



ELSEVIER

Contents lists available at ScienceDirect

## Complementary Therapies in Medicine

journal homepage: [www.elsevier.com/locate/ctim](http://www.elsevier.com/locate/ctim)

# Associations of yoga practice, health status, and health behavior among yoga practitioners in Germany—Results of a national cross-sectional survey



Holger Cramer<sup>a,b,\*</sup>, Daniela Quinker<sup>a</sup>, Karen Pilkington<sup>c</sup>, Heather Mason<sup>d</sup>, Jon Adams<sup>b</sup>, Gustav Dobos<sup>a</sup>

<sup>a</sup> Department of Internal and Integrative Medicine, Kliniken Essen-Mitte, Faculty of Medicine, University of Duisburg-Essen, Essen, Germany

<sup>b</sup> Australian Research Centre in Complementary and Integrative Medicine (ARCCIM), Faculty of Health, University of Technology Sydney, Sydney, Australia

<sup>c</sup> School of Health Sciences and Social Work, University of Portsmouth, Portsmouth, UK

<sup>d</sup> The Minded Institute, London, UK

## ARTICLE INFO

## Keywords:

Mind-body medicine

Yoga

Public health

Exercise

Relaxation

## ABSTRACT

**Background:** While yoga can improve health-related variables and health behavior, different yoga styles and practice components appear to be associated with specific health outcomes. The aim of this study was to explore the connection between yoga use, health, and health behaviors across different yoga styles.

**Methods:** A cross-sectional anonymous online survey (n = 1,702; 88.9% female; 93.3% German nationality; mean age 47.2 ± 10.8 years; 58.2% yoga teachers) assessed yoga practice characteristics, health-related variables and health behavior. The survey was distributed in Germany only but not limited to German participants.

**Results:** Ashtanga yoga (15.7%), Hatha yoga (14.2%), and Sivananda yoga (22.4%) were the most commonly practiced yoga styles; participants practiced for a mean of 12.7 ± 10.0 years. Most participants had good to excellent (96.1%) overall health; 87.7% reported improved health since starting yoga. Controlling for socio-demographic and clinical factors, health-related variables were mainly associated with frequency of yoga postures practice (p < 0.05), health behaviors also with yoga philosophy study (p < 0.05). The various yoga styles were associated with specific health-related variables (p < 0.05).

**Conclusion:** Yoga practitioners generally have a good overall health and a healthy lifestyle. While health variables are mainly associated with practice of yoga postures, health behaviors are also associated with the study of yoga philosophy. Yoga interventions targeting prevention or health promotion should include yoga philosophy to modify health behaviors. The specific yoga style employed may also influence health outcomes.

## 1. Introduction

Yoga is an ancient spiritual and health practice traditionally including physical postures, breathing exercises, meditation, philosophical and lifestyle lectures. Due, in part, to its biopsychosocial approach, it is increasingly appreciated for its role in health promotion and management.<sup>1,2</sup> Over recent years, different yoga schools have emerged that vary in their focus on physical and mental practices.<sup>2</sup> Although yoga is generally perceived as a unitary practice, its actual content can range from exclusively meditation through a combination of mental and physical techniques to relatively intensive physical activity. The ratification of an International Yoga Day by the General Assembly of the United Nations highlighted yoga's potential role in the prevention and management of non-communicable diseases.<sup>3</sup> Surveys show the primary reasons for yoga practice are to improve health and

fitness, to enhance flexibility and to reduce stress or improve mood.<sup>4</sup> Correspondingly, a growing body of research worldwide suggests yoga may be beneficial for a number of health conditions. A bibliometric analysis has shown that until February 2014, 312 randomized controlled trials on yoga had been conducted, focusing on a total of 63 medical conditions.<sup>5</sup> Until January 2017, a total of 187 systematic reviews on the effects of yoga have been published (manuscript in preparation). Therefore, it is impossible to present the available evidence for yoga as a therapeutic intervention in its entirety. Among others, yoga has been shown in meta-analyses to be more effective than no treatment and as effective as exercise in reducing pain and disability in patients with low back pain,<sup>6</sup> to be more effective than no treatment, relaxation or exercise in reducing levels of depression in patients with depression,<sup>7</sup> and to be more effective than no treatment in reducing fasting blood glucose and HbA1c in patients with type 2 diabetes.<sup>8</sup>

\* Corresponding author at: Kliniken Essen-Mitte, Klinik für Naturheilkunde und Integrative Medizin, Am Deimelsberg 34a, 45276, Essen, Germany.

E-mail address: [h.cramer@kliniken-essen-mitte.de](mailto:h.cramer@kliniken-essen-mitte.de) (H. Cramer).

<https://doi.org/10.1016/j.ctim.2018.10.026>

Received 2 August 2018; Received in revised form 30 October 2018; Accepted 30 October 2018

Available online 31 October 2018

0965-2299/ © 2018 Elsevier Ltd. All rights reserved.

