

Literature Review

Interdisciplinary Impact of Yoga on Health

Sydney Petersen, Dollie Gravley

Department of Public Health Sciences, Virginia-Maryland College of Veterinary Medicine

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Interdisciplinary Impact of Yoga in Preventative, Immune, and Cardiovascular Health

Yoga is a Sanskrit word, meaning “to unite” or “to yoke” and is a meditative and therapeutic practice originating in India dating back to 2700 B.C. (Basavaraddi, 2023). The goal of this practice is to bring harmony between the body and mind in correlation with the universe, unlocking a state of freedom within the mind. This self-realization is met with freedom of mind from suffering, anxiety, and envy. Historically, there are important authors, such as Patanjali in *The Yoga Sutras*, who heavily contributed to the conceptualization of yoga (Woods, 1982).

Written by an Indian man named Patanjali around the 2nd or 4th century BC. *Sutras*, *The Yoga Sutras* are short, meaningful phrases associated with the teachings of yoga. The 196 sutras delve into the meaning and practice of yoga, harnessing the practice, and eventually reaching enlightenment or self-realization (harmony between the mind and body). The sutras guide the reader through the elements of looking within oneself, how to silence the activity in the mind, and more importantly, to eliminate the chaos that causes us to lose sight of our true selves.

Documentary *Yoga Unveiled* describes yoga as being a consciousness of the innermost self and having a connection between the mind, spirit, and body (Desai, 2004). There are many types of yoga: Bhakti Yoga, Karma Yoga, Jnana Yoga, Raja Yoga, Tantra Yoga, Hatha Yoga, Kundalini Yoga, and Mantra Yoga. Ashtanga Yoga of Patanjali outlines the eight limbs of yoga: Yama (abstention), Niyama (observance), Asana (posture), Pranayama (breath control), Pratyahara (withdrawal of the senses), Dharana (concentration), Dhyana (meditation), and Samadhi (contemplation).

The practice of yoga has changed much over time; Westernized yoga has been influenced much by the exercise industry compared to Eastern yoga practices and concepts (Desai, 2004). Western explorers, such as the famous Christopher Columbus, were attracted to the rich life of

Indian civilization because of the high concentration of spices and jewels. This unfortunately led to much exploitation of the wealth of India, damaging the culture over time. In 1785, the popular Bhagavad Gita was translated from Indian scripture to English for the European cultures. In 1893, an inspirational man by the name of Swami Vivekananda attended a parliament of religious meeting in the West that strongly influenced Yoga traditions in the West. He became an idol to millions of people of many different faiths and backgrounds, advocating for a deeper meaning in life, away from the materialistic way of life. The modernization of yoga has encouraged society to step away from perfectionism and materialism, as is heavily seen in current-day Western culture. Yoga provides an outlet for perfectionistic influences; it encourages ease in letting go of these expectations and brings up an alternative view: looking inward at oneself with no expectations, only acceptance. The physical practice of yoga was brought to Western culture by T.K.V. Krishnamacharya, the “Father of Modern Yoga”. He creatively refined poses and brought them to the West, mastering over 3000 asanas and sharing his teachings with the mainstream world. He eventually opened his own yoga school to teach and create new ways of movement. Over time and in his later stages of life, he opened these practices to women.

Purpose Statement

The purpose of this literature review is to assess current literature research regarding health benefits of yoga to create educational materials for the In Balance Yoga Studio in Blacksburg, Virginia. This literature review is conducted in partnership with the Master of Public Health (MPH) program at Virginia Tech; two master’s students with interests in yoga health outcomes and preventative disease maintenance are creating these materials to meet requirements of the Integrative Learning Experience (ILE) graduate requirements in the MPH

program. The materials created from this project will be shared with the In Balance Yoga community members through educational materials to help integrate public health infectious disease prevention knowledge in correlation with practicing yoga.

In Balance Yoga is a local, female owned and operated studio in the Blacksburg community. Studio Owner, Nicole LaFon, is passionate about providing a wide variety of yoga practices to yogis of all levels and background. The studio mission, “We value positivity, service, connection, and fun with a passion for sharing movement! We hope this is your hOMe away from home.” illustrates the accessibility and love of sharing yoga that In Balance Yoga provides to the local community. Their social entrepreneurship business model gives back quarterly to three different non-profits (locally and internationally), they lead workshops and trainings, and actively offer weekly free and donation-based classes.

