

Lewandowska Joanna, Pawik Łukasz, Pawik Malwina, Fink-Lwow Felicja, Kałużny Krystian, Kałużna Anna, Zukow Walery. Regular yoga exercises and quality of life in women with low back pain - a pilot study. *Journal of Education, Health and Sport*. 2018;8(12):882-896. eISSN 2391-8306. DOI <http://dx.doi.org/10.5281/zenodo.2572474> <http://ojs.ukw.edu.pl/index.php/johs/article/view/6609>

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part b item 1223 (26/01/2017).
1223 Journal of Education, Health and Sport eISSN 2391-8306 7

© The Authors 2018;

This article is published with open access at Licensee Open Journal Systems of Kazimierz Wielki University in Bydgoszcz, Poland
Open Access. This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author (s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non commercial license Share alike. (<http://creativecommons.org/licenses/by-nc-sa/4.0/>) which permits unrestricted, non commercial use, distribution and reproduction in any medium, provided the work is properly cited.

The authors declare that there is no conflict of interests regarding the publication of this paper
Received: 03.12.2018. Revised: 10.12.2018. Accepted: 30.12.2018.

Regular yoga exercises and quality of life in women with low back pain - a pilot study

Joanna Lewandowska¹, Łukasz Pawik², Malwina Pawik¹, Felicja Fink-Lwow¹,
Krystian Kałużny³, Anna Kałużna³, Walery Zukow⁴

- 1) Team of Health Promotion, Faculty of Physiotherapy, University School of Physical Education in Wrocław
- 2) Department of Physiotherapy in Motor Disorders and Dysfunctions, Faculty of Physiotherapy, University School of Physical Education in Wrocław
- 3) Department of Rehabilitation, Faculty of Health Sciences, Nicolaus Copernicus University in Toruń, Ludwik Rydygier Collegium Medicum in Bydgoszcz
- 4) Department of Spatial Management and Tourism, Faculty of Earth Sciences, Nicolaus Copernicus University in Toruń

Abstract

Back pain symptoms are one of prevailing disfunctions that determine lowering quality of life and functioning in work environment becoming not only a health problem, but also a social problem in developed countries. In available literature yoga exercises are more and more indicated as a method of leveling low back pain. The aim of this pilot study was to assess the

effectiveness of 8-week yoga exercises on quality of life and back pain symptoms by its location and intensity in women with normal and excessive body weight. Twenty seven women completed both surveys (preliminary and evaluation), and systematically took part in yoga exercises for 8 weeks. The duration of a single yoga class was 45-60 minutes long. Yoga exercise program required attending to a conducted yoga classes (ashtanga yoga, yin yoga, hatha yoga, vinyasa yoga and yoga for hips and spine), at least twice a week for two months. After 8 weeks 92,59% of participants of program declared noticeable reduce in back pain intensity related to yoga exercises (including 22,22% of complete pain relief). Pain in the lumbar region of the spine was still dominating after 8 weeks (55,56%). It was observed that the majority of the SF-36 health domains scores increased values after 8-week yoga program, what could be related to the reduce of back pain intensity. After 8-week yoga program decrease in mean values of body mass were observed, however these changes were not statistically significant. Two-month yoga intervention may be recommended as a complementary physiotherapeutic method in low back pain treatment as well as to improve the quality of life for women. The relationship between yoga and prevention of obesity requires further research on larger group and the impact of obesity phenotypes is needed to be investigated.

Key words: yoga exercises, quality of life, low back pain

Introduction

Back pain symptoms are one of prevailing dysfunction that determine lowering quality of life and functioning in work environment becoming not only a health problem, but also a social problem in developed countries [1]. In 2014, almost 50,5% of adult Poles declared pain of the lumbosacral region and this problem was more frequent in women than men (54,4% vs 45,3%) [2]. The etiology of pain associated with tissues around the spine is diverse and may be associated with traumatic spine injuries, postural defects, osteoarthritis, intervertebral disc degenerations and lumbar spine instability [3, 4, 5]. Preferred health behaviors, as well as work related and its movement monotony, osteoarticular system overloads, not following work ergonomics and inadequate rest are the factors predisposing an increased risk of back pain symptoms [6, 7]. Negative relationship between sedentary lifestyle, low physical activity and low back pain have been shown. These factors, additionally, are increasing the risk of

obesity [8, 9], in which an increased incidence of complications in the musculoskeletal system function and pain associated with those complications is observed [6, 7, 10, 11, 12, 13].

