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Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-031848
Article Type:	Research
Date Submitted by the Author:	30-May-2019
Complete List of Authors:	Cartwright, Tina; University of Westminster, School of Social Sciences Mason, Heather; The Mindful Institute Porter, Alan; University of Westminster, School of Social Sciences Pilkington, Karen; University of Portsmouth, School of Health Sciences and Social Work
Keywords:	COMPLEMENTARY MEDICINE, PREVENTIVE MEDICINE, MENTAL HEALTH, PUBLIC HEALTH

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National survey of yoga practice in the UK: an insight into motivation, health benefits and behaviours

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ABSTRACT

Objectives: Despite the popularity of yoga and evidence of its positive effects on physical and mental health, little is known about yoga practice in the UK. This study investigated the characteristics of people who practise yoga, reasons for initiating and maintaining practice, and perceived impact of yoga on health and wellbeing.

Design, setting and participants: A cross-sectional online anonymous survey distributed through UK-based yoga organisations, studios and events through email invites and flyers. 2434 yoga practitioners completed the survey: 87% female, 91% white, and 71% degree educated, mean age 48.7 years.

Main outcome measures: Perceived impact of yoga on health conditions, health outcomes and injuries. Relationships between yoga practice and measures of health, lifestyle, stress and wellbeing.

Results: In comparison with national population norms, participants reported higher wellbeing, lower incidence of obesity and stress and higher rates of positive health behaviours. Almost half reported changing their motivations to practise yoga, with general wellness and fitness key to initial uptake, and stress management and spirituality important to current practice. 16% of participants reported starting yoga to manage a physical or mental health condition. High numbers of respondents reported the value of yoga for a wide range of health conditions, most notably for musculoskeletal and mental health conditions. Controlling for demographic factors, frequency of yoga practice accounted for small but significant variance in health-related regression models ($p<.001$).

Conclusion The findings of this first detailed UK survey were consistent with surveys in other countries. Yoga was perceived to have a positive impact on physical and mental health conditions and was linked to positive health behaviours. Further investigation of yoga's role in self-care could inform health-related challenges faced by many countries.

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Strengths and limitations of the study

- This is the first comprehensive survey to assess the practice and perceived impact of yoga on health, lifestyle-related behaviours and wellbeing in the UK.
- The survey design captures the significant number of practitioners who take up yoga to manage a physical or mental health condition and identifies health conditions for which yoga is rated as most helpful in self-management.
- Despite the large sample, it was self-selected and unlikely to be representative of all yoga practitioners.
- The results relied on retrospective and self-report data which may be subject to memory bias and social desirability.

INTRODUCTION

Originating in India as a comprehensive mind-body practice, yoga has become increasingly popular in the West as a holistic approach to health and wellbeing. In the US, national health surveys indicate a lifetime prevalence rate of 13.2% or 31 million adults,¹ an increase from 5.1% a decade earlier.² Surveys also demonstrate significant levels of practice in countries such as Australia³ and Germany.⁴ Although a variety of styles, the main components of yoga include physical postures (asana), breathing techniques (pranayama), relaxation and meditation. There is growing evidence that yoga is an effective multi-component health intervention that reduces stress, increases physical activity and improves wellbeing.⁵⁻⁷ Clinical studies provide preliminary support for the effectiveness of yoga as an adjunct treatment for a range of chronic conditions, such as depression,^{8,9} anxiety,^{10,11} lower back pain,^{12,13} and type 2 diabetes.^{14,15} Potential physiological mechanisms include down-regulation of the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system and reduced inflammatory markers.^{6,16,17} Additionally, psychological mechanisms such as enhanced self and body awareness, coping, mindfulness, self-compassion and social connectedness may underlie healthier lifestyle choices and more adaptive responses to stressors.¹⁷ Given the increasing personal and healthcare costs associated with lifestyle-related diseases,^{18,19} it is important to better understand the impact of yoga on health-related outcomes in both clinical and naturalistic settings.

Motivations and health benefits

Previous surveys, primarily in the US and Australia, have provided some insight into the characteristics of yoga practitioners, their motivations and perceived health impact. Yoga practitioners are consistently more likely to be female, white, educated and higher socioeconomic status.^{1,4,20-23} Whilst practitioners' health status is higher than population norms, yoga is used to manage a range of health conditions. For example, in the US National Health Interview Surveys in 2002 and 2012, musculoskeletal and mental health²² and back pain, stress and arthritis¹ were the main health conditions for which people most commonly practised yoga. The majority reported yoga as helpful in managing these conditions.²² In Australia, 20% of those surveyed practised yoga for a specific health reason reported to be improved by yoga,²³ while 88% of survey participants in Germany rated their health as improved since starting yoga.⁴ Studies have also found an association between

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yoga/meditation practice and positive health behaviours such as higher physical activity levels, lower rates of smoking, and higher likelihood of vegetarian diet.^{3 23-25}

Several studies have explored motivational factors underlying yoga practice, most commonly cited are general wellness,^{1 23} health and fitness,²³ specific health condition,²³ and improved immune function and energy.¹ Park et al. found that while physical improvement (exercise and flexibility) and stress relief were the most prevalent reasons for adopting yoga, there was a reported shift towards more holistic motivations such as spirituality over time.²⁶ Taken together, these surveys indicate that a substantial proportion of the population is attracted to yoga to manage their physical, mental and spiritual health.

It therefore surprising that little is known about yoga practice in the UK. Whilst the Health Survey for England suggested a relatively low (1.28%) prevalence of yoga practice,²⁴ the data was taken from a general question on sport and exercise over the previous four weeks. The potential impact of yoga on managing health conditions and increasing health-related behaviours is particularly relevant given the unprecedented increase in long-term conditions and links between comorbidity and poor mental health.¹⁹ Management of this ‘tsunami of need’²⁷ has led to a focus on self-care approaches to reduce lifestyle risk factors and manage chronic conditions. Social prescribing is included in the recent NHS Long Term Health Plan,²⁸ with scope for the inclusion of yoga.²⁹ A comprehensive survey of current yoga practice in the UK and perceived impact on health conditions, behaviours and wellbeing is thus timely.

The overall aim of this current study was, therefore, to gain a better understanding of current yoga practice in the UK by investigating: 1) the characteristics, lifestyle and wellbeing of those practising yoga in comparison with national norms; 2) yoga practice characteristics; 3) motivations underlying yoga practice 4) perceived impact of yoga on health outcomes and the relationship between yoga practice characteristics and wellbeing.

MATERIALS AND METHODS

Design and recruitment

The study was a cross-sectional survey design using an anonymous online questionnaire hosted on Qualtrics. Recruitment was through UK-based yoga organisations (e.g. British Wheel of Yoga), email invitations to 79 yoga studios requesting they send the link to their members, marketing at UK yoga events (e.g. International Yoga day events) and social media. Yoga practitioners were invited to participate if they met the inclusion criteria: UK resident, practised yoga within the past 12 months, and were over 18 years. Data collection took place over a six month period (June-Dec 2016).

Patient and Public Involvement

At the pilot stage, 12 yoga practitioners were consulted regarding the aims of the study and content and acceptability of the questionnaire which was incorporated into the final survey.

Survey development

Previous surveys of yoga practice were reviewed^{21 23 25} and a draft set of questions compiled focusing on the key objectives. The final questionnaire was informed by consultations with key researchers, yoga teachers and practitioners.

Socio-demographic variables

Data was collected on: gender, age, education, ethnicity, relationship and employment status, and area of residence. Additionally, the McArthur scale of subjective social status³⁰ assessed perceived social status (1-10 scale).

Health, lifestyle and wellbeing variables

Health variables included: height and weight (to calculate BMI), self-rated health,³¹ current health issues (20 listed). Lifestyle variables were assessed with single items and included: smoking status, dietary choices (e.g. vegetarian), average weekly alcohol intake (units), average daily fruit/vegetable intake (2 or less, 3-4, 5 or more), weekly frequency of brisk exercise apart from yoga. Wellbeing was assessed by: Warwick-Edinburgh Mental Well-being Scale (WEMWBS)³² to assess subjective well-being and psychological functioning, and the 4 single item 10-point Likert scale ONS measures of wellbeing.³³ Higher scores indicate higher wellbeing. The 4-item Perceived Stress Scale (PSS)³⁴ assessed global life stress with higher scores indicating higher levels of perceived stress.

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Yoga practice characteristics

This section asked about personal practice of yoga. Questions regarding motivation included: reason(s) for starting yoga, for maintaining or taking a break from yoga and whether primary motivations had changed over time. Yoga practice questions included years of practising, preferred style of yoga and class location, average weekly frequency (hours and days) spent practising at home and in class, and percentage of time spent on different components (asana, pranayama, relaxation, meditation, other). Additional questions asked about use of yoga therapy in past 12 months, any independent meditation practice, including hours spent meditating, and amount spent on yoga classes/workshops per month. Participants were asked whether they were yoga teachers or therapists.

Perceived health impact

Participants were asked to indicate if they had experienced specific health conditions/issues since practising yoga (25 conditions listed with the option to specify other issues) and rate perceived helpfulness of yoga in managing the condition (5-point Likert scale). Participants were also asked to rate on a 5-point Likert scale (strongly disagree-strongly agree) the extent to which they perceived yoga impacted on seven health outcomes identified by previous surveys²⁵, including physical, mental and lifestyle dimensions.

Yoga-related Injuries

Fixed-response questions relating to up to three injuries sustained as a result of yoga practice including: location, new or recurring injury, circumstances around occurrence (e.g. unsupervised or whilst receiving an adjustment) and yoga style practised when injury occurred. Respondents were not asked about the severity or duration of any injuries.

Data Analysis

Data was cleaned to identify miscoded and missing data. Missing cases were deleted listwise. Descriptive statistics were calculated for socio-demographic characteristics, yoga practice variables, health and lifestyle variables. Gender and other group differences were analysed using t-tests and Chi Square. Pearson’s and Spearman’s correlations were computed to assess relationships between yoga practice variables and yoga impact and

health-related variables respectively, and determine predictor variables for the regression analyses. Hierarchical multiple regression analyses were used to examine the independent effect of demographics, yoga variables, yoga teacher status, and meditation practice on health outcomes including stress, wellbeing, satisfaction with life, worthwhile life, happiness and anxiety as criterion variables.

RESULTS

2635 people responded to the survey, with 2434 people meeting the inclusion criteria and completing at least the first question about yoga participation.

Socio-demographic characteristics (Table 1)

The majority were female, white, well educated (71% \geq degree), with a wide age range (18-92 years, $M=48.7 \pm 12.5$). Participants rated themselves as above average in terms of subjective social status ($M=6.62 \pm 1.47$). All areas of the UK were represented although London and the south of England were most prevalent. Forty percent of the sample were yoga teachers.

Table 1: Sociodemographic characteristics of sample

Variables	Frequency (including N for each variable)	Percent
Gender	2410	
Male	284	11.7
Female	2126	87.3
Ethnicity	2412	
Asian/Asian British	78	3.2
Black/African/Caribbean/Black British	14	0.6
Mixed/Multiple ethnic groups	63	2.6
White	2192	90.9
Other	65	2.7
Relationship status	2417	
Single	382	15.8
In a relationship	283	11.7

Married/Cohabiting	1536	63.5
Divorced/Separated	163	6.7
Other	53	2.2
Employment	2418	
Employed full-time	776	32.1
Employed part-time	367	15.2
Self-employed	740	30.6
Unemployed	37	1.5
Student	64	2.6
Retired	339	14.0
Stay at home parent/carer	56	2.3
Other	39	1.6
Education (highest level)	2420	
Secondary school	193	8.0
College/ A level	393	16.2
University Undergraduate	755	31.2
University Postgraduate	963	39.8
Other	116	4.8
Location	2274	
North East/West	294	12.9
East/West Midlands	206	9.1
Yorkshire	161	7.1
East England	89	3.9
London	483	21.2
South East/West	769	33.8
Wales	86	3.8
Scotland	153	6.7
Northern Ireland	33	1.5

Lifestyle and health characteristics and comparison with UK norms

Only 4.2% currently smoked compared with 15.1% in the general adult UK population.³⁵ Similarly, over half reported the recommended intake of daily fruit/vegetable servings compared with 26% in the population.³⁶ Additionally, 22.7% were vegetarian/vegan and

13.5% pescetarian. Average BMI was 23 (normal), with only 5.1% of the sample obese, substantially lower than national figures of 26%.³⁶ The majority (93.5%) reported engaging in brisk exercise on at least one day per week (M=3.6). Self-reported alcohol intake was substantially below the recommended maximum weekly intake of 14 units.³⁷

Table 2: Health characteristics of sample

	N	Percent	Mean (SD)
Smoking history	2388		
Never	1348	56.4	
Ex-smoker	940	39.4	
Current smoker	100	4.2	
Fruit/veg intake (per day)	2415		
≤2	163	6.7	
3-4	932	38.6	
≥5	1320	54.7	
Diet	2414		
Omnivore	1286	53.3	
Pescetarian	328	13.6	
Vegetarian	455	18.7	
Vegan	95	3.9	
Other	250	10.4	
Alcohol units (per week)	2031		6.47 (7.53)
Exercise (days per week)	2381		3.63 (2.07)
BMI	2346		23.49 (3.61)
Obese (BMI ≥30)		5.1	
General health status	2190		
Excellent		17.9	
Very good		44.4	
Good		30.3	
Fair		6.7	
Poor		0.6	
Wellbeing (WEMWBS)	2175		53.90 (7.78)
Stress (PSS-4)	2169		4.59 (2.80)
Satisfaction with life (ONS)	2189		7.94 (1.51)

Life worthwhile (ONS)	2186		8.27 (1.53)
Happiness yesterday (ONS)	2185		7.96 (1.75)
Anxiety yesterday (ONS)	2190		3.49 (2.47)

The majority rated their general health as good, very good or excellent (92.6%), higher than representative norms.³⁸ Wellbeing was higher (53.9 vs 51.1)³² and stress lower (4.6 vs 6.1)³⁹ than norms in England, whilst ONS wellbeing compared favourably for life satisfaction (7.9 vs 7.7), life worthwhile (8.3 vs 7.9), and happiness (8.0 vs 7.5), however anxiety was higher than population norms (3.5 vs 2.9).⁴⁰

Yoga practice characteristics

Diverse styles of yoga were reported, with hatha (28%), Iyengar (25.3%), vinyasa flow (14.8%) and ashtanga (7.2%) most frequently reported. The most popular venues were: yoga studio (57.5%), community hall (38%), and gym (25.1%), with 20.7% practising at home using online resources or DVDs. Participants spent an average of £50.13 (±61.55) on classes/workshops per month. 64.6% of practice time was spent on physical poses, 13.1% breathwork, 12.0% relaxation, 8.6% meditation and 1.9% other practices such as chanting and study. 15.8% reported attending one-to-one yoga sessions and 12.8% yoga therapy sessions in the past 12 months. Over half (51.5%) of participants reported undertaking meditation practice independent of their yoga practice. Yoga practice frequency is summarised in Table 3, indicating high levels of yoga practice in both teachers and non-teachers. Participants reported practising yoga from less than one to 56 years with teachers having practised for longer and more frequently.

Table 3: Summary of yoga practice variables for teachers and non-teachers

	All	Teachers	Non-teachers
Hours at home per week	2.79 (± 3.17)	4.46 (± 3.61)	1.62 (± 2.21)
Hours in class per week	2.73 (± 2.40)	2.87 (± 2.56)	2.50 (± 1.82)
Days per week	3.88 (± 1.96)	4.99 (± 1.59)	3.25 (± 1.86)
Years of practice	13.9 (± 11.6)	18.18 (± 10.10)	10.5 (± 10.61)

Gender differences

There were few gender differences. Men were significantly older than women ($t=3.17$, $df=2153$, $p<.005$) and had practised for a shorter duration ($t=3.23$, $df=2355$, $p<.001$) but there were no differences in other practice variables. Males did not differ significantly from females on smoking, fruit/vegetable intake or exercise, but had higher BMI ($t=4.16$, $df=2330$, $p<.0025$) and alcohol intake ($t=3.29$, $df=2021$, $p<.001$). For health and wellbeing measures, females differed only on feeling life was more worthwhile ($t=2.36$, $df=2171$, $p<.05$).

Motivations

A comparison of initial and current motivations for practice is shown in Figure 1. Principal initial reasons were for general wellness (39%), fitness (19%) and flexibility (8.5%). 16% of participants reported starting yoga for a physical (9.5%) or mental health condition (6%), with musculoskeletal conditions and anxiety/depression most commonly cited. Almost half (47%) reported a change in focus over time, most notably in relation to spirituality (21%), stress management (18%) and social interaction (6%).

Fig 1 here

Perceived health impact

A large majority agreed/strongly agreed that yoga had improved their physical health (88%), mental health (86.2%), stress levels (82.6%), strength (87.1%) and flexibility (91.6%). Additionally, 69.3% reported lifestyle changes perceived as resulting from their yoga practice and 57.4% sleep improvement.

Whilst all yoga practice variables were significantly correlated with impact, frequency of practise, both in terms of hours per week and days per week (versus hours practised in class or years of practise) was most strongly correlated with all health outcomes ($p<.0005$). The strongest relationship was for lifestyle changes ($r_s=.411$, $N=1902$, $p<.0005$). [See supplementary material]

Participants rated perceived helpfulness for a range of health conditions/issues they had experienced (Table 4). In particular, musculoskeletal and mental health issues were reported by a large number of our participants, with the majority reporting yoga as helpful

or very helpful in managing these conditions. Interestingly, those currently reporting these conditions was substantially lower. Very few participants reported heart disease (N=9), COPD (N=6), Crohn’s (N=8), epilepsy (N=10), or diabetes (N=18).

Table 4: Perceived helpfulness in managing health issues and conditions

Condition	N	Helpful (%)	Neither helpful nor unhelpful	Unhelpful (%)	Currently reported (%)
Musculoskeletal					178 (7.3)
Back pain	1070	94.8	3.8	1.4	201 (8.3)
Neck/Shoulder pain	903	91.7	6.2	2.1	
Arthritis	261	87.0	12.3	0.8	
Other	424	82.8	2.4		
Mental health					
Stress	997	98.4	1.4	0.2	340 (14.0)
Anxiety	712	96.8	2.9	0.2	254 (10.4)
Depression	513	93.2	5.5	1.4	105 (4.3)
Sleep issues	463	79.0	19.7	1.2	261 (10.7)
Other	75	96.0	4.0	0	
Women’s health					
Pre/post pregnancy	86	89.5	8.1	2.3	213 (8.8)
Pre-menstrual syndrome	275	76.5	22.5	0.7	
Menopause (symptoms)	224	68.7	29.4	1.9	
Other	98	77.6	21.4	1.0	
Cardiovascular					
High BP	160	73.0	26.3	0.6	88 (3.6)
Other	57	66.7	31.6	1.8	
Respiratory					
Asthma	214	72.4	27.1	0.5	119 (4.9)
Other					
Gastrointestinal					
IBS	309	69.3	29.8	1.0	123 (5.1)
Other	98	68.4	26.5	5.1	

Neurological					
Migraines	243	54.7	41.2	4.1	96 (3.9)
Headaches	415	68.7	22.3	2.7	94 (3.9)
Other	53	83.0	17.0	0	
Other					
Allergies	296	27.2	66.4	6.4	239 (9.8)
Fertility issues	74	32.4	58.1	9.5	29 (1.2)

Only conditions with responses greater than 50 (N) are included;

Impact of yoga practice characteristics on stress & wellbeing

Hierarchical regression models with age and sex entered in the first step and yoga practice variables, teacher status and meditation practice in subsequent steps, were all significant in predicting stress and wellbeing criterion variables (Table 5). Age was positively associated with health outcomes in all models, with frequency of yoga practice contributing additional variance in all models except anxiety. Teacher status and having an independent meditation practice were significant predictors but accounted for very small additional variance.

Table 5: Results of linear regression models predicting health variables from age, yoga practice variables, yoga practitioner status and meditation.

