Research Project

Topic: The effect of yoga and mindfulness on the nervous system, and the extent to which this can alleviate different forms of chronic pain and medical conditions in addition to improving the function of different systems in the body

Research Questions

How can yoga contribute to the activation of the parasympathetic nervous system in a way that eases musculoskeletal tension and cardiovascular issues?

What role does the parasympathetic nervous system play in reducing chronic, stress related conditions?

What are the most efficient ways to activate the parasympathetic nervous system in order to maximize stress and anxiety reduction?

The first article analyzed in this research paper demonstrates how yoga and mindfulness can be used to improve and prevent several health conditions through the activation of the parasympathetic nervous system, which affects the body's physiological state. Slowing one's breathing and focusing on the present, learning acceptance, living moment to moment, and practicing yoga poses trains the body to react better to stress, which is an underlying element in the origin and continuation of many medical ailments (Woodyard, 2011). This activation also leads to a considerable amount of other physiological reactions that strengthen the body's health. Yoga is a method in training the mind and body through muscle based activity and focusing energy on breathing practices and self awareness. It is a combination of controlled breathing techniques and different physical poses and movements. Yoga is meant to energize an individual and help them embark on a journey of healing, growth and positivity. A positive attitude can optimize recovery while negativity can significantly obstruct progress. Therapeutic yoga, by extension, is designed to treat medical conditions through yoga poses and principles to ease mental and physiological pain (Woodyard, 2011). This article discusses how yoga builds muscle strength and flexibility, helps with proprioception and balance issues, reduces joint, back and muscle pain, improves functional mobility, enhances cardiovascular and respiratory health, encourages recovery from addiction and eating disorders, decreases the chances of having osteoporosis and arthritis, improves mental health by decreasing depression, anxiety, stress and other types of chronic mental and physical pain, improves sleep quality in insomnia patients, and cultivates a healthier life overall (Woodyard, 2011). These results were found due to a comprehensive study, where the researchers of this article examined a host of different studies on therapeutic yoga as a treatment on different medical conditions and presented the findings. The body is subjected to such a large extent of external stressors everyday, and this can overstimulate the sympathetic nervous system. Yoga suspends the stress response and instead, promotes a physiological state opposite to the state that the body enters when it is in the fight or flight stress mode. It induces the rest and digest reaction of the parasympathetic nervous system. This creates a sense of harmony between the mind and the body and ultimately boosts health, as outlined in the rest of this paper (Woodyard, 2011).

Yoga and mindfulness activate the nervous system in a way that induces positive physiological reactions, which reduces or alleviates many medical conditions. This kickstarts the transition to the parasympathetic nervous system. This is very calming and restorative. It lowers breathing and heart rate, decreases blood pressure, lowers cortisol levels and increases blood flow to the intestines and vital organs. Yoga also promotes pratyahara, which is the practice of listening to the sounds of one's body and really being in tune with the body, while turning away from outside noises. In application, this translates to more time for the nervous system to have down time and let the body to relax (Woodyard, 2011). Stress

management is absolutely necessary for every individual, but especially in the context of cancer treatment. Tumors and other cancer markers in the body are aggravated by stress, which is why it is so important to learn to control stress in a productive and healthy way, such as yoga (Woodyard, 2011). This is important for everyone, but especially for cancer patients. Yoga helps decrease post chemotherapy nausea issues, lowering frequency and intensity of vomiting. Yoga is also an effective complement in pain management treatment, and at times it can even eliminate the need for pain medication for certain conditions all together. For example, sleep issues such as insomnia can be tackled with yoga. It improves sleep quality, decreases the time it takes one to fall asleep, increases the number of hours slept and allows individuals to feel well rested in the morning. Another example is chronic pain, which can take a toll on health over time (Woodyard, 2011). As stated above, deep breathing and meditation in yoga can activate the parasympathetic nervous system, allowing a decrease in certain forms of chronic pain. Yoga can also be used as a treatment for individuals struggling with mental health issues, such as anxiety or depression (Woodyard, 2011). Yoga increases levels of serotonin and decreases monoamine oxidase levels, which is an enzyme that lowers cortisol and neurotransmitters by breaking them down (Woodyard, 2011). This is an especially useful and effective treatment for patients with depression and anxiety who would like to reduce or completely forgo pharmacology. Yoga also creates an equilibrium in one's energy levels (Woodyard, 2011). This stabilized energy is essential for the immune system to function properly. The sympathetic area of the hypothalamus is inhibited, which allows the body's sympathetic responses to a stimulus that induces stress is then used in the most efficient manner. This also reinstates autonomic, regulation based reflex processes that are linked to stress. There is an inhibition in regions that are in charge of fear, anger, aggression and there is a trigger in parts of the median forebrain and other areas responsible for pleasure and joy, specifically in their reward centers (Woodyard, 2011). The balancing of energy outlined above decreases anxiety, blood pressure, cardiac output, heart rate, and respiratory rate. Yoga can also tremendously improve flexibility over time (Woodyard, 2011). Yoga builds and preserves both muscle strength and muscle mass. Muscles then begin to loosen slowly. Progressive loosening of muscles and connective tissues around the joints and bones increases functional mobility, which reduces disability, chronic pain and aching. Every muscle, gland and nerve in the body is exercised during yoga. Each joint and organ may have degrees of tension, other forms of holding, and energy blockages that are targeted by yoga. The release of tension is extremely freeing, allowing energy to flow easily through the body (Woodyard, 2011). This leads to an increased sense of well being and has a powerful effect on the mind, which in turn makes it easier to practice mindfulness and deep breathing to relax the muscles further, creating a fulfilling cycle. Joints are also used in their full capabilities regarding their range of motion. Fresh nutrients, in addition to blood and oxygen, are brought to areas of cartilage that are not used

