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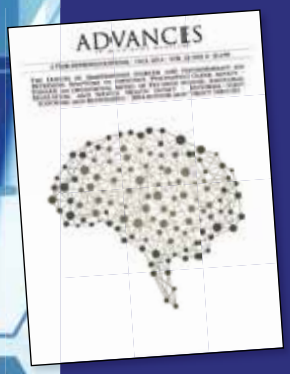

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ORIGINAL RESEARCH

Qigong in Perceptual Auditory Attention: Tool to Improve Sound Integration in Autism Spectrum Disorders

Lara Teixeira Lopes, PsyD, MTCM; Luis Carlos Matos, MTCM; Mario Gonçalves, MTCM; Bruno Ramos, BSc; Maria Joao Santos, MTCM; Jorge Machado, PhD; Henry Johannes Greten, PhD

ABSTRACT

Context • Qigong, a mind-body practice in traditional Chinese medicine (TCM), can improve cognitive functions, emotional balance, attention, multitask management, stress-coping, and well-being. One limitation of Qigong research is a lack of adequate controls.

Objective • The current study intended to evaluate whether a single 5-min practice of a White Ball (WB) Qigong exercise could improve the perceptual auditory attention, divided and focused, in adults and whether obtaining potential effects would require a minimum level of training.

Design • The research team designed a prospective, randomized, placebo-controlled, and single-blinded study.

Setting • The study took place at the Institute of Biomedical Sciences (ICBAS) at the University of Porto in Porto, Portugal.

Participants • Participants were 55 students at the University of Porto, 30 of whom were students attending the second year of medical school at ICBAS with no experience in Qigong and 25 of whom were students in the specialization and Master's programs in TCM with experience in Qigong.

Intervention • The research team randomly distributed the 30 participants without experience into two groups, a negative control group (n = 15), who watched a wildlife video for 5 min in an orthostatic position, and a positive control group , the verum Qigong group (n = 15), who participated in 5 min of Qigong practice. The Qigong-practitioner group (n = 25), the intervention group, participated in the same 5-min Qigong, doing it with expertise.

Outcome Measures • The study measured reaction time (RT) under two experimental conditions, one an auditory RT task and the second an auditory RT task with visual distraction. The procedure was constant for all the studied groups.

Results • Postintervention, the reaction time (RT) in the negative control and the verum Qigong groups hadn't changed significantly ($P > .05$), while that of the Qigong-practitioner group had decreased significantly, with shorter RTs under the two experimental conditions, with $P = .006$ for the auditory RT and $P = .003$ for the auditory + visual distraction. Qigong may induce a conditioning effect that comes with regular practice.

Conclusions • The WB Qigong had a positive effect on the AA mechanism, with a significant reduction in RT. The results support the importance of practice to achieve positive effects. People with neurodevelopmental disorders, such as autism and ADHD, struggle every day for sensory integration of AA mechanisms. Qigong can be taught and easily learned from the age of 2 years until senior ages, and it's a safe and very low-cost intervention that deserves to be researched further in clinical trials. These potential benefits of Qigong should be confirmed by future studies. (*Adv Mind Body Med.* 2022;36(3):4-11.)

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During the past century, scientists developed the foundations of basic medical science, with the period being described as the era of mechanical medicine.[1,2] More recently, interest in mind-body medicine has increased. This new area of research has explored the role of the mind in treatments such as counseling, relaxation, and biofeedback and others in the field of alternative therapies, such as Qigong.[1,2]

Qigong

Qigong is a therapeutic modality of traditional Chinese medicine (TCM) used to enhance physical and mental health and to prevent illness. In recent decades, researchers have explored the health benefits of Qigong. As shown by some published studies, Qigong can produce significant effects on health when practiced with expertise.[3-14] It combines static, slow, and soft movements with breath control and a specific mental state of awareness and imagination.[15]

Posadzki evaluated the sensations, perceived benefits, expectations, and challenges of qualified Qigong practitioners in a study on the psychology of Qigong.[15] That study differentiated the sensations felt when one group of participants had an automatic memory of the Qigong movements from experience as compared to another group that faced a challenging situation when learning the techniques. The researchers concluded that the previous experience on Qigong seemed to help to reduce performance insecurity and distraction, triggering focused attention while practicing.

Qigong practice induces physiological changes that are related to the traditional viewpoint of health regulation, in which homeostasis—the balance between yin and yang—is promoted when the qi flows smoothly without resistance and excess.[16] From a Western perspective, these exercises can be understood as traditional, vegetative feedback exercises that are able to trigger vegetative functional changes, those involving bodily processes most directly concerned with maintenance of life.[12]

Biofeedback integrates a comprehensive treatment approach called clinical psychophysiology, which is a form of mind-body medicine that uses current knowledge of learning principles and an understanding of physiological functioning to produce changes in the mind and body. The acquisition of knowledge to develop voluntary control skills enhances self-regulation, allowing individuals to play an active role in the management of their health and well-being.[1]

Practitioners often perceive bodily sensations and sensory experiences in Qigong and Tai Chi as well as in meditation and mindfulness-based practices. In them, self-regulation involves the interaction of brain, body, and environment, managing interoceptive, proprioceptive, kinesthetic, tactile, and spatial information.[17]

Some recent studies have suggested that movement-based contemplative practices, such as Qigong, can improve cognitive performance and processing capacity during multitasking challenges.[17,18-21] White Ball (WB) Qigong is a static vegetative biofeedback exercise developed by the Heidelberg model of TCM and adapted from the ancient movement of Zhan Zhuang Daoist qigong practice, commonly known as "standing like a tree" or "standing like a post". It is performed by standing in an upright orthostatic position following the instructions: knees slightly bent but not more than until the toes line, hip anterovection to correct low back curvature, tongue resting on top of the mouth, hand in front of the belly as if gentling holding a white rice paper ball, lower belly breathing in and out through the nose, connecting to; 1. the earth by breathing and focus on Kidney 1 acupuncture points (on the sole of feet), 2. the sky breathing and focus on the *bai hui* acupuncture point (on top of the head) and, 3. to the *dantian* (3 *cuns* below the umbilicus) the converging point of all meridians. This exercise combines the mindful work to move the *Qi* (vital energy or potential function) through breathing and focus intention on ren mai/du mai, kidney and pericardium meridians with a full body tendinous-muscular relaxation. Meditating about breathing through meridians and related sensations activates the interoceptive consciousness thus improving sympathetic/parasympathetic homeostatic balance. Furthermore, the bending knees and holding the ball static posture is a rich proprioceptive input, which is very known in sensory integration therapy as a treasured resource to calm anxiety and reduce fight flight or freeze responses in behavioral and sensory processing disorders.

Other studies have shown the efficacy of WB Qigong on cognitive and stress-management mechanisms. Those include anxiety,[13,22] behavioral disorders such as ADHD and autism[16], attention,[22,23] and burnout-symptoms management,[24] with all of the studies suggesting positive effects and performance improvements as a result of a Qigong regular practice of 5 min twice a day daily.

Attention

Neurodevelopmental complaints, such as autism spectrum disorders (ASD) and attention deficit and hyperactivity disorder (ADHD), have hugely increased during recent decades. Data from the Centers for Disease Control and Prevention suggested that one out of 44 American children had ASD in 2018 and one out of 11 had ADHD in 2019. The estimated costs of ASD were $268 billion in 2015, and a recent literature review estimated that its financial burden will be $461 billion in 2025.[25-27] In both disorders, sensory regulation is crucial for developing functional behavior,—sharing a common focus on something (joint attention), and other relevant socio-emotional skills.

Attention is crucial in perception and voluntary recall and in the development of skills. It also has a key role in biomechanical coordination by minimizing interference while a person accomplishes tasks. The immediate effects of attention are perceiving, conceiving, distinguishing, remembering, and shortening of reaction time.[28]

Research from the field of cognitive psychology has allowed scientists to understand some of the processes operating between a stimulus and a response.[29] Very recent preliminary research has found that the difficulty of listening

in noisy environments is a common complaint of adults with ASD, suggesting that auditory attention (AA) is a difficulty not resolved during the growing process.

Emmons et al found "overall worse task performance in the ASD group, with lower scores across all experimental conditions, compared to those having typical neurological development."[30] Individuals with ASD not only showed difficulty in switching attention between competing auditory streams, but they also showed difficulty maintaining attention on one of two simultaneous auditory streams. O'Connor's review suggested broad difficulties with selective AA in ASD, which was consistent with past research on general auditory-processing differences within ASD children and adolescents.[31]

ASD treatment for toddlers focuses mostly on applied behavior analysis (ABA), combined with speech therapy when it affects verbal communication. School-aged children might also benefit from a special-needs teacher. It's worth noting that regardless of their great therapeutic value, none of those specialists helps to develop skills related to AA or other sensory-input integration.

Cognition, the act of knowing, perceiving, or encoding something, is frequently associated with stimuli of sensory-input origin. In that process, Qin et al found that stimulus-driven attentional control was faster and stronger than goal-driven attentional control, requiring less effort in terms of mental processing to decide which stimulus was the most relevant to a current goal.[32]

Psychological approaches for improving attention usually studied the integration of mechanisms such as the divided attention found with cross-modal task difficulty and parallel processing (eg. one task of auditory stimuli input combined with a visual task occurring at the same processing time) as well as focused auditory attention.[33,34] In this field, multitask studies to evaluate and/or maximize performance are well-known.[35,36] In contrast, studies to evaluate peak performance for auditory attention are rare.

In addition to its utility for ASD and ADHD individuals, some professionals in the general population, such as musicians and call-center workers, also might significantly benefit from a better AA performance while in the presence of distracting visual subsidiary tasks. In studies on active attention, both stimuli and tasks should require minimal processing effort for activation.

The current research team developed two hypotheses: (1) that the practice of 5 min of WB Qigong would shorten reaction time (RT) and improve focused AA in the first experimental condition—listening to a randomized sound sequence, with closed eyes, and (2) that the practice of 5 min of WB Qigong would shorten RT and improve auditory attention in a cross-modal difficulty type with divided attention, in the second experimental condition—listening to a randomized sound sequence, with opened eyes plus visual distraction.