Health and wellbeing outcomes	Step 1 Age and Gender Adjusted R ²	Step 2 Yoga variables ΔR^2	Step 3 Yoga instructor ΔR^2	Step 4 Meditation practice ΔR^2	Final Adjusted Adjusted R ²	Significant predictors	B	SE B	β	t	p
Stress (PSS)	.047***	.037***	.013***	0	.092	Age	-.049	.006	-.219	-7.744	< .001
						Days per week	-.167	.048	-.116	-3.486	.001
						Yoga Teacher	-.771	.67	-.133	-4.610	< .001
WEMWBS	.017***	.053***	.011***	.005***	.082	Age	.078	.018	.125	4.378	< .001
						Days per week	.458	.33	.116	3.449	.001
						Yoga Teacher	1.787	.66	.112	3.835	< .001
Life satisfaction	.024***	.037***	.007***	.004***	.068	Age	.016	.003	.131	4.568	< .001
						Hrs in Class	.043	.018	.062	2.408	.016
						Yoga Teacher	.271	.092	.087	2.961	.003
						Practice meditation	.206	.076	.069	2.705	.007
Life worthwhile	.024***	.049***	.013***	.006***	.092	Sex	-.292	.123	-.058	-2.371	.018
						Age	.014	.004	.111	3.918	< .001
						Hrs at home	.045	.016	.090	2.787	.005
						Hrs in Class	.042	.018	.059	2.337	.020
						Yoga Teacher	.387	.092	.123	4.205	< .001

						Practice meditation	.251	.077	.082	3.277	.001
Happiness	.029***	.036***	.001	.007***	.070	Age	.020	.004	.140	4.901	< .001
						Hrs at home	.057	.018	.101	3.083	.002
						Hrs in class	.049	.021	.061	2.385	.017
						Practice Meditation	.294	.088	.085	3.338	.001
Anxiety	.014***	.007*	.004***	0	.023	Age	-.020	.006	-.102	-3.486	.001
						Yoga Teacher	-.399	.050	-.080	-2.666	.008

Note. Statistical significance: * $p < .05$; ** $p < .01$; *** $p < .001$

Sex was coded as female =0 and male =1, Not Yoga Teacher = 0 and Yoga Teacher =1, No Meditation Practice =0 and Meditation Practice = 1

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Yoga-related injuries

When asked about injuries attributable to yoga practice, 67.6% (N=1646) reported no injuries, 20.7% (N=504) at least one injury, 5.4% (N=131) a second, and 1% (N=24) a third injury. Back (24.0%), knee (13.1%), shoulder (12.5%), neck (7.5%), wrist (6.0%) and foot/ankle (3.4%) injuries were most common. The majority (72%) were new injuries and occurred in class across a range of yoga styles (48.6%), from following a specific instruction (13.5%) or receiving an adjustment from a teacher (11.2%), with a further 26.6% during unsupervised/home practice.

DISCUSSION

This is the first comprehensive survey of yoga practice in the UK. Demographic findings were broadly consistent with those in other countries, with practitioners' predominately female, white and well educated. Compared with UK population norms, participants reported better general health, higher wellbeing and positive health behaviours and lower obesity. Whilst this cannot be linked specifically to yoga given the cross-sectional nature of the study, the vast majority of participants reported that yoga had improved their physical and mental health, with two thirds attributing lifestyle changes to their yoga practice. This was associated with frequency of yoga practice rather than overall length of practising. Importantly, our survey found that participants perceived yoga as helpful in managing a wide range of health conditions, most notably musculoskeletal conditions and mental health, consistent with findings in the US² and clinical trials.^{11 13} This suggests that yoga is used in the UK to manage health conditions and support wellbeing and has further potential to support self-care of debilitating and costly health disorders.

Health and lifestyle

As expected, lifestyle variables compared favourably with the general UK population. These findings are consistent with studies in other developed countries.^{3 24 25} Similarly, wellbeing was higher^{32 40} and stress lower³⁹ than national norms. Anxiety, however, was higher than population norms⁴⁰ and was also the most commonly cited health issue. This reflects the complex relationship between yoga and physical and mental health.²⁰ Yoga practitioners

report better than average overall health,^{4 25 41} but commonly report mental health issues,²¹ frequently seeking out yoga to manage these. Over 90% of our sample found yoga helpful for such conditions and current reports of anxiety or depression were lower than prior to yoga.

Consistent reports of healthier lifestyles, lower levels of stress and higher levels of wellbeing in yoga practitioners compared to population figures are important given the increases in disease arising from modifiable health behaviours¹⁹ and in mental illness.⁴² Although this may partly reflect our white, educated, female sample there were few gender differences in health and behavioural outcomes. Alternate explanations include attitudinal change in line with ethical guidelines on lifestyle,³ reinforcement of positive affect associated with positive health behaviours,⁴³ and greater body awareness increasing motivation to take up other healthy behaviours.⁴⁴ Isolating the specific causal effects of yoga practice on behavioural outcomes is challenging but warrants further testing in controlled studies with long term follow-up.

Motivations, health impact and yoga characteristics

Few studies have explored changes in motivation over time and yet almost half our participants stated that their focus had changed, particularly towards a more holistic psycho-spiritual approach, which mirrors the findings of Park et al's smaller study.²⁶ This may also reflect a growth in commitment to yoga as a holistic lifestyle practice and underlie behavioural shifts towards a healthier lifestyle. A more spiritual focus has also been found to be associated with higher psychological wellbeing.⁴⁵ Yoga experience varied considerably but frequency of practice was a stronger predictor of health outcomes than years of practice, consistent with previous findings.²¹ Additional meditation practice was linked to higher positive wellbeing but not perceived stress or anxiety, perhaps surprising given the evidence for meditation as a stress reduction tool.⁴⁶

However, yoga-practice variables accounted for limited variance in health measures in the current and previous studies.^{4 21} The high levels of yoga practice in our sample suggest that it is primarily having a committed practice that impacts on health. Higher yoga involvement has been associated with higher mindfulness, spiritual wellbeing and lower psychiatric

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symptoms.⁴⁷ Activities, such as yoga, that offer small but frequent boosts to wellbeing, may provide an effective mechanism to increase longer-term wellbeing.⁴⁸

Consistent with previous studies, respondents strongly believed that yoga had a positive impact on their physical and mental health.^{23 25} Many reported its value in managing a range of health conditions, most notably musculoskeletal and mental health conditions. This augments clinical research on the effectiveness of yoga by demonstrating that people are perceiving health benefit in naturalistic settings. However, few respondents reported cardiovascular disease and diabetes, consistent with a previous national UK survey,²⁴ despite the potential benefits of yoga as an ancillary and preventative treatment.^{15 49}

Like any physical activity, yoga is not without the potential for adverse effects. Yoga-related injuries were consistent with a recent systematic review of observational studies, with a lifetime prevalence of 32%.⁵⁰ Whilst we did not assess severity, Cramer et al reported that adverse effects were predominately relatively minor, musculoskeletal injuries consistent with our findings.

Limitations

This is the first large study in the UK to investigate yoga practice and its impact on health. Nevertheless, the sample was self-selected with a high proportion of yoga teachers so is unlikely to be representative and may be biased towards more positive evaluations of yoga. The results relied on retrospective and self-report data which may be subject to memory bias and social desirability, whilst the cross-sectional design precludes causal inferences about the relationship between yoga practice and health outcomes. The findings are, however, remarkably consistent with surveys in other countries suggesting the findings are relatively robust.

CONCLUSION

Compared with population norms, yoga practitioners reported higher health, wellbeing and rates of health protective behaviours, and lower health risk behaviours, stress and obesity. Yoga practitioners reported a range of reasons for initiating and maintaining yoga practice with their focus changing from physical to psycho-spiritual factors over time, a potential factor underlying behavioural maintenance and integration of a healthy lifestyle. Yoga was

perceived as helpful for managing a variety of physical and psychological health issues suggesting that yoga is commonly used to support self-care and manage health conditions. It is, thus, pertinent to consider in what ways this holistic approach to health and wellbeing could help address the complex health-related issues with which many countries are now grappling.

Acknowledgements

The authors would like to thank Eleanor Connolly for her assistance with questionnaire development and data collection, and Professor Sat Bir Khalsa, Professor Holger Cramer and Dr Anna Cheshire for their feedback on the initial questionnaire. They would also like to express their gratitude to all yoga studios, teachers and the British Wheel of Yoga for promoting the survey and to participants for taking their time to complete the questionnaire.

Contributors

KP, TC and HM conceived and designed the study. TC and KP managed recruitment and TC and AP conducted data analysis. TC and KP wrote the paper with contributions from all authors. All authors read and approved the final manuscript.

Funding

No external funding was received for this study.

Competing interests

TC, KP, AP declare that they have no competing interests. The Mindful Institute and Yoga in Health Care Alliance create treatment and training programmes for professionals to use yoga and mindfulness techniques with long-term health conditions. Individuals and organisations (including health services) pay for attendance of trainings and courses.

Ethics approval

The study was approved by the University of Westminster Ethics Committee (1516-0614). Participants gave informed consent before taking part.

Data sharing statement

No additional data are available.

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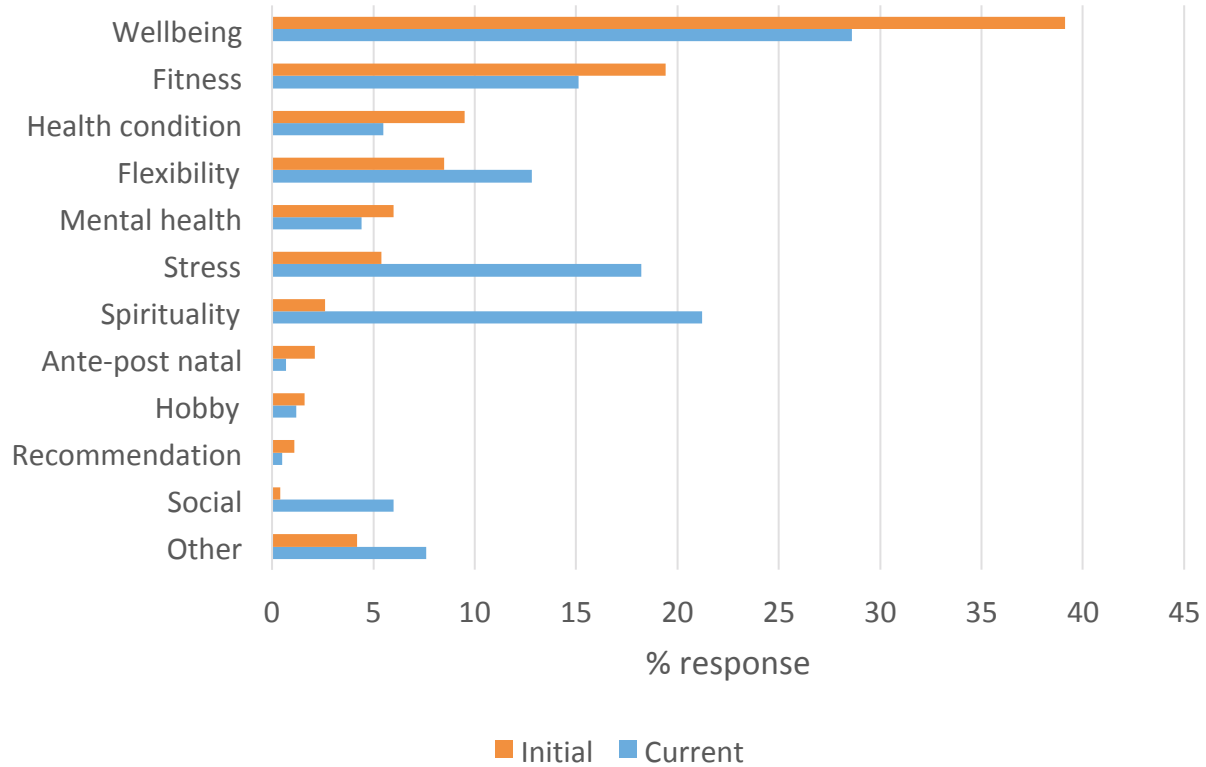


Figure 1: Initial and current principal reasons for practising yoga

Supplementary table: Spearman intercorrelations for health impact and yoga practice variables

	My physical health has improved as a result of yoga	My mental health has improved as a result of yoga	I have changed my lifestyle as a result of yoga	My stress level has improved as a result of yoga	My strength has improved as a result of yoga	My flexibility has improved as a result of yoga	My sleep has improved as a result of yoga
Hours at home per week	.305**	.276**	.411**	.303**	.283**	.226**	.265**
Hours in class per week	.194**	.104**	.165**	.102**	.142**	.158**	.127**
Days per week	.289**	.272**	.395**	.316**	.279**	.223**	.247**
Years of practice	.130**	.078**	.080**	.086**	.088**	.103**	.072**
My physical health has improved		.655**	.585**	.598**	.622**	.596**	.467**
My mental health has improved			.615**	.726**	.539**	.476**	.496**
I have changed my lifestyle				.682**	.547**	.480**	.510**
My stress level has improved					.568**	.505**	.541**
My strength has improved						.678**	.469**
My flexibility has improved							.447**

Statistical significance: *p< 0.01 level (2-tailed), **p<0.005 level (2-tailed).

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	7
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	8-9, 10-11
Outcome data	15*	Report numbers of outcome events or summary measures	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15-16
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Yoga practice in the UK: a cross-sectional survey of motivation, health benefits and behaviours

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-031848.R1
Article Type:	Original research
Date Submitted by the Author:	16-Sep-2019
Complete List of Authors:	Cartwright, Tina; University of Westminster, School of Social Sciences Mason, Heather; The Mindful Institute Porter, Alan; University of Westminster, School of Social Sciences Pilkington, Karen; University of Portsmouth, School of Health Sciences and Social Work
Primary Subject Heading:	Sports and exercise medicine
Secondary Subject Heading:	Mental health, Public health
Keywords:	COMPLEMENTARY MEDICINE, PREVENTIVE MEDICINE, MENTAL HEALTH, PUBLIC HEALTH, yoga

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Yoga practice in the UK: a cross-sectional survey of motivation, health benefits and behaviours

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ABSTRACT

Objectives: Despite the popularity of yoga and evidence of its positive effects on physical and mental health, little is known about yoga practice in the UK. This study investigated the characteristics of people who practise yoga, reasons for initiating and maintaining practice, and perceived impact of yoga on health and wellbeing.

Design, setting and participants: A cross-sectional online anonymous survey distributed through UK-based yoga organisations, studios and events, through email invites and flyers. 2434 yoga practitioners completed the survey, including 903 yoga teachers: 87% were female, 91% white, and 71% degree educated, mean age was 48.7 years.

Main outcome measures: Perceived impact of yoga on health conditions, health outcomes and injuries. Relationships between yoga practice and measures of health, lifestyle, stress and wellbeing.

Results: In comparison with national population norms, participants reported significantly higher wellbeing but also higher anxiety; lower perceived stress, BMI and incidence of obesity, and higher rates of positive health behaviours. 47% reported changing their motivations to practise yoga, with general wellness and fitness key to initial uptake, and stress management and spirituality important to current practice. 16% of participants reported starting yoga to manage a physical or mental health condition. Respondents reported the value of yoga for a wide range of health conditions, most notably for musculoskeletal and mental health conditions. 20.7% reported at least one yoga-related injury over their lifetime. Controlling for demographic factors, frequency of yoga practice accounted for small but significant variance in health-related regression models ($p < .001$).

Conclusion: The findings of this first detailed UK survey were consistent with surveys in other Western countries. Yoga was perceived to have a positive impact on physical and mental health conditions and was linked to positive health behaviours. Further investigation of yoga's role in self-care could inform health-related challenges faced by many countries.

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Strengths and limitations of the study

- This is the first comprehensive survey to assess the practice and perceived impact of yoga on health, lifestyle-related behaviours and wellbeing in the UK.
- The survey design captures the significant number of practitioners who take up yoga to manage a physical or mental health condition, and identifies health conditions for which yoga is rated as most helpful in self-management.
- Despite the large sample, it was self-selected and unlikely to be representative of all yoga practitioners.
- The results relied on retrospective and self-report data which may be subject to memory bias and social desirability.

INTRODUCTION

Originating in India as a comprehensive mind-body practice, yoga has become increasingly popular in the West as a holistic approach to health and wellbeing. In the US, national health surveys indicate a lifetime prevalence rate of 13.2% or 31 million adults in 2012,¹ an increase from 5.1% a decade earlier.² Surveys also demonstrate significant levels of practice in countries such as Australia³ and Germany.⁴ Although there are many different styles of yoga, the main components of yoga include physical postures, breathing techniques, relaxation and meditation. There is growing evidence that yoga is an effective multi-component health intervention that reduces stress, increases physical activity and improves wellbeing.⁵⁻⁷ Clinical studies provide preliminary support for the effectiveness of yoga as an adjunct treatment for a range of chronic conditions, such as depression,^{8 9} anxiety,^{10 11} lower back pain,^{12 13} and Type 2 diabetes.^{14 15} Potential physiological mechanisms include down-regulation of the hypothalamic-pituitary adrenal (HPA) axis and sympathetic nervous system and reduced inflammatory markers.^{6 16 17} Additionally, psychological mechanisms such as enhanced self and body awareness, coping, mindfulness, self-compassion and social connectedness may underlie healthier lifestyle choices and more adaptive responses to stressors.¹⁷ Moderate effects have also been reported on cognitive function.¹⁸ Given the increasing personal and healthcare costs associated with lifestyle-related diseases,^{19 20} it is important to better understand the impact of yoga on health-related outcomes in both clinical and naturalistic settings.

Previous surveys, primarily in the US and Australia, have provided some insight into the characteristics of yoga practitioners, their motivations and yoga's perceived health impact. Yoga practitioners are consistently more likely to be female, white, educated and of higher socioeconomic status.^{1 4 21-24} This contrasts with a recent survey in India where practitioners were more likely to be male and high school educated, likely to reflect both cultural factors in the perceptions of yoga given its Indian origins and the predominance of children and students in the sample.²⁵ Whilst yoga practitioners' health status is higher than population norms,^{1 26} yoga is used to manage a range of health conditions. For example, in the US National Health Interview Surveys in 2002 and 2012, musculoskeletal and mental health²³ and back pain, stress and arthritis¹ were the main health conditions for which people most commonly practised yoga. The majority reported yoga as helpful in managing these

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conditions.²³ In Australia, 20% of those surveyed practised yoga for a specific health reason reported to be improved by yoga,²⁴ while 88% of survey participants in Germany rated their health as improved since starting yoga.⁴ Studies have also found an association between yoga/meditation practice and positive health behaviours such as higher physical activity levels, lower rates of smoking, and higher likelihood of vegetarian diet.^{3 24 26 27}

Several studies have explored motivational factors underlying yoga practice; most commonly cited are general wellness,^{1 24} health and fitness,²⁴ a specific health condition,²⁴ and improved immune function and energy.¹ Park et al. found that while physical improvement (exercise and flexibility) and stress relief were the most prevalent reasons for adopting yoga, individuals' motives for continuing yoga shifted towards more holistic motivations such as spirituality over time.²⁸ Taken together, these surveys indicate that a substantial proportion of the population is attracted to yoga to manage their physical, mental and spiritual health.

It is therefore surprising that little is known about yoga practice in the UK. The Health Survey for England suggested an increasing but relatively low (1.11%) prevalence of yoga practice (0.46% in 1997/1999, 1.11% in 2006/2008).²⁶ This was, however, based on responses to the question "Have you done any other sport or exercise not listed on this card?" and referred to the previous 4 weeks only. The data is now relatively dated and limited in the extent to which it provided insight into decision-making around yoga practice. The potential impact of yoga on managing health conditions and increasing health-related behaviours is particularly relevant given the unprecedented increase in long-term conditions and links between comorbidity and poor mental health.²⁰ Management of this 'tsunami of need'²⁹ has led to a focus on self-care approaches to reduce lifestyle risk factors and manage chronic conditions. Universal Personalised Care is included in the recent NHS Long Term Health Plan,³⁰ with scope for the inclusion of yoga.³¹ A comprehensive survey of current yoga practice in the UK and perceived impact on health conditions, behaviours and wellbeing is thus timely.

