

# BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email [info.bmjopen@bmj.com](mailto:info.bmjopen@bmj.com)

# BMJ Open

## Are yoga and physical activity determinants of the quality of life of individuals and societies? Observed differences in quality of life in the context of public health and education

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-059658
Article Type:	Original research
Date Submitted by the Author:	29-Nov-2021
Complete List of Authors:	Pluto-Pradzynska, Agnieszka; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Pluto-Pradzynska, Karolina; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology; Adam Mickiewicz University, Department of Pedagogy Frydrychowicz, Magdalena; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Lagiedo-Zelazowska, Malgorzata; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Owoc, Jakub; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Benjamin, Shamiram; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Au, Tsz Yuen; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Jaracz, Krystyna; Poznan University of Medical Sciences, Department of Nursing Dworacki, Grzegorz; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Wysocki, Jacek; Poznan University of Medical Sciences, Department of Health Prevention Wasik, Jacek; Akademia im Jana Długosza w Częstochowie, Faculty of Health Sciences
Keywords:	Public health < INFECTIOUS DISEASES, EDUCATION & TRAINING (see Medical Education & Training), MENTAL HEALTH, Immunology < NATURAL SCIENCE DISCIPLINES, QUALITATIVE RESEARCH, SPORTS MEDICINE

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3 **Are yoga and physical activity determinants of the quality of life of**  
4 **individuals and societies? Observed differences in quality of life in**  
5 **the context of public health and education**  
6  
7  
8  
9

10  
11  
12  
13 Agnieszka Pluto-Pradzynska<sup>1</sup>, Karolina Pluto-Pradzynska<sup>1,2</sup>, Magdalena Frydrychowicz<sup>1</sup>,  
14 Malgorzata Lagiedo-Zelazowska<sup>1</sup>, Jakub Owoc<sup>1</sup>, Shamiram Benjamin<sup>1</sup>, Tsz Yuen Au<sup>1</sup>,  
15 Krystyna Jaracz<sup>3</sup>, Grzegorz Dworacki<sup>1</sup>, Jacek Wysocki<sup>4</sup>, Jacek Wasik<sup>5</sup>  
16  
17  
18

19 <sup>1</sup>Department of Pathomorphology and Clinical Immunology, Poznan University of Medical  
20 Sciences, Poznan, Poland  
21  
22

23 <sup>2</sup>Department of Pedagogy, Adam Mickiewicz University Poznan, Poland  
24

25 <sup>3</sup>Department of Nursing, Poznan University of Medical Sciences, Poznan, Poland  
26  
27

28 <sup>4</sup>Department of Health Prevention, Poznan University of Medical Sciences, Poznan, Poland  
29

30 <sup>5</sup>Faculty of Health Sciences, Jan Dlugosz University, Czestochowa, Poland  
31  
32

33  
34  
35 Correspondence to:

36 **Dr. Agnieszka Pluto-Pradzynska**; ORCID: 0000-0002-6402-7857  
37

38 Department of Pathomorphology and Clinical Immunology, Poznan University of Medical  
39 Sciences  
40  
41

42 ul. Rokietnicka 5d, 60-806 Poznan, Poland  
43  
44

45 Email: [agapp@ump.edu.pl](mailto:agapp@ump.edu.pl)  
46

47 Tel: +48 618 547 174  
48

49 Fax: +48 618 547 173  
50  
51

52  
53 Abstract word count: 279  
54

55 Paper word count: 2975  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

*What is already known on the subject:*

It is well-documented across many populations that physical activity plays a preventive role against aging, morbidity, disability, and the development of disease. However, there is insufficient evidence showing the relationship between yoga and quality of life in Polish adults.

*What this study adds:*

This study found higher quality of life levels in a group of randomized Polish citizens who performed yoga as part of physical activity than in those who were not physically active, as well as those who participated in other non-yoga physical activities.

## ABSTRACT

**Objective:** Yoga is an ancient form of physical activity (PA) that encompasses meditation, stretching, and breathing techniques. Although the benefits of PA and associated lifestyle interventions are clear, we here addressed the paucity of evidence regarding the specific relationship between yoga and quality of life (QOL) in adults in Poland. We hypothesized that the participation in physical activity, and yoga could result in a positive impact on QOL.

**Method:** Quantitative variables were compared among groups using Kruskal–Wallis tests with post-hoc Dunn tests, while qualitative variables were compared using chi-square (Yates correction) or Fisher's exact test. Multivariate analyses were performed using linear regression. Results were determined based on age, sex, and education level;  $p < 0.05$  was considered significant.

**Participants:** The QOL of a Polish citizen population ( $n = 714$ ) was verified using the World Health Organization's (WHO) standardized questionnaire (WHOQOL-bref). Participants were assigned to non-physically active (N-PAG;  $n = 72$ ), physically active (PAG;  $n = 642$ ), and physically active with yoga (PAG-Y;  $n = 151$ ) groups. Questionnaires were randomly delivered by researchers to participants who were willing to complete them; there are no specific entry and exclusion criteria.

**Results:** Statistically significant differences ( $p < 0.05$ ) were observed between the QOL of the PAG and N-PAG. The PAG-Y presented higher scores for QOL and health perception than the PAG without yoga.

**Conclusion:** We confirmed that both regular PA and yoga practices could improve QOL; however, PAG-Y produced higher QOL scores than PA of other types. This outcome may be explained by impact of physiological and psychological aspects within yoga practice. These results suggest that this combination impacts health more positively than PA alone, which is only physiological in nature.

**Keywords:** depression, health, mindfulness, physical activity, quality of life, yoga

## INTRODUCTION

Regular physical activity (PA) is an important factor in physiological growth, the development and maintenance of the central nervous system, as well as in general health.[1] A myriad of well-respected organizations, healthcare providers, and political establishments maintain recommendations of regular leisure and recreational PA for the sake of public health and as preventive medicine.[2] Additionally, published evidence supports the positive impact of a balanced diet and PA, associated with social education, in the prevention and treatment of disease.[3,4] In Poland, the government promotes increased PA, in order to reduce deaths due to lifestyle-related diseases.[5]

Nevertheless, in 2018, insufficient PA levels were confirmed in global surveys.[6] Additionally, the European Union reported that only about half of Europeans exercise or play sports, of which only 7% do so regularly, with the remaining 46% reporting that they never participate in PA. This report emphasized individual health benefits and a decrease in both social and economic costs achieved through PA implementation.[7] Improving PA lifestyle efficiency can pay dividends in terms of both individual and public health.[8] Previous studies confirmed better well-being due to yoga intervention combined with physical training in an industry worker group.[9]

The World Health Organization (WHO) defined QOL as “an individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns.”[11] Some studies on QOL, including those conducted in Poland,[12] have referred to the relationship between yoga and disease-related QOL,[13] whereas others have discussed health-related QOL in cancer treatment and therapy,[14,15] and in older adults.[10] In most observations, higher QOL scores were observed for those engaging in all types of PA than in those who did not.

Yoga is an ancient form of PA brought to the West at the end of the XIXth century. Its practice encompasses meditation in conjunction with stretching and breathing techniques.[19] Yoga straightens and slowly elongates the body; it both lengthens and tightens the muscles and interspinous spaces. In effect, yoga increases strength, flexibility,

1  
2  
3 and range of motion,[1] combining physical training with conscious breathing,[20] while  
4 drawing attention to the practitioner's consciousness and psychological state.[1] Therefore,  
5 yoga provides not only physical benefits, but also mental health benefits,[18] even reducing  
6 symptoms of anxiety and depression,<sup>21</sup> positively affecting mood, and reducing stress.[14]  
7  
8 Special types of yoga, such as laughter yoga, may benefit everyone, including patients with  
9 cancer.[15] Yoga offers effective exercises to intensify cognitive and behavioral factors for  
10 learning, concentration, and achievement, and can be used to mitigate the risk of  
11 burnout.[15,22] A combination of yoga and aerobic exercise has been shown to reduce  
12 mental, physical, and vascular stress in cardiovascular diseases.[23] Therefore, both yoga  
13 and mindfulness may be significant factors for lifestyle change interventions.[24] Yoga also  
14 offers promise as a preventive health intervention,[25] in supplementation to the  
15 management of symptoms and conditions.[26]

16  
17  
18 In Poland, data on yoga among adults in different age groups, which could represent  
19 a wider cross-section of society, are lacking.[16] Although yoga has been practiced in Poland  
20 for many years, it has never been widely accepted; some scepticism is likely connected to  
21 Catholic Church doctrine, with many Polish citizens never having tried yoga. Therefore, the  
22 positive impact of yoga on health may need to be recognized and promoted.[18] Thus, in this  
23 study, we sought to investigate whether yoga practice, as a unique type of PA, could be an  
24 important tool in improving QOL[17] in Polish citizens.[16]

## 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 **METHODS**

### 46 47 **Patient and public involvement**

48 Patients and/or the public were not involved in the design, or conduct, or reporting, or  
49 dissemination plans of this research.  
50  
51

### 52 53 54 55 **Ethics approval**

56 The study protocol was reviewed by the Bioethics Committee of the Poznan University of  
57 Medical Sciences (Resolution No. 1263/18), which decreed that the study does not have the  
58  
59  
60



1  
2  
3 characteristics of a medical experiment and does not require approval from the Bioethics  
4  
5 Committee.  
6  
7  
8  
9

## 11 **Participants**

12  
13 This study included a population (n = 714) of Polish adults ( $\geq$  18-years-old), comprised of  
14  
15 46% men and 54% women. Respondents were recruited through Internet advertisements, at  
16  
17 schools and universities, and at elderly communities. The following groups were composed  
18  
19 and compared to each other: no-PA control group (N-PAG, n = 72), PA group (PAG, n =  
20  
21 642), and PA with yoga group (PAG-Y; n = 151). The population was matched for sex, age,  
22  
23 and educational level.  
24  
25  
26  
27

## 28 **Survey**

29  
30 The research was evaluated using the World Health Organization's (WHO) standardized  
31  
32 questionnaire (WHOQOL-bref), which is a short-version questionnaire approved for use in  
33  
34 many countries, including Poland.[10,27,28] It is dedicated to the study of the QOL of adults,  
35  
36 with respect to individual perceptions.[29] The WHOQOL-BREF contains 26 items, 24 of  
37  
38 which use a scale of 1–100 (min–max), pertaining to four domains of QOL that are  
39  
40 incorporated into specified facets. These include the following: The Physical health domain  
41  
42 (PHD-QOL) includes items on activities of daily living, dependence on medicinal substances  
43  
44 and medical aids, energy and fatigue, mobility, pain and discomfort, sleep and rest, and work  
45  
46 capacity. The Psychological domain (PD-QOL) includes questions on body image and  
47  
48 appearance, negative feelings, positive feelings, self-esteem, spirituality/religion/personal  
49  
50 beliefs, thinking, learning, memory, and concentration. The Social domain (SD-QOL)  
51  
52 addresses personal relationships, social support, and sexual activity, The Environmental  
53  
54 domain (ED-QOL) investigates financial resources, freedom, physical safety and security,  
55  
56 health and social care (accessibility and quality), home environment, opportunities for  
57  
58 acquiring new information and skills, participation in and opportunities for recreation/leisure  
59  
60

1  
2  
3 activities, physical environment (pollution/noise/traffic/climate), and transport. Two items  
4  
5 were examined separately, with a scale of 1–5 (min–max), and asked about their perception  
6  
7 of QOL and health (HP).[11]  
8

9  
10 The respondents were asked about participation in the listed PAs (swimming, long or  
11  
12 intensive walking, cycling, jogging, riding, gym/fitness, tennis/squash/badminton, gardening,  
13  
14 yoga, and 'others'). They were asked to select the frequency of participation in the activity,  
15  
16 from among the following: none; 1–3 hours per month; 1, 1–3 h, or > 3 hours/week.  
17  
18 Additionally, the period of yoga practice was matched in years: < 1, 1–3, 3–5, 5–10, or ≥ 10  
19  
20 years.  
21  
22

## 23 24 **Statistical analysis**

25  
26 Qualitative variables was compared among the groups using the chi-square test (with Yates'  
27  
28 correction for 2 × 2 tables) or the Fisher's exact test where low expected frequencies  
29  
30 appeared in the tables. Quantitative variables in the three groups were compared using the  
31  
32 Kruskal–Wallis test. After detecting statistically significant differences, post-hoc analysis was  
33  
34 performed with Dunn's test to identify statistically significant differences between groups.  
35  
36 Multivariate analysis of the influence of a number of factors on the quantitative variables was  
37  
38 performed using a linear regression method. The results are presented as regression model  
39  
40 parameter values with a 95% confidence interval (95%CI). A significance level of 0.05 was  
41  
42 adopted in the analysis, and all p values < 0.05 were interpreted as showing significant  
43  
44 relationships. The analysis was performed using R version 4.1.0. (R Core Team, 2021. R  
45  
46 Foundation for Statistical Computing, Vienna, Austria, <https://www.R-project.org/>).  
47  
48  
49  
50

## 51 **RESULTS**

### 52 **Group constitution**

53  
54  
55 Twice as many women as men declared a non-physically active lifestyle, and nearly three  
56  
57 times the number of women than men practiced yoga (females 73.51%, males 26.49%). In  
58  
59 the N-PAG (52.78%), middle-aged adults (35–55-years-old) predominated, whereas 36.11%  
60

of the N-PAG were young adults (< 35-years-old). In the PAG young adults predominated (50.71%) in young adults, while one-third of this group (32.79%) were middle-aged adults. In the PAG-Y, middle-aged individuals (49.67%) prevailed, as compared to young adults (39.07%), while 11.26% were older adults (> 55-years-old). In terms of education level, the majority of each group were individuals with a university degree (Table 1).

Table 1. Composition of the research groups

Parameters	Group			P	
	N-PAG (n = 72)	PAG (n = 491)	PAG-Y (n = 151)		
Sex	Females	47 (65.28%)	228 (46.44%)	111 (73.51%)	p<0.001
	Males	25 (34.72%)	263 (53.56%)	40 (26.49%)	
Age	18–35 years	26 (36.11%)	249 (50.71%)	59 (39.07%)	p<0.001
	36–55 years	38 (52.78%)	161 (32.79%)	75 (49.67%)	
	> 55 years	8 (11.11%)	81 (16.50%)	17 (11.26%)	
Education	Primary	1 (1.39%)	4 (0.81%)	1 (0.66%)	p = 0.001
	Secondary	17 (23.61%)	149 (30.35%)	22 (14.57%)	
	Post-secondary	12 (16.67%)	93 (18.94%)	17 (11.26%)	
	University	34 (47.22%)	190 (38.70%)	89 (58.94%)	
	Postgraduate	8 (11.11%)	55 (11.20%)	22 (14.57%)	

P-values were obtained by the chi-squared or exact Fisher's test

The mean QOL perception in the researched population was good (4.09 points on a 1–5 point scale; SD = 0.7), as was the level of HP (3.83 points on a 1–5 scale; SD = 0.82). Across the domains, the highest mean level of QOL perception was in the PD-QOL, which

was only 1.03 points higher than that of the PHD-QOL, while the SD-QOL had a mean value of 70.23. The lowest perception of QOL was observed in the ED-QOL (Table 2).

Table 2. Quality of life scores according to the WHOQOL-bref domains.

WHOQOL-BREF	N	NAs	Mean	SD	Median	Min	Max	Q1	Q3
Physical domain	714	0	71.58	14.74	75	12	100	62	81
Psychological domain	714	0	72.61	14.07	75	0	100	69	81
Social domain	714	0	70.23	17.42	75	0	100	56	81
Environmental domain	714	0	65.24	13.65	62	19	100	56	75

Comparing the differences in the QOL between the observed groups, the study results indicated that PA could improve QOL. In all four domains of the WHOQOL-bref, the QOL was statistically significantly higher ( $p < 0.05$ ) in both PA groups (PAG and PAG-Y) than in the N-PAG.