Assessment

The immune system is essentially what dictates human health and the ability to fight off infectious diseases. There are two responses in the immune system – innate (quick response and nonspecific) and adaptive (longer response and specific) (Shao et al., 2021). These two systems include many cells that target, destroy, and stay on the lookout for foreign pathogens: macrophages, neutrophils, T cells, and B cells. The immune system is complex, constantly working to identify and respond to pathogens that have penetrated the skin or mucus membrane barriers (Nicholson, 2016). It remains flexible to adapt to emerging infectious diseases, find pathogens that hide amidst the immune system cells, and verify different protein patterns. Poor immune health can lead to a variety of health issues including acute and chronic disease, poor lifestyle, and an increase in susceptibility to acquiring new diseases. Nutritional diet and physical activity are key components of a functional immune system. When nutritional needs are not met

and physical activity (PA) is lacking, the immune system doesn't receive the benefits of muscle growth and essential nutrients, ultimately increasing the risk of developing infectious diseases. Routine PA has extensively been shown to reduce infectious disease susceptibility, boost the immune system, and increase positive health outcomes. Combined with a healthy and nutritious diet of whole grains, colorful fruits and vegetables, and healthy fats, these benefits are further ameliorated. The risks of developing multiple chronic diseases or developing an infection rise as adults age.

An increasing amount of evidence suggests that a lack of PA coincides with being the first cause of major chronic diseases (Shao et al., 2021). PA aids the prevention of infectious diseases relating to the upper respiratory tract, decreases infectious disease-related deaths, and improves immune response time to fighting pathogens in the body. Long-term studies have shown evidence that routine PA decreases inflammatory markers that are age-related (Hamer et al., 2021). Overall, daily PA is known to strengthen immune health and lower infectious disease and related mortalities. Routine PA is also known to decrease immune system activation, leading to a decrease in stress and overall immune system activation (de Frel et al., 2020). Additional factors that negatively influence immune health are stress (Morey et al., 2016) and obesity (de Frel et al., 2020). During moments of acute stress, the innate immune system will release infection-fighting cells into the bloodstream to prepare the body for a "fight or flight" response. Both acute and chronic stress trigger inflammatory markers within the body. Within chronic stress, the immune system is susceptible to dysregulation, lowering the immune response and strength in fighting off acute and chronic infectious diseases. The immune system naturally becomes immune to chronic stress markers, compromising the efficiency of the immune response. Obesity increases pro-

inflammatory cells from the metabolic stress exerted on the immune system. Further contributing towards a slower and less adaptive immune response to fighting off infectious diseases.

Acute and chronic mental stress affects cardiovascular health and the likelihood of developing cardiovascular disease (CVD) (Vancheri et al., 2022). Psychological changes during the body's "fight or flight" response interact with the immune system, affecting the heart through changes in beats per minute, blood pressure, and breaths per minute. Acute mental stress, especially associated with anger, is more likely to disrupt cardiovascular health, leading to arrhythmias, stroke, heart attacks, or even death. Acute mental stress is also likely to cause post-traumatic stress disorder (PTSD), increasing risks of CVD and obesity. Stress causes a hemodynamic imbalance of blood flow within the heart ventricles and vasoconstriction of the blood vessels. In contrast, there is a balance between those two during PA, resulting in a proper balance within the heart.

Regular yoga practice can also play a significant role in maintaining or increasing bone density and preventing osteoporosis, due to its emphasis on weight-bearing exercises and gentle resistance training (Harvard Health, n.d.). Numerous studies among older people have shown that weight-bearing exercises can help slow bone loss, and even build bone (Harvard Health, 2021). Poses such as downward-facing dog or tree pose place stress on the bones and strengthen them. In addition to building bone strength, yoga also enhances balance and coordination, reducing the risk of falls, fractures, and injuries (Tew et al., 2020).

Preventative health and preventative healthcare initiatives are practices aimed at reducing the risk of infectious diseases, disabilities, and death (*Preventative Care*, n.d.). Healthy People 2030 and organizations such as the Center for Disease Control (CDC) create these practices such as regular wellness visits and screenings to reduce, prevent, or catch diseases in the early stages

of life. There are many barriers to preventative health such as socioeconomic status, location of providers and services, and lack of education about these services. Yoga has been proven to be a preventative health practice, influencing immunity, chronic disease management, reduction in mental and physical stress, and relief of arthritis (Madan et al., 2022). The meditative aspects of yoga aid chronic stress by helping to regulate the central nervous system and aid immune functions.