The overall aim of this current study was, therefore, to gain a better understanding of current yoga practice in the UK by investigating: 1) the characteristics, lifestyle and wellbeing of those practising yoga in comparison with national norms; 2) yoga practice characteristics; 3) motivations underlying yoga practice; 4) perceived impact of yoga on

health outcomes; and 5) the relationship between yoga practice characteristics and wellbeing.

MATERIALS AND METHODS

Design and recruitment

The study was a cross-sectional survey design using an anonymous online questionnaire hosted on Qualtrics. Recruitment was through UK-based yoga organisations, yoga studios and teachers, marketing at UK yoga events and social media. Information about the study was posted on a dedicated University website and Facebook page and widely advertised by two yoga organisations and at several yoga events (during international yoga day, a yoga symposium and an All Party Parliamentary Group (APPG) on Traditional Indian Sciences) with printed flyers and presentations. Email invitations were also sent to 79 studios located in major cities across the UK and identified through online searches, requesting they send the link to their members. Yoga practitioners were invited to participate if they met the inclusion criteria: UK resident, practised yoga within the past 12 months, and were over 18 years. Ethics approval was gained from the University of Westminster Ethics committee and all participants gave informed consent. Data collection took place over a six month period (June-Dec 2016).

Patient and public involvement

At the pilot stage, 12 yoga practitioners were consulted regarding the aims of the study and content and acceptability of the questionnaire which was incorporated into the final survey. Eight were female and 5 were yoga teachers, aged 33-49 years ($M=41.5 \pm 5.37$), having practised yoga for 2-20 years ($M=13.9 \pm 5.2$).

Survey development

Previous surveys of yoga practice were reviewed^{22 24 27} and a draft set of questions compiled focusing on the key objectives. The final questionnaire was informed by consultations with key yoga researchers and feedback from yoga teachers and practitioners from the pilot.

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Socio-demographic variables

Data was collected on: gender, age, education, ethnicity, marital and employment status, and area of residence. The McArthur scale of subjective social status³² is a single-item which assesses perceived social ranking on a 10-point ladder with higher scores indicating higher perceived ranking.

Health, lifestyle and wellbeing variables

Health variables included: self-reported height and weight (to calculate BMI), self-rated health (5-point Likert scale),³³ current health issues (20 listed). Lifestyle variables were assessed with single items and included: smoking status, dietary choices (e.g. vegetarian), average weekly alcohol intake (units), average daily fruit/vegetable intake (2 or less, 3-4, 5 or more), weekly frequency of brisk exercise apart from yoga. Warwick-Edinburgh Mental Well-being Scale (WEMWBS)³⁴ assessed subjective well-being and psychological functioning, with higher scores indicate higher wellbeing. The four single item Office of National Statistics (ONS) measures of personal wellbeing assessed: satisfaction with life nowadays, feeling things in life are worthwhile, how happy yesterday, how anxious yesterday, on 10-point Likert scale (not at all to completely).³⁵ The 4-item Perceived Stress Scale (PSS)³⁶ assessed global life stress with higher scores indicating higher levels of perceived stress.

Yoga practice characteristics

This section asked about personal practice of yoga. Fixed-response questions regarding motivation included reason(s) for starting yoga, for maintaining or taking a break from yoga and whether primary motivations had changed over time. Yoga practice questions included duration of yoga practice (years/months), average days per week practising yoga, average weekly hours spent practising both at home and in class. Fixed-response questions asked about preferred style of yoga, class location, and percentage of time spent on different components (physical poses, breathwork, relaxation, meditation, other). Additional questions asked about use of yoga therapy in past 12 months, any independent meditation practice, including hours spent meditating, and amount spent on yoga classes/workshops per month. Participants were asked whether they were yoga teachers or therapists.

Perceived health impact

Participants were asked to indicate if they had experienced specific health conditions/issues since practising yoga (25 conditions listed with the option to specify other issues) and rate perceived helpfulness of yoga in managing the condition on a 5-point Likert scale (very helpful-very unhelpful). Participants were also asked to rate on a 5-point Likert scale (strongly disagree-strongly agree) the extent to which they perceived yoga impacted on seven generic aspects incorporating physical, mental and lifestyle dimensions identified by previous surveys.²⁷

Yoga-related Injuries

Fixed-response questions relating to up to three injuries sustained as a result of yoga practice including: body location, new or recurring injury, circumstances around occurrence (e.g. unsupervised or whilst receiving an adjustment) and yoga style practised when injury occurred (open response). Respondents were not asked about the severity or duration of any injuries.

Data analysis

Data was cleaned to identify miscoded and missing data. Missing cases were deleted listwise. Descriptive statistics were calculated for socio-demographic characteristics, yoga practice variables, health and lifestyle variables. Percentages were calculated according to total responses to item (valid percent). Gender and other group differences were analysed using t-tests and Chi Square. Comparisons with UK normative data, where available, were analysed using 1-sample t-tests and Chi Square. Pearson's and Spearman's correlations were computed to assess relationships between yoga practice variables and yoga impact and health-related variables respectively, and determine predictor variables for the regression analyses. Hierarchical multiple regression analyses were used to examine the independent effect of demographics, yoga variables, yoga teacher status, and meditation practice on health outcomes including stress, wellbeing, satisfaction with life, worthwhile life, happiness and anxiety as criterion variables.

RESULTS

2635 people responded to the survey, with 2434 people meeting the inclusion criteria and completing at least the first question about yoga participation.

Socio-demographic characteristics

Sociodemographic characteristics are presented in Table 1; the majority of respondents were female, white, well educated (71% ≥ degree), with a wide age range (18-92 years, M=48.7 ±12.5). Participants rated themselves as above average in terms of subjective social status (M=6.62 ±1.47). All areas of the UK were represented although London and the south of England were most prevalent. Forty percent of the sample were yoga teachers (n=903).

Table 1: Sociodemographic characteristics of sample

Variables	Frequency (including n for each variable)	Percent ^a
Gender	2410	
Male	284	11.7
Female	2126	87.3
Ethnicity	2412	
Asian/Asian British	78	3.2
Black/African/Caribbean/Black British	14	0.6
Mixed/Multiple ethnic groups	63	2.6
White	2192	90.9
Other	65	2.7
Marital status	2417	
Single	382	15.8
In a relationship	283	11.7
Married/Cohabiting	1536	63.5
Divorced/Separated	163	6.7
Other	53	2.2
Employment	2418	
Employed full-time	776	32.1
Employed part-time	367	15.2
Self-employed	740	30.6

Unemployed	37	1.5
Student	64	2.6
Retired	339	14.0
Stay at home parent/carer	56	2.3
Other	39	1.6
Education (highest level)	2420	
Secondary school	193	8.0
College/ A level	393	16.2
University Undergraduate	755	31.2
University Postgraduate	963	39.8
Other	116	4.8
Location	2274	
North East/West	455	20.0
East/West Midlands	206	9.1
East England	89	3.9
London	483	21.2
South East/West	769	33.8
Wales	86	3.8
Scotland	153	6.7
Northern Ireland	33	1.5

^a Of total responses (valid percent).

Lifestyle and health characteristics and comparison with UK norms

Given that teachers are likely to differ from non-teachers in health characteristics and yoga practice,²⁴ Table 2 shows descriptive data for each group separately and combined to enable comparisons with national norms, where available. Both groups compared favourably with health and lifestyle norms. Only 4.2% currently smoked, significantly lower than 15.1% in the general adult UK population ($p < 0.0005$).³⁷ Similarly, 55% reported the recommended intake of daily fruit/vegetable servings, significantly higher than 26% in the population ($p < 0.0005$).³⁸ Additionally, 22.7% were vegetarian/vegan and 13.5% pescetarian. Average BMI was 23 (normal), with only 5.1% of the sample obese, both significantly lower than national figures ($p < 0.0005$).³⁸ The majority (93.5%) reported engaging in brisk exercise on at least one day per week ($M = 3.6$). Self-reported alcohol intake was substantially below the recommended maximum weekly intake of 14 units.³⁹

Table 2: Health, lifestyle and yoga practice variables of complete sample, yoga teachers and yoga practitioners

	Percent ^a (n)			
	All	Yoga teachers	Yoga practitioners	Available normative data
Smoking history				
Never	56.4 (1348)	53.1 (474)	59.0 (786)	-
Ex-smoker	39.4 (940)	43.8 (391)	36.1 (481)	-
Current smoker	4.2 (100)**	3.1 (28)**	4.9 (65)**	15.1 ³⁷
Daily fruit/vegetable intake				
≤2	6.7 (163)	4.7 (42)	7.9 (107)	
3-4	38.6 (932)	33.5 (302)	41.9 (565)	
≥5	54.7 (1320)**	61.8 (557)**	50.1 (676)**	26.0 ³⁸
Diet				-
Omnivore	53.3 (1286)	42.1 (378)	60.7 (818)	
Pescetarian	13.6 (328)	18.0 (162)	10.8 (146)	
Vegetarian	18.7 (455)	24.5 (220)	14.8 (199)	
Vegan	3.9 (95)	5.1 (46)	3.3 (44)	
Other	10.4 (250)	10.2 (92)	10.5 (141)	
General health status				-
Excellent	17.9 (392)	25.0 (214)	13.3 (176)	
Very good	44.4 (973)	48.4 (415)	41.8 (552)	
Good	30.3 (664)	22.4 (192)	35.4 (467)	
Fair	6.7 (147)	3.5 (30)	8.9 (117)	
Poor	0.6 (14)	0.7 (6)	0.6 (8)	
Obese (BMI ≥30)	5.1 (114)**	3.1 (27)**	6.6 (87)**	26.0 ³⁸
Mean (± SD)				
BMI	23.49 (± 3.61)**	22.92 (± 3.20)**	23.87 (± 3.81)**	27.7 ⁴⁰
Alcohol units (per week)	6.47 (± 7.53)	5.77 (± 6.92)	7.01 (± 7.80)	-
Exercise (days per week)	3.63 (± 2.07)	3.73 (± 2.15)	3.54 (± 2.0)	-
Wellbeing (WEMWBS)	53.90 (± 7.78)**	56.02 (± 6.79)**	52.53 (± 8.08)**	51.1 ³⁴
Stress (PSS-4)	4.59 (± 2.80)**	3.90 (± 2.54)**	5.03 (± 2.86)**	6.1 ⁴¹
Satisfaction with life (ONS)	7.94 (± 1.51)**	8.28 (± 1.31)**	7.72 (± 1.57)	7.7 ⁴²
Life worthwhile (ONS)	8.27 (± 1.53)**	8.71 (± 1.24)**	7.80 (± 1.63)*	7.9 ⁴²
Happiness yesterday (ONS)	7.96 (± 1.75)**	8.29 (± 1.55)**	7.75 (± 1.84)**	7.5 ⁴²
Anxiety yesterday (ONS)	3.49 (± 2.47)**	3.19 (± 2.48)*	3.68 (± 2.43)**	2.9 ⁴²
Yoga practice				
Hours at home per week	2.79 (± 3.17)	4.46 (± 3.61)	1.62 (± 2.21)	
Hours in class per week	2.73 (± 2.40)	2.87 (± 2.56)	2.50 (± 1.82)	
Days per week	3.88 (± 1.96)	4.99 (± 1.59)	3.25 (± 1.86)	
Years of practice	13.9 (± 11.6)	18.18 (± 10.10)	10.5 (± 10.61)	

^a Of total responses (valid percent). Significantly different from available norms using chi-square and 1-sample t-tests: *p<0.05; **p<0.0005

Abbreviations: PSS - Perceived Stress Scale; WEMWBS - Warwick-Edinburgh Mental Well-being Scale; ONS – Office of National Statistics (personal wellbeing)

The majority rated their general health as good, very good or excellent (92.6%). Wellbeing was significantly higher³⁴ and perceived stress lower⁴¹ than norms in England for all participants ($p < 0.0005$). For yoga teachers, ONS wellbeing items compared favourably with norms for life satisfaction, life worthwhile, and happiness ($p < 0.0005$). For non-teachers, happiness was higher, but feeling life was worthwhile was lower than norms ($p < 0.05$). Additionally, feeling anxious was higher than population norms for all participants ($p < 0.0005$).⁴²

Males did not differ significantly from females on smoking, fruit/vegetable intake or exercise, but had higher BMI ($M = 24.3$ & 23.4 ; $t = 4.16$, $df = 2330$, $p < .0025$) and alcohol intake ($M = 8.7$ & 6.2 ; $t = 3.29$, $df = 2021$, $p < .001$). For health and wellbeing measures, females differed only on feeling life was more worthwhile ($M = 8.3$ & 8.1 ; $t = 2.36$, $df = 2171$, $p < .05$).

Yoga practice characteristics

Yoga practice frequency is summarised in Table 2, indicating high levels of yoga practice in both teachers and non-teachers. Participants reported practising yoga from less than one to 56 years, with teachers having practised for longer and more frequently at home and in class ($p < 0.0005$). Males reported practising for a shorter duration than females ($M = 11.7$ & 14.18 ; $t = 3.23$, $df = 2355$, $p < .001$), but did not differ on other characteristics. Diverse styles of yoga were reported, with Hatha (28%), Iyengar (25.3%), Vinyasa flow (14.8%) and Ashtanga (7.2%) most frequently reported. The most popular venues were: yoga studio (57.5%), community hall (38%), and gym (25.1%), with 20.7% practising at home using online resources or DVDs. Participants spent an average of £50.13 (± 61.55) on classes/workshops per month. 64.6% of practice time was spent on physical postures, 13.1% breathwork, 12.0% relaxation, 8.6% meditation and 1.9% other practices such as chanting and study. 15.8% reported attending one-to-one yoga sessions and 12.8% yoga therapy sessions in the past 12 months. Over half (51.5%) of participants reported undertaking meditation practice independent of their yoga practice.

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Motivations

A comparison of initial and current motivations for practice is shown in Figure 1. Principal initial reasons were for general wellness (39%), fitness (19%) and flexibility (8.5%). 16% of participants reported starting yoga for a physical (9.5%) or mental health condition (6%), with musculoskeletal conditions and anxiety/depression most commonly cited. Almost half (47%) of participants reported a change in focus over time, most notably in relation to spirituality (21%), stress management (18%) and social interaction (6%).

Fig 1 here

Perceived health impact

Participants' rated the extent to which they felt yoga had improved seven generic aspects of health incorporating physical, mental and lifestyle dimensions. The majority either agreed or strongly agreed that yoga had improved their physical health (88%), mental health (86.2%), stress levels (82.6%), strength (87.1%) and flexibility (91.6%). Additionally, 69.3% reported lifestyle changes perceived as resulting from their yoga practice and 57.4% sleep improvement.

All yoga practice variables were significantly correlated with perceived health impact [see supplementary material]. However, frequency of practise, both in terms of hours at home per week and days per week, were most strongly correlated with all health impact variables ($p<.0005$), with the strongest relationship for lifestyle changes ($r_s=.411$, $n=1902$, $p<.0005$).

Participants rated perceived helpfulness for a range of health conditions/issues they had experienced (Table 3). In particular, a history of musculoskeletal and mental health issues were reported by a large number of our participants, with the majority reporting yoga as helpful or very helpful in managing these conditions. The number of participants currently reporting health issues was substantially lower than the numbers who reported having experienced these in the past. The most frequent were: stress ($n=340$), sleep issues ($n=261$), anxiety ($n=254$), arthritis ($n=201$), menopausal symptoms ($n=213$), musculoskeletal problems ($n=178$), irritable bowel syndrome ($n=123$) and asthma ($n=119$). Very few

participants reported heart disease (n=9), chronic obstructive pulmonary disease (n=6), epilepsy (n =10), or diabetes (n =18).

Table 3: Perceived helpfulness in managing health issues and conditions

Condition	n	Helpful (%)	Neither helpful nor unhelpful	Unhelpful (%)
Musculoskeletal				
Back pain	1070	94.8	3.8	1.4
Neck/Shoulder pain	903	91.7	6.2	2.1
Arthritis	261	87.0	12.3	0.8
Other	424	82.8	2.4	
Mental health				
Stress	997	98.4	1.4	0.2
Anxiety	712	96.8	2.9	0.2
Depression	513	93.2	5.5	1.4
Sleep issues	463	79.0	19.7	1.2
Other	75	96.0	4.0	0
Women's health				
Pre/post pregnancy	86	89.5	8.1	2.3
Pre-menstrual syndrome	275	76.5	22.5	0.7
Menopause (symptoms)	224	68.7	29.4	1.9
Other	98	77.6	21.4	1.0
Cardiovascular				
High Blood Pressure	160	73.0	26.3	0.6
Other	57	66.7	31.6	1.8
Respiratory				
Asthma	214	72.4	27.1	0.5
Other				
Gastrointestinal				
Irritable Bowel Syndrome	309	69.3	29.8	1.0
Other	98	68.4	26.5	5.1
Neurological				
Migraines	243	54.7	41.2	4.1
Headaches	415	68.7	22.3	2.7

Other	53	83.0	17.0	0
Other				
Allergies	296	27.2	66.4	6.4
Fertility issues	74	32.4	58.1	9.5

Only conditions with responses greater than 50 (N) are included

Yoga-related injuries

When asked about injuries attributable to yoga practice, 67.6% (n=1646) reported no injuries, 20.7% (n=504) at least one injury, 5.4% (n=131) a second, and 1% (n=24) a third injury. Back (24.0%), knee (13.1%), shoulder (12.5%), neck (7.5%), wrist (6.0%) and foot/ankle (3.4%) injuries were most common. The majority (72%) were new injuries and occurred in class across (48.6%), from following a specific instruction (13.5%) or receiving an adjustment from a teacher (11.2%), with a further 26.6% during unsupervised/home practice. A range of yoga styles and specific postures were listed in association with individual injuries.

Relationship between yoga practice characteristics and stress and wellbeing

Hierarchical regression models with age and gender entered in the first step and yoga practice variables, teacher status and meditation practice in subsequent steps, were all significant in predicting stress and wellbeing criterion variables (Table 4). Age was positively associated with all wellbeing variables and negatively with stress and anxiety. Frequency of yoga practice, but not duration of yoga practice, contributed additional variance in all models except anxiety. Number of days practised per week was a predictor for measures of stress and wellbeing, whilst frequency of home and/or class practice (hours) were independent predictors of life satisfaction, feeling life was worthwhile and happiness. Teacher status and having an independent meditation practice were significant predictors but accounted for very small additional variance.

Table 4: Results of linear regression models predicting stress and wellbeing variables from age, yoga practice variables, yoga practitioner status and meditation.

Health and wellbeing outcomes	Step 1 Age and Gender Adjusted R ²	Step 2 Yoga variables ΔR^2	Step 3 Yoga instructor ΔR^2	Step 4 Meditation practice ΔR^2	Final Adjusted R ²	Significant predictors	B	SE B	β	t	p
Stress (PSS)	.047***	.037***	.013***	0	.092	Age Days per week Yoga Teacher	-.049 -.167 -.771	.006 .048 .167	-.219 -.116 -.133	-7.744 -3.486 -4.610	< .001 .001 < .001
Wellbeing (WEMWBS)	.017***	.053***	.011***	.005***	.082	Age Days per week Yoga Teacher	.078 .458 1.787	.018 .133 .166	.125 .116 .112	4.378 3.449 3.835	< .001 .001 < .001
Life satisfaction (ONS)	.024***	.037***	.007***	.004***	.068	Age Hrs in Class Yoga Teacher Meditation	.016 .043 .271 .206	.003 .018 .092 .076	.131 .062 .087 .069	4.568 2.408 2.961 2.705	< .001 .016 .003 .007
Life worthwhile (ONS)	.024***	.049***	.013***	.006***	.092	Sex Age Hrs at home Hrs in Class Yoga Teacher Meditation	-.292 .014 .045 .042 .387 .251	.223 .004 .016 .018 .092 .077	-.058 .111 .090 .059 .123 .082	-2.371 3.918 2.787 2.337 4.205 3.277	.018 < .001 .005 .020 < .001 .001

Happiness Yesterday (ONS)	.029***	.036***	.001	.007***	.070	Age	.020	.004	.140	4.901	< .001
						Hrs at home	.057	.018	.101	3.083	.002
						Hrs in class	.049	.021	.061	2.385	.017
						Meditation	.294	.088	.085	3.338	.001
Anxiety Yesterday (ONS)	.014***	.007*	.004***	0	.023	Age	-.020	.006	-.102	-3.486	.001
						Yoga Teacher	-.399	.50	-.080	-2.666	.008

Statistical significance: *p< .05; **p< .01; ***p< .001

The predictor variables included in the model were: gender, age, number of days practising yoga per week, hours practising yoga at home, hours practising yoga in class, years practising yoga and meditation status. Sex was coded as female =0 and male =1, Not Yoga Teacher= 0 and Yoga Teacher =1, No Meditation Practice =0 and Meditation Practice = 1.

