OPEN ACCESS
Turkish Journal of Kinesiology

REVIEW ARTICLE

The effect of yoga practices on health parameters: A review

Gökhan Çetinoğlu[1], Emirhan Pehlivan[2]

[1] Faculty of Sport Sciences, University of Uludag, Bursa, Türkiye. [2] Faculty of Sport Sciences, University of Burdur Mehmet Akif Ersoy, Burdur, Türkiye.

Received:
December 11, 2023

Accepted:
February 07, 2024

Online Published:
March 25, 2024

Keywords:
Anxiety, depression, meditation, stress, yoga.

Abstract

Yoga, a practice originating in India thousands of years ago, has gained immense popularity today and its effects are under scrutiny. Numerous studies demonstrate the positive impact of various types of yoga on human physiology. Specifically, research highlights the ability of yoga to mitigate stress and anxiety, as well as increase serotonin and dopamine hormones, facilitating healthy coping mechanisms in modern living. For a healthy lifestyle, yoga can be an important addition to a nutritious diet. While numerous studies have reported on the positive effects of yoga, its complete impact has yet to be fully understood. It may be recommended that the studies planned to be addressed in the future on the subject should be carried out for a specific health problem, should have a methodologically good and high quality structure and the sample size should be kept large. This review found that yoga has significant positive effects on anxiety and depression. It also increases hormones such as serotonin and dopamine in the body, which can lead to a more positive outlook. However, the review found statistically insignificant decreases in fasting blood glucose levels, postprandial blood glucose levels, and HbA1c. Additionally, yoga was found to significantly improve quality of life.

Introduction

Yoga was born in India thousands of years ago, and many people around the world have taken up the practice of yoga, not only to restore their physical health, but also to restore their spirituality. Yoga comes from the Sanskrit word 'yuj' meaning 'union' and has been defined as 'joining or merging with the higher self'. One of the most apt definitions of yoga is found in the documents that are the Yoga Sutras of Patanjali, some 2,000 years ago. One such sutra defines yoga as: "Yoga is the restraint of mental fluctuations. Thus, one of the goals of yoga is the development of attention (Mehrtash et al., 2015). According to Ross and Thomas, yoga is an ancient discipline designed to bring balance and well-being to the emotional, spiritual, and mental dimensions of human beings, and it involves an eightfold perspective and is metaphorically depicted as a tree (Ross & Thomas, 2010). The authors refer to these limbs as yama (universal ethics), niyama (individual ethics), asana (physical postures), pranayama (breath control), pratyahara (sensory control), dharana (concentration), dhyana (meditation), and samadhi (bliss). Some meditation techniques have similar goals (Danulacov et al., 2013). A growing body of research supports the belief that certain yoga techniques can improve physical and mental health by down-regulating the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS). The HPA and SNS are triggered in response to a physical or psychological demand (stressor), resulting in a variety of physiological, behavioral, and psychological effects, primarily through the release of cortisol and catecholamines (epinephrine and norepinephrine). This response results in the mobilization of energy to fight the stressor through the classic "fight or flight" syndrome (Chung et al., 2012). Over time, the constant state of hypervigilance resulting from the repeated firing of the HPA axis and SNS can lead to dysregulation of the system and ultimately to diseases such as obesity, diabetes, autoimmune disorders, depression, substance abuse, and cardiovascular disease (Chung et al., 2012). Numerous studies have shown that yoga has an immediate attenuating effect on the stress response of the SNS=HPA axis (Maheshkumar et al., 2022). Studies show that yoga reduces salivary cortisol (West et al., 2004; Michalsen et al., 2005), blood glucose (Venugopal et al., 2022; Vijayakumar et al., 2023) and

