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SHORT-TERM YOGA BREATHING INTERVENTION IMPROVES BLOOD OXYGENATION, ACTUAL EMOTIONAL STATE AND RESILIENCE SCORE IN POSTMENOPAUSAL WOMEN

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Abstract: *Negative emotional states occurring in postmenopausal women are influenced by experiencing psychosomatic changes. It seems that the application of yoga breathing techniques could lead to an improvement in the emotional state, to an increase in vitality and resistance. The aim of the study was to investigate benefits of a 4-week yoga breathing intervention according to the "System Yoga in Daily Life ©" on blood oxygenation, heart rate, resilience and mood improvement in postmenopausal women. Postmenopausal women (N = 16, age range 53-69, 61.5 ± 7.7 years) were investigated PRE and POST the intervention by diagnostic methods: the Finger Pulse Oximeter Tool, Profile of Mood States Survey POMS-short version and Connor-Davidson Resilience Scale. Postmenopausal women completed the 4-week intervention based on yoga breathing exercises performed once a day in the evening for 30-40 minutes. Statistical correlation analysis was performed using the JAMOVI statistical program. The realized yoga breathing intervention led to a significant improvement in blood oxygenation parameters and a reduction in heart rate. Furthermore, significant positive score changes were found in the following factors: Tension, Fatigue, Anger, Depression and Confusion. The Vitality factor score significantly increased. The monitored postmenopausal women also had a significantly higher Resilience score after the completed intervention. We can conclude, that the short-term yoga breathing intervention appears to be very effective in terms of solving negative psychological states in postmenopausal women. The program can be recommended for the practice of counseling and coaching of healthy lifestyle. It can also be used in spa care and in physiotherapy care for postmenopausal women.*

Keywords: *yoga breathing, wellbeing, postmenopausal period, resilience, the „System Yoga in Daily Life ©"*

Introduction

Breath is one of the basic biorhythms that we can easily monitor. It perfectly connects the somatic-mental areas. With the help of the breath, we can regulate our health, but also our expressions and emotional movements (e.g. fear, anxiety). Life is not possible without breath. Emotional tension has a negative effect on the rhythm and depth of breathing. However, it means that the psychological state can also be retroactively influenced through the deliberate regulation of the breath. Regulated breathing can dissolve the consequences of unprocessed stress, activate attention, relieve pain, overcome fatigue, ensure good digestion, facilitate

peaceful sleep, and calm aggression (Sood, R., Sood, A., Wolf, et al, 2013, Krejčí, Kornatovská, 2017).
Breathing is a process controlled by the visceral nerves, so it is mainly an unconscious act. However, since the breath can be controlled by the will, an initially unconscious movement can be converted into a conscious activity. And so mere mechanical breathing exercises, without inner concentration, are not effective enough. What is decisive is the attention and experience with which the breathing exercises are performed. Re-education of breathing patterns is necessary for practically every person. Generally, only a little attention is paid to the culture of breathing. Few people breathe fully and deeply, slowly, and rhythmically, as it should correspond to the structure of the human body and the demands of a healthy lifestyle. Perhaps only very young children breathe correctly, adults only in sleep. Breathing mechanisms, which depend mostly on mental balance, are often disturbed from childhood to such an extent that they cease to function harmoniously (Maheshwarananda, 2000; Oriňáková, 2019).

Breathing is truly unique in its effect on the organism. This is pointed out by the psychology of breathing and at the same time draws attention to the inseparability of human physiology and human behavior, where breathing plays a key role in maintaining homeostasis and self-regulation (Pandi-Perumal, Spence, Srivastava, et al., 2022):

- Respiration is controlled centrally and peripherally, affecting all cells in the body.
- Breathing goes to all parts of the body, any part of the body can be so called "breathed" (relaxation, pain relief, etc.).
- Breathing is continuous. We can realize it in every moment of life.
- Breathing can influence emotions, memories, thoughts, physical symptoms, self-concept and self-perception and even change personality.
- Breathing can be free and restricted, conscious and unconscious.
- Breathing is important for maintaining homeostasis (acid-base balance, electrolyte balance, and oxygen and glucose supply).
- Breathing is very important for social contacts during verbal communication.
- Breathing has a reflexive character, but it comprehensively connects a person with the environment.