**Table 1**  
Sociodemographic, health and health behavior characteristics of participants.

	n (%)	Mean ± Standard Deviation (Range)
Age (in years)	–	47.24 ± 10.79 (19.00 - 87.00)
Gender		
Female	1,498 (88.9%)	–
Nationality		
German	1,662 (93.8%)	–
Marital status (in a relationship)		
Married / in a relationship	1,193 (70.1%)	–
Education		
No qualification	3 (0.2%)	–
Secondary modern school (“Hauptschule”)	50 (2.9%)	–
High School (“Realschule”)	359 (21.1%)	–
A-Level diploma (“Abitur”)	369 (21.7%)	–
University degree	877 (51.5%)	–
Other	44 (2.6%)	–
Employment		
Full time	710 (41.7%)	–
Part time	534 (31.4%)	–
House keeper	60 (3.5%)	–
Unemployed	15 (0.9%)	–
Retired	126 (7.4%)	–
Student	41 (2.4%)	–
Other	183 (10.8%)	–
Chronic illness	561 (33.0%)	–
Number of chronic illnesses <sup>a</sup>	–	1.64 ± 0.95 (1.00 – 5.00)
General health status		
Excellent	219 (12.9%)	–
Very good	747 (43.9%)	–
Good	669 (39.3%)	–
Fair	60 (3.5%)	–
Poor	7 (0.4%)	–
Change in health since starting yoga		
Much better now	971 (57.1%)	–
Somewhat better now	520 (30.6%)	–
About the same	159 (9.3%)	–
Somewhat worse now	46 (2.7%)	–
Much worse now	6 (0.4%)	–
Quality of life (WHOQOL-BREF)		
Physical	–	17.46 ± 2.01 (6.86 – 20.00)
Psychological	–	16.33 ± 2.19 (5.33 – 20.00)
Social	–	15.50 ± 2.93 (4.00 – 20.00)
Environmental	–	17.14 ± 1.71 (9.00 – 20.00)
Sleep quality <sup>b</sup>	–	7.63 ± 2.02 (0.01 – 10.00)
Fatigue <sup>b</sup>	–	3.75 ± 2.25 (1.00 – 10.00)
Body mass index	–	23.16 ± 6.25 (15.04 – 184.91)
Mindfulness (FMI)	–	41.55 ± 5.97 (19.00 – 56.00)
Health behavior		
Any weekly exercise other than yoga (in minutes)	–	106.62 ± 135.49 (0.00 – 1350.00)
Regular alcohol consumption	176 (10.3%)	–
Smoker	154 (9.0%)	–
Omnivore	912 (53.6%)	–
Pescetarian	342 (20.1%)	–
Vegetarian	305 (17.9%)	–
Vegan	143 (8.4%)	–

Abbreviations: FMI – Freiburg Mindfulness Inventory; WHOQOL-BREF – World Health Organization Quality of Life Instrument.

<sup>a</sup> In the subsample of participants with chronic illnesses.

<sup>b</sup> Rated 1–10, higher values indicate better sleep quality but higher fatigue.

According to a 2014 survey, an estimated 19.4% of the population in Germany practised yoga or were interested in commencing yoga practice with the main reasons for practicing yoga being to improve physical and mental health conditions and to increase physical and mental performance.<sup>9</sup> Surveys conducted on the characteristics of yoga practitioners and yoga’s influence on health in the US and Australia suggest people with health conditions practice yoga and derive benefit.<sup>4,10–14</sup> In a national survey in Australia the majority of respondents reported practicing yoga to manage a health issue or medical condition; and 53.3% respondents perceived their condition as improving due to their yoga practice.<sup>4</sup>

A survey of US individuals practicing Iyengar yoga found that 90.5% of participants reporting a chronic or serious health condition agreed or strongly agreed that their health improved as a result of yoga

practice.<sup>13</sup> This survey found associations between different components of yoga practice and specific health outcomes or health behaviors with different yoga practice patterns influencing the practice’s health benefits, at least for this specific yoga style. Specifically, the frequency of home practice was associated with mindfulness, subjective well-being, body mass index, fruit and vegetable consumption, vegetarian status, sleep, and fatigue; and each component of yoga practice (different categories of physical poses, breath work, meditation, and philosophy study) were associated with at least one health outcome.

While these associations of different practice patterns and users’ characteristics with specific health variables are important, the applicability beyond the specific yoga style studied remains unclear. In response, the research reported here examines the associations of yoga practice characteristics (components, intensity and the specific yoga

**Table 2**  
Yoga practice characteristics.

	n (%)	Mean ± Standard Deviation (Range)
Yoga teacher	990 (58.2%)	–
Primary yoga style (alphabetical order)		
Ashtanga Yoga	267 (15.7%)	–
(Traditional) Hatha Yoga	241 (14.2%)	–
Iyengar Yoga	143 (8.4%)	–
Kundalini Yoga	186 (10.9%)	–
Krishnamacharya Tradition / Viniyoga	161 (9.5%)	–
Power Yoga	71 (4.2%)	–
Sivananda Yoga / Yoga Vidya	381 (22.4%)	–
Others <sup>b</sup>	252 (14.8%)	–
Additional yoga styles (alphabetical order) <sup>a</sup>		
Ashtanga Yoga	285 (16.7%)	–
(Traditional) Hatha Yoga	71 (4.2%)	–
Iyengar Yoga	189 (11.1%)	–
Kundalini Yoga	258 (15.2%)	–
Krishnamacharya Tradition / Viniyoga	42 (2.5%)	–
Power Yoga	165 (9.7%)	–
Sivananda Yoga / Yoga Vidya	188 (11.0%)	–
Others <sup>b</sup>	183 (10.8%)	–
Use of props	1,074 (63.1%)	–
Age when starting yoga (in years)	–	34.42 ± 10.61 (2.00 – 74.58)
Years of yoga practice	–	12.72 ± 9.95 (0.08 – 54.00)
Practice location		
Yoga classes (as a student)	1,250 (74.1%)	–
Yoga classes (as a teacher)	60 (3.6%)	–
At home (repeating what learned at class)	482 (28.6%)	–
At home (self-study)	1,026 (60.8%)	–
Weekly yoga practice (in minutes)		
Total	–	249.79 ± 184.38 (0.00 – 1530.00)
Location		
In class	–	84.81 ± 98.58 (0.00 – 1440.00)
At home	–	166.26 ± 174.42 (0.00 – 1440.00)
Practice components	–	124.51 ± 99.72 (0.00 – 1953.00)
Yoga poses	–	32.88 ± 35.56 (0.00 – 306.00)
Breathing exercises	–	39.99 ± 53.54 (0.00 – 525.00)
Meditation	–	25.81 ± 24.81 (0.00 – 306.00)
Relaxation	–	24.98 ± 36.53 (0.00 – 585.00)
Yoga philosophy	–	–

<sup>a</sup> More than one additional yoga style per participant possible.