Yoga practice was an important factor in QOL: QOL was statistically significantly higher ( $p < 0.001$ ) in the PAG-Y than in the N-PAG and PAG only. The same association was observed in three separate domains: PHD-QOL, PD-QOL, and ED-QOL ( $p < 0.001$ ). Similar results were obtained for HP ( $p < 0.003$ ; Table 3, Figure 1).

Table 3. Presentation of QOL and HP, and QOL according to WHOQOL-bref domains in each of the researched groups.

WHOQOL-BREF ITEMS		Groups			p
		N-PAG	PAG	PAG-Y	
Quality of life perception	Mean $\pm$ SD	3.83 $\pm$ 0.92	4.07 $\pm$ 0.68	4.29 $\pm$ 0.66	$p < 0.001$
	Median	4	4	4	
	Quartiles	3–4	4–4	4–5	PAG-Y > PAG, N-PA

	Mean ± SD	3.56 ± 0.95	3.86 ± 0.78	3.89 ± 0.87	p = 0.003
Health perception	Median	4	4	4	
	Quartiles	3–4	4–4	4–4	PAG-Y, PAG > N-PA
	Mean ± SD	64.24 ± 17.88	71.78 ± 14.21	74.42 ± 13.7	p < 0.001 *
Physical domain	Median	62	75	75	
	Quartiles	50–81	62–81	62–81	PAG-Y > PAG > N-PA
	Mean ± SD	66.31 ± 17.92	72.55 ± 13.09	75.79 ± 14.16	p < 0.001 *
Psychological domain	Median	69	69	81	
	Quartiles	56–81	69–81	69–81	PAG-Y > PAG > N-PAG
	Mean ± SD	65.96 ± 18.18	70.76 ± 16.66	70.58 ± 19.21	p = 0.021 *
Social domain	Median	69	75	75	
	Quartiles	56–75	56–81	56–81	PAG, PAG-Y > N-PAG
	Mean ± SD	60.96 ± 14.38	64.85 ± 13.5	68.57 ± 13.12	p < 0.001 *
Environmental domain	Median	62	62	69	
	Quartiles	50–70.5	56–75	62–75	PAG-Y > PAG > N-PAG

p - Kruskal–Wallis test + post-hoc analysis (Dunn test)

### Linear regression

The multivariate linear regression model, adjusted for age, sex, and education, showed that PA was a significant ( $p < 0.05$ ), independent predictor of both QOL and HP. The perception of QOL in the PAG was on average 0.25 points higher than that in the N-PAG (the regression parameter was 0.25). The regression parameter for PAG-Y was 0.46, while the QOL perception of PAG-Y was on average 0.46 points higher than in the N-PA.

In HP, the regression parameter in the PAG was 0.309, and in PAG-Y, it was 0.352. It showed higher QOL and HP in those groups than in N-PAG. The value of the regression parameter in each of the four WHOQOL-bref domains presented yoga and other PA as statistically significant parameters that improved QOL. Similar to the results presented in these analyses, addition of yoga practice to PA resulted in a nearly doubled regression parameter in PD-QOL (9.786) in relation to N-PAG, when compared to PAG and N-PAG (5.905). Only the SD-QOL regression parameter level in relation to N-PAG had similar scores in both groups, with a slightly higher score (5.303) in the PAG than in the PAG-Y (5.076) (Table 4).

Table 4. Results of linear regression analyses in the different groups.

WHOQOL-BREF ITEMS	Group	Regression parameter*	95%CI		p
Quality of life perception	N-PAG	Ref.			
	PAG	0.25	0.074	0.426	0.005
	PAG-Y	0.46	0.262	0.658	<0.001
Health perception	N-PAG	Ref.			
	PAG	0.309	0.107	0.512	0.003
	PAG-Y	0.352	0.125	0.58	0.002
Physical domain	N-PAG	Ref.			
	PAG	7.54	3.932	11.148	<0.001
	PAG-Y	10.305	6.247	14.362	<0.001
Psychological domain	N-PAG	Ref.			
	PAG	5.905	2.432	9.378	0.001

	PAG-Y	9.786	5.88	13.692	<0.001
	N-PAG	Ref.			
Social domain	PAG	5.303	0.951	9.654	0.017
	PAG-Y	5.076	0.182	9.97	0.042
	N-PAG	Ref.			
Environmental domain	PAG	4.313	0.944	7.682	0.012
	PAG-Y	7.29	3.501	11.078	<0.001

## DISCUSSION

In this study, we evaluated the specific relationship between yoga and QOL in adults in Poland. We found that perceived QOL as well as QOL measured with the WHO-Bref, and HP were higher in Polish adults whose PA included yoga, than in those who did not perform PA, as well as in those who participated in other non-yoga PA.

The efficiency of a yogic and physically active lifestyle pays dividends in both individual and public health. Previous research has confirmed statistically significant differences in the QOL of individuals who participate in PA and PA with yoga, as compared to those who do not participate in PA.[29] In adulthood, when movement is limited due to both technical inventions and a sedentary lifestyle,[30] suitable PA can assist in preventing diseases,[31] and spine and back pain.[32] In everyday activities, ordinary PA may include walking,[32] cycling, gardening, and short periods of calisthenics.[8] The physical and social aspects of gardening and walking in the forest elicit multifactorial positive health behaviours,[33] correlated with human relationships, constituting a part of SD-QOL, with higher scores for QOL.[34] Increasing mobility, without over-training, positively influences health and assists individuals in achieving daily goals.[35] In correlation with the PHD-QOL of the WHOQOL-bref, PA results in greater mobility, more energy for life, better study and work capacity,[10] better sleep and rest, reduced pain, and diminished dependence on medical

1  
2  
3 substances.[11] For example, young industrial workers who performed morning physical  
4 training combined with yoga in the evening for 3 months had higher scores than did another  
5 group who did not include yoga.[9]  
6  
7  
8  
9

## 10 11 **PA and psychological aspects**

12  
13 The ability to walk and utilize muscles involve balance and harmony, both within the body  
14 and in the surrounding environment, and improves QOL and HP.<sup>36</sup> PA awakens one's  
15 consciousness, maintaining a life–work balance,[3,33] and provides relaxation.[37] The  
16 American College of Sports Medicine launched “The Global Initiative” to encourage  
17 physicians, healthcare professionals, and educators to promote exercise in their practice or  
18 activities; as this would ultimately prevent, reduce, manage, or treat diseases that impact  
19 health and QOL in humans.[38] Medical staff may implement yoga in order to focus not only  
20 on biological parameters, but also on psychological parameters, yielding positive effects in  
21 both.[37] The key components of yoga are associated with better mental health outcomes  
22 and decreased severity of depressive symptoms.[21]  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33

34 Lifestyle enhancement may include exercise, nutrition, behavioural changes, and self-  
35 care, which involve all levels of collaborative medical education.[4] This concept was  
36 recognized by the ancient Greek physician and philosopher, Hippocrates of Kos (c. 460 BC  
37 to 370 BC). He proclaimed: “Let food be medicine” and “Exercise is medicine,” and was  
38 recognized as the first practitioner to prescribe exercise in treating diseases linked to obesity  
39 and sedentary living.[38]  
40  
41  
42  
43  
44  
45  
46

47 In contrast with other types of PA, yoga provides the additional effect of improving the  
48 psychological side of QOL.[15] WHOQOL-bref related to PD-QOL, measured body image  
49 and appearance, personal beliefs, self-esteem, feelings, thinking, learning, memory, and  
50 concentration. These parameters may be improved with regular yoga practice, which  
51 positively shapes QOL and HP. The present study showed the benefit of yoga practice in a  
52 randomized PAG-Y in relation to others in QOL and in three of four WHOQOL-bref  
53 domains.[35] The system of yoga encompasses specific exercises. It often involves holding  
54  
55  
56  
57  
58  
59  
60



1  
2  
3 positions for an increased amount of time. It can be easily be implementing in the workplace  
4  
5 to reduce burnout symptoms and stress levels,[22] avoid pain back caused by mostly  
6  
7 sedentary position at work.[25] A special yoga yogic type of breathing, known as  
8  
9 pranayama,[19] is leading to the development of self-control and mindfulness.[1] Additionally,  
10  
11 yoga, meditation, and pranayama practice have been shown to increase the stability of  
12  
13 telomeres by stimulating telomerase activity; which inhibits aging processes and protects  
14  
15 against certain diseases,[24] including cancer.[19] Using tools of positive psychology like  
16  
17 yoga practice or even laughter therapy can stimulate the thinking processes and  
18  
19 communication skills of individuals.[15]  
20  
21

22 Even if yoga is not for everyone, the addition of a contemplative aspect to regular PA,  
23  
24 using paths similar to those used in yoga, including prayer, awareness of the breath, and  
25  
26 daily mindfulness meditation,[20] may offer significant benefits to physical and psychological  
27  
28 wellbeing in addition to the overall QOL.[19]  
29

30 This study could be further improved via the expansion of both the number and  
31  
32 diversity of study participants. Future cohort studies should be performed in order to better  
33  
34 understand the relationship between PA, QOL, and health perception. Additional data could  
35  
36 provide community health benefits in response to the troubling epidemiological impact of the  
37  
38 COVID-19 pandemic.  
39  
40  
41  
42

## 43 CONCLUSIONS

44  
45 A mobile lifestyle can play a preventive role against degradation, morbidity,  
46  
47 disability, and the development of disease.[39] The results of the presented study suggested  
48  
49 that higher QOL parameters in the randomized population were observed more often among  
50  
51 PAG-Y and PAG than among the N-PAG. Therefore, there is a need to promote an active  
52  
53 lifestyle, not only among scholars and students, but also among adults, to achieve better  
54  
55 mobility, sleep, and school, work, and activity capacity.[31] Regular PA taken during leisure  
56  
57 time, even if it involves gardening or walking, can improve QOL and HP, regardless of the  
58  
59 practitioner's age.<sup>36</sup> PA as regular morning graining combined with evening yoga can  
60

1  
2  
3 improve the effectiveness of industry workers.<sup>9</sup> The widespread application of yoga practice  
4 may encourage the better functioning of healthier individuals and societies.[18] For those  
5 with religious concerns, yoga could be promoted in its physical aspect, absent of any  
6 traditional connection to spirituality that may be considered controversial.  
7  
8  
9

10  
11 The public should be encouraged to note that the pressing problems associated  
12 with worsening well-being and QOL level, may be associated with insufficient PA in leisure  
13 time. Given the social responsibility to safeguard and promote the health of the population, it  
14 is worth noting that the integration of scholars and students into interdisciplinary, and sport-  
15 based teams,[2] may serve as an innovative solution that may meet these demands in a  
16 scientifically sound way.[40] In conclusion, it can be stated that, in order to achieve and  
17 maintain optimal physical and psychological health,[19] people should be motivated to live a  
18 physically active life, particularly through meditative PA, such as yoga.[30]  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29

### 30 **Strength and limitation**

- 31 - This is one of the first studies evaluating the correlation between physical activities,  
32 yoga, and QOL among Polish population
- 33 - Future cohort studies should be performed in order to better understand the  
34 relationship between PA, QOL, and health perception.
- 35 - Data could provide community health benefits in response to the troubling  
36 epidemiological impact of the COVID-19 pandemic  
37  
38  
39  
40  
41  
42  
43  
44  
45

### 46 **Acknowledgments**

47 We would like to acknowledge and thank all study participants as well as the Editage Team  
48 for their contribution to this study.  
49  
50  
51  
52  
53

### 54 **Contributorship statement**

55 AP conceived of the study. AP, KP, and GD initiated the study design and SB and TA helped  
56 with implementation. MF, ML, JO collected the data and KJ helped with analysing statistical  
57  
58  
59  
60

1  
2  
3 results. AP and GD are grant holders. All authors contributed to refinement of the study  
4  
5 protocol and approved the final manuscript.  
6  
7  
8  
9

### 10 11 **Competing interests**

12  
13 no conflicts of interest  
14  
15

### 16 17 **Funding**

18  
19 This study was supported by Poznan University of Medical Sciences (grant number: 2684)  
20  
21  
22

### 23 24 **Data availability statement**

25  
26 All data relevant to the study are included in the article or uploaded as supplementary  
27  
28 information.  
29  
30

### 31 32 **References**

- 33  
34  
35 1. Kwok JYY, Kwan JCY, Auyeung M, et al. Effects of mindfulness yoga vs stretching  
36  
37 and resistance training exercises on anxiety and depression for people with  
38  
39 Parkinson disease: A randomized clinical trial. *JAMA Neurol* 2019;76:755-763.  
40  
41  
42  
43  
44  
45  
46 2. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines  
47  
48 on physical activity and sedentary behaviour. *Br J Sports Med* 2020;54:1451-1462.  
49  
50  
51  
52  
53  
54 3. Fuzeki E, Banzer W. Physical activity recommendations for health and beyond in  
55  
56 currently inactive populations. *Int J Environ Res Public Health* 2018;15:1042.  
57  
58  
59  
60

- 1  
2  
3  
4 4. Polak R, Pojednic RM, Phillips EM. Lifestyle Medicine Education. *Am J Lifestyle*  
5  
6  
7 *Med* 2015;9:361-367.  
8  
9  
10  
11 5. Ministry of Health P. National Health Program 2016-2020. Public Health Act.  
12  
13  
14 Warsaw, 2015.  
15  
16  
17  
18  
19 6. Guthold RS, G.A. Riley, L.M. et al. Worldwide trends in insufficient physical activity  
20  
21  
22 from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9  
23  
24  
25 million participants. *The Lancet Global health* 2018;6(10):e1077-e86. doi:  
26  
27 10.1016/s2214-109x(18)30357-7  
28  
29  
30  
31  
32  
33  
34 7. Commission ES. Special Eurobarometr 472. [https://sport.ec.europa.eu/news/new-](https://sport.ec.europa.eu/news/new-eurobarometer-on-sport-and-physical-activity)  
35  
36  
37 [eurobarometer-on-sport-and-physical-activity](https://sport.ec.europa.eu/news/new-eurobarometer-on-sport-and-physical-activity): EU, 2018.  
38  
39  
40  
41  
42 8. Li X, Ghosh D. Associations between Body Mass Index and Urban "Green"  
43  
44  
45 Streetscape in Cleveland, Ohio, USA. *Int J Environ Res Public Health* 2018;15:2186.  
46  
47  
48  
49  
50 9. Bhat PS, Chopra V, Mehta SG, et al. Psychological benefits of yoga in industrial  
51  
52  
53 workers. *Ind Psychiatry J* 2012;21:98-103.  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 10. Puciato D, Borysiuk Z, Rozpara M. Quality of life and physical activity in an older  
5  
6  
7 working-age population. *Clin Interventions in aging* 2017;12:1627-1634.  
8  
9

10  
11 11. WHO WHO. WHOQOL-BREF Introduction, administration, scoring and generic  
12  
13  
14 version of the assessment. Field Trial Version 1996 [Available from:  
15  
16  
17  
18 [http://www.who.int/mental\\_health/media/en/76.pdf](http://www.who.int/mental_health/media/en/76.pdf).  
19  
20  
21

22  
23 12. Łojko D, Czajkowska A, Suwalska A, et al. Symptoms of depression among  
24  
25  
26 adults in rural areas of western Poland. *Annals of agricultural and environmental*  
27  
28  
29 *medicine : AAEM* 2015;22(1):152-5. doi: 10.5604/12321966.1141386  
30  
31

32  
33  
34 13. Joshi U, Subedi R, Poudel P, et al. Assessment of quality of life in patients  
35  
36  
37 undergoing hemodialysis using WHOQOL-BREF questionnaire: a multicenter study.  
38  
39  
40  
41 *Int J Nephrol Renovasc Dis* 2017;10:195-203.  
42  
43  
44

45  
46 14. El-Hashimi D, Gorey KM. Yoga-specific enhancement of quality of life among  
47  
48  
49 women with breast cancer: Systematic review and exploratory meta-analysis of  
50  
51  
52 randomized controlled trials. *J Evid Based Integr Med* 2019;24:2515690X19828325.  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 15. Morishima T, Miyashiro I, Inoue N, et al. Effects of laughter therapy on quality of  
4 life in patients with cancer: An open-label, randomized controlled trial. *PLoS One*  
5  
6  
7

8  
9  
10 2019;14:e0219065.  
11  
12

13  
14 16. Kmiecik A BD, Plominski A. The level of mood regulation in practicing hatha yoga  
15 in the background of people who do not practice this physical activity. *Physi Act Rev*  
16  
17  
18  
19 2020;8:8.  
20  
21  
22

23  
24  
25 17. Yadav R, Yadav RK, Pandey RM, et al. Predictors of health-related quality of life  
26 in Indians with metabolic syndrome undergoing randomized controlled trial of yoga-  
27  
28  
29  
30  
31  
32  
33 based lifestyle intervention vs dietary intervention. *Behav Med* 2021;47:151-160.  
34  
35

36  
37 18. Telles S, Gupta RK, Kumar A, et al. Mental wellbeing, quality of life, and  
38 perception of chronic illness in yoga-experienced compared with yoga-naïve patients.  
39  
40  
41  
42  
43  
44  
45 *Med Sci Monit Basic Res* 2019;25:153-163.  
46  
47

48  
49 19. Brown RP, Gerbarg PL. Yoga breathing, meditation, and longevity. *Ann N Y Acad*  
50  
51  
52  
53 *Sci* 2009;1172:54-62.  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 20. Weber M, Schnorr T, Morat M, et al. Effects of mind-body interventions involving  
5  
6  
7 meditative movements on quality of life, depressive symptoms, fear of falling and  
8  
9  
10 sleep quality in older adults: A systematic review with meta-analysis. *Int J Environ*  
11  
12  
13  
14 *Res Public Health* 2020;17:6556.

