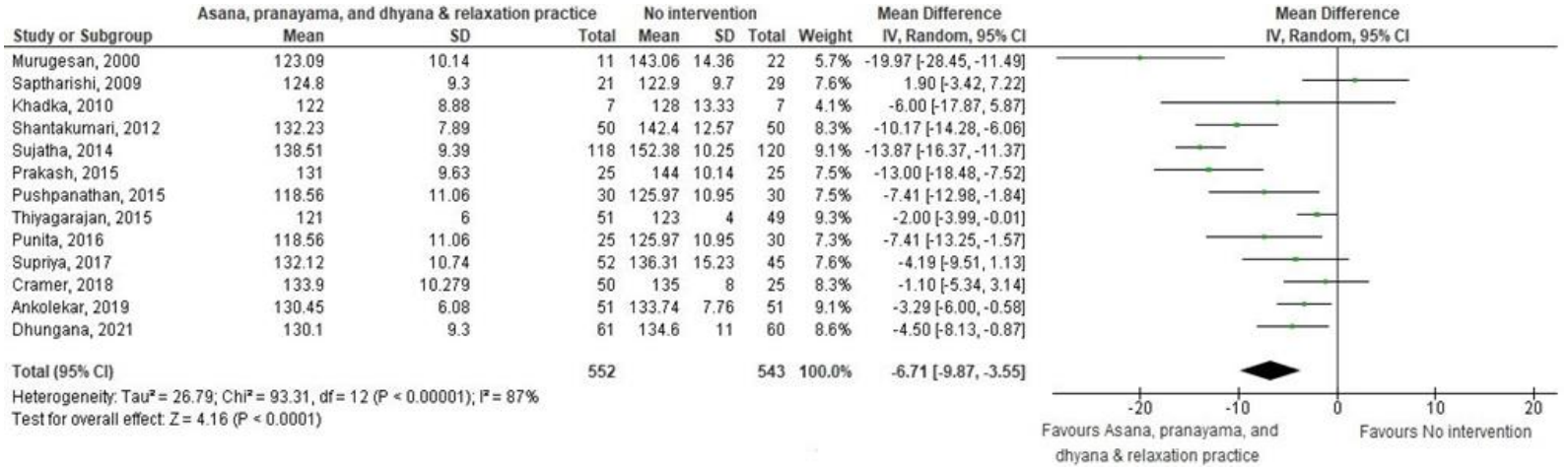

Figure 14 Asana, pranayama, and dhyana & relaxation practice versus no intervention (SBP)

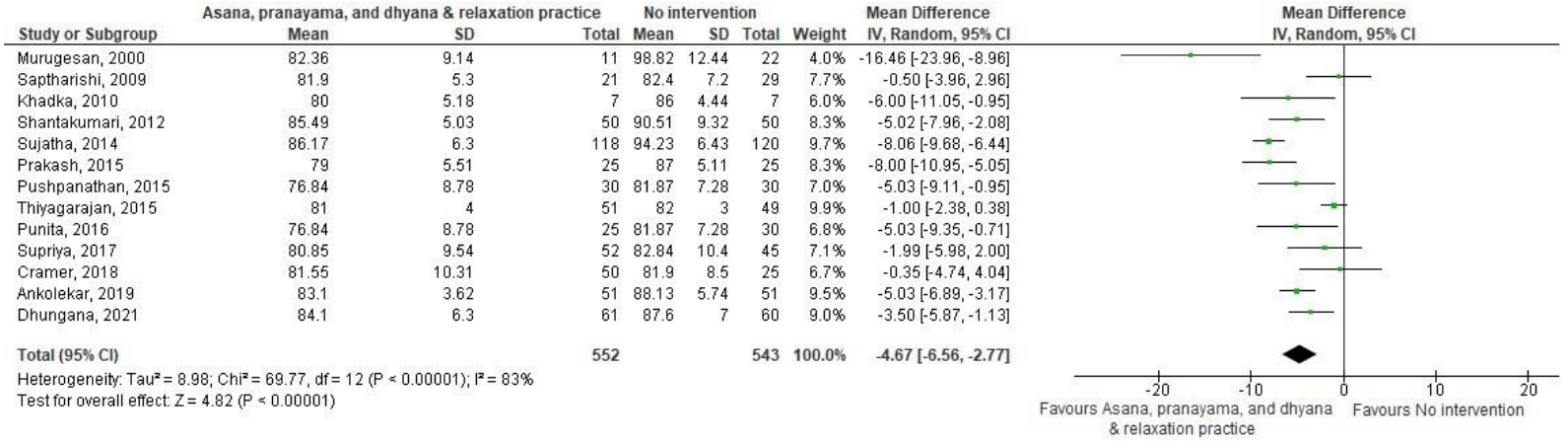

Figure 15 Asana, pranayama and dhyana & relaxation practice versus no intervention (DBP)

Study or Subgroup	Asana, pranayama, and dhyana & relaxation practice Mean	SD	Total	Non-pharmaceutical intervention Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
McCaffrey, 2005	136.04	12.98	22	161.89	17.38	25	9.6%	-25.85 [-34.56, -17.14]
Saptharishi, 2009	124.8	9.3	21	122.38	6.08	52	12.0%	2.42 [-1.89, 6.73]
Cohen, 2011	133	11.83	32	130	11.31	32	11.3%	3.00 [-2.67, 8.67]
Hagins, 2014	130.68	14.99	36	133.36	18.29	32	10.0%	-2.68 [-10.69, 5.33]
Patil, 2014a	133.86	7.37	28	146.82	6.03	29	12.3%	-12.96 [-16.46, -9.46]
Patil, 2014b	143.09	5.67	21	146.28	5.41	21	12.4%	-3.19 [-6.54, 0.16]
Patil, 2015	133.73	6.85	30	146.86	6.32	30	12.4%	-13.13 [-16.47, -9.79]
Cohen, 2016	129.6	16	43	132.5	16	48	10.8%	-2.90 [-9.48, 3.68]
Roche, 2017	-6.1	19.28	45	-2.8	12.94	10	9.0%	-3.30 [-13.10, 6.50]
Total (95% CI)			**278**			**279**	**100.0%**	**-6.36 [-11.64, -1.09]**

Heterogeneity: Tau² = 55.50; Chi² = 80.49, df = 8 (P < 0.00001); I² = 90%
Test for overall effect: Z = 2.36 (P = 0.02)

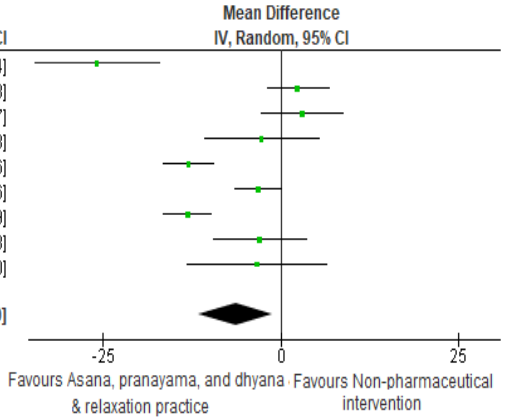

Figure 16 Asana, pranayama and dhyana/relaxation practice versus non-pharmaceutical intervention (SBP)

Study or Subgroup	Asana, pranayama, and dhyana & relaxation practice Mean	SD	Total	Non-pharmaceutical intervention Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
McCaffrey, 2005	81.01	10.34	27	100.59	9.72	27	9.7%	-19.58 [-24.93, -14.23]
Saptharishi, 2009	81.9	5.3	21	80.72	4.41	52	12.5%	1.18 [-1.38, 3.74]
Cohen, 2011	83	5.91	35	79	5.65	32	12.4%	4.00 [1.23, 6.77]
Hagins, 2014	76.89	8.61	36	79.76	11.11	32	10.3%	-2.87 [-7.64, 1.90]
Patil, 2014a	73.1	4.14	28	74.79	4.37	29	12.8%	-1.69 [-3.90, 0.52]
Patil, 2014b	75.33	3.54	21	75.09	5.43	21	12.4%	0.24 [-2.53, 3.01]
Patil, 2015	73.13	4.02	30	74.63	4.39	30	12.9%	-1.50 [-3.63, 0.63]
Cohen, 2016	78.6	14	43	80.4	13	48	9.5%	-1.80 [-7.37, 3.77]
Roche, 2017	-0.13	12.26	45	3	10.71	10	7.5%	-3.13 [-10.67, 4.41]
Total (95% CI)			**286**			**281**	**100.0%**	**-2.34 [-5.42, 0.74]**

Heterogeneity: Tau² = 17.98; Chi² = 63.88, df = 8 (P < 0.00001); I² = 87%
Test for overall effect: Z = 1.49 (P = 0.14)

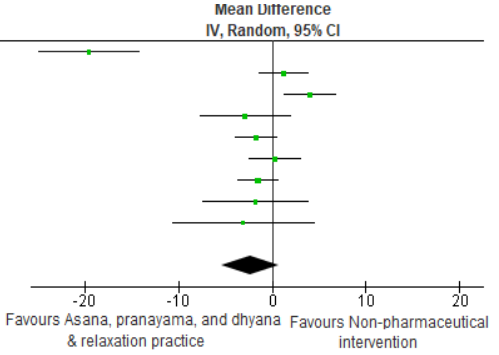

Figure 17 Asana, pranayama and dhyana/relaxation practice versus non-pharmaceutical intervention (DBP)

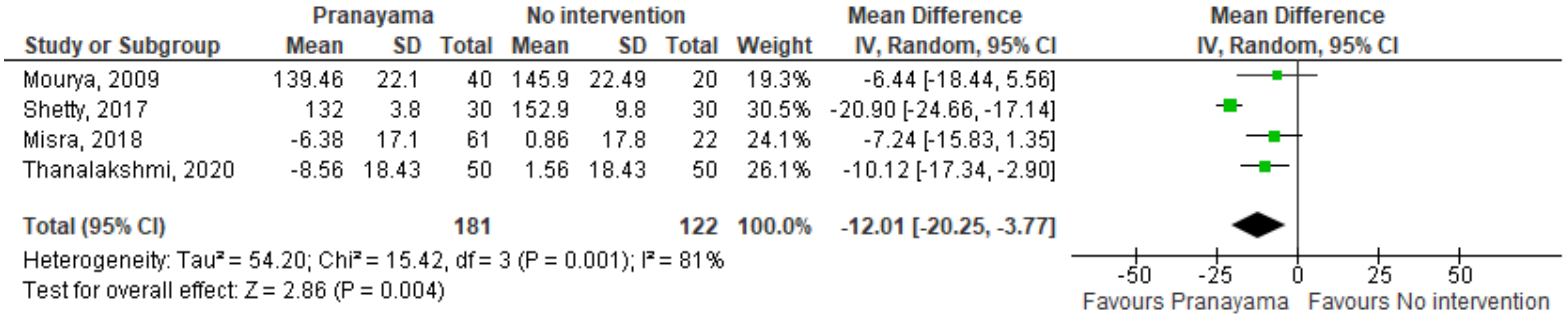

Figure 18 Pranayama versus no intervention (SBP)

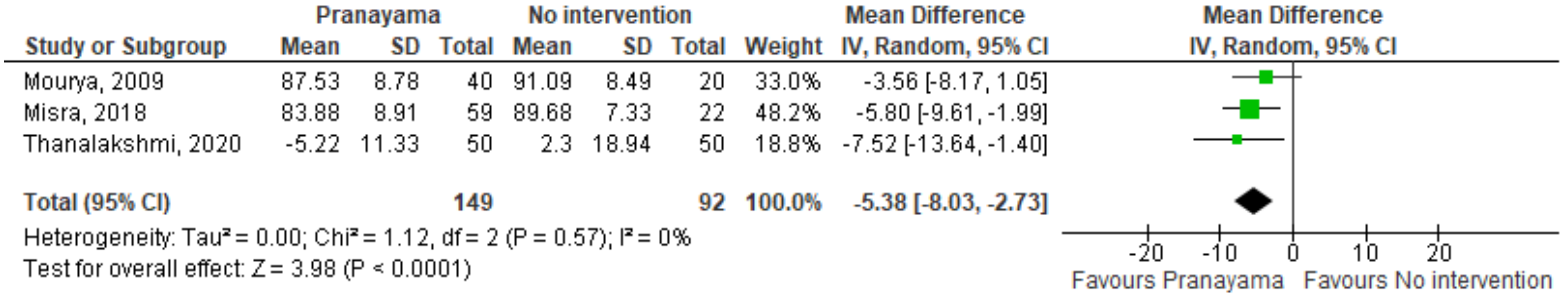

Figure 19 Pranayama versus no intervention (DBP)

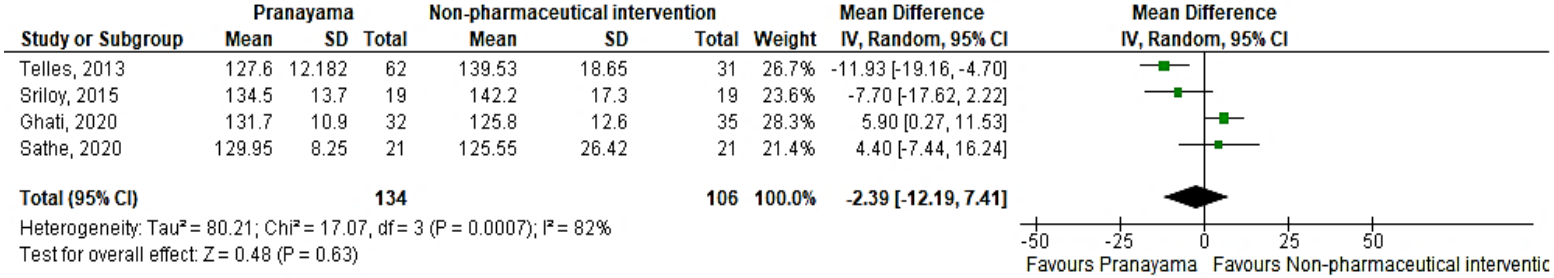

Figure 20 Pranayama versus non-pharmaceutical intervention (SBP)

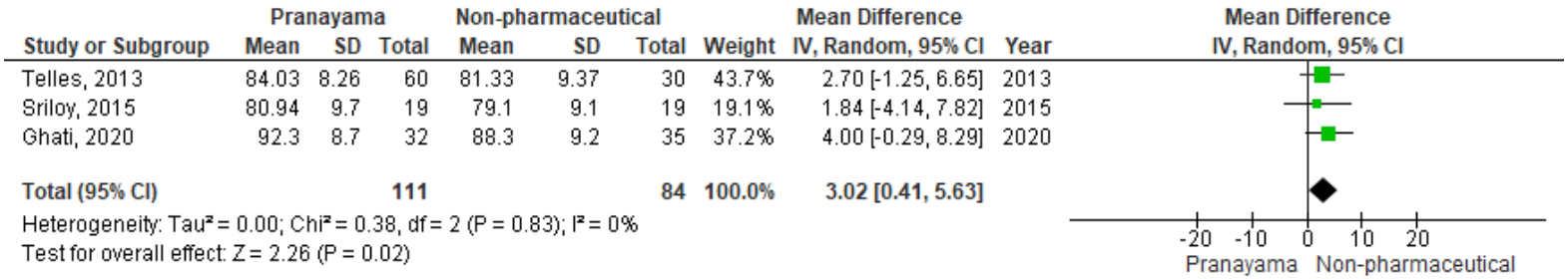

Figure 21 Pranayama versus non-pharmaceutical intervention (DBP)

2.10.8 Details of the yoga interventions

2.10.8.1 Content

Of 20 effective studies, 13 interventions incorporated 3 components of yoga: asana, pranayama, and dhyana and relaxation practices, 3 interventions combined pranayama and dhyana and relaxation practices, and 4 interventions used only pranayama. 14 effective interventions compared yoga with no intervention/no additional intervention, 5 compared with non-pharmaceutical intervention, and 1 study compared pranayama with another pranayama.[205]

The majority of the studies did not define the style of the yoga (e.g., Hatha, Iyengar yoga, etc.) used as an intervention. Only 1 out of 20 effective interventions reported that Hatha yoga was used.[187] The content of the effective yoga interventions was quite heterogeneous, and they included 41 different types of asana, 19 different types of pranayama, and 11 different types of dhyana and relaxation practices. The most common practices were Bhujangasana (Cobra pose) (in 11 interventions), Anuloma-Viloma/Nadi Shodhana (Alternate nostril breathing) (in 14 interventions), and Shavasana (Corpse pose/deep relaxation) (in 9 interventions). The Sanskrit and English names of the yogic practices used in effective interventions and the number of RCTs using these practices are detailed in Table 4.

The studies had a varying emphasis on each component. Four out of 13 effective interventions that incorporated 3 components of yoga did not report how much time was allocated to each component. Where reported, there was

a balance in how much time allocated to each component on effective interventions, whereas interventions that were not found to be effective were more focused on the asana and the duration of the asana practice was longer. The mean time allocated to asana was around 19 min, pranayama was around 9 min, and dhyana and relaxation practice was around 14 min in effective studies. The mean time allocated to asana was around 42 min, pranayama was around 8 min and dhyana and relaxation practice was around 9 min in studies that showed effectiveness.

Table 6 Yoga practices used in effective interventions

Asana			Pranayama			Dhyana and relaxation practices		
Sanskrit Name	**English Name**	**Frequency of use**	**Sanskrit Name**	**English Name**	**Frequency**	**Sanskrit Name**	**English Name**	**Frequency of use**
Ardha Baddha Konasana	Half butterfly pose		Alternate Kapalapathi Pranayama	Alternate nostril rapid exhalations		Anapanasati	Breath counting meditation	
Ardha Chakrasana	Half wheel pose	x5	Anuloma-Viloma/ Nadi Shodhana Pranayama	Alternate nostril breathing	x14	Kayakriya in Shavasana	Dynamic body relaxation	x3
Ardha Halasana	Half plough pose	x4	Bhastrika Pranayama	Bellow breathing	x4	Shavasana with Savitri Pranayama	Rhythmic breath in corpse pose	x3
Ardha Matsyendrasana	Half lord of the fishes pose	x2	Bhramari Pranayama	(Bumble) Bee breathing)	x6	Shavasana	Corpse pose/Deep relaxation	x9
Ardha Salabhasana	Half locust pose	x3	Chandranadi Pranayama	Left nostril breathing	x4	Vipassana	Mindfulness meditation	
Ardha Ustrasana	Half camel pose	x2	Chandrabhedana Pranayama	Single nostril breathing		Yoga Nidra	Yogic sleep	
Ardhakati Chakrasana	Lateral arc pose	x5	Dirga/Mahat Pranayama	Full yogic breath/ three-part breath			Cyclic meditation	x2
Bhujangasana	Cobra pose	x11	Kapalabhati Pranayama	Rapid exhalations	x4		Opening prayer	x2

Dhanurasana	Bow pose	x4	Kukriya Pranayama	Panting dog breath		Closing prayer	x2
Gomukhasana	Cow face pose		Pranav Pranayama	Om meditation breathing	x4	Om recitation and meditation	x3
Hardhayastambhasana, Navasana/ Naukasana	Boat pose		Savitri Pranayama	Rhythmic breath		One–one meditation	
Janu Sirsasana	Head to knee forward bend pose		Sheetali Pranayama	Cooling breath	x4		
Makarasana	Crocodile pose	x7	Shitkari Pranayama	Hissing breath	x2		
Matsyasana	Fish pose		Suryabhedana Pranayama	Right nostril breathing	x3		
Padahastasana	Hand to foot pose	x2	Ujjayi Pranayama	Victorious breathing	x3		
Padmasana	Lotus pose	x3		Hands in and out breathing	x2		
Parivrtta Trikonasana	Revolved triangle pose			Ankle stretch breathing	x2		
Parshwa-konasana/ Utthita Parsvakonasana	Extended side angle pose			Straight leg raising breathing	x2		
Paschimottanasana	Seated forward bend			Lumbar stretch breathing	x2		

Pawanmuktasana	Wind releasing pose	x6	Breath awareness	x2
Prasarita Padottanasana	Wide-legged forward bend pose			
Salabhasana	Locust pose			
Sarvangasana	Shoulder stand			
Shashankasana	Rabbit pose	x4		
Sukhasana	Easy pose			
Sukshma Vyayama	Loosening practices	x4		
Suptavajrasana	Supine thunderbolt pose			
Swastikasana	Auspicious pose			
Tadasana	Mountain pose	x3		
Talasana	Palm tree pose	x3		
Tarasana	Star pose			
Trikonasana	Triangle pose	x4		
Urdhva Dhanurasana/ Chakrasana	Wheel pose	x3		

Ustrasana	Camel ride/spinal flex pose	
Utkatasana	Chair pose	
Uttanpadasana	Raised leg pose	x3
Vajrasana	Thunderbolt pose	x8
Vakrasana	Twisted pose	x4
Viparita Karani	Legs up the wall	
Yoga Mudrasana	Yoga seal pose	x3
Yoni Mudra		

2.10.8.2 Structure

The duration of the effective yoga interventions ranged from one day (acute effect) to 12 weeks. Only 3 out of 20 effective studies evaluated the acute effects of yoga intervention. The frequency of sessions ranged from once a week to 7 days a week: 7 days a week (n=5), 6 days a week (n=4), 5 days a week (n=3), and 3 days a week (n=4). The duration of yoga sessions ranged from 10 min to 90 min and the mean duration of the yoga sessions was around 42 min. The most common session duration, frequency, and intervention duration of effective interventions was 45 min/session (in 5 interventions), 7 days/week (in 5 interventions), and 12 weeks (in 11 interventions).

Variations in the session duration and frequency of sessions resulted in an average weekly dose of 216 min in long-term effective interventions and the weekly dose ranged from 90 min to 420 min. The mean total dose of yoga interventions, considering the session length, session frequency, and total duration of yoga interventions, was around 2329 min (~39 hours) and it ranged from around 560 min (~9 hours) to 5,040 min (84 hours).

There were differences between the effective interventions and interventions that were not found to be effective in terms of the frequency, the weekly and total dose of the yoga interventions. Whereas the most common session frequency was 7 days a week in effective interventions, the most common session frequency was 2 days a week (n=7) in interventions that were not found to be effective. The mean weekly and total dose of effective yoga interventions

was around 216 min and 2329 min, respectively, whereas it was around 172 min and 2071 min in long-term studies that showed effectiveness, respectively. The differences between the effective and effective interventions suggest that effective yoga interventions involved regular practice and tended to have higher weekly and total dose of yoga interventions.

2.10.8.3 Delivery characteristics (context, supervision and intervention uptake and adherence)

Fifteen effective interventions were centre-based, including a research/community centre (n=7), a clinic/hospital (n=5) and an academic institution (n=2). Five interventions did not provide details of the centres where yoga interventions were practised. Eight interventions were both centre- and home-based and participants were recommended or required to practice at home.