Abbreviations: PSS - Perceived Stress Scale; WEMWBS - Warwick-Edinburgh Mental Well-being Scale; ONS – Office of National Statistics (personal wellbeing)

DISCUSSION

This is the first comprehensive survey of yoga practice in the UK. Demographic findings were broadly consistent with those in other Western countries, with practitioners' predominately female, white and well educated. Compared with UK population norms, participants reported higher wellbeing and positive health behaviours and lower stress, BMI and obesity. Whilst this cannot be linked specifically to yoga given the cross-sectional nature of the study, the vast majority of participants reported that yoga had improved their physical and mental health, with two thirds attributing lifestyle changes to their yoga practice. This was associated with frequency of yoga practice rather than overall length of practising. Importantly, our survey found that participants perceived yoga as helpful in managing a wide range of health conditions, most notably musculoskeletal conditions and mental health, consistent with findings in the US² and clinical trials.^{11 13} This suggests that yoga is used in the UK to manage health conditions and support wellbeing and has further potential to support self-care of debilitating and costly health disorders.

As expected, lifestyle variables compared favourably with the general UK population. These findings are consistent with studies in other developed countries.^{3 26 27} Similarly, wellbeing was higher^{34 42} and stress lower⁴¹ than national norms, particularly for teachers which may reflect their stronger commitment and immersion in yoga⁴ or could reflect reporting bias. Anxiety, however, was higher than population norms⁴² for all participants and was also the most commonly cited current health issue. This reflects the complex relationship between yoga and physical and mental health, as noted in previous research.²¹ It may be a manifestation of a number of factors, such as higher awareness of emotional distress associated with improved interoception resulting from yoga practice,⁴³ greater willingness to report mental distress, and higher engagement in mindful and holistic practices in this particular population.⁴⁴ Yoga practitioners report better than average overall health,^{4 27 45} but commonly report mental health issues,²² frequently seeking out yoga to manage mental health conditions such as anxiety and depression. Over 90% of our sample found yoga helpful for such conditions, and reports of current anxiety or depression were fewer than prior to yoga.

Consistent reports of healthier lifestyles, lower levels of stress and higher levels of wellbeing in yoga practitioners compared to population figures are important given the increases in

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disease arising from modifiable health behaviours²⁰ and in mental illness.⁴⁶ Although this may partly reflect our white, educated, female sample, there were few gender differences in health and behavioural outcomes. Other possible explanations include attitudinal change in line with ethical guidelines on lifestyle,³ reinforcement of positive affect associated with positive health behaviours,⁴⁷ and greater body awareness increasing motivation to take up other healthy behaviours.⁴⁸ Isolating the specific causal effects of yoga practice on behavioural outcomes is challenging but warrants further testing in controlled studies with long term follow-up. Additionally, understanding the factors underlying gender differences in yoga practice is important given the higher rates of lifestyle-related morbidity in men and challenges around engaging men in health protective behaviours.⁴⁹

Few studies have explored changes in motivation over time and yet almost half of our participants stated that their focus had changed, particularly towards a more holistic psycho-spiritual approach, which mirrors the findings of Park et al's smaller study.²⁸ This may also reflect a growth in commitment to yoga as a holistic lifestyle practice and underlie behavioural shifts towards a healthier lifestyle. A more spiritual focus has also been found to be associated with higher psychological wellbeing.⁵⁰ Yoga experience varied considerably but frequency of practice was a stronger predictor of health outcomes than years of practice, consistent with previous findings.²² Additional meditation practice was linked to higher positive wellbeing but not perceived stress or anxiety, perhaps surprising given the evidence for meditation as a stress reduction tool.⁵¹

Yoga-practice variables accounted for a relatively small amount of variance in health and wellbeing measures as has been found in previous studies.^{4 22} The high levels of yoga practice in our sample and significance of yoga frequency as a predictor variable suggest the importance of a regular yoga practice for health benefit. Higher yoga involvement has been associated with higher mindfulness, spiritual wellbeing and lower psychiatric symptoms.⁵² The 'hedonic treadmill' describes the difficulty of creating lasting change to our levels of wellbeing and happiness due to habituation to our circumstances. Activities, such as yoga, that offer small but frequent boosts to wellbeing, may provide an effective mechanism to increase longer-term wellbeing.⁵³

Consistent with previous studies, respondents strongly believed that yoga had a positive impact on their physical and mental health.^{24 27} Many reported its value in managing a range

of health conditions, most notably musculoskeletal and mental health conditions. This augments clinical research on the effectiveness of yoga by demonstrating that people are perceiving health benefit in naturalistic settings. However, few respondents reported cardiovascular disease and diabetes, consistent with a previous nationally representative UK survey,²⁶ despite the potential benefits of yoga as an ancillary and preventative treatment.¹⁵

⁵⁴ This may reflect a lack of perceived relevance or feasibility of practising yoga for people with these conditions or simply reflect the demographics of our sample. Nevertheless, future research should investigate the attitudes towards yoga of people with these conditions to more fully understand their under-representation.

Like any physical activity, yoga is not without the potential for adverse effects. Yoga-related injuries were consistent with a recent systematic review of nine observational studies, which found a lifetime prevalence of 35.4%.⁵⁵ Whilst we did not assess severity, Cramer et al reported that adverse effects were predominately relatively minor, musculoskeletal injuries consistent with our findings. In our study, a range of yoga styles were associated with injuries reflecting the diversity of styles practised by respondents; Cramer suggesting that frequency or intensity of practice may be a stronger predictor of injury than yoga style. Taken together, yoga does not appear to pose a greater risk than other physical activities,⁵⁵ but further investigation of precise risk factors would be of value.

Limitations

This is the first large cross-sectional study in the UK to investigate yoga practice and its impact on health. Nevertheless, the sample was self-selected with a high proportion of yoga teachers so is unlikely to be representative and may be biased towards more positive evaluations of yoga. The results relied on retrospective and self-report data which may be subject to memory bias and social desirability, particularly with regards to self-reporting of weight.⁵⁶ Additionally, the cross-sectional design precludes causal inferences about the relationship between yoga practice and health outcomes. The findings are, however, remarkably consistent with surveys in other Western countries, including representative national health surveys, suggesting the findings are relatively robust.

CONCLUSION

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Compared with population norms, yoga practitioners reported higher health, wellbeing and rates of health protective behaviours, and lower health risk behaviours, stress, BMI and obesity. Yoga practitioners reported a range of reasons for initiating and maintaining yoga practice with their focus changing from physical to psycho-spiritual factors over time, a potential factor underlying behavioural maintenance and integration of a healthy lifestyle. Yoga was perceived as helpful for managing a variety of physical and psychological health issues suggesting that yoga is commonly used to support self-care and manage health conditions. It is, thus, pertinent to consider in what ways this holistic approach to health and wellbeing could help address the complex health-related issues with which many countries are now grappling. The results also suggest further investigation is required into the reasons for gender differences in prevalence of yoga practice, the specific risk factors for reported adverse events and factors underlying changes in motivation to practice.

Acknowledgements

The authors would like to thank Eleanor Connolly for her assistance with questionnaire development and data collection, and Professor Sat Bir Khalsa, Professor Holger Cramer and Dr Anna Cheshire for their feedback on the initial questionnaire. They would also like to express their gratitude to all yoga studios, teachers and the British Wheel of Yoga for promoting the survey and to participants for taking their time to complete the questionnaire.

Contributors

KP, TC and HM conceived and designed the study. TC and KP managed recruitment and TC and AP conducted data analysis. TC and KP wrote the paper with contributions from all authors. All authors read and approved the final manuscript.

Funding

No external funding was received for this study.

Competing interests

TC, KP, AP declare that they have no competing interests. HM creates treatment and training programmes for professionals to use yoga and mindfulness techniques with long-

term health conditions. Individuals and organisations (including health services) pay for attendance of trainings and courses.

Ethics approval

The study was approved by the University of Westminster Ethics Committee (1516-0614). Participants gave informed consent before taking part.

Data sharing statement

No additional data are available.

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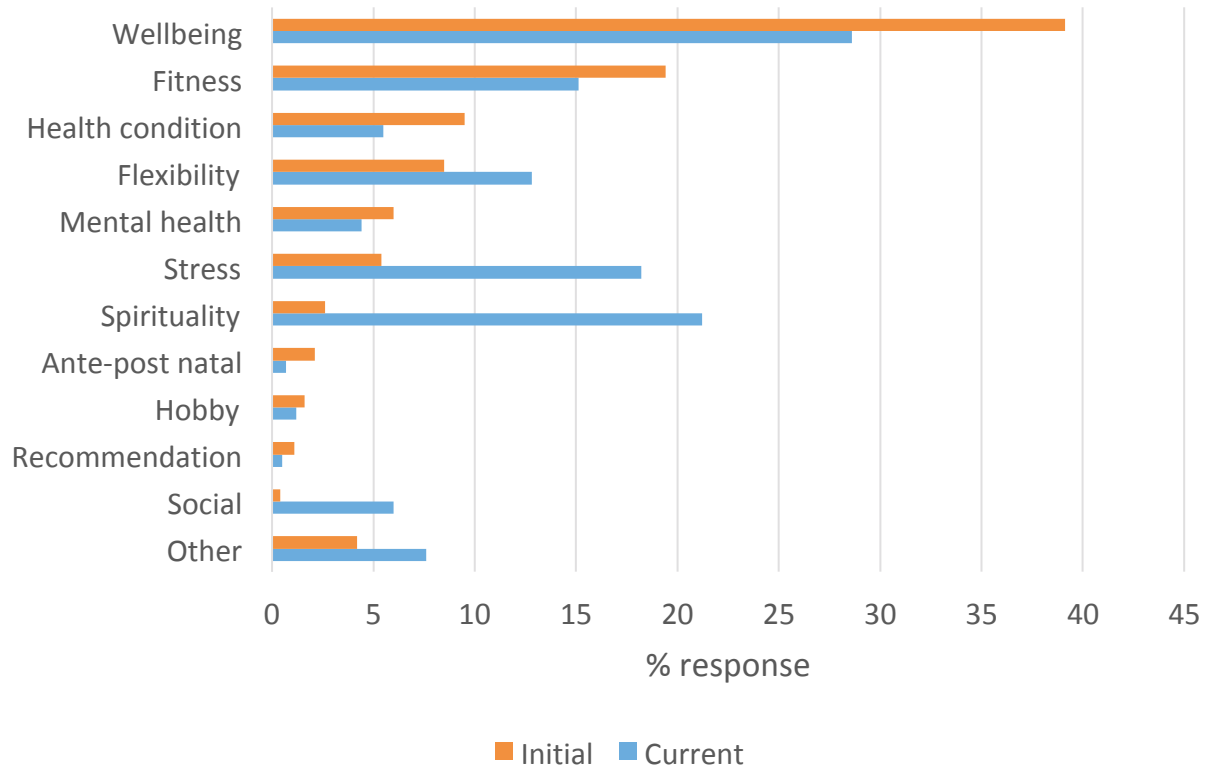


Figure 1: Initial and current principal reasons for practising yoga

Supplementary table: Spearman intercorrelations for health impact and yoga practice variables

	My physical health has improved as a result of yoga	My mental health has improved as a result of yoga	I have changed my lifestyle as a result of yoga	My stress level has improved as a result of yoga	My strength has improved as a result of yoga	My flexibility has improved as a result of yoga	My sleep has improved as a result of yoga
Hours at home per week	.305**	.276**	.411**	.303**	.283**	.226**	.265**
Hours in class per week	.194**	.104**	.165**	.102**	.142**	.158**	.127**
Days per week	.289**	.272**	.395**	.316**	.279**	.223**	.247**
Years of practice	.130**	.078**	.080**	.086**	.088**	.103**	.072**
My physical health has improved		.655**	.585**	.598**	.622**	.596**	.467**
My mental health has improved			.615**	.726**	.539**	.476**	.496**
I have changed my lifestyle				.682**	.547**	.480**	.510**
My stress level has improved					.568**	.505**	.541**
My strength has improved						.678**	.469**
My flexibility has improved							.447**

Statistical significance: *p< 0.01 level (2-tailed), **p<0.005 level (2-tailed).

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	7
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	8-9, 10-11
Outcome data	15*	Report numbers of outcome events or summary measures	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15-16
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Yoga practice in the UK: a cross-sectional survey of motivation, health benefits and behaviours

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-031848.R2
Article Type:	Original research
Date Submitted by the Author:	06-Nov-2019
Complete List of Authors:	Cartwright, Tina; University of Westminster, School of Social Sciences Mason, Heather; The Mindful Institute Porter, Alan; University of Westminster, School of Social Sciences Pilkington, Karen; University of Portsmouth, School of Health Sciences and Social Work
Primary Subject Heading:	Sports and exercise medicine
Secondary Subject Heading:	Mental health, Public health
Keywords:	PREVENTIVE MEDICINE, MENTAL HEALTH, PUBLIC HEALTH, yoga

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Yoga practice in the UK: a cross-sectional survey of motivation, health benefits and behaviours

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ABSTRACT

Objectives: Despite the popularity of yoga and evidence of its positive effects on physical and mental health, little is known about yoga practice in the UK. This study investigated the characteristics of people who practise yoga, reasons for initiating and maintaining practice, and perceived impact of yoga on health and wellbeing.

Design, setting and participants: A cross-sectional online anonymous survey distributed through UK-based yoga organisations, studios and events, through email invites and flyers. 2434 yoga practitioners completed the survey, including 903 yoga teachers: 87% were female, 91% white, and 71% degree educated, mean age was 48.7 years.

Main outcome measures: Perceived impact of yoga on health conditions, health outcomes and injuries. Relationships between yoga practice and measures of health, lifestyle, stress and wellbeing.

Results: In comparison with national population norms, participants reported significantly higher wellbeing but also higher anxiety; lower perceived stress, BMI and incidence of obesity, and higher rates of positive health behaviours. 47% reported changing their motivations to practise yoga, with general wellness and fitness key to initial uptake, and stress management and spirituality important to current practice. 16% of participants reported starting yoga to manage a physical or mental health condition. Respondents reported the value of yoga for a wide range of health conditions, most notably for musculoskeletal and mental health conditions. 20.7% reported at least one yoga-related injury over their lifetime. Controlling for demographic factors, frequency of yoga practice accounted for small but significant variance in health-related regression models ($p < .001$).

Conclusion: The findings of this first detailed UK survey were consistent with surveys in other Western countries. Yoga was perceived to have a positive impact on physical and mental health conditions and was linked to positive health behaviours. Further investigation of yoga's role in self-care could inform health-related challenges faced by many countries.

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Strengths and limitations of the study

- This is the first comprehensive survey to assess the practice and perceived impact of yoga on health, lifestyle-related behaviours and wellbeing in the UK.
- The survey design captures the significant number of practitioners who take up yoga to manage a physical or mental health condition, and identifies health conditions for which yoga is rated as most helpful in self-management.
- Despite the large sample, it was self-selected and unlikely to be representative of all yoga practitioners.
- The results relied on retrospective and self-report data which may be subject to memory bias and social desirability.

INTRODUCTION

Originating in India as a comprehensive mind-body practice, yoga has become increasingly popular in the West as a holistic approach to health and wellbeing. In the US, national health surveys indicated a lifetime prevalence rate of 13.2% or 31 million adults in 2012,¹ an increase from 5.1% a decade earlier.² Surveys also demonstrate significant levels of practice in countries such as Australia³ and Germany.⁴ Although there are many different styles of yoga, the main components of yoga include physical postures, breathing techniques, relaxation and meditation. There is growing evidence that yoga is an effective multi-component health intervention that reduces stress, increases physical activity and improves wellbeing.⁵⁻⁷ Clinical studies provide preliminary support for the effectiveness of yoga as an adjunct treatment for a range of chronic conditions, such as depression,^{8,9} anxiety,^{10,11} lower back pain,^{12,13} and Type 2 diabetes.^{14,15} Potential physiological mechanisms include down-regulation of the hypothalamic-pituitary adrenal (HPA) axis and sympathetic nervous system and reduced inflammatory markers.^{6,16,17} Additionally, psychological mechanisms such as enhanced self and body awareness, coping, mindfulness, self-compassion and social connectedness may underlie healthier lifestyle choices and more adaptive responses to stressors.¹⁷ Moderate effects have also been reported on cognitive function.¹⁸ Given the increasing personal and healthcare costs associated with lifestyle-related diseases,^{19,20} it is important to better understand the impact of yoga on health-related outcomes in both clinical and naturalistic settings.

Previous surveys, primarily in the US and Australia, have provided some insight into the characteristics of yoga practitioners, their motivations and yoga's perceived health impact. Yoga practitioners are consistently more likely to be female, white, educated and of higher socioeconomic status.^{1,4,21-24} This contrasts with a recent survey in India where practitioners were more likely to be male and high school educated, likely to reflect both cultural factors in the perceptions of yoga given its Indian origins and the predominance of children and students in the sample.²⁵ Whilst yoga practitioners' health status is higher than population norms,^{1,26} yoga is used to manage a range of health conditions. For example, in the US National Health Interview Surveys in 2002 and 2012, musculoskeletal and mental health²³ and back pain, stress and arthritis¹ were the main health conditions for which people most commonly practised yoga. The majority reported yoga as helpful in managing these

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conditions.²³ In Australia, 20% of those surveyed practised yoga for a specific health reason reported to be improved by yoga,²⁴ while 88% of survey participants in Germany rated their health as improved since starting yoga.⁴ Studies have also found an association between yoga/meditation practice and positive health behaviours such as higher physical activity levels, lower rates of smoking, and higher likelihood of vegetarian diet.^{3 24 26 27}

Several studies have explored motivational factors underlying yoga practice; most commonly cited are general wellness,^{1 24} health and fitness,²⁴ a specific health condition,²⁴ and improved immune function and energy.¹ Park et al. found that while physical improvement (exercise and flexibility) and stress relief were the most prevalent reasons for adopting yoga, individuals' motives for continuing yoga shifted towards more holistic motivations such as spirituality over time.²⁸ Taken together, these surveys indicate that a substantial proportion of the population is attracted to yoga to manage their physical, mental and spiritual health.

It is therefore surprising that little is known about yoga practice in the UK. The Health Survey for England suggested an increasing but relatively low prevalence of yoga practice (0.46% in 1997/1999, 1.11% in 2006/2008).²⁶ This was, however, based on responses to the question "Have you done any other sport or exercise not listed on this card?" and referred to the previous 4 weeks only. The data is now relatively dated and limited in the extent to which it provided insight into decision-making around yoga practice. The potential impact of yoga on managing health conditions and increasing health-related behaviours is particularly relevant given the unprecedented increase in long-term conditions and links between comorbidity and poor mental health.²⁰ Management of this 'tsunami of need'²⁹ has led to a focus on self-care approaches to reduce lifestyle risk factors and manage chronic conditions. Universal Personalised Care is included in the recent NHS Long Term Health Plan,³⁰ with scope for the inclusion of yoga.³¹ A comprehensive survey of current yoga practice in the UK and perceived impact on health conditions, behaviours and wellbeing is thus timely.

The overall aim of this current study was, therefore, to gain a better understanding of current yoga practice in the UK by investigating: 1) the characteristics, lifestyle and wellbeing of those practising yoga in comparison with national norms; 2) yoga practice characteristics; 3) motivations underlying yoga practice; 4) perceived impact of yoga on

health outcomes; and 5) the relationship between yoga practice characteristics and wellbeing.