The occurrence of pain symptoms is associated with a decrease in the quality of life [14]. The pain affects both aspects of physical and mental health as well as social health. Therefore, the assessment of quality of life is an important tool for monitoring therapy and an evaluation of its effectiveness, and at the same time allows holistic approach to health.

In available literature, yoga exercises are more and more indicated as a method of leveling low back pain [15, 16, 17]. The point of these exercises is the fact that yoga relatively not overloads the locomotor system and is well tolerated also for people less physically active, therefore yoga seems to be a suitable alternative to physical activity [15, 17]. Furthermore, yoga exercises have a multidimensional effect [18]. It affects not only the physical aspect, improving flexibility and joint mobility, hemodynamic and respiratory parameters [16, 19, 20, 21], but also positively affects the mental aspect, lowering stress level, increasing life satisfaction, enhancing well-being and self-esteem [22].

The aim of this pilot study was to assess the effectiveness of 8-week yoga exercises on quality of life and back pain symptoms by its location and intensity in women with normal and excessive body weight.

Methods

Recruitment for the research was carried out through social media, offering residents of Wrocław, Lubin and Polkowice participation in selected yoga classes (ashtanga yoga, yin yoga, hatha yoga, vinyasa yoga and yoga for hips and spine), its purpose was to perform positions, asanas, in order according to selected yoga type. Recommended series of positions, based on alternating spinal flexion and extension, were performed with synchronized breathing. Yoga program involved the participation of women who declared chronic lower back pain symptoms and consulted their family doctor determining no yoga contraindications. Yoga exercises was supervised by certified yoga teacher (Registered Yoga School RYS 300 by Yoga Alliance). Recruitment for yoga program and collecting preliminary surveys took place between 01.11.2017 and 14.11.2017. Evaluation surveys were collected between 15.01.2018 and 28.01.2018 after 8 weeks of yoga exercises.

112 women applied in the initial phase of the study, however, only 27 women completed both surveys (preliminary and evaluation), and systematically took part in yoga

exercises for 8 weeks. The duration of a single yoga class was 45-60 minutes long. Each of the 27 women exercised at least twice a week, at least once under yoga teacher supervision, other exercises could be carried out individually.

Preliminary survey

The study included filling in two surveys. Measuring points were separated by two month of yoga exercises period. Yoga exercise program required attending to a conducted yoga classes (ashtanga yoga, yin yoga, hatha yoga, vinyasa yoga and yoga for hips and spine), at least once a week for two months. The number of yoga units per week were maximum 5 sessions. Participants who attended to only one supervised class a week declared to exercise individually.

The preliminary survey, filled before yoga intervention, included demographic, administrative data and lifestyle elements questionnaire (i.e. age, education, work characteristics, drugs, diet, leisure activity), and was supplemented by pain rating scale VAS (Visual Analogue Scale) [23] and The Quality of Life Questionnaire SF-36 (license no. QM041585). The quality of life tested by The SF-36 health survey was measured according to eight domains: RE – role emotional, SF – social functioning, VT – vitality, MH – mental health, GH – general health, PF – physical functioning, RP – role physical and BP – bodily pain. The categories have been standardized according to the guidelines into two components: MCS – mental health component score (RE, SF, VT and MH) and PCS – physical health component score (GH, PF, RP and BP). The norm for standardized scores was 50.

Evaluation survey

The evaluation survey, filled after 8 weeks of yoga exercises, included questions about potential changes in lifestyle elements, pain level according to VAS and quality of life (SF-36).

