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DOES YOGA TRAINING RELATE TO HEALTH-PROMOTING MODIFICATIONS OF ANTHROPOMETRIC INDICATORS OF OVERWEIGHT AND QUALITY OF LIFE IN YOUNG WOMEN? PRELIMINARY OBSERVATIONS

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A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: Overweight and obesity are global civilization problems affecting all age groups, including in Poland. According to the Central Statistical Office, the prevalence of excessive body weight among young women in 2022 was 20%. Being overweight leads to numerous complications and increases the risk of chronic diseases. There is also a confirmed link between obesity and low self-acceptance, leading to a decrease in quality of life, especially among women. Health-promoting lifestyle modifications, including physical activity and diet, play a crucial role in obesity prevention and treatment. Regular physical activity, such as yoga, is also associated with improved quality of life, particularly in the psychological domain.

Aim of the study: The study aimed to assess changes in anthropometric indicators of body weight, including body mass index (BMI), weight change (WC), waist-to-hip ratio (WHR), and quality of life (36-item short form survey [SF-36]) after eight weeks of yoga training conducted three times a week, with each session lasting for 45 minutes.

Material and methods: The study included 27 women with an average age of 31.48 years ±10.98, who were not undergoing any medical therapy or engaging in other physical training and were not pregnant. The participants did not make any changes to their diet during the study. The results were subjected to statistical analysis, with the normality of variable distribution assessed using the Kolmogorov-Smirnov test and the difference between variables analyzed using either the Student's t-test or the Wilcoxon test. The relationships between variables were examined by Spearman's rank correlation.

Results: The analysis showed that yoga training led to a statistically significant increase in quality of life across all domains. However, there were no substantial changes observed in BMI, WC, or WHR before and after the training, which may be attributed to the small sample size and requires further research.

Conclusion: Based on the preliminary results, it can be inferred that an eight-week yoga training program may be recommended as a method to improve the quality of life in women.

KEYWORDS: yoga, quality of life, obesity

Background

Overweight and obesity are chronic civilization diseases associated with numerous complications [1–3], with the problem affecting as many as 53.3% of adults in Poland in 2022 [4]. Analysis of research conducted by the Central Statistical Office in previous years indicates increasing trends in this regard across all age groups [5]. Besides cardiovascular, metabolic, endocrine, and psychosocial complications, overweight and obesity also have an adverse impact on the musculoskeletal system. Indeed, an increased burden on the lumbar spine segment in obese individuals increases the risk of back pain symptoms [6]. Although painkillers temporarily alleviate pain symptoms in obese individuals, the joints continue to be chronically burdened, leading to cartilage damage and the need for endoprosthesis surgery [7].

Yoga is an ancient Indian system of education, hygiene, and healing, focusing not only on the physical aspect of the human being but also the psychological side [8]. In the language of the Brahmins, in Sanskrit, the word "yoga" means harnessing, uniting, or integrating. As such, it can be interpreted as the integration of various dimensions of human existence, including the body, spirit, and mind. It is thought that integrating these spheres allows for the balanced functioning of the entire organism, meaning practicing yoga can benefit both the body and the mind.

Yoga comprises physical exercises, breathing exercises, relaxation, philosophy, and hygienic recommendations. The yoga system consists of specific postures called asanas [9] which involve positioning the body as a whole with full engagement of the body and mind (the mental sphere). As a whole, yoga focuses on improving physical fitness and achieving psychoneurovegetative balance to improve overall physical fitness and increase flexibility and endurance [10,11]. Breathing techniques used during practice increase oxygen consumption and energy expenditure and reduce systolic and diastolic blood pressure [12,13]. Yoga has also shown a positive impact on patients with obsessive-compulsive disorders, panic attacks, and depressive disorders [14]. Patients receiving medication after yoga intervention demonstrated improvement in low mood, anger attacks, anxiety, and neurotic symptoms.

