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Association Between Arthritis and Yoga Among Veterans

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ASSOCIATION BETWEEN ARTHRITIS AND YOGA AMONG VETERANS

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Abstract

Yoga is a state of complete mindfulness and self-realization with an inwardly drawn focus, a state of mind – body integration in which there is a harmony between form and action. Yoga can help us treat a myriad of chronic health conditions like obesity, heart diseases, diabetes, depression, gastrointestinal problems, asthma, hypertension, chronic low back pain, and arthritis to name a few. Arthritis is a frequent, debilitating chronic disease which can cripple an individual if allowed to progress unchecked. In 2021, the prevalence of arthritis in USA was around 24% with a projection of 37% by 2030. Prevalence of arthritis is higher in Veterans (32%) than in non-Veterans (22%). Yoga de-stresses the mind, strengthens the muscles, and enhances the flexibility of joints in patients with arthritis. The objectives of our research were to determine the prevalence of arthritis, exercise, and performing yoga among Veterans in the United States, and to determine the association between arthritis and exercise and arthritis and yoga. We conducted a secondary data analysis of the Behavioral Risk Factor Surveillance System (BRFSS) survey from 2019. The participants for this study included those who self-identified as Veterans. We used chi square tests to calculate our descriptive statistics. Logistic regression analyses were performed to calculate odds ratios and where odds ratios were significant, multiple logistic regressions were performed to control for significant covariates (i.e. covariates that were related to exercise or yoga at the $p \leq 0.10$). Of the 52,856 Veterans questioned, 33.76% (weighted) had arthritis. Seventy-five percent of the Veterans surveyed, performed some type of exercise. Veterans who had arthritis were 38% less likely to exercise than Veterans who did not have arthritis. Only 1.64 % of Veterans performed yoga. The odds ratio for the Veterans who had arthritis and performed yoga was not significant. After adjusting for the covariates, the odds of exercising in Veterans with arthritis was not different from those

without arthritis. Although there is evidence that yoga can prove beneficial in the treatment of symptoms of arthritis, and also reduce stress in Veterans, our research revealed that not many Veterans practice yoga. The study brings forth the need to inculcate yoga as a part of complementary and alternative system of medicine into the treatment modalities of Veterans with arthritis.

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Chapter1: Introduction

The Sanskrit word yoga comes from the root word, 'Yoke' which means 'to connect', and it refers to the connection of mind and body (Haaz & Bartlett, 2011). The word yoga means "union", referring to mind-body integration. It means a harmony, balance, and synchronization in form and action (Sharma, 2014). Yoga is an ancient Indian practice for mind body integration devised by sage Patanjali about 2300 years ago (Stephens, 2017). 'Yoga Sutras of Patanjali', a classic Indian text defines yoga as, "The complete inhibition of the modifications of the mind". It is a state of complete mindfulness and self-realization with an inwardly drawn focus. A yogic has a complete awareness of the involuntary activities of the body like breathing, digestion, thought, heartbeat, blood flow, and even sexual discharges occurring in his or her body, at rest. Yoga is an act of complete control over the voluntary activities of the body (Stephens, 2017).

The eight conventional steps of Asthanya yoga are: "Yama (rules for living in society), Niyama (self-restraining rules), Asana (low physical impact postures), Pranayama (breathing techniques), Pratihara (detachment of the mind from senses), Dharana (concentration), Dhyana (meditation), and Samadhi (complete union with super consciousness)", (Sharma, 2014, para 4). Different techniques are used by different schools of yoga. The ancient practice of yoga was very austere but presently it has been modified for practical purposes. Ancient Indian yoga was for 'yogis' or 'sadhus' or hermits who abandoned all worldly pleasures and lead a life out of the society, but today's yoga has been modified to suit a common man's lifestyle and is given a more practical shape (Sharma, 2014). As per yoga, the definition of health or 'Svastha' is that you are yourself or 'at ease'. Dis-ease means a loss of that physiological state and acquiring a pathological state. This is in contrast with the modern viewpoint of health which means merely the absence of disease. In yogic practice, the absence of the state of vibrant health is considered

to be dis-ease, and a signal to revert back to 'ease'. Yoga hints at discovering the underlying cause of disease and connecting it to regain a healthy state or homeostasis where the milieu interior is in complete harmony with the milieu exterior (Stephens, 2017).