Menopause is a common life process that occurs throughout women's lives. It is a physiological change and not a disease (Jayabharathi, Judie, 2014; Augoulea, Moros, Lykeridou, et al., 2019). During menopause, women mainly experience symptoms such as vasomotor flashes, perspiration, insomnia, heart palpitations, mood disorders, anxiety, fatigue, irritability (Schaedel, Holloway, Bruce, & Rymer, 2021).

Breathing techniques make possibility to have control in release of mental and somatic tension. The benefits of pranayama (yogic methods of breathing control) can help increase or decrease blood pressure depending on the chosen pranayama breathing technique. Pranayama may influence the physiological systems (Saoji, Raghavendra, & Manjunath, 2019; Kornatovská, & Krejčí, 2022). Yoga exercises including pranayama techniques reduced vasomotor symptoms (5 trials, standardized mean difference (SMD) −0.27, 95% CI −0.49 to −0.05) and psychological symptoms (6 trials, SDM −0.32; 95% CI −0.47 to −0.17). Results from the meta-analysis suggest that yoga may be a useful therapy to manage bothersome vasomotor

and psychological symptoms (Shepherd-Banigan, Goldstein, Coeytaux, et al., 2017; Swain, Nanda, & Das, 2021).
The “System Yoga in Daily Life ©” is based on the traditional Indian concept of Yoga Vedanta and develops the human health potential systematically from simple exercise units to the most demanding training techniques. All breathing techniques from “System Yoga in Daily Life ©”, which should have a calming effect, have the following recommendations (Kornatovská & Krejčí, 2022; Krejčí, 2021):

- The breath should be slow, rhythmic, full and deep.
- The first step to correcting distorted breathing patterns is to restore nose breathing and thus replace emergency mouth breathing.
- Short and shallow breath is unhealthy. It causes restlessness, nervousness and tension in the body.
- The healthiest is calm, deep and slow breathing, which is characteristic of a balanced and satisfied person. It is good for us to learn "full yoga breathing".

There is a diverse alternation of three types of breathing: Clavicle breathing is the least healthy way of breathing. It's short and fast. Short and fast breathing is associated with a short life; Costal breathing is the most widespread method of respiration, is slower, but still shallow. The result is tension and nervousness; Diaphragmatic breathing is the most effective of the three methods. It's slow and deep. Deep and slow breathing is an important prerequisite for a healthy and long life. Only the interplay of all the mentioned types of breathing into one whole represents the "full yoga breathing" (Bednár, Kňazovická, Melichová, 2020).

At the same time, it is important to develop and automate breathing through the nose with the gradual lengthening and slowing down of breathing sequences and the inclusion of the so-called "Kumbhak", i.e. breath holding, which induces adaptive changes in the oxygen debt in the organism and, with regular training, induces benefits like those of endurance running.
According to the “System Yoga in Daily Life ©”, the breathing cycle consists of four breathing sequences:

1. breath (puraka),
2. breath holding after inhalation (antar kumbhak),
3. exhalation (rechaka)
4. breath holding after exhalation (bahir kumbhak).

Their mutual ratio, number of repetitions, rhythm, lengths of hold, etc., lead to activating or inhibiting effects. By breathing through the nose, breathing sequences can be gradually lengthened and slowed down (Repko, 2022; Maheshwarananda, 2021).
Breathing exercises in yoga are performed lying down or in combination with a movement component (e.g. exercise "cat"), especially in a sitting position, classically in one of the yoga sitting positions. However, it can also be performed while sitting on a chair, a low stool on a pillow, etc. It is important to achieve an upright and relaxed body position while sitting. It is recommended to perform breathing exercises around three hours after a meal (Kornatovská 2014; Feldman & Del Negro, 2006).