A review of the scientific literature allows us to conclude that spinal pain symptoms are more common in individuals with excess body weight [15], and yoga training is a method of alleviating these symptoms. However, it is important to determine whether the effectiveness of this training depends on the body mass index (BMI) and whether the relationship with potential improvement in quality of life depends on categorized BMI.

Aim of the study

The study aimed to assess the changes in anthropometric indicators of body weight, including BMI, weight change (WC), waist-to-hip ratio (WHR), and quality of life (36-item short form survey [SF-36]) after an eight-week yoga training program in women with normal BMI and those who were overweight or obese.

Material and methods

Sample

The study was conducted among women from the Lower Silesian region of Poland and was approved by the Bioethics Committee of the Medical University of Wrocław (number KB-806/2018). The participants included individuals who reported regular participation in yoga classes. Training took place at the yoga school in Lubin. Participants were women since the vast majority of people who attend the yoga studio are women. Men constituted a very small group and were not included in the study.

The yoga training was conducted by a qualified teacher (Registered Yoga School [RYS] 300 by Yoga Alliance) and involved regular classes held in accordance with the studio's weekly schedule. The study participants had not participated in yoga-related physical activity for more than half a year before the study. During the two-month training, the women attended classes twice a week, and the training took place independently of the other daily activities. The number of participants, type of yoga, and methodology were the same every week, while the pace of exercises depended on the group participating at a given moment and was regulated individually by the yoga teacher in a given training unit. Performing the poses in the order of the primary series of Ashtanga Yoga was synchronized with the breath based on the suggested methodology of this type of yoga. Individual position changes took place with inhalation or exhalation and were maintained for five breathing cycles.

The classes took place in the afternoon in groups of up to 12 people, starting with a warm-up consisting of five repetitions of Sun Salutation A, then asanas were performed according to the Ashtanga Yoga Primary Series (up to the Baddha Konasana position) [16] and concluded with ten minutes in the Savasana position. The classes lasted 45–60 minutes, with them initially lasting 45 minutes and being extended to 60 minutes with the duration of the training and the progress in the group.

Initially, 112 individuals were enrolled in the study, but only 27 women from Lubin, Wrocław, and Polkowice completed the full versions of both questionnaires, allowing for meaningful conclusions. The participants were women aged between 18 and 58 (average age of 31.48 years ±10.98), who were not undergoing any medical therapy or engaging in other physical training and were not pregnant. They did not undergo any dietary changes during the study, were informed about the purpose of the study before it started, and confirmed their willingness to participate.

Methods

The study utilized the diagnostic survey method, based on an original questionnaire created for this study, supplemented with the SF-36 questionnaire and anthropometric measurements. The SF-36 questionnaire and anthropometric measurements were conducted before and after the training.

The questionnaire was developed based on various questionnaires and a literature review and consisted mainly of questions about socio-demographic data (age, education, nature of work, family status, and chronic diseases). Additionally, there were questions related to diet (type of diet – the most typical ones for the Polish population were selected, i.e., high-carbohydrate, high-fat, mixed/traditional, vegetarian or vegan, and a space for supplementation for the respondent if they use a different type than those suggested – for all proposed, sample products included in this diet; number of meals a day; frequency of snacking between meals), use of stimulants (smoking, daily number of cigarettes smoked), and questions characterizing yoga practice (length of participation in yoga classes, how often do they practice yoga, yoga type, and time devoted to each practice).

The preliminary questionnaire included 16 questions concerning demographic and administrative data, such as age, education, and nature of work, as well as questions regarding preferred lifestyle elements related to substance use, diet, and leisure activities. The participants also completed the SF-36 questionnaire and underwent anthropometric measurements. The two-month yoga training was summarized using an evaluation survey, supplemented with the SF-36 questionnaire regarding quality of life after eight weeks of training. The evaluation survey consisted of four questions regarding changes in selected lifestyle elements of the respondents to assess how their lives changed as a result of the training.

