



Effect of Yoga Pranayama (Breathing Techniques) on the Vagus Nerve in Countering Major Depression and Related Ailments; A Literature Review

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ABSTRACT: Major depressive disorder (MDD) is a major psychiatric condition associated with functional impairment and high levels of morbidity and mortality (M. Li, 2015) (Lohoff, 2010). It is characterized by mood alterations, diminished interests, impaired cognitive function and vegetative symptoms such as disturbed sleep and appetite changes (Christian Otte, 2016) are common patients suffering from MDD. Our nervous system is built around the balance and harmony of two opposing activities (Laurie Kelly McCorry, 2007).

1. The sympathetic nervous system (SNS) is associated with the fight or flight response.
2. The parasympathetic nervous system (PNS) is associated with relaxation, digestion, and regeneration.

These two systems are meant to work in rhythmic alternation, a process that supports healthy rhythms of alertness and restfulness that facilitate physical and mental health (Shah, 2018). In order to treat ailments such as MDD, many techniques are used to stimulate the vagus nerve for better functioning (Bruno Bonaz, 2018). Different forms of pranayama tends to activate different branches of the autonomic nervous system, this causes positive changes to the oxygen consumption, metabolism and skin resistance. The literature evidence gathered states that the mechanisms of the vagul nerve stimulation helps in the parasympathetic activation in an event of stress depression and major depression. When the pranayam is mixed with certain yogic asana's while controlling the breath, it seems to have a better countering of MDD and related disorders.

KEY WORDS: Major Depressive Disorder, Pranayama, Parasympathetic Nervous System, Vagus Nerve, Yoga Asana.

INTRODUCTION

Major depressive disorder (MDD) is a major psychiatric condition associated with functional impairment and high levels of morbidity and mortality (M. Li, 2015) (Lohoff, 2010). It is characterized by mood alterations, diminished interests, impaired cognitive function and vegetative symptoms such as disturbed sleep and appetite changes (Christian Otte, 2016) are common patients suffering from MDD. Recent research shows MDD prevalence to be twice effective in woman than in men (Soraya Seedat, Kate Margaret Scott, Matthias C. Angermeyer, & Patricia Berglund, 2009). Further research has emphasized the elements of environmental factors, such as sexual, physical or emotional abuse during childhood which are strongly associated with the risk of developing MDD at later stage (M. Li, 2015) (Maurizio Fava, 2000). Stressful life events such as disease, unfortunate life turnovers and certain personality traits has been identified as great risk factors for the development of MDD (Maurizio Fava, 2000). It is said to be one of the oldest medical disorders having been clearly described in medical texts dating back to ancient Greece (Maurizio Fava, 2000). Present studies have suggested low social classes belonging to the urban population with low levels of social support are most vulnerable for been entangled with MDD. It is believed that one way to treat MDD is by performing regular yoga practices that stimulates The vagus nerve that activates the parasympathetic nervous system to calm down the mind and ruminations. It helps in the reduction of stress hormones such as cortisol and promotes the release of happy hormones such as dopamine and serotonin. The review is based upon scientific fact of establishing connection between yoga practice and vagus nerve for the treatment of major depressive disorder.

VAGUS NERVE AND ITS EFFECT ON MAJOR DEPRESSIVE DISORDER

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The vagus nerve represents a main component of the parasympathetic nervous system; it oversees a variety of crucial bodily functions, including control of mood, immune response, digestion, many involuntary actions and heart rate (Sigrid Breit, 2018). It establishes one of the most important connections between the brain and the gastrointestinal tract and sends information about the state of the inner organs to the brain. The brain–gut axis is becoming increasingly important as a therapeutic target for gastrointestinal and psychiatric disorders, such as inflammatory bowel disease (IBD), depression, major depression, anxiety and posttraumatic stress disorder (PTSD) (Shan Liang, 2018). The gut brain connection is formally made by the vagus nerve. In order to treat ailments such as MDD, many techniques are used to stimulate the vagus nerve for better functioning (Bruno Bonaz, 2018); generally it lowers the stress levels and helps one feel well. Therefore a healthy vagus nerve helps in leadership and decision making during flight or fight response (Grant Soosalu, 2019). The function of the vagus nerve is impaired by stress, depression anxiety, poor life style and other factors such as smoking and drinking.

NATURAL TECHNIQUES THAT HELP STIMULATE THE VAGUS NERVE.

For major depressed patients that do not respond to antipsychotic drugs, a surgery can be done through which an electric pulse meter is fixed to the vagus nerve for an artificial stimulation. Since this is a complex procedure it is best that an individual try out natural ways for stimulation of the vagus nerve.