Better physical and emotional functioning, greater resilience, and lower depression are associated with more positive attitudes toward aging in postmenopausal women. Modifying attitudes toward one's own aging may have the potential to influence a wide range of health and aging-related outcomes. Resilience has a positive effect on the experience of menopausal symptoms, with higher resilience being associated with fewer and milder physical and psychological symptoms of menopause (Süss, Ehlert, 2020). The importance of yoga breathing lies in the fact that it enables the

intervention of the will in the otherwise involuntary activity of the internal organs and thus opens the way to their possible regulation. Yoga breathing exercises not only affect breathing functions, but also affect the psyche, muscle tension and the function of other internal organs in the chest and abdomen area. The respiratory centers controlling breathing have a significant effect on the entire central nervous system (Süss & Ehlert, 2020).

Emotional tension has a negative effect on the rhythm and depth of breathing (Wyrwich, Yu 2011). Breathing is a process controlled by the visceral nerves, so it is mainly an unconscious act. However, since the breath can be controlled by will, an initially unconscious movement can be converted into a conscious activity. Breathing through the nose with inner attention to the process of inhaling and exhaling has a calming effect.

2. Aim, Hypotheses

The aim of the presented study was to investigate benefits of a 4-week intervention, based on pranayama techniques with calming effect according to the “System Yoga in Daily Life ©”, on blood oxygenation, heart rate and resilience and mood improvement in postmenopausal women.

Based on the established aim, tasks and analysis of literary sources, the following hypotheses were formulated:

H1: After the yoga breathing intervention, the blood saturation will increase significantly in the group of monitored women.

H2: After the yoga breathing intervention, the Vitality score will increase significantly in the group of monitored women.

H3: After the yoga breathing intervention, the Resilience score will increase significantly in the group of monitored women.

3. Methodology

3.1 Subjects, Procedure

The research sample consisted of 16 postmenopausal women (age range 53-69, 61.5 ± 7.7 years), living in Prague, in the capitol of the Czech Republic. Exclusion criteria were asthma, chronic obstructive pulmonary disease, heart disease, ongoing treatment for oncological diseases and hormone replacement therapy. The selected postmenopausal women completed the 4-week yoga breathing intervention program, based on techniques according to the “System Yoga in Daily Life ©”. Written informed consent to participation in the study was obtained. Participants were informed about the assessments and intervention. Research conformed to the requirements stipulated in the Declaration of Helsinki.

Before the 4-week yogic breathing intervention, two days of careful training in oximeter measurement and basic training in applied exercises were carried out with a group of women. The women were measured on the Connor Resilience Scale just before and just after the start of the intervention. POMS testing was performed in the second exercise unit of week 1, in the first unit of week 3, and in the last unit of week 4. Oximeter measurements were performed by the participating women every day, always before and after the interventional exercise unit.**3.2**

Diagnostics

Pulse oximetry – tool OxyWatch MD300C11 (Jubran, 2015)

The used tool OxyWatch MD300C11 is a finger pulse oximeter for rapid detection of blood oxygen saturation (SpO2) and heart rate in adult and pediatric patients in home and hospital environments. Pulse oximetry is a non-invasive method for measuring the amount of oxygen bound to hemoglobin (Jubran 2015). The pulse finger oximeter is small in size, its shape resembles a clothes

peg. It is easy to use to monitor saturation status and heart rate in any environment. All participants received the same model of pulse finger oximeter, which has a certificate of compliance, measurement accuracy ± 2%.

Connor-Davidson Resilience Scale CD-RISC (Connor-Davidson, 2003)

The Connor-Davidson Resilience Scale consists of 25 items, which are evaluated on a five-point Likert scale ranging from 0 to 4: not true at all (0), rarely true (1), sometimes true (2), often true (3), and true nearly all of the time (4) – these ratings result in a number between 0–100, and higher scores indicate higher resilience. (Connor, Davidson, 2003). The average person from the normal population ranges around 70-80 points.