The current study intended to evaluate whether a single 5-min practice of a WB Qigong exercise could improve the perceptual auditory attention, divided and focused, in adults and whether obtaining potential effects would require a minimum level of training.

METHODS

Participants

The research team designed a prospective, randomized, placebo-controlled, and single-blinded study, which was carried out at the Institute of Biomedical Sciences (ICBAS) at the University of Porto in Porto, Portugal. The research team recruited participants for the two control groups who were students attending the second year of medical school at ICBAS, and for the intervention group, students who were in the specialization and Master's programs in TCM. Recruitment of those students was done with the help of two of their teachers who kindly allowed us to introduce the research project for 15 minutes at the beginning of their classes. Individuals interested in participating signed a list of recruitment with their names and emails and selected one of the available dates/hours to come to the experimental procedure.

Potential participants were included in the control groups if they: (1) volunteered to participate, (2) were healthy, and (3) had no previous knowledge on Qigong. Potential participants were included in the Qigong-practitioner group if they: (1) volunteered to participate, (2) were healthy, and (3) had had a Qigong regular practice for a minimum of 3 months, defined as practice at least once per week for 50 minutes or more.

Participants signed informed consents in duplicate, and they kept one copy. The study followed all the ethical requirements of the Institute Biomedical Sciences at the University of Porto and according to the Helsinki Declaration.

Procedures

Group allocation and randomization. The research team had recently developed criteria for what it considered a real placebo Qigong and adopted that methodology to the study. Accordingly, placebo controls should be developed by the usage of vegetative functional assessments such as heart rate variability, thermography, reaction time and electrophysiological measurements, thus excluding major vegetative effects of the exercise, as well as by the usage of psychometric tests and other quantitative evaluations.[37]

The research team allocated potential participants who met the inclusion criteria for the control groups to one of those two groups. The control group, the negative controls, watched a wildlife video for 5 min in an orthostatic position, and the verum Qigong group, the positive control group, participated in 5 min of Qigong practice.

Allocation to the verum Qigong group or the control group, occurred as follows: (1) the research team scheduled every two volunteers for the same time interval, for instance, 9:00 to 9:30 am; (2) upon their arrival, the team asked them to sign their names in a list, and at the same time, informed them about the general purpose of the study, indicating that "We are studying the effects of Qigong, a TCM technique, on

Figure 1. White Ball Standing Qigong Exercise (adapted from Hansen and Hillyard[34]).

attention. The study doesn't involve needles or any other invasive methods and has no harmful side effects"; (3) afterward, they signed written consent, and the team allocated them individually to the groups by flipping a coin; heads indicated allocation to the verum Qigong group, and tails indicated allocation to the control group.

The Qigong-practitioner group with expertise wasn't randomized and had no placebo control, because of the participants' previous experience in Qigong. Experienced practitioners can't be in a placebo group because the simple act of staying in the Qigong orthostatic position, even if just watching a video, could lead to some level of immediate activation of the brain's somatosensory cortex. The group participated in the same 5 min of Qigong as the verum Qigong group did.

Qigong practice. The main researcher, Lara Lopes, provided instruction of the practice to each of the participants, individually and guided the 5 min of Qigong practice in the verum Qigong group and the Qigong-practitioner group. The Qigong-practitioner group had had more than 8 months of practice with the Qigong system during their TCM course; they had practiced the exercise at least once a week for more than 50 minutes. For the intervention, each participant performed the WB Qigong once in 5 min of practice. They performed the practice just that one time.

The main researcher, Lara Lopes, also guided the control group in maintaining the same orthostatic position as the Qigong verum group and Qigong-practitioner group as they watched the wildlife video for 5 min without any instructions.

Outcome Measures. The research used RT as a reliable quantitative measure to test the two hypotheses. Participants' RTs, the main variable, were assessed at baseline (immediately before the 5 m qigong practice) and post-intervention after the Qigong and placebo interventions. The procedure was constant for all the studied groups. Data were collected in individual appointments, managed by Lara Lopes and Bruno Ramos according to the scheduled recruiting list, over 7 days.

The research team assessed and recorded the RT in seconds with a polygraph, both the research hardware and the software, from Biopac MP Systems (Barcelona, Spain).[38] The hardware included the data acquisition MP36R, headphones, and pushbutton hand switch. The research team recorded the RT with the software BSL 4 (Bionic Iberica S.A., Barcelona, Spain), lesson 11, for an RT recording of auditory stimuli.

Intervention

The Qigong exercise for the study was the WB standing exercise according to the Heidelberg model of TCM (Figure 1). Practitioners perform this exercise while imagining holding a 40-cm rice-paper ball in front of the lower Dantian.[39-42] Participants performed the WB Qigong intervention individually once, and it lasted for 5 minutes.

Verum Qigong and Qigong-practitioner groups. The instructor gave clear and simple verbal instructions for the exercise, having the participants use the standing qigong position, the zhan zhuang standing-qigong meditation, also known as the *standing like a tree* movement. The instructions included imagining the holding of a rice-paper ball between their hands, providing Pc8 acupoints activation, and the cleaning and whitening of their energy each time they breathed. The instructions included grounding to the earth through the K1 acupoints, breathing to the Dantian, the seat of life force energy in the body, and connecting to the sky through Baghui, an acupuncture point in the Dumai meridian.

Control group. The control group was blinded to the technique and believed they were practicing a true Qigong exercise. These participants received no previous explanations on Qigong, neither theory nor practice. They were informed that the study was about attention and that they would be asked to practice a guided 5-min Qigong exercise. Whenever the participants questioned the research team about what Qigong is, the team told them that Qigong is a technique used in Chinese medicine. The group adopted the same Qigong orthostatic position as the verum Qigong group, with their arms positioned in an arching fashion while seeing a video of wildlife animals for 5 minutes.

Outcome Measures

The research team used ~~three~~ two important sensory stimuli: (1) auditory, tested by measuring reaction times; (2) visual, with a distraction added to delay the main task that will also be measured by auditory RT.

The team considered that segments S1 and S2, which were among the segments that the software BSL 4 provided, quantified the RT associated with auditory attention. The most relevant psychological attention theories tested in each experimental segment were: (1) focused auditory attention (S1), (2) divided attention from a difficulty type that used a cross-modal task (S2), and (3) parallel processing (S2).

During S1 with the headphones on, the team asked participants to close their eyes and press the polygraph's pushbutton hand switch as soon as they heard each auditory stimuli from a randomized sound sequence. During S2 with the headphones on and with opened eyes, the team asked participants to press the polygraph's pushbutton hand switch as soon as they heard each auditory stimuli from a randomized sound sequence, and simultaneously, to follow movements of LED lights with their other hand. For the visual distraction, the researcher placed a small LED torch at one meter from the participant, holding it in his right hand while performing circular and sinusoidal, fast, large, 360º-grade movements.

Each segment had two sequences of 10 auditory stimuli. The polygraph's hand switch was calibrated before each measurement. Immediately after this baseline measurement, each participant performed the real or placebo Qigong for 5 minutes. At the end of that period, the research team tested him or her according to the two segments (S) described above. The team called the results at baseline time zero (T0) data and those after the Qigong or placebo time one (T1) data.

Statistical Analysis

The research team analyzed the data for statistical significance with the Kolmogorov-Smirnov, t-test paired samples, and Wilcoxon test. The team processed the collected data using the software IBM SPSS Statistics 25 (Companhia Ibm Portuguesa, S.A., Lisboa, Portugal) Because the two inexperienced groups and the experienced group initially had significantly different RT results, the team couldn't verify and validate final differences between groups. The team found that the results for the Qigong-practitioner group were significantly different from those of the verum Qigong group and the negative control group. Therefore, the team could compare only the results of those two groups combined to those of the Qigong-practitioner group. The team also analyzed the differences between baseline and postintervention for Qigong-practitioner group, separately and exclusively.

According to the literature, the team selected an analysis of variance (ANOVA) and Tukey tests to analyze results between the two control groups. To analyze the changes between baseline and postintervention for each group, the team used the *t* and Wilcoxon tests, and because they were paired samples, used the normality *t* test. The team verified normality with the Kolmogorov Smirnov test.

RESULTS

Participants

The study included and analyzed the data of the 30 participants in the negative control and verum Qigong groups, 10 males and 20 females aged between 19 and 23 years old in the combined groups and of the 25 participants in the Qigong-practitioner group, 8 males and 17 females aged between 23 and 40 years old.

RT for the Negative Control and Verum Qigong Groups

Between baseline (T0) and post-intervention (T1), no significant changes in RT for S1 and S2 had occurred for the negative control group but for the verum Qigong group's statistic significant differences were found.

In S1, the T0 for the negative control group was 0.10 seconds faster in the RT auditory task than that of the verum Qigong group, with the control group's RT being 0.22s and the verum Qigong group's RT being 0.32s At T1, after 5 min of Qigong, the control group's RT remained at 0.22s, whereas the verum Qigong group's RT was 0.4 seconds faster, improving their results to 0.28s.

For the S2 task providing auditory stimuli with visual distraction, the control group's RT was 0.29s at T0 and remained the same at T1, whereas the verum Qigong group's RT was 0.38s at T0 and improved to 0.33s at T1, 0.5s faster.

RT for the Qigong-practitioner Group

At baseline, Figures 2 and 3 show that the ANOVA test found that the RTs for the control group and the verum Qigong group combined and the Qigong-practitioner group were already significantly different: (1) for S1, with $P < .001$ for the nonparametric and $P < .001$for the Mann-Whitney test; and (2) for S2, with $P = .200$ for the nonparametric and for the Mann-Whitney test and $P < .001$ for the *t* test for independent samples.

Postintervention, the Qigong-practitioner group had achieved an average improvement of 10% on the S1, at 40 milliseconds faster for auditory stimulation only, and of 12% on the S2, at 50 milliseconds faster for auditory + visual distraction. Significant differences had occurred between baseline and postintervention for both conditions, with $P = .006$ for S1 and $P = .003$ on S2.