all the time (Woodyard, 2011). These areas of cartilage are also stimulated, squeezed and soaked. This prevents chronic pain and arthritis. Over time, the cartilage is worn out and the bone underneath is exposed if the cartilage is unused and neglected (Woodyard, 2011). Yoga also improves cardiorespiratory health and cardiorespiratory health. There is an increase in cardiovascular efficiency, homeostatic control, autonomic balance and general respiratory health. Different yoga poses also have their own advantages (Woodyard 2011). Twisting poses will help squeeze out the venous blood in the body's internal organs. Once the twist in the pose is let go, the oxygenated blood flow is able to flow in. Inverted poses will help persuade venous blood flow from areas such as the pelvis and legs back to the heart, and then through the lungs where it can become newly oxygenated (Woodyard, 2011). During yoga, it is possible to maximize oxygen absorption and oxygen usage. Yoga increases blood flow, hemoglobin levels and red blood cells, and also thins blood. An increase in blood flow, hemoglobin levels and red blood cells then increases how much oxygen reaches the body's cells. This amplifies the functions of these body cells. Yoga also leads to a thinning of blood over time, which reduces chances of developing a blood clot and decreases the risk of having a heart attack or stroke (Woodyard, 2011). Mindfulness and yoga aim to create a mindset of peace and restfulness, which kickstarts the parasympathetic nervous system, and this improves the body's functions tremendously in the context of several medical conditions.

This next source also created a comprehensive report of many different studies which explore how the nervous system impacts stress, and put together a conclusion on how this relates to several medical conditions. It seems that stress is hazardous when it comes to maintaining good health. In fact, about ¾ of visits to the doctors are due to stress. According to the WHO, ⅘ of non-communicable diseases are a result of cardiovascular disease, cancer, diabetes, and respiratory diseases (Stephens, 2017). Chronic inflammation and stress is a common element of many of these conditions. This is where yoga has been extremely helpful. It decreases anxiety and depression. It also regulates blood glucose levels and keeps other systems healthy and functioning (Stephens, 2017). Yoga involves several facets, such as mindfulness, controlled breathing, self realization, meditation and reflection. Yoga encourages a personalized and holistic approach (Stephens, 2017). For example, a patient who is struggling with anxiety will be instructed to employ specific breathing techniques, practice postures that induce calming effects, and meditate. This meditation encourages focusing on the present, rather than the past which may lead to sadness or the future, which may result in anxiety. They would also work to lower their stress by learning how to construct resilience over time, manage stress and triggers in a healthy way, and reducing distractions such as a never ending chain of unhealthy thoughts (Stephens, 2017). It appears that stress is an underlying cause of many medical conditions, so it makes sense that reducing stress would be the primary intervention for preventing medical problems.