Profile of Mood States POMS, short version (Curran, Andrykowski, & Studts,1995; Stuchlíková, Man, 2005)

A shorter version of the standardized POMS questionnaire in the Czech version (Stuchlíková, Man, 2005) was used to diagnose changes during the intervention unit in six dimensions, i.e. A (Anger), F (Fatigue), D (Depression), C (Confusion), T (Tension). POMS is considered a quick method to profile emotional states and moods, especially in connection with the need to monitor the effect of a short intervention, in our case before and after the yoga breathing intervention unit lasting 30 minutes.

3.3 Intervention

The intervention lasted 4 weeks. Every day, the women performed a prescribed yoga breathing intervention unit at home, which consisted of exercises to activate and engage the respiratory muscles in the breathing process, divided into two exercise units, one for the first two weeks, the other for the second two weeks. The exercises were performed lying on the back, sitting or kneeling. The set of exercises was based on the concept "*Sarva Hita Asanas*" (meaning "Exercises that are good for everyone") of the 1st level of the "System Yoga in daily life ©" (Maheshvarananda, 2000). These are simple and safe exercises with no contraindications accompanied by the practice of three phases of the breath inhalation (in abdominal, thoracic, subclavian areas). Detail descriptions of the exercises and their benefits are given on the websites Yoga in Daily Life (2024).

Intervention unit composition of exercises for the first two weeks: Ananda asana (relaxation with diaphragmatic and full breathing); Breath exercise with arms straight; Twisting with Legs Bent; Marjari "cat"; Hasta utthana asana (Crossing the arms above the head); Nadi Shodhana Pranayama Level 1 "Purification of the Nervous System".

Intervention unit composition of exercises for the first two weeks: Ananda asana (relaxation with diaphragmatic and full breathing); Pavana mukta asana; Twisting with Legs Straight; Marjari "cat"; Shoulder Circling with Arms Bent; Nadi Shodhana Pranayama Level 1 "Purification of the Nervous System".

3.4 Statistics

Statistical analysis was performed using descriptive statistical methods using numerical and graphical methods in Microsoft Excel 2016. Absolute and relative frequencies and the paired t-test was used to compare Pre/Post measurements were used. Statistical correlation analysis was performed using the JAMOVI statistical program.

3. Results and Discussion

4.1 Blood oxygenation and heart rate results

The lowest blood oxygenation value measured was 81 before exercise, after

exercise 92. The highest blood oxygenation value measured was 99 before exercise, after exercise the value was 100. The average oxygenation value before exercise was 96.8 and after exercise 97.4. (Table 1).

Table 1: Blood oxygenation PRE/POST – basic characteristics of the group (n = 16 women)

Phases	N	Diameter	Median	SD	SE
PRE	16	96.8	97.3	1.079	0.270
POST	16	97.4	97.3	0.801	0.200

On the Figure 1, we can see the graphical presentation of the measured average values of oxygenation. It shows the time series of the oxygenation averages of individual participants during the 28 days of PRE and POST measurements.