DISCUSSION

Attention is one of the most complex neurocognitive mechanisms of the human mind. The results of the current study are in agreement with several brain-mechanism assumptions from cognitive psychology and neuropsychology, suggesting an immediate improvement on cognitive performance after a single 5 min of WB Qigong training if practiced by experienced individuals.

The current study found that Qigong doesn't have beneficial effects on the RT of inexperienced individuals. In contrast, the Qigong-practitioner group showed that previous experience with Qigong was crucial to generating a conditioning effect and improving RT.

Figure 2. Comparison of the Reaction Times Under the S1 Condition for the Negative Control and Verum Qigong Groups Combined and the Qigong-practitioner Group

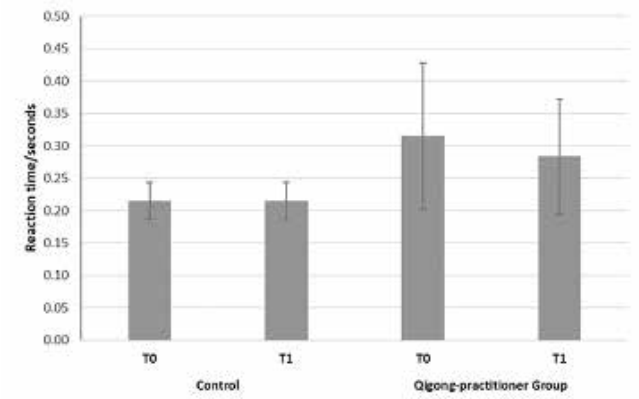
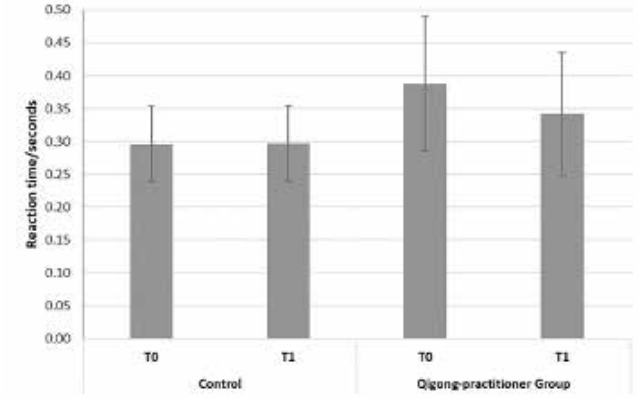


Figure 3. Comparison of the Reaction Times Under the S2 Condition for the Negative Control and Verum Qigong Groups Combined and the Qigong-practitioner Group



In the current study, the lack of positive effects in the verum Qigong group might have been due to participants' inability to focus on a practice that was completely new to them. In that case, participants might have been wondering about learning the correct positions instead of setting free their minds and allowing the Qi to flow freely in the conduits (meridians).

After data analysis, the current research team noticed that the control and verum Qigong groups had an inconsistent RT response, which was faster or slower without a specific tendency. This behavior was opposite to that of the Qigong-practitioner group, which presented a consistent tendency toward a faster RT in both experimental conditions. Moreover, in the S2 experimental condition, which combined an auditory stimulus and a visual distraction, the improvement was even greater than that in the S1 condition. These results point toward the possibility that Qigong can increase the brain's capacity, reducing the sensory, cross-modality interference-effect.

The significant improvement in RT in the Qigong-practitioner group validated the current study's two hypotheses. Thus, a 5-min WB Qigong practice was able to shorten the RT, improving both focused auditory attention ($P = .006$) and auditory divided attention with cross-modal difficulty ($P = .003$). Those results support the importance of expertise in Qigong practice as well as a consolidated theoretical background. That condition allows the mind to focus, allowing the body to relax and achieving a mind-body state that seems to produce positive effects in attention, even when the surrounding conditions are challenging, as seen with the S2 test.

The current research team designed the challenging brain-processing conditions in the S2 test—auditory and visual stimuli—to access parallel processing with the divided attention of cross-modality stimuli. Under those conditions, the results indicated that Qigong can positively enlarge a participant's processing capacity, minimizing the baseline limitations.

The current findings are in agreement with recent studies that suggest that movement-based contemplative practices, such as Qigong, can improve cognitive performance and processing capacity in multitasking challenges.[17,19-24]

As previously mentioned, the current results point toward the importance of training to gain expertise in Qigong to obtain positive effects during the practice. Regular practice leads to conditioning, with the creation of a brain's somatosensory system pattern. This pattern becomes easily recognized in future practices, immediately activating the Qi sensation. According to the current results, the control and verum Qigong groups seem to have had a lack of positive conditioning due to a lack of training.

Limitations and Future Work

The current study had some constraints related to time, equipment and sample sizes. Further studies should consider the following suggestions:

- Replicate the present study with a larger sample.
- Test the results for a Qigong-practitioner group as compared to those of a verum Qigong group, by measuring the RT after 4 weeks of practice two times daily as well as after 3 months of daily practice.
- Use thermography to check if participants are focused on the Qigong exercise. Some studies have shown that when a participant really focuses on the exercise, thinking about the acupoints and breathing, the blood perfusion in those regions (hands, arms, and lower abdomen) as well as the temperature increases.[12,43,44]
- Separate and test two groups according to participants' individualized diagnoses, based on sensations, findings, and vegetative signs, such as an assessment using tongue diagnostic signs of repletion versus depletion. Also, analyze the results for those two groups after the Qigong intervention. The current research team believes that the results for those two groups might support those of the three case-studies published by Matos, LC. because Qigong is known for its homeostatic balance effects.
- In the current team's subjective perception, after Qigong training, the current study's participants performed

significantly better when following the visual distraction of the light's trajectory with one of their hands. To confirm that observation, further studies might pay special attention to the number and amplitude of hits with a posturography device, both at the baseline and after Qigong training.

- Use JAMF attention modeling software to test Qigong effects.[45]
- Test the effects of Qigong on RT with two auditory stimuli at the same time.

Further investigations might consider the possibility of using EEG, event-related brain potentials (ERPs), and magnetic resonance (brain scans), to find out which brain areas are activated in S1 and S3, which focus on AA with individuals having closed eyes, and in S2 and S4, two other segments that the software BSL 4 provides, which focus on visual and auditory tasks simultaneously.

Because the present study has shown statistically significant results in both S1 and S2 experimental conditions and a peak performance improvement in S2 , with additional visual distraction, for the Qigong-practitioner group, the research team welcomes further studies with this type of neurophysiology monitoring to test the following hypotheses: (1) An increase in capacity of a unique brain area can better explain Qigong training's effects on perceptual AA with visual distraction, suggesting an effect on the attention system supra-model and (2) an increase in capacity of several brain areas can better explain Qigong training's effects on the perceptual auditory attention with visual distraction, suggesting an effect on a multimodal-modality attention system.

The research team is aware that physiological differences between men and women, as well as age effects, might have affected the results of the current study. However, due to sample-size limitations, the team wasn't able to divide the groups according to gender. TCM, in general, considers men to be yang and women to be yin. This is believed to influence the Qi direction vector, as yang Qi goes upward and yin Qi goes downward.[39] Further investigations with larger samples should test gender effects on attention.

To the best of the current research team's knowledge and based on a literature review, the current study was the first to test Qigong's effects on AA. Previous studies have shown the efficacy of Qigong on visual attention.[23] It would be of interest to test Qigong's effects on both sensorial modalities with a dual-task methodology.

CONCLUSIONS

The WB Qigong had a positive effect on the AA mechanism, with a significant reduction in the RT. The results support the importance of practice to achieve positive effects. People with neurodevelopmental disorders, such as autism and ADHD, struggle every day for sensory integration of AA mechanisms. Qigong can be taught and easily learned from the age of 2 years until senior ages, and it's a safe and very low-cost intervention that deserves to be researched further in clinical trials. These potential benefits of Qigong should be confirmed by future studies.

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AUTHORS' DISCLOSURE STATEMENT

The authors have no conflicts of interest to report.

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ORIGINAL RESEARCH

Breathing Exercises, Cold-Water Immersion, and Meditation: Mind–Body Practices Lead to Reduced Stress and Enhanced Well-Being

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ABSTRACT

Stress is a key contributor to several major life-threatening illnesses including depression and cardiovascular disease. Behavioral strategies that enable individuals to regulate stress responses can lead to improved health and well-being. Such practices may also help reduce required clinical interventions, ease pressure on the National Health Service (NHS), and reduce the need for medical and psychological treatments. This study explores the effects of a novel mind-body therapy for stress reduction and enhanced well-being. A single-group longitudinal intervention design was applied in a study comprising 29 healthy volunteers. The 10-day program was delivered online and consisted of deep-breathing exercises, cold-water exposure, and mindfulness meditation. Participant measures of perceived stress, depression symptoms, and mental well-being were taken at baseline and after completing the 10-day program. A MANOVA analysis revealed significant pre-post intervention differences for all psychometric measures, suggesting the intervention elicited improvements in symptoms of stress, well-being, and depression. This study provides preliminary evidence supporting the efficacy of an innovative mind-body therapy that may be learned and used by individuals to help modulate stress responses, improve mood levels, and enhance well-being. Future research could utilize multi-modal controlled study designs to understand the psychophysiological mechanisms associated with the benefits this practice may generate. (*Adv Mind Body Med.* 2022;36(3):12-20.)