15  
16  
17  
18 21. Brinsley J, Schuch F, Lederman O, et al. Effects of yoga on depressive  
19  
20  
21 symptoms in people with mental disorders: a systematic review and meta-analysis.  
22  
23  
24  
25 *Br J Sports Med* 2021;55:992-1000.

26  
27  
28  
29  
30 22. Salvado M, Marques DL, Pires IM, et al. Mindfulness-based interventions to  
31  
32  
33 reduce burnout in primary healthcare professionals: A systematic review and meta-  
34  
35  
36 analysis. *Healthcare* 2021;9:1342.

37  
38  
39  
40  
41 23. Satin JR, Linden W, Millman RD. Yoga and psychophysiological determinants of  
42  
43  
44 cardiovascular health: comparing yoga practitioners, runners, and sedentary  
45  
46  
47 individuals. *Ann Behav Med* 2014;47:231-241.

48  
49  
50  
51  
52 24. Rathore M, Abraham J. Implication of asana, pranayama and meditation on  
53  
54  
55 telomere stability. *Int J Yoga* 2018;11:186-193.  
56  
57  
58  
59  
60

- 1  
2  
3 25. Cheema BS, Marshall PW, Chang D, et al. Effect of an office worksite-based  
4  
5  
6  
7 yoga program on heart rate variability: a randomized controlled trial. *BMC Public*  
8  
9  
10 *Health* 2011;11:578.  
11  
12  
13  
14  
15 26. Chandrasekaran AM, Kinra S, Ajay VS, et al. Effectiveness and cost-  
16  
17  
18 effectiveness of a Yoga-based Cardiac Rehabilitation (Yoga-CaRe) program  
19  
20  
21 following acute myocardial infarction: Study rationale and design of a multi-center  
22  
23  
24  
25 randomized controlled trial. *Int J Cardio*2019;280:14-18.  
26  
27  
28  
29  
30 27. Jaracz K, Kalfoss M, Gorna K, et al. Quality of life in Polish respondents:  
31  
32  
33 psychometric properties of the Polish WHOQOL-Bref. *Scand J Caring Sci*  
34  
35  
36  
37 2006;20:251-260.  
38  
39  
40  
41 28. Jang Y, Hsieh CL, Wang YH, et al. A validity study of the WHOQOL-BREF  
42  
43  
44  
45 assessment in persons with traumatic spinal cord injury. *Arch Phys Med Rehabil*  
46  
47  
48 2004;85:1890-1895.  
49  
50  
51  
52  
53 29. Skevington SM. Advancing cross-cultural research on quality of life: observations  
54  
55  
56 drawn from the WHOQOL development. World Health Organisation Quality of Life  
57  
58  
59  
60  
60 Assessment. *Qual Life Res* 2002;11:135-144.



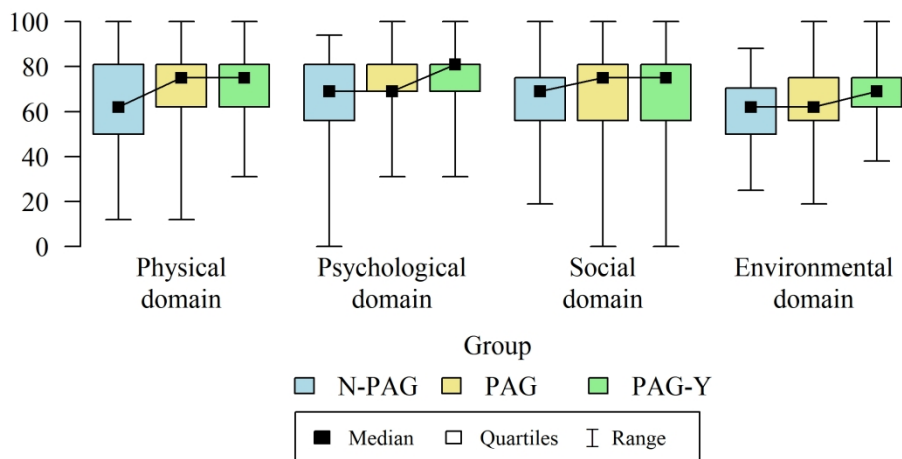
- 1  
2  
3  
4 30. Pluto-Pradzynska A. Man has always been in motion and seems to be created for  
5  
6  
7 movement: Can everyday life in balance reverse the process of ageing? *J Nurs*  
8  
9  
10 *Health Stud* 2019;4:5.  
11  
12  
13  
14  
15 31. Strijk JE, Proper KI, van der Beek AJ, et al. A worksite vitality intervention to  
16  
17  
18 improve older workers' lifestyle and vitality-related outcomes: results of a randomised  
19  
20  
21 controlled trial. *J Epidemiol Community Health* 2012;66:1071-1078.  
22  
23  
24  
25  
26 32. Gomenuka NA, Oliveira HB, Silva ES, et al. Effects of Nordic walking training on  
27  
28  
29 quality of life, balance and functional mobility in elderly: A randomized clinical trial.  
30  
31  
32  
33 *PLoS One* 2019;14:e0211472.  
34  
35  
36  
37  
38 33. Song C, Ikei H, Park BJ, et al. Psychological benefits of walking through forest  
39  
40  
41 areas. *Int J Environ Res Public Health* 2018;15:2804.  
42  
43  
44  
45  
46 34. Alaimo K, Beavers AW, Crawford C, et al. Amplifying health through community  
47  
48  
49 gardens: A framework for advancing multicomponent, behaviorally based  
50  
51  
52 neighborhood interventions. *Curr Environ Health Rep* 2016;3:302-312.  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 35. Rostami K, Ghodsbin F. Effect of yoga on the quality of life of nurses working in  
4  
5  
6 intensive care units. Randomized controlled clinical trial. *Invest Educ Enferm*  
7  
8  
9  
10 2019;37:e06.  
11  
12  
13  
14  
15 36. Kettunen O, Kyrolainen H, Santtila M, et al. Physical fitness and volume of leisure  
16  
17  
18 time physical activity relate with low stress and high mental resources in young men.  
19  
20  
21  
22 *J Sports Med Phys Fitness* 2014;54:545-551.  
23  
24  
25  
26 37. Li D, Tsui MCM, Zhang G. Evidence-based clinical application of yoga for stress  
27  
28  
29 management. *J Yoga Phys Ther* 2016;6:3.  
30  
31  
32  
33  
34 38. Tipton CM. The history of "Exercise Is Medicine" in ancient civilizations. *Adv*  
35  
36  
37  
38 *Physiol Educ* 2014;38:109-117.  
39  
40  
41  
42 39. WHO. "Global Recommendations on Physical Activity for Health" 2010.  
43  
44  
45  
46  
47 40. Cirillo J, Finch JB, Anson JG. The impact of physical activity on motor preparation  
48  
49  
50 in young adults. *Neurosci Lett* 2017;638:196-203.  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 **Figure Legends**  
4

5 Figure 1. Presentation of quality of life (QOL) in the WHOQOL-bref domains researched  
6  
7 groups.  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For peer review only



404x194mm (157 x 157 DPI)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1&3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
<b>Introduction</b>			
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	4-5
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5-6
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
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	5-6
Bias	9	Describe any efforts to address potential sources of bias	5-6
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5-6
		(b) Describe any methods used to examine subgroups and interactions	5-6
		(c) Explain how missing data were addressed	5-6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	5-6
		(e) Describe any sensitivity analyses	5-6

Continued on next page

<b>Results</b>			
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	7-12
		(b) Give reasons for non-participation at each stage	7-12
		(c) Consider use of a flow diagram	7-12
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-12
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
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	7-12
		(b) Report category boundaries when continuous variables were categorized	7-12
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7-12
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7-12
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	12-14
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	12-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-14
<b>Other information</b>			
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	15

\*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](http://www.strobe-statement.org).

# BMJ Open

## Are yoga and physical activity determinants of the quality of life in Polish population?

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-059658.R1
Article Type:	Original research
Date Submitted by the Author:	20-Jun-2022
Complete List of Authors:	Pluto-Pradzynska, Agnieszka; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Pluto-Pradzynska, Karolina; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology; Adam Mickiewicz University, Department of Pedagogy Frydrychowicz, Magdalena; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Lagiedo-Zelazowska, Malgorzata; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Owoc, Jakub; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Benjamin, Shamiram; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Au, Tsz Yuen; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Jaracz, Krystyna; Poznan University of Medical Sciences, Department of Nursing Dworacki, Grzegorz; Poznan University of Medical Sciences, Department of Pathomorphology and Clinical Immunology Wysocki, Jacek; Poznan University of Medical Sciences, Department of Health Prevention Wasik, Jacek; Akademia im Jana Długosza w Częstochowie, Faculty of Health Sciences
<b>Primary Subject Heading</b>:	Complementary medicine
Secondary Subject Heading:	Complementary medicine, Sports and exercise medicine
Keywords:	Public health < INFECTIOUS DISEASES, EDUCATION & TRAINING (see Medical Education & Training), MENTAL HEALTH, Immunology < NATURAL SCIENCE DISCIPLINES, QUALITATIVE RESEARCH, SPORTS MEDICINE

SCHOLARONE™  
Manuscripts

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60





I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

# Are yoga and physical activity determinants of the quality of life in Polish population?

Agnieszka Pluto-Pradzynska<sup>1</sup>, Karolina Pluto-Pradzynska<sup>1,2</sup>, Magdalena Frydrychowicz<sup>1</sup>,  
Malgorzata Lagiedo-Zelazowska<sup>1</sup>, Jakub Owoc<sup>1</sup>, Shamiram Benjamin<sup>1</sup>, Tsz Yuen Au<sup>1</sup>,  
Krystyna Jaracz<sup>3</sup>, Grzegorz Dworacki<sup>1</sup>, Jacek Wysocki<sup>4</sup>, Jacek Wasik<sup>5</sup>

<sup>1</sup>Department of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland

<sup>2</sup>Department of Pedagogy, Adam Mickiewicz University Poznan, Poland

<sup>3</sup>Department of Nursing, Poznan University of Medical Sciences, Poznan, Poland

<sup>4</sup>Department of Health Prevention, Poznan University of Medical Sciences, Poznan, Poland

<sup>5</sup>Faculty of Health Sciences, Jan Dlugosz University, Czestochowa, Poland

Correspondence to:

**Dr. Agnieszka Pluto-Pradzynska**; ORCID: 0000-0002-6402-7857

Department of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences

ul. Rokietnicka 5d, 60-806 Poznan, Poland

Email: [agapp@ump.edu.pl](mailto:agapp@ump.edu.pl)

Tel: +48 618 547 174

Fax: +48 618 547 173

Abstract word count: 282

Paper word count: 3656

## ABSTRACT

**Objectives:** Yoga is an ancient form of physical activity (PA) that encompasses meditation, stretching, and breathing techniques. Although the benefits of PA and associated lifestyle interventions are clear, we here addressed the paucity of evidence regarding the specific relationship between yoga and quality of life (QOL) in adults in Poland. We hypothesized that the participation in physical activity, and yoga could result in a positive impact on QOL.

**Design:** Cross-sectional, self-administered questionnaire-based survey. Both the quantitative and qualitative variables were statistically compared. Multivariate analyses were performed using linear regression. Results were determined based on age, sex, and education level;  $p < 0.05$  was considered significant.

**Setting:** Questionnaires were randomly delivered by researchers to participants who were willing to complete them at high schools, universities and elderly communities in Poland.

**Participants:** 714 polish citizens aged over 18 participated in the study; there are no specific entry and exclusion criteria besides age.

**Results:** Statistically significant differences ( $p < 0.05$ ) were observed between the QOL of the physically active group (PAG) and non-physically active group (N-PAG). Meanwhile, yoga practice was revealed to have a significant effect on QOL; QOL was found to be statistically higher ( $p < 0.001$ ) in the physically active group with yoga (PAG-Y) ( $4.29 \pm 0.66$ ) than in the N-PAG ( $3.83 \pm 0.92$ ) and PAG without yoga ( $4.07 \pm 0.68$ ).

**Conclusions:** The study shows that both regular PA and yoga practices could improve QOL; however, PAG-Y produced higher QOL scores than PA of other types. This outcome may be explained by impact of physiological and psychological aspects within yoga practice. These results suggest that this combination impacts health more positively than other kind of PA alone, which is only physiological in nature.

**Keywords:** depression, health, mindfulness, lifestyle, prevention, health education

## Strength and limitation

- This study is one of the first to evaluate how physical activity and yoga practice may affect QOL of Polish citizens.
- Future cohort studies should be performed in order to better understand the relationship between PA, QOL, and health perception.
- Data could provide community health benefits in response to the troubling epidemiological impact of the COVID-19 pandemic.

## INTRODUCTION

Regular physical activity (PA) is an important factor in physiological growth, the development and maintenance of the central nervous system, as well as in general health,[1]. A myriad of well-respected organizations, healthcare providers, and political establishments maintain recommendations of regular leisure and recreational PA for the sake of public health and as preventive medicine,[2]. Additionally, published evidence supports the positive impact of a balanced diet and PA, associated with social education, in the prevention and treatment of disease,[3, 4]. In Poland, the government promotes increased PA, in order to reduce deaths due to lifestyle-related diseases,[5].