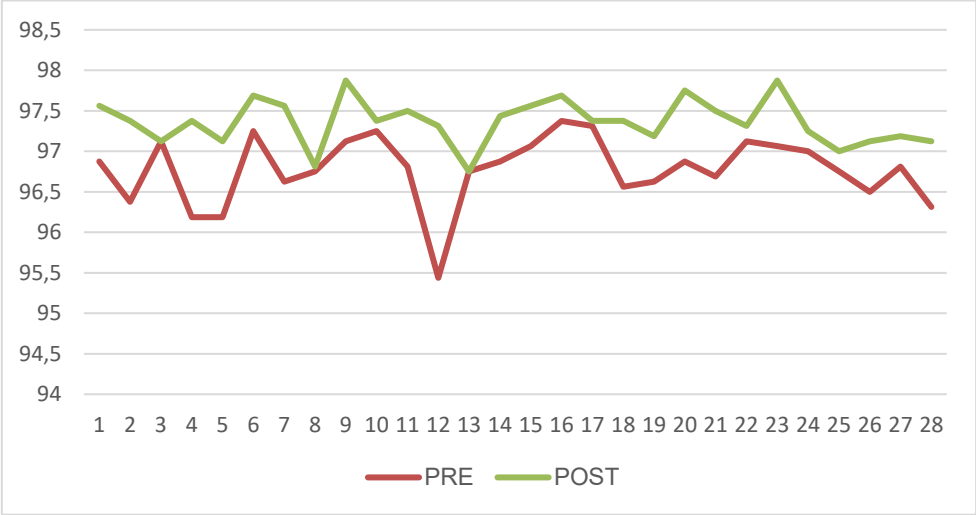

Figure 1. Blood oxygenation PRE/POST - average daily values in 28 days (n = 16 women)

The lowest heart rate measured was 60 before exercise, 54 after exercise. The highest measured heart rate was 85 before exercise, 89 after exercise. The average heart rate before exercise was 70.2 and after exercise was 67.2 (Table 2, Figure 2).

Table 2: Heart rate PRE and POST - basic statistical characteristics (n = 16 women)

	N	Mean	Median	SD	SE
PRE	16	70.2	69.8	4.800	1.200
POST	16	67.2	66.3	5.453	1.363

In the Figure 2, you can see the time series of heart rate averages of individual participants during the 28 days of PRE and POST measurements. To assess the influence of individual variables, a regression model with a random effect was constructed (Table 2), where the explained variable is the heart rate of the participants, the explanatory variable is the type of measurement (PRE and POST the yoga breathing intervention unit) and the monitored day (order 1 to 28). Each participant could have different input characteristics in terms of heart rate and a different response to exercise, therefore the participant was considered as a variable entering the model as a random effect. A similar model cannot be used for the explained variable due to the specific characteristics of the distribution.

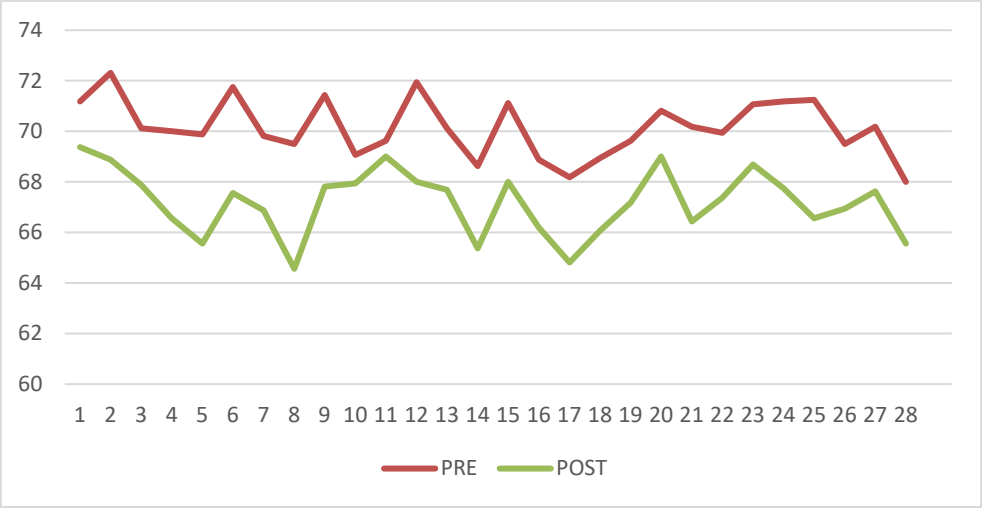

Figure 2. Heart rate PRE and POST - average daily values in 28 days (n = 16 women).

From the point of view of the studied variables, it turns out that it plays a statistically significant role when the heart rate was taken, whether PRE/POST the intervention unit (Table 3). It can therefore be interpreted that, on average, the pressure drops by 2.8 units due to this effect.