1. Splash of cold water

Splash of cold water has been long expected show a significant immediate relief for people with MDD disorders and anxiety disorders. In a research done on 2018 demonstrated that cold stimulation in the lateral neck region activates the parasympathetic nervous system in ways that resemble significant research findings to support vagus nerve activation (Manuela Jungmann, 2018).

2. Probiotic and omega 3 rich diets

Probiotics are live bacteria that help in good health if eaten through food that consisting them. Probiotics that affect the brain are often referred to as “psychobiotics” Some these probiotics have been shown to improve symptoms of stress, anxiety and depression (Ghodarz Akkasheh, 2016) (Michaël Messaoudi, 2011).

A small study of people with irritable bowel syndrome and mild-to-moderate anxiety or depression found that taking a probiotic called *Bifidobacterium longum*NCC3001 for six weeks significantly improved symptoms (Maria Ines Pinto-Sanchez, 2017). Another study found that taking a prebiotic called galactooligosaccharides for three weeks significantly reduced the amount of stress hormone cortisol (Kristin Schmidt, 2015). Since the gut brain axis is coordinated largely by the vagus nerve, food items consisting of probiotics will the better functioning of the vagus nerve and the brain. The two marine omega-3 fatty acids are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), prevalent in fish and fish oils (Schacky, 251-262). Omega 3 fatty acids find in vegetarian diets are alpha-linolenic acid (ALA), fatty acids are essential for your body, meaning that your body can't make it, so you must get it from the green foods and beverages you consume (Giuseppe Grosso, 2014). Your body can convert some ALA into EPA and then to DHA, but only in very small amounts. Vegetables, especially green leafy ones, are good sources of ALA, one form of omega-3 fatty acids. Source of omega 3 fatty acids are mentioned since the thesis focuses on yogic diet for the treatment of MDD by controlling aspects of the gross body that may help reduce the effects of MDD such as stimulating the vagus nerve. There is not much direct evidence to suggest the direct depletion of depressive symptoms although it helps in countering cardiac related ailments such as elevated heart rate are often found with depressed patients. Interestingly, few studies indicate that people who consume omega-3s regularly are less likely to be depressed (Giuseppe Grosso, 2014). Therefore consumption of adequate diet of green leafy vegetables for vegetarians and vegans are a must for a better stimulation of vagus nerve if any or either way to be mentally fit face daily stresses and depressions. In general a healthy diet with rich fiber and other minerals in very beneficial for a good gut health that gives a good digestive tone that helps in the positive stimulation of the vagus nerve.

3. Yoga, deep breathing, pranayama, meditation, chanting and laughter.

All under this heading will be considered as aspects of yoga. Yoga in general refers to the asana practice. Swami Swatmarama explains in his text ‘Hata yoga Pradipika’ that yoga asana should be practiced with ease and comfort with concentration. The yoga Asana practice will help in adjusting of the muscles that directly interact with the vagus nerve. Since general yoga practices burns



the extra calories influencing the additional removal of fat in the body and balances the hormones for proper metabolism, like other physical exercises, mind-body exercises improve general physical function, most notably bone density, balance, strength and flexibility (Jahnke, 2010). Therefore we can assume vagus nerve gets all the positive impulses to balance the parasympathetic nervous system through physical exercise such as yoga asana practice. It helps to reduce the impact of depression on the mind. Research done on the effect of vagal stimulation showed that they reduce multiple physiological stress markers this includes: heart rate, blood pressure, cortisol levels and inflammatory bodies (M. C., 2017).

Different forms of pranayama tends to activate different branches of the autonomic nervous system, this causes positive changes to the oxygen consumption, metabolism and skin resistance. Pranayamic breathing, characterized by brief breathing in and retention was found to have a significant increase in oxygen consumption and metabolic rate while specific pranayamic breathing, but long breath retention has caused some lowering of oxygen consumption and metabolic rate in certain studies (RavinderJerath, 2006). Therefore it is important for a beginner to assess his or her state of breathing feasibility before attempting long term retention. In the case of major depression the effect of breath on your mood swings would be one of the best indicators of how long the duration of Pranayama should last, this helps in creating an exclusive model for each patient.

Deep breathing and pranayama has being considered to help in vagal stimulation by many psychiatrist and psychologists. The vagus nerve stimulation has many functions and the activity that is most amenable to assessment is its effect in controlling the cardiac rhythm (Alan W C Yuen, 2017). Decreased heart rate variability (HRV) is a result of poorer vagal parasympathetic tone and is associated with a wide range of illnesses. Therefore by introducing natural ways of stimulation we can identify the positive changes in cardiac rhythm. Your vagal tone can be measured by tracking certain biological processes such as your heart rate(pulse), your breathing rate, and your heart rate variability (HRV) (Sylvain Laborde, 2017). Under this assumption we can measure these variables in depressed patients for comparison. Over the years it has been found that deep breathing, pranayama, laughter chanting and mindfulness meditation are ways related to yoga that helps in vagal stimulation (E. Sankaranarayanan, 2006). Especially the practice of bhrammari pranayama seems have a positive effect on vagal tone (Maheshkumar Kuppasamy, 2016). Therefore it indirectly helps the anti-inflammatory processes and proper stimulation of neurotransmitters. This allows proper parasympathetic activation and the proper functioning of the limbic system associated with MDD and other psychological disorders.