Nevertheless, in 2018 insufficient PA levels were confirmed in global surveys,[6]. Additionally, the European Union reported that only about half of Europeans exercise or play sports, of which only 7% do it regularly, with the remaining 46% reporting that they never participate in PA. This report emphasized individual health benefits and a decrease in both social and economic costs achieved through PA implementation,[7]. Improving PA lifestyle efficiency can pay dividends in terms of both individual and public health,[8]. Previous studies confirmed better well-being due to lifestyle enhancements like yoga intervention combined with physical training in an industry worker group,[9].

Lifestyle enhancement may include exercise, nutrition, behavioral changes, and self-care, which involve all levels of collaborative medical education,[4]. This concept was recognized by the ancient Greek physician and philosopher, Hippocrates of Kos (c. 460 BC to 370 BC) who proclaimed: "Let food be medicine" and "Exercise is medicine," and was

1  
2  
3 recognized as the first practitioner to prescribe exercise in treating diseases linked to obesity  
4 and sedentary living,[10].

7 The World Health Organization (WHO) defined QOL as “an individual’s perception of  
8 their position in life in the context of the culture and value systems in which they live and in  
9 relation to their goals, expectations, standards, and concerns”,[11]. Some studies on QOL,  
10 including those conducted in Poland,[12], have referred to the relationship between yoga and  
11 disease-related QOL,[13], whereas others have discussed health-related QOL in cancer  
12 treatment and therapy,[14, 15], and in older adults,[16]. In most observations, higher QOL  
13 scores were observed for those engaging in all types of PA than in those who did not.

22 Yoga is an ancient form of PA brought to the West at the end of the XIXth century. Its  
23 practice encompasses meditation in conjunction with stretching and breathing  
24 techniques,[17]. In addition to straightening and elongating the body, yoga increases  
25 strength, flexibility, and range of motion,[1], combining physical training with conscious  
26 breathing,[18], while drawing attention to the practitioner’s consciousness and psychological  
27 state,[1]. Therefore, yoga provides not only physical benefits, but also mental health  
28 benefits,[14, 19], even reducing symptoms of anxiety and depression, positively affecting  
29 mood, and reducing stress,[14, 20]. Special types of yoga, such as laughter yoga, may  
30 benefit everyone, including patients with cancer,[15]. Yoga offers effective exercises to  
31 intensify cognitive and behavioral factors for learning, concentration, and achievement, and  
32 can be used to mitigate the risk of burnout,[15, 21]. A combination of yoga and aerobic  
33 exercise has been shown to reduce mental, physical, and vascular stress in cardiovascular  
34 diseases,[22]. Therefore, both yoga and mindfulness may be significant factors for lifestyle  
35 change interventions,[23]. Yoga also offers promise as a preventive health intervention,[24],  
36 in supplementation to the management of symptoms and conditions,.

53 The system of yoga encompasses specific exercises. It often involves holding  
54 positions for an increased amount of time. It can be easily implementing in the workplace to  
55 reduce burnout symptoms and stress levels,[21], avoid pain back caused by mostly  
56 sedentary position at work,[24]. A special yogic type of breathing, known as pranayama,[17],  
57  
58  
59  
60

1  
2  
3 is leading to the development of self-control and mindfulness,[1]. Additionally, yoga,  
4  
5 meditation, and pranayama practice have been shown to increase the stability of telomeres  
6  
7 by stimulating telomerase activity; which inhibits aging processes and protects against  
8  
9 certain diseases,[23], including cancer,[17]. Using tools of positive psychology like yoga  
10  
11 practice or even laughter therapy can stimulate the thinking processes and communication  
12  
13 skills of individuals,[15].  
14

15  
16 In Poland, data on yoga among adults in different age groups, which could represent  
17  
18 a wider cross-section of society, are lacking[25]. Although yoga has been practiced in Poland  
19  
20 for many years, it has never been widely accepted and many Polish citizens have never tried  
21  
22 yoga at all; some scepticism is likely connected to popular Catholic Church doctrine which  
23  
24 frowns upon the activity's ties to Jainism, Buddhism, Hinduism, and other non-Christian  
25  
26 faiths. Therefore, the positive impact of yoga on health may need to be recognized and  
27  
28 promoted,[19]. Thus, in this study, we sought to investigate whether the effects of yoga on  
29  
30 QOL as a unique type of physical activity, are different from the effects of physical activity  
31  
32 alone without components of yoga,[25, 26].  
33  
34  
35  
36

## 37 **METHODS**

### 38 **Patient and public involvement**

39  
40 Patients and/or the public were not involved in the design, or conduct, or reporting, or  
41  
42 dissemination plans of this research.  
43  
44

45 The survey was conducted in the 3 month of 2017 (April, May, June).  
46

### 47 **Ethics approval**

48  
49 The study protocol was reviewed by the Bioethics Committee of the Poznan University of  
50  
51 Medical Sciences (Resolution No.1263/18), which decreed that the study does not have the  
52  
53 characteristics of a medical experiment and does not require approval from the Bioethics  
54  
55 Committee.  
56  
57  
58  
59  
60

## Participants

This study included a sample (n = 714) of Polish adults ( $\geq 18$ -years-old), comprised of 46% men (n= and 54% women. Respondents were recruited through Internet advertisements, at high schools and universities and at elderly communities. The following groups were composed and compared to each other: control group (N-PAG, n = 72), PA group (PAG, n = 642), and PA with yoga group (PAG-Y; n = 151). There were differences between groups in sex, age, and educational level.

## Survey

Quality of life was evaluated using the World Health Organization's (WHO) standardized questionnaire (WHOQOL - BREF), which is a short-version questionnaire approved for use in many countries, including Poland,[16, 27, 28]. It is dedicated to the study of the QOL of adults, with respect to individual perceptions,[29]. The WHOQOL-BREF contains 26 items, 24 of which use a scale of 1–100 (min–max), pertaining to four domains of QOL that are incorporated into specified facets. These include the following: The Physical health domain (PHD-QOL) includes items on activities of daily living, dependence on medicinal substances and medical aids, energy and fatigue, mobility, pain and discomfort, sleep and rest, and work capacity. The Psychological domain (PD-QOL) includes questions on body image and appearance, negative feelings, positive feelings, self-esteem, spirituality/religion/personal beliefs, thinking, learning, memory, and concentration. The Social domain (SD-QOL) addresses personal relationships, social support, and sexual activity, The Environmental domain (ED-QOL) investigates financial resources, freedom, physical safety and security, health and social care (accessibility and quality), home environment, opportunities for acquiring new information and skills, participation in and opportunities for recreation/leisure activities, physical environment (pollution/noise/traffic/climate), and transport. Two items are examined separately, with a scale of 1–5 (min–max), and ask about individual's overall perception of QOL and health (HP),[11].

1  
2  
3 The respondents were asked about participation in the listed PAs (swimming, long or  
4 intensive walking, cycling, jogging, riding, gym/fitness, tennis/squash/badminton, gardening,  
5 yoga, and 'others'). They were asked to select the frequency of participation in the activity,  
6 from among the following: none; 1–3 hours per month; 1, 1–3 h, or > 3 hours/week.  
7  
8 Additionally, the period of yoga practice was matched in years: < 1, 1–3, 3–5, 5–10, or ≥ 10  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19

## 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

**Statistical analysis**

Qualitative variables was compared among the groups using the chi-square test (with Yates' correction for 2×2 tables) or the Fisher's exact test where low expected frequencies appeared in the tables. Quantitative variables in the three groups were compared using the Kruskal–Wallis test. After detecting statistically significant differences, post-hoc analysis was performed with Dunn's test to identify statistically significant differences between groups. Multivariate analysis of the influence of a number of factors on the quantitative variables was performed using a linear regression method. The results are presented as regression model parameter values with a 95% confidence interval (95%CI). A significance level of 0.05 was adopted in the analysis, and all p values < 0.05 were interpreted as showing significant relationships. The analysis was performed using R version 4.1.0. (R Core Team, 2021. R Foundation for Statistical Computing, Vienna, Austria, <https://www.R-project.org/>).

## RESULTS

### Group constitution

The entire sample consisted of 714 participants. Twice as many women as men declared a non-physically active lifestyle, and nearly three times more women than men practiced yoga (females 73.51%, males 26.49%). In the N-PAG middle-aged adults (35–55-years-old) predominated (52.78%), whereas 36.11% were young adults (< 35-years-old). In the PAG young adults predominated (50.71%), while one-third of this group were middle-aged adults (32.79%). In the PAG-Y prevailed middle-aged individuals (49.67%), as compared to young



adults (39.07%), while 11.26% were older adults (> 55-years-old). In terms of education level the majority of each group were individuals with a university degree (Table 1).

Table 1. Composition of the research groups.

Parameters	Groups			P	
	N-PAG (n = 72)	PAG (n = 491)	PAG-Y (n = 151)		
Sex	Females	47 (65.28%)	228 (46.44%)	111 (73.51%)	p<0.001
	Males	25 (34.72%)	263 (53.56%)	40 (26.49%)	
Age	18–35 years	26 (36.11%)	249 (50.71%)	59 (39.07%)	p<0.001
	36–55 years	38 (52.78%)	161 (32.79%)	75 (49.67%)	
	> 55 years	8 (11.11%)	81 (16.50%)	17 (11.26%)	
Education	Primary	1 (1.39%)	4 (0.81%)	1 (0.66%)	p = 0.001
	Secondary	17 (23.61%)	149 (30.35%)	22 (14.57%)	
	Post-secondary	12 (16.67%)	93 (18.94%)	17 (11.26%)	
	University	34 (47.22%)	190 (38.70%)	89 (58.94%)	
	Postgraduate	8 (11.11%)	55 (11.20%)	22 (14.57%)	

p-values were obtained by the chi-squared or exact Fisher's test

The mean QOL perception in the researched population was good (4.09 points on a 1–5 point scale; SD = 0.7), as was the level of HP (3.83 points on a 1–5 scale; SD = 0.82). Across the domains, the highest mean level of QOL perception was in the PD-QOL, which was only 1.03 points higher than that of the PHD-QOL, while the SD-QOL had a mean value of 70.23. The lowest perception of QOL was observed in the ED-QOL (Table 2).

Table 2. Quality of life scores according to the WHOQOL- BREF domains.

WHOQOL-BREF	N	Mean	±SD	Median	Min	Max	Q1	Q3
Physical domain	714	71.58	14.74	75	12	100	62	81
Psychological domain	714	72.61	14.07	75	0	100	69	81
Social domain	714	70.23	17.42	75	0	100	56	81
Environmental domain	714	65.24	13.65	62	19	100	56	75

Analysing the differences in the QOL between the observed groups, the study results indicated that PA could be linked to an improved QOL. In all four domains of the WHOQOL - BREF the QOL was statistically significantly higher ( $p < 0.05$ ) in both PA groups (PAG and PAG-Y) than in the N-PAG.

Yoga practice was an important factor in QOL; QOL was significantly higher ( $p < 0.001$ ) in the PAG-Y than in the N-PAG and PAG only. The same association was observed in three separate domains: PHD-QOL, PD-QOL, and ED-QOL ( $p < 0.001$ ). Similar results were obtained for HP ( $p < 0.003$ ; Table 3, Figure 1).

Table 3. Presentation of QOL and HP, and QOL according to WHOQOL—BREF domains in each of the researched groups.

WHOQOL- BREF ITEMS		Groups			p
		N-PAG	PAG	PAG-Y	
Quality of life perception	Mean ± SD	3.83 ± 0.92	4.07 ± 0.68	4.29 ± 0.66	$p < 0.001$
	Median	4	4	4	
	Quartiles	3–4	4–4	4–5	PAG-Y > PAG, N-PA
Health perception	Mean ± SD	3.56 ± 0.95	3.86 ± 0.78	3.89 ± 0.87	$p = 0.003$
	Median	4	4	4	

	Quartiles	3–4	4–4	4–4	PAG-Y, PAG > N-PA
	Mean ± SD	64.24 ± 17.88	71.78 ± 14.21	74.42 ± 13.7	p < 0.001 *
Physical domain	Median	62	75	75	
	Quartiles	50–81	62–81	62–81	PAG-Y > PAG > N-PA
	Mean ± SD	66.31 ± 17.92	72.55 ± 13.09	75.79 ± 14.16	p < 0.001 *
Psychological domain	Median	69	69	81	
	Quartiles	56–81	69–81	69–81	PAG-Y > PAG > N-PAG
	Mean ± SD	65.96 ± 18.18	70.76 ± 16.66	70.58 ± 19.21	p = 0.021 *
Social domain	Median	69	75	75	
	Quartiles	56–75	56–81	56–81	PAG, PAG-Y > N-PAG
	Mean ± SD	60.96 ± 14.38	64.85 ± 13.5	68.57 ± 13.12	p < 0.001 *
Environmental domain	Median	62	62	69	
	Quartiles	50–70.5	56–75	62–75	PAG-Y > PAG > N-PAG

p - Kruskal–Wallis test + post-hoc analysis (Dunn's test)

### Linear regression

The multivariate linear regression model, adjusted for age, sex, and education, showed that PA was a significant ( $p < 0.05$ ), independent predictor of both QOL and HP. The perception of QOL in the PAG was on average 0.25 points higher than that in the N-PAG (the regression parameter was 0.25). The regression parameter for PAG-Y was 0.46, while the QOL perception of PAG-Y was on average 0.46 points higher than in the N-PA.

In HP the regression parameter in the PAG was 0.309 and in PAG-Y it was 0.352. It showed higher QOL and HP in those groups than in N-PAG. The value of the regression parameter in each of the four WHOQOL - BREF domains presented yoga and other PA as

1  
2  
3 statistically significant parameters that improved QOL. Similar to the results presented in  
4 these analyses, addition of yoga practice to PA resulted in a nearly doubled regression  
5 parameter in PD-QOL (9.786) in relation to N-PAG, when compared to PAG and N-PAG  
6 (5.905). Only the SD-QOL regression parameter level in relation to N-PAG had similar scores  
7 in both groups with a slightly higher score (5.303) in the PAG than in the PAG-Y (5.076)  
8  
9  
10  
11  
12  
13  
14 (Table 4).  
15  
16  
17

18 Table 4. Results of linear regression analyses in the different groups.  
19

WHOQOL- BREF ITEMS	Group	Regression parameter*	95%CI		p
Quality of life perception	N-PAG	Ref.			
	PAG	0.25	0.074	0.426	0.005
	PAG-Y	0.46	0.262	0.658	<0.001
Health perception	N-PAG	Ref.			
	PAG	0.309	0.107	0.512	0.003
	PAG-Y	0.352	0.125	0.58	0.002
Physical domain	N-PAG	Ref.			
	PAG	7.54	3.932	11.148	<0.001
	PAG-Y	10.305	6.247	14.362	<0.001
Psychological domain	N-PAG	Ref.			
	PAG	5.905	2.432	9.378	0.001
	PAG-Y	9.786	5.88	13.692	<0.001
Social domain	N-PAG	Ref.			

	PAG	5.303	0.951	9.654	0.017
	PAG-Y	5.076	0.182	9.97	0.042
	N-PAG	Ref.			
Environmental domain	PAG	4.313	0.944	7.682	0.012
	PAG-Y	7.29	3.501	11.078	<0.001

## DISCUSSION

In this study we evaluated the specific relationship between yoga and QOL in the relative large (n=714) study group so far completed in Polish adults. There were differences between groups in sex, age, and educational level. We found that QOL measured with the WHOQOL - BREF were higher in the participants whose to PA included yoga, than in those who did not perform PA, as well as in those who practiced other than yoga PA. It concerned an overall QOL, satisfaction with health and three out of four WHOQOL - BREF domains. These results are in line with previous studies confirming statistically significant differences in the QOL of individuals who participate in PA and PA with yoga, as compared to those who do not participate in PA,[29]. In adulthood, when movement is limited due to both technical inventions and a sedentary lifestyle,[30], suitable PA can assist in preventing diseases,[31], and spine and back pain,[32]. In everyday activities, ordinary PA may include walking,[32], cycling, gardening, and short periods of calisthenics.[8] The physical and social aspects of gardening and walking in the forest elicit multifactorial positive health behaviors,[33], correlated with human relationships, constituting a part of SD-QOL, with higher scores for QOL,[34].