✉ G. Çetinoğlu, e-mail: gokhan.cetinoglu@hotmail.com
To Cite: Çetinoğlu, G., & Pehlivan, E. (2024). The effect of yoga practices on health parameters: A review. *Turk J Kinesiol*, 10(1), 41-47.
DOI: 10.31459/turkjkin.1402949

plasma rennin levels, and 24-hour urinary norepinephrine and epinephrine levels (Gokal & Shillito, 2007). Yoga significantly reduces heart rate and systolic and diastolic blood pressure (Thanalakshmi et al., 2020). Studies show that yoga reverses the negative effects of stress on the immune system by increasing immunoglobulin A12 levels and natural killer cells (Rao et al., 2007). Yoga has been found to reduce inflammatory markers such as high-sensitivity C-reactive protein and inflammatory cytokines such as interleukin-614 and lymphocyte-1B (Schultz et al., 2007). This review aims to present objective information on the impacts of yoga on selected human health parameters, potential alterations in human physiology, as well as certain chronic illnesses. The ultimate goal of this review is to raise awareness of these effects and to provide suggestions for future research in this domain.

Types of Yoga

Raja Yoga, Bhakti Yoga, Karma Yoga, and Jnana Yoga, with different goals and focuses. First, the focus on self-control is Raja Yoga. Second, Bhakti Yoga is defined in terms of emotional involvement. The third type of yoga, Karma, focuses on the actions of the individual and the effects of those actions on the individual's life. Finally, Jnana Yoga focuses on knowledge and enlightenment through self-study. In general, the goal of all types of yoga is to increase and transcend consciousness and to eliminate unhealthy habits not only in the mental dimension but also in the physical dimension. A study by Herrick & Ainswoth (2000) found that Hatha Yoga (as part of Raja Yoga) is the most popular of the various types of yoga. Maharshi Patanjali had given Ashtanga Yoga which has eight limbs or steps about 1800 years ago (Mehrtash et al., 2015).

These parts are Yama (universal ethics), Nyama (ethical observation), Asana (postures), Pranayama (breath control), Pratyahara (withdrawal of the senses), Dharna (concentration), Dhyana (meditation), and Samadhi (high concentration) (Taneja, 2014).

Yoga Today

In recent years, many studies have shown that the root cause of many health problems, such as depression, anxiety, and even high blood pressure, may be related to stress (Yaribeygi et al., 2017). Over the past 50 years, the use of meditation and yoga, which are widely practiced as effective adjuncts to conventional medical treatment, has increased rapidly in the general population (Rajagopalan et al., 2022). Many people practice yoga to help them become physically more robust and flexible. It also contributes to staying energetic, focused, and alert.

Various studies suggest that yoga benefits the wellness body by promoting health and activity habits, balance, sleep, mental and emotional health, and stress management (Earthweb, 2023). Yoga, long a popular practice in India, is becoming increasingly common in Western societies. According to a recent survey conducted by Yoga Alliance and Yoga Journal, the number of Americans practicing yoga has increased by over 50% in the last four years, reaching over 36 million in 2016, up from 20.4 million in 2012. The survey also found that 90% of Americans are familiar with yoga, with one in three having tried it at least once, and over 15% having practiced it in the last six months. Additionally, more than a third of Americans expressed a strong interest in trying yoga within the next year. Although yoga is predominantly practiced by women (70%), the number of American men practicing yoga has more than doubled, increasing from 4 million in 2012 to 10 million in 2016. Additionally, the number of American adults over 50 practicing yoga has tripled over the last four years, reaching 14 million (Harvard Health Publishing, 2016).

Table 1
The American data of yoga practitioners.

Age Group	%
18 to 29 years old	19
30 to 49 years old	43
50 years old and above	38

Table 1 illustrates the American data of yoga practitioners. The “golden yogis” or those aged 50 and above, have significantly increased in numbers over the years. It closely followed the 43% of the 30 to 49 age group (Earthweb, 2023).