Sixteen effective studies mentioned supervision of the yoga sessions, but four studies did not provide any information about the yoga sessions' supervision status. Interventions were supervised by instructors with training in yoga (n=9) and instructors without any yoga training (n=5). Of the studies that mentioned supervision of the yoga sessions, 2 studies did not provide further details about the person who supervised the sessions.

Four effective interventions did not report anything about the strategies used to increase intervention uptake and adherence and how compliant participants were to the intervention. A variety of strategies was used to increase attendance and adherence of participants to the intervention. Keeping

attendance register,[177, 179, 181, 186, 187, 196, 200, 206, 208] providing an audio recording, DVD, and/or training manuals for home practice,[176, 177, 187, 194, 202, 208] recording home practice,[176, 177, 194, 202] contacting the clinic/hospital to follow-up advice[176, 202, 208] and providing sessions at different times[187] were among the strategies used. Six out of 16 effective long-term studies reported the commitments of the participants to the intervention, and it ranged from 70% to 100%.[179, 181, 187, 196, 200, 202]

Effective interventions and interventions that were not found to be effective were similar in terms of the context, supervision, and strategies used to increase intervention uptake and adherence. However, participants' adherence to the intervention protocol tended to be higher in effective yoga interventions, where reported.

2.11 Discussion

This systematic review synthesised the content, structure, and delivery characteristics of effective yoga interventions used for managing hypertension and compared these between effective interventions and interventions that were not found to be effective. Eighteen, 14 and 20 interventions were effective in improving SBP, DBP or either, respectively. 13 out of 20 effective interventions incorporated all the 3 major components of yoga, namely, asana, pranayama, and dhyana and relaxation practices and allocated similar durations to each component. These interventions involved regular practice and higher commitment of participants to the intervention protocol. The most common duration and frequency of effective yoga interventions were 45

min/session (in 5 interventions), 7 days/week (in 5 interventions) and 12 weeks (in 11 interventions). Fifteen were centre-based, 8 were both centre- and home-based and 16 were supervised.

Yoga has been promoted as an aerobic form of exercise,[1] and many of the studies had an emphasis on asana, however, this systematic review suggests that to be beneficial for hypertension yoga should include a balance of the three major components. One of the previous systematic reviews also showed that yoga interventions were more effective when they incorporated the three major components of yoga[77] but it is not possible to make a direct comparison as this review did not consider the time allocated to each component. A recent hypertension guideline suggests that moderate-intensity exercise should be practised 5-7 days a week and stress reduction strategies like meditation should be introduced to the daily routine.[1] This supports our finding that effective yoga interventions included regular practice. Another systematic review also found that DBP reductions were larger when yoga was practised more than 3 sessions per week.[168]

Adherence of the participants to the interventions is one of the most important points that affect the effectiveness of an intervention. To achieve high adherence, it is suggested that complex interventions, e.g., yoga, should combine counselling, self-monitoring, reinforcements, and supervision.[1] The methods used to increase intervention uptake and adherence to effective interventions were synthesised. Although many of the effective studies included in this review kept attendance register and self-report of home-

practice, they generally did not report the adherence rate. The guidance provided by the yoga instructors, and characteristics of the yoga instructors such as their training on the intervention protocol are critical for the effectiveness of the intervention and to ensure intervention fidelity and safe practice.[209, 210] Many of the effective interventions included in this review reported if the intervention was supervised and if the instructors were trained in yoga but they mostly did not report if the instructors were trained in the intervention protocol. None of the previous systematic reviews synthesised the strategies used to increase intervention uptake and adherence, adherence rate, and yoga instructor characteristics.

2.11.1 Methodological quality of the studies

Inadequate reporting was found in the included studies in terms of yoga intervention details, study design, and adverse events. Some important aspects of yoga interventions such as the characteristics of yoga providers, the existence of home practice, and attendance and adherence of participants to yoga sessions and home practice were not reported in 32%, 59%, and 48% of the included studies, respectively. In addition, the intervention development method and the details of the settings where yoga interventions were delivered were not adequately reported. The majority of the studies had low methodological quality with small sample sizes and short follow-ups. The low methodological quality was due to either inadequate reporting or issues in the design of the studies.

As there was no sham or blinded comparison group in the majority of RCTs, the chances of performance bias (of participants) were high. It should be noted that yoga in the West is often considered as a standalone physical activity type of practice, however, traditionally and in many South Asian nations yoga incorporates a healthy lifestyle such as a healthy diet, physical activity, smoking cessation, and restriction on alcohol intake.[83, 211] Thus, yoga can be considered a complex intervention, and participants in the yoga study arm might have been motivated to pursue a healthy lifestyle which is conducive to lowering blood pressure.

Future studies should ensure rigorous methodology, i.e., a larger sample size, longer follow-up, and ITT analysis, and reporting should be improved.[210] In addition, although blinding of intervention deliverers is not possible in yoga interventions, blinding of participants can be achieved through sham therapies. Adverse events were also not explicitly reported in most of the studies, which are important to indicate the safety of yoga interventions. These issues should be addressed, and reporting should be improved in future RCTs.

2.11.2 Implications of the findings

The outcomes of this systematic review carry important implications for practice and research. The potential effectiveness of yoga in managing hypertension highlights its value as a complement to conventional approaches. The emphasis on a balanced integration of asana, pranayama, and dhyana and relaxation practices underscores the significance of adopting a holistic perspective. While acknowledging these positive findings, the review prompts

a critical exploration into the feasibility and acceptability of the synthesised yoga intervention characteristics across varied cultural contexts. Therefore, to carry the work done in this review to the next stage, with inspiration from the findings of this systematic review and meta-analysis, a funding application has been submitted to NIHR to develop a yoga intervention that is likely to lead to maximum benefits for people with high blood pressure and to explore the acceptability and accessibility to people with different physical abilities in the UK.

2.11.3 Recommendations for future research and practice

Despite the low quality and heterogeneity of included studies, our findings suggest yoga interventions may effectively manage hypertension, and provide an indication of the content, structure, and delivery characteristics, which may be most beneficial for managing hypertension. However, most of the included studies have not reported the intervention development process and it is hard to know whether these interventions were carefully thought out (e.g., their safety and acceptability) and comprehensive in their development. In addition, some intervention details were inadequately described (e.g., adherence and home practice), and it is difficult to replicate successful interventions. Thus, future studies should aim to systematically develop a yoga program for hypertension management in consultation with experts (e.g., yoga, hypertension) by using the synthesised findings of the effective interventions in this review. Then, they should aim to evaluate the intervention and implement it, if found effective. In addition, this review, showing that there are

some narrative differences between effective interventions and interventions that were not found to be effective, paved the way for future research. The next potential step can be to do a meta-analysis, using the methods developed for evaluating the effects of individual components in complex interventions,[212] to predict what intervention variables are associated with reductions in blood pressure as well as to address the questions of what works for whom and in what circumstances.[213]

2.11.4 Strengths and weaknesses

This is the first systematic review to synthesise the content, structure, and delivery characteristics of effective yoga interventions used for managing hypertension and to compare these between effective and interventions that were not found to be effective. This systematic review was conducted following a robust systematic process and using the JBI and the PRISMA guidelines by trained JBI-accredited systematic reviewers. Everything was done by two reviewers independently with the involvement of a third reviewer in case of any disagreements. Sixteen databases were searched with no date or language restrictions. Secondary hypertension and gestational hypertension were outside the scope of this review.

Only studies that explicitly defined the used intervention as yoga were included in this review and this might cause missing some studies that might be potentially relevant. This systematic review tended to concentrate on the characteristics of effective yoga interventions and the effectiveness of the interventions was decided based on the statistical significance. This has a

potential limitation due to the heterogeneity of the yoga interventions in terms of content, structure, and delivery characteristics and the inclusion of a lot of small studies in this review, which did not have enough power to achieve statistical significance. However, doing a meta-analysis was the best possible way to decide effectiveness because although studies had a comparator group, many of them compared pre-and post-test data within the group, and did not compare between intervention and control groups.

2.12 Conclusion

Despite the low quality and heterogeneity of included studies, our findings suggest yoga interventions may effectively manage hypertension. The differences between the effective and interventions that were not found to be effective suggest that effective yoga interventions mostly incorporated asana, pranayama, and dhyana and relaxation practices and they had a balance between these three components and included regular practice. They were mostly delivered in a centre and under supervision. Despite these promising findings, it is not clear if similar results can be achieved in the UK due to the lack of knowledge about yoga practices there. Therefore, it is essential to investigate if the current yoga provisions in the UK match the beneficial aspects identified in this review.

CHAPTER 3: Characteristics of yoga providers and their sessions and attendees in the UK: a cross-sectional survey

3.1 Abstract

Background and aim: Yoga is an ancient Indian philosophy and way of life that is being used as a method of improving health and well-being. Evidence shows that yoga has several health benefits, such as managing many non-communicable diseases, such as hypertension, and improving mental health. The popularity of yoga is growing in the UK, but it is mostly unregulated with little information available about yoga providers and their sessions and attendees. This study aimed to explore who is providing yoga; what sessions are available, where, and at what cost; who attends these sessions in the UK and whether yoga providers were aware of health conditions in their sessions.

Methods: A cross-sectional survey was undertaken among yoga providers in the UK. They were approached through four major UK yoga associations.

Results: In total, 407 yoga providers participated. Most providers were aged 45–64 years (69%), female (93%), and white (93%). The median number of group sessions and one-to-one sessions delivered per week was four and two, respectively. The most common styles were Hatha (28%), Iyengar (26%), and Vinyasa (15%). Sessions had a varying emphasis on different yogic practices, but 59% of providers allocated most time to yogic poses (asana), 18% to breathing practices (pranayama), and 12% to meditation (dhyana) and relaxation practices. Most (73%) reported that their attendees disclosed their health conditions to them, most commonly mental health issues (41%), hypertension (25%), and heart diseases (9%).

Conclusion: This study showed that yoga sessions are widely available in the UK, often provided and practised by women, and concentrate on yogic poses. Sessions concentrate on the asana and tend not to include many of the more holistic aspects of yoga that are practised in South Asian countries. Yoga providers are often aware of health conditions but may benefit from training to deliver sessions suitable for specific health conditions.

3.2 Introduction

Yoga, an ancient system of health and way of life, originated in the Indian subcontinent over 5000 years ago.[77] There are different branches of yoga, each with a different emphasis on and approach to practice. Of the six main branches of yoga, Hatha yoga is the most commonly practised style, and it is an overarching term for physically based yoga styles such as Iyengar, Asthanga, and Kundalini.[154, 155] Yoga, as defined by Patanjali (the author of the textbook of Classical yoga), has eight components which are ethical standards (yama), self-discipline (niyama), yogic poses (asana), breathing practices (pranayama), withdrawal of the senses (pratyahara), concentration (dharana), meditation (dhyana), and transcendence (samadhi).[83, 157]

Yoga helps discipline the body and mind through low- to moderate-intensity physical activities, breathing practices, meditation and relaxation practices, and a healthy lifestyle.[214] It requires no or very little equipment and can be practised indoors and outdoors.[214] It is usually safe, even in individuals with comorbidities.[141, 214, 215] There is growing evidence to support the use of yoga as a method of improving health and well-being. Numerous systematic reviews have shown that yoga appears to improve a range of health conditions including hypertension, mental health issues, heart diseases, musculoskeletal conditions, respiratory diseases, diabetes, obesity, and stroke.[89, 108, 216-218] In addition, yoga significantly reduced SBP and DBP compared to a control intervention (MD −6.49 and −2.78; 95% CI −8.94 to −4.04 and −4.11 to −1.45, respectively) (see Chapter 2).

Yoga has a high acceptance rate in South Asian countries such as India and Nepal and it is widely practised in these countries.[219, 220] The Ministry of Ayush in India is dedicated exclusively towards traditional therapies including yoga, and yoga is part of the Indian health care system.[221] In terms of yoga education, there are bachelor's degree, which is a recognised medical course in India,[222] and postgraduate taught and research degrees.[223] Higher education and practice is not currently regulated in India as it should have been but there are some initiatives to regulate these. The Indian government initiated the Scheme for Voluntary Certification of Yoga Professionals, which is monitored by the Ministry of Ayush[224, 225] and is creating a regulatory body for higher education and practice.[226, 227] Similarly, Nepal has also established yoga as a health promotional tool for noncommunicable disease prevention and control.[228] Yoga is also popular in other parts of the world including several high-income countries such as Australia, Germany, and the US.[133, 143, 229, 230]

Yoga is also growing in popularity in the UK.[139, 231] A representative study of 1,106 people in the UK found around 10% of participants practised yoga and around 13% of participants practised meditation.[139] In the UK, there are approximately 10,000 yoga teachers [143] and a further 150 yoga therapists, that is, yoga teachers with additional training and experience in therapeutic adaptation and application of yoga to those with health issues [142] and they do not have to be recognised health professionals in the UK. The UK's NHS suggests yoga as a safe and beneficial practice for people with a variety of health conditions,[141] and NHS provides yoga sessions for the staff in some places.[146,

[232, 233] Despite the popularity of yoga and its potential health benefits, yoga does not feature as a health and well-being approach for patients within the NHS.[232] Although there are yoga associations in the UK providing guidance and setting requirements for their members, registration with these organizations is entirely voluntary. Yoga is unregulated in the UK and there is little data about yoga practice.[234] If yoga is to be recommended for those with health conditions in the UK, it is important to understand what is being provided and by whom, who attends yoga sessions, how accessible it is across the country and whether yoga providers know anything about the health conditions of their attendees.

3.2 Aims

This study aimed to find out who is providing yoga, what types of yoga sessions are available, where, at what cost and who attends these sessions, and whether yoga providers were aware of health conditions in their sessions.

3.3 Methods

3.3.1 Study design

A research paradigm is defined as views that guide a researcher's thinking, beliefs, and assumptions about society and themselves, and it frames how they view the world around them.[235] This framework acts as a guide for researchers as they explore questions and challenges in their field, including the selection of research methods and data analysis techniques to be used.[235] Positivism and constructivism are the two of the main paradigms.[236] Positivism is based on the belief that reality is objective and objective knowledge can be produced

through rigorous methods by examining empirical evidence and hypothesis testing.[236] On the other hand, constructive paradigm accepts that reality is socially constructed and ultimately subjective.[237] Therefore, researchers need to understand the complex world of experiences from the perspective of those who live it.[238] These paradigms do not fall into a hierarchical order, with one being superior to another. It is rather that each paradigm is appropriate for answering different types of research questions. Considering that the knowledge about the availability, cost and setting of yoga sessions and characteristics of yoga providers and their attendees exist independent of people's perceptions of these, the positivist paradigm which can produce useful knowledge to be generalised fits better with the aims of this study.

The positivist paradigm lends itself to the use of quantitative methodology. Descriptive (non-experimental), quasi-experimental and experimental research are the quantitative research designs.[239] An experimental design allows the researcher to quantify the effect of an intervention while a quasi-experimental design mimics an experiment, but in which the researcher has no control over who receives the intervention and who does not.[239] Descriptive studies on the other hand do not manipulate any of the variables but instead only describe the characteristics of a population, identify problems or look at variations within a unit, an organization, or a population.[240] Since this study aimed to describe the characteristics of yoga providers and their sessions and attendees in the UK, a descriptive research design was selected.

There are five descriptive research methods: case study, case series, case-control study, cross-sectional study and longitudinal (cohort) study.[239] A cross-sectional study provides a snapshot of phenomena at a particular moment in time, enabling the measurement of health outcome prevalence, understanding of health determinants, and description of a population characteristic.[241] Cross-sectional study fits well with the aims of the study because, as stated in the paragraph above, this study aimed to describe the characteristics of yoga providers and their sessions and attendees in the UK.

A cross-sectional study can be conducted face-to-face, postal, over the phone or online.[242] Conducting an online survey enables the researcher to access a larger population in a short time and to implement the study at a much lower cost than the other two survey methods.[242] In addition, it facilitates data analysis processes by allowing to export of data into statistical software packages such as STATA and easy visualisation of the data by generating tables.[243] Therefore, this study was conducted using positivism as the underlying paradigm, descriptive research as the study design and online cross-sectional study as the research method. A web-based, anonymous, self-completion survey was designed using Jics Online Surveys, formerly known as Bristol Online Surveys software.[244] Jisc Online Surveys software was chosen as it is more suitable for academic studies and ensures compliance with the General Data Protection Regulation.[245]

3.3.2 Study participants and eligibility criteria

Yoga providers (i.e., teachers and therapists) were eligible if they were at least 18 years old and delivered a yoga session at least once a fortnight during the last six months in the UK prior to the survey date.

3.3.3 Data collection tool

A web-based survey questionnaire was developed by the researcher (GN) under supervision (KC and SL) as part of this PhD thesis and piloted among yoga providers (three yoga teachers and one yoga therapist) (Appendix 3). The questionnaire was administered through Jisc Online Surveys.[244] The questionnaire included 32 questions and collected data on; (i) the sociodemographic characteristics of yoga providers and their yoga training; (ii) the delivery of yoga sessions; (iii) the styles of yoga taught and the components practised in a yoga session and (iv) the awareness of yoga providers of health conditions including hypertension, diabetes, obesity, heart diseases, stroke, chronic kidney disease, respiratory diseases, and mental issues. As this survey was conducted as part of a PhD looking at yoga for hypertension, a specific question on whether yoga providers had received training on hypertension and if they required further training was also asked.

3.3.4 Recruitment and study period

Yoga providers were approached through professional yoga associations in the UK. Five yoga associations were approached to circulate the survey among their members, and four agreed, namely, Association for Iyengar Yoga in the UK and Republic of Ireland, British Wheel of Yoga (BWY), Complementary and Natural

Health Council (CNHC), and Independent Yoga Network. They either emailed their members an invitation letter with the survey link or posted the study details on their website and Facebook page. Data collection took place from March 3 to Sept 3, 2020.

3.3.5 Sample size

The required sample size was estimated on the basis of the accuracy of estimates of proportions, for example of the proportion delivering a certain style of yoga. A sample size of 384 was sufficient to estimate proportions to within 5% error using a 95% confidence interval. A larger sample was approached presuming that not all would respond.

3.3.6 Ethics approval

Ethics approval was obtained from the Faculty of Medicine and Health Sciences Research Ethics Committee, the University of Nottingham, UK (Ref No. 467-2001) (Appendix 4). The participant information sheet was provided at the beginning of the study and those interested gave written informed consent. Participation in this study was entirely voluntary. Participants were entered into a prize draw of £100 if they provided their email addresses. Participation in the prize draw was entirely voluntary and confidentiality was protected in accordance with regulatory requirements. Email data were not downloaded, and participants were not identifiable in any process.

3.3.7 Data analysis

Mean and SD were calculated for normally distributed continuous variables, median and interquartile range (IQR) for skewed continuous variables, and

number and percentage for categorical variables. Responses of yoga teachers and therapists were compared descriptively using the Wilcoxon Rank Sum test for continuous variables and the Chi-squared test for categorical variables. If more than 20% of cells had a value <5, Fisher Exact test was preferred over the Chi-squared test. Data were analysed using Stata16 (StataCorp, Texas, USA) [246]. ArcMap 10.4.1 was used to map out the distribution of yoga sessions in the UK.[247] Regions of the UK were based on the Office for National Statistics (ONS) 2017 data and were divided into 12 regions: Wales, Scotland, Northern Ireland, North East, North West, Yorkshire, and the Humber, East Midlands, West Midlands, East, London, South East, and South West.[248] Missing data were reported for all variables but were not included in the analysis. The level of statistical significance was set at $p \leq 0.05$.

3.4 Results

3.4.1 Socio-demographic characteristics of participants

The socio-demographic characteristics of participants are presented in Table 5. A total of 407 yoga providers (i.e., 340 yoga teachers and 67 yoga therapists) from all the regions of the UK completed the survey (Figure 19). They were mostly aged 45-64 years (69%), female (93%), and white (93%). They were mostly self-employed (82%) and had a diploma degree in yoga (46%). Only around 8% of them stated that they were a member of a regulated healthcare profession. Yoga therapists tended to have a higher rate of yoga educational level than yoga teachers ($p<0.001$). In addition, they had a significantly higher

rate of self-employment (p=0.01) and longer years of delivering yoga sessions (p<0.001) compared to yoga teachers.