Table 3: Fixed effects parameter estimates of heart rate, type of measurement (PRE/ POST intervention unit) and observed day (order 1 - 28), (n = 16 women)

NAME	Effect	Estimate	SE	Df	T	P
(Intercept)	(Intercept)	68.750	1.265	15.0	54.338	< .001
Period	Pre – Post	-2.803	0.4926	15.0	-5.691	< .001
Period	DAY 1-28	-0.0388	0.0392	15.0	-0.990	0.338

4.2 Results of the POMS questionnaire

The answers in the questionnaire were subsequently divided into six factors: 1 – Anger, 2 – Fatigue, 3 – Vitality, 4 – Depression, 5 – Confusion, 6 – Tension (Stuchlíková, Man, 2005). In each of these categories, the relevant set of ordinal questions was evaluated and then a total scale of the given evaluation was created (Figure 3, Figure 4).

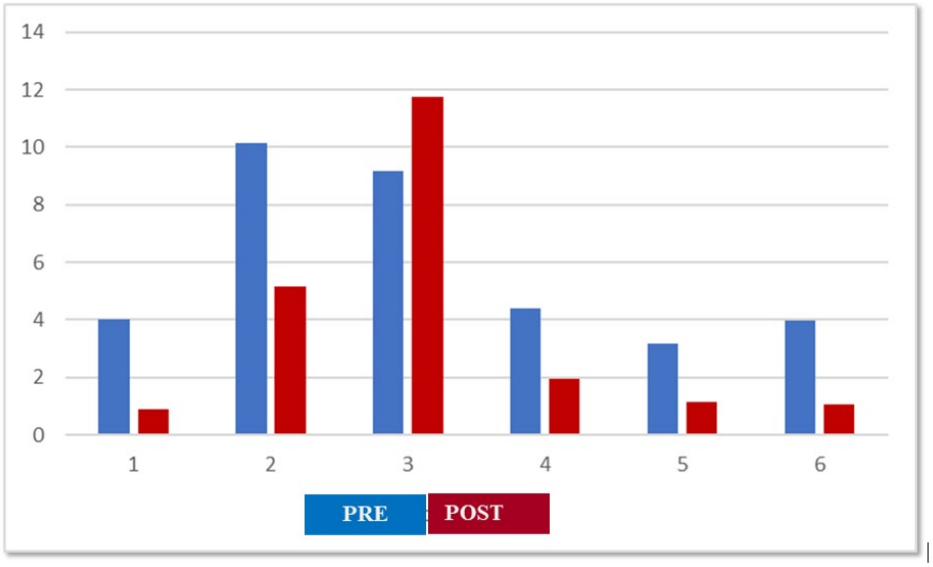

Figure 3. Comparison of the six factors: 1 – Anger, 2 – Fatigue, 3 – Vitality, 4 – Depression, 5 – Confusion, 6 – Tension, average scores of the PRE/POST intervention unit (n = 16 women)

The Figure 3 shows a comparison of the variable in relation to the period during which the data was collected. The blue color indicates the average value of the answers in the POMS A questionnaire, the red color the average value obtained from the answers of the POMS B questionnaire.