<sup>b</sup> Other yoga styles included: acro-yoga, Advanced Yoga Practices (AYP), aerial yoga, akku yoga, Ananda yoga, Antastha yoga, Anusara yoga, autogenic yoga, Ayur yoga, back yoga, benefit yoga, Bhakti yoga, Bihar yoga, Bikram yoga, Breathwalk, Business yoga, chair yoga, Chakra mediation, ChiYoga, DAO yoga, Egyptian tradition according to Dr. Babacar Khane, element yoga, energy yoga, fascia yoga, Feuerabendt yoga, flow yoga, Forrest yoga, Gitananda yoga, healing yoga according to Maria Dieste, hot yoga, housewife yoga, hormone yoga, Indrajala yoga, Integral yoga, intuitive yoga, Jesudian yoga, Jivamukti yoga, Jnana yoga, Jule yoga, Karma yoga, Kashmir yoga, kashmirian shivaism-based yoga, KRIBA, Kriya yoga, Kripalu yoga, laughter yoga, lu jong, luna yoga, Maharishi yoga asanas, male yoga, Marma yoga, Matma yoga, meditation yoga, mindful yoga, mindful flow yoga, naad yoga, neck yoga, new yoga will according to Heinz Grill, physio yoga, prana yoga, pranala yoga, Raja yoga, restorative yoga, sampada yoga, sat nam rasayan, Satya yoga, Sayananda yoga, shaktiyoga, shiatsu yoga, siva sakti yoga, sound yoga, Sri Sai prana yoga, tantra yoga, tantric Nirswara Samkya yoga, tao yoga, therapeutic yoga, Tibetan healing yoga, Tibetan heart yoga, trauma-sensitive yoga, Tri yoga, vedic yoga, Vijnana yoga, vox yoga, Yin yoga, yoga according to Swami Kvalayananda, yoga according to T.K. Srihashyam, yoga dancing, yoga for kids, yoga nidra, yoga on stand up paddle board, yoga zero, Yogananda yoga, yogaswing, Yogamare, YogaMalish.

style employed) with health and health behaviors across different yoga styles. The aims of this study were to assess associations of health variables and health behaviors with yoga practice characteristics.

The specific research questions were:

- 1) Are health-related quality of life, sleep quality, fatigue, body mass index and/or mindfulness associated with being a yoga teacher, the primary yoga style, the use of props, the duration of yoga practice, the location of yoga practice, the yoga practice frequency, and/or the frequency of practice of: yoga poses, breathing exercises, meditation, relaxation, philosophy and other yoga components?
- 2) Are alcohol consumption, smoking, vegetarian status, and/or the frequency of exercise other than yoga associated with being a yoga teacher, the primary yoga style, the use of props, the duration of yoga practice, the location of yoga practice, the yoga practice frequency, and/or the frequency of practice of: yoga poses, breathing exercises, meditation, relaxation, philosophy and other yoga

components?

## 2. Methods

### 2.1. Design and participants

This cross-sectional analysis used data from a national anonymous online survey conducted from January to June 2016 using the online platform SoSciSurvey.<sup>15</sup> To avoid missing data, the survey was created so that participants could only proceed to the next survey section when each question in the current section was answered. Ethics approval was gained from the ethics committee of the University of Duisburg-Essen. Participants were recruited by email (send by DQ) from national (i.e. registered in Germany) yoga teachers' associations, yoga studios, and the Yoga Conference Germany as well as through Facebook. A total of 4 yoga teachers' associations, 3 congress organizers, and 145 yoga studios were contacted by email and asked to send the link of the survey to

**Table 3**  
Predictors associated independently with dichotomous health variables (controlling for age, gender, marital status, education, employment, chronic illness).

Dependent variable	Predictor variable	Adjusted odds ratio (95% confidence interval)
General health status good or excellent Health improved since starting yoga	Yoga teacher	3.50 (2.01-6.11)
	Age when starting yoga	
	below 18	Reference
	18 to 29	1.81 (0.93-3.52)
	30 to 39	1.75 (0.90-3.41)
	40 to 49	5.89 (2.72-12.77)
	50 to 64	2.98 (1.26-7.07)
	65 or greater	6.15 (0.60-63.45)
Regular alcohol consumption	Weekly practice frequency: yoga poses	
	First quartile	Reference
	Second quartile	1.18 (0.80-1.76)
	Third quartile	2.03 (1.31-3.16)
	Fourth quartile	2.98 (1.85-4.81)
	Yoga teacher	0.68 (0.47-0.99)
Smoker	Weekly practice frequency: philosophy	
	First quartile	Reference
	Second quartile	0.71 (0.46-1.09)
	Third quartile	0.67 (0.42-1.07)
	Fourth quartile	0.39 (0.23-0.68)
	Yoga teacher	0.55 (0.39-0.78)
Vegetarian or vegan	Primary yoga style	
	Asthanga Yoga (Traditional) Hatha Yoga	2.10 (1.28-3.45)
	Iyengar Yoga	1.06 (0.62-1.82)
	Kundalini Yoga	1.88 (1.04-3.40)
	Krishnamacharya Tradition	1.81 (1.07-3.06)
	/ Viniyoga	1.11 (0.61-2.02)
	Power Yoga	1.33 (0.63-2.82)
	Sivananda Yoga / Yoga Vidya	3.94 (2.51-6.19)
	Other	Reference
	Home practice (self-study)	1.50 (1.13-2.00)
	Weekly practice frequency: breathing exercises	
	First quartile	Reference
	Second quartile	0.58 (0.39-0.86)
	Third quartile	0.53 (0.36-0.80)
Fourth quartile	0.80 (0.53-1.22)	
Weekly practice frequency: meditation		
First quartile	Reference	
Second quartile	1.13 (0.75-1.71)	
Third quartile	1.81 (1.16-2.81)	
Fourth quartile	2.49 (1.56-3.97)	
Weekly practice frequency: philosophy		
First quartile	Reference	
Second quartile	1.33 (0.89-2.00)	
Third quartile	1.96 (1.30-2.96)	
Fourth quartile	2.11 (1.38-3.23)	