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INTRODUCTION

Stress contributes to several major illnesses including clinical depression and cardiovascular disease.[1–3] Data from 2018 suggests that 74% of the UK adult population felt overwhelmed or unable to cope due to stress experienced during the preceding year, with 32% reporting suicidal ideations.[4]

In terms of etiology, the biological model proposes that stress is a set of physiological reactions triggered by environmental pressures. Dysregulation of biological stress reactivity is evidenced by cortisol and cytokine abnormalities in individuals suffering from depression.[5] Cytokines regulate immune responses, support healthy brain function and development, and are linked to neural pathways that elicit behaviors associated with the conservation of energy for defense and recovery.[6] However, individuals exposed to chronically elevated proinflammatory cytokines may suffer from an inhibited ability to recover from stress, leading to "sickness behaviors", including depression symptoms (i.e., anhedonia, anorexia, sleep abnormalities, and social withdrawal).[2,6] In particular, cytokine Interleukin-6 (IL-6) and Tumor Necrosis Factor-α (TNFα) are highlighted as being elevated at baseline levels in individuals with major depressive disorder.[7–9]

While the biological perspective focuses on studying responses, research assessing psychosocial stress centers on the association between environmental events and disease onset. However, evidence suggests that stressful events do not always contribute to disease. Stress-related growth has been documented in real-life contexts such as personal transformation following suicide-survivor experiences[10] and parental challenges.[11] A contemporary therapeutic example is exposure therapy for PTSD treatment, which involves repeated, habituated exposure to a stress-inducing scenario, leading to the extinction of Pavlovian-learned autonomic stress reactivities.[12]

This differentiation between positive (eustress) and negative (distress) stress is explored through psychological models that emphasize the role of cognitive appraisal (evaluation of stress-response efficacy) and coping mechanisms as mediators between objective events and physiological responses. The transactional model of Lazarus and Folkman places cognitive appraisal at the center of stress processes; they propose that pathophysiological responses occur when an individual believes that environmental conditions present threats that exceed their ability to cope effectively.[13]

Multimodal studies have investigated the association between biomarkers, stressful life events, and psychological appraisal to investigate stress-related illness from a biopsychosocial perspective.[14] For example, Cohen et al. documented significant associations between perceived stress and impeded immune response to viral infections.[15] Evidence also indicates that psychological stress is associated with impaired wound healing.[16] Furthermore, biological responses to stress, including autonomic arousal and subsequent impacts on immune response, may be driven by psychological appraisal. Therefore, research investigating stress-reduction strategies would benefit from assessing interventions that target both physiological arousal (including the activation of the autonomic nervous system [ANS]) and cognitive appraisal.

The relationship between perception and bodily processes has been a point of contention in the philosophy of the mind since Descartes proposed dualism of distinctly separate physicality and subjectivity.[17] Contemporary proponents of opposing views, e.g., the physicalist-monism of Dennet and the idealist-monism of Kastrup, have garnered little consensus.[18,19] However, there is real-world evidence of a biopsychosocial model. The opposing biomedical perspective, that bodily health operates according to self-contained mechanistic processes, fails to account for interdependent interactions between perception, the body, and the environment. Evidence suggests that holistic, process-based interpretations are more complete and accurate.[20]

The Wim-Hoff Method

The Wim-Hoff Method (WHM) is a contemporary mind-body practice consisting of meditation, breathing techniques, and cold exposure.[21] While few studies have been conducted on the WHM, findings suggest that the practice may influence both psychological and physiological stress reactivities. For example, a study investigated the role of WHM in influencing autonomic and immune responses based on an assessment of physiological reactions to being administered *E. coli* endotoxin.[22] Participants (n = 24) took part in a parallel, randomized controlled trial (RCT) where 12 participants were given specialist WHM training for 10 days followed by breathing techniques (E-coli endotoxin was administered to both the intervention and control group). Between-group differences in endotoxin reactions were evidenced by increased levels in epinephrine and anti-inflammatory cytokine IL-10, as well as decreased proinflammatory cytokines TNFα, IL-6, and IL-8 in the WHM group compared to the intervention group. The intervention group also showed a significantly faster return to baseline arousal levels following endotoxin reactions, as evidenced by the cortisol measurements.

A follow-up study repeated the experiment, with added psychological scores assessing outcome expectancies.[23] Between-group differences in epinephrine and cytokines were correlated with higher measures of optimism in the WHM group. However, notable limitations were the small sample size and lack of pre-post measures assessing whether the intervention group experienced changes in baseline measures over time. Positive outcomes were also cultivated through expert tutelage and mindset coaching, meaning that psychological parameters may not be generalizable to real-world situations.

However, the potential for the WHM to enhance psychophysiological functioning was supported in a field project.[24] The participants (n = 26) undertook 10 days of WHM training before ascending Mount Kilimanjaro. The participants were a group of non-athletes, with some having conditions such as rheumatoid arthritis and multiple sclerosis. A total of 92% of participants completed the climb in 48 hours with none experiencing acute mountain sickness, compared to a previous report showing a 61% completion rate at 4–5 days with 77% of the participants developing acute mountain sickness.[25]

Thus, while further investigation is required concerning health implications, current outcomes suggest that WHM engagement may augment physiological functioning and mental resilience. Furthermore, although no studies exploring the impact of the practice on mental health have been conducted to date, research has explored the separate components of the WHM method to differing extents.

Meditation

A meta-analysis (29 papers; n = 2668) provides evidence of the efficacy of mindfulness meditation in improving mental health and well-being in non-clinical populations.[26] A large effect size was found for stress reduction and a moderate effect in terms of reducing depression and improving quality of life. However, most studies rely on training programs led by specialist instructors and require lengthy participant commitments—such as 26 hours of training and daily private practice for over 8 weeks. Additionally, qualitative studies have documented participant difficulties in committing to structured programs[27] with some evidence of low completion rates.[28]

Other studies have investigated the efficacy of accessible, flexible, and technologically facilitated meditation programs in non-clinical samples. Evidence suggests that 10–20 minutes of mindfulness meditation daily—using digital applications—may enable significant reductions in perceived stress and improvements in well-being.[29]

Yang et al. conducted an RCT with 88 medical students, measuring perceived stress and general well-being at the baseline and at the 30-day and 60-day follow-ups.[30] A significant decrease in perceived stress and increase in well-being were evidenced in the meditation group at both post-intervention time points. No changes in the control group were documented. However, the study was limited because, in addition to using self-report measures, participants may have had an active interest in the study subject, increasing the chances of outcome bias and poor generalizability. These limitations are reflected elsewhere,[31] along with other limitations such as outcomes of marginal significance ($P = .07$),[29] short follow-up periods, and an over-reliance on one specific type of meditation intervention (i.e., the Headspace smartphone application).[32] Nonetheless, despite these limitations, outcomes suggest that brief, technologically facilitated meditation programs may enhance mental health for the general population.[33]

Deep Breathing

Evidence suggests that the breathing technique used in the WHM may lead to heightened circulating epinephrine and blood pH values,[23] although little is known about the effects on baseline psychophysiological parameters. A comparable set of techniques, collectively referred to as *pranayama* in yogic traditions, has been investigated more thoroughly. Much of the research exploring *pranayama* has evaluated its effects on physiological parameters,[34] although four RCTs have also utilized psychological assessments to examine its effect in non-clinical samples. Results indicate that *pranayama* may elicit reductions in perceived stress[35] and improve cognitive performance.[36]

An RCT evaluated three participant groups over 12 weeks, practicing fast, slow, and no *pranayama*.[36] Significant pre-post and between-group differences in perceived stress and physiological correlates of baseline heart rate, blood pressure, and myocardial stress were seen for slow *pranayama*. Fast *pranayama* elicited differences in subjective measures only. The researchers assert that improvements in physiological parameters could be attributed to the decreased activation of the sympathetic nervous system. This is also supported in two RCTs that provided evidence of significant blood pressure reduction in hypertensive participants undertaking slow-breathing techniques.[38,39] However, a limitation of the research area overall is that many different *pranayama* techniques have revealed different study outcomes.[34]

Cold-water Exposure

Regarding the routine cold-water exposure component of the WHM, Tulleken et al. conducted a year-long case study of an individual experiencing medication-resistant major depressive disorder for seven years.[40] Weekly cold-water swimming sessions led to a reduction in depressive symptoms and cessation of medication after four months. Furthermore, complete symptom remission and discontinuation of medication were reported at the one-year follow-up. The researchers suggest that these outcomes may have occurred due to the direct effects of cold-water exposure and health-related behavioral changes (e.g., exercise).[41] While the case study lacks methodological robustness, the report details how the participant integrated the practice into everyday routines, offering ecological validity.

In an RCT based on cold-water exposure (n = 3018), participants engaging in 30–90 seconds of daily cold showers over 30 days were assessed against a control group.[42] Primary outcomes were the absence of sickness and illness days. Significant between-group differences were identified for sickness absence only, although the researchers argued that this was the most robust measure of illness severity. Outcomes suggested the cold-water exposure may have strengthened the immune response to viruses circulating in the workplace during the study. However, physiological effects were only implied as no physiological measurements were included. Thus, while preliminary evidence suggests that there may be therapeutic benefits, more research on cold-water adaptation is needed.

The Present Study

With evidence suggesting that stress is a key contributor to a range of illnesses, studies exploring lifestyle strategies that reduce the damaging effects of stress upon mental and physical health are warranted. Currently, in the UK, in the limited geographical regions that offer NHS-funded psychosocial therapies, services operate with waitlist times of up to 18 weeks[43] and require that patients meet specific diagnostic criteria. Individuals experiencing difficulties but who do not qualify for treatment can only access therapy privately, which is unlikely to be affordable for many. Conversely, readily available technologically facilitated therapeutic programs that offer access to cost-effective, immediately available services can empower individuals to take control of their health and well-being.

The current study is the first to assess whether a practice comprising breathing exercises, cold-water exposure, and meditation may have implications for mental health and well-being. Previous studies have investigated these practices by examining the effect of WHM accompanied by expert tutelage and specialist resources. However, the current study explores whether the approach can be applied as a self-managed behavioral strategy with minimal costs or resources. Outcomes related to perceived stress, depression symptoms, and mental well-being measures were chosen based on the previous literature on the benefits of mind-body therapies and the connection between these findings and research completed on the WHM thus far.

It was hypothesized that, compared to the baseline, the three-part practice, delivered over 10 days, would lead to a significant decrease in stress and depression and a significant improvement in well-being. Furthermore, it was hypothesized that more time spent in the cold-water exposure condition would correlate with lower post-intervention depression scores.