The SF-36 questionnaire consists of 11 questions that determine quality of life based on the past four weeks and encompasses eight aspects, including general health (GH), physical functioning (PF), role limitations due to physical health (RP), role limitations due to emotional problems (RE), social functioning (SF), bodily pain (BP), vitality (VT), and mental health (MH). Additionally, respondents compare their current health status to their health status one year ago (reported health transition [HT]). The responses to the questions varied, with some based on a binary yes/no response, while others allowed for responses on a three-, five-, or six-point scale. After conversion according to specified rules, all categories enable a score on a scale from 0 to 100, with a higher score indicating better quality of life. For the purposes of the study, the questionnaire was used twice, before and after the two-month yoga training, to compare changes in quality of life [17,18]. Participants completed the Polish adaptation of the SF-36 questionnaire presented in the article by Tylka and Piotrowicz [19].

Anthropometric measurements included height, body weight, waist circumference, and hip circumference. Body height (in centimeters) and weight (in kilograms) were determined without shoes and outer clothing. Waist circumference (in centimeters) was measured halfway between the upper iliac crest and the lower rib arch. Hip circumference (in centimeters) was measured at the widest point near the greater trochanter [2,20]. All parameters were recorded in the attached measurement chart during the initial questionnaire and after the two-month yoga training. Before the training, the physiotherapist measured waist and hip circumferences and taught participants how to perform them because the women performed these measurements on their own after the training. The respondents provided the values for each parameter in the questionnaire after a prior explanation of the measurement procedure. Based on the results, BMI and WHR were calculated for each participant at both measurement points. The BMI was calculated as the ratio of body weight (kg) to the square of height (m), while WHR was calculated as the ratio of waist circumference (cm) to hip circumference (cm) [20].

According to the recommendations defined by the International Diabetes Federation (IDF), the values of the indicators were assigned to the following groups:

a) BMI

Obesity: BMI≥30,

Overweight: 25≤BMI<30,
Normal weight: 18.5<BMI<25.

b) WHR
Abdominal obesity: WHR≥0.8,
Normal value: WHR<0.8.

c) Waist circumference for Caucasian women
Abdominal obesity: Waist circumference ≥80 cm,
Normal value: Waist circumference <80 cm [2].

Statistical analysis

Statistical analysis employed SPSS Statistics 24 software (IBM Corporation, NY, USA). The normality of variable distribution was assessed using the Kolmogorov-Smirnov test. The difference between variables was evaluated using either Student's t-tests or the Wilcoxon test, while the relationships between variables were examined using Spearman's rank correlation. Relationships were considered statistically significant when $p<0.05$.

Results

Results of the author's questionnaire

Respondents were asked about changes in their dietary habits as a result of participating in yoga training, with 44.44% declaring that they pay more attention to a healthy eating style, while 7.41% changed their diet to vegetarian or vegan due to the training. On the other hand, 40.74% did not change their dietary habits. Additionally, 3.70% of the surveyed women quit smoking as a result of the yoga training.

SF-36 questionnaire before the training sessions

By completing the SF-36 questionnaire before the eight-week yoga training, quality of life was assessed using specific domain designations, including PF, RP, BP, GH, VT, SF, RE, and MH. Additionally, two composite domains, the Physical Component Summary (PCS) and Mental Component Summary (MCS), were determined. The norm for all domains was 50, with values below 50 indicating poorer health and those above 50 signifying better health.

In the surveyed group, values above 50 were observed for the PF (54.56), GH (53.42), VT (51.06), and PCS (51.24) domains. On the other hand, values below 50 were found for the RP (49.67), BP (43.79), SF (47.31), RE (47.92), MH (48.15), and MCS (47.36) domains.