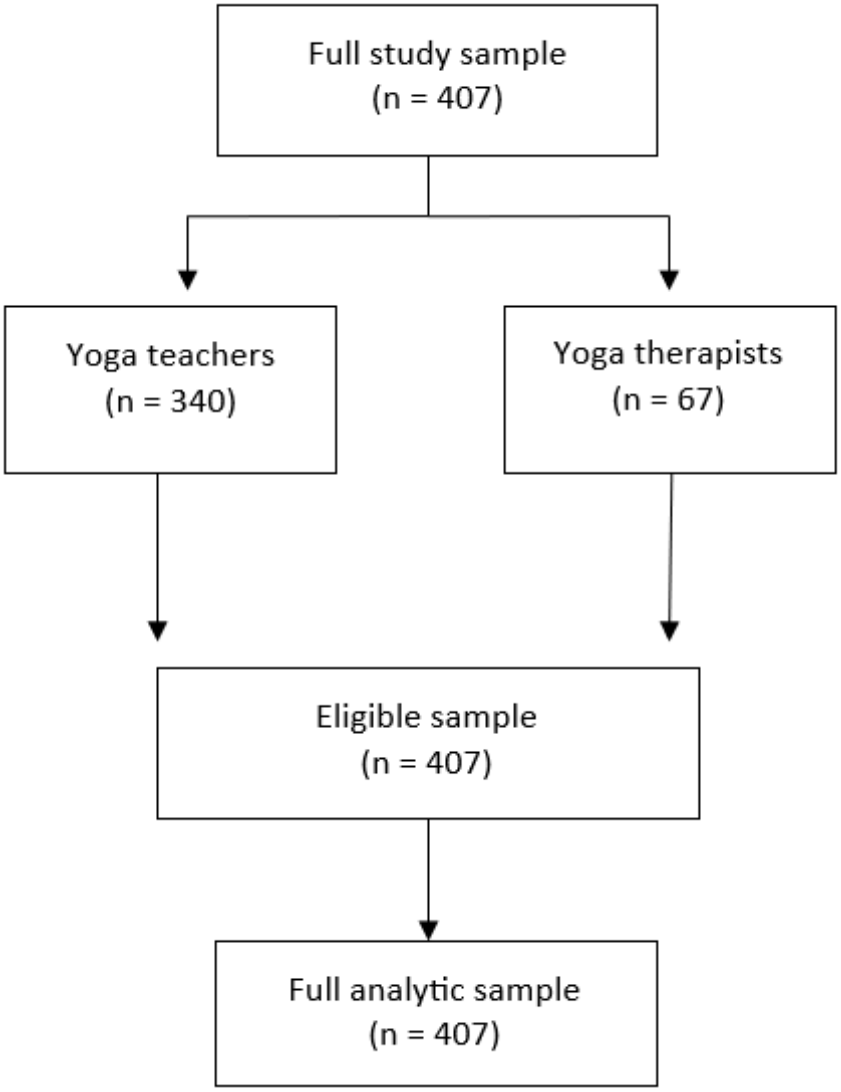

Figure 22 Quantitative study participant flowchart

Table 7 Socio-demographic characteristics of the yoga providers

	All	Yoga Teacher	Yoga Therapist	
	N (%)	N (%)	N (%)	p
Gender				
Female	379 (93.12)	313 (93.43)	62 (92.54)	0.19
Male	23 (5.65)	19 (5.67)	3 (4.48)	
Other	1 (0.25)	1 (0.30)	0	
Prefer not to say	3 (0.74)	1 (0.30)	2 (2.99)	
Missing	1 (0.25)	1 (0.30)	0	
Age (years)				
18-24	0	0	0	0.12
25-44	60 (14.74)	51 (15.22)	7 (10.45)	
45-64	280 (68.80)	231 (68.96)	46 (68.66)	
65+	64 (15.72)	52 (15.52)	12 (17.91)	
Prefer not to say	3 (0.74)	1 (0.30)	2 (2.99)	
Ethnic group				
White	378 (92.87)	314 (93.73)	59 (88.06)	0.29
Asian/Asian British	6 (1.47)	4 (1.19)	2 (2.99)	
Black/African/Caribbean/Black	1 (0.25)	1 (0.30)	0	
British	8 (1.97)	6 (1.79)	2 (2.99)	
Mixed/Multiple ethnic groups	6 (1.47)	5 (1.49)	1 (1.49)	
Other	8 (1.97)	5 (1.49)	3 (4.48)	
Prefer not to say				
Yoga education level				
Certificate	121 (29.73)	106 (31.74)	12 (28.36)	<0.001
Diploma	199 (48.89)	172 (51.50)	26 (38.81)	
Bachelor	18 (4.42)	14 (4.19)	4 (5.97)	
Higher education	52 (12.78)	32 (9.58)	19 (28.36)	
Other	16 (3.93)	10 (2.99)	6 (8.96)	
Missing	1 (0.25)	1 (0.29)	0	
Yoga associations*				
British Wheel of Yoga	252 (54.90)	211 (57.49)	39 (44.82)	0.45
Iyengar Yoga UK	108 (23.52)	86 (23.43)	20 (22.98)	0.47
Independent Yoga Network	27 (5.88)	23 (6.26)	4 (4.59)	0.78

Yoga Alliance Professionals	20 (4.35)	16 (4.35)	4 (4.59)	0.75
Yoga Alliance Internationals	15 (3.26)	10 (2.72)	5 (5.74)	0.07
Other	31 (6.75)	16 (4.35)	14 (16.09)	<0.001
Missing	6 (1.30)	5 (1.36)	1 (1.14)	
Current yoga teaching role*				
Self-employed	369 (82.00)	299 (81.47)	66 (84.62)	0.01
Employed (public sector)	44 (9.77)	36 (9.80)	8 (10.26)	1.00
Employed (private sector)	19 (4.22)	15 (4.08)	3 (3.85)	0.78
Other	17 (3.77)	16 (4.35)	1 (1.28)	0.32
Missing	1 (0.22)	1 (0.27)	0	
A member of the statutorily regulated healthcare profession				
Yes	32 (7.86)	28 (8.36)	4 (5.97)	0.90
No	373 (91.65)	305 (91.04)	63 (94.03)	
Missing	2 (0.49)	2 (0.60)	0	
Teaching experience (in years)				
Median	10	10	15	<0.001
Min.	0.5	0.5	2	
Max.	50	50	50	

*Participants were allowed to choose more than one response.

3.4.2 Structure, delivery, and cost of yoga sessions

Yoga sessions were available as group and one-to-one sessions though the majority of participants (95%) delivered group sessions (Table 8). The delivery of one-to-one sessions was more common among yoga therapists (66%) than yoga teachers (24%) ($p<0.001$). The median number of group sessions and one-to-one sessions delivered per week was four (IQR= 2,6) and two (IQR= 1,3), respectively and the group size was 10 (IQR= 8,15). Yoga therapists delivered more group and one-to-one sessions than yoga teachers in a week and interestingly, the number of attendees in a group session was higher for yoga therapists ($p=0.01$). Eighty per cent of participants were providing evening sessions. Many also delivered sessions at the weekend (25%) though weekend sessions were more common for yoga therapists (40%) than yoga teachers (22%).

Sessions were available in all the ONS regions of the UK although South West (14%), South East (13%) and London (13%) were the most common regions among respondents (Table 6 and Figure 18). Sessions were available in private, public, and public and private partnership settings but were mostly delivered in private settings (60%). The median cost per group session was £7 and per one-to-one session was £40. the cost for group sessions was higher by a median of £3 and for one-to-one groups was a median of £5 higher in the sessions delivered by yoga therapists. The cost of the sessions was mostly paid out-of-pocket by attendees (82%) and a very small fraction was public-funded (6%).

The majority of the participants (63%) reported that 75-100% of the attendees in a session were female.

Table 8 Structure, delivery, and cost of yoga sessions

	All N (%)	Yoga Teacher N (%)	Yoga Therapist N (%)	p
Delivery of group yoga sessions				
Yes	387 (95.09)	319 (95.22)	63 (94.03)	1.00
No	19 (4.67)	16 (4.78)	(4.48)	
Missing	1 (0.25)	0	1 (1.49)	
Delivery of one-to-one yoga sessions				
Yes	127 (31.20)	82 (24.48)	44 (65.67)	<0.001
No	277 (68.06)	250 (74.63)	23 (34.33)	
Missing	3 (0.74)	3 (0.90)	0	
Evening yoga sessions				
Yes	326 (80.10)	267 (79.70)	55 (82.09)	0.55
No	78 (19.16)	66 (19.70)	11 (16.42)	
Missing	3 (0.74)	2 (0.60)	1 (1.49)	
Weekend yoga sessions				
Yes	104 (25.55)	73 (21.79)	27 (40.30)	<0.001
No	300 (73.71)	260 (77.61)	39 (58.21)	
Missing	3 (0.74)	2 (0.60)	1 (1.49)	
Proportion of female attendees				
0-25%	2 (0.49)	2 (0.60)	0	0.16
25-50%	11 (2.70)	10 (2.99)	1 (1.49)	
50-75%	133 (32.68)	103 (30.75)	30 (44.78)	
75-100%	257 (63.14)	216 (64.48)	36 (53.73)	
Missing	4 (0.98)	4 (1.19)	0	
Payment method of yoga sessions*				
Out-of-pocket payment by yoga attendees	381 (81.75)	312 (81.03)	65 (85.52)	0.22
Public funded (e.g., NHS)	28 (6.00)	22 (5.71)	5 (6.57)	0.78
Private insurance	0	0	0	
Other (e.g., charity-funded)	52 (11.15)	47 (12.20)	5 (6.57)	0.14
Missing	5 (1.07)	4 (1.03)	1 (1.31)	
Setting of yoga sessions*				
In private (non-government) settings	321 (60)	257 (58.54)	59 (67.04)	0.03
In public (government) settings	71 (13.27)	61 (13.89)	8 (9.09)	0.21
In public and private partnership settings	97 (18.13)	82 (18.67)	15 (17.04)	0.72
Other (e.g., online, outdoors)	40 (7.47)	34 (7.74)	5 (5.68)	0.50
Missing	6 (1.12)	5 (1.13)	1 (1.13)	
Regions				

Wales	6 (1.47)	3 (0.90)	3 (4.48)	0.06
Scotland	28 (6.87)	23 (6.87)	5 (7.46)	0.88
Northern Ireland	6 (0.98)	4 (1.19)	0	1.00
North East	11 (2.70)	10 (2.99)	1 (1.49)	0.48
North West	48 (11.79)	42 (12.54)	6 (8.96)	0.38
Yorkshire and the Humber	39 (9.58)	35 (10.45)	4 (5.97)	0.36
East Midlands	39 (9.58)	33 (9.85)	6 (8.96)	0.79
West Midlands	20 (4.91)	19 (5.67)	1 (1.49)	0.22
East	36 (8.84)	26 (7.76)	10 (14.93)	0.06
London	53 (13.02)	35 (10.45)	18 (26.87)	<0.001
South East	54 (13.26)	45 (13.43)	9 (13.43)	0.96
South West	55 (13.51)	48 (14.33)	7 (10.45)	0.37
Missing	17 (4.17)	15 (4.48)	2 (2.95)	
	Median (IQR)	Median (IQR)	Median (IQR)	p
Number of group yoga sessions per week	4 (2,6)	3 (2,6)	6 (3,8)	<0.001
Number of attendees in a group yoga session	10 (8,15)	10 (8, 15)	12 (9, 15)	0.01
Duration of a group yoga session (min)	90 (67.5,90)	90 (67.5,90)	90 (65,90)	0.56
Cost of a group yoga session (£)	7 (6,8.75)	7 (6, 8)	8 (6, 10)	<0.001
Number of one-to-one yoga sessions per week	2 (1,3)	2 (1,3)	3 (2,4)	<0.001
Duration of a one-to-one yoga session (min)	60 (60,75)	60 (60,75)	60 (60,75)	0.27
Cost of a one-to-one yoga session (£)	40 (30,50)	35 (30,45)	40 (30,50)	<0.001

*Participants were allowed to choose more than one response.

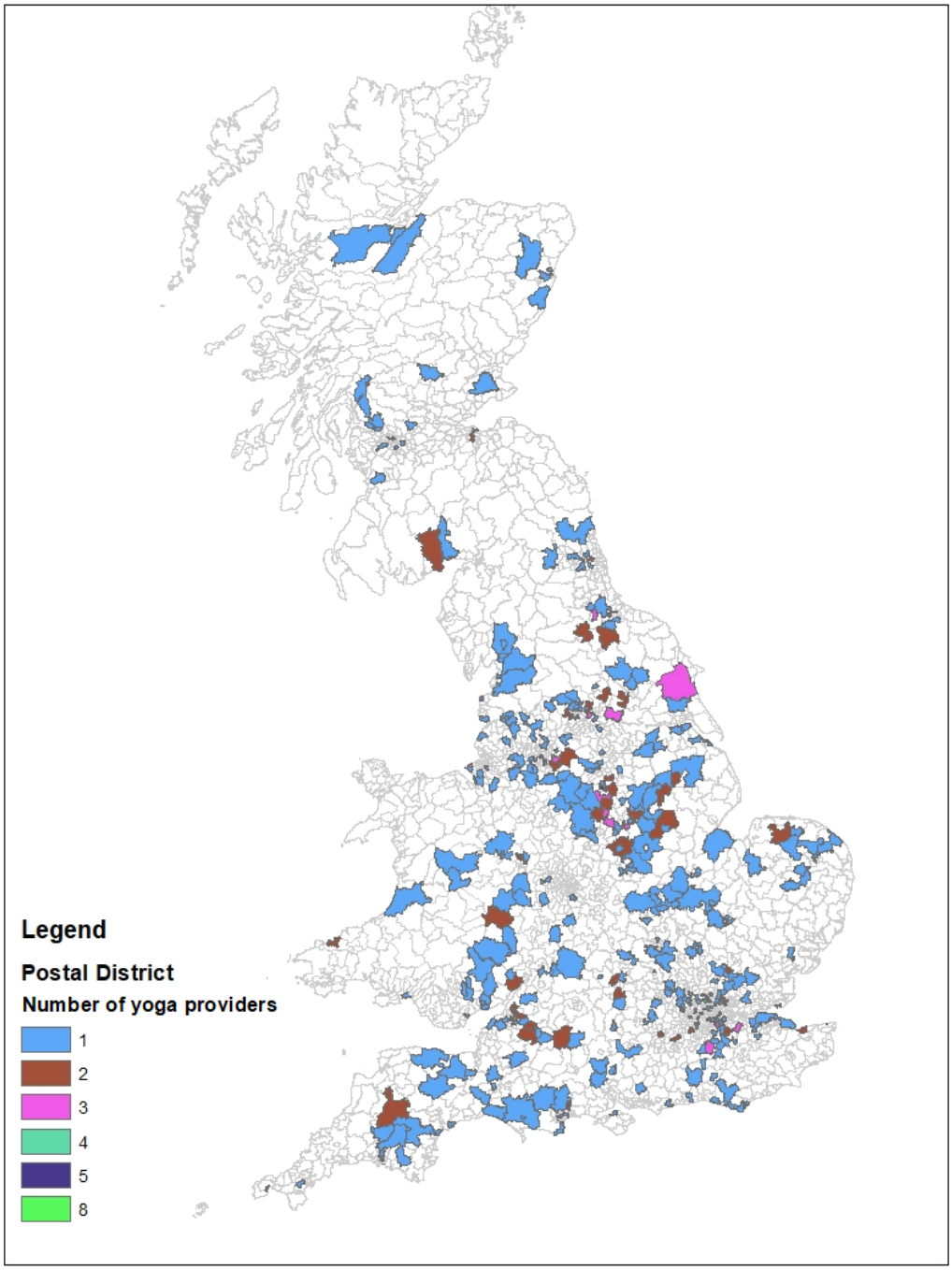

Figure 23 Distribution of yoga providers who responded to the survey by districts

3.4.3 Style and content of yoga sessions

Participants reported using different styles of yoga, but the most common styles reported were Hatha (28%), Iyengar (26%), and Vinyasa (15%) yoga (Table 3). Hatha yoga was more common among yoga teachers (30%) and Iyengar yoga was more common among yoga therapists (28%). There was a statistically significant higher number of yoga teachers offering Hatha yoga compared to yoga therapists ($p<0.001$), and the number of yoga therapists providing Viniyoga was also statistically significantly higher than that of yoga teachers ($p<0.001$). Over half of the participants (68%) used only one style of yoga in their sessions. Sessions had a varying emphasis on different yogic practices, but 59% of providers allocated most time to asana, 18% to pranayama, and 12% to dhyana and relaxation practices. Yoga therapists gave a slightly higher emphasis on the other yoga components (pranayama, dharana, pratyahara, niyama, yama and samadhi, respectively) which seems to understate the statistical differences identified. Missing data were high for the questions of frequency of yama, niyama, pratyahara, dharana and samadhi.

Table 9 Style and content of yoga sessions

	All N (%)	Yoga Teacher N (%)	Yoga Therapist N (%)	p
Style of yoga*				
Iyengar	162 (26.04)	131 (25.63)	29 (27.88)	0.54
Asthanga	32 (5.14)	24 (4.69)	7 (6.73)	0.36
Vinyasa	91 (14.63)	78 (15.26)	12 (11.54)	0.32
Bikram	2 (0.32)	1 (0.19)	1 (0.96)	0.30
Kundalini	9 (1.44)	8 (1.56)	1 (0.96)	1.00
Yin	58 (9.32)	46 (9.00)	11 (10.58)	0.57
Viniyoga	37 (5.94)	24 (4.69)	13 (12.50)	<0.001
Hatha	172 (27.65)	152 (29.73)	18 (17.30)	<0.001
Other	56 (9.00)	44 (8.60)	12 (11.53)	
Missing	3 (0.48)	3 (0.58)	0	
Number of yoga styles used				
1 style	277 (68.06)	228 (68.06)	45 (67.16)	0.96
2 styles	68 (16.71)	56 (16.72)	12 (17.91)	
3 or more styles	59 (13.95)	48 (14.32)	10 (14.93)	
Missing	3 (0.74)	3 (0.90)	0	
Yama (rules of moral code)**				
0-25% (i.e., none or little emphasis)	178 (43.73)	157 (46.87)	20 (29.85)	0.01
25-50% (i.e., some emphasis)	134 (32.92)	104 (31.04)	27 (40.30)	
50-75% (i.e., a good deal of emphasis)	26 (6.39)	18 (5.37)	8 (11.94)	
75-100% (i.e., a great deal of emphasis)	19 (4.67)	12 (3.58)	6 (8.96)	
Missing	50 (12.29)	44 (13.13)	6 (8.96)	
Niyama (rules of personal behaviour)**				
0-25% (i.e., none or little emphasis)	171 (42.01)	150 (44.78)	20 (29.85)	<0.001
25-50% (i.e., some emphasis)	144 (35.38)	116 (34.63)	25 (37.31)	
50-75% (i.e., a good deal of emphasis)	28 (6.88)	19 (5.67)	8 (11.94)	
75-100% (i.e., a great deal of emphasis)	17 (4.18)	10 (2.99)	7 (10.45)	
Missing	47 (11.55)	40 (11.94)	7 (10.45)	
Asana (yogic poses)**				
0-25% (i.e., none or little emphasis)	4 (0.98)	3 (0.90)	1 (1.49)	0.07
25-50% (i.e., some emphasis)	15 (3.69)	10 (2.99)	5 (33.33)	
50-75% (i.e., a good deal of emphasis)	140 (34.40)	110 (32.84)	28 (41.79)	
75-100% (i.e., a great deal of emphasis)	242 (59.46)	206 (61.49)	33 (49.25)	
Missing	6 (1.47)	6 (1.79)	0	
Pranayama (breathing practices)**				
0-25% (i.e., none or little emphasis)	60 (14.74)	51 (15.22)	9 (13.43)	0.03
25-50% (i.e., some emphasis)	154 (37.84)	134 (40.00)	16 (23.88)	
50-75% (i.e., a good deal of emphasis)	116 (28.50)	90 (26.87)	26 (38.81)	
75-100% (i.e., a great deal of emphasis)	72 (17.69)	55 (16.42)	16 (23.88)	
Missing	5 (1.23)	5 (1.49)	0	

Pratyahara (withdrawal of senses)**				
0-25% (i.e., none or little emphasis)	150 (36.86)	135 (40.30)	14 (20.90)	<0.001
25-50% (i.e., some emphasis)	119 (29.24)	97 (28.96)	19 (28.36)	
50-75% (i.e., a good deal of emphasis)	55 (13.51)	42 (12.54)	13 (19.40)	
75-100% (i.e., a great deal of emphasis)	21 (5.16)	9 (2.69)	11 (16.42)	
Missing	62 (15.23)	52 (15.52)	10 (14.93)	
Dharana (concentration)**				
0-25% (i.e., none or little emphasis)	108 (26.54)	92 (27.46)	15 (22.39)	<0.001
25-50% (i.e., some emphasis)	129 (31.70)	108 (32.24)	19 (28.36)	
50-75% (i.e., a good deal of emphasis)	81 (19.90)	68 (20.30)	12 (17.91)	
75-100% (i.e., a great deal of emphasis)	39 (9.58)	23 (6.87)	15 (22.39)	
Missing	50 (12.29)	44 (13.13)	6 (8.96)	
Dhyana (meditation) and relaxation practices**				
0-25% (i.e., none or little emphasis)	80 (19.66)	68 (20.30)	11 (16.42)	0.28
25-50% (i.e., some emphasis)	159 (39.07)	132 (39.40)	24 (35.82)	
50-75% (i.e., a good deal of emphasis)	92 (22.62)	74 (22.09)	17 (25.37)	
75-100% (i.e., a great deal of emphasis)	50 (12.29)	37 (11.04)	13 (19.40)	
Missing	26 (6.39)	24 (7.16)	2 (2.99)	
Samadhi (transcendence)**				
0-25% (i.e., none or little emphasis)	260 (63.88)	219 (65.37)	38 (56.72)	<0.001
25-50% (i.e., some emphasis)	36 (8.85)	27 (8.06)	7 (10.45)	
50-75% (i.e., a good deal of emphasis)	15 (3.69)	7 (2.09)	8 (11.94)	
75-100% (i.e., a great deal of emphasis)	4 (0.98)	2 (0.60)	2 (2.99)	
Missing	92 (22.60)	80 (23.88)	12 (17.91)	

*Participants were allowed to choose more than one response.

**Participants were told that some of these may not feature at all in yoga sessions (e.g., Samadhi) and may be covered throughout the session (e.g., pranayama) so the total does not need to add up to 100%.

3.4.4 Yoga providers' awareness of health conditions

The majority of participants (73%) reported that attendees disclosed their health conditions (Table 4). They reported that the most frequently disclosed health condition was mental health issues (41%) and it was followed by hypertension (25%) and heart diseases (9%). When specifically about training on hypertension was asked, 87% said they had received training but 186 yoga providers, almost half of the participants, said they needed further training to deal with it and to provide a safer yoga practice. Interestingly, no significant differences were found between yoga teachers and therapists in terms of the awareness of health conditions except for respiratory diseases and the perceived need for further training.

