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## A comprehensive review on effect of yogic practices (Pranayama) on stress and anxiety

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### Abstract

Yoga is a system of practices with ancestral roots in India. It is defined as Chitta Vritti Nirodha the cessation of the whirlwinds of the mind - which is better understood in contemporary language as a tool to calm the mind. Breathing exercise in various conditions has been reported to improve quality of life, reduce mental health problems such as stress, anxiety & depression. Practice of Bhr. P for 5-10 min continuously induce subjective feelings of mind refreshment and blissfulness and sometimes the subjects are believed to go to even meditative state. The lockdown and social distancing has led to challenges like feeling of stress, anxiety, fear, loneliness at times, depression, irritability, insomnia, confusion, anger, frustration, and boredom. Bhr.P intervention is an effective technique to manage the depression, anxiety and stress, during COVID-19 home isolation. The findings further support that Bhr.P intervention helped to improve the quality of sleep and general wellbeing during the treatment period. Stress may aggravate the underlying autoimmunity, whereas yoga helps in reducing sympathetic arousal and the activity of the hypothalamus pituitary and renal axis, which in turn reduces stress and anxiety levels.

**Keywords:** Stress, pranayama, anxiety, yoga, biological markers, WHO

### Introduction

The prevalence of cardiovascular illness has increased recently, and technological advancements in medicine have led to an increase in the use of invasive diagnostic procedures like coronary angiography (CA). Presently, the annual number of cardiac catheterizations (CAs) conducted in the US exceeds one million <sup>[1]</sup>. There are pharmaceutical and non-pharmacological ways to lessen anxiety associated with CA. The mainstay of pharmacological anxiety reduction involves benzodiazepine usage. Pharmacological anxiolytic medications, however, typically have distinct side effects and a brief half-life. Consequently, in recent years, complementary therapies and other non-pharmacological anxiety reduction techniques have drawn particular attention <sup>[5]</sup>. India is the ancestor of the yoga system of activities.

The definition of Chitta Vritti Nirodha is the cessation of mental whirlwinds, which is more accurately described in modern terminology as a mental-calming technique <sup>[2]</sup>. Eight practices, also known as Ashtanga Yoga or Yoga of the eight limbs, are integrated into the Patanjali Yoga Sutras: yamas (abstentions), niyamas (observances), asanas (postures), pranayama (breath control), pratyahara (withdrawal of senses), dharana (concentration), dhyana (meditation), and samadhi (oneness). Pranayama, the Sanskrit term for prana (vital energy) and ayama (control), refers to the breathing exercises. It describes a sequence of deliberate, regulated breathing exercises that work the respiratory frequency, body locks (bandhas), inhalation (puraka), retention (kumbhaka), and exhalation (rechaka) <sup>[3]</sup>.

The Sanskrit word yuj, which means "to join," is the root of the word yoga, which denotes the fusion of the body with the consciousness of the mind and spirit <sup>[2]</sup>.

Elevated levels of reactive oxygen species (ROS) and reactive nitrogen species (RNS) relative to antioxidants cause oxidative stress, which damages various biomolecules such as DNA, proteins, and lipids. This, in turn, exacerbates diseases like cancer, cardiovascular disease, neurodegenerative disorders, and aging <sup>[12-15]</sup>.

With its many practices, yoga, an ancient Indian science, crafts a way of life. Practitioners use

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a variety of techniques and styles to practice it, such as Asana (posture), Pranayama (breathing manipulation), and meditation (concentration technique) [1]. Under a variety of circumstances, breathing exercises have been shown to enhance life quality and lessen mental health issues like stress, anxiety, and depression [10-12]. When practicing Bhr. P for five to ten minutes at a period, people report feeling mentally refreshed and contented, and occasionally they even report entering a meditative state [19].