As previously stated, yoga builds a healthy balance within the nervous system by activating the parasympathetic nervous system. The sympathetic nervous system is kick started when the body perceives a threat or any sort of external stress (Stephens, 2017). This flight or fight creates a vasoconstriction effect, decreasing blood flow to the digestive system and other extremities related to survival. Heart rate and blood pressure will also increase. The liver will transform glycogen into glucose and then release glucose in the bloodstream. Other blood flow changes will also occur as a result. The bronchioles will open up. All of this decreases the digestive system activity, and even decreases urination output (Stephens, 2017). The parasympathetic system is the opposite, it is kick started when the body relaxes. Yoga teaches individuals how to practice movements along with deep breathing and meditation, which encourages the parasympathetic nervous system to start. Certain breathing techniques, such as switching from breathing in through the left and right nostril, is especially effective at increasing parasympathetic activation (Stephens, 2017). This in turn will release prolactin and oxytocin, and decrease cortisol. It also decreases the activity in the locus coeruleus, which is the main area for norepinephrine to synthesize in reaction to stress. A lower norepinephrine output allows the body to relax and decrease cortisol, and lower heart and respiratory rates (Stephens, 2017). Therefore, this system controls the rest and digest aspect of the nervous system. It stimulates blood flow to the brain, extremities, digestive system and sexual organs (Stephens, 2017). Throughout the day, every external activity creates an interconnection between the two dimensions of the nervous system. Yoga decreases physiological arousal and also quiets down the sympathetic nervous system. Meditation also increases how thick the left hippocampus is, which is the area of the brain that works to build resilience against chronic stress and depressive conditions. It also decreases the activity of anxiety related portions of the brain, like the amygdala. The connection between the amygdala and the PFC, decreasing reaction to stress. Meditation allows the activity in the PFC to increase and stimulates the thalamus. This increases GABA levels, which is related to stress (Stephens, 2017). Our bodies are not equipped to handle continuous stress and it is not healthy for the sympathetic nervous system to be so overstimulated. This sets the hypothalamic-pituitary-adrenal (HPA), which is a neuroendocrine system in the body, to be in motion (Stephens, 2017). This axis is responsible for several bodily functions, such as how the body reacts to stress, the regulation of the immune system, digestion, the storage and usage of energy. This axis is sparked when the corticotropin-releasing factor (CRF) is released from the hypothalamus. This allows for the release of adrenocorticotropic hormone (ACTH) from the anterior pituitary gland. Then the adrenal cortex creates and releases cortisol (Stephens, 2017). Over the long term, this can have adverse effects on the body. This is how stress destroys the body, and yoga and meditation can be used as a treatment to combat these negative stress oriented effects.

Another source investigates the physiological benefits after both short term and long term yoga treatment. Specifically, the yoga treatment is called surya namaskar, which is a fundamental part of yoga. This specific study spanned 6 months. 42 children from the 12 to 16 age group were divided into two groups. One group received teachings of slow surya namaskar (SSN) and the other group received teachings of fast surya namaskar (FSN) (Bhavani, Udupa, Madanmohan, & Ravindra, 2011). The results of this study were that the yoga treatment created a large decrease in diastolic pressure, and a major increase in systolic pressure (Bhavani et al., 2011). There was an increase in hand grip endurance in both groups, and pulmonary function tests showed that there was an improvement in both groups. Additionally, maximum inspiratory pressure and maximum expiratory pressure increased drastically in both groups (Bhavani et al., 2011). Yoga is able to create these physiological changes in the body in a short time period.

This study supports the idea that yoga has the ability to change the body on a physiological level through the nervous system. Slow surya namaskar has a positive impact on the pulmonary function, respiratory pressures, cardiovascular parameters and even hand grip strength and endurance (Bhavani et al., 2011). These systems are all controlled, to an extent by the nervous system. Facets of the autonomic nervous system work together and interconnect for blood pressure regulation, and try to keep it within limits. In yoga, the necessity for blood and oxygen is lessened because it is less strenuous on the body and relaxes the muscles (Bhavani et al., 2011). When combined with deep breathing, the autonomic nervous system is in charge of this regulation of blood pressure. For example, a particular pose called the shoulder stand helps calm the body, by restraining the carotid and therefore making the local pressure higher (Bhavani et al., 2011). This communicates with the parasympathetic nervous system, which believes that the brain tissue is getting too much blood, and tells the circulatory system and the heart to cut down on the pressure.

A different source focused on musculoskeletal disorders to explore how yoga affects musculoskeletal pain in dental students. Musculoskeletal pain can lower one's ability to work and live their life successfully. The study discussed in this article approached this musculoskeletal pain through yoga intervention. Out of 77 dental hygiene students, half were designated as a control group and the other half were instructed to attend two yoga classes a week. These lessons were 60 minutes in length, and spanned across 13 weeks (Monson, Chismark, Cooper, & Krenik-Matejcek, 2017). These students were given questionnaires and a Comparative Pain Scale evaluation to fill out prior to the treatment and after (Monson et al., 2017). The treatment group demonstrated a considerable amount of improvement after the intervention, with a P score of less than 0.001 (Monson et al., 2017). The control group, however, showed no change, reporting a P score of about 0.881 (Monson et al., 2017). This study

suggests that yoga sessions twice a week are shown to greatly improve musculoskeletal pain and enhance quality of life.

The parasympathetic nervous system is crucial in getting the body to relax. Over time, tension can build and have a detrimental effect on muscle strength and flexibility. Muscular pain can often be managed with deep breathing, yoga and other meditation based practices (Monson et al., 2017). Yoga promotes relaxation, which encourages the parasympathetic nervous system to activate. This process relaxes muscles. There is an increase in the range of functionality and mobility, and a decrease in tenderness, disability and pain during activity (Monson et al., 2017). It takes time and patience for the treatment to show results. Over time, yoga can not only relieve musculoskeletal pain, but lengthen and loosen muscles that are holding a lot of tension and contributing to chronic pain.