Table 10 Yoga providers' awareness of health conditions and their training on hypertension

	All	Yoga Teacher	Yoga Therapist	
	N (%)	N (%)	N (%)	P
Disclosure of health conditions by yoga attendees				
Never	4 (0.98)	4 (1.19)	0	0.40
Rarely/Sometimes	101 (24.82)	86 (25.67)	13 (19.40)	
Often	299 (73.46)	242 (72.24)	54 (80.60)	
Missing	3 (0.74)	3 (0.90)	0	
Disclosure of hypertension/high blood pressure by yoga attendees				
Never	34 (8.35)	28 (8.36)	5 (7.46)	0.14
Rarely/Sometimes	242 (59.46)	205 (61.20)	35 (51.24)	
Often	103 (25.31)	78 (23.28)	24 (35.82)	
Missing	28 (6.88)	24 (7.16)	3 (4.48)	
Disclosure of diabetes by yoga attendees				
Never	99 (24.32)	86 (25.67)	12 (17.91)	0.11
Rarely/Sometimes	230 (56.51)	183 (54.63)	43 (64.18)	
Often	24 (5.90)	17 (5.07)	7 (10.45)	
Missing	54 (13.27)	49 (14.63)	5 (7.46)	
Disclosure of obesity by yoga attendees				
Never	156 (38.33)	133 (39.70)	22 (32.84)	0.29
Rarely/Sometimes	164 (40.29)	128 (38.21)	33 (49.25)	
Often	17 (4.18)	14 (4.18)	2 (2.98)	
Missing	70 (17.20)	60 (17.91)	10 (14.93)	
Disclosure of heart diseases (e.g., coronary heart disease, angina, history of myocardial infarction, etc.) by yoga attendees				
Never	91 (22.36)	81 (24.18)	9 (13.43)	0.06
Rarely/Sometimes	232 (57.00)	188 (56.12)	40 (59.70)	
Often	38 (9.34)	28 (8.36)	10 (14.93)	
Missing	46 (11.30)	38 (11.34)	8 (11.94)	
Disclosure of stroke by yoga attendees				
Never	205 (50.37)	174 (51.94)	28 (41.79)	0.12
Rarely/Sometimes	126 (30.96)	97 (28.95)	27 (40.30)	
Often	11 (2.70)	8 (2.39)	3 (4.48)	
Missing	65 (15.97)	56 (16.72)	9 (13.43)	
Disclosure of chronic kidney disease by yoga attendees				
Never	254 (62.41)	211 (62.99)	39 (58.21)	0.21
Rarely/Sometimes	82 (20.15)	64 (19.10)	17 (25.37)	
Often	5 (1.23)	3 (0.90)	2 (2.99)	
Missing	66 (16.21)	57 (17.01)	9 (13.43)	
Disclosure of respiratory diseases (e.g., pulmonary hypertension) by yoga attendees				
Never	103 (25.31)	91 (27.16)	11 (16.42)	0.04
Rarely/Sometimes	226 (55.53)	182 (54.33)	40 (59.70)	
Often	27 (6.63)	19 (5.67)	8 (11.94)	

Missing	51 (12.53)	43 (12.84)	8 (11.94)	
Disclosure of mental issues (e.g., depression, stress, anxiety) by yoga attendees				
Never	21 (5.16)	19 (5.67)	2 (2.99)	0.31
Rarely/Sometimes	201 (49.38)	168 (50.15)	31 (46.26)	
Often	166 (40.79)	130 (38.81)	33 (49.25)	
Missing	19 (4.67)	18 (5.37)	1 (1.5)	
Previous training in hypertension				
Yes	356 (87.47)	292 (87.16)	59 (88.06)	0.34
No	47 (11.55)	41 (12.24)	6 (8.96)	
Missing	4 (0.98)	2 (0.60)	2 (2.99)	
Need for further training on hypertension				
Yes	186 (45.70)	157 (46.87)	27 (40.30)	0.30
No	219 (53.81)	176 (52.54)	40 (59.70)	
Missing	2 (0.49)	2 (0.60)	0	

3.5 Discussion

A contemporary description of yoga providers and their practice across the country has been provided; it was found that yoga providers were mostly aged 45-64 years, female and white and yoga was mostly practised by women. The predominance of women in both delivery and practice in the UK is similar to that seen in previous surveys here[138, 234] and other high-income countries,[137, 229, 230] and contrasts with findings from India where practitioners were more likely to be men.[134, 135] The potential reason for the popularity of yoga among men in India might be that the roots of yoga and the growth of yoga as a practice were predominantly in males.[249] However, the findings of this study imply that yoga is perceived to be something more of interest to women than it is to men in the UK and there may be a need to look at why that is the case.

Yoga sessions were available in the evenings and on the weekends, which makes them accessible for those who are not able to attend sessions during day times on weekdays. Because of the wide availability of group yoga sessions and the significant difference between the cost of group and one-to-one sessions, group sessions appear to be more affordable and accessible for a wider range of people than one-to-one sessions.

Different styles of yoga were reported in this study with Hatha and Iyengar being the most commonly delivered styles. Hatha yoga is an overarching term for physically based yoga practices and the high rate of the report of Hatha yoga possibly suggests that Hatha yoga appears to be a common UK parlance used for any type of yoga. Our study found that yoga, as practised in the UK,

concentrates on asana, and to a lesser extent pranayama and dhyana and relaxation practices and this is similar to that seen in other high-income countries such as Australia [250] and Germany.[251] However, this finding suggests that yoga practice in the UK tends not to include many of the more holistic aspects of yoga that are practised in South Asian countries[252] where many of the yoga trials have been conducted. Therefore, it is important to be aware that the practice of yoga varies between contexts in terms of the styles and emphasis given to components.[135]

This study showed that attendees commonly disclosed their health conditions and the high rate of disclosure suggests that yoga providers were generally aware of the health conditions of their attendees. The most commonly disclosed health conditions in yoga sessions were mental health issues and hypertension, both in our study and in studies from the UK and other countries.[137, 138, 234] There is growing evidence of the benefits of yoga for a variety of health conditions, including mental health conditions[89, 164] and hypertension[216] and yoga is commonly being used as a way for supporting well-being and managing a variety of health issues.[234] Whilst good quality studies are still needed to confirm the effectiveness of yoga in specific conditions and to determine which aspects of yoga are most beneficial, it seems likely that yoga may have a role to play in the management of a range of health conditions. If so, there may even be a role for offering yoga within the NHS. If yoga were to be more actively promoted, it is likely that sessions run by yoga teachers would be a more feasible way of providing yoga to large numbers of people because

of the wider availability of yoga teachers and the cost of sessions provided by yoga teachers. Although yoga providers including teachers do often find out about the health conditions of their attendees, they may not have enough information on how to deliver yoga sessions to people with specific conditions, and hence they may need some further training to deal with different conditions. When specifically about hypertension was asked, it was found that most yoga providers have had some kind of training for this, but most felt they needed further training to deal with it and to provide a safer yoga practice.

3.5.1 Implications for practice

Yoga is unregulated in the UK and this might mean that yoga teachers with no proper training can deliver yoga sessions in the UK. People with health conditions attend these sessions, therefore, there is a need for an initiative to better regulate yoga practice in the UK. In addition, there is clearly a need for better training for yoga teachers in supporting specific health conditions, especially for mental health issues, hypertension, and heart disease, which were found to be the most commonly disclosed health conditions in this study. It is also important for yoga providers to be aware of their attendees' health conditions to provide a safer practice.

3.5.2 Implications for research

Yoga is understudied in the UK and our findings showed that further studies are warranted. One important question to be further investigated in this thesis is the knowledge, experiences, and attitudes of yoga providers in relation to managing health conditions in their sessions, and that of health professionals

in recommending yoga for people with these conditions. In addition, future studies should aim to explore the motivations of the attendees and reasons for the popularity of yoga among women in the UK.

3.5.3 Strengths and limitations

To the best of our knowledge, this was the first study describing the characteristics of yoga providers and their sessions and attendees in the UK. The standard steps in questionnaire development (design and pretesting) were followed to ensure the validity and reliability of the questionnaire. Missing data were low in this study. An online survey was conducted so those who have accessibility issues to online platforms may have been missed. It was not possible to know the exact number of yoga providers in the UK because registration with a yoga association is not mandatory in the UK, and yoga providers can register with more than one association, so the response rate cannot be accurately estimated. However, it is expected that there are around 150 yoga therapists in the UK, and most yoga therapists delivering sessions in the UK were involved in this study. In addition, the findings may not represent the characteristics of yoga providers not being registered with a yoga association. The survey was conducted during the COVID-19 pandemic, an unprecedented time for everyone, which is likely to affect the delivery of yoga sessions; however, participants were requested to report their usual yoga sessions.

3.6 Conclusions

This study shows that yoga sessions are widely available in the UK and often provided and practised by women. Sessions concentrate on the asana and tend not to include many of the more holistic aspects of yoga that are practised in South Asian countries. Yoga teachers are often aware of health conditions but may benefit from training to deliver sessions suitable for specific health conditions.

CHAPTER 4: Delivering yoga to people with hypertension in the UK: a qualitative study to explore yoga providers' knowledge, experiences and attitudes

4.1 Abstract

Background and aim: Yoga has become increasingly popular in the world and the UK for improving health and well-being. A growing body of research suggests that yoga could be used to improve the management of hypertension in addition to current management strategies. Previous cross-sectional studies have also reported that hypertension is one of the most commonly disclosed health conditions in yoga sessions in the United Kingdom. Therefore, semi-structured qualitative interviews were conducted with yoga providers in the United Kingdom (n = 19) to explore their knowledge, experiences, and attitudes toward delivering yoga to people with hypertension.

Methods: Interviews were audio-recorded, transcribed verbatim, and analysed thematically.

Results: Eight themes were identified. Yoga providers were generally aware of the health conditions of their attendees, and they had a reasonable knowledge of the causes, signs and symptoms, and management of hypertension. While most had received some information about hypertension as part of their initial yoga teaching training, this was generally felt to be limited. They mentioned the biopsychosocial benefits of yoga on hypertension but also expressed their concerns about the lack of regulation, the wide disparity in what is being delivered under the label of yoga, and the competency of some yoga providers.

Conclusion: The findings suggest that yoga provision in the United Kingdom should be regulated with a better link with health service providers. A manual and training for yoga providers in the United Kingdom for managing hypertension using yoga would be helpful to address the training needs of yoga

providers. However, there is a need for more robust studies before recommending the implementation of yoga in the management of hypertension in the United Kingdom.

4.2 Introduction

Hypertension or high blood pressure is a global public health concern which is a major risk factor for stroke, myocardial infarction, heart failure, and chronic kidney disease[253] and thus, one of the most important, treatable causes of premature morbidity and mortality in the world.[254] It is highly prevalent, and around one in six people have hypertension worldwide.[32] In the UK, hypertension is one of the most common health conditions, and around one in four people have hypertension.[56] It is the third biggest risk factor for disease and disability in England after smoking and poor diet.[56]

A growing body of research suggests that yoga, a mind-body practice that originated in the ancient Indian subcontinent, could be used to improve the management of hypertension in addition to current management strategies, predominantly, lifestyle modification and anti-hypertensive medication. Several systematic reviews have shown that yoga can reduce high blood pressure.[77, 92, 97, 255] Yoga can achieve a 6.49 mmHg reduction (95 CI% 4.04 to 8.94) in SBP and a 2.78 mmHg reduction (95 CI% 1.45 to 4.11) in DBP compared to control (see chapter 2).[255] Furthermore, yoga has become increasingly popular[129] and is being used as a therapeutic approach by many attendees to improve their well-being and manage health conditions in the world[256-258] and the UK.[234, 259] Hypertension was one of the most commonly disclosed health conditions in yoga sessions (see chapter 3).[138] This is similar to what was found in the previous cross-sectional surveys conducted in the UK[138] and other countries such as the US and Japan.[124, 257, 258] Hypertensive attendees also

expressed a high perceived benefit of yoga in managing their condition.[111, 234, 260]

Yoga is widely practised in South Asian countries such as India and Nepal and it has been integrated into the health care system.[219-221, 228] For example, in India, there are initiatives to regulate higher education and practice. There are various levels of yoga-related education in India, including a bachelor's degree, which is a recognised medical course[222] and postgraduate taught and research degrees.[261] There are also some regulations in place to guarantee the quality of yoga sessions.[221, 226, 228] The Indian government initiated the Scheme for Voluntary Certification of Yoga Professionals, which is monitored by the Ministry of Ayush [224, 225] and is creating a regulatory body for higher education and practice.[226, 227]

In the UK, yoga is delivered by a combination of yoga teachers and yoga therapists, that is, yoga teachers with additional training and experience in the therapeutic adaptation and application of yoga to those with health issues.[142] Since yoga is largely unregulated in the UK, teachers may be heterogeneous in their training and skills. In addition, most yoga providers felt that they needed further training to deal with hypertension and to provide a safer yoga practice (see Chapter 3). Despite yoga's potential benefits for managing hypertension and its popularity among people with hypertension, little is known about the knowledge, experiences, or attitudes of these UK yoga providers in relation to managing hypertension in their sessions. In the process of generating evidence, yoga providers' inputs would be relevant and useful for decision-makers as

yoga providers' views as service providers would help to understand the potential issues in using yoga for the management of hypertension in the UK and ways to address the challenges. Hence, this study aimed to explore what yoga providers in the UK know about hypertension, its management and the potential benefits of yoga for people with hypertension, what are their experiences of and attitudes to, delivering yoga to people with hypertension and what further training may be needed.

4.3 Materials and methods

4.3.1 Study design

The differences between the most commonly used two paradigms, positivism and constructivism, were discussed in Chapter 3 (p. 120-121). Thus, this section exclusively gives the reason underlying the selection of constructivist paradigm for this study. The constructivist paradigm recognises that reality is socially constructed and participants generate knowledge and meaning from an interaction between their existing knowledge, experiences and their ideas.[262] In other words, we can only comprehend a person's perception of reality through their individual experiences, which may differ from another person's due to their unique historical or social context.[263] Constructivist researchers rely on questioning and observation in order to discover or generate a rich and deep understanding of the phenomenon being studied.[264] This study aimed to provide an in-depth understanding of the knowledge, experiences, and attitudes of yoga providers, acknowledging that there is no one objective truth that can be universally grasped or measured due to varying individual

perspectives and the complex nature of interpreting phenomena. Therefore, the constructivist paradigm fits well with the aim of this study.

Constructivist paradigm predominantly uses qualitative research designs and methods to capture the depth, richness and complexity of human experiences which are often difficult to quantify using quantitative measures.[265] Grounded theory, phenomenology and observational research are the most commonly used qualitative study designs for the constructivist paradigm.[266] Grounded theory involves developing theories from data by identifying patterns and relationships through constant comparison, ultimately resulting in new theoretical insights.[267] Observational research focuses on observing and recording natural behaviour of participants, thereby providing valuable insights into real-world dynamics.[267] On the other hand, phenomenology seeks to understand participant experiences by delving into participants' descriptions, revealing underlying meanings and structures and inductively generating a meaning from the patterns obtained throughout the research process.[266] For this study, which aimed to explore the unique experiences and attitudes of yoga providers rather than develop a theory or observe changes about the experiences and attitudes of yoga providers in delivering yoga to people with hypertension in real-life settings, phenomenology was chosen as the research design.

Focus groups and in-depth interviews are the most common qualitative data collection methods.[268] In terms of selection of either focus groups or in-depth interviews, each method has advantages and disadvantages. Focus groups are

likely to bring together people with different opinions and therefore generate a wide range of responses.[236] However, it is also likely that one respondent might dominate the discussion, and groupthink might discourage individuals with different views from expressing their views. In-depth interviews generally take a longer time to complete data collection but they are considered as an optimal way of developing a rapport with respondents and for an easy clarification of questions.[269] It also enables the researcher to obtain more detailed information about the knowledge, experiences and attitudes of yoga providers. Therefore, an in-depth interview approach was used in this research.

In-depth interviews can be conducted in three different ways as structured, semi-structured and unstructured interviews. Semi-structured interviews are generally time-consuming but they are flexible enough to go into novel areas as well as covering pre-determined topics.[236] It also promotes an open dialogue between participant and interviewer to allow the identification of new concepts and to elaborate, provide detail for and clarify the participants' responses.[270] In this research, semi-structured interview approach was used.

Given the explanations above, this study was conducted using constructivism as the underlying paradigm, phenomenology as the research design and semi-structured interviews as the data collection method.

4.3.2 Study location, period, and reporting

This phenomenological qualitative study was conducted in the UK from March to September 2021. Reporting of this study was guided by the Consolidated Criteria for Reporting Qualitative Research (COREQ-32) guideline.[271]

4.3.3 Study participants and recruitment

All the 404 yoga providers in the UK who participated in a previous online cross-sectional survey were eligible to take part in this qualitative study.[272] Yoga providers were approached through professional yoga associations in the UK (see methods section in Chapter 3). Five yoga associations were approached to circulate the survey among their members, and four agreed, namely, the Association for Iyengar Yoga in the UK and Republic of Ireland, the British Wheel of Yoga (BWY), Complementary and Natural Health Council (CNHC) and Independent Yoga Network. Yoga providers were provided with information about this qualitative study and contact details of the lead researcher (GN) at the end of the online survey. Participants were recruited purposively on the basis of voluntariness and representing different styles of yoga practised in the UK. A purposive sampling technique was adopted in the selection of the samples because the study required yoga providers who had experience or interest in delivering yoga to people with stress or hypertension. Twenty-two yoga providers were interested and contacted the lead researcher but three of them did not respond to the follow-up emails. A link to the participant information sheet and consent form (Appendix 5), created using Microsoft Forms was emailed to them. They were given at least 24 hours to decide to

participate in this qualitative study and the date for the interview was arranged. Further verbal consent was taken at the beginning of the interview. Participants were informed that transcripts would be anonymised and treated confidentially and that they were free to withdraw at any point during the interview if they so wished.

4.3.4 Interview guide

A semi-structured interview guide was developed by the researchers through a series of discussions, based on the aim of the qualitative study (Appendix 5). The interview guide was reviewed by a senior qualitative researcher (MB) and revised in line with her recommendations. It was also pretested among two yoga providers (yoga teachers) but no changes were required following piloting. The data from pilot interviews were not included in the study and these yoga providers were not reinterviewed for the study. The interview guide included the following three sections: (i) what do yoga providers know about hypertension, its management, and the potential benefits of yoga for people with hypertension; (ii) what are their experiences in delivering yoga to people with hypertension; and (iii) what are their attitudes to delivering yoga to people with hypertension.

4.3.5 Sample size

Intent was to interview 20 yoga providers with an aim of achieving the saturation of themes (i.e., the point where no new or relevant themes were discovered in the analysis). Saturation is often described as the point in data collection and analysis when new incoming data produces little or no new

information to address the research question.[273] However, the saturation of themes was achieved at the 15th interview, and a few more yoga providers were interviewed to ensure that any important theme was not missed.

4.3.6 Interview procedures and transcription

All the interviews were conducted by the lead researcher, trained in qualitative research methods, in English using the interview guide. Interviews were conducted through video conferencing or phone calls due to the COVID-19 pandemic. With the consent of the participants, the interviews were digitally recorded and none of the interviewees refused to be recorded. Field notes were also taken to complement interviews in terms of nonverbal cues such as gestures and the tone and pitch of voice that may not have been adequately captured through the audio recording. Five recordings were transcribed verbatim by the lead researcher to familiarize herself with the data, and the remaining 14 recordings were transcribed by an external specialist company after signing the non-disclosure agreement. The quality of the transcripts was ensured by the lead researcher listening to the recordings and constantly comparing them to transcripts to rule out the possibility of missing data. Any potential identifiers were removed by the lead researcher, and each transcript was labelled with a number.

4.3.7 Data storage

All data were kept confidential and accessible to the research team only. The recording of the interviews was password-protected on an encrypted and password-protected university laptop.

4.3.8 Data analysis

Transcripts were imported into NVIVO 12 (QSR International, Australia) software to enable data storage and organisation for analysis.[274] Data were analysed thematically using an inductive approach so that the researchers could determine the important concepts from the participants' perspectives.[275] As an initial step to aid familiarisation with the data, the first five interviews were read several times by two independent researchers (GN and ZMH) and then the transcripts were coded line by line. The preliminary codes were discussed between them and if any discrepancies were found, these were discussed with senior study authors (SL and KC). Then, codes were organised into overarching categories, which formed themes. Codes and themes were subsequently discussed among all the researchers resulting in an initial thematic codebook. The preliminary themes were then applied and refined following analysis of the remaining transcripts, which were independently analysed by the same two researchers (GN and ZMH). All the researchers reviewed themes to ensure that they were distinct and not overlapping. The themes were further considered in relation to the whole data set to ensure they accurately reflected the data set. The analysis was iterative rather than a linear process, and all these codes were refined during analysis as the data emerged. Each theme was described with supporting quotes that were chosen based on the best illustration of the notion of the theme. Quotes mentioned in the results section are verbatim unless indicated by an ellipsis (…) to signal that small

segments of text have been removed for clarity. Participants did not provide feedback on the findings.

4.3.9 Reflexivity

Interviewees had no prior relationship with the interviewer. The lead researcher is a female and a PhD student doing a program of work around yoga for hypertension. During data collection, though she attended yoga classes in the UK, she did not have prior knowledge and experience of yoga teacher training in the UK. This enabled her to approach the participant with an open attitude even though at some points, she felt like an outsider to the yoga providers group in the UK. Therefore, before attempting to analyse the collected data, she took an effort to grasp the overall scenario of training of yoga teachers in the UK and she completed yoga teacher training in the UK and is now a qualified yoga teacher. This helped her to understand the data better, for example, made her familiar with the jargon used by the participants. During the interpretation of data, potential biases were avoided by involving independent senior researchers (SL and KC).

4.4 Results

4.4.1 Participants

Interviews lasted 49 min on average. 19 yoga providers were interviewed who were generally based in England but some were also delivering online yoga sessions to people in other parts of the UK. They were delivering yoga sessions in public, private and public-private settings. The majority of them mentioned

that they did not link their practice to a particular school or style of yoga but generally called their style Hatha yoga and some of them mentioned specific branches of Hatha yoga. Yoga providers said that attendees were of mixed abilities, mixed sexes, and mainly adults with a broad range of health issues.

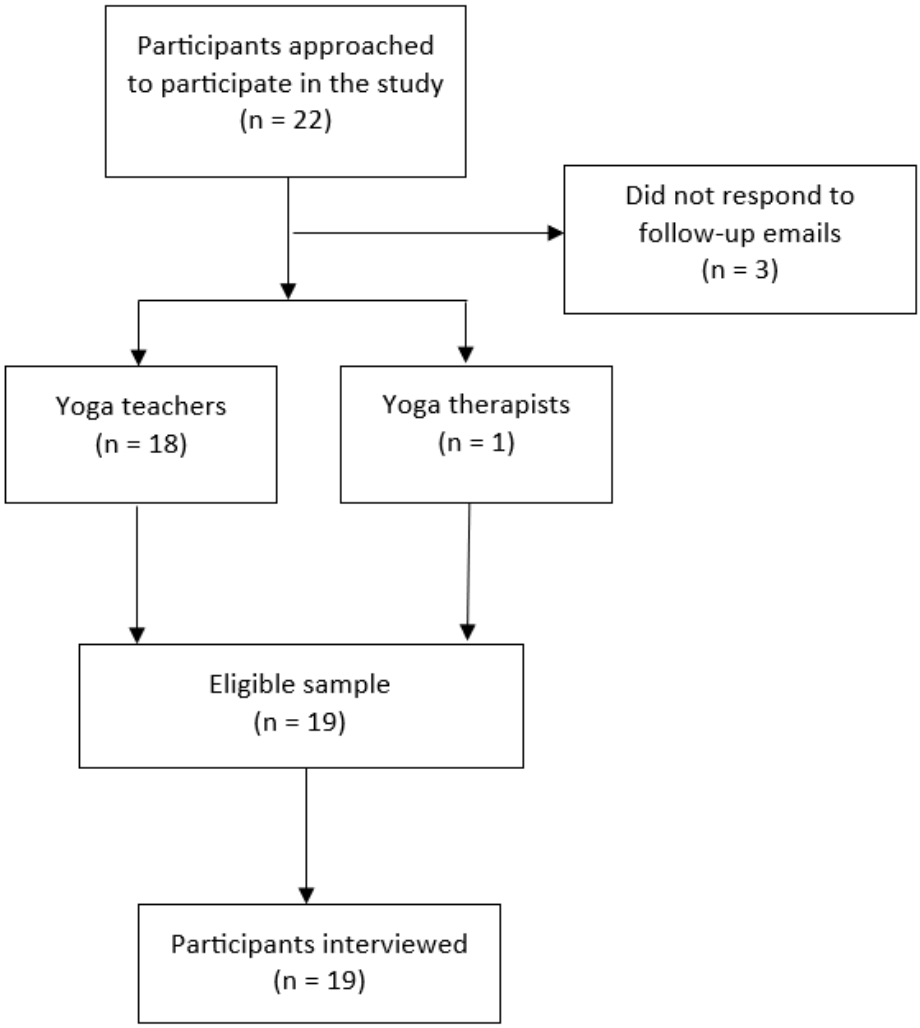

Figure 24 Qualitative study participant chart

Table 11 Socio-demographic characteristics of the interviewees

Characteristics	N
Yoga providers	
Yoga teacher	18
Yoga therapist	1
Gender	
Male	1
Female	18
Age, in years (range)	25-73
Teaching experience, in years (range)	1.5-30
Settings†	
In private settings (e.g., yoga studios, gyms, health clubs, and attendees' homes)	14
In public settings (e.g., leisure centres, community halls, church halls, GP surgeries, and hospital wards)	10
In public-private settings (e.g., online, outdoors)	8
Style of Yoga*	
Gentle yoga	1
Hatha yoga	13
Iyengar yoga	1
Jivamukti	1
Sivananda	2
Satyananda	1
Therapeutic yoga	1
Viniyoga	1

4.4.2 Thematic analysis

Eight themes were identified.