In correlation with the PHD-QOL of the WHOQOL-bref, PA results in greater mobility, more energy for life, better study and work capacity,[16], better sleep and rest, reduced pain, and diminished dependence on medical substances,[11]. For example, young industrial

1  
2  
3 workers who performed morning physical training combined with yoga in the evening for 3  
4 months had higher scores than did another group who did not include yoga,[9]. For aging  
5 populations, increasing mobility, without over-training, positively influences health and assists  
6 individuals in achieving daily goals,[35]. Since much PA may be too strenuous for regular  
7 practice, the efficiency of a yogic and physically active lifestyle pays dividends in both  
8 individual and public health.  
9  
10  
11  
12  
13  
14  
15  
16  
17

### 18 **Psychological impacts of PA**

19  
20 Participation in PA has been shown to improve QOL and HP,[36], awakens one's  
21 consciousness, assist in maintaining a life-work balance,[3, 33], and provide relaxation,[37].  
22  
23 The American College of Sports Medicine launched “The Global Initiative” to encourage  
24 physicians, healthcare professionals, and educators to promote exercise to ultimately  
25 prevent, reduce, manage, or treat diseases that impact health and QOL in humans,[10].  
26  
27 Given the results, the implementation of yoga could address similar biological parameters  
28 while also potentially yielding positive effects on psychological parameters,[15, 37], as yoga  
29 practice is associated with better mental health outcomes and decreased severity of  
30 depressive symptoms,[20]. Specifically, WHOQOL – BREF related to PD-QOL, measured  
31 body image and appearance, personal beliefs, self-esteem, feelings, thinking, learning,  
32 memory, and concentration. These parameters may be improved with regular yoga practice,  
33 which positively shapes QOL and HP. The present study showed the benefit of yoga practice  
34 in a randomized PAG-Y in relation to others in QOL and in three of four WHOQOL - BREF  
35 domains,[35].  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48

49 When considering the general population, including elderly or frail patients, this study  
50 supports how yoga is a practice that may potentially offer substantial physical and  
51 psychological benefit, even in patients with limited physical capacity for PA. In cases where  
52 individuals do not prefer to practice yoga, even the addition of a contemplative aspect to  
53 regular PA, using paths similar to those used in yoga, including prayer, breathing exercises,  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 or daily mindfulness meditation,[18], may offer significant benefits to physical and  
4  
5 psychological wellbeing in addition to the overall QOL.[19]  
6

7           Limitations of this study revolve around its limited generalizability. The participants  
8 selected all come from Poland and consisted of Polish adults, as WHOQOL – BREF protocol  
9  
10 advices, which limits the scalability to populations. Future studies could be done to include  
11  
12 more diverse populations/nationalities, with comparison between different educational  
13  
14 backgrounds and socio-economic status. Additionally, future cohort studies should be  
15  
16 performed in order to better understand the relationship between PA and QOL to provide  
17  
18 more insight on the results obtained.  
19  
20

21  
22 The public should be encouraged to note that the pressing problems associated with  
23  
24 worsening well-being and QOL level, may be associated with insufficient PA in leisure  
25  
26 time,[38]. Given the social responsibility to safeguard and promote the health of the  
27  
28 population, it is worth noting that the integration of scholars and students into  
29  
30 interdisciplinary, and sport-based teams,[2], may serve as an innovative solution to promote  
31  
32 health, while this study shows how yoga may provide similar benefits as well, albeit  
33  
34 enhanced in comparison,[39]. In conclusion it can be stated that in order to achieve and  
35  
36 maintain optimal physical and psychological health,[17], people should be motivated to live a  
37  
38 physically active life, particularly through meditative PA such as yoga,[30].  
39  
40  
41  
42  
43  
44

## 45 **CONCLUSIONS**

46  
47 The results of the presented study showed were observed more often among physically  
48  
49 active individuals, regardless of the type of activities, than in those non-active and that higher  
50  
51 QOL parameters were more often documented among the PAG-Y than the N-PAG  
52  
53 individuals. Therefore, it would be appropriate to conclude that the practice of yoga have a  
54  
55 greater beneficial effects on the QOL of society than non-yogic PA.  
56

57           Historically, though enhanced as a result of the recent COVID-19 pandemic, there  
58  
59 is a critical need to promote a healthy lifestyle within the population and reduce the  
60

1  
2  
3 prevalence of conditions that may place the general public at risk. Overall, the results of the  
4 present study when coupled with existing literature illustrates that yoga may be a powerful  
5 and inexpensive tool to promote healthier living and greater QOL within getting older  
6 societies. It is a specially important since burden of costs of health care is dramatically  
7 increasing when we get older, so promoting PA in general, including yoga, should be  
8 introduce in the lifestyle education at the very early age, so it would become a common habit.  
9 Further investigations in presented topic should be conducted in order to deepen the  
10 observed relationships.  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24

### 25 **Acknowledgments**

26 We would like to acknowledge and thank all study participants as well as the Editage Team  
27 for their contribution to this study.  
28  
29  
30  
31  
32  
33

### 34 **Contributorship statement**

35 AP-P conceived of the study. AP-P, KP-P, and GD initiated the study design and SB and TA  
36 helped with implementation. MF, ML, JO collected the data and KJ helped with analysing  
37 statistical results. AP-P and GD are grant holders. All authors contributed to refinement of the  
38 study protocol and approved the final manuscript.  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48

### 49 **Competing interests**

50 no conflicts of interest  
51  
52  
53

### 54 **Funding**

55 This study was supported by Poznan University of Medical Sciences,  
56  
57  
58  
59  
60



## Data availability statement

All data relevant to the study are included in the article or uploaded as supplementary information.

## References

1. Kwok JYY, Kwan JCY, Auyeung M, Mok VCT, Lau CKY, Choi KC, Chan HYL: **Effects of Mindfulness Yoga vs Stretching and Resistance Training Exercises on Anxiety and Depression for People With Parkinson Disease: A Randomized Clinical Trial.** *JAMA neurology* 2019.
2. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, Carty C, Chaput JP, Chastin S, Chou R *et al*: **World Health Organization 2020 guidelines on physical activity and sedentary behaviour.** *Br J Sports Med* 2020, **54**(24):1451-1462.
3. Fuzeki E, Banzer W: **Physical Activity Recommendations for Health and Beyond in Currently Inactive Populations.** *Int J Environ Res Public Health* 2018, **15**(5).
4. Polak R, Pojednic RM, Phillips EM: **Lifestyle Medicine Education.** *Am J Lifestyle Med* 2015, **9**(5):361-367.
5. Ministry of Health P: **National Health Program 2016-2020.** In: *Public Health Act.* Warsaw; 2015.
6. Guthold RS, G.A. Riley, L.M. *et al*: **Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants.** *The Lancet Global health* 2018, **6**(10):e1077-e1086.
7. Commission ES: **Special Eurobarometr 472.** In. <https://sport.ec.europa.eu/news/new-eurobarometer-on-sport-and-physical-activity>; EU; 2018.
8. Li X, Ghosh D: **Associations between Body Mass Index and Urban "Green" Streetscape in Cleveland, Ohio, USA.** *Int J Environ Res Public Health* 2018, **15**(10).
9. Bhat PS, Chopra V, Mehta SG, Srivastava K, Kumar SR, Prakash J: **Psychological benefits of yoga in industrial workers.** *Ind Psychiatry J* 2012, **21**(2):98-103.
10. Tipton CM: **The history of "Exercise Is Medicine" in ancient civilizations.** *Adv Physiol Educ* 2014, **38**(2):109-117.
11. **WHOQOL-BREF Introduction, administration, scoring and generic version of the assessment. Field Trial Version** [[http://www.who.int/mental\\_health/media/en/76.pdf](http://www.who.int/mental_health/media/en/76.pdf)]
12. Łojko D, Czajkowska A, Suwalska A, Pałys W, Jaracz K, Górna K, Pniewska J, Gołębiwska K, Baron U, Rybakowski J: **Symptoms of depression among adults in rural areas of western Poland.** *Annals of agricultural and environmental medicine : AAEM* 2015, **22**(1):152-155.
13. Joshi U, Subedi R, Poudel P, Ghimire PR, Panta S, Sigdel MR: **Assessment of quality of life in patients undergoing hemodialysis using WHOQOL-BREF questionnaire: a multicenter study.** *Int J Nephrol Renovasc Dis* 2017, **10**:195-203.
14. El-Hashimi D, Gorey KM: **Yoga-Specific Enhancement of Quality of Life Among Women With Breast Cancer: Systematic Review and Exploratory Meta-Analysis of Randomized Controlled Trials.** *Journal of evidence-based integrative medicine* 2019, **24**:2515690x19828325.
15. Morishima T, Miyashiro I, Inoue N, Kitasaka M, Akazawa T, Higeno A, Idota A, Sato A, Ohira T, Sakon M *et al*: **Effects of laughter therapy on quality of life in patients with cancer: An open-label, randomized controlled trial.** *PLoS One* 2019, **14**(6):e0219065.
16. Puciato D, Borysiuk Z, Rozpara M: **Quality of life and physical activity in an older working-age population.** *Clinical interventions in aging* 2017, **12**:1627-1634.
17. Brown RP, Gerbarg PL: **Yoga breathing, meditation, and longevity.** *Ann N Y Acad Sci* 2009, **1172**:54-62.

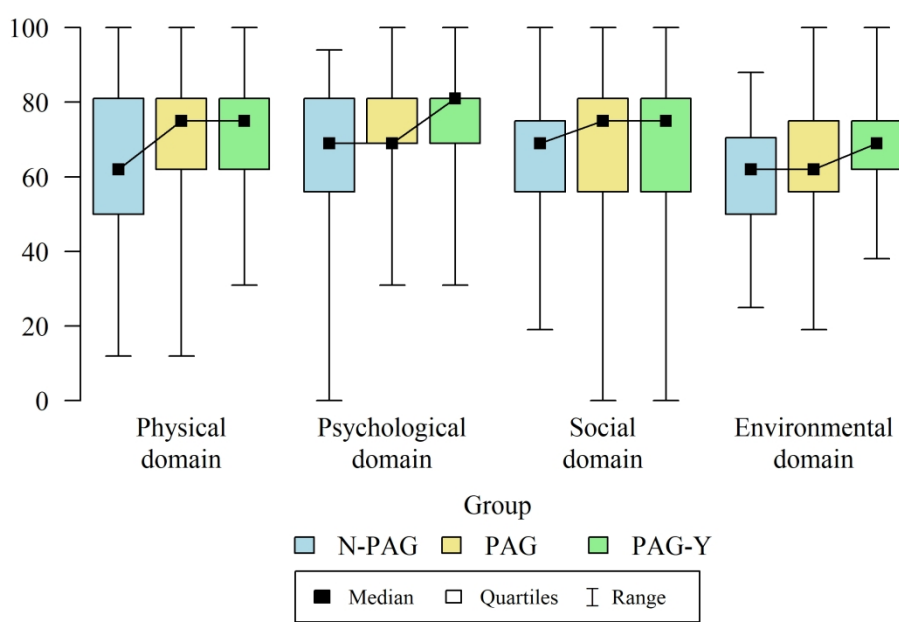
18. Weber M, Schnorr T, Morat M, Morat T, Donath L: **Effects of Mind-Body Interventions Involving Meditative Movements on Quality of Life, Depressive Symptoms, Fear of Falling and Sleep Quality in Older Adults: A Systematic Review with Meta-Analysis.** *Int J Environ Res Public Health* 2020, **17**(18).
19. Telles S, Gupta RK, Kumar A, Pal DK, Tyagi D, Balkrishna A: **Mental Wellbeing, Quality of Life, and Perception of Chronic Illness in Yoga-Experienced Compared with Yoga-Naïve Patients.** *Med Sci Monit Basic Res* 2019, **25**:153-163.
20. Brinsley J, Schuch F, Lederman O, Girard D, Smout M, Immink MA, Stubbs B, Firth J, Davison K, Rosenbaum S: **Effects of yoga on depressive symptoms in people with mental disorders: a systematic review and meta-analysis.** *British Journal of Sports Medicine* 2021, **55**(17):992-1000.
21. Salvado M, Marques DL, Pires IM, Silva NM: **Mindfulness-Based Interventions to Reduce Burnout in Primary Healthcare Professionals: A Systematic Review and Meta-Analysis.** *Healthcare (Basel)* 2021, **9**(10).
22. Satin JR, Linden W, Millman RD: **Yoga and psychophysiological determinants of cardiovascular health: comparing yoga practitioners, runners, and sedentary individuals.** *Ann Behav Med* 2014, **47**(2):231-241.
23. Rathore M, Abraham J: **Implication of Asana, Pranayama and Meditation on Telomere Stability.** *Int J Yoga* 2018, **11**(3):186-193.
24. Cheema BS, Marshall PW, Chang D, Colagiuri B, Machliss B: **Effect of an office worksite-based yoga program on heart rate variability: a randomized controlled trial.** *BMC Public Health* 2011, **11**:578.
25. Kmiecik A BD, Plominski A,: **The level of mood regulation in practicing hatha yoga in the background of people who do not practice this physical activity.** *Physi Act Rev* 2020, **8**(1):8.
26. Yadav R, Yadav RK, Pandey RM, Upadhyay AD: **Predictors of Health-Related Quality of Life in Indians with Metabolic Syndrome Undergoing Randomized Controlled Trial of Yoga-Based Lifestyle Intervention vs Dietary Intervention.** *Behav Med* 2021, **47**(2):151-160.
27. Jaracz K, Kalfoss M, Gorna K, Baczyk G: **Quality of life in Polish respondents: psychometric properties of the Polish WHOQOL-Bref.** *Scand J Caring Sci* 2006, **20**(3):251-260.
28. Jang Y, Hsieh CL, Wang YH, Wu YH: **A validity study of the WHOQOL-BREF assessment in persons with traumatic spinal cord injury.** *Arch Phys Med Rehabil* 2004, **85**(11):1890-1895.
29. Skevington SM: **Advancing cross-cultural research on quality of life: observations drawn from the WHOQOL development. World Health Organisation Quality of Life Assessment.** *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation* 2002, **11**(2):135-144.
30. Pluto-Pradzynska A: **Man Has Always Been in Motion and Seems to Be Created for Movement: Can Everyday Life in Balance Reverse the Process of Ageing?** *J of Nursing and Health Studies* 2019, **4**(1:4):5.
31. Strijk JE, Proper KI, van der Beek AJ, van Mechelen W: **A worksite vitality intervention to improve older workers' lifestyle and vitality-related outcomes: results of a randomised controlled trial.** *J Epidemiol Community Health* 2012, **66**(11):1071-1078.
32. Gomenuka NA, Oliveira HB, Silva ES, Costa RR, Kanitz AC, Liedtke GV, Schuch FB, Peyre-Tartaruga LA: **Effects of Nordic walking training on quality of life, balance and functional mobility in elderly: A randomized clinical trial.** *PLoS One* 2019, **14**(1).
33. Song C, Ikei H, Park BJ, Lee J, Kagawa T, Miyazaki Y: **Psychological Benefits of Walking through Forest Areas.** *Int J Environ Res Public Health* 2018, **15**(12).
34. Alaimo K, Beavers AW, Crawford C, Snyder EH, Litt JS: **Amplifying Health Through Community Gardens: A Framework for Advancing Multicomponent, Behaviorally Based Neighborhood Interventions.** *Current environmental health reports* 2016, **3**(3):302-312.