Yoga for Stress and Anxiety

Since the 1970s, researchers have studied meditation and other stress-reduction techniques as possible treatments for depression and anxiety. Although yoga has become increasingly popular in recent decades, it has received less attention in the medical literature. However, available reviews of a wide range of yoga practices suggest that they can reduce the impact of exaggerated stress responses and may be helpful for both anxiety and depression (Sengupta, 2012). Yoga and meditation practices have been researched as potential techniques for reducing stress, anxiety and depression, improving physical and mental flexibility,

enhancing various cognitive areas of the person, and improving quality of life. During these practices, a person develops the ability to focus by paying attention to the present moment instead of getting caught up in thoughts. This mental stability has a positive effect on the parasympathetic nervous system, which has the opposite effect of stress and anxiety (Danulacov et al., 2013). Yoga has shown promising results for depression and anxiety (Padmavathi et al., 2023). Physical movements and interventions are increasingly being used to reduce stress. Relaxation is a method that can be taught as a form of self-help to achieve a state of mental calm, and its benefits have been supported in a systematic review evaluating effects on hypertension, headache, insomnia, and anxiety. Another review also looked at the use of relaxation techniques to reduce psychosocial symptoms in cancer patients, and found a beneficial effect on depression and anxiety. Relaxation may therefore play a positive role in improving psychosocial outcomes (Vambheim et al., 2021). Yoga also has psychological benefits in reducing stress, anxiety, and depression (Padmavathi et al., 2023). In a study of patients taking antidepressants who were only in partial remission, significant reductions in depression, anger, anxiety, and neurotic symptoms were observed (Taneja, 2014). In 2008, researchers at the University of Utah used functional magnetic resonance imaging (MRI) to show that between control subjects and yoga practitioners, the yoga practitioners had greater pain tolerance and greater pain-related brain activity during MRI. The study demonstrates the importance of yoga in regulating pain responses and associated stress (Taneja, 2014).

A study compares the mental well-being and state anxiety of primary school teachers who practiced 15 days of yoga in a residential setting with those who continued their usual routine.

A total of 236 primary school teachers participated in the study. The study assigned 118 primary school teachers to the experimental group, which underwent 15 days of yoga training for 6 hours per day at a residential yoga center. The non-yoga control group consisted of 118 teachers who continued with their normal teaching routine. The results showed that following a 15-day residential yoga program, there was a significant increase in overall mental well-being ($p<.001$) and a decrease in state anxiety ($p<.01$) as determined by a repeated-measures ANOVA, followed by post hoc multiple comparison tests. The non-yoga control group had higher levels of state anxiety at baseline, likely due to their continued presence in the workplace (Telles et al., 2018).

In a study to investigate the effects of regular yoga practice on antioxidant status, immune function, and stress oscillations in young healthy people, 30 university students (Daejeon, Republic of Korea) who had never practiced yoga, did not work nights, did not drink alcohol, did not take medication, and were not overweight were enrolled. These students were divided into two groups, and the yoga practice group participated in 90-minute yoga sessions once a week for 12 weeks. They were also asked to practice yoga on their own three times a week using a 40-minute DVD prepared by an instructor. The study included whole blood measurements at weeks 0 and 12. The study found that serum levels of nitric oxide, F2-isoprostane, and lipid peroxide were significantly reduced in the yoga group. Total glutathione (GSH), GSH peroxidase activity, and GSH-s enzyme were significantly increased in the yoga group compared to the control group. Yoga practice also significantly increased cytokines such as interleukin-12 and interferon-c, which are also important for the immune system (Lim & Cheong, 2015). Yoga practice showed a significant decrease in plasma adrenaline levels compared to the control group and a significant increase in serotonin levels compared to the control group (Lim & Cheong, 2015).

In a study designed to evaluate the efficacy of a low-level, standardized, and manualized meditation intervention of Sahaj Samadhi meditation on heart rate variability and depressive symptoms, a randomized controlled trial included 83 men and women between the ages of 65 and 85 who had previously been regularly treated with antidepressants, There was no significant change in heart rate variability in either group at the end of 12 weeks, but a significant difference was observed on the Hamilton Rating Scale for Depression in favor of the yoga (Sahaj Samanhi Meditation) group compared to the control group (Ionson et al., 2018).

