

1 **Associations of yoga practice, health status, and health behavior**
2 **among yoga practitioners in Germany - Results of a national cross-**
3 **sectional survey**

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23 **Abstract**

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

28 Methods: A cross-sectional anonymous online survey (n=1,702; 88.9% female;
29 93.3% German nationality; mean age 47.2±10.8 years; 58.2% yoga teachers)
30 assessed yoga practice characteristics, health-related variables and health behavior.
31 The survey was distributed in Germany only but not limited to German participants.

32 Results: Ashtanga yoga (15.7%), Hatha yoga (14.2%), and Sivananda yoga (22.4%)
33 were the most commonly practiced yoga styles; participants practiced for a mean of
34 12.7±10.0 years. Most participants had good to excellent (96.1%) overall health;
35 87.7% reported improved health since starting yoga. Controlling for
36 sociodemographic and clinical factors, health-related variables were mainly
37 associated with frequency of yoga postures practice ($p<0.05$), health behaviors also
38 with yoga philosophy study ($p<0.05$). The various yoga styles were associated with
39 specific health-related variables ($p<0.05$).

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

46 **Keywords:** Mind-body medicine; yoga; public health; exercise; relaxation

47 Introduction

48 Yoga is an ancient spiritual and health practice traditionally including physical
49 postures, breathing exercises, meditation, philosophical and lifestyle lectures. Due, in
50 part, to its biopsychosocial approach, it is increasingly appreciated for its role in
51 health promotion and management.^{1,2} Over recent years, different yoga schools have
52 emerged that vary in their focus on physical and mental practices.² Although yoga is
53 generally perceived as a unitary practice, its actual content can range from
54 exclusively meditation through a combination of mental and physical techniques to
55 relatively intensive physical activity. The ratification of an International Yoga Day by
56 the General Assembly of the United Nations highlighted yoga's potential role in the
57 prevention and management of non-communicable diseases.³ Surveys show the
58 primary reasons for yoga practice are to improve health and fitness, to enhance
59 flexibility and to reduce stress or improve mood.⁴ Correspondingly, a growing body of
60 research worldwide suggests yoga may be beneficial for a number of health
61 conditions. A bibliometric analysis has shown that until February 2014, 312
62 randomized controlled trials on yoga had been conducted, focusing on a total of 63
63 medical conditions.⁵ Until January 2017, a total of 187 systematic reviews on the
64 effects of yoga have been published (manuscript in preparation). Therefore, it is
65 impossible to present the available evidence for yoga as a therapeutic intervention in
66 its entirety. Among others, yoga has been shown in meta-analyses to be more
67 effective than no treatment and as effective as exercise in reducing pain and
68 disability in patients with low back pain,⁶ to be more effective than no treatment,
69 relaxation or exercise in reducing levels of depression in patients with depression,⁷
70 and to be more effective than no treatment in reducing fasting blood glucose and
71 HbA1c in patients with type 2 diabetes.⁸

72 According to a 2014 survey, an estimated 19.4% of the population in Germany
73 practised yoga or were interested in commencing yoga practice with the main
74 reasons for practicing yoga being to improve physical and mental health conditions
75 and to increase physical and mental performance.⁹ Surveys conducted on the
76 characteristics of yoga practitioners and yoga's influence on health in the US and
77 Australia suggest people with health conditions practice yoga and derive benefit.^{4,10-14}
78 In a national survey in Australia the majority of respondents reported practicing yoga
79 to manage a health issue or medical condition; and 53.3% respondents perceived
80 their condition as improving due to their yoga practice.⁴

81 A survey of US individuals practicing Iyengar yoga found that 90.5% of participants
82 reporting a chronic or serious health condition agreed or strongly agreed that their
83 health improved as a result of yoga practice.¹³ This survey found associations
84 between different components of yoga practice and specific health outcomes or
85 health behaviors with different yoga practice patterns influencing the practice's health
86 benefits, at least for this specific yoga style. Specifically, the frequency of home
87 practice was associated with mindfulness, subjective well-being, body mass index,
88 fruit and vegetable consumption, vegetarian status, sleep, and fatigue; and each
89 component of yoga practice (different categories of physical poses, breath work,
90 meditation, and philosophy study) were associated with at least one health outcome.