MATERIALS AND METHODS

Design and recruitment

The study was a cross-sectional survey design using an anonymous online questionnaire hosted on Qualtrics. Recruitment was through UK-based yoga organisations, yoga studios and teachers, marketing at UK yoga events and social media. Information about the study was posted on a dedicated University website and Facebook page and widely advertised by two yoga organisations and at several yoga events (during International Yoga Day, a yoga symposium and an All Party Parliamentary Group (APPG) on Traditional Indian Sciences) with printed flyers and presentations. Email invitations were also sent to 79 studios located in major cities across the UK and identified through online searches, requesting they send the link to their members. Yoga practitioners were invited to participate if they met the inclusion criteria: UK resident, practised yoga within the past 12 months, and were over 18 years. Ethics approval was gained from the University of Westminster Ethics committee and all participants gave informed consent. Data collection took place over a six month period (June-Dec 2016).

Patient and public involvement

At the pilot stage, 12 yoga practitioners were consulted regarding the aims of the study and content and acceptability of the questionnaire which was incorporated into the final survey. Eight were female and 5 were yoga teachers, aged 33-49 years ($M=41.5 \pm 5.37$), having practised yoga for 2-20 years ($M=13.9 \pm 5.2$).

Survey development

Previous surveys of yoga practice were reviewed^{22 24 27} and a draft set of questions compiled focusing on the key objectives. The final questionnaire was informed by consultations with key yoga researchers and feedback from yoga teachers and practitioners from the pilot.

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Socio-demographic variables

Data was collected on: gender, age, education, ethnicity, marital and employment status, and area of residence. The McArthur scale of subjective social status³² is a single-item which assesses perceived social ranking on a 10-point ladder with higher scores indicating higher perceived ranking.

Health, lifestyle and wellbeing variables

Health variables included: self-reported height and weight (to calculate BMI), self-rated health (5-point Likert scale),³³ current health issues (20 listed). Lifestyle variables were assessed with single items and included: smoking status, dietary choices (e.g. vegetarian), average weekly alcohol intake (units), average daily fruit/vegetable intake (2 or less, 3-4, 5 or more), weekly frequency of brisk exercise apart from yoga. Warwick-Edinburgh Mental Well-being Scale (WEMWBS)³⁴ assessed subjective well-being and psychological functioning, with higher scores indicate higher wellbeing. The four single item Office of National Statistics (ONS) measures of personal wellbeing assessed: satisfaction with life nowadays, feeling things in life are worthwhile, how happy yesterday, how anxious yesterday, on 10-point Likert scale (not at all to completely).³⁵ The 4-item Perceived Stress Scale (PSS)³⁶ assessed global life stress with higher scores indicating higher levels of perceived stress.

Yoga practice characteristics

This section asked about personal practice of yoga. Fixed-response questions regarding motivation included reason(s) for starting yoga, for maintaining or taking a break from yoga and whether primary motivations had changed over time. Yoga practice questions included duration of yoga practice (years/months), average days per week practising yoga, average weekly hours spent practising both at home and in class. Fixed-response questions asked about preferred style of yoga, class location, and percentage of time spent on different components (physical poses, breathwork, relaxation, meditation, other). Additional questions asked about use of yoga therapy in past 12 months, any independent meditation practice, including hours spent meditating, and amount spent on yoga classes/workshops per month. Participants were asked whether they were yoga teachers or therapists.

Perceived health impact

Participants were asked to indicate if they had experienced specific health conditions/issues since practising yoga (25 conditions listed with the option to specify other issues) and rate perceived helpfulness of yoga in managing the condition on a 5-point Likert scale (very helpful-very unhelpful). Participants were also asked to rate on a 5-point Likert scale (strongly disagree-strongly agree) the extent to which they perceived yoga impacted on seven domains of health (physical, mental, stress, strength, flexibility, sleep and lifestyle) identified by previous surveys.²⁷

Yoga-related Injuries

Fixed-response questions relating to up to three injuries sustained as a result of yoga practice including: body location, new or recurring injury, circumstances around occurrence (e.g. unsupervised or whilst receiving an adjustment) and yoga style practised when injury occurred (open response). Respondents were not asked about the severity or duration of any injuries.

Data analysis

Data was cleaned to identify miscoded and missing data. Missing cases were deleted listwise. Descriptive statistics were calculated for socio-demographic characteristics, yoga practice variables, health and lifestyle variables. Percentages were calculated according to total responses to item (valid percent). Gender and other group differences were analysed using t-tests and Chi Square. Comparisons with UK normative data, where available, were analysed using 1-sample t-tests and Chi Square. Pearson's and Spearman's correlations were computed to assess relationships between yoga practice variables and yoga impact and health-related variables respectively, and determine predictor variables for the regression analyses. Hierarchical multiple regression analyses were used to examine the independent effect of demographics, yoga variables, yoga teacher status, and meditation practice on health outcomes including stress, wellbeing, satisfaction with life, worthwhile life, happiness and anxiety as criterion variables.

RESULTS

2635 people responded to the survey, with 2434 people meeting the inclusion criteria and completing at least the first question about yoga participation.

Socio-demographic characteristics

Sociodemographic characteristics are presented in Table 1; the majority of respondents were female, white, well educated (71% ≥ degree), with a wide age range (18-92 years, M=48.7 ±12.5). Participants rated themselves as above average in terms of subjective social status (M=6.62 ±1.47). All areas of the UK were represented although London and the south of England were most prevalent. Forty percent of the sample were yoga teachers (n=903).

Table 1: Sociodemographic characteristics of sample

Variables	Percent ^a (n) ^b		
	All	Yoga teachers	Yoga practitioners
Gender	2410	899	1342
Male	11.7 (284)	9.9 (89)	12.5 (169)
Female	87.3 (2126)	89.5 (808)	87.0 (1173)
Ethnicity	2412	897	1345
Asian/Asian British	3.2 (78)	2.7 (24)	3.3 (45)
Black/African/Caribbean/Black British	0.6 (14)	0.3 (3)	0.8 (11)
Mixed/Multiple ethnic groups	2.6 (63)	3.7 (33)	1.9 (25)
White	90.9 (2192)	90.9 (815)	90.9 (1223)
Other	2.7 (65)	2.5 (22)	3.0 (41)
Marital status	2417	897	1349
Single	15.8 (382)	13.3 (119)	18.2 (245)
In a relationship	11.7 (283)	9.4 (84)	12.1 (163)
Married/Cohabiting	63.5 (1536)	67.4 (605)	61.2 (825)
Divorced/Separated	6.7 (163)	7.9 (71)	6.1 (82)
Other	2.2 (53)	2.0 (18)	2.5 (34)
Employment	2418	898	1349
Employed full-time	32.1 (776)	22.4 (201)	39.5 (533)
Employed part-time	15.2 (367)	14.6 (131)	15.2 (205)

Self-employed	30.6 (740)	51.0 (458)	16.5 (223)
Unemployed	1.5 (37)	0.7 (6)	2.2 (30)
Student	2.6 (64)	1.0 (9)	3.8 (51)
Retired	14.0 (339)	6.9 (62)	18.6 (251)
Stay at home parent/carer	2.3 (56)	1.9 (17)	2.6 (35)
Other	1.6 (39)	1.6 (14)	1.6 (21)
Education (highest level)	2420	899	1350
Secondary school	8.0 (193)	6.2 (56)	8.7 (118)
College/ A level	16.2 (393)	14.1 (127)	17.6 (237)
University Undergraduate	31.2 (755)	32.4 (291)	30.3 (409)
University Postgraduate	39.8 (963)	40.7 (366)	39.8 (537)
Other	4.8 (116)	6.6 (59)	3.6 (49)
Location	2274	844	1264
North East/West	20.0 (455)	18.6 (155)	21.2 (268)
East/West Midlands	9.1 (206)	9.2 (77)	9.3 (117)
East England	3.9 (89)	5.3 (45)	3.2 (40)
London	21.2 (483)	20.9 (176)	21.6 (273)
South East/West	33.8 (769)	33.3 (370)	34.0 (429)
Wales	3.8 (86)	4.7 (40)	3.2 (41)
Scotland	6.7 (153)	6.5 (55)	6.3 (80)
Northern Ireland	1.5 (33)	1.8 (15)	1.3 (16)

^a Of total responses (valid percent). ^b n for each variable in bold type.

Lifestyle and health characteristics and comparison with UK norms

Participants reported a range of current health conditions, most frequently: stress (n=340), sleep issues (n=261), anxiety (n=254), arthritis (n=201), menopausal symptoms (n=213), musculoskeletal problems (n=178), irritable bowel syndrome (n=123) and asthma (n=119). Very few participants reported heart disease (n=9), chronic obstructive pulmonary disease (n=6), epilepsy (n =10), or diabetes (n =18).

Given that teachers are likely to differ from non-teachers in health characteristics and yoga practice,²⁴ Table 2 shows descriptive data for each group separately and combined to enable comparisons with national norms, where available. Both groups compared favourably with health and lifestyle norms. Only 4.2% currently smoked, significantly lower

than 15.1% in the general adult UK population.³⁷ Similarly, 55% reported the recommended intake of daily fruit/vegetable servings, significantly higher than 26% in the population.³⁸ Additionally, 22.7% were vegetarian/vegan and 13.5% pescetarian. Average BMI was 23 (normal), with only 5.1% of the sample obese, both significantly lower than national figures.³⁸ The majority (93.5%) reported engaging in brisk exercise on at least one day per week (M=3.6). Self-reported alcohol intake was substantially below the recommended maximum weekly intake of 14 units.³⁹

Table 2: Health, lifestyle and yoga practice variables of complete sample, yoga teachers and yoga practitioners

	Percent ^a (n)			
	All	Yoga teachers	Yoga practitioners	Available normative data
Smoking history				
Never	56.4 (1348)	53.1 (474)	59.0 (786)	-
Ex-smoker	39.4 (940)	43.8 (391)	36.1 (481)	-
Current smoker	4.2 (100)**	3.1 (28)**	4.9 (65)**	15.1 ³⁷
Daily fruit/vegetable intake				
≤2	6.7 (163)	4.7 (42)	7.9 (107)	
3-4	38.6 (932)	33.5 (302)	41.9 (565)	
≥5	54.7 (1320)**	61.8 (557)**	50.1 (676)**	26.0 ³⁸
Diet				-
Omnivore	53.3 (1286)	42.1 (378)	60.7 (818)	
Pescetarian	13.6 (328)	18.0 (162)	10.8 (146)	
Vegetarian	18.7 (455)	24.5 (220)	14.8 (199)	
Vegan	3.9 (95)	5.1 (46)	3.3 (44)	
Other	10.4 (250)	10.2 (92)	10.5 (141)	
General health status				-
Excellent	17.9 (392)	25.0 (214)	13.3 (176)	
Very good	44.4 (973)	48.4 (415)	41.8 (552)	
Good	30.3 (664)	22.4 (192)	35.4 (467)	
Fair	6.7 (147)	3.5 (30)	8.9 (117)	
Poor	0.6 (14)	0.7 (6)	0.6 (8)	
Obese (BMI ≥30)	5.1 (114)**	3.1 (27)**	6.6 (87)**	26.0 ³⁸
	Mean (± SD)			
BMI	23.49 (± 3.61)**	22.92 (± 3.20)**	23.87 (± 3.81)**	27.7 ⁴⁰
Alcohol units (per week)	6.47 (± 7.53)	5.77 (± 6.92)	7.01 (± 7.80)	-
Exercise (days per week)	3.63 (± 2.07)	3.73 (± 2.15)	3.54 (± 2.0)	-
Wellbeing (WEMWBS)	53.90 (± 7.78)**	56.02 (± 6.79)**	52.53 (± 8.08)**	51.1 ³⁴
Stress (PSS-4)	4.59 (± 2.80)**	3.90 (± 2.54)**	5.03 (± 2.86)**	6.1 ⁴¹
Satisfaction with life (ONS)	7.94 (± 1.51)**	8.28 (± 1.31)**	7.72 (± 1.57)	7.7 ⁴²

Life worthwhile (ONS)	8.27 (\pm 1.53)**	8.71 (\pm 1.24)**	7.80 (\pm 1.63)*	7.9 ⁴²
Happiness yesterday (ONS)	7.96 (\pm 1.75)**	8.29 (\pm 1.55)**	7.75 (\pm 1.84)**	7.5 ⁴²
Anxiety yesterday (ONS)	3.49 (\pm 2.47)**	3.19 (\pm 2.48)*	3.68 (\pm 2.43)**	2.9 ⁴²
Yoga practice				
Hours at home per week	2.79 (\pm 3.17)	4.46 (\pm 3.61)	1.62 (\pm 2.21)	
Hours in class per week	2.73 (\pm 2.40)	2.87 (\pm 2.56)	2.50 (\pm 1.82)	
Days per week	3.88 (\pm 1.96)	4.99 (\pm 1.59)	3.25 (\pm 1.86)	
Years of practice	13.9 (\pm 11.6)	18.18 (\pm 10.10)	10.5 (\pm 10.61)	

^a Of total responses (valid percent). Significantly different from available norms using chi-square and 1-sample t-tests: * $p < 0.05$; ** $p < 0.0005$ (see Table 1 in Supplementary material for further details)

Abbreviations: PSS - Perceived Stress Scale; WEMWBS - Warwick-Edinburgh Mental Well-being Scale; ONS – Office of National Statistics (personal wellbeing)

The majority rated their general health as good, very good or excellent (92.6%). Wellbeing was significantly higher³⁴ and perceived stress lower⁴¹ than norms in England for all participants. For yoga teachers, ONS wellbeing items compared favourably with norms for life satisfaction, life worthwhile, and happiness. For non-teachers, happiness was higher, but feeling life was worthwhile was lower than norms. Additionally, feeling anxious was higher than population norms for all participants.⁴²

Males did not differ significantly from females on smoking, fruit/vegetable intake or exercise, but had higher BMI ($M = 24.3$ & 23.4 ; $t = 4.16$, $df = 2330$, $p < .0025$) and alcohol intake ($M = 8.7$ & 6.2 ; $t = 3.29$, $df = 2021$, $p < .001$). For health and wellbeing measures, females differed only on feeling life was more worthwhile ($M = 8.3$ & 8.1 ; $t = 2.36$, $df = 2171$, $p < .05$).

Yoga practice characteristics

Yoga practice frequency is summarised in Table 2, indicating high levels of yoga practice in both teachers and non-teachers. Participants reported practising yoga from less than one to 56 years, with teachers having practised for longer and more frequently at home and in class ($p < 0.0005$). Males reported practising for a shorter duration than females ($M = 11.7$ & 14.18 ; $t = 3.23$, $df = 2355$, $p < .001$), but did not differ on other characteristics. Diverse styles of yoga were reported, with Hatha (28%), Iyengar (25.3%), Vinyasa flow (14.8%) and Ashtanga (7.2%) most frequently reported. The most popular venues were: yoga studio (57.5%), community hall (38%), and gym (25.1%), with 20.7% practising at home using online resources or DVDs. Participants spent an average of £50.13 (\pm 61.55) on classes/workshops

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per month. 64.6% of practice time was spent on physical postures, 13.1% breathwork, 12.0% relaxation, 8.6% meditation and 1.9% other practices such as chanting and study. 15.8% reported attending one-to-one yoga sessions and 12.8% yoga therapy sessions in the past 12 months. Over half (51.5%) of participants reported undertaking meditation practice independent of their yoga practice.

Motivations

A comparison of initial and current motivations for practice is shown in Figure 1. Principal initial reasons were for general wellness (39%), fitness (19%) and flexibility (8.5%). 16% of participants reported starting yoga for a physical (9.5%) or mental health condition (6%), with musculoskeletal conditions and anxiety/depression most commonly cited. Almost half (47%) of participants reported a change in focus over time, most notably in relation to spirituality (21%), stress management (18%) and social interaction (6%).

Fig 1 here

Perceived health impact

Participants’ rated the extent to which they felt yoga had improved seven aspects of health incorporating physical, mental and lifestyle dimensions. The majority either agreed or strongly agreed that yoga had improved their physical health (88%), mental health (86.2%), stress levels (82.6%), strength (87.1%) and flexibility (91.6%). Additionally, 69.3% reported lifestyle changes perceived as resulting from their yoga practice and 57.4% sleep improvement.

All yoga practice variables were significantly correlated with perceived health impact [see Table 2 in supplementary material], with greater yoga frequency and duration associated with higher perceived impact. However, frequency of practise, both in terms of hours at home per week and days per week, were most strongly correlated with all health impact variables , with the strongest relationship for home practice and lifestyle changes ($r_s=.411$, $n=1902$, $p< .0005$).

Participants rated perceived helpfulness for a range of health conditions/issues they had experienced before or since practising yoga (Table 3). In particular, a history of musculoskeletal and mental health issues were reported by a large number of our

participants, with the majority reporting yoga as helpful or very helpful in managing these conditions.

Table 3: Perceived helpfulness in managing health issues and conditions

Condition	n	Helpful (%)	Neither helpful nor unhelpful	Unhelpful (%)
Musculoskeletal				
Back pain	1070	94.8	3.8	1.4
Neck/Shoulder pain	903	91.7	6.2	2.1
Arthritis	261	87.0	12.3	0.8
Other	424	82.8	2.4	
Mental health				
Stress	997	98.4	1.4	0.2
Anxiety	712	96.8	2.9	0.2
Depression	513	93.2	5.5	1.4
Sleep issues	463	79.0	19.7	1.2
Other	75	96.0	4.0	0
Women's health				
Pre/post pregnancy	86	89.5	8.1	2.3
Pre-menstrual syndrome	275	76.5	22.5	0.7
Menopause (symptoms)	224	68.7	29.4	1.9
Other	98	77.6	21.4	1.0
Cardiovascular				
High Blood Pressure	160	73.0	26.3	0.6
Other	57	66.7	31.6	1.8
Respiratory				
Asthma	214	72.4	27.1	0.5
Other				
Gastrointestinal				
Irritable Bowel Syndrome	309	69.3	29.8	1.0
Other	98	68.4	26.5	5.1
Neurological				
Migraines	243	54.7	41.2	4.1
Headaches	415	68.7	22.3	2.7

Other	53	83.0	17.0	0
Other				
Allergies	296	27.2	66.4	6.4
Fertility issues	74	32.4	58.1	9.5

Only conditions with responses greater than 50 (N) are included

Yoga-related injuries

When asked about injuries attributable to yoga practice, 67.6% (n=1646) reported no injuries, 20.7% (n=504) at least one injury, 5.4% (n=131) a second, and 1% (n=24) a third injury. Back (24.0%), knee (13.1%), shoulder (12.5%), neck (7.5%), wrist (6.0%) and foot/ankle (3.4%) injuries were most common. The majority (72%) were new injuries and occurred in class across (48.6%), from following a specific instruction (13.5%) or receiving an adjustment from a teacher (11.2%), with a further 26.6% during unsupervised/home practice. A range of yoga styles and specific postures were listed in association with individual injuries.

Relationship between yoga practice characteristics and stress and wellbeing

Hierarchical regression models with age and gender entered in the first step and yoga practice variables, teacher status and meditation practice in subsequent steps, were all significant in predicting stress and wellbeing criterion variables (Table 4). Age was positively associated with all wellbeing variables and negatively with stress and anxiety. Frequency of yoga practice, but not duration of yoga practice, contributed additional variance in all models except anxiety. Number of days practised per week was a predictor for measures of stress and wellbeing, whilst frequency of home and/or class practice (hours) were independent predictors of life satisfaction, feeling life was worthwhile and happiness. Teacher status and having an independent meditation practice were significant predictors but accounted for very small additional variance. Frequency of yoga, teacher status and meditation practice were positively associated with wellbeing variables and negatively with stress.

Table 4: Results of linear regression models predicting stress and wellbeing variables from age, yoga practice variables, yoga practitioner status and meditation.