Group characteristics

The mean age in the group of women was 31,48 years \pm 10,98, the largest group (51,85%) were women aged 18-28. Higher education (74%) prevailed in women group, the others declared secondary education. 70,37% of respondents were an active worker (intellectual job or physical job with intellectual elements). Majority (66,67%) preferred

mixed diet, eating 4 times a day. Similarly, majority (96,3%) declared eating between meals. The participants preferred active leisure time activities (81,48%). The great number preferred, among others walking, fitness or gym, swimming and cycling.

Women underwent anthropometric measurements (body height, body weight, waist and hip circumference) before and after yoga program, these measurements allowed to determine the values of BMI (Body Mass Index) defined as the body weight divided by the square of the body height and WHR (Waist to Hip Ratio).

Statistics

Collected data was analyzed using IBM SPSS Statistics 24. The Kolmogorov-Smirnov test was used to verify the normality of the results' distribution, while the t-test and the Wilcoxon Signed Rank test was used to assess differences between variables and Spearman rank correlation was used to find correlation between variables, Statistical significance level was $p < 0,05$.

Results

Participation in the 8-week yoga program required back pain symptoms occurrence. Women underwent the back pain symptoms characteristics assessment. Pain could be described as a chronic or chronic with remission periods. The characteristics of pain in the group of respondents (before yoga program) was varied (37,04% chronic pain, 62,96% chronic pain with remission periods). The assessment of back pain location allowed to conclude that the majority of participants had the pain in lumbar region of the spine (62,96%). The others declared the pain in cervical region (14,81%), thoracic region (11,11%) and sacral region (11,11%). Mean pain intensity, determined using the VAS scale, was 3,96 in the range between 2 to 7. Yoga exercises affected significantly (Table 1) lowering the mean of pain intensity of the whole group ($p < 0,001$) to 2,87 (range 0 to 5) according to the VAS scale. A detailed analysis of back pain intensity contributed to reveal the two women with increased pain intensity after 8 weeks. Most of participants (92,59%) after 8 weeks of program, declared noticeable reduce in back pain intensity related to yoga exercises (including 22,22% of complete pain relief). Pain in the lumbar region of the spine was still dominating after 8 weeks (55,56%).

Table 1. Comparison of the back pain intensity according to the VAS scale pre and post 8-week yoga program (Wilcoxon Signed Rank Test).

VAS post – VAS pre	Wilcoxon Signed Rank Test	N	Mean rank	Sum of Ranks
	Negative ranks	20 ^a	12,40	248,00
	Positive ranks	3 ^b	9,33	28,00
	Ties	4 ^c		
	Total	27		
	a – VAS post < VAS pre b – VAS post > VAS pre c – VAS post = VAS pre			
	Z	-3,409 ^d		
	Asymp. Sig (2-tailed)	0,001		
	d – based on positive ranks			

It was observed that the majority of the SF-36 health domains scores increased values after 8-week yoga program, what could be related to the reduce of back pain intensity (Fig.1). Before the 8-week yoga exercises majority of the mean values of health domains in women group were below the norm, i.e. 50. Particularly low value before the yoga program was presented in BP domain (bodily pain) i.e. 43,79. After two months of yoga program statistically significant positive change of the values was shown in almost all domains (SF – social functioning, $p < 0,003$; VT – vitality, $p < 0,001$; MH – mental health, $p < 0,003$; GH – general health, $p < 0,001$; PF – physical functioning, $p < 0,049$; RP – role physical, $p < 0,0001$; BP – bodily pain, $p < 0,0001$). The value of RE domain (role emotional) also showed the positive change, however it was not statistically significant ($p < 0,181$). The largest positive change occurred in two domains BP (bodily pain) and VT (vitality). The changes in the values are presented in the Figure 1. Table 2 and Table 3 present the level of significance in values changes before and after yoga program, i.e. for PCS $p < 0,0001$ and MCS $p < 0,004$.