SF-36 questionnaire after the training sessions

Completing the SF-36 questionnaire again after the eight-week yoga training allowed for quality of life assessment based on the values of specific domains. The numerical values for the SF-36 in the domains in Figure 1 are the mean values for the entire group, color-coded for pre- and post-training scores, respectively. Numerical results were converted automatically by the program based on the NBS "Norm-based scoring" algorithm for the Polish population (QualityMetric Health Outcomes(tm) Scoring Software 5.1) using a license obtained from the Medical Outcomes Trust and Quality Matric Incorporated. The license number for using the questionnaire alongside the appropriate software for this study was QM041585.

In the surveyed group, values above 50 were observed for the PF (55.34), RP (52.33), BP (50.01), GH (56.11), VT (55.9), SF (51.21), MH (51.16), PCS (54.64), and MCS (50.37) domains. However, a value below 50 was observed for the RE (49.33) domain. A statistically significant quality of life improvement was observed after the eight-week yoga training, including in the PCS ($p<0.0001$) and MCS ($p<0.004$) composite domains (Tables 1 and 2).

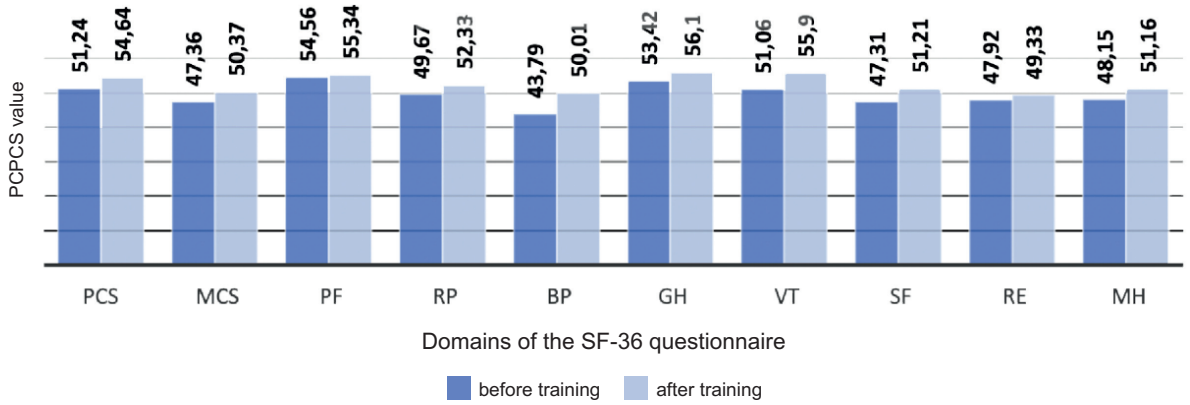

Figure 1. The Wilcoxon signed-rank test for the Physical Component Summary (PCS) values before and after the program

A comparison of pre and post-training results for PCS (non-normal distribution) was performed using the Wilcoxon signed-rank test (z=–4.276, p<0.0001). The mean PCS value before training was 51.242±5.276. The chi-squared test for the PCS domain before training, divided into above (n=9) and below the norm (n=18), was statistically insignificant (p=0.083). However, the PCS value after training was 54.644±3.526, and the chi-squared test for the PCS domain after training, divided into above (n=3) and below the norm (n=24), showed significant differences in the group size (p<0.001) (Table 1).

Table 1. The Wilcoxon signed-rank test for the Physical Component Summary (PCS) values before and after the program

PCS after – PCS before	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
	Bindings	0[c]		
	Total	27		
	a – PCS after<PCS before b – PCS after>PCS before c – PCS after=PCS before			
	Z			–4.276[d]
	Asymptotic significance (two-sided)			0,000
	d – based on positive ranks			

Comparing the MCS (non-normal distribution) results before and after training employed the Wilcoxon signed-rank test (z=–2.859, p=0.004). The mean MCS value before training was 47.363±11.403. The chi-squared test for the MCS domain before training, divided into above (n=13) and below the norm (n=14), showed no significant differences in the group size (p=0.847). The mean MCS value after training was 50.374±9.564. The chi-squared test for the MCS domain after training, divided into above (n=11) and below normal (n=16), showed no significant differences in group size (p=0.336) (Table 2).