Health and wellbeing outcomes	Step 1 Age and Gender Adjusted R ²	Step 2 Yoga variables ΔR^2	Step 3 Yoga instructor ΔR^2	Step 4 Meditation practice ΔR^2	Final Adjusted R ²	Significant predictors	B	SE B	β	t	p
Stress (PSS)	.047***	.037***	.013***	0	.092	Age Days per week Yoga Teacher	-.049 -.167 -.771	.006 .048 .167	-.219 -.116 -.133	-7.744 -3.486 -4.610	< .001 .001 < .001
Wellbeing (WEMWBS)	.017***	.053***	.011***	.005***	.082	Age Days per week Yoga Teacher	.078 .458 1.787	.018 .133 .166	.125 .116 .112	4.378 3.449 3.835	< .001 .001 < .001
Life satisfaction (ONS)	.024***	.037***	.007***	.004***	.068	Age Hrs in Class Yoga Teacher Meditation	.016 .043 .271 .206	.003 .018 .092 .076	.131 .062 .087 .069	4.568 2.408 2.961 2.705	< .001 .016 .003 .007
Life worthwhile (ONS)	.024***	.049***	.013***	.006***	.092	Sex Age Hrs at home Hrs in Class Yoga Teacher Meditation	-.292 .014 .045 .042 .387 .251	.223 .004 .016 .018 .092 .077	-.058 .111 .090 .059 .123 .082	-2.371 3.918 2.787 2.337 4.205 3.277	.018 < .001 .005 .020 < .001 .001

Happiness Yesterday (ONS)	.029***	.036***	.001	.007***	.070	Age	.020	.004	.140	4.901	< .001
						Hrs at home	.057	.018	.101	3.083	.002
						Hrs in class	.049	.021	.061	2.385	.017
						Meditation	.294	.088	.085	3.338	.001
Anxiety Yesterday (ONS)	.014***	.007*	.004***	0	.023	Age	-.020	.006	-.102	-3.486	.001
						Yoga Teacher	-.399	.50	-.080	-2.666	.008

Statistical significance: *p< .05; **p< .01; ***p< .001

The predictor variables included in the model were: gender, age, number of days practising yoga per week, hours practising yoga at home, hours practising yoga in class, years practising yoga and meditation status. Sex was coded as female =0 and male =1, Not Yoga Teacher = 0 and Yoga Teacher =1, No Meditation Practice =0 and Meditation Practice = 1.

Abbreviations: PSS - Perceived Stress Scale; WEMWBS - Warwick-Edinburgh Mental Well-being Scale; ONS – Office of National Statistics (personal wellbeing)

DISCUSSION

This is the first comprehensive survey of yoga practice in the UK. Demographic findings were broadly consistent with those in other Western countries, with practitioners' predominately female, white and well educated. Compared with UK population norms, participants reported higher wellbeing and positive health behaviours and lower stress, BMI and obesity. Whilst this cannot be linked specifically to yoga given the cross-sectional nature of the study, the vast majority of participants reported that yoga had improved their physical and mental health, with two thirds attributing lifestyle changes to their yoga practice. This was associated with frequency of yoga practice rather than overall length of practising. Importantly, our survey found that participants perceived yoga as helpful in managing a wide range of health conditions, most notably musculoskeletal conditions and mental health, consistent with findings in the US² and clinical trials.^{11 13} This suggests that yoga is used in the UK to manage health conditions and support wellbeing and has further potential to support self-care of debilitating and costly health disorders.

As expected, lifestyle variables compared favourably with the general UK population. These findings are consistent with studies in other developed countries.^{3 26 27} Similarly, wellbeing was higher^{34 42} and stress lower⁴¹ than national norms, particularly for teachers which may reflect their stronger commitment and immersion in yoga⁴ or could reflect reporting bias. Anxiety, however, was higher than population norms⁴² for all participants and was also the most commonly cited current health issue. This reflects the complex relationship between yoga and physical and mental health, as noted in previous research.²¹ It may be a manifestation of a number of factors, such as higher awareness of emotional distress associated with improved interoception resulting from yoga practice,⁴³ greater willingness to report mental distress, and higher engagement in mindful and holistic practices in this particular population.⁴⁴ Yoga practitioners report better than average overall health,^{4 27 45} but commonly report mental health issues,²² frequently seeking out yoga to manage mental health conditions such as anxiety and depression. Indeed, over 90% of our sample found yoga helpful for such conditions.

Consistent reports of healthier lifestyles, lower levels of stress and higher levels of wellbeing in yoga practitioners compared to population figures are important given the increases in

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disease arising from modifiable health behaviours²⁰ and in mental illness.⁴⁶ Although this may partly reflect our white, educated, female sample, there were few gender differences in health and behavioural outcomes. Other possible explanations include attitudinal change in line with ethical guidelines on lifestyle,³ reinforcement of positive affect associated with positive health behaviours,⁴⁷ and greater body awareness increasing motivation to take up other healthy behaviours.⁴⁸ Isolating the specific causal effects of yoga practice on behavioural outcomes is challenging but warrants further testing in controlled studies with long term follow-up. Additionally, understanding the factors underlying gender differences in yoga practice is important given the higher rates of lifestyle-related morbidity in men and challenges around engaging men in health protective behaviours.⁴⁹ Further exploration of the gender differential is warranted and could draw on the perceptions of yoga in Western countries compared with those in India.

Few studies have explored changes in motivation over time and yet almost half of our participants stated that their focus had changed, particularly towards a more holistic psycho-spiritual approach, which mirrors the findings of Park et al's smaller study.²⁸ This may also reflect a growth in commitment to yoga as a holistic lifestyle practice and underlie behavioural shifts towards a healthier lifestyle. A more spiritual focus has also been found to be associated with higher psychological wellbeing.⁵⁰ Yoga experience varied considerably but frequency of practice was a stronger predictor of health outcomes than years of practice, consistent with previous findings.²² Additional meditation practice was linked to higher positive wellbeing but not perceived stress or anxiety, perhaps surprising given the evidence for meditation as a stress reduction tool.⁵¹

Yoga-practice variables accounted for a relatively small amount of variance in health and wellbeing measures as has been found in previous studies.^{4 22} Nevertheless, this variance is significant and since yoga is an accessible form of practice for all ages and levels of fitness, it provides an important benefit to psychological health.²² The high levels of yoga practice in our sample and significance of yoga frequency as a predictor variable suggest the importance of a regular yoga practice for health benefit. Higher yoga involvement has been associated with higher mindfulness, spiritual wellbeing and lower psychiatric symptoms.⁵² The 'hedonic treadmill' describes the difficulty of creating lasting change to our levels of wellbeing and happiness due to habituation to our circumstances, thereby diminishing the

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3 impact of life events that increase short-term happiness, such as a lottery win.⁵³ In contrast,
4 activities, such as yoga, that offer small but frequent boosts to wellbeing, may provide an
5 effective mechanism to increase longer-term wellbeing due to their cumulative effects.⁵⁴
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9 Consistent with previous studies, respondents strongly believed that yoga had a positive
10 impact on their physical and mental health.^{24 27} Many reported its value in managing a range
11 of health conditions, most notably musculoskeletal and mental health conditions. This
12 augments clinical research on the effectiveness of yoga by demonstrating that people are
13 perceiving health benefit in naturalistic settings. However, few respondents reported
14 cardiovascular disease and diabetes, consistent with a previous nationally representative UK
15 survey,²⁶ despite the potential benefits of yoga as an ancillary and preventative treatment.¹⁵
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⁵⁵ This may reflect a lack of perceived relevance or feasibility of practising yoga for people
with these conditions or simply reflect the demographics of our sample. Nevertheless,
future research should investigate the attitudes towards yoga of people with these
conditions to more fully understand their under-representation.

Like any physical activity, yoga is not without the potential for adverse effects. Yoga-related
injuries were consistent with a recent systematic review of nine observational studies,
which found a lifetime prevalence of 35.4%.⁵⁶ Whilst we did not assess severity, Cramer et al
reported that adverse effects were predominately relatively minor, musculoskeletal injuries
consistent with our findings. In our study, a range of yoga styles were associated with
injuries reflecting the diversity of styles practised by respondents; Cramer suggesting that
frequency or intensity of practice may be a stronger predictor of injury than yoga style.
Taken together, yoga does not appear to pose a greater risk than other physical activities,⁵⁶
but further investigation of precise risk factors would be of value.

Limitations

This is the first large cross-sectional study in the UK to investigate yoga practice and its
impact on health. Nevertheless, the sample was self-selected with a high proportion of yoga
teachers so is unlikely to be representative and may be biased towards more positive
evaluations of yoga. The results relied on retrospective and self-report data which may be
subject to memory bias and social desirability, particularly with regards to self-reporting of
weight.⁵⁷ Additionally, the cross-sectional design precludes causal inferences about the

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relationship between yoga practice and health outcomes. The findings are, however, remarkably consistent with surveys in other Western countries, including representative national health surveys, suggesting the findings are relatively robust.

CONCLUSION

Compared with population norms, yoga practitioners reported higher health, wellbeing and rates of health protective behaviours, and lower health risk behaviours, stress, BMI and obesity. Yoga practitioners reported a range of reasons for initiating and maintaining yoga practice with their focus changing from physical to psycho-spiritual factors over time, a potential factor underlying behavioural maintenance and integration of a healthy lifestyle. Yoga was perceived as helpful for managing a variety of physical and psychological health issues suggesting that yoga is commonly used to support self-care and manage health conditions. It is, thus, pertinent to consider in what ways this holistic approach to health and wellbeing could help address the complex health-related issues with which many countries are now grappling. The results also suggest further investigation is required into the reasons for gender differences in prevalence of yoga practice, the specific risk factors for reported adverse events and factors underlying changes in motivation to practice.

Acknowledgements

The authors would like to thank Eleanor Connolly for her assistance with questionnaire development and data collection, and Professor Sat Bir Khalsa, Professor Holger Cramer and Dr Anna Cheshire for their feedback on the initial questionnaire. They would also like to express their gratitude to all yoga studios, teachers and the British Wheel of Yoga for promoting the survey and to participants for taking their time to complete the questionnaire.

Contributors

KP, TC and HM conceived and designed the study. TC and KP managed recruitment and TC and AP conducted data analysis. TC and KP wrote the paper with contributions from all authors. All authors read and approved the final manuscript.

Funding

No external funding was received for this study.

Competing interests

TC, KP, AP declare that they have no competing interests. HM creates treatment and training programmes for professionals to use yoga and mindfulness techniques with long-term health conditions. Individuals and organisations (including health services) pay for attendance of trainings and courses.

Ethics approval

The study was approved by the University of Westminster Ethics Committee (1516-0614). Participants gave informed consent before taking part.

Data sharing statement

No additional data are available.

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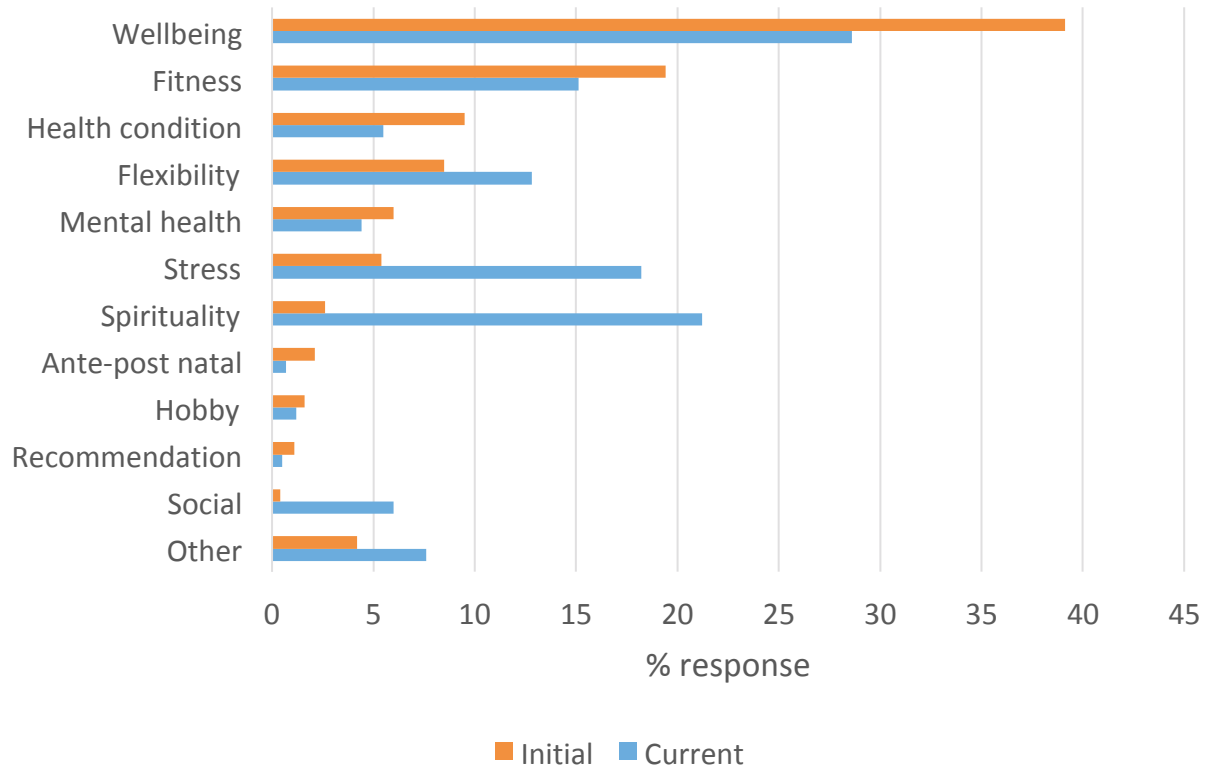


Figure 1: Initial and current principal reasons for practising yoga

Supplementary Table 1: Results of analyses comparing health and lifestyle characteristics of sample with national normative data

	Results of χ^2 comparing smoking, fruit and vegetable intake and obesity norms for the whole sample and by yoga teachers and yoga practitioners		
	All	Yoga teachers	Yoga practitioners
Current Smoker	χ^2 (1, N=100) =221.814, p < .0005	χ^2 (1, N=28) =99.714, p<.0005	χ^2 (1, N=65) =108.25, p <.0005
Daily fruit/vegetable intake ≥ 5	χ^2 (1, N=1320) = 1030.898, p<.0005	χ^2 (1, N=557) = 600.86, p<.005	χ^2 (1, N= 676) = 408.56, p<.0005
Obese (BMI ≥ 30)	χ^2 (1, N=114) =510.537, p<.0005	χ^2 (1, N=27) = 510.537 p<.0005	χ^2 (1,N=87) = 245.98 p<.0005
	Results of one-sample t-tests (two-tailed) comparing BMI and wellbeing scales with available norms for the whole sample and by yoga teachers and yoga practitioners		
	All	Yoga teachers	Yoga practitioners
BMI	t(2345)=-56.495, p<.0005	t(872)=-44.251, p<.0005	t(1311)=-36.499, p<.0005
Wellbeing (WEMWBS)	t(2174)=16.808, p<.0005	t(853)=21.163, p<.0005	t(1306)= 6.396, p<.0005
Stress (PSS-4)	t(2168)= -25.209, p< .0005	t(848)= -25.161, p<.0005	t(1306)=-13.497, p<.0005
Satisfaction with life (ONS)	t(2188)= 7.453, p<.0005	t(858)=12.899, p<.0005	t(1311)= .399, p=.690
Life worthwhile (ONS)	t(2185)=11.344, p<.0005	t(857)=18.791, p<.0005	t(1314)= 1.971, p=.049
Happiness yesterday (ONS)	t(2184)=12.349, p<.0005	t(856)=14.943, p<.0005	t(1313)=4.849, p<.0005
Anxiety yesterday (ONS)	t(2189)=11.157, p=.009	t(859)=3.475, p=.001	t(1315)=11.675, p<.0005

Supplementary Table 2: Spearman intercorrelations for health impact and yoga practice variables

	My physical health has improved as a result of yoga	My mental health has improved as a result of yoga	I have changed my lifestyle as a result of yoga	My stress level has improved as a result of yoga	My strength has improved as a result of yoga	My flexibility has improved as a result of yoga	My sleep has improved as a result of yoga
Hours at home per week	.305**	.276**	.411**	.303**	.283**	.226**	.265**
Hours in class per week	.194**	.104**	.165**	.102**	.142**	.158**	.127**
Days per week	.289**	.272**	.395**	.316**	.279**	.223**	.247**
Years of practice	.130**	.078**	.080**	.086**	.088**	.103**	.072**
My physical health has improved		.655**	.585**	.598**	.622**	.596**	.467**
My mental health has improved			.615**	.726**	.539**	.476**	.496**

I have changed my lifestyle				.682**	.547**	.480**	.510**
My stress level has improved					.568**	.505**	.541**
My strength has improved						.678**	.469**
My flexibility has improved							.447**

Statistical significance: *p< 0.01 level (2-tailed), **p<0.005 level (2-tailed).

For peer review only

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	7
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	8-9, 10-11
Outcome data	15*	Report numbers of outcome events or summary measures	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15-16
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

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Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-031848.R3
Article Type:	Original research
Date Submitted by the Author:	03-Dec-2019
Complete List of Authors:	Cartwright, Tina; University of Westminster, School of Social Sciences Mason, Heather; The Mindful Institute Porter, Alan; University of Westminster, School of Social Sciences Pilkington, Karen; University of Portsmouth, School of Health Sciences and Social Work
Primary Subject Heading:	Sports and exercise medicine
Secondary Subject Heading:	Mental health, Public health
Keywords:	PREVENTIVE MEDICINE, MENTAL HEALTH, PUBLIC HEALTH, yoga

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Yoga practice in the UK: a cross-sectional survey of motivation, health benefits and behaviours

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ABSTRACT

Objectives: Despite the popularity of yoga and evidence of its positive effects on physical and mental health, little is known about yoga practice in the UK. This study investigated the characteristics of people who practise yoga, reasons for initiating and maintaining practice, and perceived impact of yoga on health and wellbeing.

Design, setting and participants: A cross-sectional online anonymous survey distributed through UK-based yoga organisations, studios and events, through email invites and flyers. 2434 yoga practitioners completed the survey, including 903 yoga teachers: 87% were female, 91% white, and 71% degree educated, mean age was 48.7 years.

Main outcome measures: Perceived impact of yoga on health conditions, health outcomes and injuries. Relationships between yoga practice and measures of health, lifestyle, stress and wellbeing.

Results: In comparison with national population norms, participants reported significantly higher wellbeing but also higher anxiety; lower perceived stress, BMI and incidence of obesity, and higher rates of positive health behaviours. 47% reported changing their motivations to practise yoga, with general wellness and fitness key to initial uptake, and stress management and spirituality important to current practice. 16% of participants reported starting yoga to manage a physical or mental health condition. Respondents reported the value of yoga for a wide range of health conditions, most notably for musculoskeletal and mental health conditions. 20.7% reported at least one yoga-related injury over their lifetime. Controlling for demographic factors, frequency of yoga practice accounted for small but significant variance in health-related regression models ($p < .001$).

Conclusion: The findings of this first detailed UK survey were consistent with surveys in other Western countries. Yoga was perceived to have a positive impact on physical and mental health conditions and was linked to positive health behaviours. Further investigation of yoga's role in self-care could inform health-related challenges faced by many countries.

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Strengths and limitations of the study

- This is the first comprehensive survey to assess the practice and perceived impact of yoga on health, lifestyle-related behaviours and wellbeing in the UK.
- The survey design captures the significant number of practitioners who take up yoga to manage a physical or mental health condition, and identifies health conditions for which yoga is rated as most helpful in self-management.
- Despite the large sample, it was self-selected and unlikely to be representative of all yoga practitioners.
- The results relied on retrospective and self-report data which may be subject to memory bias and social desirability.

INTRODUCTION

Originating in India as a comprehensive mind-body practice, yoga has become increasingly popular in the West as a holistic approach to health and wellbeing. In the US, national health surveys indicated a lifetime prevalence rate of 13.2% or 31 million adults in 2012,¹ an increase from 5.1% a decade earlier.² Surveys also demonstrate significant levels of practice in countries such as Australia³ and Germany.⁴ Although there are many different styles of yoga, the main components of yoga include physical postures, breathing techniques, relaxation and meditation. There is growing evidence that yoga is an effective multi-component health intervention that reduces stress, increases physical activity and improves wellbeing.⁵⁻⁷ Clinical studies provide preliminary support for the effectiveness of yoga as an adjunct treatment for a range of chronic conditions, such as depression,^{8,9} anxiety,^{10,11} lower back pain,^{12,13} and Type 2 diabetes.^{14,15} Potential physiological mechanisms include down-regulation of the hypothalamic-pituitary adrenal (HPA) axis and sympathetic nervous system and reduced inflammatory markers.^{6,16,17} Additionally, psychological mechanisms such as enhanced self and body awareness, coping, mindfulness, self-compassion and social connectedness may underlie healthier lifestyle choices and more adaptive responses to stressors.¹⁷ Moderate effects have also been reported on cognitive function.¹⁸ Given the increasing personal and healthcare costs associated with lifestyle-related diseases,^{19,20} it is important to better understand the impact of yoga on health-related outcomes in both clinical and naturalistic settings.