91 While these associations of different practice patterns and users' characteristics with
92 specific health variables are important, the applicability beyond the specific yoga
93 style studied remains unclear. In response, the research reported here examines the
94 associations of yoga practice characteristics (components, intensity and the specific
95 yoga style employed) with health and health behaviors across different yoga styles.

96 The aims of this study were to assess associations of health variables and health
97 behaviors with yoga practice characteristics.

98 The specific research questions were:

99 1) Are health-related quality of life, sleep quality, fatigue, body mass index and/or
100 mindfulness associated with being a yoga teacher, the primary yoga style, the
101 use of props, the duration of yoga practice, the location of yoga practice, the
102 yoga practice frequency, and/or the frequency of practice of: yoga poses,
103 breathing exercises, meditation, relaxation, philosophy and other yoga
104 components?

105 2) Are alcohol consumption, smoking, vegetarian status, and/or the frequency of
106 exercise other than yoga associated with being a yoga teacher, the primary
107 yoga style, the use of props, the duration of yoga practice, the location of yoga
108 practice, the yoga practice frequency, and/or the frequency of practice of:
109 yoga poses, breathing exercises, meditation, relaxation, philosophy and other
110 yoga components?

111 **Methods**

112 *Design and participants*

113 This cross-sectional analysis used data from a national anonymous online survey
114 conducted from January to June 2016 using the online platform SoSciSurvey.¹⁵ To
115 avoid missing data, the survey was created so that participants could only proceed to
116 the next survey section when each question in the current section was answered.

117 Ethics approval was gained from the ethics committee of the University of Duisburg-
118 Essen. Participants were recruited by email (sent by DQ) from national (i.e.
119 registered in Germany) yoga teachers' associations, yoga studios, and the Yoga

120 Conference Germany as well as through Facebook. A total of 4 yoga teachers'
121 associations, 3 congress organizers, and 145 yoga studios were contacted by email
122 and asked to send the link of the survey to their members or customers. Calls were
123 posted on Facebook yoga groups. All participants aged 18 years or older who
124 currently practiced yoga were eligible for the survey. It was not checked whether non-
125 German yoga practitioners participated. Both yoga teachers and other yoga
126 practitioners were eligible.

127 *Yoga practice characteristics*

128 Questions on yoga practice characteristics were modelled after prior surveys on yoga
129 and health.^{9,12,13} The questions were not pilot tested, and face validity was not
130 assessed. Participants indicated whether they were certified yoga teachers or not,
131 which yoga style they were primarily practicing (only one style could be chosen),
132 what additional styles they practiced, whether they used props (such as belts, blocks
133 or blankets) during their yoga practice, and how long ago they had started practicing
134 yoga. Participants were further questioned as to whether they were practicing at yoga
135 classes, at home after being trained by a yoga teacher (repeating what they learned
136 in class) or at home without prior training by a yoga teacher (self-study), and/or
137 elsewhere (multiple answers could be chosen). Yoga practice frequency (times per
138 week or month) and average duration of practice sessions were assessed for both
139 home practice and supervised practice, as was practice time for yoga poses,
140 breathing exercises, meditation, relaxation, philosophy and other yoga components
141 (in % of total yoga practice time). For each variable, practice frequency was
142 calculated as minutes per week.