- 1  
2  
3 35. Rostami K, Ghodsbin F: **Effect of Yoga on the Quality of Life of Nurses Working in Intensive Care Units. Randomized Controlled Clinical Trial.** *Invest Educ Enferm* 2019, **37**(3).
- 4  
5  
6 36. Kettunen O, Kyrolainen H, Santtila M, Vasankari T: **Physical fitness and volume of leisure time physical activity relate with low stress and high mental resources in young men.** *J Sports Med Phys Fitness* 2014, **54**(4):545-551.
- 7  
8  
9 37. Li D, Tsui MCM, Zhang G: **Evidence-Based Clinical Application of Yoga for Stress Management.** *Journal of Yoga & Physical Therapy* 2016, **6**:1-1.
- 10  
11 38. WHO: **"Global Recommendations on Physical Activity for Health"**; 2010.
- 12  
13 39. Cirillo J, Finch JB, Anson JG: **The impact of physical activity on motor preparation in young adults.** *Neuroscience letters* 2017, **638**:196-203.
- 14  
15  
16  
17  
18

### 19 **Figure Legends**

20  
21 Figure 1. Presentation of quality of life (QOL) in the WHOQOL-bref domains researched  
22  
23 groups.  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



404x258mm (157 x 157 DPI)

## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1&3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
<b>Introduction</b>			
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	4-5
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5-6
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
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	5-6
Bias	9	Describe any efforts to address potential sources of bias	5-6
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5-6
		(b) Describe any methods used to examine subgroups and interactions	5-6
		(c) Explain how missing data were addressed	5-6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	5-6
		(e) Describe any sensitivity analyses	5-6

Continued on next page

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60**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	7-12
		(b) Give reasons for non-participation at each stage	7-12
		(c) Consider use of a flow diagram	7-12
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-12
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
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	7-12
		(b) Report category boundaries when continuous variables were categorized	7-12
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7-12
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7-12

**Discussion**

Key results	18	Summarise key results with reference to study objectives	12-14
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	12-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-14

**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	15
---------	----	---	----

\*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](http://www.strobe-statement.org).



# BMJ Open

## Are yoga and physical activity determinants of quality of life in Polish adults? A cross-sectional study.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-059658.R2
Article Type:	Original research
Date Submitted by the Author:	22-Aug-2022
Complete List of Authors:	<p>Pluto-Pradzynska, Agnieszka; Poznan University of Medical Sciences, Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland</p> <p>Pluto-Pradzynska, Karolina; Poznan University of Medical Sciences, Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland;</p> <p>Adam Mickiewicz University, Department of Pedagogy</p> <p>Frydrychowicz, Magdalena; Poznan University of Medical Sciences, Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland</p> <p>Lagiedo-Zelazowska, Malgorzata; Poznan University of Medical Sciences, Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland</p> <p>Owoc, Jakub; Poznan University of Medical Sciences, Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland</p> <p>Benjamin, Shamiram; Poznan University of Medical Sciences, Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland</p> <p>Au, Tsz Yuen; Poznan University of Medical Sciences, Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland</p> <p>Jaracz, Krystyna; Poznan University of Medical Sciences, Department of Neurological Nursing, Poznan University of Medical Sciences, Poznan, Poland</p> <p>Dworacki, Grzegorz; Poznan University of Medical Sciences, Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan University of Medical Sciences, Poznan, Poland</p> <p>Wysocki, Jacek; Poznan University of Medical Sciences, Department of Health Prevention</p> <p>Wasik, Jacek; Akademia im Jana Długosza w Częstochowie, Faculty of Health Sciences</p>
<b>Primary Subject Heading</b>:	Complementary medicine
Secondary Subject Heading:	Complementary medicine, Sports and exercise medicine
Keywords:	Public health < INFECTIOUS DISEASES, EDUCATION & TRAINING (see Medical Education & Training), MENTAL HEALTH, Immunology < NATURAL SCIENCE DISCIPLINES, QUALITATIVE RESEARCH, SPORTS

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

	MEDICINE

SCHOLARONE™  
Manuscripts





I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3 **Are yoga and physical activity determinants of quality of life in**  
4  
5 **Polish adults? A cross-sectional study.**  
6  
7  
8  
9

10 Agnieszka Pluto-Pradzynska<sup>1</sup>, Karolina Pluto-Pradzynska<sup>1,2</sup>, Magdalena Frydrychowicz<sup>1</sup>,  
11 Malgorzata Lagiedo-Zelazowska<sup>1</sup>, Jakub Owoc<sup>1</sup>, Shamiram Benjamin<sup>1</sup>, Tsz Yuen Au<sup>1</sup>,  
12 Krystyna Jaracz<sup>3</sup>, Grzegorz Dworacki<sup>1</sup>, Jacek Wysocki<sup>4</sup>, Jacek Wasik<sup>5</sup>  
13  
14

15  
16  
17 <sup>1</sup>Department of Immunology, Chair of Pathomorphology and Clinical Immunology, Poznan  
18 University of Medical Sciences, Poznan, Poland  
19

20  
21 <sup>2</sup>Department of Pedagogy, Adam Mickiewicz University Poznan, Poland  
22

23 <sup>3</sup>Department of Neurological Nursing, Poznan University of Medical Sciences, Poznan,  
24 Poland  
25

26  
27 <sup>4</sup>Department of Health Prevention, Poznan University of Medical Sciences, Poznan, Poland  
28

29 <sup>5</sup>Faculty of Health Sciences, Jan Dlugosz University, Czestochowa, Poland  
30  
31

32  
33  
34 Correspondence to:

35  
36 **Dr Agnieszka Pluto-Pradzynska**; ORCID: 0000-0002-6402-7857  
37

38 Department of Pathomorphology and Clinical Immunology, Poznan University of Medical  
39 Sciences  
40

41  
42 ul. Rokietnicka 5d, 60-806 Poznan, Poland  
43

44 Email: [agapp@ump.edu.pl](mailto:agapp@ump.edu.pl)  
45

46 Tel: +48 618 547 174  
47

48 Fax: +48 618 547 173  
49

50  
51  
52 Abstract word count: 270  
53

54 Paper word count: 3491  
55

56  
57  
58 What is already known on the subject?  
59  
60

1  
2  
3 It is well-documented across many populations that physical activity plays a preventive role  
4 against aging, morbidity, disability, and the development of disease. However, there is  
5 insufficient evidence showing the relationship between yoga and quality of life in Polish  
6 adults.  
7  
8

9 What this study adds:

10  
11 This study found higher quality of life levels in a group of Polish citizens who performed yoga  
12 as part of physical activity than in those who were not physically active, as well as those who  
13 participated in physical activity other than yoga.  
14  
15  
16

## 17 **ABSTRACT**

18  
19  
20 **Objectives:** Yoga is an ancient form of physical activity (PA) that encompasses meditation,  
21 stretching, and breathing techniques. Although the benefits of PA and associated lifestyle  
22 interventions are clear, we here addressed the paucity of evidence regarding the specific  
23 relationship between yoga and quality of life (QOL) in adults in Poland. We hypothesized that  
24 participation in PA and yoga could result in a positive impact on QOL.  
25  
26  
27  
28  
29

30  
31 **Design:** Cross-sectional, self-administered questionnaire-based survey. Both the  
32 quantitative and qualitative variables were statistically compared. Multivariate analyses were  
33 performed using linear regression. Results were determined based on age, sex, and  
34 education level;  $p < 0.05$  was considered significant.  
35  
36  
37  
38

39  
40 **Setting:** Questionnaires were delivered to participants **online**, at high schools and  
41 universities, and in elderly communities in Poland.  
42

43  
44 **Participants:** 714 polish citizens aged over 18 participated in the study; there are no specific  
45 entry and exclusion criteria besides age.  
46

47  
48 **Results:** Statistically significant differences ( $p < 0.05$ ) were observed between the QOL of  
49 the physically active group (PAG) and non-physically active group (N-PAG). Meanwhile,  
50 yoga practice was revealed to have a significant effect on QOL; QOL was found to be  
51 statistically higher ( $p < 0.001$ ) in the physically active group with yoga (PAG-Y) ( $4.29 \pm 0.66$ )  
52 than in the N-PAG ( $3.83 \pm 0.92$ ) and PAG without yoga ( $4.07 \pm 0.68$ ).  
53  
54  
55  
56

57  
58 **Conclusions:** The study shows that both regular PA and yoga practices could improve QOL;  
59 however, PAG-Y produced higher QOL scores than PA of other types. This outcome may be  
60

1  
2  
3 explained by the impact of physiological and psychological aspects within yoga practice.

4  
5 These results suggest that this unique combination impacts health more positively than other  
6  
7 kinds of PA alone.  
8  
9

10  
11 **Keywords:** lifestyle, health prevention, mindfulness, stress, health education  
12  
13

### 14 15 **Strength and limitation**

- 16  
17 - This study is one of the first to evaluate how physical activity and yoga practice may  
18 affect QOL of Polish citizens.
- 19  
20 - Using online questionnaires permitted increased diversity and inclusion of a greater  
21 number of participants.
- 22  
23 - It was a cross-sectional study; therefore, it cannot be definitively concluded that the  
24 relationship between yoga and quality of life was of a cause-and-effect nature.
- 25  
26 - This study was conducted on a voluntary response sample, which may have  
27 contributed to a potential inclusion bias of those self-selected only, omitting the rest of  
28 the population.
- 29  
30 - Some elderly participants were surveyed via traditional structured interviews due to  
31 lack of access to online surveys.  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44

### 45 **INTRODUCTION**

46  
47 Regular physical activity (PA) is an important factor in physiological growth, the  
48 development and maintenance of the central nervous system, as well as in general health,[1].  
49  
50 A myriad of well-respected organizations, healthcare providers, and political establishments  
51 maintain recommendations of regular leisure and recreational PA for the sake of public  
52 health and as preventive medicine,[2]. Additionally, published evidence supports the positive  
53 impact of a balanced diet and PA, associated with social education, in the prevention and  
54 treatment of disease,[3, 4].  
55  
56  
57  
58  
59  
60

1  
2  
3 Nevertheless, in 2018 insufficient PA levels were confirmed in global surveys,[5].  
4  
5 Additionally, the European Union reported that only about half of Europeans exercise or  
6  
7 play sports, of which only 7% do it regularly, with the remaining 46% reporting that they  
8  
9 never participate in PA. This report emphasized individual health benefits and a decrease  
10  
11 in both social and economic costs achieved through PA implementation,[6]. In Poland, the  
12  
13 government promotes increase of PA, in order to reduce deaths due to lifestyle-related  
14  
15 diseases,[7]. Improving PA lifestyle efficiency can pay dividends in terms of both individual  
16  
17 and public health,[8]. Previous studies confirmed better well-being due to lifestyle  
18  
19 enhancements like yoga intervention combined with physical training in an industry worker  
20  
21 group,[9].  
22  
23

24 Lifestyle enhancement may include exercise, nutrition, behavioral changes, and self-  
25  
26 care, which involve all levels of collaborative medical education,[4]. This concept is  
27  
28 ascribable to the ancient Greek physician and philosopher, Hippocrates of Kos (c. 460 BC to  
29  
30 370 BC) who proclaimed: “Let food be medicine” and “Exercise is medicine,” and was  
31  
32 recognized as the first practitioner who prescribed exercise in treating diseases linked to  
33  
34 obesity and sedentary living,[10].  
35  
36

37 The World Health Organization (WHO) defined QOL as “an individual’s perception of  
38  
39 their position in life in the context of the culture and value systems in which they live and in  
40  
41 relation to their goals, expectations, standards, and concerns”,[11]. Some studies on QOL,  
42  
43 including those conducted in Poland,[12], have referred to the relationship between yoga and  
44  
45 disease-related QOL,[13], whereas others have discussed health-related QOL in cancer  
46  
47 treatment and therapy,[14, 15], and in older adults,[16]. In most observations, higher QOL  
48  
49 scores were observed for those engaging in all types of PA than in those who did not.  
50  
51

52 Yoga is an ancient form of PA brought to the West at the end of the XIXth century. Its  
53  
54 practice encompasses meditation in conjunction with stretching and breathing  
55  
56 techniques,[17]. In addition to straightening and elongating the body, yoga increases strength,  
57  
58 flexibility, and range of motion,[1], combining physical training with conscious breathing,[18],  
59  
60 while drawing attention to the practitioner’s consciousness and psychological state,[1].

1  
2  
3 Therefore, yoga provides not only physical benefits, but also mental health benefits,[14, 19],  
4 even reducing symptoms of anxiety and depression, positively affecting mood, and reducing  
5 stress,[14, 20]. Special types of yoga, such as laughter yoga, may benefit everyone,  
6 including patients with cancer,[15]. Yoga offers effective exercises to intensify cognitive and  
7 behavioral factors for learning, concentration, and achievement, and can be used to mitigate  
8 the risk of burnout,[15, 21]. A combination of yoga and aerobic exercise has been shown to  
9 reduce mental, physical, and vascular stress in cardiovascular diseases,[22]. Therefore, both  
10 yoga and mindfulness may be significant factors for lifestyle change interventions,[23]. Yoga  
11 also offers promise as a preventive health intervention,[24], in supplementation to the  
12 management of symptoms and conditions,.

13  
14 The system of yoga encompasses specific exercises, with results augmented by a  
15 skilled teacher,[25]. It often involves holding positions for increasing amounts of time. It can  
16 be readily implemented in the workplace to reduce burnout symptoms and stress levels,[21],  
17 and prevent pain back associated with prolonged sitting,[24]. A special yogic type of  
18 breathing, known as pranayama,[17], leads to the development of self-control and  
19 mindfulness,[1]. Additionally, yoga, meditation, and pranayama practice have been shown to  
20 increase the stability of telomeres by stimulating telomerase activity, which inhibits aging  
21 processes and protects against certain diseases,[23], including cancer,[17]. Using tools of  
22 positive psychology like yoga practice or even laughter therapy can stimulate the thinking  
23 processes and communication skills of individuals,[15].

24  
25 In Poland, data on yoga among adults in different age groups, which could represent  
26 a wider cross-section of society, are lacking[26]. Although yoga has been practiced in Poland  
27 for many years, it has never been widely accepted and many Polish citizens have never tried  
28 yoga at all; some skepticism likely stems from popular Catholic Church doctrine which frowns  
29 upon the activity's ties to Jainism, Buddhism, Hinduism, and other non-Christian faiths,[27].