Although numerous research have been done to explore the various advantages of pranayama, there is still a dearth of information regarding individual pranayama practices. One such method that offers numerous health advantages but little proof of its effects from science is the Bhr. P. The majority of existing literature focuses on the collective benefits of pranayama practices; it does not support Bhr. P. on an individual basis. We sought to examine the current body of scientific research on the Bhr.P. in this review. In order to evaluate how the research were conducted and which benefits of Bhr.P were covered, we have thus carefully examined all of the papers that are currently accessible on the subject. This evaluation may help pinpoint the gaps in the current body of research and investigate potential new avenues for scientific advancement in this area. Administration software was utilized by the online library program to manage and cite the data [21].

Challenges like stress, worry, fear, loneliness, sadness, irritability, insomnia, perplexity, rage, irritation, and boredom have been brought on by the lockdown and social separation [3]. According to theoretical theories, the vagus nerve mediates the psychobiological mechanism via which pranayama works. This mechanism is thought to involve connections between the prefrontal brain, limbic regions, thalamus, and peripheral sensory organs [17, 22]. Additionally, through improved acceptance and present-moment awareness, the practice of meditation, which includes breathing exercises, promotes optimal emotion regulation [30-33].

## Discussion

As far as we are aware, this is the first study to look at how pranayama (Bhr.P) intervention affects stress, sadness, anxiety, and sleep quality in COVID-19 patients receiving home isolation. Our results demonstrate how Bhr. P's intervention can help COVID-19 patients' psychological well-being. Previous research using other types of yoga therapies on COVID-19 patients has shown similar results [12, 22, 24].

The information gathered from the aforementioned results clearly shows the impact of Bhr.P. The parasympathetic predominance of Bhr. P has been found in all studies, whether directly or indirectly, and this has served as the foundation for the results that have been obtained, including decreased heart rate and blood pressure, decreased response to the cold pressor test, improved cognition, decreased irritability in tinnitus, favourable EEG changes, and decreased stress levels. [26]. While the initial effects of the Bhr. P intervention have been evaluated in two studies [26, 28], prolonged yoga practice is widely acknowledged to produce significant and long-lasting effects. For example, practicing anything for several months at a time will result in a more reproducible effect than practicing it once for only five minutes. In these situations, there are two things to consider: first, if the same practice is applied over an extended length of time, the outcomes may vary, and second, the practice may not have the entire effect [28].

As a result, it is clear that it affects a number of bodily

systems, and it may therefore have positive effects on the autonomic nerve system, respiratory system, stress level, anxiety, and general emotional state of the practitioner, among other things. Deeper down, the research might even concentrate on how Bhr. P affects stress indicators like cortisol, alpha amylase, MDA, and so on. For more accurate and dependable results, attention must be paid to improving the technique and study designs. Because they are so highly reproducible, randomized controlled trials (RCTs) are the most often used study design. Therefore, more RCTs in this area are necessary to objectively demonstrate Bhr. P's impact [31].

Depression and hypothyroidism have a lot in common. Studies have shown that a significant number of patients with hypothyroidism also have depression. Because depression is positively correlated with the TPO-Ab level in hypothyroidism, it may exacerbate symptoms and the illness process. As a result, managing and preventing depression is important while hypothyroid. Research has indicated that yoga has beneficial effects on depression and hypothyroidism [18, 19].

In this study, women with clinical depression and hypothyroidism were evaluated for the impact of a 3-IY on depression and sTSH levels. Additionally assessed were the BMI, lipid profiles, anxiety, stress, and exhaustion that were associated with depression and hypothyroidism. After the 3-IY, depression and sTSH levels were significantly lower than the equivalent baseline levels. Research has indicated that yoga intervention has a positive impact on serum thyroid hormone (sTSH) levels in hypothyroid women. After six months of yoga intervention, *Nee Lakanthan et al.* (2016) saw a substantial decrease in BMI, lipid profile, and sTSH levels. Other research has shown that yoga therapy improves the quality of life and pulmonary function tests in hypothyroid women [20, 21]. The results of this study are in line with previous research on the benefits of yoga for depression in terms of improved mood, cognitive abilities, and serum cortisol levels [22, 23].