143 *Sociodemographic, clinical, and health-related variables*

144 The survey collected sociodemographic data on age, gender, nationality, marital
145 status, education, and employment status. No information on race or ethnicity were
146 collected. Health-related variables included chronic illness (presence/absence,
147 number of chronic illnesses), general health status assessed on a 5-point Likert scale
148 ranging from poor to excellent, and perceived change in general health status since
149 starting yoga assessed on a 5-point Likert scale ranging from much worse now to
150 much better.¹⁶ Health-related quality of life was assessed on the abbreviated World
151 Health Organization Quality of Life Instrument (WHOQOL-BREF) on the four
152 dimensions physical, psychological, social, and environmental well-being.¹⁷
153 Cronbach's alpha in this study was 0.8, 0.8, 0.7, and 0.7 for physical, psychological,
154 social, and environmental well-being, respectively. Higher scores indicate higher
155 quality of life. Sleep quality and fatigue were measured on numerical rating scales
156 ranging from 1 to 10 with higher scores indicating better sleep quality and higher
157 fatigue. Comparable measures have been validated in different samples.¹⁸⁻²¹
158 Mindfulness was measured using the Freiburg Mindfulness Inventory (FMI).²²
159 Cronbach's alpha in this study was 0.8. Higher scores indicate higher quality of life.
160 Height and weight were recorded and body mass index (BMI) was calculated as
161 kg/m².²³

162 *Health behavior*

163 Health behavior included any exercise other than yoga which was assessed as
164 frequency (times per week or month) and average duration, and recalculated as
165 minutes per week. Because this survey mainly focused on yoga and not on other
166 exercise, it was decided not to use an exhaustive Alcohol consumption was assessed
167 as no consumption, irregular consumption, or regular consumption. The answers
168 were converted to standard drinks [less Smoking status was assessed as smoking or

169 non-smoking. Because this survey assessed current health behavior, prior smoking
170 status was not within its focus and therefore not assessed. Participants were asked
171 whether they consumed meat or poultry, fish, eggs or dairy products; participants
172 were then classified as vegan (no meat, fish, eggs, or dairy products), vegetarian (no
173 meat or fish but eggs and/or dairy products), pescetarian (no meat but fish, with or
174 without consumption of eggs and/or dairy products), or omnivore (meat, with or
175 without consumption of fish, eggs and/or dairy products).

176 *Statistical Analyses*

177 Analyses were conducted for all participants who completed the survey. Since
178 participants could only proceed to the next survey section when each question in the
179 current section was answered, there were no missing data in the final data set.
180 Sociodemographic, yoga-related, health-related and health behavior data were
181 expressed as means, standard deviations and range or frequencies and percentages
182 as appropriate. Associations of yoga practice with health-related and health behavior
183 variables were determined by forward stepwise multiple linear or logistic regression
184 analyses. Adjusted odds ratios with 95% confidence intervals were computed for
185 dichotomous predictor variables. Independent variables included: being a certified
186 yoga teacher or not, the primary yoga style used, the use of props, the duration of
187 yoga practice, the location of yoga practice, yoga practice frequency, and the
188 frequency of practice of: yoga poses, breathing exercises, meditation, relaxation,
189 philosophy and other yoga components. Dichotomous dependent variables included:
190 general health status (good or excellent), health improved since starting yoga,
191 regular alcohol consumption, being a smoker, being a vegetarian or vegan. Linear
192 dependent variables included: physical, psychological, social, environmental quality
193 of life (WHOQOL-BREF), sleep quality, fatigue, body mass index, mindfulness (FMI),

194 and weekly frequency of any exercise other than yoga (in minutes). Analyses were
 195 adjusted for sociodemographic (age, gender, marital status, education, employment)
 196 and clinical characteristics (presence/absence of chronic illness). Among the
 197 potential predictor variables that were entered in the regression model, only those
 198 variables were selected that were associated with the dependent variable at a p-
 199 value of ≤ 0.10 in univariate analysis by Chi-squared tests. All statistical analyses
 200 were performed using IBM SPSS® software (IBM SPSS Statistics for Windows,
 201 release 22.0. Armonk, NY: IBM Corp.).

202 Results

203 *Participants*

204 A total of 1,702 participants completed the online survey. Sociodemographic
 205 characteristics are presented in table 1. Participants' age ranged from 19 to 87 years,
 206 89% were female, 73% had an A-level diploma and/or university degree, and 73%
 207 were employed (Table 1).