their members or customers. Calls were posted on Facebook yoga groups. All participants aged 18 years or older who currently practiced yoga were eligible for the survey. It was not checked whether non-German yoga practitioners participated. Both yoga teachers and other yoga practitioners were eligible.

## 2.2. Yoga practice characteristics

Questions on yoga practice characteristics were modelled after prior surveys on yoga and health.<sup>9,12,13</sup> The questions were not pilot tested, and face validity was not assessed. Participants indicated whether they were certified yoga teachers or not, which yoga style they were

primarily practicing (only one style could be chosen), what additional styles they practiced, whether they used props (such as belts, blocks or blankets) during their yoga practice, and how long ago they had started practicing yoga. Participants were further questioned as to whether they were practicing at yoga classes, at home after being trained by a yoga teacher (repeating what they learned in class) or at home without prior training by a yoga teacher (self-study), and/or elsewhere (multiple answers could be chosen). Yoga practice frequency (times per week or month) and average duration of practice sessions were assessed for both home practice and supervised practice, as was practice time for yoga poses, breathing exercises, meditation, relaxation, philosophy and other yoga components (in % of total yoga practice time). For each variable, practice frequency was calculated as minutes per week.

## 2.3. Sociodemographic, clinical, and health-related variables

The survey collected sociodemographic data on age, gender, nationality, marital status, education, and employment status. No information on race or ethnicity were collected. Health-related variables included chronic illness (presence/absence, number of chronic illnesses), general health status assessed on a 5-point Likert scale ranging from poor to excellent, and perceived change in general health status since starting yoga assessed on a 5-point Likert scale ranging from much worse now to much better.<sup>16</sup> Health-related quality of life was assessed on the abbreviated World Health Organization Quality of Life Instrument (WHOQOL-BREF) on the four dimensions physical, psychological, social, and environmental well-being.<sup>17</sup> Cronbach's alpha in this study was 0.8, 0.8, 0.7, and 0.7 for physical, psychological, social, and environmental well-being, respectively. Higher scores indicate higher quality of life. Sleep quality and fatigue were measured on numerical rating scales ranging from 1 to 10 with higher scores indicating better sleep quality and higher fatigue. Comparable measures have been validated in different samples.<sup>18–21</sup> Mindfulness was measured using the Freiburg Mindfulness Inventory (FMI).<sup>22</sup> Cronbach's alpha in this study was 0.8. Higher scores indicate higher quality of life. Height and weight were recorded and body mass index (BMI) was calculated as kg/m<sup>2</sup>.<sup>23</sup>

## 2.4. Health behavior

Health behavior included any exercise other than yoga which was assessed as frequency (times per week or month) and average duration, and recalculated as minutes per week. Because this survey mainly focused on yoga and not on other exercise, it was decided not to use an exhaustive Alcohol consumption was assessed as no consumption, irregular consumption, or regular consumption. The answers were converted to standard drinks [less Smoking status was assessed as smoking or non-smoking. Because this survey assessed current health behavior, prior smoking status was not within its focus and therefore not assessed. Participants were asked whether they consumed meat or poultry, fish, eggs or dairy products; participants were then classified as vegan (no meat, fish, eggs, or dairy products), vegetarian (no meat or fish but eggs and/or dairy products), pescetarian (no meat but fish, with or without consumption of eggs and/or dairy products), or omnivore (meat, with or without consumption of fish, eggs and/or dairy products).

## 2.5. Statistical analyses

Analyses were conducted for all participants who completed the survey. Since participants could only proceed to the next survey section when each question in the current section was answered, there were no missing data in the final data set. Sociodemographic, yoga-related, health-related and health behavior data were expressed as means, standard deviations and range or frequencies and percentages as appropriate. Associations of yoga practice with health-related and health behavior variables were determined by forward stepwise multiple linear or logistic regression analyses. Adjusted odds ratios with 95%

**Table 4**  
Predictors associated independently with linear health variables (controlling for age, gender, marital status, education, employment, chronic illness).