Yoga's precise mechanism is yet unknown. The reduction in sadness and TSH levels may be attributed to higher levels of physical activity after the 3-IY, which includes many dynamic movements [24, 25]. While yoga helps lower sympathetic arousal and the activity of the hypothalamus pituitary and renal axis, which in turn lowers stress and anxiety levels, stress can exacerbate the underlying autoimmunity. Yoga has been shown to be beneficial in raising brain-derived neurotrophic hormone (BDNF) and gamma amino butyric acid (GABA), both of which are known to have a beneficial effect on depression [26, 27].

After a three-month yoga intervention, troubled women in a study by Mischalsen reported significantly lower levels of anxiety, sadness, joint pain, mental state wellness, psychological quality of life, and physical complaints [28]. Previous research has shown that pranayama reduces anxiety and alters affect [4, 5, 17, 53], even after just one practice.

In our investigation, fMRI alterations during passive viewing of negative images point to a noteworthy interaction effect in the bilateral insula and right amygdala.

Moreover, those with higher levels of enhanced activity in the insula and amygdala showed less pronounced decreased negative affect. Previous research indicates that, in comparison to a control group, anxiety-prone people exhibit noticeably higher activity in both the bilateral amygdala and insula [55]. This finding is consistent with our findings. It has been proposed that a shift in the sympatho-vagal balance is

linked to lower anxiety levels. Actually, the preponderance of parasympathetic activity seen following the practice [13, 54] was linked to the observed stress reduction following a yoga breathing training [22, 23].

Yoga is an intricate practice that incorporates a wide range of concepts, such as physical postures, breathing exercises, meditation, focus, ethical principles, spirituality, inward awareness, and self-awareness [20]. This summary shows how various yoga techniques, such as physical postures, breathing exercises, meditation, Bhramary Pranayama, Sahaj Yoga and laughter yoga can be beneficial for both adults and children. Asanas, or physical postures for various body parts, promote the body's strength, flexibility, and endurance while enhancing cardiovascular and pulmonary health. In addition to promoting the healing process from many illnesses and chronic pain, it also lowers stress, anxiety, and depression, enhances sleep patterns, and improves general health and quality of life [21–26].

Meditation is a practice in which a person trains his or her mind to focus on a certain thing, idea, or activity by using techniques like mindfulness and mantra meditation. Regular meditation practice improves both biochemical indicators and anxiety ratings. It encourages a physiological state that is in opposition to the stress-inducing flight-or-fight reaction, fostering a sense of mental and physical equilibrium [28].

Laughing therapy appears to be a promising adjunct to medicine or other therapies. It is inexpensive and has gained popularity during the past ten years. Laughter is thought to boost our mood by buffering the negative effects of stress on the immune system and lowering levels of stress hormones [28]. But it works best in groups, under the guidance of a trainer who can control the duration and dosage of laughter therapy [15].

**Biological Markers for yoga as effective and alternate medicine:** It would be crucial to comprehend the enhancements brought about by yoga and how they relate to alterations in biomarkers.

#### Anti-oxidant nature of yoga

Elevated levels of reactive oxygen species (ROS) and reactive nitrogen species (RNS) relative to antioxidants cause oxidative stress, which damages various biomolecules such as DNA, proteins, and lipids. This, in turn, exacerbates diseases like cancer, cardiovascular disease, neurodegenerative disorders, and aging [12–15]. One important non-enzymatic intracellular indicator of antioxidant status is glutathione (GSH) level [4]. Glutathione levels in male Indian Navy volunteers who practiced yoga improved significantly from 235.3 + 16.9 nmol/L to 331.7 + 37.6 nmol/L. Strong elements of an antioxidant defence system include vitamins C and E. After three months of yoga practice, there was a significant ( $p < 0.05$ ) rise in vitamin C and E levels [17].

#### Improvement of cardiovascular health due to yogic practices

Research has demonstrated that yoga can enhance mood, promote adaptability to hypoxia, and improve coronary artery calcium (CAC) in addition to breathing [32–34].