Previous surveys, primarily in the US and Australia, have provided some insight into the characteristics of yoga practitioners, their motivations and yoga's perceived health impact. Yoga practitioners are consistently more likely to be female, white, educated and of higher socioeconomic status.^{1,4,21-24} This contrasts with a recent survey in India where practitioners were more likely to be male and high school educated, likely to reflect both cultural factors in the perceptions of yoga given its Indian origins and the predominance of children and students in the sample.²⁵ Whilst yoga practitioners' health status is higher than population norms,^{1,26} yoga is used to manage a range of health conditions. For example, in the US National Health Interview Surveys in 2002 and 2012, musculoskeletal and mental health²³ and back pain, stress and arthritis¹ were the main health conditions for which people most commonly practised yoga. The majority reported yoga as helpful in managing these

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conditions.²³ In Australia, 20% of those surveyed practised yoga for a specific health reason reported to be improved by yoga,²⁴ while 88% of survey participants in Germany rated their health as improved since starting yoga.⁴ Studies have also found an association between yoga/meditation practice and positive health behaviours such as higher physical activity levels, lower rates of smoking, and higher likelihood of vegetarian diet.^{3 24 26 27}

Several studies have explored motivational factors underlying yoga practice; most commonly cited are general wellness,^{1 24} health and fitness,²⁴ a specific health condition,²⁴ and improved immune function and energy.¹ Park et al. found that while physical improvement (exercise and flexibility) and stress relief were the most prevalent reasons for adopting yoga, individuals' motives for continuing yoga shifted towards more holistic motivations such as spirituality over time.²⁸ Taken together, these surveys indicate that a substantial proportion of the population is attracted to yoga to manage their physical, mental and spiritual health.

It is therefore surprising that little is known about yoga practice in the UK. The Health Survey for England suggested an increasing but relatively low prevalence of yoga practice (0.46% in 1997/1999, 1.11% in 2006/2008).²⁶ This was, however, based on responses to the question "Have you done any other sport or exercise not listed on this card?" and referred to the previous 4 weeks only. The data is now relatively dated and limited in the extent to which it provided insight into decision-making around yoga practice. The potential impact of yoga on managing health conditions and increasing health-related behaviours is particularly relevant given the unprecedented increase in long-term conditions and links between comorbidity and poor mental health.²⁰ Management of this 'tsunami of need'²⁹ has led to a focus on self-care approaches to reduce lifestyle risk factors and manage chronic conditions. Universal Personalised Care is included in the recent NHS Long Term Health Plan,³⁰ with scope for the inclusion of yoga.³¹ A comprehensive survey of current yoga practice in the UK and perceived impact on health conditions, behaviours and wellbeing is thus timely.

The overall aim of this current study was, therefore, to gain a better understanding of current yoga practice in the UK by investigating: 1) the characteristics, lifestyle and wellbeing of those practising yoga in comparison with national norms; 2) yoga practice characteristics; 3) motivations underlying yoga practice; 4) perceived impact of yoga on

health outcomes; and 5) the relationship between yoga practice characteristics and wellbeing.

MATERIALS AND METHODS

Design and recruitment

The study was a cross-sectional survey design using an anonymous online questionnaire hosted on Qualtrics. Recruitment was through UK-based yoga organisations, yoga studios and teachers, marketing at UK yoga events and social media. Information about the study was posted on a dedicated University website and Facebook page and widely advertised by two yoga organisations and at several yoga events (during International Yoga Day, a yoga symposium and an All Party Parliamentary Group (APPG) on Traditional Indian Sciences) with printed flyers and presentations. Email invitations were also sent to 79 studios located in major cities across the UK and identified through online searches, requesting they send the link to their members. Yoga practitioners were invited to participate if they met the inclusion criteria: UK resident, practised yoga within the past 12 months, and were over 18 years. Ethics approval was gained from the University of Westminster Ethics committee and all participants gave informed consent. Data collection took place over a six month period (June-Dec 2016).

Patient and public involvement

At the pilot stage, 12 yoga practitioners were consulted regarding the aims of the study and content and acceptability of the questionnaire which was incorporated into the final survey. Eight were female and 5 were yoga teachers, aged 33-49 years ($M=41.5 \pm 5.37$), having practised yoga for 2-20 years ($M=13.9 \pm 5.2$).

Survey development

Previous surveys of yoga practice were reviewed^{22 24 27} and a draft set of questions compiled focusing on the key objectives. The final questionnaire was informed by consultations with key yoga researchers and feedback from yoga teachers and practitioners from the pilot.

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Socio-demographic variables

Data was collected on: gender, age, education, ethnicity, marital and employment status, and area of residence. The McArthur scale of subjective social status³² is a single-item which assesses perceived social ranking on a 10-point ladder with higher scores indicating higher perceived ranking.

Health, lifestyle and wellbeing variables

Health variables included: self-reported height and weight (to calculate BMI), self-rated health (5-point Likert scale),³³ current health issues (20 listed). Lifestyle variables were assessed with single items and included: smoking status, dietary choices (e.g. vegetarian), average weekly alcohol intake (units), average daily fruit/vegetable intake (2 or less, 3-4, 5 or more), weekly frequency of brisk exercise apart from yoga. Warwick-Edinburgh Mental Well-being Scale (WEMWBS)³⁴ assessed subjective well-being and psychological functioning, with higher scores indicate higher wellbeing. The four single item Office of National Statistics (ONS) measures of personal wellbeing assessed: satisfaction with life nowadays, feeling things in life are worthwhile, how happy yesterday, how anxious yesterday, on 10-point Likert scale (not at all to completely).³⁵ The 4-item Perceived Stress Scale (PSS)³⁶ assessed global life stress with higher scores indicating higher levels of perceived stress.

Yoga practice characteristics

This section asked about personal practice of yoga. Fixed-response questions regarding motivation included reason(s) for starting yoga, for maintaining or taking a break from yoga and whether primary motivations had changed over time. Yoga practice questions included duration of yoga practice (years/months), average days per week practising yoga, average weekly hours spent practising both at home and in class. Fixed-response questions asked about preferred style of yoga, class location, and percentage of time spent on different components (physical poses, breathwork, relaxation, meditation, other). Additional questions asked about use of yoga therapy in past 12 months, any independent meditation practice, including hours spent meditating, and amount spent on yoga classes/workshops per month. Participants were asked whether they were yoga teachers or therapists.

Perceived health impact

Participants were asked to indicate if they had experienced specific health conditions/issues since practising yoga (25 conditions listed with the option to specify other issues) and rate perceived helpfulness of yoga in managing the condition on a 5-point Likert scale (very helpful-very unhelpful). Participants were also asked to rate on a 5-point Likert scale (strongly disagree-strongly agree) the extent to which they perceived yoga impacted on seven domains of health (physical, mental, stress, strength, flexibility, sleep and lifestyle) identified by previous surveys.²⁷

Yoga-related Injuries

Fixed-response questions relating to up to three injuries sustained as a result of yoga practice including: body location, new or recurring injury, circumstances around occurrence (e.g. unsupervised or whilst receiving an adjustment) and yoga style practised when injury occurred (open response). Respondents were not asked about the severity or duration of any injuries.

Data analysis

Data was cleaned to identify miscoded and missing data. Missing cases were deleted listwise. Descriptive statistics were calculated for socio-demographic characteristics, yoga practice variables, health and lifestyle variables. Percentages were calculated according to total responses to item (valid percent). Gender and other group differences were analysed using t-tests and Chi Square. Comparisons with UK normative data, where available, were analysed using 1-sample t-tests and Chi Square. Pearson's and Spearman's correlations were computed to assess relationships between yoga practice variables and yoga impact and health-related variables respectively, and determine predictor variables for the regression analyses. Hierarchical multiple regression analyses were used to examine the independent effect of demographics, yoga variables, yoga teacher status, and meditation practice on health outcomes including stress, wellbeing, satisfaction with life, worthwhile life, happiness and anxiety as criterion variables.

RESULTS

2635 people responded to the survey, with 2434 people meeting the inclusion criteria and completing at least the first question about yoga participation.

Socio-demographic characteristics

Sociodemographic characteristics are presented in Table 1; the majority of respondents were female, white, well educated (71% ≥ degree), with a wide age range (18-92 years, M=48.7 ±12.5). Participants rated themselves as above average in terms of subjective social status (M=6.62 ±1.47). All areas of the UK were represented although London and the south of England were most prevalent. Forty percent of the sample were yoga teachers (n=903).

Table 1: Sociodemographic characteristics of sample

Variables	Percent ^a (n) ^b		
	All ^c	Yoga teachers	Yoga practitioners
Gender	2410	899	1342
Male	11.7 (284)	9.9 (89)	12.5 (169)
Female	87.3 (2126)	89.5 (808)	87.0 (1173)
Ethnicity	2412	897	1345
Asian/Asian British	3.2 (78)	2.7 (24)	3.3 (45)
Black/African/Caribbean/Black British	0.6 (14)	0.3 (3)	0.8 (11)
Mixed/Multiple ethnic groups	2.6 (63)	3.7 (33)	1.9 (25)
White	90.9 (2192)	90.9 (815)	90.9 (1223)
Other	2.7 (65)	2.5 (22)	3.0 (41)
Marital status	2417	897	1349
Single	15.8 (382)	13.3 (119)	18.2 (245)
In a relationship	11.7 (283)	9.4 (84)	12.1 (163)
Married/Cohabiting	63.5 (1536)	67.4 (605)	61.2 (825)
Divorced/Separated	6.7 (163)	7.9 (71)	6.1 (82)
Other	2.2 (53)	2.0 (18)	2.5 (34)
Employment	2418	898	1349
Employed full-time	32.1 (776)	22.4 (201)	39.5 (533)
Employed part-time	15.2 (367)	14.6 (131)	15.2 (205)

Self-employed	30.6 (740)	51.0 (458)	16.5 (223)
Unemployed	1.5 (37)	0.7 (6)	2.2 (30)
Student	2.6 (64)	1.0 (9)	3.8 (51)
Retired	14.0 (339)	6.9 (62)	18.6 (251)
Stay at home parent/carer	2.3 (56)	1.9 (17)	2.6 (35)
Other	1.6 (39)	1.6 (14)	1.6 (21)
Education (highest level)	2420	899	1350
Secondary school	8.0 (193)	6.2 (56)	8.7 (118)
College/ A level	16.2 (393)	14.1 (127)	17.6 (237)
University Undergraduate	31.2 (755)	32.4 (291)	30.3 (409)
University Postgraduate	39.8 (963)	40.7 (366)	39.8 (537)
Other	4.8 (116)	6.6 (59)	3.6 (49)
Location	2274	844	1264
North East/West	20.0 (455)	18.6 (155)	21.2 (268)
East/West Midlands	9.1 (206)	9.2 (77)	9.3 (117)
East England	3.9 (89)	5.3 (45)	3.2 (40)
London	21.2 (483)	20.9 (176)	21.6 (273)
South East/West	33.8 (769)	33.3 (370)	34.0 (429)
Wales	3.8 (86)	4.7 (40)	3.2 (41)
Scotland	6.7 (153)	6.5 (55)	6.3 (80)
Northern Ireland	1.5 (33)	1.8 (15)	1.3 (16)

^a Of total responses (valid percent). ^b n for each variable in bold type. ^c Includes participants who did not state whether yoga teacher or not.

Lifestyle and health characteristics and comparison with UK norms

Participants reported a range of current health conditions, most frequently: stress (n=340), sleep issues (n=261), anxiety (n=254), arthritis (n=201), menopausal symptoms (n=213), musculoskeletal problems (n=178), irritable bowel syndrome (n=123) and asthma (n=119). Very few participants reported heart disease (n=9), chronic obstructive pulmonary disease (n=6), epilepsy (n =10), or diabetes (n =18).

Given that teachers are likely to differ from non-teachers in health characteristics and yoga practice,²⁴ Table 2 shows descriptive data for each group separately and combined to enable comparisons with national norms, where available. Both groups compared

favourably with health and lifestyle norms. Only 4.2% currently smoked, significantly lower than 15.1% in the general adult UK population.³⁷ Similarly, 55% reported the recommended intake of daily fruit/vegetable servings, significantly higher than 26% in the population.³⁸ Additionally, 22.7% were vegetarian/vegan and 13.5% pescetarian. Average BMI was 23 (normal), with only 5.1% of the sample obese, both significantly lower than national figures.³⁸ The majority (93.5%) reported engaging in brisk exercise on at least one day per week (M=3.6). Self-reported alcohol intake was substantially below the recommended maximum weekly intake of 14 units.³⁹

Table 2: Health, lifestyle and yoga practice variables of complete sample, yoga teachers and yoga practitioners

	Percent ^a (n)			
	All	Yoga teachers	Yoga practitioners	Available normative data
Smoking history				
Never	56.4 (1348)	53.1 (474)	59.0 (786)	-
Ex-smoker	39.4 (940)	43.8 (391)	36.1 (481)	-
Current smoker	4.2 (100)**	3.1 (28)**	4.9 (65)**	15.1 ³⁷
Daily fruit/vegetable intake				
≤2	6.7 (163)	4.7 (42)	7.9 (107)	
3-4	38.6 (932)	33.5 (302)	41.9 (565)	
≥5	54.7 (1320)**	61.8 (557)**	50.1 (676)**	26.0 ³⁸
Diet				-
Omnivore	53.3 (1286)	42.1 (378)	60.7 (818)	
Pescetarian	13.6 (328)	18.0 (162)	10.8 (146)	
Vegetarian	18.7 (455)	24.5 (220)	14.8 (199)	
Vegan	3.9 (95)	5.1 (46)	3.3 (44)	
Other	10.4 (250)	10.2 (92)	10.5 (141)	
General health status				-
Excellent	17.9 (392)	25.0 (214)	13.3 (176)	
Very good	44.4 (973)	48.4 (415)	41.8 (552)	
Good	30.3 (664)	22.4 (192)	35.4 (467)	
Fair	6.7 (147)	3.5 (30)	8.9 (117)	
Poor	0.6 (14)	0.7 (6)	0.6 (8)	
Obese (BMI ≥30)	5.1 (114)**	3.1 (27)**	6.6 (87)**	26.0 ³⁸
	Mean (± SD)			
BMI	23.49 (± 3.61)**	22.92 (± 3.20)**	23.87 (± 3.81)**	27.7 ⁴⁰
Alcohol units (per week)	6.47 (± 7.53)	5.77 (± 6.92)	7.01 (± 7.80)	-
Exercise (days per week)	3.63 (± 2.07)	3.73 (± 2.15)	3.54 (± 2.0)	-
Wellbeing (WEMWBS)	53.90 (± 7.78)**	56.02 (± 6.79)**	52.53 (± 8.08)**	51.1 ³⁴

Stress (PSS-4)	4.59 (± 2.80)**	3.90 (± 2.54)**	5.03 (± 2.86)**	6.1 ⁴¹
Satisfaction with life (ONS)	7.94 (± 1.51)**	8.28 (± 1.31)**	7.72 (± 1.57)	7.7 ⁴²
Life worthwhile (ONS)	8.27 (± 1.53)**	8.71 (± 1.24)**	7.80 (± 1.63)*	7.9 ⁴²
Happiness yesterday (ONS)	7.96 (± 1.75)**	8.29 (± 1.55)**	7.75 (± 1.84)**	7.5 ⁴²
Anxiety yesterday (ONS)	3.49 (± 2.47)**	3.19 (± 2.48)*	3.68 (± 2.43)**	2.9 ⁴²
Yoga practice				
Hours at home per week	2.79 (± 3.17)	4.46 (± 3.61)	1.62 (± 2.21)	
Hours in class per week	2.73 (± 2.40)	2.87 (± 2.56)	2.50 (± 1.82)	
Days per week	3.88 (± 1.96)	4.99 (± 1.59)	3.25 (± 1.86)	
Years of practice	13.9 (± 11.6)	18.18 (± 10.10)	10.5 (± 10.61)	

^a Of total responses (valid percent). Significantly different from available norms using chi-square and 1-sample t-tests: *p<0.05; **p<0.0005 (see Table 1 in Supplementary material for further details)

Abbreviations: PSS - Perceived Stress Scale; WEMWBS - Warwick-Edinburgh Mental Well-being Scale; ONS – Office of National Statistics (personal wellbeing)

The majority rated their general health as good, very good or excellent (92.6%). Wellbeing was significantly higher³⁴ and perceived stress lower⁴¹ than norms in England for all participants. For yoga teachers, ONS wellbeing items compared favourably with norms for life satisfaction, life worthwhile, and happiness. For non-teachers, happiness was higher, but feeling life was worthwhile was lower than norms. Additionally, feeling anxious was higher than population norms for all participants.⁴²

Males did not differ significantly from females on smoking, fruit/vegetable intake or exercise, but had higher BMI (M=24.3 & 23.4; t=4.16, df=2330, p<.0025) and alcohol intake (M=8.7 & 6.2; t=3.29, df=2021, p<.001). For health and wellbeing measures, females differed only on feeling life was more worthwhile (M=8.3 & 8.1; t=2.36, df=2171, p<.05).

Yoga practice characteristics

Yoga practice frequency is summarised in Table 2, indicating high levels of yoga practice in both teachers and non-teachers. Participants reported practising yoga from less than one to 56 years, with teachers having practised for longer and more frequently at home and in class (p<0.0005). Males reported practising for a shorter duration than females (M=11.7 & 14.18; t=3.23, df=2355, p<.001), but did not differ on other characteristics. Diverse styles of yoga were reported, with Hatha (28%), Iyengar (25.3%), Vinyasa flow (14.8%) and Ashtanga (7.2%) most frequently reported. The most popular venues were: yoga studio (57.5%),

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community hall (38%), and gym (25.1%), with 20.7% practising at home using online resources or DVDs. Participants spent an average of £50.13 (± 61.55) on classes/workshops per month. 64.6% of practice time was spent on physical postures, 13.1% breathwork, 12.0% relaxation, 8.6% meditation and 1.9% other practices such as chanting and study. 15.8% reported attending one-to-one yoga sessions and 12.8% yoga therapy sessions in the past 12 months. Over half (51.5%) of participants reported undertaking meditation practice independent of their yoga practice.

Motivations

A comparison of initial and current motivations for practice is shown in Figure 1. Principal initial reasons were for general wellness (39%), fitness (19%) and flexibility (8.5%). 16% of participants reported starting yoga for a physical (9.5%) or mental health condition (6%), with musculoskeletal conditions and anxiety/depression most commonly cited. Almost half (47%) of participants reported a change in focus over time, most notably in relation to spirituality (21%), stress management (18%) and social interaction (6%).

Fig 1 here

Perceived health impact

Participants' rated the extent to which they felt yoga had improved seven aspects of health incorporating physical, mental and lifestyle dimensions. The majority either agreed or strongly agreed that yoga had improved their physical health (88%), mental health (86.2%), stress levels (82.6%), strength (87.1%) and flexibility (91.6%). Additionally, 69.3% reported lifestyle changes perceived as resulting from their yoga practice and 57.4% sleep improvement.

All yoga practice variables were significantly correlated with perceived health impact [see Table 2 in supplementary material], with greater yoga frequency and duration associated with higher perceived impact. However, frequency of practise, both in terms of hours at home per week and days per week, were most strongly correlated with all health impact variables , with the strongest relationship for home practice and lifestyle changes ($r_s=.411$, $n=1902$, $p< .0005$).

Participants rated perceived helpfulness for a range of health conditions/issues they had experienced before or since practising yoga (Table 3). In particular, a history of musculoskeletal and mental health issues were reported by a large number of our participants, with the majority reporting yoga as helpful or very helpful in managing these conditions.