208

209 Table 1: Sociodemographic, health and health behavior characteristics of participants.

	n (%)	Mean \pm Standard Deviation (Range)
Age (in years)	-	47.24 \pm 10.79 (19.00 - 87.00)
Gender		
Female	1,498 (88.9%)	-
Nationality		
German	1,662 (93.8%)	

Yoga practice, health status, and health behavior

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*	-	1.64 ± 0.95 (1.00 – 5.00)
General health status		

Yoga practice, health status, and health behavior

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 [§]	-	7.63 ± 2.02 (.001 – 10.00)
Fatigue [§]	-	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)

Yoga practice, health status, and health behavior

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%)	–

*In the subsample of participants with chronic illnesses.

§Rated 1 to 10, higher values indicate better sleep quality but higher fatigue.

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

210

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

219

220 Table 2: Yoga practice characteristics.

Yoga practice, health status, and health behavior

	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 [§]	252 (14.8%)	-
Additional yoga styles (alphabetical order)*		
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%)	-

Yoga practice, health status, and health behavior

Others [§]	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		
Yoga poses	–	124.51 ± 99.72 (0.00 – 1953.00)
Breathing exercises	–	32.88 ± 35.56 (0.00 – 306.00)
Meditation	–	39.99 ± 53.54 (0.00 – 525.00)
Relaxation	–	25.81 ± 24.81 (0.00 – 306.00)
Yoga philosophy	–	24.98 ± 36.53 (0.00 – 585.00)

*More than one additional yoga style per participant possible.

§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 meditation, 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 Kuvalayananda, yoga according to T.K. Sribhashyam, yoga dancing, yoga for kids, yoga nidra, yoga on stand up paddle board, yoga zero, Yogananda yoga, yogaswing, Yogamare, YogaMalish

221

222 Health characteristics and health behavior are given in table 1. While 33% of participants
 223 were suffering from one or more chronic illnesses, 96% indicated their health status to be
 224 good, very good, or excellent, and 88% rated their current health status to be somewhat or
 225 much better than before they had started practicing yoga. 10% and 9% of participants were
 226 regularly consuming alcohol and smoking, respectively, and 29% indicated they did not eat
 227 meat, poultry or fish (Table 1).

228

229 *Associations of yoga practice with health status*

230 Associations are given in Tables 3 and 4. Controlling for age, gender, marital status,
 231 education, employment, and chronic illness, yoga teachers had 3.5 times the odds of having
 232 good to excellent health status than non-yoga teachers. Controlling for age, gender, marital
 233 status, education, employment, and chronic illness, participants who had started practicing

234 yoga between 40 and 64 years of age health status had 3.0 to 5.9 times the odds of reporting
 235 improved health than those who had started practice earlier. Improvements were further
 236 associated with higher practice frequency of yoga poses (Table 4). Controlling for age,
 237 gender, marital status, education, employment, and chronic illness, all dimensions of quality
 238 of life were higher in yoga teachers except for environmental well-being; and all dimensions
 239 increased with increasing practice frequency of yoga poses except for social well-being
 240 which was associated with frequency of yoga philosophy study. Psychological well-being was
 241 better in participants whose primary yoga style was Iyengar yoga and those who were
 242 repeating at home what they had learned in yoga classes; environmental well-being was
 243 higher in those whose primary yoga style was the Krishnamacharya tradition / Viniyoga.
 244 Controlling for age, gender, marital status, education, employment, and chronic illness, sleep
 245 quality and fatigue were better in yoga teachers and associated with frequency of practice of
 246 yoga poses; lower fatigue was further associated with the practice of Power Yoga as a
 247 primary yoga style and higher frequency of yoga philosophy study. Controlling for age,
 248 gender, marital status, education, employment, and chronic illness, body mass index was
 249 negatively associated with frequency of yoga poses practice, and was lower in yoga teachers
 250 but higher in those who were practicing Kundalini yoga as their primary yoga style.
 251 Controlling for age, gender, marital status, education, employment, and chronic illness,
 252 mindfulness was positively associated with Sivananda yoga practice as their primary yoga
 253 style, self-study of yoga at home, and practice frequency of yoga poses, meditation, and
 254 yoga philosophy, and negatively with the use of props during yoga practice and yoga practice
 255 in yoga classes (Table 5).