30  
31 Even if not every book on yoga promotes Hindu gods, and not every yoga class  
32 has pagan statuary, some do, and this concern was voiced in the "Letter to the bishops of  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 the Catholic Church of some aspects of Christian meditation”,[28]. The impact of religious  
4 beliefs was observed in the willingness to integrate complementary and alternative  
5 therapies into a treatment program, too,[29, 30]. Therefore, the positive impact of yoga on  
6 health may need to be recognized and promoted, regardless of religious affiliations,[19].  
7  
8 Thus, in this study we sought to investigate the effects of yoga on QOL relative to the effects  
9 of physical activity without components of yoga,[26, 31].  
10  
11  
12  
13  
14  
15  
16  
17

## 18 **METHODS**

### 19 **Patient and public involvement**

20 Patients and/or the public were not involved in the design, conduct, reporting, or  
21 dissemination plans of this research.  
22

23 The survey was conducted in April, May, and June of 2017.  
24  
25  
26  
27  
28  
29  
30

### 31 **Ethics approval**

32 The study protocol was reviewed by the Bioethics Committee of the Poznan University of  
33 Medical Sciences (Resolution No.1263/18), which decreed that the study does not have the  
34 characteristics of a medical experiment and does not require approval from the Bioethics  
35 Committee.  
36  
37  
38  
39  
40  
41  
42  
43

### 44 **Participants**

45 This study included a sample (n = 714) of Polish adults ( $\geq$  18-years-old), comprised of 46%  
46 men and 54% women. Respondents were recruited through Internet advertisements, at high  
47 schools and universities, and in elderly communities. The following groups were composed  
48 and compared to each other: control group (N-PAG, n = 72), PA group (PAG, n = 642), and  
49 PA with yoga group (PAG-Y; n = 151). There were differences between groups in sex, age,  
50 and educational level.  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Survey

Quality of life was evaluated using the World Health Organization's (WHO) standardized questionnaire (WHOQOL - BREF), which is a short-version questionnaire approved for use in many countries including Poland,[16, 32, 33]. It is dedicated to the study of the QOL of adults, with respect to individual perceptions,[34]. The WHOQOL-BREF contains 26 items, 24 of which use a scale of 1–100 (min–max), pertaining to four domains of QOL that are incorporated into specified facets. These domains include the following: The Physical health domain (PHD-QOL) includes items on activities of daily living, dependence on medicinal substances and medical aids, energy and fatigue, mobility, pain and discomfort, sleep and rest, and work capacity; the Psychological domain (PD-QOL) includes questions on body image and appearance, negative feelings, positive feelings, self-esteem, spirituality/religion/personal beliefs, thinking, learning, memory, and concentration; the Social domain (SD-QOL) addresses personal relationships, social support, and sexual activity; the Environmental domain (ED-QOL) investigates financial resources, freedom, physical safety and security, health and social care (accessibility and quality), home environment, opportunities for acquiring new information and skills, participation in and opportunities for recreation/leisure activities, physical environment (pollution/noise/traffic/climate), and transport. Two items are examined separately, with a scale of 1–5 (min–max), and ask about an individual's overall perception of QOL and health (HP),[11].

The respondents were asked about participation in the listed PAs (swimming, long or intensive walking, cycling, jogging, riding, gym/fitness, tennis/squash/badminton, gardening, yoga, and 'others'). They were asked to select the frequency of participation in the activity from among the following: none; 1–3 hours per month; 1, 1–3 h, or > 3 hours/week. Additionally, the period of yoga practice was matched in years: < 1, 1–3, 3–5, 5–10, or ≥ 10 years.

## Statistical analysis



Qualitative variables were compared among the groups using the chi-square test (with Yates' correction for 2×2 tables) or the Fisher's exact test where low expected frequencies appeared in the tables. Quantitative variables in the three groups were compared using the Kruskal–Wallis test. After detecting statistically significant differences, post-hoc analysis was performed with Dunn's test to identify statistically significant differences between groups. Multivariate analysis of the influence of a number of factors (age, sex, and education) on the quantitative variables was performed using linear regression. The results are presented as regression model parameter values with a 95% confidence interval (95%CI). A significance level of 0.05 was adopted in the analysis, and all p values < 0.05 were interpreted as showing significant relationships. The analysis was performed using R version 4.1.0. (R Core Team, 2021. R Foundation for Statistical Computing, Vienna, Austria, <https://www.R-project.org/>).

## RESULTS

### Group constitution

The entire sample consisted of 714 participants. Twice as many women as men declared a non-physically active lifestyle, and nearly three times more women than men practiced yoga (females 73.51%, males 26.49%). In the N-PAG, middle-aged adults (35–55-years-old) predominated (52.78%), whereas 36.11% were young adults (< 35-years-old). In the PAG, young adults predominated (50.71%), while middle-aged adults comprised one-third of this group (32.79%). In the PAG-Y prevailed middle-aged individuals (49.67%), as compared to young adults (39.07%), while 11.26% were older adults (> 55-years-old). In terms of education level, the majority of each group were individuals with a university degree (Table 1).

Table 1. Composition of the research groups.

Parameters	Groups
------------	--------

		<b>N-PAG (n = 72)</b>	<b>PAG (n = 491)</b>	<b>PAG-Y (n = 151)</b>	<b>P</b>
Sex	Females	47 (65.28%)	228 (46.44%)	111 (73.51%)	p<0.001
	Males	25 (34.72%)	263 (53.56%)	40 (26.49%)	
Age	18–35 years	26 (36.11%)	249 (50.71%)	59 (39.07%)	p<0.001
	36–55 years	38 (52.78%)	161 (32.79%)	75 (49.67%)	
	> 55 years	8 (11.11%)	81 (16.50%)	17 (11.26%)	
Education	Primary	1 (1.39%)	4 (0.81%)	1 (0.66%)	p = 0.001
	Secondary	17 (23.61%)	149 (30.35%)	22 (14.57%)	
	Post-secondary	12 (16.67%)	93 (18.94%)	17 (11.26%)	
	University	34 (47.22%)	190 (38.70%)	89 (58.94%)	
	Postgraduate	8 (11.11%)	55 (11.20%)	22 (14.57%)	

p-values were obtained by the chi-squared or exact Fisher's test

The mean QOL perception in the researched population was good (4.09 points on a 1–5 point scale; SD = 0.7), as was the level of HP (3.83 points on a 1–5 scale; SD = 0.82). Across the domains, the highest mean level of QOL perception was in the PD-QOL, which was only 1.03 points higher than that of the PHD-QOL, while the SD-QOL had a mean value of 70.23. The lowest perception of QOL was observed in the ED-QOL (Table 2).

Table 2. Quality of life scores according to the WHOQOL- BREF domains.

<b>WHOQOL-BREF</b>	<b>N</b>	<b>Mean</b>	<b>±SD</b>	<b>Median</b>	<b>Min</b>	<b>Max</b>	<b>Q1</b>	<b>Q3</b>
Physical domain	714	71.58	14.74	75	12	100	62	81
Psychological domain	714	72.61	14.07	75	0	100	69	81
Social domain	714	70.23	17.42	75	0	100	56	81

WHOQOL-BREF	N	Mean	±SD	Median	Min	Max	Q1	Q3
Environmental domain	714	65.24	13.65	62	19	100	56	75

Given the differences in the QOL between the observed groups, the results indicated that PA could be linked to an improved QOL. In all four domains of the WHOQOL - BREF, the QOL was statistically significantly higher ( $p < 0.05$ ) in both PA groups (PAG and PAG-Y) than in the N-PAG.

Yoga practice was an important predictor of QOL, which was significantly higher ( $p < 0.001$ ) in the PAG-Y than in the N-PAG and PAG only. The same association was observed in three separate domains: PHD-QOL, PD-QOL, and ED-QOL ( $p < 0.001$ ). Similar results were obtained for HP ( $p < 0.003$ ; Table 3, Figure 1).

Table 3. Presentation of QOL and HP, and QOL according to WHOQOL - BREF domains in each of the researched groups.

WHOQOL-BREF ITEMS		Groups			p
		N-PAG	PAG	PAG-Y	
Quality of life perception	Mean ± SD	3.83 ± 0.92	4.07 ± 0.68	4.29 ± 0.66	$p < 0.001$
	Median	4	4	4	
	Quartiles	3–4	4–4	4–5	PAG-Y > PAG, N-PA
Health perception	Mean ± SD	3.56 ± 0.95	3.86 ± 0.78	3.89 ± 0.87	$p = 0.003$
	Median	4	4	4	
	Quartiles	3–4	4–4	4–4	PAG-Y, PAG > N-PA
Physical	Mean ± SD	64.24 ± 17.88	71.78 ± 14.21	74.42 ± 13.7	$p < 0.001$ *

1						
2						
3	domain	Median	62	75	75	
4						
5		Quartiles	50–81	62–81	62–81	PAG-Y > PAG > N-PA
6						
7		Mean ± SD	66.31 ± 17.92	72.55 ± 13.09	75.79 ± 14.16	p < 0.001 *
8						
9						
10	Psychological	Median	69	69	81	
11						
12	domain					
13		Quartiles	56–81	69–81	69–81	PAG-Y > PAG > N-
14						PAG
15						
16		Mean ± SD	65.96 ± 18.18	70.76 ± 16.66	70.58 ± 19.21	p = 0.021 *
17						
18						
19	Social domain	Median	69	75	75	
20						
21		Quartiles	56–75	56–81	56–81	PAG, PAG-Y > N-
22						PAG
23						
24		Mean ± SD	60.96 ± 14.38	64.85 ± 13.5	68.57 ± 13.12	p < 0.001 *
25						
26						
27	Environmental	Median	62	62	69	
28						
29	domain					
30		Quartiles	50–70.5	56–75	62–75	PAG-Y > PAG > N-
31						PAG
32						

p - Kruskal–Wallis test + post-hoc analysis (Dunn's test)

### Linear regression

The multivariate linear regression model, adjusted for age, sex, and education, showed that PA was a significant ( $p < 0.05$ ), independent predictor of both QOL and HP. The perception of QOL in the PAG was on average 0.25 points higher than that in the N-PAG, with a regression parameter of 0.25. The regression parameter for PAG-Y was 0.46, while the QOL perception of PAG-Y was on average 0.46 points higher than in the N-PAG.

In HP the regression parameter in the PAG was 0.309 and in PAG-Y it was 0.352. It showed higher QOL and HP in those groups than in N-PAG. The value of the regression parameter in each of the four WHOQOL - BREF domains presented yoga and other PA as statistically significant parameters that improved QOL. Similarly, the addition of yoga practice to PA resulted in a nearly doubled regression parameter in PD-QOL (9.786) in relation to N-PAG, when compared to PAG and N-PAG (5.905). Only the SD-QOL regression parameter

level, in relation to N-PAG, had similar scores in both groups with a slightly higher score (5.303) in the PAG than in the PAG-Y (5.076) (Table 4).

Table 4. Results of linear regression analysis in the observed groups.

WHOQOL-BREF ITEMS	Group	Regression parameter*	95%CI		p
Quality of life perception	N-PAG	Ref.			
	PAG	0.25	0.074	0.426	0.005
	PAG-Y	0.46	0.262	0.658	<0.001
Health perception	N-PAG	Ref.			
	PAG	0.309	0.107	0.512	0.003
	PAG-Y	0.352	0.125	0.58	0.002
Physical domain	N-PAG	Ref.			
	PAG	7.54	3.932	11.148	<0.001
	PAG-Y	10.305	6.247	14.362	<0.001
Psychological domain	N-PAG	Ref.			
	PAG	5.905	2.432	9.378	0.001
	PAG-Y	9.786	5.88	13.692	<0.001
Social domain	N-PAG	Ref.			
	PAG	5.303	0.951	9.654	0.017
	PAG-Y	5.076	0.182	9.97	0.042
Environmental	N-PAG	Ref.			

domain	PAG	4.313	0.944	7.682	0.012
	PAG-Y	7.29	3.501	11.078	<0.001

---

## DISCUSSION

In this study we evaluated the specific relationship between yoga and QOL in a relatively large (n=714) group of Polish adults. The study relied on Internet surveys delivered online, at high schools and universities, and in elderly communities.

There were differences between groups in sex, age, and educational level. We found that QOL measured with the WHOQOL - BREF was higher in participants whose PA included yoga, than in those who did not perform PA, as well as in those who practiced PA other than yoga. QOL was measured holistically, accounting for satisfaction with health and three out of four WHOQOL - BREF domains. These results are in line with previous studies confirming statistically significant differences in the QOL of individuals who participate in PA and PA with yoga, as compared to those who do not participate in PA,[34]. Results seem attributable to the specific physiological and psychological benefits of yoga training,[1, 35]. In adulthood, when movement is limited due to both technical inventions and a sedentary lifestyle,[36], suitable PA can assist in preventing diseases,[37], and spine and back pain,[38]. In everyday activities, ordinary PA may include walking,[38], cycling, gardening, and short periods of calisthenics.[8] The physical and social aspects of gardening and walking in the forest elicit multifactorial positive health effects,[39], correlated with meaningful human relationships, constituting a part of SD-QOL, with higher scores for QOL,[40]. In correlation with the PHD-QOL of the WHOQOL- BREF, PA results in greater mobility, increased energy, better study and work capacity,[16], better sleep and rest, reduced pain, and diminished dependence on medical care,[11]. For example, young industrial workers who performed morning physical training combined with yoga in the evening for 3 months

1  
2  
3 achieved more beneficial psychological effect than did another group who did not include  
4  
5  
6 yoga,[9]. For aging populations, increasing mobility, without over-training, positively  
7  
8 influences health and assists individuals in achieving daily goals,[41]. Yoga is thus  
9  
10 particularly valuable for elderly populations, for whom other forms of PA may be too  
11  
12 strenuous. The efficacy of a yogic and physically active lifestyle pays dividends for both  
13  
14 individual and public health.  
15  
16  
17

### 18 **Psychological impacts of PA**

19  
20 A range of biological benefits have been linked to PA, yet yoga in particular confers  
21  
22 unique psychological benefits for practitioners of all ages and ability levels.  
23

24  
25 Participation in PA has been shown to improve QOL and HP,[42], awaken one's  
26  
27 consciousness, assist in maintaining a life–work balance,[3, 39], and provide relaxation,[43].  
28  
29 The American College of Sports Medicine launched “The Global Initiative” to encourage  
30  
31 physicians, healthcare professionals, and educators to promote exercise to ultimately  
32  
33 prevent, reduce, manage, or treat diseases that impact health and QOL in humans,[10].  
34  
35 Given the results of the current study, the implementation of yoga could address similar  
36  
37 biological parameters-while also potentially yielding positive effects on psychological  
38  
39 parameters,[15, 43], as yoga practice is associated with better mental health outcomes and  
40  
41 decreased severity of depressive symptoms,[20]. Yoga is also recommended for cancer  
42  
43 patients, as a means to improve physical and mental health,[14], and may be also  
44  
45 considered as a supplementary cancer treatment since it may improve therapy  
46  
47 outcomes,[44], in agreement with patient’s beliefs,[30]. It is further considered a form of  
48  
49 rehabilitation for patients at cardiovascular risk,[22] and for patients with type 2 diabetes,[45].  
50  
51 Specifically, WHOQOL – BREF related to PD-QOL, measured body image and appearance,  
52  
53 personal beliefs, self-esteem, feelings, thinking, learning, memory, and concentration. These  
54  
55 parameters may be improved with regular yoga practice, which positively shapes QOL and  
56  
57  
58  
59  
60

1  
2  
3 HP,[41]. The present study showed the benefits of yoga practice on QOL and in three of four  
4  
5 WHOQOL - BREF domains.  
6

7 It should be taken into account that the effects of yoga may be different for each  
8  
9 practitioner and depend not only on one's age, flexibility, frequency of training, and years of  
10  
11 practice, but also on access to a skilled teacher,[25].  
12

13 Considering the general population, this study supports yoga as a practice that may  
14  
15 potentially offer substantial physical and psychological benefit, even in patients with limited  
16  
17 physical capacity for PA. In cases where individuals do not prefer yoga practice, the addition  
18  
19 of a contemplative aspect to regular PA, using techniques found in yoga, like prayer,  
20  
21 breathing exercises, or daily mindfulness meditation,[18], may offer significant benefits to  
22  
23 physical and psychological wellbeing and to overall QOL,[19].  
24  
25

26 Limitations of this study revolve around its limited generalizability. The participants  
27  
28 selected all come from Poland and consisted of Polish adults, as WHOQOL – BREF protocol  
29  
30 advises, which limits the scalability. However, there is no prior yoga study of a group of this  
31  
32 size, yet statistical significance was achieved nonetheless. Future studies could be done to  
33  
34 include more diverse populations/nationalities, with comparison between different  
35  
36 educational backgrounds and socio-economic status. Additionally, future cohort studies could  
37  
38 be performed in order to better understand the relationship between PA and QOL.  
39  
40

41 The public should be encouraged to note that decreasing QOL may be associated  
42  
43 with insufficient PA in leisure time,[46]. Given the social responsibility to safeguard and  
44  
45 promote public health, it is worth noting that the integration of scholars and students into  
46  
47 interdisciplinary, and sport-based teams,[2], may serve as an innovative solution to promote  
48  
49 health; this study shows that yoga may provide similar benefits, albeit enhanced in  
50  
51 comparison,[47]. In conclusion it can be stated that in order to achieve and maintain optimal  
52  
53 physical and psychological health,[17], people should be motivated from an early age by  
54  
55 family's members, teachers and healthcare professionals to live physically active lives,  
56  
57 particularly through meditative PA such as yoga,[36].  
58  
59  
60



## CONCLUSIONS

The results of the observed groups of Polish adults showed that yoga practice might have greater beneficial effects on QOL than non-yogic PA alone. Nevertheless physically active individuals, regardless of their chosen activities, have higher QOL parameters than N-PAG. Taking into account the limitations of the study, these conclusions could be confirmed by further investigations employing a broader representative sample and more rigorous research design.