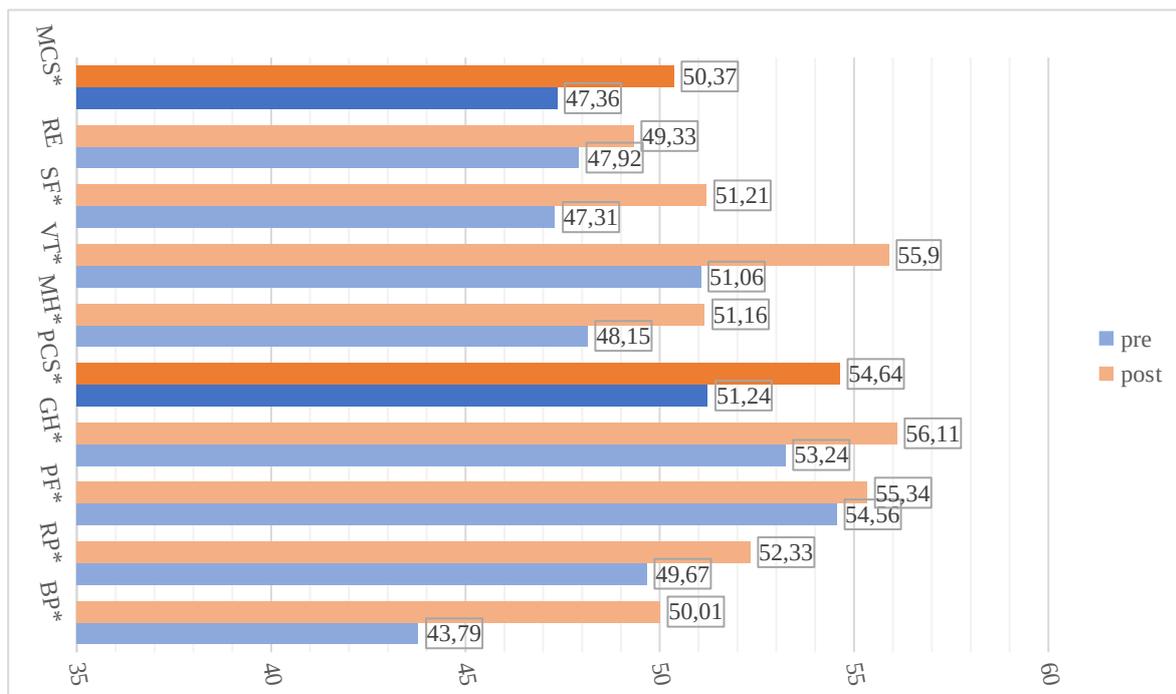


Figure 1. The mean values of health domains by the SF-36 questionnaire before and after yoga program (* - statistically significant)

Table 2. Wilcoxon Signed Rank Test for PCS score before and after yoga program

PCS post – PCS pre	Wilcoxon Signed Rank Test	N	Mean rank	Sum of Ranks
	Negative ranks	3 ^a	3,67	11,00
	Positive ranks	24 ^b	15,29	367,00
	Ties	0 ^c		
	Total	27		
	a – PCS post < PCS pre b – PCS post > PCS pre c – PCS post = PCS pre			
	Z	-4,276 ^d		
	Asymp. Sig (2-tailed)	0,000		
d – based on positive ranks				

Table 3. Wilcoxon Signed Rank Test for MCS score before and after yoga program

MCS post – MCS pre	Wilcoxon Signed Rank Test	N	Mean rank	Sum of Ranks
	Negative ranks	6 ^a	11,67	70,00
	Positive ranks	21 ^b	14,67	308,00
	Ties	0 ^c		
	Total	27		
	a – MCS post < MCS pre b – MCS post > MCS pre c – MCS post = MCS pre			
	Z	-2,859 ^d		
	Asymp. Sig (2-tailed)	0,004		
d – based on positive ranks				

The evaluation of the anthropometric measurements showed lower values in women group. After 8-week yoga program decrease in mean values of body mass ($62,41 \text{ kg} \pm 9,37$ vs $61,87 \text{ kg} \pm 9,9$), WHR ($0,8 \pm 0,07$ vs $0,79 \pm 0,07$) and BMI ($22,33 \text{ kg/m}^2 \pm 2,70$ vs $22,13 \text{ kg/m}^2 \pm 2,77$) were observed, however these changes were not statistically significant. There were no significant relationships between the changes of anthropometric indicators and the age of women. The change in back pain intensity after yoga program in women group was also not related to the age of participants. No statistically significant correlation between the change of the VAS score and BMI or obesity phenotype by WHR was showed.