According to Venkatesh and his colleagues, "Medical yoga is defined as prevention and treatment of medical conditions by incorporating holistic approach, appropriate breathing techniques, mindfulness, and meditation, in order to achieve harmony between the functions of the body and mind for self-realization", (Venkatesh, Ravish, Silvia, & Srinivas, 2020. Para 8.). It is believed that loss of self-realization results in disease, and yoga helps in regaining health by restoring that lost connection between mind and body. That is the reason why yoga can help us treat a myriad of chronic health conditions like depression, anxiety, posttraumatic stress disorder, schizophrenia, autism, learning disorders, obesity, heart diseases, diabetes, depression, gastrointestinal problems, asthma, headaches, hypertension, chronic low back pain, ulcers, and multiple sclerosis to name a few (Venkatesh, Ravish, Silvia, & Srinivas, 2020). Yoga is further shown to reduce inflammation by acting at a molecular level and reversing some harmful molecular reactions involving DNA and histones (Venkatesh, Ravish, Silvia & Srinivas, 2020). Yoga is a form of highly disciplined physical exercise, and there is ever-expanding evidence that it can be used as a self-care technique for individuals. For example, a regular yoga practice for six months in patients of hypothyroidism lead to a reduction in serum cholesterol levels and TSH levels (Nilakanthan, Metri, Raghuram, & Hongasandra, 2016). Patients with Type 2 diabetes had significant improvement in their blood glucose and cholesterol levels, as well as an improvement in their body composition after performing yoga regularly (Baily et al., 2016).

Yoga provides physical, mental, and spiritual balance to an individual. Modern life is becoming more and more chaotic, and the world is in a dire need for a therapy that can provide

solace to the stressed minds and bodies. Evidence supports the fact that yoga is becoming more popular in the United States. It was seen in a national survey in 1998, that the number of individuals who practiced yoga in the past twelve months in the USA was 7.5 million. The life time prevalence of yoga at that time was 7.5%, and the 12-month prevalence was 3.8% (Saper, Eisenberg, Davis, Culpepper & Phillips, 2004). It increased to 13.2% lifetime prevalence and 8.9% twelve- month prevalence in 2012. More females and college educated people were practicing yoga in the USA. (Cramer et al., 2016).

Arthritis is a frequent, debilitating chronic disease which can cripple an individual if allowed to progress unchecked. In 2012, the prevalence of arthritis in USA was around 21 percent. There were 46.4 million known cases of arthritis at that time with a projection of 67 million by the year 2030, with 37 % of people with arthritis being disabled. The economic cost of arthritis in 2003 was estimated to be around \$ 128 Billion for that year, almost 1.2 % of America's Gross Domestic Product (GDP). Thus, arthritis is a chronic disease of major public health concern (Sharma, 2014,).

Osteoarthritis is usually genetically acquired or age related; however, in 12 % of cases, it is post-traumatic in nature. Post-traumatic osteoarthritis is most frequently seen in the military because of the nature of the job of servicemen. Due to the gulf war, the cases of trauma in military men and women have risen. Arthritis is the most common cause for retirement from the military, and joint related injuries are quite common in war. Arthritis is present in Iraq war Veterans, hand and glove with post-traumatic stress disorder, and is one of the most common conditions treated at the Veteran affairs (Rivera, Amuan, Morris, Johnson, & Pugh, 2017). Analysis of BRFSS data from 2011, 2012 and 2013 conducted by Centers of Disease Control and Prevention (CDC) revealed that the prevalence of arthritis was higher in Veterans than in non-

Veterans. Twenty-five percent of male and 31.3 percent of female Veterans had arthritis (Murphy et al., 2014).

Exercise plays a major role in preventing the progression of arthritis. According to CDC, if an individual has arthritis, it can be beneficial for him/ her to engage in physical activity. Exercise can help a patient with arthritis by reducing joint pain, elevating mood, increasing productivity, and improving overall quality of life. There are many physical activities that are joint-friendly and low impact, like biking, walking, and swimming. Such type of physical activity also helps patients with arthritis by reducing the chances of disability arising from arthritis, and managing other existing co-morbidities like diabetes, heart disease, and obesity (CDC, 2022).

According to the National Academy of Sports Medicine, arthritis is a chronic disease condition, involving the inflammation of the joints. Arthritis is of two main varieties, namely osteoarthritis (OA) and rheumatoid arthritis (RA). OA is a painful condition of the joints caused by the slow degeneration of the cartilage in the joints. RA is a chronic, autoimmune, degenerative disease that causes the slow erosion of the joints. Movement and pressure provided by exercise, nourishes and lubricates the cartilage in the joints. Immobilization of joints leads to stiffness due to the malnutrition, dryness, and lack of lubrication. Hence, regular exercise is important for the maintenance of healthy joints and relieving joint pain. A study conducted by National Academy of Sports Medicine (NASM) found that performance of specific exercise regularly for four weeks resulted in the reduction in muscle inhibition of patients who were experiencing it (NASM, 2021). Moreover, exercise also lead to an increase in muscle strength in such patients. Regular exercise increased flexibility around joints by strengthening the muscles and lubricating the cartilage, and hence might help reduce symptoms of arthritis (NASM, 2021).