256 *Associations of yoga practice with health behavior*

257 Associations are given in Tables 3 and 4. Controlling for age, gender, marital status,
 258 education, employment, and chronic illness, yoga teachers 0.55 times the odds of smoking
 259 and 0.68 times the odds of consuming alcohol regularly compared to non-yoga teachers.
 260 Regular alcohol consumption was further negatively associated with higher frequency of
 261 yoga philosophy practice. . Controlling for age, gender, marital status, education,

262 employment, and chronic illness, those participants who were practicing Ashtanga Yoga (2.1
 263 times the odds compared to those using another yoga style than those mentioned here),
 264 Iyengar Yoga (1.9 times the odds), Kundalini Yoga (1.8 times the odds) or Sivananda Yoga /
 265 Yoga Vidya (2.5 times the odds) as their primary yoga style were more likely to be
 266 vegetarians or vegans. Being a vegetarian or vegan was further associated with self-study of
 267 yoga at home and with higher practice frequency of breathing exercises, meditation, and
 268 yoga philosophy (Table 3). Controlling for age, gender, marital status, education,
 269 employment, and chronic illness, weekly frequency of non-yoga exercise was positively
 270 associated with practicing Power Yoga as a primary yoga style and with higher practice
 271 frequency of yoga poses (Table 4).

272

273 Table 3: Predictors associated independently with dichotomous health variables (controlling
 274 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	Yoga teacher	3.50 (2.01-6.11)
Health improved since starting yoga	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)
	Weekly practice frequency: yoga poses	
	First quartile	Reference

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	Second quartile	1.18 (0.80-1.76)
	Third quartile	2.03 (1.31-3.16)
	Fourth quartile	2.98 (1.85-4.81)
Regular alcohol consumption	Yoga teacher	0.68 (0.47-0.99)
	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)
Smoker	Yoga teacher	0.55 (0.39-0.78)
Vegetarian or vegan	Primary yoga style	
	Asthanga Yoga	2.10 (1.28-3.45)
	(Traditional) Hatha Yoga	1.06 (0.62-1.82)
	Iyengar Yoga	1.88 (1.04-3.40)
	Kundalini Yoga	1.81 (1.07-3.06)
	Krishnamacharya Tradition / 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)

275

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

Dependent variable	Predictor variable	B±SE	β	P	R ²
Quality of life (WHOQOL-BREF)					
Physical					0.18
	Yoga teacher	0.71 ± 0.10	0.173	<0.001	
	Weekly practice frequency: yoga poses	0.002 ± 0.000	0.112	<0.001	
Psychological					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	
	Weekly practice frequency: meditation	0.004 ± 0.001	0.062	<0.001	

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Social					0.08
	Yoga teacher	0.48 ± 0.15	0.081	0.001	
	Weekly practice frequency: philosophy	0.01 ± 0.002	0.075	0.003	
Environmental					0.07
	Primary yoga style: Krishnamacharya	0.29 ± 0.14	0.049	0.043	
	Weekly practice frequency: yoga poses	0.001 ± 0.000	0.084	0.001	
Sleep quality*					0.06
	Yoga teacher	0.46 ± 0.10	0.113	<0.001	
	Weekly practice frequency: yoga poses	0.001 ± 0.001	0.062	0.012	
Fatigue*					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	
	Weekly practice frequency: philosophy	-0.004 ± 0.002	-0.071	0.005	
Body mass index					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	

Yoga practice, health status, and health behavior

	Weekly practice frequency: yoga poses	-0.003 ± 0.001	-0.062	0.014	
Mindfulness (FMI)					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	
*Higher values indicate better sleep quality but higher fatigue.					
Abbreviations: FMI – Freiburg Mindfulness Inventory; WHOQOL-BREF – World Health Organization Quality of Life Instrument.					