Discussion

The current scientific literature indicates the beneficial effects of yoga exercises on health and as a non-invasive method supporting pharmacotherapy in disfunctions and chronic diseases, including neurological disorders [24] and pain symptoms [25]. The positive impact on disease entities such as hypertension, cancer and autoimmune diseases have been proven. At the same time the positive effect on physical fitness was shown. Yoga is suggested as a method lowering stress and it's after-effects in specific occupational groups, e.g. soldiers, regardless of age [26]. The changes in back pain intensity, location and character of pain in the group before and after 8-week yoga program were assessed. It was shown that significant decrease in the intensity of back pain according to the VAS scale occurred. Additionally, an interview was used regarding the occurrence of back pain after yoga program. The majority of women (92,59%) showed subjective decrease in back pain intensity.

However, two participants reported deterioration of back pain intensity. This phenomenon can be understood as a temporary increase in the intensity of back pain, that is occurring in relatively small number of yoga participants. Sherman and Tilbrook in their researches confirmed this fact, both researches emphasize that yoga exercises as a therapy of back pain is safe and possible deterioration is rare [15, 17]. In the study of Groessl et al., authors obtained similar results in positive impact on low back pain intensity. That research included 10-week yoga exercises program in the group of women and men. In both of groups the intensity of low back pain decreased, however better results were showed in women group [27]. Other authors in their research compared the effects of yoga exercises program and typical exercises used in low back pain treatment on the back pain intensity decrease and improve of physical functioning. It was proven that yoga program was more beneficial [17].

A similar conclusion occurred in the research comparing yoga and stretching. Results of that study confirmed the comparable impact of both of these trainings on lowering low back pain intensity [28].

In the group of women, 78% of them presented normal body weight. After 8-week yoga exercises, this number increased to 85%, however, the difference in body mass index (BMI) before and after program was not statistically significant.

Different results were showed in the research of Dhananjai et al., where statistically significant reduction of body weight and decrease in BMI and WHR were caused by yoga exercises [29]. The reason for this difference may be the number of yoga classes and the number of participants. In that research the exercising program was much longer and lasted 180 days. As it was confirmed, after such period of yoga exercises, statistically significant changes in anthropometric obesity indicators are noticeable [30, 31].

In our study correlation between body mass index (BMI) and the intensity of back pain was not showed. In contrast, in the research of other authors the correlation between body mass index and the intensity of back pain was demonstrated. The study of the American population is an example, where obese and overweight people, with a higher BMI, were more likely to develop higher level of back pain intensity [32]. In our study, the lack of a significant relationship between BMI and back pain intensity could be related to relatively small number of participants. This aspect requires further study.

Yoga exercises allow holistic approach to health, bringing positive effects not only in physical but also in mental aspects. Chronic low back pain not only affects physical aspects of health. It has been proven by Lame et al., that chronic pain is related to decrease in quality of life, in particular, in mental health domain, which was also confirmed in this research. Decreased self-esteem, life satisfaction and motivation related to pain occurrence was showed [14]. Thus, the influence of low back pain symptoms becomes a visible problem also in professional, social and family life. To estimate the quality of life in this study used the SF-36 questionnaire, before and after exercising period. Two aspects of quality of life was studied, physical and mental. Values below the norm, meaning decreased quality of life, were showed in five out of eight domains before the yoga program (RP – role physical, BP – bodily pain, SF – social functioning, RE – role emotional, MH – mental health). Four of above-mentioned domains are equivalent to determining health as a lack of disability and limitations. This means there are limitations related to low back pain in the group. The mean value in mental

health component score (MCS) was below the norm (47,36), while the mean value of physical health component score (PCS) was above the norm (51,24). This may be related to general physical activity of women before yoga exercises. After yoga exercises period, a positive change was showed in seven out of eight domains. Health component scores also increased their value above the norm. This proves that there was a significant change in the quality of life in women group after yoga exercises. Similar effects was noted by Smith et al., in that study after 10-week yoga exercises the level of stress and anxiety decreased and there was a positive change in the quality of life by the SF-36 questionnaire [33]. Mental aspect in yoga exercises had been researched in other study. Reduction of anxiety and depression symptoms as a result of yoga exercises was proven [29], which confirms multidimensional yoga influence on health. There was a decrease in back pain intensity (improvement in physical aspect), increase in body awareness and decrease in stress level (improvement in mental aspect).