Yoga and Lifestyle

Yoga is an increasingly popular therapy for maintaining health and managing various health conditions (Woodyard, 2011). Its therapeutic potential has been studied and applied to several lifestyle-related diseases in particular. Four major risk factors for lifestyle-related chronic diseases, such as obesity, hypertension, hyperglycemia, and cholesterol, can be reduced by yoga intervention. It can have a positive effect on coronary artery disease. It has even been shown to improve exercise capacity and reduce levels of inflammatory

markers in chronic heart failure patients with an ejection fraction of 25%. Yogic practices are useful in the treatment of diabetes and bronchial asthma (Malarvizhi et al., 2019). Yoga interventions for specific health conditions are being developed and demonstrated quite rapidly and the number of randomized controlled trials (RCTs) using yoga to improve health has increased dramatically since 2004. Despite this increase in RCTs, the results are inconclusive (Elwy et al., 2014). However, systematic reviews have concluded that yoga shows promise for improving health outcomes in people with chronic low back pain (Cramer et al., 2013). In recent years, yoga has become an important complementary approach sought by many cancer patients and survivors, regardless of cultural background (Groessl et al., 2015). There are some of the health benefits of yoga. Such as; improves overall wellness through stress relief and good health habits, better sleep and balance, and emotional and mental health wellness boost, aids people in managing stress, anxiety, and depression symptoms related to facing difficulties in life, enhances balance and flexibility, promotes strength and stamina, increases concentration, improves the quality of life and promotes better self-care (Earthweb, 2023).

Yoga and Type 2 Diabetes

For people with type 2 diabetes, the use of mind-body practices—things like yoga, deep breathing, and meditation may further lower blood glucose (blood sugar) levels. Engaging in mindfulness activities appears to lower blood glucose (also called blood sugar) as much as some diabetes medications (American Diabetes Association, 2023).

Yoga practice can be beneficial in managing various lifestyle diseases, including type-2 diabetes. The beneficial effects of yoga on diabetes are due to psycho-neuro-endocrine and immune mechanisms. Incorporating yoga practice into daily life can help achieve glycaemic control and reduce the risk of complications in people with diabetes (Raveendran et al., 2018).

A meta-analysis showed that yoga can improve glycemic outcomes, lipid profile, blood pressure, and waist/hip ratio in adults with T2DM (Thind et al., 2017).

Yoga also has beneficial effects in metabolic diseases such as type 2 diabetes and obesity. The practice of yoga (pranamaya and asanas) in type 2 diabetic patients with neuropathy has been found to improve nerve conduction velocity and glycemic control (Torgutalp, 2018). In a study conducted in diabetic patients, twenty type 2 diabetic patients aged 30-60 years were studied to see the effect of 40 days of yoga asanas on nerve conduction velocity. The duration of diabetes ranged from 1-10 years. Patients with cardiac, renal and proliferative retinal complications were excluded. Subjects were called to the cardio-respiratory laboratory in the morning hours and practiced by a yoga specialist. Tadasan, Konasan, Padmasan Pranayam, Paschimottansan Ardhmatsyendrasan, Shavasan, Pavanmukthasan, Sarpasan and Shavasan yogasanas were performed daily for 30-40 minutes for 40 days. The subjects were prescribed some medications and diet. Basal blood glucose and median nerve conduction velocity were measured and repeated after 40 days of the yogic program. Another group of 20 type 2 diabetics, identical in age and characteristics, called the control group, were kept on prescribed medication and light physical exercise such as walking. Baseline and 40-day parameters were recorded for comparison. In the treatment group, right and left median nerve conduction velocities increased from 52.81 +/- 1.1 m/s to 53.87 +/- 1.1 m/s and from 52.46 +/- 1.0 to 54.75 +/- 1/1 m/s, respectively. The nerve function parameters of the control group worsened during the study period, indicating that diabetes is a slowly progressive disease that affects the nerves. Yoga asanas have been observed to have a beneficial effect on glycemic control and improve nerve function in mild to moderate type-2 diabetes with subclinical neuropathy (Malhotra et al., 2002). Its role in the treatment of chronic insomnia has also been reported (Khalsa, 2004). In a study conducted to evaluate the effect of a comprehensive yoga breathing program (Sudarshan Kriya Yoga) on glycemic control and quality of life in patients with diabetes, 49 type 2 diabetic patients with similar HbA1c levels were enrolled. These patients were randomized into a control group and a Sudarshan Kriya Yoga (SKY) group. While both groups continued their normal diabetes treatment, the yoga group practiced SKY once a week in the hospital with an instructor for 3 months. In addition, this group was asked to do SKY at home every day of the week, even if it was short, and to have a staff member or relative confirm that it was being done and to sign a notebook. The study looked at changes in fasting blood glucose, postprandial blood glucose and HbA1c, and used the World Health Organization Quality of Life scale. The results of the study showed statistically insignificant reductions in fasting glucose, postprandial glucose and HbA1c. On the quality of life scale, there was a significant improvement in physical,