YOGA PRACTICES FOR STIMULATING VAGUS NERVE AND COUNTERING MDD

Mechanism of vagas stimulation.

When it comes to yoga practice, it is important to understand the vagal tone which refers to the variability between the heart rate on the inhale and the exhale (KABEL, 2016). The greater the variability, the higher the vagal tone, which means that your body can easily switch from the fight-or-flight to rest-and-digest mode and vice versa. It basically reflects your resilience at any given situation. When your mind perceives something dangerous or stressful it activates the sympathetic nervous system (Kim, 2016) which induces adrenaline and other stress hormones into your body and your body responds (apa, 2018) – the blood pulls toward large skeletal muscles, you begin to breathe faster (Matthew J Watt, 2001). So your body is now ready to “fight or flight” and sends a signal of readiness to your brain. The brain perceives that your body is in real danger and continues with the stress response, which, in turn, keeps the body in a fight-or-flight mode, which then sends those stress signals back to the brain (Chu, Marwaha, Sanvictores, & Ayers., 2021). The cycle continues on and on if its not altered to bring the action reaction response to a rest. To break out of the loop you need to activate your parasympathetic nervous system (the rest-and-digest mode) (Lívea Dornela Godoy, 2018). Two main ways to do to convince your mind that there is no more danger or to stop the biological stress response so that the body signals the mind that it is no longer in a fight-or-flight mode. What’s important to note is that the vagus nerve would communicate both of those messages, since it is responsible for most of parasympathetic messaging both from the brain to the body and from the body to the brain (Martina Corazzol, 2017). This shows that by controlling the vagus stimuli it is possible to control the stress response and help slow down rumination in patients suffering from MDD.

YOGA PRACTICES

Pranayama (control of breath)

The most common type of pranayama for parasympathetic activation is deep diaphragmatic breathing also known as full yogic breathing (Xiao Ma, 2017). Sympathetic response is created during short fast breathing bordering on hyperventilation (Komori,



2018), this happens due to the fact of opening of airway passages that widen up when a person is gulping the air in. Parasympathetic activation leads to deep relaxed breathing (Marc A. Russo, 2017) (Komori, 2018), since your airways constrict and you will need to take time to breathe in and out to get the same amount of air in. Therefore controlling of the breathe will lead to either fight or flight if the air is taken in rapidly, and if you seep the air in and let it out slowly, your brain will take it as an invitation to rest and digest (Xiao Ma, 2017).

A preliminary study done through four weeks of Bhastrika pranayama, the results indicated a reduction of anxiety and an increase positive effects on self control, and that these changes are associated with the activity and connectivity of a brain network involved with processing emotions, particularly the amygdala, anterior cingulate, anterior insula, and the prefrontal cortex of the brain (Morgana M. Novaes, 2020). And the Resting-state fMRI revealed significantly reduced functional connectivity particularly involving the anterior insula and lateral portions of the prefrontal cortex which participate in awareness and attention (Morgana M. Novaes, 2020), which singles a chain reaction of the brain anatomy balancing itself during long term Pranayama sessions.

Kapalbhati pranayama will induce a rapid fight or flight response and yogic breathing will induce parasympathetic activation which gives a good vagal tone.

Bhramari pranayama will also induce a good vagal tone since it vibrates the vocal cords with the sound of the humming bee. Since the area of the neck is a vagal tone activation site, bhramari pranayama is an immensely a great technique to relive stress, depression and anxiety due to the fact that the pranayama helps to resonate at an ideal frequency for the stimulating of the vagus nerve. The following empirical research shows the success rates on depression and major depression related disorders.

Table 1. Pranayama practices and its effect on depression, MDD and anxiety.

Author and reference	Sample size (n)	Study type and method	Treatment groups	findings
Role of self-induced sound therapy: Bhramari Pranayama in Tinnitus (Pandey S, 2010)	n=84	Experimental study pre-post	Single group	BP significantly reduced the irritability, depression and the anxiety associated with tinnitus.
The effect of Bhramari pranayama on pregnant women having cardiovascular hyper-reactivity to cold presser test (Sanjeev Rampalliwar, 2013)	n=28	Experimental pre-post	Single group study	Hyper reactivity reduced to hypo reactivity and basal blood pressure, rise in blood pressure and pulse rate reduced significantly.
The Effect of Pranayama on Stress and Depression in College Female Students (Pinkesh, 2020)	n=40	RCT	Experimental and control groups	Depression and stress decreased significantly in women after 12 sessions of regular pranayama yoga practice.
Assessing depression following two ancient Indian interventions: effects of yoga and ayurveda on older adults in	n=69	RCT	Experimental and control	The depression symptom scores of the Yoga Group at both 3 and 6 months decreased significantly.