In addition to its well-known benefits for depression, anxiety, and stress, Sudarshan Kriya yoga (SKY) has been shown to enhance spontaneous respiratory coupling and cardiac autonomous control in patients suffering from anxiety and stress disorders. This lowers the patients' risk of cardiovascular disease [39–41].

#### Anti-aging impacts of yoga

Aging is defined as a series of changes in an organism, or a deterioration in physiological quality, that increases the risk of disease, debilitates the organism, and prevents it from adapting to metabolic stress in adults before dying [46]. The main causes of genomic aging are reactive oxygen species (ROS), chemicals like benzo [a] pyrene, ultraviolet and infrared radiation, spontaneous hydrolytic reactions, and errors in DNA replication. These damage events result in a variety of genetic lesions, including point mutations, gene disruption, telomere shortening, translocations, and others. DNA repair mechanisms, such as base excision repair (BER), nucleotide excision repair (NER), and non-homologous end joining (NHEJ), are employed to repair the damage induced by these lesions [47–51].

The impact of a 12-week yoga-based lifestyle intervention (Yogasanas, pranayama, and meditation) on both cardinal and metabotropic indicators linked to cellular aging was investigated by Tohuna Singh. The results demonstrated a substantial increase in the mean levels of telomerase activity and total antioxidant capacity (TAC) but a significant decrease in the mean levels of 8-hydroxy 2 deoxyguanosine (8-OH2dG) and ROS (all values  $p < 0.05$ ). There was an increase in the mean telomere length, although the difference was not statistically significant ( $p = 0.069$ ). Brain-derived neurotrophic factor (BDNF), cortisol,  $\beta$ -endorphin, IL-6, and sirtuin-1 are the metabotropic blood biomarkers linked to cellular aging. Substantial decreases were observed in the mean levels of cortisol and IL-6, while substantial increases were observed in the mean levels of  $\beta$ -endorphin, BDNF, and sirtuin-1 (all values  $p < 0.05$ ) [60].

In a related study, Krishna *et al.* found that practicing yoga and engaging in yogic activities such as asanas (bodily / tangible poses), pranayama, and dhyana (meditation) significantly ( $p < 0.001$ ) enhanced the leukocyte telomere length (LTL), which was then assessed by quantitative PCR [63].

#### Magnetic Resonance imaging

##### a. Emotion Processing Scheme

The patients' vision was either normal or corrected to normal. They had a training session right before scanning to make sure they were following the instructions, and they used a different collection of photographs as stimulus. Using a 5-point Likert scale (very negative, negative, neutral, positive, and very positive), subjects were asked to rate the emotional impact of a series of images with varying emotion valence (neutral or negative) during the fMRI emotion processing task, which was programmed using Psychopy v.1.79 [42]. A fiber optic response pad with five buttons was used to record responses.

Images were classified based on valence and arousal value. Negative images had low valence and high arousal values, and neutral images had medium valence and low arousal values. During the presentation of negative images, participants were instructed to either passively observe the image or attempt a reappraisal, depending on instructions displayed on the screen before the image. In this context, reappraisal refers to an attempt to attribute new meaning to an aroused stimulus in order to reduce its emotional impact [44, 45].

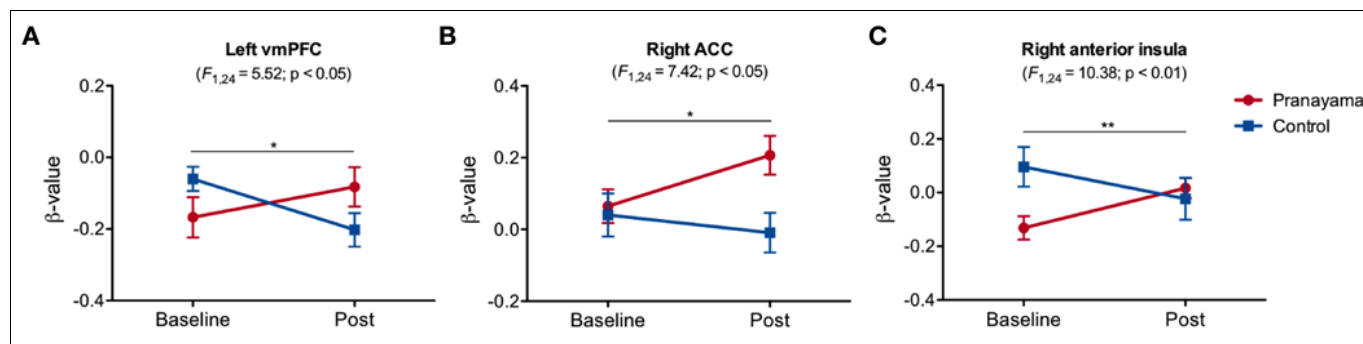
##### b. f MRI Emotional Processing Analysis