279 A main finding of this survey is that yoga practitioners generally enjoy a relatively good
280 health with 96.1% reporting good, very good or excellent overall health, and 87.7% reporting
281 improved health since commencing yoga. This is in line with earlier surveys in the general
282 population and in patients with chronic diseases where yoga practitioners were more likely
283 to report a good to excellent health status than non-users.^{11,24} Also, BMI in our sample was
284 lower than the German norm.²⁵ A possible explanation for this good overall health in yoga
285 practitioners might be that they also, overall, reported a health-promoting lifestyle:
286 compared to the German norm,^{26,27} the proportion of vegetarians or vegans among German
287 yoga practitioners participating in our survey was more than 6 times higher than in the
288 general German population and the proportion of smokers was less than half. We need to
289 remain mindful that women and those possessing a higher level of education are more likely
290 to a vegetarian diet to be non-smokers, and that the predominance of females and higher
291 educated individuals in the specific sample of our survey may partly (but not completely)
292 explain the higher proportions of vegetarians and non-smokers in the survey compared to the
293 German norm. Compared to a US survey on Iyengar yoga practitioners,¹³ German yoga
294 practitioners in our survey were more likely to be vegetarians but also more often smoked
295 probably reflecting a different likelihood to follow these health behaviors in the two countries'
296 general population.²⁶⁻²⁹

297 Our analyses show positive health behaviors such as alcohol abstinence and adopting a
298 vegetarian or vegan diet were commonly associated with higher frequency of yoga
299 philosophy study. The ethical guidelines or 'restraints' provided in yoga philosophy include
300 recommending behavior that does not hurt oneself or others.² This so-called 'ahimsa' is
301 referred to as non-violence against all living being – including animals but also the yoga
302 practitioners themselves.² Based on these guidelines, several yoga traditions purport the
303 following a vegetarian diet as an ethical and health necessity to practice yoga and view
304 eating meat as inducing animal suffering.^{30,31} Other behaviors potentially endangering
305 oneself or others, such as alcohol consumption, which are also thought to interfere with
306 mental yoga exercises, are also often viewed by yoga teachers and users as incompatible

307 with yoga practice.³¹ Overall, a generally healthy lifestyle is frequently recommended in
308 addition to formal yoga exercises;^{30,32} and yoga practitioners have been shown to more often
309 follow a vegetarian or vegan diet and to exercise than yoga non-users.³³ It needs to be kept
310 in mind that due to the cross-sectional nature of this survey, the interpretation that individuals
311 with a healthy lifestyle feel attracted to yoga practice is also possible.

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

318

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

325

326 The single most important independent predictor of almost all health variables in our study
327 was having the status of a yoga teacher. This is interesting as it cannot be explained by age
328 or the more intensive practice yoga teachers are likely to follow (this was controlled for in the
329 regression analyses). Due to the cross-sectional nature of our analysis, it is not clear whether
330 being a yoga teacher per se is beneficial for health because it involves a stronger immersion
331 in yoga³⁴ and a stronger influence of yoga on overall lifestyle, or whether this finding simply
332 reflects a possibility that healthy individual are more likely to become yoga teachers.

333

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

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

353 Our survey has a number of limitations. As an anonymous retrospective online survey, it
354 remains unclear whether the results were distorted by social desirability, memory bias or
355 other sources of bias. In addition, since a snowball system was used for recruitment, the
356 response rate cannot be determined and possibly due to the recruitment via yoga teacher
357 associations, professional yoga teachers were overrepresented in our sample meaning that
358 this was not representative to yoga practitioners. The survey did not assess race and
359 ethnicity because these are difficult topics in Germany. The exact meaning of the yoga
360 practice components were not explained to the participants because it was expected that
361 they are common concepts in yoga. Nevertheless, there might have been differing

362 interpretations of these categories in different practitioners. Questions on physical activity
363 and alcohol consumption were not based on validated instruments. Therefore, the findings
364 on these health behaviors might be less reliable than those on the other health-related
365 variables. Finally, the cross-sectional nature of our survey precludes any causal
366 interpretations of the study findings.

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

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381 **Compliance with ethical standards:**

382 **Conflict of Interest:** All authors declare that they have no conflict of interest.

383 **Ethical approval:** All procedures performed in studies involving human participants were in
384 accordance with the ethical standards of the institutional and/or national research committee
385 and with the 1964 Helsinki declaration and its later amendments or comparable ethical
386 standards.

387 **Informed consent:** Informed consent was obtained from all individual participants included
 388 in the study.

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