Author and reference	Sample size (n)	Study type and method	Treatment groups	findings
a residential home (Manjunath Nandi Krishnamurthy, 2007)				
Wellness through a comprehensive Yogic breathing program – A controlled pilot trial (Anette Kjellgren, 2007)	n=103	RCT	55 experimental and 48 control group	Compared with the control group the experimental group lowered their degree of anxiety, depression and stress, and also increased their degree of optimism (ANOVA; $p < 0.001$).
Yoga and exercise for symptoms of depression and anxiety in people with post-stroke disability: a randomized, controlled pilot trial (Weili Chan, 2012)	n=419	RCPT	Experimental group only	The pilot study provides preliminary data on the effects of yoga combined with exercise to influence mood post-stroke.
Sudarshan Kriya Yogic breathing in the treatment of stress, anxiety, and depression. Part II--clinical applications and guidelines (Richard P Brown, 2005)	n=15 dysthemia n=15major depression n=60 Alcohol abuse and depression n=45 dysthemic disorder (area of interest)	Randomized Pre-post multiple trails	4 different groups of disorder yet same intervention.	Yoga has proved to be potentially beneficial, low-risk adjunct for the treatment of stress, anxiety, PTSD, depression, stress-related medical illnesses, and substance.
Effects of yoga intervention on sleep and quality-of-life in elderly: A randomized controlled trial (V R Hariprasad, 2013)	n=120	RCT	Contol group=58 Experimental group=62	Yoga intervention appears to improve the QOL and sleep quality of elderly living in old age homes and signifies less depression.
The effect of pranayama on test anxiety and test performance (Nemati, 2013)	n=107	RCT	Control group=48, experimental group	From the first three research questions, the positive effect of practicing <i>pranayama</i> in



Author and reference	Sample size (n)	Study type and method	Treatment groups	findings
				lowering test anxiety has been seen.
Antidepressant efficacy of Sudarshan Kriya Yoga (SKY) in melancholia: a randomized comparison with electroconvulsive therapy (ECT) and imipramine(IMN) (N. Janakiramaiah, 2000)	ECT=15 SKY=15 IMN=15	RCT comparison	with Single experimental groups with three variables	Significant reduction in total BDI scores in all groups but SKY and IMN showed the lowest mean difference.
Evaluation of Siddha Samadhi Yoga for Anxiety and Depression Symptoms: A Preliminary Study (Kozasa, 2008).	n=22	RCT	n=14 experimental group n=8 control group	A significant reduction in scores on anxiety, depression, and tension was found in yoga group when compared with the control group.

Asana practice (physical postures)

Asana practice along with pranayam would also help the cause in intervening major depressive episodes. Inverting poses like downward facing dog(parvatasana), supported bridge (setubhandasana), shoulder stand with and without support(sarvangasana) and headstand are well known asanas for activating rest and vagal tone (Wood, 2017). Generally a pose where the head is below the heart helps to reduce the effects of stress by toning the blood pressure. According to ancient literature backward bending will help to alleviate sluggishness, dullness, and apathy caused by depressive symptoms by opening the flow of energy to the lungs and the heart (MISHRA, 2013). Gentle backbends can have huge impacts on your overall health this ranges from marjariyasana(Cat pose lumber flexing) to standing back bending and twisting asanas such as matseyndrasana(Spinal twist); combination of backbend to standing pose (Tadasana) has shown effective presence of vagal tone activation.

A sequence of asana may be beneficial in activating a flow sequence to tone the vagus nerve; it focuses on a sequence that will have a quieting effect on the nervous system. Slowing the flow can encourage a shift from Fight or Flight mode to rest and digest mode, which is a hallmark of an optimally functioning vagus nerve.

Shavasana has shown to be a relaxing pose that brings down the adrenaline and cortisol rush which gives an important relaxation after yoga practices (Kishore Kumar Katuri, 2016).

CONCLUSION

The literature evidence gathered states that the mechanisms of the vagul nerve stimulation helps in the parasympathetic activation in an event of stress depression and major depression. The paranayam practices which includes is deep diaphragmatic breathing also known as full yogic breathing , bhramari and bhastrika helps in the activation on vagus nerve and the parasympatheitic nervous system and help calm down a person during a depressive episode. This can be observed in the systemic table that states the success rates of pranayama. When the pranayam is mixed with certain yogic asana’s while controlling the breath, it seems to gain a better progress in countering MDD and related ailments.

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