psychological and social activity parameters and quality of life in the yoga group compared to the control group (Jyotsna et al., 2012).

Controlled studies have shown that yoga practices can significantly improve glycemic control, lipid levels, and body composition in individuals with DM2. Limited data also suggest that yoga may reduce oxidative stress and blood pressure, improve pulmonary and nervous system function, enhance mood, sleep, and quality of life, and decrease medication use. It is important to note that these evaluations are objective and supported by scientific evidence (Kim & Selfe, 2016).

Yoga and Respiratory Diseases

In a study, it has been concluded that yoga, particularly the pranayamic breathing exercises, can significantly improve TLCO in individuals with mild-to-moderate grades of COPD when used in conjunction with standard pharmacological treatment and concluded that yogic breathing exercises improve diffusion capacity, making them a beneficial adjunct therapy for COPD patients alongside conventional medical treatment (Soni et al., 2012).

A meta-analysis discovered strong evidence that yoga can improve exercise capacity and pulmonary function in patients with COPD. Specifically, yoga breathing techniques were found to be an effective supplementary intervention for COPD patients (Cramer et al., 2019).

In a study, it was found that yoga influenced respiratory functions, symptom control and quality of life positively in asthma patients (Bahçecioğlu & Tan, 2020).

In an another study, evidence indicates that yoga training has a positive effect on improving lung function and exercise capacity, and it could be used as an adjunct pulmonary rehabilitation program in COPD patients (Liu et al., 2014).

A meta-analysis revealed moderate evidence supporting yoga as an adjunctive therapy for managing mild to moderate asthma. It demonstrated significant improvements in FEV1, FVC, FEV1/FVC, and PEFR in patients with asthma. Additionally, it was found to aid in improving asthma symptoms and health-related quality of life in the subdomains of activity, emotion, and environment. Yoga, meditation, postures, and breathing exercises are suggested as complementary therapies for patients with asthma (Anshu et al., 2022).

In an interventional study involving twenty-four healthy men with a mean age of 62.5 years, maximum expiratory pressure (MEP), 40 mmHg endurance test, breath hold time (BHT), and hand grip strength were assessed in these individuals who had never practiced yoga before and were enrolled in a two-week yoga training camp. Individuals with cardiorespiratory disease, diabetes mellitus, previous yoga practice, hypertension, asthma, recent major surgery, and athletic background were excluded from the study. Asana and pranamaya practices were performed for two hours each morning between 5:30 and 7:30 am for two weeks. Measurements were taken before and after the practice. The results of the study showed that 2 weeks of yoga practice resulted in a significant increase in respiratory pressure, breath hold time (BHT), and hand grip strength (HGS) (Mullur et al., 2014). Yoga is a heterogeneous set of activities, and different classes practice yoga in very different ways. While this heterogeneity reflects the richness and diversity of yogic approaches, it also makes it difficult to compare findings across studies and limits our ability to understand the mechanisms that influence physical and mental mindfulness with yoga (Groessl et al., 2012).

Limitations include small sample sizes and non-randomized designs, but more recent research is increasingly focusing on issues such as the selection of control groups and inadequate descriptions of the yoga interventions studied (Sherman, 2012).