The last source examines how yoga programs can be used in order to help women with pelvic floor related conditions, such as urinary incontinence. This is a very difficult health problem for women, usually women who are middle aged. Pelvic muscle exercise is the main treatment for this condition, but this article introduces a study that analyzes whether yoga is an effective complementary treatment (Kim, Kim, Shin, Choo, & Kim, 2015). A single group was used in this study, and data was collected from them before and after they received the yoga intervention. These participants were selected from a community health center in Korea, and were given a questionnaire survey. 55 women participated in the initial stages of the intervention, 34 of them finished the program. This program consisted of biweekly interventions, over a span of 8 weeks (Kim et al., 2015). Urinary incontinence was assessed using five categories of urinary tract symptoms, such as sexual function, voiding factor, filling factor, incontinence factor, and overall quality of life. They also noted pelvic muscle strength and attitude towards pelvic muscle exercise. The results showed an extreme improvement in every single one of these categories (Kim et al., 2015). Yoga appears to be a very effective complementary method regarding pelvic conditions, more specifically in relieving urinary tract symptoms.

Similar to the musculoskeletal system, the pelvic floor can also benefit tremendously due to yoga intervention because of how yoga kickstarts the parasympathetic nervous system. Yoga encourages deep breathing and relaxing. It also lengthens muscles over time, which relieves several pelvic pain issues (Kim et al., 2015). In many women with pelvic pain, their muscles are weak and stiff. Usually, for a woman to maintain optimal pelvic health, she needs to build strong muscles and increase muscle flexibility (Kim et al., 2015). The muscles loosen over time and lead to progress when dealing with pelvic pain, but this cannot happen if an individual is not relaxing and undergoing some sort of treatment to meet this goal. It is often difficult to relax to such an extent or even stretch properly without some sort of guidance or structure, and this is where yoga comes in. Yoga promotes deep breathing and mindfulness,

which is the most effective way to switch the body to the parasympathetic nervous system. This is crucial for the body to relax and allow pelvic muscle pain to progressively alleviate.

This paper aimed to explore the effect of yoga and mindfulness on the nervous system, and the extent to which this can alleviate different forms of chronic pain and medical conditions in addition to improving the function of different systems in the body. Some specific questions that surfaced as this subject was explored were how yoga can contribute to the activation of the parasympathetic nervous system in a way that eases musculoskeletal tension and cardiovascular issues, what role the parasympathetic nervous system plays in reducing chronic, stress related conditions, and the most efficient way to activate the parasympathetic nervous system is in order to maximize stress and anxiety reduction. These sources were able to answer the first two questions in depth, however, the third question was not touched on as much. A way to continue this research would be to study specific yoga treatments and compare different programs to see which poses decrease stress most efficiently. The initial two sources examined in this paper explored how yoga impacts the nervous system. Specifically, the transition from the sympathetic nervous system to the parasympathetic nervous system is inspected. These systems work together to create a balance, and take turns being activated in response to the environment, Yoga involves several components that induce relaxation through meditation, stretching and physical poses. This relaxation allows the body to transition to the parasympathetic nervous system (Woodyard, 2011). This transition is very important in relaxing the body and shifting it to a resting mode. This shift allows several physiological processes to take place. The heart rate begins to slow, muscles begin to relax and the rest of the body reacts in a similar manner. Cortisol production decreases, and there is an increase in serotonin and dopamine (Woodyard, 2011). The first and second sources were good introductory sources to what medical yoga is, what it entails and how effective it is as a treatment. The second source took a more stress based approach, connecting increased stress to medical conditions and explaining how yoga lowers stress. The rest of the sources are focused on specific systems in the body, such as the circulatory system (Bhavani et al., 2011) and the musculoskeletal system (Monson et al., 2017). Yoga decreases stress levels significantly. This is important because stress is detrimental to the immune system, and over an extended period of time this subjection can have disastrous consequences, as many illnesses and conditions originate from stress (Stephens, 2017). Daily external stressors and over stimulation can harm the nervous system, and yoga controls this excessive stimulation. Yoga encourages relaxation, mindfulness, meditation, and controlling one's breathing (Stephens, 2017). Yoga leads to an improved quality of life, especially in patients dealing with cancer or other difficult conditions (Stephens, 2017). Often, the burden of having a medical condition is so traumatic, even without the symptomatic pain that accompanies it. Yoga can help alleviate this trauma and pain in a natural manner (Stephens, 2017). Yoga

is a useful tool that activates the parasympathetic nervous system, which plays a role in maintaining bodily systems, treatment and recovery. Both prevention and treatment of several medical conditions can be tackled with yoga, either as a sole intervention or as a complementary intervention.

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