METHODS

Design

A pragmatic uncontrolled trial was conducted using repeated measures to assess scores of perceived stresses, depression symptoms, and mental well-being before and after engagement in the 10-day program. Drawing on previous research by Tulleken et al.,[40] a correlational analysis was conducted to assess whether significant relationships could be identified between time in the cold water and pre-post changes in outcome measures.

Participants

The study used a general population sample with participants recruited via social media channels operated by members of the research team or their institution, as well as internal employee notifications sent via a local charity. Inclusion criteria required participants to be at least 18 years of age and not diagnosed with a mental health condition, cardiovascular illness, hypertension or high blood pressure, hypotension or low blood pressure, Raynaud's disease, or other circulatory disorders (as these might be triggered by the cold-water condition).

As the program includes aspects likely to elicit changes in physiological arousal and comfort, participants were also required to confirm the following: (1) non-engagement in the cold-shower condition if symptoms of the common cold or flu were present (the symptoms were stipulated accordingly), (2) engagement in the cold-shower condition only for the recommended 90 seconds, (3) discontinuation of the cold-shower condition if experiencing light-headedness, dizziness, or disproportionate discomfort, (4) participation in the breathing condition while lying down and not standing up if experiencing any light-headedness, and (5) an agreement to being sent email reminders to engage in the program every day for 10 days. All participants provided informed consent and the study was approved by the Research Ethics Committee of the researchers' institution.

Procedure

Prospective participants were directed to read the complete study information on Qualtrics and were then directed to a set of eligibility and demographic questions. Participants then completed baseline psychometric tests and were provided with written instructions and video guidance for engaging in the three-part practice. Participants were encouraged to start the program straight away and to download a diary template to record their levels of participation across the 10 days. The diary was included to provide evidence of participation and facilitate correlation analyses of relationships between time in the cold water and pre-post changes in outcome measures. Throughout the 10 days, participants were sent daily reminder emails, including links to full, written instructions and embedded video guidance. On the 11th day, participants were emailed a link to complete the psychometric tests again and were also asked to send their completed diaries to the researcher.

Measures

Demographic variables such as gender, age, and ethnicity were collected. The following questionnaires were used in the study:

Perceived Stress Scale (PSS)

The PSS is a self-report measure that assesses subjective perceptions of stress and has been validated internationally.[44] Responses are measured on a 5-point Likert scale, with scores on positively expressed items (items 4, 5, 7, & 8) reversed, such that higher overall scores indicate higher measures of perceived stress. The 10-item version was used in the current study, which evidences high internal consistency of around 0.75–0.83 and strong construct validity.[44] As this study was conducted over 12 days (including assessments), the item timescale was changed from "in the past month" to "in the last two weeks". Cronbach's alpha for the present study was .77.

Patient Health Questionnaire-9 (PHQ-9)

The PHQ-9 assesses symptoms of depression and is based on DSM diagnostics. Internal consistency is high, $\alpha = 0.83–0.92$,[45] and adequate construct validity is reported. Titov et al. suggest the PHQ-9 may be superior to established alternatives due to it being shorter to administer and the items being directly based on DSM criteria.[46] All items are measured on a 4-point Likert scale, with higher scores indicating elevated measures of depression symptoms. Cronbach's alpha for the present study was .84.

Warwick and Edinburgh Mental Well-being Scale (WEMWBS)

The WEMWBS assesses mental well-being in the general population and is used widely across clinical and non-clinical samples.[47] The 14-item scale has high reliability at .93.[47] Convergent and divergent validity presents with medium to high correlations with eudemonic measures and moderate inverse relationships with mental health pathology assessment tools (e.g., GAD-7 and PHQ-9).[48] Items are measured on a 5-point Likert scale, with scores varying between 14–70. Higher scores indicate greater levels of well-being. Cronbach's alpha for the present study was .85.

Intervention

The program consisted of: (1) Breathing exercises: Each breath consisted of four stages: (i) Breathing deep into the abdomen, filling the bottom half of the lungs with air, (ii) opening up the chest and filling the top half of the lungs, (iii) visualizing the breath ascending into the brain, and (iv) relaxing the chest and abdomen as air is released and exhaling to the relaxation point without fully expiring air. Participants were required to repeat the technique 30 times, hold the exhalation for as long as possible on the 30th repetition, and then hold the final inhalation for approximately 15 seconds. This was then repeated twice. Participants were recommended to complete 3 × 30 rounds. (2) Cold exposure:

Cold showers were taken shortly after completing the breathing exercises. Based on a study by Buijze et al., participants were advised to engage with this condition for 30–90 seconds.[42] Participants were also advised to gradually adapt to the cold by starting with warm/hot water and then slowly decreasing the temperature to reduce discomfort. Participants were also encouraged to ensure that the cold water covered their entire bodies. (3) Previous studies quoted the meditation technique used in the WHM as being "third-eye meditation",[22] although there is limited information available on how this is applied. A wealth of research supports the efficacy of mindfulness meditation for reducing stress and depression symptoms in the general population.[26] Mindfulness meditation uses techniques derived from Buddhist traditions. The study utilized a 10-minute guided meditation narrated by Jon Kabat-Zinn.[49] Participants were directed to focus their center of attention on the breath and observe any thoughts and emotions that arise with passing interest, letting go of them as they occur, and bringing the attention back to the breath repeatedly.

Statistical Analysis

Analyses were conducted using SPSS-26. A repeated-measures MANOVA was conducted to determine significant differences between pre-and post-scores on the PSS, PHQ-9, and WEMWBS. Before conducting the MANOVA, data were screened for univariate and multivariate outliers, normality, linearity, homogeneity of variances, and multicollinearity. A correlational analysis examined whether any significant relationships could be identified between pre-post changes in psychometric measures, time in the cold water, and demographic variables. For all analyses, significance was defined as $P < .05$.

RESULTS

Participant Diaries

A total of 48 participants began the study and 29 completed it. The 18 non-completers did not deliver any post-program data through Qualtrics, and therefore could not be included in the analyses. In total, 22 participants submitted their program diaries (i.e., 75.86% of those who completed and fully adhered to the program). One participant missed three days of breathing exercises and meditation, and two participants missed one day of meditation. The cold-water condition was adhered to by all participants on all days. The mean of the time in the cold across the 10-day period was 10.37 minutes. Demographics can be seen in Table 1.

MANOVA Analysis

Histograms indicated that post-PSS, pre-PHQ-9, and post-PHQ-9 scores were non-normally distributed. The Mahalanobis Distances test showed that no multivariate outliers were identified. Stem and Leaf box plots were used to identify univariate outliers.[50] After Winsorizing three outliers,[51] all z-scores for skewness and kurtosis fell within the range of normality (-1.96 to 1.96). Shapiro-Wilks (S-W) tests showed that the data met the required assumptions on all measures other than the post-PSS and post-PHQ9 (see Table 2 for descriptive statistics and normality tests).

The assumption of linearity was checked visually using a scatterplot matrix, and the assumption of homogeneity of variances was checked using Bartlett's test, with no issues identified in each case. Pearson's correlations were used to test for multicollinearity, and several moderately strong correlations were identified (>.50), although these were expected due to previous research identifying strong associations between stress and depression symptoms, and inverse relationships between these variables and mental well-being. With the correlations not indicating violations, the data was considered to have met parametric assumptions, and a one-way repeated-measures MANOVA was applied to all outcome variables.

Multivariate analysis revealed a significant overall effect of time-point measurements on stress, depression symptoms, and well-being – ($F_{(3, 26)} = 12.63$, $P < .0005$; Wilk's $\Lambda = .41$), partial $\eta 2 = .59$. Separate univariate ANOVAs showed a

Table 1. Participant Demographics *(n = 29)*

Age	
Under 25	3.45%
26 to 35	37.93%
36 to 45	55.17%
46 to 55	3.45%
Gender	
Male	44.82%
Female	55.17%
Ethnicity	
Undeclared	10.34%
White British	72.41%
British	3.45%
White Irish	3.45%
English Irish	3.45%
Caribbean	3.45%
Hispanic	3.45%

Table 2. Descriptive Statistics and Normality Tests for Pre-Post Variables *(n = 29)*

Variable	Mean	SD of M	95% of CI	Z of Skew	Z of Kurtosis	S-W (sig)
PSS Pre	28.10	4.74	26.30 - 29.90	-.35	.12	.27
PSS Post	21.31	5.14	19.35 - 23.27	1.12	1.24	.03
PHQ-9 Pre	6.72	4.20	5.13 - 8.32	1.35	–.54	.07
PHQ-9 Post	2.83	1.94	2.09 - 3.57	.16	–.60	.04
WEMWBS Pre	44.55	8.18	41.44 - 47.66	-.37	.01	.20
WEMWBS Post	52.69	6.92	50.06 - 55.32	.63	1.04	.05

Abbreviations: M, Mean; SD, standard deviation; CI, confidence Interval; S-W, Shapiro-Wilk test; PSS, Perceived Stress Scale; PHQ-9, Patient Health Questionnaire-9; WEMWBS, Warwick and Edinburgh Mental Well-being Scale.

significant difference between pre-and post-scores on stress ($F_{(1, 28)} = 32.11$, $P = .001$), depression symptoms ($F_{(1, 28)} = 31.24$, $P = .001$), and well-being ($F_{(1, 28)} = 33.54$, $P = .001$). Residuals were plotted using Q-Q plots. No issues were identified. The results indicate that engagement in the 10-day program was associated with significant reductions in stress and depression symptoms and increased mental well-being. Figures 1 and 2.1 to 2.3 present changes between pre- and post-outcome measures on all scales.

Correlation Analysis

Correlation analyses were run to determine whether significant relationships could be identified between time in the cold and pre-post changes in PSS, PHQ-9, and WEMWBS scores. Only the 22 participants who submitted their program diaries were included in this part of the analysis (Table 3).