Yoga Practices and Stress Management

Yoga can be utilized as an effective, multifaceted approach to stress management because it addresses the interconnectedness of mind, body, and spirit. Physical postures (asanas), breathing techniques (pranayama), and meditation (dhyana) are central to traditional yoga practice, all of which may positively impact mental health. Yoga serves as a powerful tool for regulating the nervous system, eliciting the body's relaxation response, and reducing stress hormones.

When practicing physical postures (asanas), a previous study found that “yoga stretching can enhance parasympathetic nerve activity and improve stress hormones” (Eda et al., 2020). Another study found that yoga stretching may “enhance salivary immune functions and improve stress hormones and mental states” (Eda et al., 2013; 2018). Stimulation of the parasympathetic nervous system induces a relaxation response that counters the physiological effects of stress.

The association between slow breathing techniques (pranayama) and psychophysiological changes in the brain and body is widely recognized and well understood. One study suggests that breathwork's impact extends deep into the body's physiological systems, influencing interoception, the central nervous system (CNS), and heart rate variability (HRV) through modulation of the autonomic nervous system (ANS) and heightened parasympathetic

activity (Zaccaro et al., 2018). Slow breathing techniques promote autonomic changes that produce psychological/behavioral outputs such as “increased comfort, relaxation, pleasantness, vigor and alertness, and reduced symptoms of arousal, anxiety, depression, anger, and confusion” (Zaccaro et al., 2018). Breathwork can be used as a tool to influence the body's stress response system, modulate the autonomic nervous system, and promote relaxation.

Meditation (dhyana) is the heart of yoga practice, and this practice plays a pivotal role in stress reduction. Meditation induces physiologically quiescent states, by decreasing heart rate, respiratory rate, and blood pressure (Khalsa, 2015). A widely cited systemic review found that mindfulness meditation programs improve anxiety, depression, and pain, and improve stress/distress and mental health-related quality of life (Goyal et al., 2014). Meditation, in combination with physical postures and breathwork, can be a powerful tool in activating the shifting of the body away from fight-or-flight and activating the parasympathetic system, which is the body's relaxation response (Woodyard, 2011).

Yoga and the Lymphatic System

The lymphatic system is an intricate network that helps support immune health by filtering and removing toxins, waste products, and pathogens, while also facilitating the body's immune response by sending immune cells to areas of infection or inflammation (Kataru et al., 2019). Adequate functioning of the lymphatic system is essential for maintaining healthy immune function and protection from disease and infection.

Yoga practice has been recognized for its ability to enhance lymphatic flow, thereby supporting immune function. Yoga practices can stimulate lymphatic flow and support immune health through dynamic movements and asanas (poses), such as twists and side bends, which involve rhythmic movements that promote the contraction and relaxation of muscles (Land,

2020). These movements encourage the movement of lymph fluid through the lymphatic vessels, thereby enhancing lymphatic circulation (Land, 2020). Incorporating dynamic sequences into yoga practice can improve lymphatic flow and support detoxification (Land, 2020).

Inversions are another key practice of yoga that can support lymphatic drainage. Inversions involve positioning the hips above the head, thereby reversing the flow of gravity. Inversion poses encourage lymphatic fluid to drain more efficiently from the lower extremities and other areas of the body, helping to reduce swelling and congestion (Davidson, 2021). Poses such as Downward Facing Dog and Legs-Up-the-Wall Pose are particularly effective in promoting lymphatic drainage and supporting immune function (Davidson, 2021).

Breathwork, or pranayama, is another essential component of yoga that can enhance lymphatic circulation. Deep, diaphragmatic breathing is one of the easiest ways to move lymphatic fluid through your system, as it “creates a pressure variation between the thoracic and abdominal cavities which favors fluids such as blood and lymph moving towards the heart” (Douglass et al., 2019). Specific pranayama techniques may also stimulate lymphatic flow, such as Kapalabhati (skull-shining breath) and Bhastrika (bellows breath), which involve rapid and forceful breathing patterns that create internal pressure changes within the body (Sovik, 2015; Meehan, 2022). These techniques encourage the movement of lymph fluid and promote detoxification at a cellular level (Zope, S. A. & Zope, R. A., 2013). Incorporating mindful breathwork into yoga practice can help support lymphatic circulation and enhance immune function.

Yoga offers a holistic approach to supporting immune health through its ability to stimulate lymphatic flow. By incorporating dynamic movements, inversions, and breathwork

into their practice, individuals can enhance lymphatic circulation and support detoxification, therefore improving immune health and overall well-being.