Theme 1: Awareness of health conditions

Yoga providers generally asked their attendees if they had any injury or health issues at the beginning of each class, or the stage of an individual joining a new class. Some asked for a verbal disclosure of any health issues, whereas others asked them to fill in a written health form. However, some yoga providers added that it was not always possible to ask attendees if they had any health issues, for example in gyms where sessions are drop-in or when collecting health information in written form was not allowed by the centre. In addition, the difficulty of asking attendees to disclose their issues in an online class was mentioned as the attendees were only able to see the yoga provider or were muted throughout the session.

> *"They have to fill out a form so that I'm fully aware of what – well everything from their challenges you know, what issues they've got, what they want to get out of yoga and what their aims are." (P18)*
>
> *"Sometimes, when you're teaching in a space that's open, people just turn up and that can be a bit challenging." (P14)*

A variety of health issues were disclosed by attendees to the yoga providers including musculoskeletal issues, mental health issues such as stress, anxiety and depression, hypertension, and cancer. Stress and hypertension were among the most commonly disclosed conditions along with musculoskeletal issues such as joint or back pain. Most yoga providers reported that at least some of their attendees disclosed hypertension to them and the percentage

who did so varied from 1% to almost 100%. It was highlighted that awareness of health conditions was dependent on disclosure, and attendees might not have disclosed hypertension either because they were not aware of it themselves or because they did not perceive it as relevant to mention to the provider.

> *"I've had high blood pressure, low blood pressure, stress, anxiety, depression… A lot of joint problems knees, hips, wrists, and things." (P1)*
>
> *"The ones declared, it's quite low…It's not as high as I thought it would be. That's why I think either they're not saying because they think, oh it's not important, or some people don't like to admit particular conditions that they've got and others, they just don't know they've got it." (P5)*

Theme 2: Variability in knowledge or understanding of hypertension

Yoga providers generally had some concept of the causes, symptoms, and management of hypertension though a few of them acknowledged they were not very knowledgeable about these. They mostly perceived hypertension to be associated with stress, but some listed that age, ethnicity, genetic factors, lifestyle (including unhealthy diet, sedentary lifestyle, smoking, and alcohol consumption), some health conditions and medicines, and thickening of arteries can be causes of hypertension. Some mentioned that being aware of the condition is the first step in its management. Many yoga providers perceived that having a healthier lifestyle including exercise, moderation in

diet, smoking and alcohol consumption, and medication would help in its management. In addition, they noted that yoga and any activity that helps reduce stress helps to manage hypertension.

> *"My understanding is that stress is a key factor in increasing blood pressure." (P11)*
>
> *"Breathing, meditation, changing your diet, changing your lifestyle, being in nature… allows you to manage it." (P15)*

Many yoga providers learned about hypertension as part of their general yoga training. However, it was not covered in enough detail but rather often involved a list of contraindications. This was because the training encompassed a vast amount of information covered in a short timeframe, of which, managing hypertension was only one aspect. Some of the yoga providers knew about hypertension from a course undertaken after their general training, or through personal life experiences or personal interests and a few of them were health service providers so they already had background knowledge. Yoga providers were not aware of any specific training or guidance on the use of yoga for hypertension. In addition, although they suggested that yoga could help manage hypertension, many of them were not aware of any evidence of the effectiveness of yoga on hypertension. Most suspected there must be relevant evidence available even though they had not searched for it. A few of them had explored the published literature and were aware that the current evidence is limited. One yoga provider who had some knowledge of the available evidence questioned the quality of available research studies. Some yoga providers

suggested that more research into the benefits of yoga for hypertension was probably needed.

> *"I did read a study. The thing is a lot of the studies that you read are very small and a lot of them are very contradictory. So you can read one that says yes it's brilliant for this and another one says it is rubbish." (P3)*
>
> *"I actually believe yoga is beneficial, and I also believe that we need more scientific research to show that… Because people just go, "Oh yes, well it's all in the head". Science likes to have factual evidence-based research, so that's why I wanted to participate." (P6)*

Theme 3: Variability in yoga and standards of yoga available

When asked about the style of yoga practised, yoga providers generally referred to Hatha yoga, but there are various styles created out of this type of yoga. Many of them mentioned that yoga has rich and diverse styles but surmised that not all these practices would be suitable for those with hypertension. Therefore, finding the right class for people with hypertension was deemed important.

> *"Yoga is such a massive title; a yoga class could mean so many different things and so I think it's really important that people check with the teacher and make sure that what they're doing is yoga that's suitable for hypertension." (P7)*

Most yoga providers expressed their concerns that yoga is not regulated in the UK and there are no set requirements to be a yoga provider resulting in the delivery of yoga classes by those with no proper training. There was concern that guidance by a trained yoga provider was important to get benefits from

yoga and avoid any potential harm that could be caused to people with hypertension. Yoga providers spoke of the important characteristics of such a yoga provider, not only having years of teaching experience but also having experience in teaching to a particular population and being open to learning and engaging in ways of helping the variety of health issues they came across. It was suggested that yoga provision should be regulated and accredited for the safety of the attendees, the credibility of the yoga providers, and the assurance of health service providers (e.g., clinicians and nurses).

> *"Yoga isn't registered, yoga teachers aren't registered so you can be somebody that's gone on holiday to Spain for two weeks and done a yoga teaching course for two weeks and you can come back, and you can be a yoga teacher." (P3)*
>
> *"If you are under the right guidance, yoga will not be harmful but if you are under the wrong guidance, it may be harmful in that way." (P15)*

Theme 4: Perceived benefits of yoga for people with hypertension

Yoga providers shared some of their experiences and spoke of positive feedback received from their attendees in relation to the effects of yoga on their blood pressure and some of them even exemplified that their attendees reduced their medication during their yoga journey. Many yoga providers were aware that yoga could help manage hypertension through its physiological, physical, and mental benefits. Some yoga providers had more detailed knowledge of some of the mechanisms by which yoga can be beneficial, for example, its effects on the nervous system. Some perceived that yoga helps to improve physical strength and self-awareness of people about their bodies and

leads them to make healthier lifestyle choices. Yoga's contribution to mental health through its calming and stress-reducing effects was especially highlighted by most yoga providers as stress was seen as one of the major contributors to hypertension. It was also added that doing something beneficial for themselves makes attendees feel better and some of them said that yoga enhances the feeling of a sense of community and acceptance, which contributes to emotional well-being.

> *"There is no medical evidence but what there is, a lot of people tell me, they feel better, they use less medication, they stop using painkillers, they manage their lifestyle a lot better, having come to yoga for a period of months or years." (P11)*
>
> *"It is definitely stress reduction and also yoga can put you in a different frame of mind and that sort of self-care perspective that can have a knock-on effect on how you manage the rest of your life…" (P16)*

Most yoga providers perceived that gentler styles of yoga where postures were held for longer such as Restorative Yoga, Yin Yoga, and Gentle Hatha Yoga rather than fast-flow yoga styles would be more beneficial for people with hypertension. Some believed that doing any yogic practice, e.g., asana, pranayama, or dhyana and relaxation practices, would help people with hypertension whereas some emphasized the importance of pranayama practices for lowering blood pressure such as breath awareness, exhalation longer than inhalation, and Sheetali pranayama. However, several yoga providers mentioned the incorporation of these three yogic practices, i.e., yogic

poses, breathing practices, and relaxation and meditation, in a session to get the maximum benefit.

> *"I think that the whole process of yoga practice could potentially be helpful, certainly in terms of encouraging people to become aware of their breath and to use their breath, particularly their exhalation, to perhaps try and stimulate the parasympathetic nervous system in order to calm the whole system." (P19)*
>
> *"The combination of everything together, you know the movement, the breathing, the focused concentration…so it's really kind of bringing everything together to a point of focus to hopefully calm things down..." (P2)*

Theme 5: Perceived harms from yoga or contraindications

Yoga providers suggested there were some yoga styles and practices that needed to be modified or avoided totally for people with hypertension. Yoga styles practised in a hot environment and with dynamic fast flow practices such as Hot/Bikram, Ashtanga, Vinyasa, and Power yoga were not advised by most yoga providers for an attendee with hypertension. In terms of yogic practices, it was related that any asana taking the head lower than heart levels such as headstand, handstand, shoulder stand, and deep back arches are contraindicated and holding arms above the head for long periods might not be advisable. For example, some mentioned that they offer a half-forward bend instead of a forward bend where the head is kept below the heart level. Pranayamas including breath retention and forceful breathing such as Bhastrika

and Kapalabhati were also considered risky to be practised by people with hypertension.

> *"Hypertensive people need to be very careful which type of yoga they do. So there has to be a distinction between fitness yoga and therapeutic yoga." (P17)*
>
> *"I would advise against going to hot yoga, fast-flowing Ashtanga, or Vinyasa yoga where you link all the poses together and work quite quickly. I would advocate against strong working back-arching poses where you're working very actively to open up the front chest, like back arches." (P8)*

Yoga providers perceived that without the necessary modifications, there was a chance of increasing blood pressure. It was suggested that yogic practices should be introduced working from basic to advanced levels and attendees should be observed for any visual clue of struggle to adapt practices to the individuals' needs. Though necessary modifications were generally provided, they tried to teach their attendees to be aware of their bodies and recommended knowing their limitations and adapting accordingly. Some mentioned that attendees can be very competitive and may not pay attention to the modifications offered to them. Most yoga providers had not experienced any adverse events with people with hypertension, but some mentioned very mild issues such as dizziness and light-headedness experienced when the attendees did not pay attention to the modifications offered.

> *"You need to make adjustments for people, which is why it's really important to watch and adjust your students and observe them during classes and if they're struggling with something." (P7)*

"People sometimes have a competition with themselves, they go to a class, and they think that everyone should be doing the same thing, the same way where it's not like that but they don't want to be the first person to come out of a posture." (P12)

Theme 6: Views on how yoga can be best delivered to people with hypertension

Yoga providers varied in their opinions on whether people with hypertension need separate classes. Some yoga providers expressed concerns that if the number of people with hypertension attending a class increases markedly as a result of referrals by health service providers, they would plan to set up a special class for them or they would have one-to-one sessions as they might be otherwise ignoring other attendees' needs. However, many yoga providers suggested that people with hypertension could be managed in a group class as all attendees in a class had some kind of issues and hypertensives were not any different from others. They also mentioned that setting up a special class for them might make some attendees feel isolated from others and might give them false hope that their hypertension could be cured by these yoga classes.

"…if the adaptation actually made the whole class better for everybody, then, that would be great. But if those adaptations made that I was taking out things that other people value in class, then, that would be my challenge." (P4)

"Equally, that then puts them into some kind of awful, "we're the hypertensive group" and maybe yoga might help them not to be hypertensive anymore, so I would prefer to absorb them into a mainstream class. Why not?" (P19)

Theme 7: Gaps in yoga training in relation to managing hypertension and ways to address these gaps

The information provided during the training of yoga teachers was adequate to deliver a generic yoga session, but yoga providers suggested that further training was needed to build their capacity for managing hypertension.

> *"When you start a teacher training, I think there is such a vast amount of knowledge to cover; you can only touch on each of the individual topics that you need to have a grasp of. I would not put detailed training about using yoga for hypertension in a general training course." (P13)*
>
> *"All it said was you don't do shoulder stand and headstand if you've got high blood pressure. I think that's more or less all it covered really; just certain postures aren't appropriate for certain medical conditions." (P5)*

Yoga providers were generally happy to include people with hypertension in their sessions as they already modified their practices according to their attendees' needs. Some spoke of self-educating themselves to provide safer practices by searching online but others also complained about the contradiction of information available online. Many also expressed uncertainty about whether adaptations and contraindications were relevant when people with hypertension are medicated. They, therefore, suggested that further formal training such as a day-long workshop or a continual professional development course would be helpful to refresh and deepen their knowledge, especially if they were to set up a special class for hypertensive people. The training could cover evidence-based up-to-date information on how yoga providers could help people with hypertension, the rationale behind certain modifications, and the medical side of hypertension, e.g., if there were

differences between medicated and non-medicated attendees in terms of what practices they could do.

> *"…having a module for that would be, or even just a short course… just to teach that would be quite helpful I think, to make sure we're all doing the right thing and what we're doing is backed up, because everybody has their own ideas I think at the moment." (P5)*
>
> *"What would be good to know is why exactly shouldn't a hypertensive person do inversion … if I understood more about that the why then, I could apply that knowledge to other things as well." (P4)*
>
> *"What I don't know is to what extent medication balances things out for people with hypertension. I was taught that if somebody is on medication for hypertension then often, they're fine to do a lot of yoga practices..." (P18)*

Theme 8: The need for a better link with health service providers

Yoga providers felt strongly that yoga should be encouraged more widely by the government and NHS, and in particular, health service providers should have a role in encouraging their patients to try yoga, as health service providers tend to be more highly trusted. A couple of them mentioned that there were some local initiatives where GPs referred their patients to yoga classes. However, some yoga providers talked of the health system not yet recognising the potential of yoga for managing hypertension and other conditions and they expressed that NHS is very slow with coming on board and recognising yoga as a health management and wellbeing tool. It was exemplified by a yoga provider

who was aware of a major research project on yoga for healthy lower backs going on for more than 10 years but still not recognised by the NHS.

> *"I think it would be their health care professionals because also that would hopefully give it a credibility that it could be suggested." (P4)*
>
> *"It still hasn't quite got into the mainstream GP surgeries, hospitals, NHS. They're still not quite recognising it. It's getting there, but it's taking such a long time, partly because the NHS needs to be convinced of these alternative therapies, they might call them, of being effective..." (P5)*

Some yoga providers acknowledged the difficulty for health service providers to recommend the right yoga classes to their patients among the plethora of offers available and that there was a need for more evidence-based research to convince the NHS of the benefits of yoga on hypertension management. Many yoga providers, therefore, suggested that if partnerships with health service providers were established, it would help in terms of offering the right yoga practices to people with hypertension and would save time and money for the NHS as yoga would promote self-management of hypertension and hypertension-related issues. Some yoga providers talked of a more collaborative approach that might be used, for example, the idea of social prescribing, i.e., prescribing yoga as a way of managing a medical problem.

> *"From a community perspective, obviously GPs and specialist nurses could certainly start prescribing it, it would be great if they even held a yoga clinic at their GP surgery, or directed them to, I think there might be some link in terms of, I don't know if it quite comes under social prescribing..." (P16).*

4.5 Discussion

This qualitative study provided unique insights into the knowledge, experiences, and attitudes of yoga providers in delivering yoga to people with hypertension in the UK. Any study exploring the knowledge of yoga providers on hypertension and their experiences and attitudes to delivering sessions to people with hypertension could not be found in the world including the Indian subcontinent where yoga originated and is popular. Many yoga providers were aware of the health conditions of their attendees though this was dependent on disclosure, and they had a reasonable knowledge of the causes, signs and symptoms, and management of hypertension. Whilst most had received some information about hypertension as part of their initial yoga teacher training, this was generally felt to be limited. Many of them were trying to meet the needs of those with hypertension for example by making adaptations within the yoga sessions but they generally lacked confidence in what they were advising for people with hypertension. Interestingly, though hypertension is a prevalent health condition and people with hypertension frequently attend yoga sessions in the UK,[56, 138, 272] any yoga manuals or training on hypertension management using yoga could not be found. Yoga providers were also unaware of such a manual or training. Yoga providers, however, mentioned the availability of training and sessions for cancer, back pain, and pregnancy in the UK.

There are many studies suggesting the effectiveness of yoga interventions for managing hypertension[77, 92, 255, 276] but yoga providers were mostly not aware

of such evidence which may suggest that they mostly do not incorporate evidence-based findings into their sessions. This is probably because it is difficult for them to locate and utilise the data on the most effective and safe yogic practices. They also tend to lack the knowledge and skills how to critically appraise research articles, therefore, they can struggle to make sense of the results from studies, which are at times contradictory in their findings.[277, 278] Thus, a manual and a training program based on the manual for yoga providers in the UK for managing hypertension would be helpful to address their training needs. However, Chapter 2 found some evidence of the effectiveness of yoga in managing hypertension, but the quality of the included studies was poor.[255] It also synthesised the heterogeneous content, structure, and delivery characteristics of effective yoga interventions used for hypertension management.[255] Therefore, the subsequent step would be to attain a consensus over the findings of this review to develop the intervention (i.e., intervention materials like a manual for yoga providers) and conduct a robustly designed RCT. However, even if a manual is developed for hypertension management using yoga, initially, it may not be feasible to expect all yoga providers to adhere to it. Nevertheless, some yoga providers have searched for evidence on what practices would be helpful or contraindicated for people with hypertension but recognised that there is currently a lack of evidence in this field. This implies that some of them comprehend the concept of evidence-based practices and may still be able to engage in evidence-based practices to some extent.

Yoga providers highlighted the biopsychosocial benefits of yoga for hypertension, which include physical, psychological and social benefits. For example, generally, yoga is a non-strenuous activity practised in a calm environment and a class with a group of people.[250, 279, 280] These aspects of yoga were perceived by yoga providers to be making it an activity that increases mobility and physical function as well as improving the mental well-being of attendees and providing them with a sense of community. This is in accord with earlier studies where participants reported increased social connection and more positive relations with others.[110-112, 281] In addition, a systematic review and meta-analysis showed that yoga is a reasonably safe and well-tolerated practice with limited adverse events when practised appropriately.[282] As well as yoga being a potential way of managing hypertension, it may cause concern due to its potential to cause harm. For example, there are more than 20 yoga styles, and certain styles, such as Hot/Bikram yoga, may not be suitable for people with hypertension.[283, 284] As suggested by yoga providers in this study, even if the right style is chosen, if yoga is not practised correctly and under proper guidance, it may lead to adverse events. Similarly, a survey assessing yoga-related injuries found that the most common causes were excessive effort, inadequate training of yoga providers, and improper or inadequate instruction given by yoga providers.[285]

Along with the increasing popularity of yoga and the number of yoga attendees, the number of yoga providers has also increased.[259] As there are no nationally set standards for yoga provision in the UK,[272] people with no adequate training

can also use the title "yoga teacher". Though yoga providers showed a willingness to teach yoga to people with hypertension, concerns have been raised about the lack of regulation and the competency of some yoga providers.[286] The lack of regulation may also cause hesitation by health service providers in recommending yoga to their patients. Therefore, to maintain the quality of yoga sessions and to ensure the credibility of yoga providers and the safety of yoga attendees, yoga should be regulated by a formal organisation or association for example yoga associations. However, the regulation of yoga teaching could lead to some concerns, such as the possibility of reducing the diversity of yoga teaching and deviating from the traditional or personalised approach of yoga. Additionally, there may be unintended consequences, such as a potential increase in the cost of yoga sessions, as there would be an additional financial burden on yoga studios due to government regulation and expenses such as licensing fees, taxes, and legal consultation.

4.5.1 Implications of the findings

This study suggests that the lack of regulation is an issue that must be addressed for people with hypertension or other health conditions as well as for people without any health condition (i.e., as part of a healthy lifestyle to prevent diseases). Yoga is also not regulated in the US and some other European countries such as Germany,[287, 288] however, it appears that yoga has been incorporated into patient care in these countries.[287, 289] For example, a study in the US reported that 25.6% of physicians recommended yoga to their patients as a complementary health approach[289] and another study reported

that at least 14 million people in the US started practising yoga because a physician recommended it for their health condition.[290] However, very little is known about the attitudes of health service providers in the referral of patients to yoga classes in the UK. A study in the UK reported a low rate of patient referral by GPs and 14% (of 524) referred their patients to a private yoga class in 2001.[291] Collaboration between yoga providers and health service providers in the UK was recommended by yoga providers to overcome hesitation in recommending yoga to people with hypertension among health service providers and to help people with hypertension to access a yoga session that is suitable to their needs. Yoga might be included within the wider context of what is known as social prescribing, where individuals can be linked from health providers to holistic health resources in the community aimed at improving health and well-being. Indeed, a pilot project (Yoga4Health) was conducted in London in 2017 with the aim of social prescription of yoga for various health issues including high blood pressure in the UK.[292] A before and after, mixed method study was used to evaluate the project and results showed a reduction in perceived stress and anxiety and improvements in well-being and social connectedness. Improvement in blood pressure was also reported. In addition, this project was perceived as acceptable to both yoga attendees and stakeholders (such as yoga providers). The Yoga4Health project has also been expanded to other cities in the UK suggesting that it will have wider acceptability. However, before recommending the inclusion of yoga for hypertension management within social prescription in the UK, there is a need for more robust studies, e.g., high-quality RCTs to understand the effectiveness,

cost-effectiveness and affordability of yoga in the management of hypertension and its acceptability to people with hypertension and health service providers and regulating yoga practices in the UK.

4.5.2 Strengths and weaknesses

To the best of our knowledge, this was the first study which explored the knowledge, experiences, and attitudes of yoga providers in delivering yoga to people with hypertension. The interviews were conducted by the lead researcher (GN) with whom the study participants had no prior acquaintance. In addition, to ensure the dependability and credibility of the research findings, other researchers (KC, SL, ZMH) who had not conducted the interviews were involved in analytic decisions relating to data interpretation. The lead researcher (GN) also reflected on her previous experiences and their effects on decisions related to different phases of data collection and analysis. The selection and recruitment relied on voluntarism; therefore, yoga providers who were already delivering yoga sessions to people with hypertension may have shown interest in this study. Therefore, their views may not be transferrable to yoga providers across the UK or other settings. Only one male yoga teacher and one yoga therapist were involved in this research, providing some insights from this group of yoga providers, but the involvement of more male yoga teacher and yoga therapists would enhance the transferability of the study findings to a broader population. This study predominantly reflected the views of yoga teachers in the UK but the vast majority of yoga is delivered by yoga teachers,[272] and hence if yoga is to be more widely promoted as part of a healthy lifestyle,

it is likely to be yoga teachers who need to be trained to deliver what is required.