Physical activity has beneficial effect on health, however, not all forms of physical activities have the same impact on lowering back pain intensity [34]. The positive impact of yoga in this aspect was confirmed [15]. Positive impact is related to the methodology of executing asanas, positions that affect progressive increase in joints mobility and muscle stretching. Positions are executed with alternating spinal flexion and extension [19, 35].

Majority of women who participated in our research preferred active leisure time activities. The most frequently declared activities were walking, fitness or gym, swimming and cycling. Based on these declarations, it can be said that the group of women were physically active. This could affect negatively the influence of yoga exercises on anthropometric parameters modification.

Many studies have shown positive relations between physical activity and mental and social health [22, 36]. Even low systematic physical activity positively affects the mood [37]. The preference to active leisure time activities is associated with an increase in quality of life, which is caused by an increase in self-esteem [38]. Physical effort affects the growth of endogenous opioid secretion, which results in a decrease in the level of cortisol and an increase in the level of serotonin and norepinephrine. These hormones secreted into the bloodstream have a direct effect on improving mood after exercises [39]. Therefore, yoga can be treated as a stimulator of various healthy behaviors. This is confirmed by positive changes in some elements of lifestyle declared by the participants of this research. More than half of

them, after 8-week yoga program, declared positive changes in their diet. Despite the fact that only a few of them have changed their diet into, associated with yoga, a vegetarian or vegan diet, 51,85% of women declared to eat more healthily. Few women, who declared smoking cigarettes reduced the number of cigarettes smoked per day. However, it is impossible to draw any conclusions, because only 11,11% of participants declared smoking before 8-week yoga exercises.

Conclusions

1. Two-month systematic yoga intervention significantly improved the quality of life of women with back pain symptoms in all domains according to the SF-36 questionnaire.
2. Yoga intervention was a tool that effectively reduced the intensity of low back pain, regardless of age, BMI and WHR in the group.
3. The incidence of women's excessive body weight decreased after two months of yoga intervention, however, this change was not statistically significant.
4. Yoga exercises can be treated as a stimulator of healthy lifestyle.

General conclusion

Two-month yoga intervention may be recommended as a complementary physiotherapeutic method in low back pain treatment as well as to improve the quality of life for women. The relationship between yoga and prevention of obesity requires further research on larger group and the impact of obesity phenotypes is needed to be investigated.

Bibliography

1. Maher Ch, Underwood M, Buchbinder R. Non-specific low back pain. *Lancet* 2017, 389: 736-47.
2. Eurostat. Persons reporting a chronic disease, by disease, sex, age and level of activity limitation v3.4.1 – 20170407-5840-PROD-EUROBASE: <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>
3. Hoy D, Brooks P, Blyth F, Buchbinder R. The Epidemiology of low back pain. *Best Pract Res Clin Rheumatol* 2010, 24(6): 769-781.
4. Peng BG. Pathophysiology, diagnosis, and treatment of discogenic low back pain. *World J Orthop* 2013, 4(2): 42-52.