Dependent variable	Predictor variable	B ± SE	β	P	R <sup>2</sup>
Quality of life (WHOQOL-BREF)	Physical				0.18
	Yoga teacher	0.71 ± 0.10	0.173	< 0.001	
Psychological	Weekly practice frequency: yoga poses	0.002 ± 0.000	0.112	< 0.001	0.12
	Yoga teacher	0.73 ± 0.12	0.163	< 0.001	
	Primary yoga style: Iyengar yoga	0.55 ± 0.19	0.068	0.005	
	Home practice (repeating what learned at class)	0.23 ± 0.11	0.049	0.041	
	Weekly practice frequency: yoga poses	0.001 ± 0.001	0.103	0.013	
Social	Weekly practice frequency: meditation	0.004 ± 0.001	0.062	< 0.001	0.08
	Yoga teacher	0.48 ± 0.15	0.081	0.001	
Environmental	Weekly practice frequency: philosophy	0.01 ± 0.002	0.075	0.003	0.07
	Primary yoga style: Krishnamacharya	0.29 ± 0.14	0.049	0.043	
Sleep quality <sup>a</sup>	Weekly practice frequency: yoga poses	0.001 ± 0.000	0.084	0.001	0.06
	Yoga teacher	0.46 ± 0.10	0.113	< 0.001	
Fatigue <sup>a</sup>	Weekly practice frequency: yoga poses	0.001 ± 0.001	0.062	0.012	0.12
	Yoga teacher	-0.50 ± 0.12	-0.110	< 0.001	
	Primary yoga style: Power yoga	-0.74 ± 0.27	-0.065	0.006	
	Weekly practice frequency: yoga poses	-0.001 ± 0.001	-0.058	0.021	
Body mass index	Weekly practice frequency: philosophy	-0.004 ± 0.002	-0.071	0.005	0.05
	Yoga teacher	-0.95 ± 0.26	-0.096	< 0.001	
	Primary yoga style: Kundalini yoga	0.96 ± 0.39	0.061	0.013	
Mindfulness (FMI)	Weekly practice frequency: yoga poses	-0.003 ± 0.001	-0.062	0.014	0.18
	Yoga teacher	1.83 ± 0.36	0.151	< 0.001	
	Primary yoga style: Sivananda yoga / Yoga Vidya	0.68 ± 0.34	0.048	0.046	
	Use of props	-0.85 ± 0.29	-0.068	0.004	
	Practice at yoga classes	-1.00 ± 0.35	-0.073	0.004	
	Home practice (self-study)	0.84 ± 0.33	0.069	0.010	
	Weekly practice frequency: yoga poses	0.004 ± 0.002	0.061	0.015	
	Weekly practice frequency: meditation	0.01 ± 0.003	0.082	0.002	
	Weekly practice frequency: philosophy	0.02 ± 0.004	0.103	< 0.001	
	Weekly exercise other than yoga (in minutes)				0.02
	Primary yoga style: Power yoga	64.10 ± 16.81	0.096	< 0.001	
	Weekly practice frequency: yoga poses	0.12 ± 0.03	0.087	0.001	

Abbreviations: FMI – Freiburg Mindfulness Inventory; WHOQOL-BREF – World Health Organization Quality of Life Instrument.

<sup>a</sup> Higher values indicate better sleep quality but higher fatigue.

confidence intervals were computed for dichotomous predictor variables. Independent variables included: being a certified yoga teacher or not, the primary yoga style used, the use of props, the duration of yoga practice, the location of yoga practice, yoga practice frequency, and the frequency of practice of: yoga poses, breathing exercises, meditation, relaxation, philosophy and other yoga components. Dichotomous dependent variables included: general health status (good or excellent), health improved since starting yoga, regular alcohol consumption, being a smoker, being a vegetarian or vegan. Linear dependent variables included: physical, psychological, social, environmental quality of life (WHOQOL-BREF), sleep quality, fatigue, body mass index, mindfulness (FMI), and weekly frequency of any exercise other than yoga (in minutes). Analyses were adjusted for sociodemographic (age, gender, marital status, education, employment) and clinical characteristics (presence/absence of chronic illness). Among the potential predictor variables that were entered in the regression model, only those variables were selected that were associated with the dependent variable at a p-value of  $\leq 0.10$  in univariate analysis by Chi-squared tests. All statistical analyses were performed using IBM SPSS® software (IBM SPSS Statistics for Windows, release 22.0. Armonk, NY: IBM Corp.).

### 3. Results

#### 3.1. Participants

A total of 1,702 participants completed the online survey. Sociodemographic characteristics are presented in Table 1. Participants' age ranged from 19 to 87 years, 89% were female, 73% had an A-level diploma and/or university degree, and 73% were employed (Table 1).

About 58% of participants were yoga teachers, the most prominent yoga styles used were Sivananda Yoga / Yoga Vidya (a German yoga tradition based on the teachings of Swami Sivananda and Swami Vishnu-Devananda), Ashtanga Yoga, Iyengar Yoga, Kundalini Yoga and traditional Hatha Yoga. Props were used by 63% of participants. Yoga was practiced about 4 h per week on average, about two thirds of this time was practiced at home, and about half of the practice time was dedicated to yoga poses. Breathing exercises, meditation, relaxation, and yoga philosophy were practiced between 24 and 38 min per week on average (Table 2). Further yoga practice characteristics are shown in Table 2.

Health characteristics and health behavior are given in Table 1. While 33% of participants were suffering from one or more chronic illnesses, 96% indicated their health status to be good, very good, or excellent, and 88% rated their current health status to be somewhat or much better than before they had started practicing yoga. 10% and 9% of participants were regularly consuming alcohol and smoking,

respectively, and 29% indicated they did not eat meat, poultry or fish (Table 1).