Conclusion and Recommendations

As a result, the practice of yoga has been shown to have positive effects on some chronic diseases, anxiety and depression. Studies have shown that it increases hormones such as serotonin and dopamine in the body, which make people happier and develop a positive outlook. The benefits of yoga in chronic diseases can be further explored and developed as an adjunctive treatment to systemic medication. It may even be possible to prevent many diseases with its prophylactic effect. Thus, in today's challenging urban living conditions, it can have a positive effect on the fight against many diseases, especially chronic diseases, stress, depression and anxiety, and provide mental and physical development. It is recommended that the practice of yoga be considered, developed and utilized in a more comprehensive manner, and that more comprehensive disease-specific research be conducted to reach a much clearer conclusion.

Authors' Contribution

Study Design: GÇ, EP; Data Collection: GÇ; Manuscript Preparation: GÇ, EP.

Ethical Approval

Since our study was a review study, we did not obtain an ethics committee report.

Funding

The authors declare that the study received no funding.

Conflict of interest

The authors hereby declare that there was no conflict of interest in conducting this research.

Acknowledgement

I would like to thank my advisor Prof. Dr. Şerife Vatansever from Uludag University Faculty of Sports Sciences.

References

American Diabetes Association. (2023). Adapted from I Hate to Exercise, 2nd edition, by Charlotte Hayes, MMSc, MS, RD, CDE. ©American Diabetes Association. https://diabetes.org/health-wellness/fitness/yoga-blood-glucose.

Anshu, Singh, N., Deka, S., Saraswati, P., Sindhwani, G., Goel, A., & Kumari, R. (2023). The effect of yoga on pulmonary function in patients with asthma: A meta-analysis. *Complement Ther Clin Pract*, 50, 101682.

Bahçecioğlu, T. G., & Tan, M. (2020). The effect of yoga on respiratory functions, symptom control and life quality of asthma patients: A randomized controlled study. *Complement Ther Clin Pract*, 38, 101070.

Chung, S. C., Brooks, M. M., Rai, M., Balk, J. L., & Rai, S. (2012). Effect of Sahaja yoga meditation on quality of life, anxiety, and blood pressure control. *J Altern Complement Med,* 18(6), 589-596.

Cramer H, Haller H, Klose P, Ward L, Chung VC, Lauche R. (2019). The risks and benefits of yoga for patients with chronic obstructive pulmonary disease: a systematic review and meta-analysis. *Clin Rehabil*, 33(12), 1847-1862.

Cramer, H., Lauche, R., Haller, H., & Dobos, G. (2013). A systematic review and meta-analysis of yoga for low back pain. *Clin J Pain*, 29(5), 450–460.

Danucalov, M. A., Kozasa, E. H., Ribas, K. T., Galduróz, J. C., Garcia, M. C., Verreschi, I. T., Oliveira, K. C., Romani de Oliveira, L., & Leite, J. R. (2013). A yoga and compassion meditation program reduces stress in familial caregivers of Alzheimer's disease patients. *Evid Based Complement Alternat Med*, eCAM, 2013, 513149.

Earthweb. (2023, April 20). Earthweb, Data & Statistics, Demographics, Health, Lifestyle, Resources, by Kelly Indah, https://earthweb.com/how-many-people-do-yoga/

Elwy, A. R., Groessl, E. J., Eisen, S. V., Riley, K. E., Maiya, M., Lee, J. P., & Park, C. L. (2014). A systematic scoping review of yoga intervention components and study quality. *Am J Prev Med*, 47(2), 220-232.

Gokal, R., & Shillito, L. (2007). Positive impact of yoga and pranayam on obesity, hypertension, blood sugar, and cholesterol: A pilot assessment. *J Altern Complement Med,* 13, 1056–1057.

Groessl E. J., Maiya M., Elwy A.R., Riley K.E., Sarkin A.J., Eisen S.V., Braun T., Gutierrez I., Kidane L., & Park C.L. (2015). The essential properties of yoga questionnaire: development and methods. *Int J Yoga Therap*, 25 (1), 51–59.

Groessl, E. J., Sklar, M., & Chang, D. (2012). *Yoga for low back pain: A review of concepts and literature. In A. A. Norasteh (Ed.), Low Back Pain*. InTech.