Cardiovascular System Strengthening through Yoga

Cardiovascular health is crucial for overall well-being and immune function. Yoga offers a holistic approach to health, wellness, and strengthening of the cardiovascular system. Studies suggest that regular yoga practice may be beneficial for heart health because of its effect on reducing blood pressure, cholesterol, and stress, promoting cardiovascular strength, and enhancing blood circulation (American Heart Association, 2023).

The purpose of the cardiovascular system is to circulate blood adequately, and this plays a vital role in transporting nutrients, oxygen, and immune cells throughout the body (Chaudhry et al., 2022). A healthy cardiovascular system supports immune function by facilitating the movement of immune cells to fight infections, diseases, and health threats (Dal Lin et al., 2019). Maintaining appropriate cardiovascular health is important for overall well-being and resilience against illnesses (Dal Lin et al., 2019).

Yoga asanas or poses such as Trikonasana (Triangle pose), Setu Bandhasana (Bridge pose), and Dhanurasana (Bow pose) may target the heart and enhance cardiovascular strength (The Art of Living, 2023). These asanas improve heart muscle flexibility, increase circulation, and stimulate the cardiovascular system (The Art of Living, 2023). Regular practice of heart-opening asanas may help prevent cardiovascular diseases and improve heart health.

Pranayama techniques play a significant role in promoting cardiovascular health. Practices such as Nadi Shodhana (alternate nostril breathing), Bhramari (humming bee breath), and Ujjayi (victorious breath) regulate breathing patterns, reduce stress, and enhance the

oxygenation of blood (Nivethitha et al., 2016). Deep breathing techniques improve lung capacity, optimize oxygen intake, and support cardiovascular function (Seltmann et al., 2020).

Yoga practices, including asanas and pranayama, positively impact blood circulation throughout the body. These movements help stimulate blood flow, improving circulation to various organs and tissues, and enhance blood oxygenation throughout the tissues and organs. A combination of yoga poses, and yoga breathing techniques promotes cardiovascular health and enhanced blood circulation. Yoga practice is a promising preventive measure against cardiovascular diseases that promotes overall well-being.

Oxygenation of Organs and Tissues

Yoga has gained considerable attention for its numerous health benefits, one impact being its profound impact on the oxygenation of organs and tissues within the body. Various yoga practices can enhance oxygen supply, including deep breathing exercises (pranayama), yoga poses (asanas) for lung capacity, and overall improvement in oxygenated blood flow. Oxygenation plays an important role in supporting the functionality of the immune system. Immune cells require optimal oxygen levels to carry out their functions effectively (Zenewicz, 2017). Adequate oxygenation ensures the efficient delivery of nutrients and removal of metabolic waste products, thereby bolstering the immune system's ability to combat pathogens and maintain overall health (Woodyard, 2011). Both deep breathing exercises and yoga poses can help improve oxygen supply to organs and tissues.

Deep breathing techniques, such as diaphragmatic breathing and alternate nostril breathing, facilitate deep inhalation and exhalation, allowing for enhanced oxygen intake and carbon dioxide expulsion (Russo et al., 2017). These exercises optimize lung capacity and

improve respiratory efficiency, promoting better oxygenation of tissues throughout the body (Russo et al., 2017).

Certain yoga poses specifically target the expansion and strengthening of the lungs, thereby increasing lung capacity, and improving oxygen uptake. Poses such as Bhujangasana (Cobra Pose), Ustrasana (Camel Pose), and Dhanurasana (Bow Pose) involve chest opening and deep breathing, which stretch the respiratory muscles and enhance lung function (Shiraz, 2022). Consistent practice of these poses aids in maintaining respiratory health and optimizing oxygen delivery to vital organs.

Regular yoga practice stimulates circulation and improves blood flow throughout the body (Woodyard, 2011). Asanas (yoga postures) and sequences incorporate movements that facilitate the efficient transport of oxygenated blood to organs and tissues (Woodyard, 2011). Additionally, yoga promotes relaxation and stress reduction, which in turn enhances cardiovascular function and promotes vasodilation, further facilitating oxygen delivery to cells (Sengupta, 2012).

The oxygenation of organs and tissues is fundamental for maintaining optimal health and supporting the functions of the immune system. Yoga offers a holistic and multifaceted approach to enhancing oxygen supply through deep breathing exercises, poses targeting lung capacity, and overall improvement in oxygenated blood flow. By incorporating regular yoga practice, individuals can optimize respiratory health, bolster immune function, and promote overall well-being through improved oxygenation of vital organs and tissues.