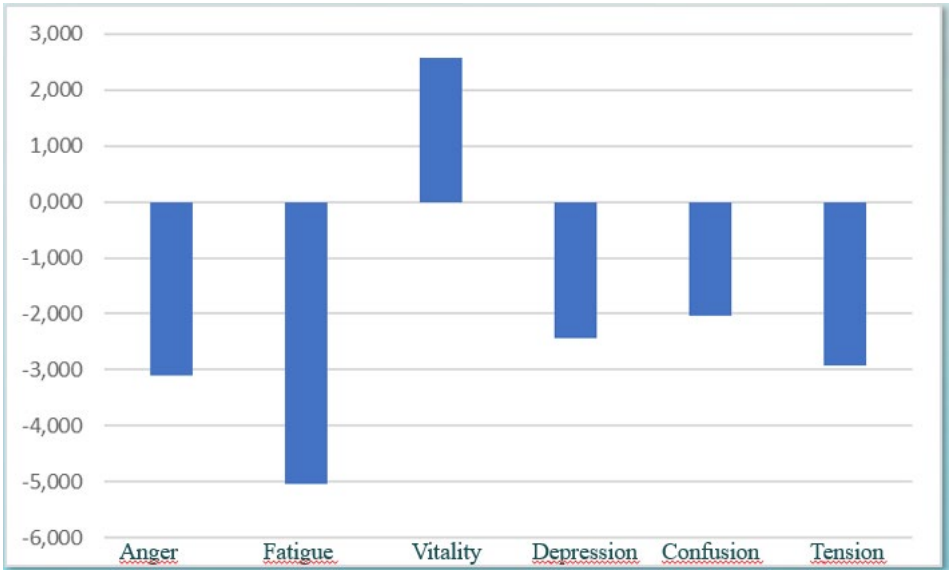

Figure 4. Average change in participant scores PRE/POST intervention unit (n = 16 women)

Results of the resilience score

Based on the answers of the sixteen participants in the resilience questionnaire, a score was created as a total scale of the given answers. Participants completed a questionnaire before and after a 4-week yogic breathing intervention. The aim of the analysis was to compare whether the

scores achieved at the beginning and at the end of the monitored period are statistically significantly different. Since the total scale is calculated from twenty-five questions that were asked on a five-point scale, the resulting score can be considered a quantitative continuous variable. In Figure 5, at the beginning of monitoring, participants achieve a lower mean score with a higher standard deviation than at the end of monitoring. At the start of the intervention, the mean score was 67.365. At the end of the intervention 70 937. The difference between the mean PRE/POST scores is 3.572. A paired t-test for two dependent groups was used to compare PRE/POST results. A significant improvement in mean resilience scores was demonstrated from baseline.

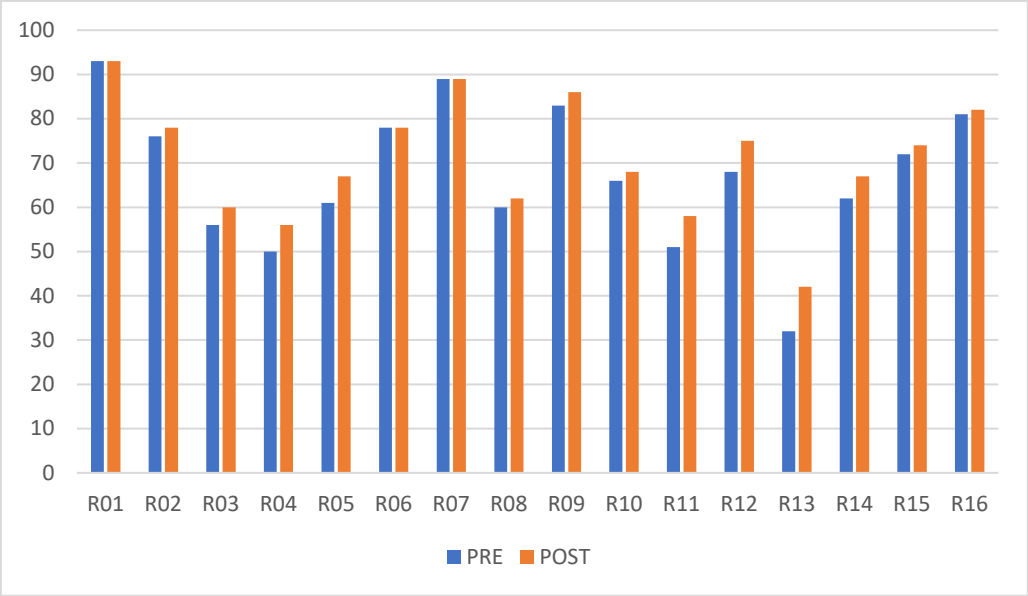

Figure 5. Results of PRE and POST scores for individual participants, (n = 16 women)