4.6 Conclusion

Yoga providers showed a willingness to teach yoga to people with hypertension, however, the wide disparity in what is being delivered under the label of yoga and the competency of some yoga providers was a concern to them. Therefore, lack of regulation is an issue that needs to be addressed for people with hypertension or other health conditions as well as for people without any health condition. A manual and training for yoga providers in the UK for managing hypertension using yoga would be helpful to address the training needs of yoga providers. In addition, a better link between health service providers and yoga providers could be established to overcome the hesitation of health service providers in recommending yoga to people with hypertension and to direct people with hypertension to a yoga session that is suitable to their needs. However, there is a need for more robust studies before recommending the implementation of yoga in the management of hypertension in the UK and yoga practice should be regulated.

CHAPTER 5: Discussion and conclusion

5.1 Abstract

This thesis identified some similarities between the delivery characteristics of effective yoga interventions and what is being provided in yoga sessions in the UK although a direct comparison was not feasible. However, a mismatch was observed between the characteristics of yoga sessions in the UK and effective interventions identified in trials, particularly in terms of content and structure. Despite these disparities, yoga holds promise for managing hypertension in the UK, given its availability and accessibility to individuals with hypertension, along with the willingness of yoga providers to cater to this population. Nevertheless, yoga regulation should be improved, with standardisation for its training and delivery, and stronger evidence should be established to validate and enhance the identified findings before recommending the integration of yoga into the NHS for managing hypertension.

5.2 Introduction

The overall aim of this thesis was to contribute to the development of a yoga intervention for managing hypertension and to investigate the potential of yoga provision in the management of hypertension in the UK. The implications of the findings have been discussed within each chapter of this thesis. This concluding chapter gives an overview of the key findings from the research in this thesis and discusses implications for future research and practice based on the study findings.

5.3 Summary of findings

Chapter 2 of this thesis synthesised the content, structure and delivery characteristics of effective yoga interventions used to manage hypertension and compared these characteristics with yoga interventions that were not found to be effective. A systematic review and meta-analysis with a comprehensive database search was conducted and 31 RCTs were included. This systematic review indicated that yoga interventions may effectively manage hypertension and identified differences in the content and structure of effective and yoga interventions that were not found to be effective. These differences suggested that effective yoga interventions incorporated asana, pranayama and dhyana and relaxation practices and had a balance between these three components and included regular practice. In addition, a list of yogic practices that were used in effective interventions was provided. One of the key findings of this review was that there is a need for well-designed RCTs to further investigate the effectiveness of these specific yoga practices as well

as other potential yoga practices. This review provided valuable data that can be utilised in the development of yoga interventions aimed at improving blood pressure in people with hypertension.

Chapter 3 of this thesis explored the characteristics of yoga providers and their sessions and attendees in the UK. This study helped find out what yoga comprises as currently delivered in the UK and how this compares to the interventions that have shown effectiveness in the trials (Chapter 2). This study showed that yoga sessions are available across the UK and often delivered and attended by women. The focus of the sessions was primarily on asana, with pranayama, dhyana and relaxation practices receiving comparatively less attention. A key finding from this study was that hypertension was one of the commonly disclosed health conditions in yoga sessions and yoga providers felt that they needed further training to deliver sessions to people with hypertension.

Chapter 4 of this thesis explored the knowledge, experiences, and attitudes of yoga providers in delivering yoga to people with hypertension in the UK. By exploring these qualitative aspects, this chapter provided an in-depth understanding of the concerns and recommendations specific to delivering yoga to people with hypertension, complementing the findings from Chapter 3, which primarily focused on presenting representative data concerning the provision of yoga throughout the UK. This study found that yoga providers were concerned about the wide disparity in what is being delivered under the label of yoga and the competency of some yoga providers. Therefore, the regulation

of yoga provision in the UK was suggested. The training of yoga providers in delivering yoga to people with hypertension was also found to be limited, highlighting a need for a manual and training program to enhance their knowledge and confidence. Additionally, establishing a stronger link between health service providers and yoga providers was proposed to help overcome hesitation among health service providers in recommending yoga to people with hypertension and directing them to a yoga session that is suitable to their needs. It was also proposed that yoga might be included within the wider context of what is known as social prescribing, where individuals can be linked from health providers to holistic health resources in the community aimed at improving health and well-being. However, despite the recommendations of yoga providers, before establishing such a link with health care providers, yoga practice needs to be regulated in the UK and there is a need for more robust research to provide a robust evidence base for yoga in the management of people with hypertension.

5.4 Comparison between the characteristics of effective yoga interventions and yoga provision in the UK

There were some similarities between the delivery characteristics of effective yoga interventions and what is being provided in yoga sessions in the UK though it was not possible to make a direct comparison. For example, around 60% of yoga sessions were delivered in private settings in the UK (Chapter 3) and 9 out of 15 effective interventions were delivered in private settings such as community centres (Chapter 2). In addition, yoga sessions were supervised by

yoga providers who mostly had diploma-level training (172 out of 404 yoga providers) (Chapter 3) and yoga sessions were supervised in 16 out of 20 effective interventions (Chapter 2). Nine interventions were supervised by a provider trained in yoga, but the level of training was not reported.

There was a mismatch between the characteristics of yoga sessions in the UK and effective yoga interventions identified in the trials in terms of content and structure (see Table 10). First, effective yoga interventions incorporated the three major components of yoga, i.e., asana, pranayama and dhyana and relaxation practices, and allocated similar durations to each component (Chapter 2) whereas yoga sessions in the UK concentrated on asana and to a lesser extent on pranayama and dhyana and relaxation practices (Chapter 3). Second, effective yoga interventions were mostly 45 minutes long (Chapter 2) whereas group yoga sessions in the UK lasted an average of 90 minutes and one-to-one sessions lasted 60 minutes (Chapter 3). One reason for this difference might be that in research settings, shorter sessions would be needed to keep participants engaged, but in real-world settings, individuals are eager to pay for and engage in yoga and therefore desire longer sessions.

It is also important to note that yoga interventions that showed effectiveness were mostly conducted in South Asia and therefore, there may be some conceptual differences in yoga practice between the contexts. Yoga has spiritual roots and is viewed as a holistic system of philosophy encompassing physical, mental, and spiritual well-being in South Asian countries.[293, 294] Therefore, spiritual and philosophical aspects of yoga are practised as well as

asana, pranayama, dhyana and relaxation practices. However, yoga emerged and was primarily popularised as a form of physical exercise in the UK.[126, 294] This is why the focus of yoga sessions is primarily on the asana, with less emphasis on pranayama and dhyana and relaxation practices (Chapter 3). Thus, the conceptual differences are possibly leading to differences in the perception and practice of yoga between the contexts. These differences might also suggest that current approaches in yoga sessions in the UK might not be as effective as yoga interventions in the RCTs for managing hypertension.

Most yoga providers who participated in the qualitative study (Chapter 4) perceived that gentler styles of yoga which require holding postures for longer such as Restorative Yoga, Yin Yoga, and Gentle Hatha Yoga rather than fast-flow yoga styles would be more beneficial for people with hypertension. Although the style of yoga and pace of the sessions were not reported in RCTs, making it difficult to compare this finding to effective yoga interventions directly, similarities were found between the yogic practices that were used in effective interventions and those that were perceived to be helpful for hypertension management by yoga providers. For example, several yoga providers believed that the incorporation of the three major yogic practices, i.e., asana, pranayama, and dhyana and relaxation practices, in a session would be more beneficial, similar to effective interventions. In addition, similar to what was used in effective interventions, many yoga providers recommended avoiding poses that bring the head below heart level and providing a modified version, e.g., Ardha Uttanasana (half forward bend) and suggested using breathing

practices like breath awareness and Sheetali pranayama (cooling breath). Interestingly, they did not mention alternate nostril breathing, which was the most commonly used breathing practice in effective interventions. Furthermore, data from the qualitative study (Chapter 4) indicated that people with hypertension attending yoga sessions in the UK inform their yoga providers about their condition, and the providers are motivated to offer yoga sessions that are appropriate to and centred on their attendees so there is potential to do more to make sessions bespoke.

Table 12 Comparison between effective yoga interventions for managing hypertension in the RCTs and yoga sessions in the UK

	Effective yoga interventions conducted globally for managing hypertension in the RCTs	**Yoga sessions in the UK in general**
Yoga participants/ attendees	A similar ratio of female and male participants was included.	Attendees were mostly female.
Number of participants/ attendees in a yoga session	Only one RCT reported that 25 attendees were present in the yoga sessions.	10 attendees were present in a group yoga session on average. People with hypertension ranged from 1% to 100%.
Style of yoga	The style of yoga was not reported for 19 out of 20 interventions.	Hatha and Iyengar yoga were the most commonly used styles with 28% and 26%, respectively. Gentler styles of yoga such as Restorative Yoga, Yin Yoga, and Gentle Hatha Yoga were perceived to be recommended by yoga providers for those with hypertension in interviews.
Components of yoga	13 out of 20 effective interventions incorporated asana, pranayama and dhyana and relaxation practices and allocated similar durations to each component.	59% of yoga providers allocated most time to asana, 18% to pranayama and 12% to dhyana and relaxation practices. Some yoga providers emphasised the importance of pranayama, and some mentioned the incorporation of these three yogic practices, i.e., asana, pranayama, and dhyana and relaxation practices in interviews.
Duration and frequency of yoga	Yoga sessions lasted 45 minutes in 5 interventions and yoga was practised 7 days a week in 5 interventions.	On average, group sessions lasted 90 minutes and were delivered 4 times a week. On average, one-to-one sessions lasted 60 minutes and were delivered twice a week.

Delivery setting of yoga	Yoga sessions were centre-based in 15 out of 20 interventions i.e., delivered in a community centre, a healthcare or an academic setting.	60% of yoga sessions were delivered in a private setting (e.g., yoga studios).
Supervision of yoga session	Yoga sessions were supervised by instructors with training in yoga (n = 9) and instructors without any yoga training (n = 5).	Sessions were supervised by a yoga provider.

5.5 Implications of the findings

The findings of this thesis provide a novel addition to the evidence-based yoga literature and carry important implications for practice, research as well as policy.

5.5.1 Implications for research

The emphasis on a balanced integration of physical postures (asana), breath control (pranayama), meditation (dhyana), and relaxation practices underscores the importance of adopting a more holistic approach to be used in the management of hypertension. Considering that many studies with effective outcomes were conducted in South Asia, and the comparison between the findings of the review (Chapter 2) and the cross-sectional survey (Chapter 3) showed some differences for yoga practice in the UK, this prompts researchers to consider contextual factors, acceptability, and feasibility of the yoga intervention within the UK context as outlined in Chapter 2. Therefore, to carry the work done in this review to a next stage, with inspiration from the findings of this systematic review and meta-analysis, a funding application has been submitted to NIHR with the purpose of developing a yoga intervention that is likely to lead to maximum benefits for people with high blood pressure and to explore the acceptability and accessibility to people with different physical abilities in the UK.

5.5.2 Implications for practice

The results of the Chapter 2 suggests that yoga is likely to be more helpful for people with hypertension if incorporated a balanced practice of asana, pranayama and dhyana and relaxation practices. This sheds light on the yoga practices in the UK which commonly focuses on asana and suggest that it is of importance for yoga providers and yoga associations to recognise the disparities with potentially beneficial yoga practices in trials for people with hypertension and various other health concerns, and to consider embedding these potentially beneficial aspects into current practice. In addition, considering that people with various health conditions attend yoga sessions, the delivery of yoga sessions that is suitable to the needs of this population by experienced and well-trained yoga providers is needed.

5.5.3 Implications for policy

An important finding from this thesis informing policymakers was that potentially effective yoga interventions were in line with the lifestyle recommendations in the hypertension guideline by the ISH.[1] In addition, considering that yoga is an affordable practice and yoga providers were willing to deliver yoga to people with hypertension, yoga could be of some help with managing hypertension which could also potentially help reducing hypertension-related costs. This suggestion is also supported by The Yoga4health pilot social prescription study of yoga,[292] showing that yoga practiced by those at risk of developing cardiovascular disease including those with hypertension helped cost saving mostly accruing due to a

reduction in health service usage (e.g., reduced GP and A&E attendance). Moreover, with the average cost of yoga sessions being £7 per individual, yoga appears to be an affordable practice, and this cost may further decrease with membership options. Therefore, it is important for policymakers to recognise the existence of yoga practice and its role in the lives of people with various health conditions. In addition, this thesis highlights the need for regulatory measures, such as setting standards for yoga provider certification, training and the delivery of sessions. These findings suggest that to truly understand the potential of yoga in the management of hypertension as well as other health conditions in the UK, policymakers and government funding agencies should consider investing more in yoga research.

5.6 Avenue for future research

Given the potential of yoga and the poor quality of evidence supporting its effectiveness, more research prioritisation and funding for yoga research for hypertension and other conditions more generally is advocated. Specifically, future studies focusing on yoga and hypertension should address four key areas in order to advance the development of a yoga intervention for managing hypertension and to find out if a yoga intervention using the synthesised findings of the effective interventions in Chapter 2 are actually effective in a well conducted, appropriate powered and analysed study. First, a Delphi study would be needed to reach a consensus over the synthesised content, structure and delivery characteristics of

the effective yoga interventions for managing hypertension in Chapter 2 and to develop an intervention (i.e., intervention materials like a manual for yoga providers). Second, a pilot study should assess the feasibility of the developed yoga intervention in the management of hypertension. A survey or interview should also explore the acceptability of the intervention for both people with hypertension and healthcare providers (e.g., general practitioners and nurses). Third, the effectiveness and cost-effectiveness of the developed yoga intervention should be assessed in a robustly designed RCT. Once these steps have been completed, yoga could be implemented as an approach to form part of the management of hypertension in the UK if it is found to be effective in the management of hypertension. Fourth, the findings of this thesis (Chapter 3) showed that yoga is mostly delivered and practised by women in the UK aligning with trends observed in other high-income countries. However, this pattern differs from the situation in India. It is important to investigate and understand the underlying reasons for this disparity.

5.7 Potential role of yoga in the management of hypertension in the UK and avenue for future practice

The thesis has identified several factors that indicate the potential of yoga as a promising health approach for managing hypertension in the UK. Chapter 3 highlighted the wide availability and accessibility of yoga sessions, while Chapter 4 suggested that the willingness of yoga providers to deliver yoga to people with

hypertension could serve as a facilitative factor in promoting the utilisation of yoga for hypertension management in the UK.

If yoga is to be recognised as a strategy for managing health conditions in the UK, two issues should be addressed. First, it is challenging to determine who is providing yoga and what is being provided in yoga sessions in the UK. Therefore, some regulation of who is delivering yoga is needed to ensure that appropriate teaching is in place. In addition, it is important to ensure that people teaching yoga have some understanding of what is likely to be clinically helpful for people with health conditions regardless of whether it is hypertension or anything else. Thus, yoga regulation should be improved, where standardisation for its training and delivery is established (Chapter 4). Second, there is evidence that yoga can positively contribute to the mental health of individuals and even the NHS webpage recommends that regular yoga practice may help people with high blood pressure, heart disease, aches and pains, depression and stress.[27, 148] There are also some initiatives to offer yoga to NHS staff and patients at some places in the UK.[292] However, given the abundance of options available, individuals may find it challenging to select a yoga session that best suits their needs. Therefore, it is worth considering how yoga provision can be better integrated with the NHS system to guide people towards yoga sessions that are suitable for their specific requirements.

5.8 Conclusion

This thesis has both exposed and improved gaps in our current understanding of yoga and its role in the management of hypertension in the UK. This thesis enhanced the evidence base in yoga research and provided valuable data that can be utilised in the development of yoga interventions aimed at improving blood pressure in people with hypertension. It showed that effective yoga interventions mostly incorporated asana, pranayama, and dhyana and relaxation practices and they had a balance between these three components and included regular practice. Despite some mismatches between yoga sessions in the UK and effective yoga interventions, yoga holds promise for hypertension management in the UK as it was an available and accessible practice in the UK, practised by people with hypertension and yoga providers showed willingness to deliver yoga to people with hypertension. However, the current evidence lacks strength in terms of both quality and quantity, but it does indicate some consistency in the characteristics of effective yoga interventions. Comprehensive investigations involving different study populations, with a focus on validating and improving the identified findings, are needed to establish stronger evidence and before recommending the integration of yoga into the NHS for managing hypertension.

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APPENDIX

APPENDIX 1 Search strategy

Medline (Ovid) (1946-present)

1. exp Yoga/
2. exp Mind-Body Therapies/
3. exp Meditation/
4. yoga*.mp.
5. mind body therap*.mp.
6. yogi*.mp.
7. asana*.mp.
8. pranayam*.mp.
9. dhyan*.mp.
10. meditat*.mp.
11. ashtanga.mp.
12. bikram.mp.
13. hatha.mp.
14. iyengar.mp.
15. kripalu.mp.
16. kundalini.mp.
17. vinyasa.mp.
18. raja.mp.
19. radja.mp.

20. bhakti.mp.

21. jnana.mp.

22. kriya*.mp.

23. karma.mp.

24. yama.mp.

25. niyama.mp.

26. pratyahara.mp.

27. dharana.mp.

28. samadhi.mp.

29. bandha.mp.

30. mudra*.mp.

31. chanda.mp.

32. sivananda.mp.

33. or/1-32

34. exp Blood Pressure/

35. exp Essential Hypertension/

36. exp Hypertension/

37. (blood pressure or BP).mp.

38. hypertens*.mp.

39. pre?hypertens*.mp.

40. ((high or increase* or elevat*) adj2 (blood pressur* or BP)).mp.

41. ((diastolic or systolic or arterial) adj2 (pressur* or BP)).mp.

42. or/34-41

43. randomized controlled trial.pt.

44. controlled clinical trial.pt.

45. clinical trial.pt.

46. exp clinical trials as topic/

47. exp placebos/

48. exp random allocation/

49. exp double-blind method/

50. exp single-blind method/

51. exp cross-over studies/

52. ((random$ or control$ or clinical$) adj3 (trial$ or stud$)).tw.

53. (random$ adj3 allocat$).tw.

54. placebo$.tw.

55. ((singl$ or doubl$ or trebl$ or tripl$) adj (blind$ or mask$)).tw.

56. (crossover$ or (cross adj over$)).tw.

57. or/43-56

58. 33 and 42 and 57

Embase (Ovid) (1974-present)

1. exp Yoga/
2. exp Meditation/
3. yoga*.mp.

4. mind body therap*.mp.
5. yogi*.mp.
6. asana*.mp.
7. pranayam*.mp.
8. dhyan*.mp.
9. meditat*.mp.
10. ashtanga.mp.
11. bikram.mp.
12. hatha.mp.
13. iyengar.mp.
14. kripalu.mp.
15. kundalini.mp.
16. vinyasa.mp.
17. raja.mp.
18. radja.mp.
19. bhakti.mp.
20. jnana.mp.
21. kriya*.mp.
22. karma.mp.
23. yama.mp.
24. niyama.mp.
25. pratyahara.mp.

26. dharana.mp.

27. samadhi.mp.

28. bandha.mp.

29. mudra*.mp.

30. chanda.mp.

31. sivananda.mp.

32. or/1-31

33. exp Blood Pressure/

34. exp Essential Hypertension/

35. exp Hypertension/

36. (blood pressure or BP).mp.

37. hypertens*.mp.

38. pre?hypertens*.mp.

39. ((high or increase* or elevat*) adj2 (blood pressur* or BP)).mp.

40. ((diastolic or systolic or arterial) adj2 (pressur* or BP)).mp.

41. or/33-40

42. exp clinical trial/

43. exp randomized controlled trial/

44. exp randomization/

45. exp single blind procedure/

46. exp double blind procedure/

47. exp crossover procedure/

48. exp placebo/

49. randomi?ed controlled trial$.tw.

50. rct.tw.

51. random allocation.tw.

52. randomly allocated.tw.

53. allocated randomly.tw.

54. (allocated adj2 random).tw.

55. single blind$.tw.

56. double blind$.tw.

57. ((treble or triple) adj blind$).tw.

58. placebo$.tw.

59. exp prospective study/

60. Or/42-59

61. Exp case study/

62. Case report.tw.

63. Exp abstract report/ or exp letter/

64. Or/61-63

65. 60 not 64

66. 32 and 41 and 65

CINAHL (EBSCOhost) (1937-present)

S1. (MH "Yoga+")

S2. (MH “Mind body techniques+”)

S3. (MH “Meditation”)

S4. TX yoga*

S5. TX “mind body therap*”

S6. TX yogi*

S7. TX asana*

S8. TX pranayam*

S9. TX dhyan*

S10. TX meditat*

S11. TX ashtanga

S12. TX bikram

S13. TX hatha

S14. TX iyengar

S15. TX kripalu

S16. TX kundalini

S17. TX vinyasa

S18. TX raja

S19. TX radja

S20. TX bhakti

S21. TX jnana

S22. TX kriya*

S23. TX karma

S24. TX yama

S25. TX niyama

S26. TX pratyahara

S27. TX dharana

S28. TX samadhi

S29. TX bandha

S30. TX mudra*

S31. TX chanda

S32. TX sivananda

S33. OR/S1-S32

S34. (MH "Blood Pressure+")

S35. (MH "Essential Hypertension")

S36. (MH "Hypertension+")

S37. TX “blood pressure” or BP

S38. TX hypertens*

S39. TX pre*hypertens*

S40. TX ((high or increase* or elevat*) N2 (blood pressur* or BP))

S41. TX ((diastolic or systolic or arterial) N2 (pressur* or BP))

S42. OR/S34-S41

S43. S33 AND S42

PsycINFO (Ovid) (1806-present)

1. exp Yoga/
2. exp Mind Body Therapy/
3. exp Meditation/
4. yoga*.mp.
5. mind body therap*.mp.
6. yogi*.mp.
7. asana*.mp.
8. pranayam*.mp.
9. dhyan*.mp.
10. meditat*.mp.
11. ashtanga.mp.
12. bikram.mp.
13. hatha.mp.
14. iyengar.mp.
15. kripalu.mp.
16. kundalini.mp.
17. vinyasa.mp.
18. raja.mp.

19. radja.mp.

20. bhakti.mp.

21. jnana.mp.

22. kriya*.mp.

23. karma.mp.

24. yama.mp.

25. niyama.mp.

26. pratyahara.mp.

27. dharana.mp.

28. samadhi.mp.

29. bandha.mp.

30. mudra*.mp.

31. chanda.mp.

32. sivananda.mp.