The effects of pranayama were examined in the following regions of interest (ROIs) previously thought to be involved



in emotional processing: ACC, amygdala; anterior insula, orbitofrontal cortex (OFC), dorsolateral prefrontal cortex (dlPFC), dorsomedial prefrontal cortex (dmPFC), ventrolateral prefrontal cortex (vlPFC) and ventromedial prefrontal cortex (vmPFC) [46, 47]. Except for vmPFC [48] and

anterior insula [49], all other ROIs were obtained directly from his WFU PickAtlas [50] in SPM12 (Figure 1). The mean B value for each ROI was extracted from the contrast for each subject using MarsBaR (SPM12).



**Fig 1:** Effects of the intervention in the reappraisal condition. Significant interaction was found (A) the left vmPFC ( $F_{1,24} = 5.52$ ,  $p = 0.027$ , Cohen's  $d = 0.95$ ); (B) Right ACC ( $F_{1,24} = 7.42$ ,  $p = 0.012$ , Cohen's  $d = 1.11$ ), with significant increased activity in the pranayama group ( $t_{12} = 2.37$ ;  $p = 0.035$ ); (C) Right anterior insula ( $F_{1,24} = 10.38$ ;  $p = 0.003$ , Cohen's  $d = 1.31$ ). Figures show mean beta values and standard error of them and for each group (pranayama and control) before and after the intervention. Effects of the intervention in the NEG-REAP condition.  $*p < 0.01$

## Conclusion

Bhr.P intervention is an effective technique to manage the depression, anxiety and stress, during COVID-19 home isolation. The findings further support that Bhr. P intervention helped to improve the quality of sleep and general wellbeing during the treatment period. Hence, it could be used as a complementary and alternative therapy to manage the negative emotions during home isolation in COVID-19. Yogic interventions improve overall health of body which can be analysed by assessing the levels of biological indicators. These indicators can also help to determine which practice could be employed to have greater impact in curing a specific ailment or getting a specific benefit. These studies would be important for people who are predisposed to diseases due to genetic or environmental factors. Further studies, with proper control groups, can be taken to analyse the impact of diet or change in lifestyle could further add value to the yogic interventions. Another interesting area of study could be to determine the relation between ethnic/genetic diversity, economic variability, and environmental factors and their impact on the final outcome of yogic practices. Practicing yoga can be beneficial to improve psychological health of the people. COVID-19 has made a dramatic change in the daily routine of the elderly, in terms of their care and support system, and their social connections. In this regard WHO has declared an agenda of "Decade of Healthy Ageing (2020–2030)". It comprises of an opportunity to bring together government, civil societies, international agencies, professionals, academicians, the media and private sectors, and so on under a collaborative action to improve the lives of the elderly, their families, and the community in which they live (WHO, 2020b).

## Future Perspectives

There are various parts that are still remaining untouched and needs a thorough research to protect peoples from their sedentary lifestyle and moving them to natural practices like various yogic asanas to overcome their daily life comorbidities. Researchers have suggested many new techniques and methods for being healthy and free from these high dose medications that have their adverse effects of physical as well as mental being of patients. There is a lot to be enlightened in this particular field of using different yogic

asanas to cure illness and their management.

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