Table 2. The Wilcoxon signed-rank test for the Mental Component Summary (MCS) values before and after the program

MCS after – MCS before	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
	Bindings	0[c]		
	Total	27		
	a – MCS after<MCS before b – MCS after>MCS before c – MCS after=MCS before			
	Z			–2.859[d]
	Asymptotic significance (two-sided)			0.004
	d – based on positive ranks			

After completing the project, significant improvements were observed in the RP (p<0.0001), BP (p<0.0001), GH (p<0.001), VT (p<0.001), SF (p<0.003), and MH (p<0.003) domains. A positive change was also observed in the RE domain, though it was not statistically significant (p<0.181) (Figure 1).

Anthropometric indicators

After the training period, no statistically significant decreases in BMI or WHR were observed among the surveyed women. Mean BMI, WC, and WHR are given as the arithmetic mean (Figures 2 and 3). Mean body weight before training was 62.410 kg ±9.374, and after training was 61.870 kg ±9.901 (t=1.051, p=0.303). Meanwhile, BMI was 22.33 kg/m^2 ±2.70 before training and 22.13 kg/m^2 ±2.77 after (z=–1.751, p=0.080). BMI after training was compared to BMI before training, with data divided into women with normal weight (n=21) and overweight (n=6), and showed a statistically significant difference (p=0.004). However, after training, the division of women into underweight (n=1), normal weight (n=22), and overweight (n=4) demonstrated a sub-

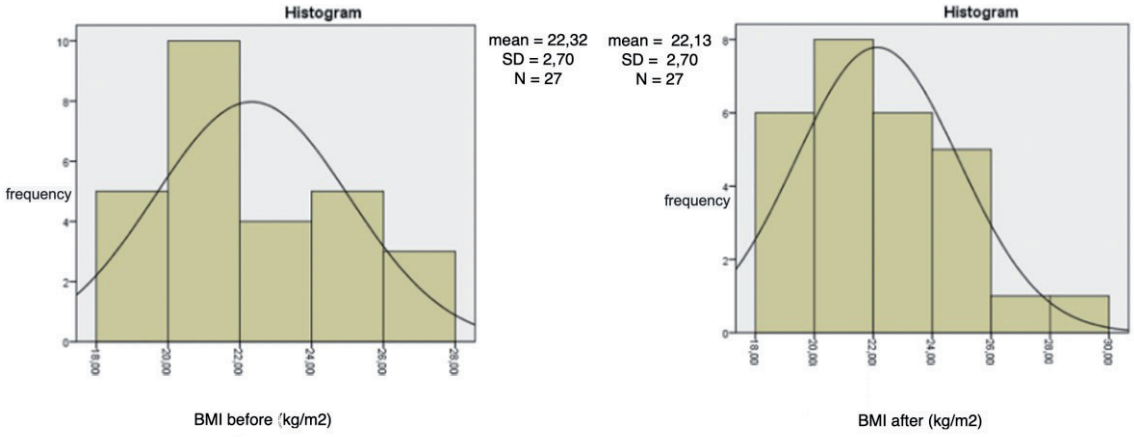

Figure 2. Normality testing of the body mass index (BMI) distribution before and after the implemented program