Harvard Health Publishing (2016, March 7). New survey reveals the rapid rise of yoga - and why some people still haven't tried it. https://www.health.harvard.edu/blog/new-survey-reveals-the-rapid-rise-of-yoga-and-why-some-people-still-havent-tried-it-201603079179

Innes, K. E., & Selfe, T. K. (2016). Yoga for adults with type 2 diabetes: a systematic review of controlled trials. *Journal of Diabetes Research,* 2016, 6979370.

Ionson, E., Limbachia, J., Rej, S., Puka, K., Newman, R. I., Wetmore, S., Burhan, A. M., Vasudev, A. (2018). Effects of Sahaj Samadhi meditation on heart rate variability and depressive symptoms in patients with late-life depression. *Br J Psychiatry*, 214(4), 218-224.

Jyotsna, V. P., Joshi, A., Ambekar, S., Kumar, N., Dhawan, A., & Sreenivas, V. (2012). Comprehensive yogic breathing program improves quality of life in patients with diabetes. *Indian J Endocrinol Metab*, 16(3), 423-428.

Khalsa, S. B. S. (2004). Treatment of chronic insomnia with yoga: a preliminary study with sleep-wake diaries. *Appl Psychophysiol Biofeedback*, 29(4), 269-278.

Lim, S. A., & Cheong, K. J. (2015). Regular yoga practice improves antioxidant status, immune function, and stress hormone releases in young healthy people: a randomized, double-blind, controlled pilot study. *J Altern Complement Med*, 21(9), 530-538.

Liu, X. C., Pan, L., Hu, Q., Dong, W. P., Yan, J. H., & Dong, L. (2014). Effects of yoga training in patients with chronic obstructive pulmonary disease: a systematic review and meta-analysis. *J Thorac Dis*, 6(6), 795-802.

Maheshkumar, K., Dilara, K., Ravishankar, P., Julius, A., Padmavathi, R., Poonguzhali, S., & Venugopal, V. (2022). Effect of six months pranayama training on stress-induced salivary cortisol response among adolescents-Randomized controlled study. *Explore (NY),* 18(4), 463-466.

Malarvizhi, M., Maheshkumar, K., Bhavani, M., & Hariprasad, B. (2019). Effect of 6 months of yoga practice on quality of life among patients with asthma: A randomized control trial. *Advances in Integrative Medicine*, 6(4), 163-166.

Malhotra, V., Singh, S., Tandon, O. P., Madhu, S. V., Prasad, A., & Sharma, S. B. (2002). Effect of Yoga asanas on nerve conduction in type 2 diabetes. *Indian J Physiol Pharmacol*, 46(3), 298-306.

Mehrtash, S., Kocak, S., & Altunsoz, I. H. (2015). The Effect of Yoga on Stress, Anxiety and Depression among Turkish Adults: A preliminary study. Pamukkale Journal of Sport Sciences, 6(1), 39-49

Mullur, L. M., Khodnapur, J. P., Bagali, S., Aithala, M., & Dhanakshirur, G. B. (2014). Short communication role of yoga in modifying anxiety level in women. *Indian J Physiol Pharmacol*, 58(1), 92-95.

Padmavathi R., Kumar, A. P., Dhamodhini K S, Venugopal, V., Silambanan, S., K, M., & Shah, P. (2023). Role of yoga in stress management and implications in major depression disorder. *J Ayurveda Integr Med*, 14(5), 100767.

Rajagopalan, A., Kuppusamy, M., & Gandhi, T. S. (2022). Meditation Alleviates Psychological Distress and Sleep Quality in COVID-19 Patients during Home Isolation. *J Young Pharm*, 14(4), 441-443.

Rao, R. M., Telles, S., Nagendra, H. R., Nagarathna, R., Gopinath, K., Srinath, S., & Chandrashekara, C. (2008). Effects of yoga on natural killer cell counts in early breast cancer patients undergoing conventional treatment. Comment to: recreational music-making modulates natural killer cell activity, cytokines, and mood states in corporate employees Masatada Wachi, Masahiro Koyama, Masanori Utsuyama, Barry B. Bittman, Masanobu Kitagawa, Katsuiku Hirokawa Med Sci Monit, 2007; 13(2): CR57-70. *Med Sci Monit*, 14(2), LE3–LE4.