Endocrine System and Thyroid Health

The endocrine system, which is responsible for producing hormones that regulate various bodily functions, benefits greatly from yoga's holistic techniques. Specific yoga poses, such as

shoulder stand and fish pose, exert gentle pressure on the thyroid gland, stimulating its activity and promoting hormone production (Cronkleton, 2017). Additionally, inverted poses enhance blood circulation to the endocrine glands, aiding in hormone distribution and balance (Cronkleton, 2017). Breathing exercises and meditation also help regulate the sympathetic and parasympathetic nervous systems, influencing hormone secretion and metabolism (Nilkantham et al., 2023). Yoga poses and breathwork encourage and support endocrine system function and thyroid health, which have the potential to optimize hormone balance, improve metabolism, and foster overall vitality (Nilkantham et al., 2023).

Holistic Approach

While many yogis in the Western culture do not practice the full eight limbs of yoga, the popular asana, pranayama, and meditative practices still provide a full range of multiple benefits concerning preventative, immune, and cardiovascular health. Many of these benefits lead into one another, such as the release of hormones oxytocin, serotonin, and melatonin during the practice of yoga, causing a decrease in anxiety and stress, increasing immune and cardiovascular health, and aiding in the prevention of acute and chronic infectious disease risk (Madan et al., 2022). Yoga is also a therapeutic method in managing chronic diseases with the immune and cardiovascular systems by reducing inflammation and further progression of disease.

Yoga is a holistic practice that simultaneously boosts the immune system through increasing immune cells responses to inflammation in the body, stabilizes blood glucose and blood pressure levels, and lowers mental stress (Madan et al., 2022). These benefits are provided through asanas that increase lymphatic flow, aid cardiovascular health, balance insulin production in chronic diabetic patients, and improve psychological health outcomes. Eight-week

practice studies have proven to decrease tumor necrosis factor genes, inhibiting inflammatory pathways in the body, and decreasing the risk of chronic disease (Gagrani et al., 2018).

Yoga provides a holistic approach to the overall mental and physical well-being of those who participate in regular practice. Many of these benefits can be seen long before a regular practice develops. This is a practice that meets people where they are in their current mental and physical states, making it extremely accessible to everyone. Yoga can be modified to meet the physical needs of those who are advanced in their practice and for those who may be more limited. Yoga is a non-discriminatory practice that has a wide array of mental and physical health benefits.

Limitations and Challenges

Despite a growing body of research supporting the benefits of yoga for immune health, there are still gaps in scientific literature. The amount of peer-reviewed and accessible studies discussing the immune benefits of yoga was limited. The role of yoga on stress markers is well understood, but the role of yoga on immune function and inflammatory markers seems less studied. More comprehensive studies, including randomized controlled trials with larger sample sizes and long-term follow-ups are needed to establish the efficacy of specific yoga interventions for immune-related outcomes.

Conclusion

Yoga is a multifaceted practice that goes beyond physical exercise to encompass mental, emotional, and spiritual well-being. Originating in ancient India, yoga has evolved over centuries, adapting to different cultural contexts and modern lifestyles. From its historical roots to its modern Western interpretations, yoga has served as an effective practice for individuals seeking harmony and connection between mind, body, and spirit. Through physical postures,

breathing techniques, and meditation, yoga offers a pathway to alleviate stress, enhance immune function, promote cardiovascular health, and optimize the oxygenation of organs and tissues.

Yoga acts as a comprehensive approach to health and well-being. Yoga addresses multiple facets of immune health and disease prevention by stimulating lymphatic flow, supporting cardiovascular strength, and promoting relaxation. Additionally, yoga's emphasis on mindfulness and self-awareness fosters resilience against the damaging effects of chronic stress and inflammation on the body and mind. Whether through gentle stretches or vigorous flows, yoga can be tailored to meet the unique needs and goals of each yogi, making it a valuable practice for people of all ages and physical abilities.

In conclusion, the holistic approach of yoga can have a profound impact on the overall well-being of individuals. By harmonizing mind, body, and spirit, yoga empowers individuals to cultivate resilience, vitality, and a deeper connection to themselves and the world around them. As the practice of yoga changes and evolves, it remains a timeless practice that embraces balance, cultivates self-awareness, and optimizes health and wellness through physical, mental, emotional, and spiritual practice.

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