33. or/1-32

34. exp Blood Pressure/

35. exp Essential Hypertension/

36. exp Hypertension/

37. (blood pressure or BP).mp.

38. hypertens*.mp.

39. pre?hypertens*.mp.

40. ((high or increase* or elevat*) adj2 (blood pressur* or BP)).mp.

41. ((diastolic or systolic or arterial) adj2 (pressur* or BP)).mp.

42. or/34-41

43. 33 and 42

Allied and Complementary Medicine Database (AMED) (Ovid) (1985-present)

1. exp Yoga/
2. exp Mind body medicine/
3. exp Meditation/
4. yoga*.mp.
5. mind body therap*.mp.
6. yogi*.mp.
7. asana*.mp.
8. pranayam*.mp.
9. dhyan*.mp.
10. meditat*.mp.
11. ashtanga.mp.
12. bikram.mp.
13. hatha.mp.
14. iyengar.mp.
15. kripalu.mp.

16. kundalini.mp.

17. vinyasa.mp.

18. raja.mp.

19. radja.mp.

20. bhakti.mp.

21. jnana.mp.

22. kriya*.mp.

23. karma.mp.

24. yama.mp.

25. niyama.mp.

26. pratyahara.mp.

27. dharana.mp.

28. samadhi.mp.

29. bandha.mp.

30. mudra*.mp.

31. chanda.mp.

32. sivananda.mp.

33. or/1-32

34. exp Blood Pressure/

35. exp Hypertension/

36. (blood pressure or BP).mp.

37. hypertens*.mp.

38. pre?hypertens*.mp.

39. ((high or increase* or elevat*) adj2 (blood pressur* or BP)).mp.

40. ((diastolic or systolic or arterial) adj2 (pressur* or BP)).mp.

41. or/34-40

42. 33 and 41

Cochrane Central Register of Controlled Trials (CENTRAL) (1996-present)

#1 MeSH descriptor: [Yoga] explode all trees

#2 MeSH descriptor: [Mind-Body Therapies] explode all trees

#3 MeSH descriptor: [Meditation] explode all trees

#4 Yoga* (Word variations have been searched)

#5 “mind body therapies” (Word variations have been searched)

#6 yogi* (Word variations have been searched)

#7 asana* (Word variations have been searched)

#8 pranayam* (Word variations have been searched)

#9 dhyan*(Word variations have been searched)

#10 meditat*(Word variations have been searched)

#11 ashtanga (Word variations have been searched)

#12 bikram (Word variations have been searched)

#13 hatha (Word variations have been searched)

#14 iyengar (Word variations have been searched)

#15 kripalu (Word variations have been searched)

#16 kundalini (Word variations have been searched)

#17 vinyasa (Word variations have been searched)

#18 raja (Word variations have been searched)

#19 radja (Word variations have been searched)

#20 bhakti (Word variations have been searched)

#21 jnana (Word variations have been searched)

#22 kriya* (Word variations have been searched)

#23 karma (Word variations have been searched)

#24 yama (Word variations have been searched)

#25 niyama (Word variations have been searched)

#26 pratyahara (Word variations have been searched)

#27 dharana (Word variations have been searched)

#28 samadhi (Word variations have been searched)

#29 bandha (Word variations have been searched)

#30 mudra* (Word variations have been searched)

#31 chanda (Word variations have been searched)

#32 sivananda (Word variations have been searched)

#33 295-#32

#34 MeSH descriptor: [Blood Pressure] explode all trees

#35 MeSH descriptor: [Essential Hypertension] explode all trees

#36 MeSH descriptor: [Hypertension] explode all trees

#37 (“blood pressure” or BP) (Word variations have been searched)

#38 hypertens* (Word variations have been searched)

#39 pre?hypertens* (Word variations have been searched)

#40 ((high or increase* or elevat*) adj2 (blood pressur* or BP))

#41 ((diastolic or systolic or arterial) adj2 (pressur* or BP))

#42

#43 #33 and #42

Web of Science (1900-present)

#1 All=(yoga* OR “mind body therap*” OR meditation OR yogi* OR asana* OR pranayam* OR dhyan* OR meditat* OR ashtanga OR bikram OR hatha OR iyengar OR kripalu OR kundalini OR vinyasa OR raja OR radja OR bhakti OR jnana OR kriya* OR karma OR yama OR niyama OR pratyahara OR dharana OR samadhi OR bandha OR mudra* OR chanda OR sivananda)

#2 ALL=(“blood pressure” OR BP OR hypertens* OR pre-hypertens*)

#3 TS=(((high or increase* or elevat*) near/2 (“blood pressur*” or BP)) OR ((diastolic or systolic or arterial) near/2 (pressur* or BP)))

#4 #2 OR #3

#5 ALL=(“randomized controlled trial” OR “controlled clinical trial” OR “clinical trial” OR “clinical trials” OR placebo$ OR “random allocation” OR “double-blind method” OR “single-blind method” OR “cross-over studies”)

#6 TS=(((random$ or control$ or clinical$) near/3 (trial$ or stud$)) OR (random$ near/3 allocat$) OR ((singl$ or doubl$ or trebl$ or tripl$) near (blind$ or mask$)) OR (crossover$ or (cross near over$)))

#7 #5 OR #6

#8 #1 AND #4 AND #7

Turning Research into Practice (TRIP) (1997-present)

(yoga* OR “mind body therapies” OR yogi* OR asana* OR pranayam* OR dhyan* OR meditation OR meditate OR ashtanga OR bikram OR hatha OR iyengar OR

kripalu OR kundalini OR vinyasa OR raja OR radja OR bhakti OR jnana OR kriya* OR karma OR yama OR niyama OR pratyahara OR dharana OR samadhi OR bandha OR mudra* OR chanda OR sivananda) AND ("blood pressure" OR BP OR hypertension OR hypertensive OR pre-hypertension OR prehypertension OR pre-hypertensive OR prehypertensive)

AYUSH Research Portal

Selected medical system > Yoga & Naturopathy > selected category > Clinical Research and Preclinical Research and Fundamental Research

A Bibliography of Indian Medicine (ABIM)

1. Blood pressure
2. BP
3. Hypertension
4. Hypertensive
5. Prehypertension
6. Pre-hypertension
7. Prehypertensive
8. Pre-hypertensive

Digital Helpline for Ayurveda Research Articles (DHARA)

1. Blood pressure [title]
2. BP [title]
3. Hypertension [title]
4. Hypertensive [title]
5. Prehypertension [title]
6. Pre-hypertension [title]
7. Prehypertensive [title]
8. Pre-hypertensive [title]

CAM-QUEST

Selected therapy – Mind-body medicine –> selected disease pattern – Cardiovascular diseases –> selected disease – Hypertension – selected study design –> Randomized trial

Directory of Open Access Journals (DOAJ)

1. yoga* and hypertens*
2. yoga* and blood pressure
3. yoga* and BP
4. yoga* and prehypertens*
5. yoga* and pre-hypertension

6. yoga* and pre-hypertensive
7. yogi* and hypertens*
8. yogi* and blood pressure
9. yogi* and BP
10. yogi* and pre-hypertension
11. yogi* and pre-hypertensive
12. yogi* and prehypertension
13. yogi* and prehypertensive

OpenGrey

1. yoga*
2. yogi*

EthOS

1. yoga [any word]
2. yogi [any word]
3. yogic [any word]

ProQuest Dissertations and Theses

1. (ti(yoga* OR mind body therap* OR yogi* OR asana* OR pranayam* OR dhyan* OR meditat* OR ashtanga OR bikram OR hatha OR iyengar OR kripalu OR kundalini OR vinyasa OR raja OR radja OR bhakti OR jnana OR kriya* OR karma OR yama OR niyama OR pratyahara OR dharana OR samadhi OR bandha OR mudra* OR chanda OR sivananda)
2. ti(blood pressure OR BP OR hypertens* OR pre?hypertens* OR ((high OR increase* OR elevat*) NEAR/2 (“blood pressur*” OR BP)) OR ((diastolic OR systolic or arterial) NEAR/2 (pressur* OR BP)))
3. 1 and 2
4. ab(yoga* OR mind body therap* OR yogi* OR asana* OR pranayam* OR dhyan* OR meditat* OR ashtanga OR bikram OR hatha OR iyengar OR kripalu OR kundalini OR vinyasa OR raja OR radja OR bhakti OR jnana OR kriya* OR karma OR yama OR niyama OR pratyahara OR dharana OR samadhi OR bandha OR mudra* OR chanda OR sivananda)
5. ab(blood pressure OR BP OR hypertens* OR pre?hypertens* OR ((high OR increase* OR elevat*) NEAR/2 (“blood pressur*” OR BP)) OR ((diastolic OR systolic OR arterial) NEAR/2 (pressur* OR BP)))
6. 4 and 5
7. 3 or 6

APPENDIX 2 Excluded studies with reasons for exclusion

Full-text studies excluded (n=47)

Related to population e.g., different target population (n=1)

Cade WT, Reeds DN, Mondy KE, Overton ET, Grassino J, Tucker S, et al. Yoga lifestyle intervention reduces blood pressure in HIV-infected adults with cardiovascular disease risk factors. *HIV Med* (2010) 11(6):379-88. doi: 10.1111/j.1468-1293.2009.00801.x.

Related to intervention e.g., not the main/only intervention, no adequate description of intervention (n=18)

Aivazyan TA, Zaitsev VP, Salenko BB, Yurenev AP, Patrusheva IF. Efficacy of relaxation techniques in hypertensive patients. *Health Psychol* (1988) 7:193-200.

Anderson DE, McNeely JD, Windham BG. Regular slow-breathing exercise effects on blood pressure and breathing patterns at rest. *J Hum Hypertens* (2010) 24(12):807-13. doi: 10.1038/jhh.2010.18.

Bell TP. Meditative practice cultivates mindfulness and reduces anxiety, depression, blood pressure, and heart rate in a diverse sample. *J Cogn Psychother* (2015) 29(4):343-55.

Bhasin MK, Denninger JW, Huffman JC, Joseph MG, Niles H, Chad-Friedman E, et al. Specific transcriptome changes associated with blood pressure reduction in hypertensive patients after relaxation response training. *J Altern Complement Med* (2018) 24(5):486-504. doi: 10.1089/acm.2017.0053.

Blom K, Baker B, How M, Dai M, Irvine J, Abbey S, et al. Hypertension analysis of stress reduction using mindfulness meditation and yoga: results from the HARMONY randomized controlled trial. *Am J Hypertens* (2014) 27(1):122-9. doi: 10.1093/ajh/hpt134.

Cort DA. A comparison of compliance to group meditation, individual meditation and didactic group training in a program to help lower blood pressure in Black adults. USA: The Florida State University (1988).

Dusek JA, Hibberd PL, Buczynski B, Chang BH, Dusek KC, Johnston JM, et al. Stress management versus lifestyle modification on systolic hypertension and medication elimination: a randomized trial. *J Altern Complement Med* (2008) 14(2):129-38. doi: 10.1089/acm.2007.0623.

Kaushik RM, Kaushik R, Mahajan SK, Rajesh V. Effects of mental relaxation and slow breathing in essential hypertension. *Complement Ther Med* (2006) 14(2):120-6. doi: 10.1016/j.ctim.2005.11.007.

Latha, Kaliappan K. Yoga, pranayama, thermal biofeedback techniques in the management of stress and high blood pressure. *J Indian Psychol* (1991) 9(1):36-46.

Dobos G. Comprehensive lifestyle modification for patients with hypertension and metabolic syndrome: a multicenter randomized controlled trial. [Unpublished]. Available from: https://www.medrxiv.org/content/medrxiv/suppl/2020/02/25/2020.02.23.20027029.DC1/2020.02.23.20027029-1.pdf

Nejati S, Zahiroddin A, Afrookhteh G, Rahmani S, Hoveida S. Effect of group mindfulness-based stress-reduction program and conscious yoga on lifestyle, coping strategies, and systolic and diastolic blood pressures in patients with hypertension. *J Tehran Heart Cent* (2015) 10(3):140-8.

Schroer S, Mayer-Berger W, Pieper C. Effect of telerehabilitation on long-term adherence to yoga as an antihypertensive lifestyle intervention: results of a randomized controlled trial. *Complement Ther Clin Pract* (2019) 35:148-53. doi: 10.1016/j.ctcp.2019.02.001.

Roche L, Hesse B. Application of an integrative yoga therapy programme in cases of essential arterial hypertension in public healthcare. *Complement Ther Clin Pract* (2014) 20(4):285-90.

Ublosakka-Jones C, Tongdee P, Pachirat O, Jones DA. Slow loaded breathing training improves blood pressure, lung capacity and arm exercise endurance for older people with treated and stable isolated systolic hypertension. *Exp Gerontol* (2018) 108:48-53. doi: 10.1016/j.exger.2018.03.023.

Ubolsakka-Jones C, Tongdee P, Jones DA. The effects of slow loaded breathing training on exercise blood pressure in isolated systolic hypertension. *Physiother Res Int* (2019) 24(4):e1785. doi: 10.1002/pri.1785.

van Montfrans GA, Karemaker JM, Wieling W, Dunning AJ. Relaxation therapy and continuous ambulatory blood pressure in mild hypertension: a controlled study. *BMJ* (1990) 300(6736):1368-72.

Ziv A, Vogel O, Keret D, Pintov S, Bodenstein E, Wolkomir K, et al. Comprehensive approach to lower blood pressure (CALM-BP): a randomized controlled trial of a multifactorial lifestyle intervention. *J Hum Hypertens* (2013) 27(10):594-600. doi: 10.1038/jhh.2013.29.

Srinivasan B, Rajkumar D. Effects of slow breathing on blood pressure and end-tidal carbon dioxide in hypertension: randomised controlled trial. *J Clin Diagn Res* (2019) 13(9):YC01-YC3. doi: 10.7860/JCDR/2019/42327.13121.

Related to comparator (n=1)

Kapoor G. An analytical study to find out the effects of four asanas on decreasing blood pressure and to compare immediate effects on blood pressure of four different sequences of common asanas used in treatment of hypertension. *Indian J Phys Ther* 2(1):46-50.

Related to study design e.g., not an/unclear RCT (n=21)

Agte VV, Jahagirdar MU, Tarwadi KV. The effects of Sudarshan Kriya Yoga on some physiological and biochemical parameters in mild hypertensive patients. *Indian J Physiol Pharmacol* (2011) 55(2):183-7.

Andrews G, MacMahon SW, Austin A, Byrne DG. Hypertension: comparison of drug and non-drug treatments. *Br Med J (Clin Res Ed)* (1982) 284(6328):1523-6.

Bhavanani AB, Madanmohan, Sanjay Z. Immediate effect of chandra nadi pranayama (left unilateral forced nostril breathing) on cardiovascular parameters

in hypertensive patients. *Int J Yoga* (2012) 5(2):108-11. doi: 10.4103/0973-6131.98221.

Bhavanani AB, Sanjay Z, Madanmohan. Immediate effect of sukha pranayama on cardiovascular variables in patients of hypertension. *Int J Yoga Therap* (2011) (21):73-6.

Damodaran A, Malathi A, Patil N, Shah N, Suryavansihi, Marathe S. Therapeutic potential of yoga practices in modifying cardiovascular risk profile in middle aged men and women. *J Assoc Physicians India* (2002) 50(5):633-40.

Das D, Manik R, Gartia R. Effects of integrated approach of yoga (IAY) on essential hypertension. *J Evid Based Med Healthc* (2015) 2:4925-38. doi: 10.18410/jebmh/2015/689.

Datey K, Deshmukh S, Dalvi C, Vinekar S. Shavasan a yogic exercise in the management of hypertension. *Angiologie* (1969) 20(6):325-33. doi: 10.1177/000331976902000602.

Dhameja K, Singh S, Mustafa MD, Singh KP, Banerjee BD, Agarwal M, et al. Therapeutic effect of yoga in patients with hypertension with reference to GST gene polymorphism. *J Altern Complement Med* (2013) 19(3):243-9. doi: 10.1089/acm.2011.0908.

Gowtham L, Vasanthi B, Jayshree N, Ambika, Halder N, Velpandian T. Effects of yoga in type 2 diabetes mellitus with hypertension: alteration in RBC morphology as a marker for oxidative stress. *Indian J Physiol Pharmacol* (2016) 62(1):51-8.

Miles SC, Chun-Chung C, Hsin-Fu L, Hunter SD, Dhindsa M, Nualnim N, et al. Arterial blood pressure and cardiovascular responses to yoga practice. *Altern Ther Health Med* (2013) 19(1):38-45.

Mizuno J, Monteiro HL. An assessment of a sequence of yoga exercises to patients with arterial hypertension. *J Bodywork Mov Ther* (2013) 17(1):35-41. doi: 10.1016/j.jbmt.2012.10.007.

Murthy SN, Rao NS, Nandkumar B, Kadam A. Role of naturopathy and yoga treatment in the management of hypertension. *Complement Ther Clin Pract* (2011) 17(1):9-12. doi: 10.1016/j.ctcp.2010.08.005.

Ranawat R, Agarwal V, Sharma V, Sharma P. Prevention and management of hypertension and associated disorders by Bhastrika pranayama (A breathing exercise). *JAHM* (2015) 3(3):7-10.

Santaella DF, Araujo EA, Ortega KC, Tinucci T, Mion D, Jr., Negrao CE, et al. Aftereffects of exercise and relaxation on blood pressure. *Clin J Sport Med* (2006) 16(4):341-7. doi: 10.1097/00042752-200607000-00010.

Selvamurthy W, Sridharan K, Ray US, Tiwary RS, Hegde KS, Radhakrishan U, et al. A new physiological approach to control essential hypertension. *Indian J Physiol Pharmacol* (1998) 42(2):205-13.

Shaha R. Effect of Rajyoga meditation on psychological and physical well-being among hypertensive, diabetic and coronary artery disease patients [Ph.D.]. Ann Arbor: Devi Ahilya Vishwavidyalaya (2013).

Shrikrishna. Comprehensive approach for the treatment of essential hypertension through yoga. *Yoga-Mimamsa* (1990) 29(1):67-70.

Vasantha Priya J, Kanniammal C, Mahendra J, Valli G. Impact of yoga on blood pressure and quality of life in patients with hypertension. *Int J Pharm Clin Res* (2017) 9(5):413-16.

Walsh KL. Yoga as a complementary therapy in the management of hypertension. USA: The University of North Carolina at Chapel Hill (2019).

Wolff M, Sundquist K, Larsson Lönn S, Midlöv P. Impact of yoga on blood pressure and quality of life in patients with hypertension - a controlled trial in primary care, matched for systolic blood pressure. *BMC Cardiovasc Disord* (2013) 13(1):111. doi: 10.1186/1471-2261-13-111.

Deepa T, Sethu G, Thirrunavukkarasu N. Effect of yoga and meditation on mild to moderate essential hypertensives. *J Clin Diagn Res* (2012) 6(1):21-6.

Combination of the above four criteria (n=7)

Metri KG, Pradhan B, Singh A, Nagendra HR. Effect of 1-week yoga-based residential program on cardiovascular variables of hypertensive patients: a comparative study. *Int J Yoga* (2018) 11(2):170-4. doi: 10.4103/ijoy.IJOY_77_16.

Packyanathan J, Preetha S. Comparison of the effect of yoga, zumba and aerobics in controlling blood pressure in the Indian population. *J Family Med Prim Care* (2020) 9(2):547-51. doi: 10.4103/jfmpc.jfmpc_607_19.

Patel C. Yoga and biofeedback in the management of hypertension. *J Psychosom Res* (1975) 19(5-6):355-60. doi: 10.1016/0022-3999(75)90014-8.

Telles S, Sharma SK, Balkrishna A. Blood pressure and heart rate variability during yoga-based alternate nostril breathing practice and breath awareness. *Med Sci Monit Basic Res* (2014) 20:184-93. doi: 10.12659/MSMBR.892063.

Pramanik T, Sharma HO, Mishra S, Mishra A, Prajapati R, Singh S. Immediate effect of slow pace Bhastrika pranayama on blood pressure and heart rate. *J Altern Complement Med* (2009) 15(3):293-5. doi: 10.1089/acm.2008.0440.

Patel C. 12-month follow-up of yoga and bio-feedback in the management of hypertension. *Lancet* (1975) 1(7898):62-4. doi: 10.1016/s0140-6736(75)91070-3.

Yadav RK, Ray RB, Vempati R, Bijlani RL. Effect of a comprehensive yoga-based lifestyle modification program on lipid peroxidation. *Indian J Physiol Pharmacol* (2005) 49(3):358-62.

Ongoing Studies (n=8)

Effect of yoga Nidra on blood pressure in patients with resistant hypertension: a randomized controlled trial. India. CTRI/2020/02/023365

Effect of OM chanting on emotional regulation and its effect on hypertension. India. CTRI/2020/02/023458

Effect of yoga nidra with Om chanting on the control of blood pressure and hypertension. India. CTRI/2020/02/023400

Comparison of the effectiveness of interventions based on the Eastern mind-body approach on cardiovascular responses and stress reduction in prehypertensive subjects. Iran. IRCT20200607047679N1

Immediate effect of ice massage to head and spine and cooling pranayamas on heart rate variability in hypertensive individuals a comparative study. India. CTRI/2019/12/022378

Immediate effect of Nadishodhana pranayama and bhramari pranayama on heart rate variability in hypertensive individuals a comparative study. India. CTRI/2019/12/022263

Efficacy of integrated yoga as a comprehensive intervention among paramilitary personnel with hypertension – YCT. India. CTRI/2020/06/026172

Effects of yoga training on cardiovascular reactivity to psychological stress in patients with hypertension. Taiwan. NCT03274193

APPENDIX 3 Questionnaire for the cross-sectional study

Mapping the characteristics of yoga providers and the content of their sessions and types of student in the UK: a cross-sectional survey

Page 1: Information About This Survey

Thank you for your interest in taking part in this online survey.

- We are a research team in the Division of Epidemiology and Public Health at the University of Nottingham. We are undertaking a research project which aims to map the characteristics of yoga providers and the content of their sessions and types of student in the UK.
- This survey should take you about **10-15 minutes** to complete with a total of 25 questions. You will be entered into an optional/voluntary prize draw of **£100** upon completion of the survey as a token of appreciation.
- Your answers will be completely anonymous and we will use all reasonable endeavours to keep them confidential. The University of Nottingham is the data controller for the purposes of data protection. Designated individuals of the University of Nottingham may be given access to data for monitoring and/or audit of the survey to ensure we are complying with guidelines.
- Your participation in this survey is entirely voluntary.

If you would like to read more detailed information about this survey, please click here.

1 / 16

Page 2: Consent Page

1. **Please, tick each box to continue:** * *Required*

Please select at least 3 answer(s).