Figure 1. Clustered Bar Chart of Mean Values for Pre-post Measures of PSS, PHQ-9, and WEMWBS Data

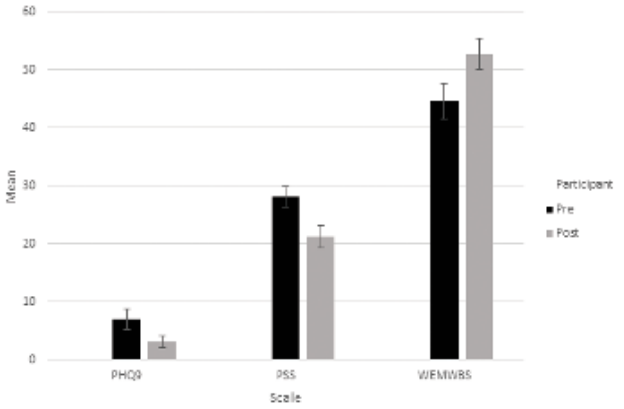


Table 3. Correlation Table Showing Relationships between Time in the Cold, Pre-post Change in Outcome Measures, and Demographic Variables (n = 22)

	Cold Time	PHQ9 Change	PSS Change	WEMWBS Change	Age	Gender
Cold Time	1	.105	.421	.354	-0.130	.694[a]
PHQ9 Change	.105	1	.641[a]	.600[a]	0.010	0.107
PSS Change	.421	.641[**]	1	-0.683[a]	-.320	.339
WEMWBS Change	.354	.600[a]	.683[a]	1	-.214	.195
Age	-.130	.010	-.320	-.214	1	0.140
Gender	.694[**]	.107	.339	.195	.140	1

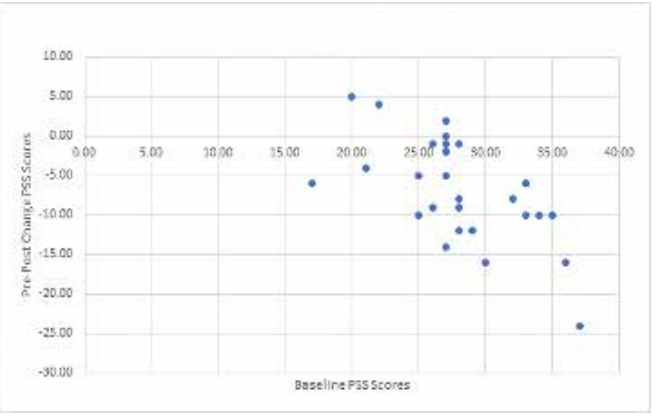
[a]$P < .01$

Note: Pearson Correlation between groups

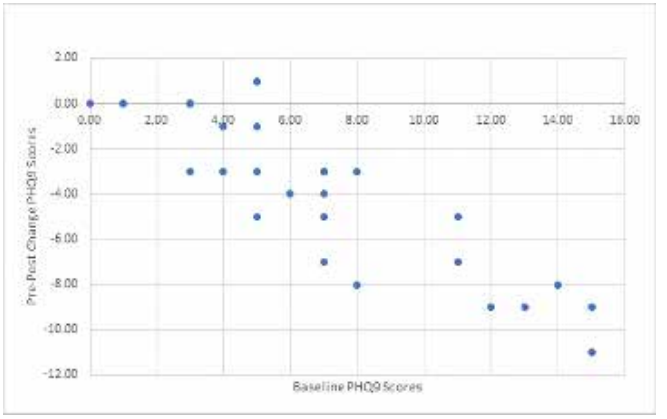
Abbreviations: PHQ-9, Patient Health Questionnaire-9; PSS, Perceived Stress Scale; WEMWBS, Warwick and Edinburgh Mental Well-being Scale.

Figure 2. (A) A Scatterplot for Baseline and Pre-post intervention Change PSS Scores. **(B)** A Scatterplot for Baseline and Pre-post Intervention Change in PHQ9 Scores. **Figure 2. (C)** A Scatterplot for Baseline and Pre-post Intervention Change in WEMWBS Scores

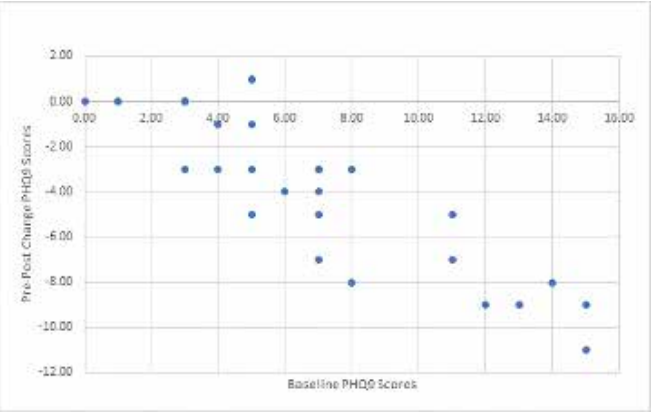
A



B



C



No significant relationships between time in the cold and outcome measures of depression, stress, or well-being were identified. A relationship between time in the cold and gender was shown, suggesting that male participants spent significantly longer in the cold-water condition. A correlation between age and well-being was identified, suggesting older participants experienced lower post-program well-being.

DISCUSSION

This study examined whether an online 10-day mind-body program comprising deep-breathing techniques, cold showers, and mindfulness meditation could improve perceived stress, depression symptoms, and mental well-being. To the authors' knowledge, this was the first study to explore the efficacy of remote delivery of a WHM-based practice, including for mental health and well-being outcomes. The intervention led to significant improvements in stress, depression, and well-being compared to the baseline. However, there was no significant association identified between time spent in cold water and pre-post changes in stress, well-being, or depression symptoms.

Meta-analyses show strong evidence in support of meditation practices for reducing psychological stress and depression symptoms in non-clinical samples.[26,52] Evidence from cross-sectional studies also suggests that meditation can help individuals cultivate everyday mindfulness as a meditator of well-being.[53] However, it is difficult to compare the current study's outcomes to standardized meditation programs due to differences in intervention practices, commitment requirements, and delivery mediums (e.g., face-to-face versus online).

In terms of remote delivery approaches, Krusche et al. tested the effects of an online mindfulness program requiring 4–8 weeks of online tutoring and commitment to daily private practice.[28] The participants were a self-selected general population sample (n = 273), and pre-post intervention changes in perceived stress, depression, and anxiety symptoms were reported, with increased personal practice time being correlated with enhanced improvements. However, notable limitations were the lack of a control group, the self-selection of participants, and the use of self-report assessments only. Furthermore, only 29% of those who began the course completed it.

A small number of studies have examined more accessible options, utilizing flexible, digitally facilitated meditation programs, with evidence so far supporting their efficacy for enhanced well-being and reduced stress (Bostock et al., 2019; Yang et al., 2018; Zollars et al., 2019).[29–31] The findings of the current study align with this evidence in that the intervention elicited reduced perceived stress and enhanced well-being. However, the previous studies required participant commitment of 4–8 weeks, whereas the current study evidenced meaningful effects over 10 days. Furthermore, previous studies focused mainly on measures of stress, well-being, and dispositional mindfulness, while the current study evidenced significant reductions in depression symptoms using a brief, digitally facilitated intervention.

Another key component of the current program is the deep-breathing technique. Previous research has examined the effects of *pranayama* breathing practices on ANS and psychological parameters, with outcomes showing reductions in the baseline heart rate and blood pressure in non-clinical and hypertensive samples.[54,55] Evidence suggests that these practices may elicit increased parasympathetic nervous system activity and decreased sympathetic activation, leading to reduced baseline physiological arousal. Significant reductions in perceived stress[36] and improved cognitive performance[56] have also been observed.

However, these approaches require further exploration due to the use of different techniques eliciting different research outcomes.[34] Consequently, it is difficult to ascertain the specific effects of the deep-breathing component on outcomes in the present study. Nevertheless, preliminary evidence shows that the WHM technique may elicit heightened sympathetic activation, as evidenced by elevated epinephrine levels.[23]

The therapeutic effects of routine cold-water exposure have been subjected to even less empirical evaluation. Two studies to date have assessed impacts upon psychophysiological factors, including (1) an RCT demonstrating reduced employee absenteeism during a flu epidemic, associated with daily cold showers over 30 days,[42] and (2) a case study reporting that regular cold-water swimming led to symptom remission and discontinuation of anti-depressant medication in an individual with major depressive disorder.[40]

In the aforementioned case study, the participant was assessed in their natural environment, offering ecological validity and suggesting that the benefits may be transferable to real-world scenarios. Ecological validity was also demonstrated in the current study, with participants using their own apparatus (cold shower). Furthermore, the present study findings are also consistent with those of Tulleken et al., because both studies elicited a reduction in depression symptoms.[40]

A possible biological factor linked to reduced depression through cold-water exposure is the impact on the proinflammatory cytokine IL-6. IL-6 is evidenced as being heightened at baseline levels in individuals experiencing major depression.[57] There is no existing research exploring the connection between cold therapy, cytokines, and depression, although associated studies have shown that cold adaptation can lead to changes in baseline IL-6. Dugue and Leppanen evidenced heightened resting-state plasma levels in cold-adapted versus non-adapted participants, although lipopolysaccharide-stimulated IL-6 levels were reduced in adapted individuals.[58] Kox et al. and Middendorp et al. also highlighted reduced stress-induced IL-6 and TNFα in WHM-trained individuals versus non-trained controls.[22,23] However, it is difficult to draw any meaningful comparisons due to the complexity of cytokine processes and the lack of previous research.

No significant relationship between time in the cold and pre-post changes in PHQ-9 scores was identified in the current study, which may be attributable to the short intervention period. For example, Buijze et al. assessed pre-post developments across 30 days, and Tulleken et al. evidenced recovery from major depression across one year.[40, 42] Therefore, future research could examine whether the cold-water condition specifically impacted depression and whether increased exposure is associated with compounded improvements.