Historically, and especially as a result of the recent COVID-19 pandemic, there is a critical need to promote a healthy lifestyle within the population and reduce the prevalence of conditions that may place the general public at risk. Overall, the results of the present study, coupled with existing literature, illustrate that yoga may be a powerful and inexpensive tool to promote healthier living and greater QOL within aging societies. These findings are especially important for elderly populations since health care costs dramatically increase with age. So promoting PA in general, supplemented by elements of yoga, would be beneficial to introduce in the lifestyle from an early age. Further investigations on this topic could be conducted in order to enhance the observed relationships.

## Acknowledgments

We would like to acknowledge and thank all study participants as well as the Editage Team and Mr. Douglas A. Neagoy for their contribution to this manuscript.

## Contributorship statement

AP-P conceived of the study. AP-P, KP-P, and GD initiated the study design and SB, TA, J.Wysocki and J.Wasik helped with implementation. MF, ML, JO collected the data and KJ helped with analyzing statistical results. AP-P and GD are grant holders. KJ, GD, J.Wysocki and J.Wasik as mentors supported in substantive scientific knowledge. All authors contributed to refinement of the study protocol and approved the final manuscript.

## Competing interests

No conflicts of interest

## Funding

Poznan University of Medical Sciences supported this study,

## Data availability statement

All data relevant to the study are included in the article or uploaded as supplementary information.

## References

1. Kwok JYY, Kwan JCY, Auyeung M et al: **Effects of Mindfulness Yoga vs Stretching and Resistance Training Exercises on Anxiety and Depression for People With Parkinson Disease: A Randomized Clinical Trial.** *JAMA neurology* 2019.
2. Bull FC, Al-Ansari SS, Biddle S et al: **World Health Organization 2020 guidelines on physical activity and sedentary behaviour.** *Br J Sports Med* 2020, **54**(24):1451-1462.
3. Fuzeki E, Banzer W: **Physical Activity Recommendations for Health and Beyond in Currently Inactive Populations.** *Int J Environ Res Public Health* 2018, **15**(5).
4. Polak R, Pojednic RM, Phillips EM: **Lifestyle Medicine Education.** *Am J Lifestyle Med* 2015, **9**(5):361-367.
5. Guthold RS, G.A. Riley, L.M. et al: **Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants.** *The Lancet Global health* 2018, **6**(10):e1077-e1086.
6. Commission ES: **Special Eurobarometr 472.** In. <https://sport.ec.europa.eu/news/new-eurobarometer-on-sport-and-physical-activity:EU; 2018>.
7. Ministry of Health P: **National Health Program 2016-2020.** In: *Public Health Act.* Warsaw; 2015.
8. Li X, Ghosh D: **Associations between Body Mass Index and Urban "Green" Streetscape in Cleveland, Ohio, USA.** *Int J Environ Res Public Health* 2018, **15**(10).
9. Bhat PS, Chopra V, Mehta SG et al: **Psychological benefits of yoga in industrial workers.** *Ind Psychiatry J* 2012, **21**(2):98-103.
10. Tipton CM: **The history of "Exercise Is Medicine" in ancient civilizations.** *Adv Physiol Educ* 2014, **38**(2):109-117.
11. **WHOQOL-BREF Introduction, administration, scoring and generic version of the assessment. Field Trial Version** [[http://www.who.int/mental\\_health/media/en/76.pdf](http://www.who.int/mental_health/media/en/76.pdf)]

12. Łojko D, Czajkowska A, Suwalska A et al: **Symptoms of depression among adults in rural areas of western Poland.** *Annals of agricultural and environmental medicine : AAEM* 2015, **22**(1):152-155.
13. Joshi U, Subedi R, Poudel P et al: **Assessment of quality of life in patients undergoing hemodialysis using WHOQOL-BREF questionnaire: a multicenter study.** *Int J Nephrol Renovasc Dis* 2017, **10**:195-203.
14. El-Hashimi D, Gorey KM: **Yoga-Specific Enhancement of Quality of Life Among Women With Breast Cancer: Systematic Review and Exploratory Meta-Analysis of Randomized Controlled Trials.** *Journal of evidence-based integrative medicine* 2019, **24**:2515690x19828325.
15. Morishima T, Miyashiro I, Inoue N et al: **Effects of laughter therapy on quality of life in patients with cancer: An open-label, randomized controlled trial.** *PLoS One* 2019, **14**(6):e0219065.
16. Puciato D, Borysiuk Z, Rozpara M: **Quality of life and physical activity in an older working-age population.** *Clinical interventions in aging* 2017, **12**:1627-1634.
17. Brown RP, Gerbarg PL: **Yoga breathing, meditation, and longevity.** *Ann N Y Acad Sci* 2009, **1172**:54-62.
18. Weber M, Schnorr T, Morat M et al: **Effects of Mind-Body Interventions Involving Meditative Movements on Quality of Life, Depressive Symptoms, Fear of Falling and Sleep Quality in Older Adults: A Systematic Review with Meta-Analysis.** *Int J Environ Res Public Health* 2020, **17**(18).
19. Telles S, Gupta RK, Kumar A et al: **Mental Wellbeing, Quality of Life, and Perception of Chronic Illness in Yoga-Experienced Compared with Yoga-Naïve Patients.** *Med Sci Monit Basic Res* 2019, **25**:153-163.
20. Brinsley J, Schuch F, Lederman O et al: **Effects of yoga on depressive symptoms in people with mental disorders: a systematic review and meta-analysis.** *British Journal of Sports Medicine* 2021, **55**(17):992-1000.
21. Salvado M, Marques DL, Pires IM et al: **Mindfulness-Based Interventions to Reduce Burnout in Primary Healthcare Professionals: A Systematic Review and Meta-Analysis.** *Healthcare (Basel)* 2021, **9**(10).
22. Satin JR, Linden W, Millman RD: **Yoga and psychophysiological determinants of cardiovascular health: comparing yoga practitioners, runners, and sedentary individuals.** *Ann Behav Med* 2014, **47**(2):231-241.
23. Rathore M, Abraham J: **Implication of Asana, Pranayama and Meditation on Telomere Stability.** *Int J Yoga* 2018, **11**(3):186-193.
24. Cheema BS, Marshall PW, Chang D et al: **Effect of an office worksite-based yoga program on heart rate variability: a randomized controlled trial.** *BMC Public Health* 2011, **11**:578.
25. Awan RL, E. R.: **Yoga: Safe for All?** *Mayo Clinic proceedings* 2019(94):385-387.
26. Kmiecik A, Bakota, D., Plominski, A.,: **The level of mood regulation in practicing hatha yoga in the background of people who do not practice this physical activity.** *Physi Act Rev* 2020, **8**(1):8.
27. Piotrowski MP, M. Czechyra, L: **Joga In:** <https://milujcieszepi/?s=joga>. Poland: Agape Sp zoo; 2016-2022.
28. **Letter to the bishops of the Catholic Church on some aspects of Christian meditation.**  
[[https://www.vatican.va/roman\\_curia/congregations/cfaith/documents/rc\\_con\\_cfaith\\_doc\\_19891015\\_meditazione-cristiana\\_en.html](https://www.vatican.va/roman_curia/congregations/cfaith/documents/rc_con_cfaith_doc_19891015_meditazione-cristiana_en.html)]
29. Curlin FA, Rasinski KA, Kaptchuk TJ et al: **Religion, clinicians, and the integration of complementary and alternative medicines.** *J Altern Complement Med* 2009, **15**(9):987-994.
30. Arvonio MM: **Cultural competency, autonomy, and spiritual conflicts related to Reiki/CAM therapies: Should patients be informed?** *Linacre Q* 2014, **81**(1):47-56.
31. Yadav R, Yadav RK, Pandey RM et al: **Predictors of Health-Related Quality of Life in Indians with Metabolic Syndrome Undergoing Randomized Controlled Trial**

- 1  
2  
3 **of Yoga-Based Lifestyle Intervention vs Dietary Intervention. *Behav Med* 2021,  
4 **47(2):151-160.****
- 5 32. Jaracz K, Kalfoss M, Gorna K et al: **Quality of life in Polish respondents:**  
6 **psychometric properties of the Polish WHOQOL-Bref.** *Scand J Caring Sci* 2006,  
7 **20(3):251-260.**
- 8 33. Jang Y, Hsieh CL, Wang YH et al: **A validity study of the WHOQOL-BREF**  
9 **assessment in persons with traumatic spinal cord injury.** *Arch Phys Med Rehabil*  
10 2004, **85(11):1890-1895.**
- 11 34. Skevington SM: **Advancing cross-cultural research on quality of life:**  
12 **observations drawn from the WHOQOL development.** *World Health*  
13 **Organisation Quality of Life Assessment.** *Quality of life research : an international*  
14 *journal of quality of life aspects of treatment, care and rehabilitation* 2002, **11(2):135-**  
15 **144.**
- 16 35. Ross A, Thomas S: **The health benefits of yoga and exercise: a review of**  
17 **comparison studies.** *J Altern Complement Med* 2010, **16(1):3-12.**
- 18 36. Pluto-Pradzynska A: **Man Has Always Been in Motion and Seems to Be Created**  
19 **for Movement: Can Everyday Life in Balance Reverse the Process of Ageing?** *J*  
20 *of Nursing and Health Studies* 2019, **4(1:4):5.**
- 21 37. Strijk JE, Proper KI, van der Beek AJ et al: **A worksite vitality intervention to**  
22 **improve older workers' lifestyle and vitality-related outcomes: results of a**  
23 **randomised controlled trial.** *J Epidemiol Community Health* 2012, **66(11):1071-**  
24 **1078.**
- 25 38. Gomenuka NA, Oliveira HB, Silva ES et al: **Effects of Nordic walking training on**  
26 **quality of life, balance and functional mobility in elderly: A randomized clinical**  
27 **trial.** *PLoS One* 2019, **14(1).**
- 28 39. Song C, Ikei H, Park BJ et al: **Psychological Benefits of Walking through Forest**  
29 **Areas.** *Int J Environ Res Public Health* 2018, **15(12).**
- 30 40. Alaimo K, Beavers AW, Crawford C et al: **Amplifying Health Through Community**  
31 **Gardens: A Framework for Advancing Multicomponent, Behaviorally Based**  
32 **Neighborhood Interventions.** *Current environmental health reports* 2016, **3(3):302-**  
33 **312.**
- 34 41. Rostami K, Ghodsbin F: **Effect of Yoga on the Quality of Life of Nurses Working**  
35 **in Intensive Care Units. Randomized Controlled Clinical Trial.** *Invest Educ*  
36 *Enferm* 2019, **37(3).**
- 37 42. Kettunen O, Kyrolainen H, Santtila M et al: **Physical fitness and volume of leisure**  
38 **time physical activity relate with low stress and high mental resources in young**  
39 **men.** *J Sports Med Phys Fitness* 2014, **54(4):545-551.**
- 40 43. Li D, Tsui MCM, Zhang G: **Evidence-Based Clinical Application of Yoga for**  
41 **Stress Management.** *Journal of Yoga & Physical Therapy* 2016, **6:1-1.**
- 42 44. Raghavendra MRea: **Effect of Yoga on Sleep Quality and Neuroendocrine**  
43 **Immune Response in Metastatic Breast Cancer Patients.** *Indian J Palliat Care*  
44 2017, **23(3):253-260.**
- 45 45. Bock BC, Thind H, Fava JL et al: **Feasibility of yoga as a complementary therapy**  
46 **for patients with type 2 diabetes: The Healthy Active and in Control (HA1C)**  
47 **study.** *Complement Ther Med* 2019, **42:125-131.**
- 48 46. WHO: **"Global Recommendations on Physical Activity for Health";** 2010.
- 49 47. Cirillo J, Finch JB, Anson JG: **The impact of physical activity on motor**  
50 **preparation in young adults.** *Neuroscience letters* 2017, **638:196-203.**

## Figure Legends

51  
52  
53  
54  
55  
56  
57  
58 Figure 1. Presentation of quality of life (QOL) in the WHOQOL-BREF domains researched  
59 groups.  
60

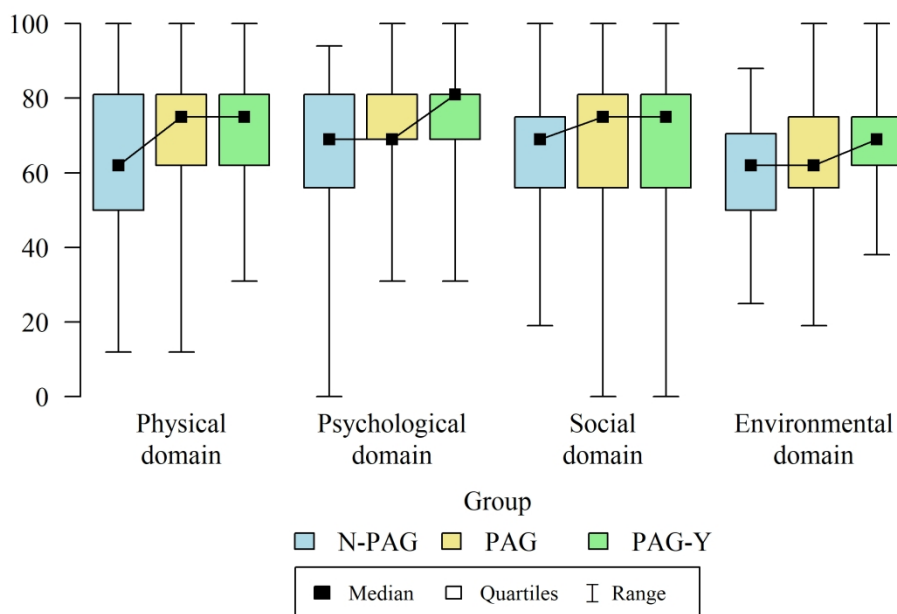


Figure 1. Presentation of quality of life (QOL) in the WHOQOL-BREF domains researched groups.

404x258mm (157 x 157 DPI)

## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1&3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
<b>Introduction</b>			
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	4-5
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5-6
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
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	5-6
Bias	9	Describe any efforts to address potential sources of bias	5-6
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5-6
		(b) Describe any methods used to examine subgroups and interactions	5-6
		(c) Explain how missing data were addressed	5-6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	5-6
		(e) Describe any sensitivity analyses	5-6

Continued on next page



<b>Results</b>			
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	7-12
		(b) Give reasons for non-participation at each stage	7-12
		(c) Consider use of a flow diagram	7-12
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-12
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
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	7-12
		(b) Report category boundaries when continuous variables were categorized	7-12
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7-12
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7-12
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	12-14
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	12-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-14
<b>Other information</b>			
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	15

\*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](http://www.strobe-statement.org).