### 3.2. Associations of yoga practice with health status

Associations are given in Tables 3 and 4. Controlling for age, gender, marital status, education, employment, and chronic illness, yoga teachers had 3.5 times the odds of having good to excellent health status than non-yoga teachers. Controlling for age, gender, marital status, education, employment, and chronic illness, participants who had started practicing yoga between 40 and 64 years of age had 3.0 to 5.9 times the odds of reporting improved health than those who had started practice earlier. Improvements were further associated with higher practice frequency of yoga poses (Table 4). Controlling for age, gender, marital status, education, employment, and chronic illness, all dimensions of quality of life were higher in yoga teachers except for environmental well-being; and all dimensions increased with increasing practice frequency of yoga poses except for social well-being which was associated with frequency of yoga philosophy study. Psychological well-being was better in participants whose primary yoga style was Iyengar yoga and those who were repeating at home what they had learned in yoga classes; environmental well-being was higher in those whose primary yoga style was the Krishnamacharya tradition / Viniyoga. Controlling for age, gender, marital status, education, employment, and chronic illness, sleep quality and fatigue were better in yoga teachers and associated with frequency of practice of yoga poses; lower fatigue was further associated with the practice of Power Yoga as a primary yoga style and higher frequency of yoga philosophy study. Controlling for age, gender, marital status, education, employment, and chronic illness, body mass index was negatively associated with frequency of yoga poses practice, and was lower in yoga teachers but higher in those who were practicing Kundalini yoga as their primary yoga style. Controlling for age, gender, marital status, education, employment, and chronic illness, mindfulness was positively associated with Sivananda yoga practice as their primary yoga style, self-study of yoga at home, and practice frequency of yoga poses, meditation, and yoga philosophy, and negatively with the use of props during yoga practice and yoga practice in yoga classes (Table 4).

### 3.3. Associations of yoga practice with health behavior

Associations are given in Tables 3 and 4. Controlling for age, gender, marital status, education, employment, and chronic illness, yoga teachers 0.55 times the odds of smoking and 0.68 times the odds of consuming alcohol regularly compared to non-yoga teachers. Regular alcohol consumption was further negatively associated with higher frequency of yoga philosophy practice. Controlling for age, gender, marital status, education, employment, and chronic illness, those participants who were practicing Ashtanga Yoga (2.1 times the odds compared to those using another yoga style than those mentioned here), Iyengar Yoga (1.9 times the odds), Kundalini Yoga (1.8 times the odds) or Sivananda Yoga / Yoga Vidya (2.5 times the odds) as their primary yoga style were more likely to be vegetarians or vegans. Being a vegetarian or vegan was further associated with self-study of yoga at home and with higher practice frequency of breathing exercises, meditation, and yoga philosophy (Table 3). Controlling for age, gender, marital status, education, employment, and chronic illness, weekly frequency of non-yoga exercise was positively associated with practicing Power Yoga as a primary yoga style and with higher practice frequency of yoga poses (Table 4).

## 4. Discussion

A main finding of this survey is that yoga practitioners generally enjoy a relatively good health with 96.1% reporting good, very good or excellent overall health, and 87.7% reporting improved health since

commencing yoga. This is in line with earlier surveys in the general population and in patients with chronic diseases where yoga practitioners were more likely to report a good to excellent health status than non-users.<sup>11,24</sup> Also, BMI in our sample was lower than the German norm.<sup>25</sup> A possible explanation for this good overall health in yoga practitioners might be that they also, overall, reported a health-promoting lifestyle: compared to the German norm,<sup>26,27</sup> the proportion of vegetarians or vegans among German yoga practitioners participating in our survey was more than 6 times higher than in the general German population and the proportion of smokers was less than half. We need to remain mindful that women and those possessing a higher level of education are more likely to a vegetarian diet to be non-smokers, and that the predominance of females and higher educated individuals in the specific sample of our survey may partly (but not completely) explain the higher proportions of vegetarians and non-smokers in the survey compared to the German norm. Compared to a US survey on Iyengar yoga practitioners,<sup>13</sup> German yoga practitioners in our survey were more likely to be vegetarians but also more often smoked probably reflecting a different likelihood to follow these health behaviors in the two countries' general population.<sup>26–29</sup>

Our analyses show positive health behaviors such as alcohol abstinence and adopting a vegetarian or vegan diet were commonly associated with higher frequency of yoga philosophy study. The ethical guidelines or 'restraints' provided in yoga philosophy include recommending behavior that does not hurt oneself or others.<sup>2</sup> This so-called 'ahimsa' is referred to as non-violence against all living being – including animals but also the yoga practitioners themselves.<sup>2</sup> Based on these guidelines, several yoga traditions purport the following a vegetarian diet as an ethical and health necessity to practice yoga and view eating meat as inducing animal suffering.<sup>30,31</sup> Other behaviors potentially endangering oneself or others, such as alcohol consumption, which are also thought to interfere with mental yoga exercises, are also often viewed by yoga teachers and users as incompatible with yoga practice.<sup>31</sup> Overall, a generally healthy lifestyle is frequently recommended in addition to formal yoga exercises,<sup>30,32</sup> and yoga practitioners have been shown to more often follow a vegetarian or vegan diet and to exercise than yoga non-users.<sup>33</sup> It needs to be kept in mind that due to the cross-sectional nature of this survey, the interpretation that individuals with a healthy lifestyle feel attracted to yoga practice is also possible.

Our research shows the only health behavior that was not associated with yoga philosophy study was exercising time (besides practicing yoga). Exercise time was associated with using power yoga as a primary yoga style and with more frequent yoga pose practice (i.e. with a likely conceptualization of yoga mainly as a physical practice). This can be interpreted as either power yoga practitioners being attracted to other exercise, regular exercisers being attracted to power yoga or both variables being influenced by a non-tested third variable.

Frequency of yoga posture practice was also a predictor for health variables in our study. There are at least two possible interpretations for this finding: i) yoga postures might be an important mechanism by which yoga improves both physical and mental health in yoga practitioners; or ii) given the cross-sectional nature of our survey, this finding can also be interpreted as physical and mental health constituting a stronger prerequisite for practicing yoga postures than for practicing any other yoga components.