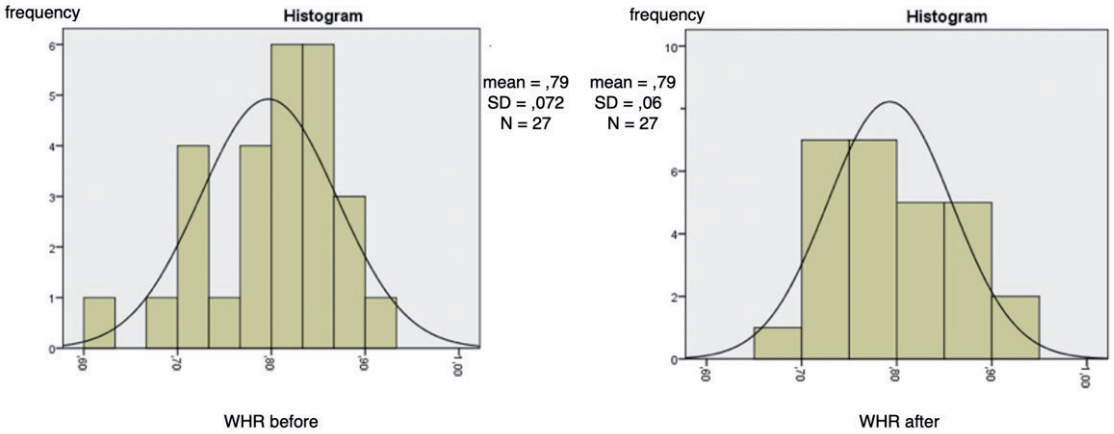

Figure 3. Normality testing of the waist-to-hip ratio (WHR) distribution before and after the implemented program

stantial difference ($p<0.0001$). The mean WHR index was 0.797±0.073 before and 0.793±0.065 after training ($t=0.468$, $p=0.644$). Meanwhile, the average waist circumference was 72.07 cm ±12.878 before training and 72.07 cm ±11.552 ($t=0.000$, $p=1.000$).

Discussion

Physical activity is one of the most critical components of a healthy lifestyle, with numerous studies confirming the positive impact of physical exercise on reducing the risk of many diseases [1–3, 21]. Regular physical activity is associated with maintaining a healthy body weight and achieving energy balance. Moderate and high-intensity physical activities include walking, jogging, brisk walking, fitness classes, cycling, swimming, dancing, general gymnastics, and yoga, with even a minor increase in physical activity levels leading to quality of life improvements [22]. Furthermore, positive changes in the emotional sphere are experienced more quickly than changes in somatic health. Indeed, mood improvement, reduction in depression symptoms, and decreased anxiety levels are observed more rapidly [23].

A survey conducted by Telles et al. in India, where yoga originated, showed that 94.5% of respondents experienced benefits from practicing yoga regularly (n=3135). The survey most frequently cited improvements in physical and mental health and cognitive functions. The mean age of the respondents was 35.1 years ±17.9, close to the average age of the women in this study, 31.48 years ±10.98. Telles et al. suggested that such a high percentage of people benefiting from this form of physical activity may be due to the relatively young age of the subjects. The indicated benefits, in terms of physical health, included improved muscle strength, balance, flexibility, motor coordination and endurance (ability to carry out physical activity), and body weight normalization (health-promoting change in BMI). Mental health benefits included increased life satisfaction and reduced symptoms of depression, while cognitive functions improved in terms of concentration, attention, learning, and memory. Notably, these benefits were assessed subjectively by the study participants, similar to the impact of yoga on health-promoting behaviors (modifying diet and the use of tobacco products) and pain symptoms in the spine area [24].

Studies have also confirmed the positive impact of regular yoga training on the quality of life of women. The results obtained showed a statistically significant improvement in quality of life after eight weeks of yoga training, especially in the composite domains of physical and mental health. Similar improvements were observed in the study by Patil et al. after six weeks of yoga training among a group of 88 nurses reporting low back pain, with a statistically significant improvement found in the physical, psychological, and social health domains in the World Health Organization Quality of Life Brief Version (WHOQOL-BREF). The improvement in quality of life was greater in the yoga training group compared to the control group performing a set of exercises typically used for patients with chronic low back pain [25]. Additionally, the benefits of yoga training on the quality of life of patients with various medical conditions have been confirmed. A study by Kuloor et al. demonstrated a positive impact of eight weeks of yoga training on the quality of life of human immunodeficiency virus (HIV) patients, with improvement in all domains according to the WHOQOL-HIV BREF questionnaire. Furthermore, a significant reduction in anxiety and depression symptoms on the Hospital Anxiety and Depression Scale (HADS), as well as improved Fatigue Severity Scale (FSS) scores, was observed compared to the control group not engaging in regular physical activity [26]. Another study evaluating the effects of an eight-week yoga training program was conducted among women with endometriosis and found a significant reduction in perceived pain, stress intensity, and improvement in health-related quality of life us-

ing the Endometriosis Health Profile 30-item instrument (EHP-30) [27].