- [ ] I confirm that I have read and understood the information on the previous page.
- [ ] I am 18 years old or older.
- [ ] I consent to take part in this survey.

Page 3: A. Socio-Demographic Questions

2. What is your current gender?

- Female
- Male
- Other
- Prefer not to say

3. What is your age group?

- 18-24 years old
- 25-44 years old
- 45-64 years old
- 65 years and older
- Prefer not to say

4. What is your ethnic group? Please choose one option that best describes your ethnic group or background.

- White
- Asian/Asian British
- Black/African/Caribbean/Black British
- Mixed/Multiple ethnic groups
- Other
- Prefer not to say

4.a. If you selected Other, please specify:

3 / 16

5. Are you a yoga therapist? Yoga therapists, as defined by the British Council of Yoga Therapy, are those having a yoga therapy training to manage health conditions/diseases after completing at least 200 hours of yoga teacher training course.

- ○ Yes
- ○ No

6. What is your yoga education level? Please tick all that apply.

- ☐ Certificate
- ☐ Diploma
- ☐ Bachelor
- ☐ Postgraduate certificate
- ☐ Postgraduate diploma
- ☐ Master
- ☐ PhD
- ☐ Other

6.a. If you selected Other, please specify:

7. How long have you been delivering yoga sessions in total in the UK and elsewhere? Please state in years.

8. Which yoga associations are you currently registered with? Please tick all that apply.

- ☐ Association for Iyengar Yoga in the UK and Republic of Ireland

- [ ] British Wheel of Yoga
- [ ] Yoga Alliance Professionals
- [ ] The Independent Yoga Network
- [ ] Yoga Alliance International
- [ ] Other

8.a. If you selected Other, please specify:

9. Which of the following best describes your current yoga teaching role? Please tick all that apply.

- [ ] Self-employed
- [ ] Employed (public sector)
- [ ] Employed (private sector)
- [ ] Other

9.a. If you selected Other, please specify:

10. Are you currently a member of the statutorily regulated healthcare profession in the UK or elsewhere?

- ( ) No
- ( ) Medical doctor
- ( ) Nurse
- ( ) Physiotherapist
- ( ) Other

10.a. If you selected Other, please specify:

Page 4: B. Structure, Delivery and Cost of Yoga Sessions

11. During the last 6 months, have you regularly delivered **group** yoga sessions? Here, regularly means at least one session in most weeks.

- ○ Yes
- ○ No

11.a. During the last 6 months, in a typical 7-day week, **on average**, how many group yoga sessions have you delivered? Please count a group yoga session as 1 however many people can be in the group. E.g., 3 group yoga sessions a week.

11.b. During the last 6 months, in a typical 7-day week, **on average**, how many yoga students have attended each group yoga session? We appreciate you may not know actual numbers but please provide an estimate of the average number per session.

11.c. During the last 6 months, **on average**, how long has each group session lasted? Please state in minutes.

11.d. During the last 6 months, **on average**, how much was the cost to each individual of attending a group yoga session? We appreciate there might be variations and people might have attended yoga sessions through gym membership but please estimate the average cost for the individual.

£

12. During the last 6 months, have you regularly delivered **one-to-one** yoga sessions? Here, regularly means at least one session in most weeks.

- Yes
- No

12.a. During the last 6 months, in a typical 7-day week, **on average**, how many individuals have you delivered a one-to-one yoga session to?

12.b. During the last 6 months, **on average**, how long has a one-to-one yoga session lasted? Please state in minutes.

12.c. During the last 6 months, **on average**, how much was the cost of a one-to-one yoga session? We appreciate that there might be variations and people might have attended yoga sessions through gym membership but please estimate the average cost for the individual.

£

13. During the last 6 months, have you regularly delivered yoga sessions in the evenings? Here, regularly means at least one session in most weeks and evening means 5 pm onward. Please take into consideration both group and one-to-one yoga sessions.

- Yes
- No

14. During the last 6 months, have you regularly delivered yoga sessions at the weekends? Here, regularly means at least one session in most weeks and weekend means Saturdays and Sundays. Please

take into consideration both group and one-to-one yoga sessions.

- ○ Yes
- ○ No

15. During the last 6 months, **on average**, what proportion of yoga students attending your yoga sessions were female? Please take into consideration both group and one-to-one yoga sessions.

- ○ 0-25%
- ○ 25-50%
- ○ 50-75%
- ○ 75-100%

16. During the last 6 months, **typically**, how were the yoga sessions paid for? Please tick all that apply and please take into consideration both group and one-to-one yoga sessions.

- ☐ Out-of-pocket payment (direct payment) by yoga students
- ☐ Public funded (e.g., NHS)
- ☐ Private insurance
- ☐ Other

16.a. If you selected Other, please specify:

17. During the last 6 months, where have you delivered your yoga sessions? Please tick all that apply and please take into consideration both group and one-to-one yoga sessions.

- ☐ In private (non-government) settings
- ☐ In public (government) settings
- ☐ In public and private partnership settings
- ☐ Other

17.a. If you selected Other, please specify:

18. We are trying to map the locations where yoga sessions are delivered in the UK. Please provide the initial part of the postcode(s) of the places where you have delivered yoga sessions during the last 6 months. Please take into consideration both group and one-to-one yoga sessions. E.g., NG7.

Page 5: C. Style and Content of Yoga Sessions

19. During the last 6 months, which style(s) of yoga have you used in your yoga sessions? We are aware that there are many styles of yoga and you might have followed more than one style but please tick all that apply.

- ☐ Iyengar
- ☐ Asthanga
- ☐ Vinyasa
- ☐ Bikram
- ☐ Kundalini
- ☐ Yin
- ☐ Viniyoga
- ☐ Other

19.a. If you selected Other, please specify:

20. Yoga sessions can emphasise different aspects of yoga and cover any of the following components in varying proportions. During the last 6 months, in a **typical** yoga session, how much of the yoga session was allocated to practise the following components? We are aware that some of these may not feature at all in your yoga sessions (e.g., Samadhi) and may be covered throughout the session (e.g., Pranayama) so the total does not need to add up to 100%:

Please don't select more than 1 answer(s) per row.

	0-25% (i.e., none or little emphasis)	25-50% (i.e., some emphasis)	50-75% (i.e., a good deal of emphasis)	75-100% (i.e., a great deal of emphasis)
Yama (rules of moral code)	☐	☐	☐	☐
Niyama (rules of personal behaviour)	☐	☐	☐	☐
Asana (yogic poses)	☐	☐	☐	☐
Pranayama (breathing practices)	☐	☐	☐	☐
Pratyahara (withdrawal of senses)	☐	☐	☐	☐
Dharana (concentration)	☐	☐	☐	☐

Dhyana (meditation) and relaxation practices	☐	☐	☐	☐
Samadhi (transcendence)	☐	☐	☐	☐

20.a. If you used any components other than those listed above, please specify these components and how much of the yoga session was allocated to these components?

	Please specify the component.	How much of a yoga session was allocated to these components			
		0-25% (i.e., none or little emphasis)	25-50% (i.e., some emphasis)	50-75% (i.e., a good deal of emphasis)	75-100% (i.e., a great deal of emphasis)
Name of the component		○	○	○	○
Name of the component		○	○	○	○
Name of the component		○	○	○	○
Name of the component		○	○	○	○
Name of the component		○	○	○	○
Name of the component		○	○	○	○

Page 6: D. Information on Health Conditions/Diseases

21. During the last 6 months, how often did your yoga students disclose their health conditions/diseases to you?

- Never
- Rarely
- Sometimes
- Often

22. During the last 6 months, which of the following health conditions/diseases have your yoga students disclosed to you? Please tick all that apply.

Please don't select more than 1 answer(s) per row.

	Never	Rarely	Sometimes	Often
Hypertension/high blood pressure	☐	☐	☐	☐
Diabetes	☐	☐	☐	☐
Obesity	☐	☐	☐	☐
Heart diseases (e.g., coronary heart disease, angina, history of myocardial infarction, history of revascularisation procedure (coronary artery bypass surgery or angioplasty))	☐	☐	☐	☐
Stroke	☐	☐	☐	☐
Chronic kidney disease	☐	☐	☐	☐
Respiratory diseases (e.g., pulmonary hypertension)	☐	☐	☐	☐
Mental issues (e.g., depression, stress, anxiety)	☐	☐	☐	☐

23. During the last 6 months, what proportion of yoga students attending your yoga sessions do you **think** had hypertension/high blood pressure? This is irrespective of whether or not they have disclosed their hypertension/high blood pressure to you.

- 0-25%
- 25-50%
- 50-75%

- 75-100%

24. Have you had any training on hypertension/high blood pressure during your yoga education?

- Yes
- No

25. Do you think you need further training on how to deliver yoga sessions to people with hypertension/high blood pressure?

- Yes
- No

26. What further training on hypertension do you think would be helpful? Please provide details.

Page 7: Prize Draw

27. As you are aware, this survey is completely anonymous. Therefore, to be able to contact you after the prize draw, we need your contact details. If you would like to enter the prize draw of **£100**, please provide your email address:

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Page 8: Final Page

Many thanks for completing this survey.

*We are doing a **qualitative research study** and would like to have a further discussion to explore your experiences in managing health conditions/diseases like stress and hypertension. All the participants will be given a **£10 shopping voucher** as a token of appreciation. For further information about the qualitative research study, please contact Gamze Nalbant.*

Email: Gamze.Nalbant@nottingham.ac.uk

APPENDIX 4 Ethics approval

University of Nottingham
UK | CHINA | MALAYSIA

Faculty of Medicine & Health Sciences
Research Ethics Committee
Faculty Hub
Room E41, E Floor, Medical School
Queen's Medical Centre Campus
Nottingham University Hospitals
Nottingham, NG7 2UH
Email: FMHS-ResearchEthics@nottingham.ac.uk

19 February 2020

Gamze Nalbant
PhD Student
Division of Epidemiology and Public Health
Clinical Sciences Building
City Hospital Nottingham Campus
Nottingham University Hospitals
Nottingham
NG5 1PB

Dear Gamze

Ethics Reference No: 467-2001 **– please always quote**	
Study Title: Yoga for Hypertension Management	
Chief Investigator/Supervisor: Kaushik Chattopadhyay, Assistant Professor in Evidence Based Healthcare, Sarah Lewis, Professor of Medical Statistics, Epidemiology and Public Health, School of Medicine	
Lead Investigators/student: Gamze Nalbant, PhD Student, Epidemiology and Public Health, School of Medicine	
Proposed Start Date: 20/02/2020	**Proposed End Date:** 01/12/2021

Thank you for submitting the above application and the following documents were received:

- FMHS REC Application form and supporting documents version 1.0: 09/01/2020

These have been reviewed at the meeting on 24 January 2020 and the project has been given a favourable opinion.

A favourable opinion has been given on the understanding that:

1. The protocol agreed is followed and the Committee is informed of any changes using a notice of amendment form (please request a form).
2. The Chair is informed of any serious or unexpected event.
3. An End of Project Progress Report is completed and returned when the study has finished (Please request a form).

Yours sincerely

Dr John Williams, Associate Professor in Anaesthesia and Pain Medicine
Chair, Faculty of Medicine & Health Sciences Research Ethics Committee

APPENDIX 5 Participant information sheet

PARTICIPANT INFORMATION SHEET

Research Ethics Reference: 467-2001

Version 1.0 Date: 13/01/2020

We would like to invite you to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read this carefully and discuss it with others if you wish.

What is the purpose of the research?

Yoga is one of the most popular complementary therapies with growing use particularly in older hypertensive patients in the world and the UK. There is encouraging evidence that yoga may have potential in managing hypertension. The UK's NHS also suggests yoga as a blood pressure-lowering therapy. The number of people with hypertension undertaking yoga is likely to increase as a result of recommendations made by NHS. Therefore, this research aims to explore the knowledge, experiences and attitudes of yoga teachers and therapists in hypertension management in the UK.

Why have I been invited to take part?

You have been invited to take part in this research because you are a yoga teacher/therapist who delivered a yoga session at least once a fortnight during the

last 6 months and are aged 18 years or older (no upper age limit). Your views and experiences are very important in shaping the final resource by helping us to understand what are your knowledge, experiences and attitude in the use of yoga for hypertension management. We will be recruiting up to 30 yoga teachers and therapists in this study.

Do I have to take part?

No. It is up to you to decide if you want to take part in this research. We will describe the study and go through this information sheet with you to answer any questions you may have. If you agree to participate, we will ask you to sign a consent form and will give you a copy to keep. However, you would still be free to withdraw from the study at any time, without giving a reason and without any negative consequences, by advising the researchers of this decision. This would not affect your legal rights.

What will happen to me if I take part?

A researcher will go over the information sheet, explain the procedure which involves having an interview with the researcher. We will ask you about your knowledge, experiences and in the use of yoga for hypertension management. This interview will be only one time and last for approximately 30 to 45 minutes. Interviews will be digitally recorded but you will not be identifiable in the records. If you are happy to take part, then you will be asked to sign a consent form.

Are there any risks in taking part?

We are not aware of any risks of taking part in this study.

Are there any benefits in taking part?

There will be no direct benefit to you from taking part in this research but your contribution may help to explore your knowledge, experiences and attitudes in hypertension management in the UK.

Will my time/travel costs be reimbursed?

Participants will receive an inconvenience allowance to participate in the study for giving up their time and they will be offered a £10 shopping voucher. No travel cost will be required for the participants because either the lead researcher will be going to them or the interview will be done through electronic means (e.g., Skype and phone calls).

What happens to the data provided?

The research data will be stored confidentially and anonymized in an encrypted electronic storage device/laptop. You will not be identifiable in any report or publication. All research information will only be accessed by the research team [i.e. researcher, supervisor]. However, we would like your permission to use anonymised data in future studies, and to share our research data (e.g. in online databases) with other researchers in other Universities and organisations both inside and outside the European Union. This would be used for research in health and social care. Sharing research data is important to allow peer scrutiny, re-use (and therefore avoiding duplication of research) and to understand the bigger

picture in particular areas of research. All personal information that could identify you will be removed or changed before information is shared with other researchers or results are made public. All research data and records will be stored for a minimum of 7 years after publication or public release of the work of the research.

Personal / sensitive data will be stored confidentially using password protected computers. The research team will have access to personal/sensitive data collected in this study. To help ensure your privacy, you will be assigned a volunteer study identification number (for example P01 for participant number 1), and it will be used instead of your name. Your name and any information about you will not be disclosed outside the study centre.

What will happen if I don't want to carry on with the study?

Even after you have signed the consent form, you are free to withdraw from the study at any time without giving any reason and without your legal rights being affected. If you withdraw, we will no longer collect any information about you or from you but we will keep the anonymous research data that has already been collected and stored as we are not allowed to tamper with study records. This information may have already been used in some analyses and may still be used in the final study analyses. To safeguard your rights, we will use the minimum personally-identifiable information possible.

Who will know that I am taking part in this research?

All information collected about you during this research would be kept strictly confidential. All such data are kept on password-protected databases sitting on a restricted access computer system and any paper information (such as your consent form, contact details and any research questionnaires) would be stored safely in lockable cabinets in a swipe-card secured building and would only be accessed by the research team. Under UK Data Protection laws the University is the Data Controller (legally responsible for the data security) and the Chief Investigator of this study (named above) is the Data Custodian (manages access to the data). This means we are responsible for looking after your information and using it properly. Your rights to access, change or move your information are limited as we need to manage your information in specific ways to comply with certain laws and for the research to be reliable and accurate. To safeguard your rights, we will use the minimum personally – identifiable information possible. You can find out more about how we use your information and to read our privacy notice at:

https://www.nottingham.ac.uk/utilities/privacy.aspx/

Designated individuals of the University of Nottingham may be given access to data for monitoring and/or audit of the study to ensure we are complying with guidelines. With your consent, we will keep your personal information on a secure database in order to contact you for future studies. Anything you say during the interview will be kept confidential, unless you reveal something of concern that

may put yourself or anyone else at risk. It will then be necessary to report to the appropriate persons.

What will happen to the results of the research?

The research will be written up as a thesis for the degree of PhD. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. The thesis will be published open access. Result of the thesis may also be used for scientific presentation or publication. The research will be written up as a dissertation for the degree of PhD.

Who has reviewed this study?

All research involving people is looked at by an independent group of people, called a Research Ethics Committee, to protect your interests. This study has been reviewed and given favourable opinion by the Faculty of Medicine and Health Sciences Research Ethics Committee (Reference number: FMHS 467- 2001).

Who is organising and funding the research?

The research is being organized by the University of Nottingham and is being funded by the Ministry of National Education of Turkey.

What if something goes wrong?

If you have a concern about any aspect of this project, please speak to the researcher Gamze Nalbant or the Principal Investigator Dr Kaushik Chattopadhyay,

who will do their best to answer your query. The researcher should acknowledge your concern within 10 working days and give you an indication of how he/she intends to deal with it. If you remain unhappy and wish to complain formally, you should then contact the FMHS Research Ethics Committee Administrator, Faculty Hub, Medicine and Health Sciences, E41, E Floor, Medical School, Queen's Medical Centre Campus, Nottingham University Hospitals, Nottingham, NG7 2UH.

E-mail: FMHS-ResearchEthics@nottingham.ac.uk

Contact Details

If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

Primary Researcher

Gamze Nalbant

Division of Epidemiology and Public Health

School of Medicine

University of Nottingham

Tel: 07713965839

Email: Gamze.Nalbant@nottingham.ac.uk

Supervisors:

Kaushik Chattopadhyay, PhD

Assistant Professor in Evidence Based Healthcare, Faculty of Medicine & Health Sciences University of Nottingham, United Kingdom

Email: Kaushik.Chattopadhyay@nottingham.ac.uk

Sarah Lewis, PhD

Professor of Medical Statistics

University of Nottingham, United Kingdom

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APPENDIX 6 Interview guide for the qualitative study

Introduction

- I am Gamze Nalbant from the University of Nottingham.
- My colleagues and I are doing these interviews to explore what yoga teachers and therapists in the UK know about hypertension, its management and the potential benefits of yoga for people with hypertension, what are their experiences in and attitudes to delivering yoga to hypertensive people. I would like to assure you that our purpose is not to test how good a yoga teacher you are. We just would like to have an overview of the management of hypertension in yoga classes in the UK.
- I contacted you as you previously expressed an interest in taking part in this research.
- Before the interview, I would like to ask if you have read the information sheet provided. Do you have any questions?
- The interview is expected to last approximately 30-45 minutes. I will be recording the interview. However, I would like to assure you that all data relating to you will be kept strictly confidential. The recording of this interview and any quotes used in the study report will not identify you in any way. Your participation is entirely voluntary.

Background

1. Can you tell me a bit about your yoga history/story as a yoga teacher/therapist?
    - How long have you been practising as a yoga teacher/therapist?
    - Which setting/s do you work in (including NHS)?
    - What types of yoga do you currently deliver and to whom?
    - Talk me through what your typical yoga session involves (yogic poses, breathing practices, and meditation and relaxation practices)

Knowledge

1. What do you do when someone new joins your sessions? (e.g., do you take a detailed medical history?)
    - Are you aware of any health conditions that your students have?
    - What health conditions/diseases have they disclosed to you?
    - What are the main reasons for them disclosing/discussing these with you?
    - Have any of them disclosed to you about hypertension/high blood pressure?
    - What proportion of your students do you think have hypertension?
2. What do you know about hypertension/high blood pressure?
    - Are you aware of anything that causes hypertension? What are

these? (e.g., stress)

- What do you think can help to manage hypertension/high blood pressure?

3. To what extent do you think yoga could be beneficial for people with hypertension/high blood pressure?
    - Are there any particular types of yoga which you think might be beneficial for hypertension? What are these?
    - What makes this type of yoga beneficial?
    - How do these benefits apply to different types of yoga?
4. To what extent do you think yoga could be harmful to people with hypertension/high blood pressure?
    - Are there any particular types of yoga which you think you have to be mindful of when delivering to hypertensive individuals? What are these?
    - What makes this type of yoga harmful?
    - How do these harms apply to different types of yoga?
5. <u>(If they know about hypertension)</u> How have you learned what you know about hypertension/high blood pressure? (E.g., during yoga training, reading on this)

- Have you had any training on hypertension during your yoga training?
- (If they had training) Has training applied specifically to hypertension/high blood pressure or whether it was around cardiovascular conditions, in general?
- Where do you think the gaps are in yoga training in relation to managing health conditions like hypertension/ high blood pressure?
- How could these gaps be addressed?
- Are you aware of any specific guidance/training on delivering yoga to people with health conditions like hypertension?

Experience

1. Do you have any experience of delivering yoga to someone with hypertension?
    - Can you tell me about your experiences in teaching yoga to people with hypertension/high blood pressure?
    - How do you deal with these people?
    - If you are aware at least one in seven students have hypertension, could you adapt the class? To what extent are you able to adapt your class? How could you adapt it?
    - (If they had any training on hypertension) How has your training on hypertension affected/would affect the way you adapt your class?
    - Have you experienced any problems?

- How have you felt about teaching them?

<u>If they do not have any experience:</u>

- What do you think the needs of hypertensive people would be?
- If you are aware at least one in seven students has hypertension in your class, how would you deal with this group? Would you adapt the class? To what extent would you be able to adapt your class? How would you adapt it?
- (If they had any training on hypertension) How could your training affect the way you adapt your class?
- What kind of problems do you think you could experience?
- What could be the factors that help or improve (i.e., facilitators) the successful delivery of yoga practice to hypertensive people?
- What could be the factors that impede (i.e., barriers) the successful delivery of yoga practice to hypertensive people?
- How would you feel about teaching them?

Attitudes

1. Are you aware of any evidence suggesting that yoga might help manage hypertension/high blood pressure?
2. If there is evidence of yoga being beneficial for hypertensive people, whose role do you think it is to encourage such individuals to take part in yoga?

3. If healthcare practitioners encourage their patients with hypertension to do yoga and the number of students with hypertension attending your yoga sessions increases, how would you feel?
    - How would you feel being in a position to deliver yoga to people with hypertension? Would you like to teach yoga to people with hypertension? Why/why not?
    - What would be your concerns if you had to teach a class where at least one in seven students have hypertension (e.g., lack of knowledge and experience)?
    - How confident would you feel about delivering classes to those with hypertension and the extent to which these would differ from those delivered to healthy people?
    - What kind of support would you need when delivering yoga to people with hypertension? (e.g., guidelines, training)
    - What do you think your training needs are in relation to hypertension and its management?

4. If we could identify what aspects of yoga are more beneficial for hypertension, could you envisage you adapt the class according to these beneficial practices? To what extent you could adapt the class according to these beneficial practices?

"Is there anything you would like to add that you feel is important?" Conclusion

- We have reached the end of the interview.
- Do you have any questions about this study?
- I would like to reassure you that all data relating to you will be kept strictly confidential.
- Thank you very much for your time.