5. Waterman BR, Belmont Jr PJ, Schoenfeld AJ. Low back pain in the United States: incidence and risk factors for presentation in the emergency setting. *Spine J* 2012, 12(1): 63-70.
6. Gajewski T, Owoc A, Chudak B, Bojar I, Stelmach W, Stelmach I. Efektywność programu profilaktycznego „Zapobieganie Zespołom Bólowym Kręgosłupa u pracowników biurowych” – Część I: Analiza wstępna. Krakowiak J, Cichońska D (red), Zarządzanie w ochronie zdrowia – wybrane aspekty. SAN, Łódź, 2013, tom XIV, zeszyt 10, część III, ss. 23-32.
7. Kałużna A, Kałużny K, Hagner-Derengowska M, Pyskir M, Kochański B, Hagner W, Budzyński J, Zukow W. Wybrane zachowania prozdrowotne pacjentów z bólem odcinka lędźwiowo-krzyżowego kręgosłupa w wieku 30-50 lat. *Journal of Education, Health and Sport* 2017, 7(5): 436-448.
8. Healy GN, Wijndaele K, Dunstan DW, Shaw JE, Salmon J, Zimmet PZ, Owen N. Objectively Measured Sedentary Time, Physical Activity, and Metabolic Risk. *AusDiab* 2008, 31(2): 369-371.
9. Lwow F. Wpływ standaryzowanego wysiłku fizycznego na stres oksydacyjny w aspekcie fenotypu otyłości i polimorfizmu genu receptora beta3 adrenergicznego u kobiet pomenopauzalnych. *Studia i Monografie AWF* 2010 (99): 8-36.
10. Kędra A, Czaprowski D. Częstość występowania bólu kręgosłupa a sposób spędzania czasu wolnego dzieci i młodzieży. *Medycyna Ogólna i Nauki o Zdrowiu* 2013, 19(2): 183-187.
11. Derewiecki T, Mroczek K, Zaworski K, Chruściel P, Chmiel-Derewiecka D, Mroczek M. Znaczenie aktywności fizycznej w dolegliwościach bólowych kręgosłupa i stawów obwodowych. *Hygeia Public Health* 2014, 49(1): 160-165.
12. Okifuji A, Hare BD. The association between chronic pain and obesity. *J Pain Res* 2015, 8: 399-408.
13. Zhang, TT, Liu Z, Liu YL, Zhao JJ, Liu DW, Tian QB. Obesity as a Risk Factor for Low Back Pain: A Meta-Analysis. *Clin Spine Surg* 2018, 31(1): 22-27.
14. Lame IE, Peters ML, Vlaeyen JWS, Kleef MV, Patijn J. Quality of life in chronic pain is more associated with beliefs about pain, than with pain intensity. *Eur J Pain* 2005, 9(1): 15-24.

15. Sherman KJ, Cherkin DC, Wellman RD, Cook AJ, Hawkes RJ, Delaney K, Deyo RA. A Randomized Trial Comparing Yoga, Stretching, and Self-care Book for Chronic Low Back Pain. *Arch Intern Med* 2011, 171(22): 2019-2026.
16. Tekur P, Nagarathna R, Chametcha S, Hankey A, Nagendra HR. A comprehensive yoga programs improves pain, anxiety and depression in chronic low back pain patients more than exercise: An RCT. *Complement Ther Med* 2012, 20(3): 107-118.
17. Tilbrook HE, Cox H, Hewitt CE, Kang'ombe AR, Chuang LH, Jayakody S, Aplin JD, Samlyen A, Trehwela A, Watt I, Torgerson DJ. Yoga for Chronic Low Back Pain: A Randomized Trial. *Ann Intern Med* 2011, 155(9): 569-578.
18. Sengupta P. Health Impacts of Yoga and Pranayama: A State-of-the-Art Review. *Int J Prev Med* 2012, 3(7): 444-458.
19. Walczyk D, Uba-Guminiak S. Wpływ jogi na stan funkcjonalny w obrębie narządu ruchu. Umiastowska D (red), Aktywność ruchowa ludzi w różnym wieku. Wydawnictwo Promocyjne Albatros, Szczecin, 2016, ss. 45-53.
20. Hagins M, States R, Selfe T, Innes K. Effectiveness of Yoga for Hypertension: Systematic Review and Meta-Analysis. *EVID-BASED COMPL ALT* 2013, 2013(1): 649836.
21. Fulambarker A, Farooki B, Kheir F, Copur AS, Srinivasan L, Schultz S. Effect of Yoga in Chronic Obstructive Pulmonary Disease. *Am J Ther* 2012, 19(2): 96-100.
22. Hartfiel N, Havenhand J, Khalsa SB, Clarke G, Krayner A. The effectiveness of yoga for the improvement of well-being and resilience to stress in the workplace. *Scand J Work Environ Health* 2011, 37(1): 70-76.
23. Caraceni A, Cherny N, Fainsinger R, Kaasa S, Poulain P, Radbruch L, De Conno F. Pain measurement tools and methods in clinical research in palliative care”: recommendations of an Expert Working Group of the European Association of Palliative Care. *J Pain Symptom Manag* 2002, 23(3): 239-255.
24. Mooventhan A, Nivethitha L. Evidence based effects of yoga in neurological disorders. *J Clin Neurosci* 2017, 43: 61-67.
25. Field T. Yoga research review. *Complement Ther Clin Pract* 2016, 24: 145-161.
26. Hurst S, Maiya M, Casteel D, Sarkin AJ, Libretto S, Elwy AR, Park CL, Groessl EJ. Yoga therapy for military personnel and veterans: Qualitative perspectives of yoga students and instructors. *Complement Ther Med* 2018, 40: 222-229.