The presented study was primarily concerned with comparing the current psychological state and changes in the physical sphere (saturation and heart rate) before and after the practicing of the yoga breathing intervention unit. However, it was also investigated whether the 28-day intervention would demonstrate significant changes in vitality and tension. We can agree with previous research by Krejčí & Hornof (2017) and Swain, Nanda, & Das (2021), that a yoga intervention demonstrates significant improvements in menopause-specific quality of life across vasomotor, psychosocial, and physical symptoms.

Our previous studies (Krejčí, Psotta, Hill, Kajzar, Jandová, Hošek, 2020; Krejčí, 2021) described significant somatic-mental balance improvements after short-term yoga interventions in elderly, when especially the disappearance of pain and stiffness in the shoulder and neck area and the breathing improvement was accented. Everyone's self-confidence improved to varying degrees, resistance to stressful situations increased, better mood and improved sleep quality were also described. A more lasting effect can also be expected for stays (spa, wellness, relaxation centers away from home), where women have time and space for themselves. (Sood et al. 2013) showed in their research that doing breathing techniques twice a day seems to be most beneficial than breathing once a day. It can therefore be assumed that the intensity and duration of the exercises lead to better and more permanent results as

similarly declare Krejčí & Jandová, (2020) and Kornatovska & Rehor (2021)

What is important to mention is that the woman's intervention program stimulated the motivation to exercise regularly, devote more time to herself, feel satisfied with herself and enjoy life. Thus, one can agree with Jayabharathi, Judie (2014), that yoga is an effective complementary health approach to improve quality of life in postmenopausal women. Socializing and sharing is important for postmenopausal women. To achieve a deeper experience, it seems more effective to perform exercises in wellness facilities or residential courses, preferably in groups. To lead women to realize that menopause is not the end of life, in the sense of accepting aging as a maturing process that can bring positive benefits to women's lives in general. Modifying attitudes toward one's own aging may have the potential to influence a wide range of health and successful aging-related outcomes as Süss, Ehlert (2020) demonstrated.

Better results could be achieved by exercising more intensively and possibly changing the choice of breathing exercises. Sood et al. (2013) demonstrated that the intensity and duration of the exercise intervention led to better and more lasting results.

Conclusion

The presented study examined 3 hypotheses. The hypothesis H1 “After the yoga breathing intervention, the blood saturation will increase significantly in the group of monitored women” was verified. It can be declared that performing breathing exercises has a significant effect on the increasing blood saturation, immediately after the yoga breathing intervention unit. Also the change in heart rate measured before and after the yoga breathing intervention unit showed a statistically significant improvement.

The hypotheses H2 “After the yoga breathing intervention, the Vitality score will increase significantly in the group of monitored women” was verified. The POMS questionnaire showed the significant differences of the intervention effects on the optimization of emotional states of the monitored postmenopausal women. The statistically significant effect was shown on the increase of the factor "Vitality". We can conclude that the intervention had a significant increase in vitality. If it is looking about a change in the "Tension" category, there is again a statistically significant relationship. The diagnostic tool POMS is very sensitive to changes in current emotional states and can be recommended as a suitable diagnostic tool for similar research on intervention effects.

The results of the PRE/POST resilience score evaluation confirmed the improvement in the resilience. The hypotheses H3 “After the yoga breathing intervention, the Resilience score will increase significantly in the group of monitored women” was verified.

It can be concluded that practicing of the breathing exercises based on the “System Yoga in daily life ©" seems to be safe, effective and beneficial especially of negative psychological states solving in postmenopausal women.

We can recommend the 4-week yoga breathing intervention also for the practice of counseling and coaching. It can also be used in spa care and in physiotherapy care for postmenopausal women. The study may be inspirative for understanding of the somatic-mental effects for further research in connection with the quality of life in the postmenopausal female population.

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