While the aforementioned research evaluating individual components of the three-part practice supports their therapeutic applications, in the current study, it is possible that when combined, the three conditions acted on psychophysiological mechanisms in a way that the individual components alone do not. For example, stress reduction and enhanced well-being linked to meditation are widely attributed to the cultivation of present-moment mindful awareness. Indeed, mindfulness liberates practitioners from fixating on distressing thoughts and emotions and being preoccupied with past or potential future events.[27] Deep-breathing techniques and routine cold exposure may improve ANS functionality and impact inflammatory processes linked to depression.[34,58] Therefore, the health benefits evidenced through the three-part practice may be attributable to mindful awareness cultivation through meditation, augmented with physiological adaptations enabled via breathing techniques and cold exposure.

In terms of study limitations, this was a pragmatic trial and no control group was used, meaning that the outcomes are open to the influence of effects from extraneous variables. Furthermore, internal validity may have been compromised due to the study being conducted remotely, as face-to-face contact might have enabled greater consistency in participant engagement in the three conditions, especially with the cold shower. For example, while study diaries recorded time in the cold, there were likely inconsistencies concerning temperatures and the degree of full-body immersion.

Another limitation relates to potential demand characteristics due to the self-selection of participants, which could have led to participants influencing self-report responses and overstating the intervention effects. Additionally, the sample age was clustered, with 93% of participants falling within ages 26 to 45 years, making the results less generalizable to older or younger populations. Also, post-program data was not provided by the 18 non-completers. They were therefore excluded, and analyses were conducted with the completion group (N = 29). The small sample size should be considered when interpreting the results. Finally, while the study overall revealed pre-post differences, data analysis did not provide insights into whether specific components or the program overall elicited these changes. Future studies could examine each of the conditions separately or in varying dualities—as active control groups—in comparison to the three-part program.

A notable strength of delivering the study remotely via digital media was the ease of accessibility. Individuals could participate from any international location, requiring only a digital device with internet and a cold shower. Ecological validity was also strong, with participants able to integrate the practice naturally into their everyday routines. A further strength relates to the research environment because, while previous studies examining comparable WHM interventions have employed expert mindset coaching and specialized environmental conditions,[22,23] this study did not use any special resources and therefore provided a more impartial research environment.

Our study has provided preliminary evidence supporting the efficacy of a low-cost, easily accessible intervention that may reduce psychological distress and enhance well-being. Previous studies suggest that combination treatments, such as psychosocial therapy and medication together, are more effective than individual options alone.[59] Remotely delivered digital interventions offering time- and resource-efficient therapies could fill an important gap in an environment where private therapists are unaffordable for many and access to funded services comes with long waitlists.[43] If verified with further evidence, this intervention could potentially operate as a standalone treatment or as an adjunct to psychosocial therapies, both for the general public and suitable clinical populations.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available upon request. If the manuscript is accepted for publishing, the data will be made available via a public repository.

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CASE REPORT

Effect of a Structured Naturopathy and Yoga Intervention on Pain, Depression, and Quality of Sleep in a Postmenopausal Breast Cancer Patient

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ABSTRACT

A 54-year-old postmenopausal woman was diagnosed with adenoid cystic carcinoma (ACCA) of the right breast. She had complaints of pain in the upper quadrant of the right breast, stress, disturbed sleep, and depression. Her self-reported pain intensity using the visual analog scale (VAS) was 8 and her perceived stress scale value was 19. Her depression score on the Patient Health Questionnaire–9 (PHQ-9) was 12. Her quality of sleep, evaluated using the Pittsburgh Sleep Quality Index (PSQI), was 18. She was given integrated naturopathy and yoga therapy for 43 days. She showed a reduction in pain, stress, and depression scores. Her quality of sleep also improved after the integrated naturopathy and yoga therapy. Our structured integrated naturopathy and yoga therapy improved pain, stress, depression, and sleep quality in a postmenopausal breast cancer patient and may be used as adjuvant therapy for patients with breast cancer. (*Adv Mind Body Med.* 2022;36(3):21-25.)

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INTRODUCTION

Adenoid cystic carcinoma is an uncommon neoplasm of the breast that accounts for less than 1% of all cases of mammary malignancies.[1] According to the National Cancer Registry, cancer of the breast was the most common cancer in women with an increasing trend of incidence. With advances in multidisciplinary prevention approaches, screening, and therapeutic management, there has been a decline in its incidence and consequent mortality among Indian women recently.[2] Due to its rarity and wide variations in patterns of practice, no consensus has been established on the optimal therapeutic management for adenoid cystic carcinoma of the breast. The treatment of choice is predominantly breast-conserving surgeries.[3,4]

Stress and depressive symptoms are more common in cancer patients than they are in the general population, and they are linked to a worse prognosis in cancer patients.[5] There is growing evidence that behavioral interventions aimed at reducing psychological distress and sleep dysfunction, such as diet and lifestyle modifications, could be effective in improving cancer-related outcomes by modifying several interlinked bio-behavioral pathways.[6]

In persons with various cancer types, naturopathy, yoga, and dietary therapies have been demonstrated to improve physical and mental wellness.[7,8] A growing number of yoga interventions have demonstrated their positive effects on cancer-related symptoms and quality of life.[9–11] In this case report, we describe the effects of integrated naturopathy and a yoga intervention in an adenoid cystic carcinoma patient.

CASE REPORT

A 54-year-old postmenopausal woman diagnosed with adenoid cystic carcinoma (ACCA) of the right breast in 2018 was admitted to the in-patient department of the Government Yoga and Naturopathy Medical College Hospital with complaints of pain in the upper quadrant of the right breast in April 2019. Her symptoms first manifested as a painful lump in her right breast. The pain was sharp and occurred intermittently during the night while sleeping. She underwent fine needle aspiration cytology (FNAC) as her doctor recommended and was diagnosed with adenoid cystic carcinoma (ACCA) of the right breast. The doctor advised that she have surgery, but she refused as she preferred conservative

treatment. The patient had no family history of breast cancer. She had been diagnosed with hypertension in 2017 and had been prescribed allopathic medication. Physical examination revealed that the breasts were symmetrical, with no visible abnormalities like erythema, ecchymosis, skin ulceration, dimpling, or nipple discharge. A hard and mobile lump was discovered under the upper quadrant of the right breast during the breast examination. There was no axillary lymphadenopathy. The patient did not undergo a mammogram.

The patient received no mastectomy, chemotherapy, or radiation therapy. She complained of severe pain, tenderness, and depression, which prevented her from carrying out her daily household tasks. The patient also reported poor sleep quality and duration because of night-time pain. Written informed consent was obtained from the patient before the commencement of the study. The patient was admitted to our Government Yoga and Naturopathy Medical College & Hospital, Chennai as an inpatient.

Outcome measures

The Visual Analog Scale (VAS) was used to assess self-reported pain.[12] More severe pain is indicated by higher scores. The pain was graded as mild (score 0–3), moderate (score 4–6), or severe (score 7–9), (score 7-10). With a total score of 8, the patient was found to have severe pain.

The validated 10-question Perceived Stress Scale (PSS-10) was used to assess her stress level.[13] The items are rated on a 5-point scale ranging from 0 (never) to 4 (very often). Items 4, 5, 7, and 8 had their scores reversed. She was prompted to identify the frequency of occurrence, and the total score was calculated by adding all items to a total score ranging from 0 to 40. Scores between 0 and 13 were labeled as "low stress", 14 to 26 as "moderate stress", and 27 to 40 as "high stress." The patient was found to have moderate stress with a total score of 19.

The Patient Health Questionnaire–9 (PHQ-9) was used to evaluate her depression symptoms.[14] The PHQ-9 is a validated four-point scale for depressive symptom severity that can be answered with "not at all" (0 points), "on individual days" (1 point), "more than half the days" (2 points), or "nearly every day" (3 points). After totaling the items, the score can range from 1 to 27, with higher scores indicating more severe depressive symptoms (total score 1–4: minimal depression, 5–9: mild depression, 10–14: moderate depression, 15–19: moderately severe depression, and 20–27: severe depression). With a total score of 12, the patient was found to have moderate depression.

Her quality of sleep was evaluated using the Pittsburgh Sleep Quality Index (PSQI).[15]internal consistency, test-retest reliability, and construct validity of the European Portuguese version of the Pittsburgh Sleep Quality Index (PSQI The PSQI consists of 19 self-report questions that are added together to form seven component scores including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each element has a score range of 0–3 points. A global PSQI score is calculated by adding all the component scores together to provide an overall indication of the quality of sleep. The PSQI global score ranges from 0 to 21, with 0 representing no difficulty and 21 representing severe difficulty. The patient's PSQI global score was found to be 18. In addition, weight, body mass index, blood pressure, blood glucose levels, total cholesterol, hemoglobin, and natural killer cells status were assessed. All the measures were assessed at the beginning and end of the intervention period. The patient was reluctant to undergo other investigation procedures like mammograms and tumor-marker screening as she preferred to have conservative treatment due to a fear of surgeries and medical procedures.

Intervention

She was given a structured naturopathy and yoga intervention for 43 days. The structured yoga therapy was provided to the patient as a one-on-one session by the naturopathy physician. The class lasted 60 minutes and comprised a series of standing and lying *asanas* for 30 minutes followed by *pranayama* in the seated position for 30 minutes. Each *asana* was held for 30 seconds to 1 minute and was repeated again on the other side. The session was followed by tailored naturopathic interventions (Table 1).