Raveendran, A. V., Deshpandae, A., & Joshi, S. R. (2018). Therapeutic role of yoga in type 2 diabetes. *Endocrinol Metab (Seoul)*, 33(3), 307-317.

Ross, A., & Thomas, S. (2010). The health benefits of yoga and exercise: a review of comparison studies. *J Altern Complement Med*, 16(1), 3-12

Schultz, P. E., Haberman, M., Karatha, K., Blank, S. E., & Nichols, J. (2007). *Iyengar Yoga can promote well-being in women breast cancer survivors*. Spokane, WA: Washington State University.

Sengupta P. (2012). Health Impacts of Yoga and Pranayama: A State-of-the-Art Review. *Int J Prev Med*, 3(7), 444–458.

Sherman K. J. (2012). Guidelines for developing yoga interventions for randomized trials. *Evid Based Complement Alternat Med: eCAM*, 2012, 143271.

Soni, R., Munish, K., Singh, K., & Singh, S. (2012). Study of the effect of yoga training on diffusion capacity in chronic obstructive pulmonary disease patients: A controlled trial. *Int J Yoga*, 5(2), 123-127.

Taneja D. K. (2014). Yoga and health. *Indian J Community Med*, 39(2), 68-72.

Telles, S., Gupta, R. K., Bhardwaj, A. K., Singh, N., Mishra, P., Pal, D. K., & Balkrishna, A. (2018). Increased mental well-being and reduced state anxiety in teachers after participation in a residential yoga program. *Med Sci Monit Basic Res*, 24, 105-112.

Thanalakshmi, J., Maheshkumar, K., Kannan, R., Sundareswaran, L., Venugopal, V., & Poonguzhali, S. (2020). Effect of Sheetali pranayama on cardiac autonomic function among patients with primary hypertension - A randomized controlled trial. *Complement Ther Clin Pract*, 39, 101138.

Thind, H., Lantini, R., Balletto, B. L., Donahue, M. L., Salmoirago-Blotcher, E., Bock, B. C., & Scott-Sheldon, L. A. J. (2017). The effects of yoga among adults with type 2 diabetes: A systematic review and meta-analysis. *Prev Med*, 105, 116–126.

Torgutalp, S. S. (2018). Effects of yoga principles (asana, pranayama and meditation) on brain waves. *Turk J Sports Med*, 53, 89-93.

Vambheim, S. M., Kyllo, T. M., Hegland, S., & Bystad, M. (2021). Relaxation techniques as an intervention for chronic pain: A systematic review of randomized controlled trials. *Heliyon*, 7(8), e07837.

Venugopal, V., Geethanjali, S., Poonguzhali, S., Padmavathi, R., Mahadevan, S., Silambanan, S., & Maheshkumar, K. (2022). Effect of yoga on oxidative stress in type 2 diabetes mellitus: a systematic review and meta-analysis. *Curr Diabetes Rev*, 18(2), e050421192663.

Vijayakumar, V., Mavathur, R., Kannan, S., Sharma, M. N. K., Raguram, N., & Kuppusamy, M. (2023). Effect of yoga on reducing glycaemic variability in individuals with type 2 diabetes: A randomised controlled trial. *Diabetes Metab*, 49(4), 101457.

West, J., Otte, C., Geher, K., Johnson, J., & Mohr, D. C. (2004). Effects of Hatha yoga and African dance on perceived stress, affect, and salivary cortisol. Ann Behav Med, 28(2), 114-118.

Woodyard, C. (2011). Exploring the therapeutic effects of yoga and its ability to increase quality of life. *Int J Yoga*, 4(2), 49-54.

Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T. P., & Sahebkar, A. (2017). The impact of stress on body function: A review. *EXCLI J*, 16, 1057-1072.