Yoga training can have positive effects on mental health when performed in shorter training cycles, which is supported by a study conducted among 54 office workers who performed ten minutes of asanas activity daily from Monday to Friday while working remotely during the coronavirus disease 19 (COVID-19) pandemic. Improvement in mood (Profile of Mood States [POMS] total mood score) and pain symptoms in the head, neck, upper and lower torso, and pelvic region were observed [28].

Research by Lim and Park showed significant quality of life improvement using the SF-36 questionnaire in people practicing Pilates compared to people practicing yoga. Both groups, aged between 30 and 40, took part in Pilates or yoga training, which included three 60-minute training units per week for eight weeks. Improvements in favor of Pilates training were noted in the RE VT, MH, and GH domains for health change and total score. However, no significant differences were found between the groups in the RP and SF domains, as both interventions had a similarly positive impact on improving the quality of life. In summary, the study showed a greater impact of Pilates training on quality of life compared to yoga [29]. Similar quality of life improvements were found in another study, despite fewer training units per week (two units vs. three in the study by Lim and Park). Considering the similar age of the people in both studies, future studies could compare the impact of yoga training on the quality of life, taking into account two and three training units per week, to determine whether this results in a significant difference in the quality of life in this age group.

Importantly, the eight-week yoga training did not significantly impact the BMI and WHR indicators, which may be attributed to the relatively short duration of the project. However, a significant reduction in BMI was observed in a study by Chauhan et al. [30]. The participants performed 60 minutes of yoga training daily for four weeks, in contrast to the current project, where the training was conducted less frequently, which may have contributed to the difference in BMI change.

Anheyer et al. demonstrated no direct effect of yoga on BMI and WHR in women with above-average body weight. They examined women who underwent 12 weeks of yoga training, which consisted of two training units a week lasting 90 minutes each (the training was conducted by a hatha yoga teacher). The study indicated a positive modification of BMI through a combination of the effect of training and health-promoting modification of the respondents' lifestyle, including increasing physical activity in free time and increased fruit and vegetable consumption [31].

A meta-analysis by Chen et al. on the impact of yoga training on risk factors associated with type II diabetes showed no significant impact of yoga training on BMI changes compared to the control group not engaged in physical activity. The meta-analysis indicated that these effects are not observed in short-term training lasting between 10 and 24 weeks [32].

No significant BMI improvement was observed in the present study. Similarly, the lack of yoga training effects on body weight, body fat content, and waist circumference was demonstrated in a meta-analysis by Lauche et al., though they noted improved BMI in people with above-normal body weight (overweight or obesity) and a significant impact of yoga on WHR in healthy adults [33].

The frequency of classes may have influenced the results, although the available literature on the subject does not specifically emphasize that the training cycle impacts this. However, the training sessions usually lasted longer (ten or more weeks, with two or more units per week) or shorter, but more training sessions were carried out per week (3 or more). Moreover, most of the women examined had a normal BMI, which could also have contributed to the fact there were no BMI differences before and after training. Further research with a larger group of women and a greater number of training sessions is recommended.

Limitations

A limitation of the research is the small number of women included in the study.

Conclusions

The eight-week yoga training significantly improved the quality of life of the enrolled women, with significant changes observed in the PF, RP, BP, GH, VT, SF, and MH domains, as well as the PCS and MCS composite domains of physical health. Furthermore, a decreasing tendency was observed in the incidence of overweight and obesity among study participants.

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