The single most important independent predictor of almost all health variables in our study was having the status of a yoga teacher. This is interesting as it cannot be explained by age or the more intensive practice yoga teachers are likely to follow (this was controlled for in the regression analyses). Due to the cross-sectional nature of our analysis, it is not clear whether being a yoga teacher per se is beneficial for health because it involves a stronger immersion in yoga<sup>34</sup> and a stronger influence of yoga on overall lifestyle, or whether this finding simply reflects a possibility that healthy individuals are more likely to become yoga teachers.

Interestingly, our analyses show that improvement in overall health since practising yoga was most common in individuals who were middle-aged (40–64 years old) when they commenced practice. As such, it may be that commencing yoga in middle age can contribute to reducing the age-related health decline typically starting around this age.<sup>5</sup> On the other hand, this finding might also be partly explained by the tendency to self-report better subjective health with increasing age.<sup>35</sup>

Our analysis found a few indicators of different health categories being uniquely influenced by specific yoga styles: Ashtanga, Iyengar and Sivananda yoga practitioners were more likely to be vegetarians; Iyengar yogis had higher psychological quality of life, Viniyogis had higher environmental quality of life; body mass index was higher in Kundalini yogis; mindfulness was higher in Sivananda yogis; and fatigue was lower and exercise frequency higher in Power yogis. While it is a common finding in clinical trials that yoga can increase quality of life and mindfulness,<sup>36</sup> and decrease obesity,<sup>37,38</sup> and fatigue,<sup>39</sup> there currently is no suggestion from clinical trials that the various yoga styles differ in their effectiveness.<sup>40</sup> Our survey is the first to show differential associations of different yoga styles with specific health dimensions. Importantly, except for a slightly higher BMI in Kundalini yoga practitioners (the direction of this association of course is not clear), no other associations of specific yoga styles with negative health outcomes were observed. This can be interpreted as yoga not being associated with serious detrimental effects but more with positive effects on health.<sup>3, 41</sup>

Our survey has a number of limitations. As an anonymous retrospective online survey, it remains unclear whether the results were distorted by social desirability, memory bias or other sources of bias. In addition, since a snowball system was used for recruitment, the response rate cannot be determined and possibly due to the recruitment via yoga teacher associations, professional yoga teachers were over-represented in our sample meaning that this was not representative to yoga practitioners. The survey did not assess race and ethnicity because these are difficult topics in Germany. The exact meaning of the yoga practice components were not explained to the participants because it was expected that they are common concepts in yoga. Nevertheless, there might have been differing interpretations of these categories in different practitioners. Questions on physical activity and alcohol consumption were not based on validated instruments. Therefore, the findings on these health behaviors might be less reliable than those on the other health-related variables. Finally, the cross-sectional nature of our survey precludes any causal interpretations of the study findings.

In conclusion, our study found that yoga practitioners generally have a good overall health and a healthy lifestyle. The various yoga styles differ in their associations with specific health variables. While health variables are mainly associated with the frequency of practice of yoga postures, health behaviors are also associated with the frequency of study of yoga philosophy. Longitudinal studies are needed to assess the causality of these associations.

#### Conflict of interest

All authors declare that they have no conflict of interest.

#### Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

#### Informed consent

Informed consent was obtained from all individual participants included in the study.

#### Acknowledgments

The authors wish to express their gratefulness to all yoga teacher associations, yoga studios, and individuals who contributed to participant recruitment for this survey, especially the Berufsverband der Yogalehrenden in Deutschland (BDY), Iyengar-Yoga Deutschland e.V., Yoga Vidya/Berufsverband der Yoga Vidya Lehrer/innen (BYVG), 3H Organisation Deutschland e.V. (3HO Deutschland), and the organizers of the Yoga Conference Germany in Cologne, Germany. The authors further thank all yoga practitioners who participated in the survey. No external funding was received for this survey.