Table 1. A Detail of the Intervention Given to the Subject

Name of the Therapy	Name of the Specific Treatment	Duration	Frequency in 43 days
Yoga	*Tadasana, Artha Chakrasana, Kati Chakrasana, Artha Kati Chakrasana, Vrikshasana, Uttana Padasana, Sethubandhasana*	30 minutes	42
Pranayama	*Surya Anuloma Violoma, Chandra Anuloma Viloma, Nadisuddhee, Brahmari*, sectional breathing	30 minutes	42
Chromotherapy	Blue glass exposure to chest	20 minutes	42
Magnetotherapy	Sujok magnet in breast point in the right index finger	2 hours	43
Sujok (seed therapy)	Grapeseed in right thumb	4 hours	42
Acupuncture	Auricular therapy breast points	10 minutes	42
Massage	Partial massage to both legs	20 minutes	8
	UB meridian massage	20 minutes	6
Hydrotherapy	Cold chest pack	60 minutes	42
	Cold hip bath	20 minutes	42
	Coldwater enema		6
Compress	Cabbage to the breast (morning)	20 minutes	42
	Ginger (evening)	20 minutes	42
Mud therapy	Direct mud application to legs	30 minutes	10
	Direct mud application to chest	30 minutes	25
	Mud pack to abdomen and eyes	30 minutes	42
Reflexology	Palm and sole reflexology	30 minutes	42

Table 2. Details of the Diet Therapy Given to the Patient

Timings	Food Items	Quantity	Serving/Day
6.30 AM	Pinch of turmeric powder mixed with water	200 ml	1
07:30 AM	Juice made by any of the following: curry leaf, lemon, orange, wheatgrass, ash gourd, lemon with mint, mint with coriander leaves, plantain pith, carrot, beetroot, carrot with beetroot	200 ml	1
09:30 AM	Vegetable salad made by a mix of 2/3 of the following: carrot, beetroot, snake gourd, bottle gourd, ivy gourd, chow-chow, coconut, groundnut, cucumber, cabbage, capsicum, onion, tomato, mango Note: Mixer of 2/3 food item	120 g	1
	Fruits salad made by a mixer of 2/3 of the following: pineapple, papaya, muskmelon, orange, mosambi, sapota, watermelon, pomegranate, gooseberry	180 g	1
11:00 AM	Cabbage juice	100 ml	1
12:00 Noon	Juice made by any of the following: curry leaf, lemon, orange, wheatgrass, ash gourd, lemon with mint, mint with coriander leaves, plantain pith, carrot, beetroot, carrot with beetroot	200 ml	1
02:00 PM	Fruits salad made by a mixer of 2/3 of the following: pineapple, papaya, muskmelon, orange, mosambi, sapota, watermelon, pomegranate, gooseberry	180 g + 200 g	1
04:30 PM	Any of the following: ragi milk, bottle gourd juice, ash gourd juice, amla juice, lemon, cucumber juice, carrot juice, orange juice	200 ml	1
07:00 PM	Vegetable salad made by a mixer of 2/3 of the following: carrot, beetroot, snake gourd, bottle gourd, ivy gourd, chow-chow, coconut, groundnut, cucumber, cabbage, capsicum, onion, tomato, mango	120	1
	Fruits salad made by a mixer of 2/3 of the following: pineapple, papaya, muskmelon, orange, mosambi, sapota, watermelon, pomegranate, gooseberry	180	1

Table 3. Baseline and Post-test Assessments of the Study Subject

Variables	Baseline	Post-test
Weight (kg)	66	58
Body Mass Index (kg/m^2)	31.4	27.6
SBP (mmHg)	120	110
DBP (mmHg)	80	70
FPG (mg/dl)	80	94
PPPG (mg/dl)	115	111
Hemoglobin (gm/dl)	10	10
Serum Cholesterol (mg/dl)	155	163
NK Cell Test (Cytometry)		
Absolute lymphocyte count	2624	2042
T LYMPHOCYTES		
CD3 (total cells) %	57.57	60.37
Absolute CD3	1511.00	1233
Natural Killer Cells		
CD3 - /CD(16+56) %	11.34	7.19
ABSOLUTE CD3-/CD(16+56)	296	147
Patient Health Questionnaire		
Visual Analog Scale	8	0
Perceived Stress Scale (PSS-10)	19	5
Patient Health Questionnaire–9 (PHQ-9)	12	3
Pittsburgh Sleep Quality Index (PSQI)	18	6

Abbreviations: SBP, Systolic blood pressure; DBP, Diastolic blood pressure; FPG, Fasting plasma glucose; PPPG, Post-prandial plasma glucose.

The patient followed a plant-based diet (Table 2). She adhered daily to the integrated yoga and naturopathy intervention because it was adaptable and customized to the patient's physical health.

RESULTS

All the biochemical variables, pain, stress, depression, and quality of sleep scores were reassessed after 43 days (Table 3).

Weight and body mass index (BMI) were both reduced after the intervention. Both before and after the intervention, hemoglobin levels were low and unchanged. All other biochemical parameters and lymphocyte profiles were within the normal reference range. There was a reduction in the VAS pain score from 8 to 0, while the stress score reduced from 19 to 5. The patient's depression score reduced from 12 to 3. Her quality of sleep also showed an improvement in all seven domains with the total PSQI global score reducing from 18 to 6. No adverse events were reported during the intervention period.

DISCUSSION

This study shows that integrated naturopathy and yoga therapy had a positive impact on physiological and psychological aspects in a breast cancer patient. Yoga has been shown in multiple studies to mitigate self-reported depression, anxiety, and stress in cancer patients.[8,16] The different components of yoga-like *asanas*, *pranayama*, meditation, and relaxation techniques exert antidepressant and anxiolytic effects by acting on multiple biological pathways.[17] Yoga, according to studies, alters the cellular milieu through rapid gene expression variations in circulating immune cells, thereby boosting cellular immunity and improving physical and psychological well-being.[18,19] Yoga reduces exaggerated stress responses by down-regulating the

hypothalamic-pituitary axis and modifying the autonomic balance.[20] It alters pain perception by decreasing sympathetic nervous system activity, inflammatory markers, and stress markers while increasing flexibility, strength, circulation, and cardiorespiratory capacity.[21,22] Likewise, yogic techniques have been shown to be psychophysiological triggers that increase endogenous melatonin secretion, improving the individual's sense of well-being and quality of sleep.[19,20] Similar changes in pain, sleep quality, and psychological health were also noted in our study.

Previous research has shown a decrease in depression and pain and improved quality of sleep following massage therapy in breast cancer patients. Massage acts on the spinal afferents by augmenting descending suppression of nociception. This was mediated by the effect of massage on immune cells, like natural killer cells and lymphocytes, and the increase it causes in neurotransmitters like dopamine and serotonin while decreasing cortisol.[25–27] Similarly, foot reflexology was observed to be an effective intervention for reducing anxiety and pain and improving sleep quality in cancer patients.[28–30] These data support the findings of our current study.

Acupuncture is one of the widely used non-pharmacological interventions in the management of cancer-related symptoms in patients. Significant reductions in pain and cancer-related dysfunctions were observed in patients receiving acupuncture. The analgesic effects of acupuncture are attributed to its ability to raise endomorphin-1, beta-endorphin, encephalin, and serotonin levels in plasma and brain tissue.[27,28] Acupuncture has been shown to boost gamma-aminobutyric acid (GABA) levels and improve sleep quality. Likewise, acupuncture's effect on the body's immunological response has been studied extensively and has been attributed to the suppression of overactive immune response and its impact on cytotoxic NK cell activity.[31] Following the data above, our patient also reported a considerable reduction in pain and discomfort with improved sleep quality after acupuncture therapy.

Similarly, mud therapy's therapeutic impact on cancer-related symptoms has been ascribed mostly to its thermal and systemic anti-inflammatory properties.[33] Thermal mud-pack therapy has been shown to reduce circulating levels of mediators of inflammation and pain, such as prostaglandin E2 (PGE2), leukotriene B4 (LTB4), pro-inflammatory interleukin-8 (IL-8), interleukin-1β (IL-1β), and tumor necrosis factor α (TNF-α). The immunosuppressive effect of thermal stress has also been documented.[30, 31] According to the pain gate theory, reactions to noxious stimuli applied in the excitatory receptive field are blocked by noxious stimuli delivered to other areas of the body. Cold hydrotherapy applications in the form of packs and baths act on thermoreceptors and mechanoreceptors to suppress nociceptors. A change in central opioid beta-endorphin levels following exposure to cold temperatures has been observed in a few studies, which could have been advantageous for our patients in the management of pain.

Limitations and future perspectives

A lack of information gathered through mammograms and serum tumor markers, and a lack of long-term follow-up of the patient, were a few limitations of the study. Therefore, the prognosis could not be followed-up. The validity and reproducibility of this finding may vary as this study pertained to a single case and thus cannot be generalized. As a result, future well-planned clinical observational studies including the aforementioned variables and a large sample size are required to corroborate our findings.

CONCLUSION

Our structured integrated naturopathy and yoga therapy improved pain, stress, depression, and sleep quality in a postmenopausal breast cancer patient and may be used as adjuvant therapy for breast cancer patients. However, more research into this promising approach with regards the treatment dose and frequency of yoga during cancer treatment is required.

Patient perspective

On the day of discharge, the patient reported a sense of well-being and the ability to do her day-to-day activities. She reported improvements in sleep and pain. She felt at ease and assured to follow-up the yoga and naturopathy treatments with lifestyle modifications.

INFORMED CONSENT

Informed written consent was obtained from the patient to report this case.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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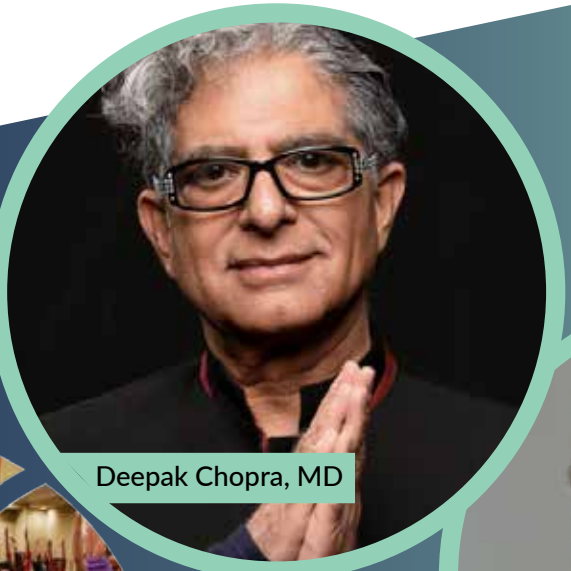

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