27. Groessl EJ, Weingart KR, Johnson N, Baxi S. The Benefits of Yoga for Women Veterans with Chronic Low Back Pain. *J Altern Complement Med* 2012, 18(9): 832-838.
28. Sherman KJ, Wellman RD, Cook AJ, Cherkin DC, Ceballos RM. Mediators of yoga and stretching for chronic low back pain. *Evid Based Complement Alternat Med* 2013, 2013: 130818.
29. Dhananjai S, Sadashiv, Tiwari S, Dutt K, Kumar R. Reducing psychological distress and obesity through Yoga practice. *Int J Yoga* 2013, 6(1): 66-70.
30. Balaji PA, Smitha R, Syed Sadat Ali. Effects of Yoga – Pranayama Practices on Metabolic Parametres and Anthropometry in Type 2 Diabetes. *Int Multidiscp Res J* 2011, 1(10).
31. Tundwala V, Gupta RP, Kumar S, Singh VB, Sandeep BR, Dayal P, Parkash P. A study on effect of yoga and various asanas on obesity, hypertension and dyslipidemia. *Int J App Basic Med Res* 2012, 2(1): 93-98.
32. Stone AA, Broderick JE. Obesity and Pain Are Associated in the United States. *Obesity* 2012, 20(7).
33. Smith C, Hancock H, Blake-Mortimer J, Eckert K. A randomized comparative trial of yoga and relaxation to reduce stress and anxiety. *Complement Ther Med* 2007, 15(2): 77-83.
34. World Health Organization, Global recommendations on physical activity for health, 2011:
http://www.who.int/dietphysicalactivity/publications/recommendations18_64yearsold/en/
35. Grabara M, Szopa J. Ćwiczenia hatha-jogi w profilaktyce kręgosłupa. Nałęcka D, Bytniewski M (red), *Teoria i praktyka w rekreacji ruchowej*. Państwowa Wyższa Szkoła Zawodowa im Papieża Jana Pawła II w Białej Podlaskiej, Biała Podlaska, 2006, ss. 144-151.
36. Cleland V, Granados A, Crawford D, Winzenberg T, Ball K. Effectiveness of interventions to promote physical activity among socioeconomically disadvantaged women: a systematic review and meta-analysis. *OBES REV* 2013, 14: 197-212.
37. Wiese CW, Kuykendall L, Tay L. Get active? A meta-analysis of leisure-time physical activity and subjective well-being. *J Posit Psychol* 2018, 13(1): 57-66.

38. Elavsky S. Physical Activity, Menopause, and Quality of Life: The Role of Affect and Self-Worth across Time. *Menopause* 2009, 16(2): 265-271.
39. Chu AHY, Koh D, Moy FM, Müller-Riemenschneider F. Do workplace physical activity interventions improve mental health outcomes?. *OCCUP MED-OXFORD* 2014, 64(4): 235-245.