#### References

1. De Michelis E. *A history of modern yoga: Patanjali and western esotericism*. London, UK: Continuum International Publishing Group; 2005.
2. Feuerstein G. *The yoga tradition*. Prescott: Hohm Press; 1998.
3. United Nations. International Day of Yoga 21 June 2017; <http://www.un.org/en/events/yogaday/>. Accessed November 11, 2017.
4. Penman S, Cohen M, Stevens P, Jackson S. 'Yoga in Australia: Results of a national survey'. *Int J Yoga*. 2012;5(2):92–101.
5. Cramer H, Lauche R, Dobos G. Characteristics of randomized controlled trials of yoga: a bibliometric analysis. *BMC Complement Altern Med*. 2014;14:328.
6. Cramer H, Lauche R, Haller H, Dobos G. A systematic review and meta-analysis of yoga for low back pain. *Clin J Pain*. 2013;29(5):450–460.
7. Cramer H, Lauche R, Langhorst J, Dobos G. Yoga for depression: a systematic review and meta-analysis. *Depress Anxiety*. 2013;30(11):1068–1083.
8. Cramer H, Lauche R, Haller H, Steckhan N, Michalsen A, Dobos G. Effects of yoga on cardiovascular disease risk factors: a systematic review and meta-analysis. *Int J Cardiol*. 2014;173(2):170–183.
9. Cramer H. [Yoga in Germany - results of a nationally representative survey]. *Forsch Komplementmed*. 2015;22(5):304–310.
10. Birdee GS, Legedza AT, Saper RB, Bertisch SM, Eisenberg DM, Phillips RS. Characteristics of yoga users: Results of a national survey. *J Gen Intern Med*. 2008;23(10):1653–1658.
11. Cramer H, Ward L, Steel A, Lauche R, Dobos G, Zhang Y. Prevalence, patterns, and predictors of yoga use: results of a U.S. nationally representative survey. *Am J Prev Med*. 2016;50(2):230–235.
12. Ross A, Friedmann E, Bevans M, Thomas S. Frequency of yoga practice predicts health: results of a national survey of yoga practitioners. *Evid Based Complement Alternat Med*. 2012;2012:983258.
13. Ross A, Friedmann E, Bevans M, Thomas S. National survey of yoga practitioners: mental and physical health benefits. *Complement Ther Med*. 2013;21(4):313–323.
14. Saper RB, Eisenberg DM, Davis RB, Culpepper L, Phillips RS. Prevalence and patterns of adult yoga use in the United States: results of a national survey. *Altern Ther Health Med*. 2004;10(2):44–49.
15. SoSci Survey. SoSci Survey - der onlineFragebogen. 2015; <https://www.sosicisurvey.de/index.php?page=home&l=eng>.
16. Ware Jr JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30(6):473–483.
17. The WHOQOL Group. Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychol Med*. 1998;28(3):551–558.
18. Chuang LL, Lin KC, Hsu AL, et al. Reliability and validity of a vertical numerical rating scale supplemented with a faces rating scale in measuring fatigue after stroke. *Health Qual Life Outcomes*. 2015;13:91.
19. Minnock P, Kirwan J, Bresnihan B. Fatigue is a reliable, sensitive and unique outcome measure in rheumatoid arthritis. *Rheumatology (Oxford)*. 2009;48(12):1533–1536.
20. Cappelleri JC, Bushmakina AG, McDermott AM, Sadosky AB, Petrie CD, Martin S. Psychometric properties of a single-item scale to assess sleep quality among individuals with fibromyalgia. *Health Qual Life Outcomes*. 2009;7:54.
21. Avila-Ribeiro P, Brault Y, Dougados M, Gossec L. Psychometric properties of sleep and coping numeric rating scales in rheumatoid arthritis: a subanalysis of an etanercept trial. *Clin Exp Rheumatol*. 2017;35(5):786–790.
22. Walach H, Buchheld N, Buttenmüller V, Kleinknecht N, Schmidt S. Measuring mindfulness - the Freiburg Mindfulness Inventory (FMI). *Pers Individ Dif*. 2006;40(8):1543–1555.
23. Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999–2010. *JAMA*. 2012;307(5):491–497.
24. Cramer H, Lauche R, Langhorst J, Dobos G, Paul A. Quality of life and mental health in patients with chronic diseases who regularly practice yoga and those who do not: a case-control study. *Evid Based Complement Alternat Med*. 2013;2013:702914.
25. Statistisches Bundesamt. *Körpermaße nach Altersgruppen und Geschlecht*. 2017; <https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/Gesundheit/GesundheitszustandRelevantesVerhalten/Tabellen/Koerpermasse.html>.
26. Mensink GBM, Barbosa CL, Brettschneider AK. Verbreitung der vegetarischen Ernährungsweise in Deutschland. *J Health Monit*. 2016;1(2):2–15.
27. Zeiher J, Kuntz B, Lange C. Rauchen bei Erwachsenen in Deutschland. *J Health Monit*. 2017;2(2):59–65.
28. Stahler C. How many vegetarians are there? The Vegetarian Resource Group asked in

- a 2009 national poll. *Veg J.* 2009;27(4):12–13.
29. CDC. *Vital and health statistics summary health statistics for US adults: National Health Interview Survey*. Hyattsville, MD: US Department of Health and Human Services Center for Disease Control and Prevention National Center for Health Statistics; 2010.
  30. Iyengar BKS. *Light on yoga*. New York: Schocken Books; 1966.
  31. Shivananda S. *Practice of karma yoga*. Rishikesh, India: Divine Life Society; 2004.
  32. Vishnudeyananda S. *The complete illustrated book of yoga*. New York: Crown Trade Paperbacks; 1988.
  33. Cramer H, Sibbritt D, Park CL, Adams J, Lauche R. Is the practice of yoga or meditation associated with a healthy lifestyle? Results of a national cross-sectional survey of 28,695 Australian women. *J Psychosom Res.* 2017;101:104–109.
  34. Bussing A, Hedtstuck A, Khalsa SB, Ostermann T, Heusser P. Development of specific aspects of spirituality during a 6-month intensive yoga practice. *Evid Based Complement Alternat Med.* 2012;2012:981523.
  35. Idler EL. Age differences in self assessments of health: Age changes, cohort differences, or survivorship? *J Gerontol Soc Sci.* 1993;48:289–300.
  36. Hendriks T, de Jong J, Cramer H. The effects of yoga on positive mental health among healthy adults: a systematic review and meta-analysis. *J Altern Complement Med.* 2017;23(7):505–517.
  37. Rioux JG, Ritenbaugh C. Narrative review of yoga intervention clinical trials including weight-related outcomes. *Altern Ther Health Med.* 2013;19(3):32–46.
  38. Lauche R, Langhorst J, Lee MS, Dobos G, Cramer H. A systematic review and meta-analysis on the effects of yoga on weight-related outcomes. *Prev Med.* 2016;87:213–232.
  39. Boehm K, Ostermann T, Milazzo S, Bussing A. Effects of yoga interventions on fatigue: a meta-analysis. *Evid Based Complement Alternat Med.* 2012;2012:124703.
  40. Cramer H, Lauche R, Langhorst J, Dobos G. Is one yoga style better than another? A systematic review of associations of yoga style and conclusions in randomized yoga trials. *Complement Ther Med.* 2016;25:178–187.
  41. Cramer H, Ward L, Saper R, Fishbein D, Dobos G, Lauche R. The safety of yoga: a systematic review and meta-analysis of randomized controlled trials. *Am J Epidemiol.* 2015;182(4):281–293.