Table 3: Perceived helpfulness in managing health issues and conditions

Condition	n ^a	Helpful (%)	Neither helpful nor unhelpful	Unhelpful (%)
Musculoskeletal				
Back pain	1070	94.8	3.8	1.4
Neck/Shoulder pain	903	91.7	6.2	2.1
Arthritis	261	87.0	12.3	0.8
Other	424	82.8	2.4	
Mental health				
Stress	997	98.4	1.4	0.2
Anxiety	712	96.8	2.9	0.2
Depression	513	93.2	5.5	1.4
Sleep issues	463	79.0	19.7	1.2
Other	75	96.0	4.0	0
Women's health				
Pre/post pregnancy	86	89.5	8.1	2.3
Pre-menstrual syndrome	275	76.5	22.5	0.7
Menopause (symptoms)	224	68.7	29.4	1.9
Other	98	77.6	21.4	1.0
Cardiovascular				
High Blood Pressure	160	73.0	26.3	0.6
Other	57	66.7	31.6	1.8
Respiratory				
Asthma	214	72.4	27.1	0.5
Other				
Gastrointestinal				
Irritable Bowel Syndrome	309	69.3	29.8	1.0
Other	98	68.4	26.5	5.1

Neurological				
Migraines	243	54.7	41.2	4.1
Headaches	415	68.7	22.3	2.7
Other	53	83.0	17.0	0
Other				
Allergies	296	27.2	66.4	6.4
Fertility issues	74	32.4	58.1	9.5

^a Number stating they had experienced the health condition/issue before or since practising yoga. Only conditions with responses greater than 50 (N) are included.

Yoga-related injuries

When asked about injuries attributable to yoga practice, 67.6% (n=1646) reported no injuries, 20.7% (n=504) at least one injury, 5.4% (n=131) a second, and 1% (n=24) a third injury. Back (24.0%), knee (13.1%), shoulder (12.5%), neck (7.5%), wrist (6.0%) and foot/ankle (3.4%) injuries were most common. The majority (72%) were new injuries and occurred in class across (48.6%), from following a specific instruction (13.5%) or receiving an adjustment from a teacher (11.2%), with a further 26.6% during unsupervised/home practice. A range of yoga styles and specific postures were listed in association with individual injuries.

Relationship between yoga practice characteristics and stress and wellbeing

Hierarchical regression models with age and gender entered in the first step and yoga practice variables, teacher status and meditation practice in subsequent steps, were all significant in predicting stress and wellbeing criterion variables (Table 4). Age was positively associated with all wellbeing variables and negatively with stress and anxiety. Frequency of yoga practice, but not duration of yoga practice, contributed additional variance in all models except anxiety. Number of days practised per week was a predictor for measures of stress and wellbeing, whilst frequency of home and/or class practice (hours) were independent predictors of life satisfaction, feeling life was worthwhile and happiness. Teacher status and having an independent meditation practice were significant predictors but accounted for very small additional variance. Frequency of yoga, teacher status and meditation practice were positively associated with wellbeing variables and negatively with stress.

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Table 4: Results of linear regression models predicting stress and wellbeing variables from age, yoga practice variables, yoga practitioner status and meditation.

Health and wellbeing outcomes	Step 1 Age and Gender Adjusted R ²	Step 2 Yoga variables ΔR^2	Step 3 Yoga instructor ΔR^2	Step 4 Meditation practice ΔR^2	Final Adjusted R ²	Significant predictors	B	SE B	β	t	p
Stress (PSS)	.047***	.037***	.013***	0	.092	Age	-.049	.006	-.219	-7.744	< .001
						Days per week	-.167	.048	-.116	-3.486	.001
						Yoga Teacher	-.771	.67	-.133	-4.610	< .001
Wellbeing (WEMWBS)	.017***	.053***	.011***	.005***	.082	Age	.078	.018	.125	4.378	< .001
						Days per week	.458	.33	.116	3.449	.001
						Yoga Teacher	1.787	.66	.112	3.835	< .001
Life satisfaction (ONS)	.024***	.037***	.007***	.004***	.068	Age	.016	.003	.131	4.568	< .001
						Hrs in Class	.043	.018	.062	2.408	.016
						Yoga Teacher	.271	.092	.087	2.961	.003
						Meditation	.206	.076	.069	2.705	.007
Life worthwhile (ONS)	.024***	.049***	.013***	.006***	.092	Sex	-.292	.223	-.058	-2.371	.018
						Age	.014	.004	.111	3.918	< .001
						Hrs at home	.045	.016	.090	2.787	.005
						Hrs in Class	.042	.018	.059	2.337	.020
						Yoga Teacher	.387	.092	.123	4.205	< .001
						Meditation	.251	.077	.082	3.277	.001

Happiness Yesterday (ONS)	.029***	.036***	.001	.007***	.070	Age	.020	.004	.140	4.901	< .001
						Hrs at home	.057	.018	.101	3.083	.002
						Hrs in class	.049	.021	.061	2.385	.017
						Meditation	.294	.088	.085	3.338	.001
Anxiety Yesterday (ONS)	.014***	.007*	.004***	0	.023	Age	-.020	.006	-.102	-3.486	.001
						Yoga Teacher	-.399	.50	-.080	-2.666	.008

Statistical significance: *p< .05; **p< .01; ***p< .001

The predictor variables included in the model were: gender, age, number of days practising yoga per week, hours practising yoga at home, hours practising yoga in class, years practising yoga and meditation status. Sex was coded as female =0 and male =1, Not Yoga Teacher = 0 and Yoga Teacher =1, No Meditation Practice =0 and Meditation Practice = 1.

Abbreviations: PSS - Perceived Stress Scale; WEMWBS - Warwick-Edinburgh Mental Well-being Scale; ONS – Office of National Statistics (personal wellbeing)

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DISCUSSION

This is the first comprehensive survey of yoga practice in the UK. Demographic findings were broadly consistent with those in other Western countries, with practitioners’ predominately female, white and well educated. Compared with UK population norms, participants reported higher wellbeing and positive health behaviours and lower stress, BMI and obesity. Whilst this cannot be linked specifically to yoga given the cross-sectional nature of the study, the vast majority of participants reported that yoga had improved their physical and mental health, with two thirds attributing lifestyle changes to their yoga practice. This was associated with frequency of yoga practice rather than overall length of practising. Importantly, our survey found that participants perceived yoga as helpful in managing a wide range of health conditions, most notably musculoskeletal conditions and mental health, consistent with findings in the US² and clinical trials.^{11 13} This suggests that yoga is used in the UK to manage health conditions and support wellbeing and has further potential to support self-care of debilitating and costly health disorders.

As expected, lifestyle variables compared favourably with the general UK population. These findings are consistent with studies in other developed countries.^{3 26 27} Similarly, wellbeing was higher^{34 42} and stress lower⁴¹ than national norms, particularly for teachers which may reflect their stronger commitment and immersion in yoga⁴ or could reflect reporting bias. Anxiety, however, was higher than population norms⁴² for all participants and was also the most commonly cited current health issue. This reflects the complex relationship between yoga and physical and mental health, as noted in previous research.²¹ It may be a manifestation of a number of factors, such as higher awareness of emotional distress associated with improved interoception resulting from yoga practice,⁴³ greater willingness to report mental distress, and higher engagement in mindful and holistic practices in this particular population.⁴⁴ Yoga practitioners report better than average overall health,^{4 27 45} but commonly report mental health issues,²² frequently seeking out yoga to manage mental health conditions such as anxiety and depression. Indeed, over 90% of our sample found yoga helpful for such conditions.

Consistent reports of healthier lifestyles, lower levels of stress and higher levels of wellbeing in yoga practitioners compared to population figures are important given the increases in

disease arising from modifiable health behaviours²⁰ and in mental illness.⁴⁶ Although this may partly reflect our white, educated, female sample, there were few gender differences in health and behavioural outcomes. Other possible explanations include attitudinal change in line with ethical guidelines on lifestyle,³ reinforcement of positive affect associated with positive health behaviours,⁴⁷ and greater body awareness increasing motivation to take up other healthy behaviours.⁴⁸ Isolating the specific causal effects of yoga practice on behavioural outcomes is challenging but warrants further testing in controlled studies with long term follow-up. Additionally, understanding the factors underlying gender differences in yoga practice is important given the higher rates of lifestyle-related morbidity in men and challenges around engaging men in health protective behaviours.⁴⁹ Further exploration of the gender differential is warranted and could draw on the perceptions of yoga in Western countries compared with those in India.

Few studies have explored changes in motivation over time and yet almost half of our participants stated that their focus had changed, particularly towards a more holistic psycho-spiritual approach, which mirrors the findings of Park et al's smaller study.²⁸ This may also reflect a growth in commitment to yoga as a holistic lifestyle practice and underlie behavioural shifts towards a healthier lifestyle. A more spiritual focus has also been found to be associated with higher psychological wellbeing.⁵⁰ Yoga experience varied considerably but frequency of practice was a stronger predictor of health outcomes than years of practice, consistent with previous findings.²² Additional meditation practice was linked to higher positive wellbeing but not perceived stress or anxiety, perhaps surprising given the evidence for meditation as a stress reduction tool.⁵¹

Yoga-practice variables accounted for a relatively small amount of variance in health and wellbeing measures as has been found in previous studies.^{4 22} Nevertheless, this variance is significant and since yoga is an accessible form of practice for all ages and levels of fitness, it provides an important benefit to psychological health.²² The high levels of yoga practice in our sample and significance of yoga frequency as a predictor variable suggest the importance of a regular yoga practice for health benefit. Higher yoga involvement has been associated with higher mindfulness, spiritual wellbeing and lower psychiatric symptoms.⁵² The 'hedonic treadmill' describes the difficulty of creating lasting change to our levels of wellbeing and happiness due to habituation to our circumstances, thereby diminishing the

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impact of life events that increase short-term happiness, such as a lottery win.⁵³ In contrast, activities, such as yoga, that offer small but frequent boosts to wellbeing, may provide an effective mechanism to increase longer-term wellbeing due to their cumulative effects.⁵⁴

Consistent with previous studies, respondents strongly believed that yoga had a positive impact on their physical and mental health.^{24 27} Many reported its value in managing a range of health conditions, most notably musculoskeletal and mental health conditions. This augments clinical research on the effectiveness of yoga by demonstrating that people are perceiving health benefit in naturalistic settings. However, few respondents reported cardiovascular disease and diabetes, consistent with a previous nationally representative UK survey,²⁶ despite the potential benefits of yoga as an ancillary and preventative treatment.¹⁵ ⁵⁵ This may reflect a lack of perceived relevance or feasibility of practising yoga for people with these conditions or simply reflect the demographics of our sample. Nevertheless, future research should investigate the attitudes towards yoga of people with these conditions to more fully understand their under-representation.

Like any physical activity, yoga is not without the potential for adverse effects. Yoga-related injuries were consistent with a recent systematic review of nine observational studies, which found a lifetime prevalence of 35.4%.⁵⁶ Whilst we did not assess severity, Cramer et al reported that adverse effects were predominately relatively minor, musculoskeletal injuries consistent with our findings. In our study, a range of yoga styles were associated with injuries reflecting the diversity of styles practised by respondents; Cramer suggesting that frequency or intensity of practice may be a stronger predictor of injury than yoga style. Taken together, yoga does not appear to pose a greater risk than other physical activities,⁵⁶ but further investigation of precise risk factors would be of value.

Limitations

This is the first large cross-sectional study in the UK to investigate yoga practice and its impact on health. Nevertheless, the sample was self-selected with a high proportion of yoga teachers so is unlikely to be representative and may be biased towards more positive evaluations of yoga. The results relied on retrospective and self-report data which may be subject to memory bias and social desirability, particularly with regards to self-reporting of weight.⁵⁷ Additionally, the cross-sectional design precludes causal inferences about the

relationship between yoga practice and health outcomes. The findings are, however, remarkably consistent with surveys in other Western countries, including representative national health surveys, suggesting the findings are relatively robust.

CONCLUSION

Compared with population norms, yoga practitioners reported higher health, wellbeing and rates of health protective behaviours, and lower health risk behaviours, stress, BMI and obesity. Yoga practitioners reported a range of reasons for initiating and maintaining yoga practice with their focus changing from physical to psycho-spiritual factors over time, a potential factor underlying behavioural maintenance and integration of a healthy lifestyle. Yoga was perceived as helpful for managing a variety of physical and psychological health issues suggesting that yoga is commonly used to support self-care and manage health conditions. It is, thus, pertinent to consider in what ways this holistic approach to health and wellbeing could help address the complex health-related issues with which many countries are now grappling. The results also suggest further investigation is required into the reasons for gender differences in prevalence of yoga practice, the specific risk factors for reported adverse events and factors underlying changes in motivation to practice.

Acknowledgements

The authors would like to thank Eleanor Connolly for her assistance with questionnaire development and data collection, and Professor Sat Bir Khalsa, Professor Holger Cramer and Dr Anna Cheshire for their feedback on the initial questionnaire. They would also like to express their gratitude to all yoga studios, teachers and the British Wheel of Yoga for promoting the survey and to participants for taking their time to complete the questionnaire.

Contributors

KP, TC and HM conceived and designed the study. TC and KP managed recruitment and TC and AP conducted data analysis. TC and KP wrote the paper with contributions from all authors. All authors read and approved the final manuscript.

Funding

No external funding was received for this study.

Competing interests

TC, KP, AP declare that they have no competing interests. HM creates treatment and training programmes for professionals to use yoga and mindfulness techniques with long-term health conditions. Individuals and organisations (including health services) pay for attendance of trainings and courses.

Ethics approval

The study was approved by the University of Westminster Ethics Committee (1516-0614). Participants gave informed consent before taking part.

Data sharing statement

No additional data are available.

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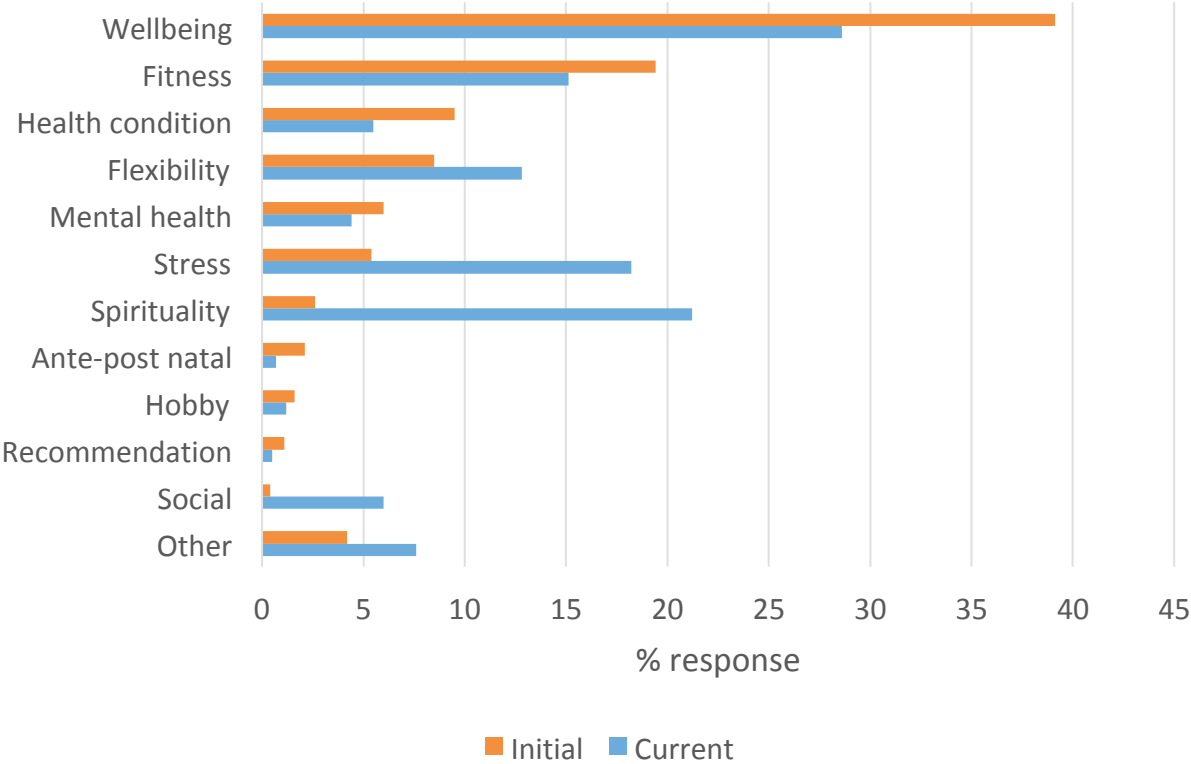


Figure 1: Initial and current principal reasons for practising yoga

Supplementary Table 1: Results of analyses comparing health and lifestyle characteristics of sample with national normative data

	Results of χ^2 comparing smoking, fruit and vegetable intake and obesity norms for the whole sample and by yoga teachers and yoga practitioners		
	All	Yoga teachers	Yoga practitioners
Current Smoker	χ^2 (1, N=100) =221.814, p < .0005	χ^2 (1, N=28) =99.714, p<.0005	χ^2 (1, N=65) =108.25, p <.0005
Daily fruit/vegetable intake ≥ 5	χ^2 (1, N=1320) = 1030.898, p<.0005	χ^2 (1, N=557) = 600.86, p<.005	χ^2 (1, N= 676) = 408.56, p<.0005
Obese (BMI ≥ 30)	χ^2 (1, N=114) =510.537, p<.0005	χ^2 (1, N=27) = 510.537 p<.0005	χ^2 (1, N=87) = 245.98 p<.0005
	Results of one-sample t-tests (two-tailed) comparing BMI and wellbeing scales with available norms for the whole sample and by yoga teachers and yoga practitioners		
	All	Yoga teachers	Yoga practitioners
BMI	t(2345)=-56.495, p<.0005	t(872)=-44.251, p<.0005	t(1315)=-36.499, p<.0005
Wellbeing (WEMWBS)	t(2174)=16.808, p<.0005	t(853)=21.163, p<.0005	t(1306)= 6.396, p<.0005
Stress (PSS-4)	t(2168)= -25.209, p< .0005	t(848)= -25.161, p<.0005	t(1306)=-13.497, p<.0005
Satisfaction with life (ONS)	t(2188)= 7.453, p<.0005	t(858)=12.899, p<.0005	t(1311)= .399, p=.690
Life worthwhile (ONS)	t(2185)=11.344, p<.0005	t(857)=18.791, p<.0005	t(1314)= 1.971, p=.049
Happiness yesterday (ONS)	t(2184)=12.349, p<.0005	t(856)=14.943, p<.0005	t(1313)=4.849, p<.0005
Anxiety yesterday (ONS)	t(2189)=11.157, p=.009	t(859)=3.475, p=.001	t(1315)=11.675, p<.0005

Supplementary Table 2: Spearman intercorrelations for health impact and yoga practice variables

	My physical health has improved as a result of yoga	My mental health has improved as a result of yoga	I have changed my lifestyle as a result of yoga	My stress level has improved as a result of yoga	My strength has improved as a result of yoga	My flexibility has improved as a result of yoga	My sleep has improved as a result of yoga
Hours at home per week	.305**	.276**	.411**	.303**	.283**	.226**	.265**
Hours in class per week	.194**	.104**	.165**	.102**	.142**	.158**	.127**
Days per week	.289**	.272**	.395**	.316**	.279**	.223**	.247**
Years of practice	.130**	.078**	.080**	.086**	.088**	.103**	.072**
My physical health has improved		.655**	.585**	.598**	.622**	.596**	.467**
My mental health has improved			.615**	.726**	.539**	.476**	.496**

I have changed my lifestyle				.682**	.547**	.480**	.510**
My stress level has improved					.568**	.505**	.541**
My strength has improved						.678**	.469**
My flexibility has improved							.447**

Statistical significance: *p< 0.01 level (2-tailed), **p<0.005 level (2-tailed).

For peer review only

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	7
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	8-9, 10-11
Outcome data	15*	Report numbers of outcome events or summary measures	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15-16
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.