According to the American College of Rheumatology, people with arthritis should exercise in order to experience less arthralgias, have higher energy levels, sleep better, and have an improved quality of life. As per the guidelines provided by the American College of Rheumatology, exercise should be one of the main treatment methodologies for OA of the hip and knee (Fontaine, Heo, & Bathon, 2004). Inactivity can worsen arthritis by reducing muscle strength, increasing stiffness in joints, decreasing pain intolerance, and decreasing balance. However, it is very important that people with arthritis perform the right kind of exercise. Research shows that moderate physical activity and weight bearing exercise can be helpful in patients with rheumatoid arthritis to reduce symptoms, reduce bone loss, and lessen the extent of damage to small joints (Fontaine, Heo, & Bathon, 2004). Lack of exercise in patients with osteoarthritis of the knee leads to the weakness of thigh muscles and worsens subsequent disability (Fontaine, Heo, & Bathon, 2004). Regular and appropriate exercise regimens that provide muscle strengthening, stretching, and aerobic exercise, help decrease symptoms, improve functions of joints, increase balance, and reduce weight gain in cases of OA (Fontaine, Heo, & Bathon, 2004). A certain set of body awareness exercises like tai chi and yoga have a positive impact on posture, balance, proprioception, coordination, and relaxation along with an element of mindfulness (Fontaine, Heo, & Bathon, 2004).

There is clear evidence that one of the important causes of chronic diseases is lack of physical activity. Performance of regular exercise in some form prevents or postpones the development of chronic diseases like diabetes, hypertension, heart disease, obesity, and arthritis. (Booth, Roberts, & Laye, 2012). Prevention of inactivity is vital in primary prevention of chronic diseases. WHO recommends that all adults should perform 150 minutes of physical activity in one week, preferably 30 minutes daily. While exercise has been shown to improve symptoms of

arthritis, high impact exercise may hasten the onset of osteoarthritis in those genetically predisposed and should be avoided by such individuals (Booth, Roberts, & Laye, 2012).

Yoga provides gentle exercise and correct postural techniques to reduce the stiffness due to osteoarthritis. Yoga alleviates chronic pain by enhancing flexibility and strengthening of muscles, tendons, ligaments, and joints (Cheung, Park, & Wyman, 2016). Yogic exercises are framed in accordance with the anatomy and physiology of our body. The state of mindfulness in yoga relaxes the body, lowers the heart rate, controls breathing and voluntary movements of the eyes. The yogic postures involving the extension, flexion, abduction, and adduction of various muscles of the body are conducted in a rhythmical and gentle manner. It leads to the proper stretching of muscle fibers and tendons and toning of the muscles. The subsequent toning and stretching of muscles strengthens them and the regular movement across joints gives them flexibility and improves arthritis (Haaz, & Bartlett, 2011).

A randomized clinical trial was conducted at John Hopkins arthritis center to study the role of yoga in arthritis (Moonaz et al., 2019). It was observed that, patients with rheumatoid arthritis as well as osteoarthritis show mental and physical health benefits from yoga. There was evidence to suggest that yoga reduced stress and pain observed in such patients and improved walking speed and physical function. The participants reported of continuing with the yoga practice even after a decade and inculcated yoga into their daily lives (Moonaz et al., 2019).

Health needs of Veterans are different from those of the general population. Some studies suggest that the mortality rate of Veterans is lower than that of the general population. This is called 'The healthy soldier effect' (Hull et al., 2015). It may be because of the high health standards expected from military people at the time of their recruitment. However, due to the hectic and stressful life in the military, and also because of the continuous wars in the last

decade, the health patterns in the Veterans are changing and are complex. These health patterns usually consist of a combination of arthritis, disability, chronic pain, Post-Traumatic Stress Disorder (PTSD), and other psychopathologies. Complementary system of medicine is very deft at handling such multisystem conditions, hence they produce better results in handling the complex health states of Veterans (Hull et al., 2015).

Many Veterans suffer from chronic pain. Since drugs and opioids might cause dependence, chronic pain conditions in Veterans are being treated through non-pharmacologic techniques, like physical activity, physiotherapy, tai-chi, yoga, and meditation. The Veterans' healthcare associations are increasingly using complementary and alternative treatment for Veterans. Moreover, yoga also helps handle stress which is part and parcel of the Veterans' health situations (Taylor, Hoggatt & Kligler, 2019). Many nonprofit organizations have initiated yoga programs for Veterans with PTSD and arthritis (Saper, Eisenberg, Davis, Culpepper & Phillips, 2004). Low back pain becomes chronic in 20-30 % of those affected. It is seen in both active combatants and retired personnel, and is associated with disability and psychological distress. Yoga has been found to be very effective in the treatment of chronic back pain and stress management in such patients. Yoga and meditation activate the hypo-thalami- pituitary-adrenal axis, thus leading to a better harmony between neuro-endocrine, metabolic, and immune systems of the body. Moreover, yoga can be conducted in a group and need not be conducted at an individual level. In totality, it has the potential to save thousands of dollars in medical costs and also leads to enhanced productivity of ex-servicemen (Schulz-Heik et al, 2017).

Yoga de-stresses the mind, strengthens the muscles, and enhances the flexibility of joints in patients with arthritis (Sharma, 2014). Yoga has been found to be useful in physical and psychological healing in the military personnel after their retirement and in those suffering from

PTSD (Staples, Hamilton, & Uddo, 2013). But the research on how effective yoga is in chronic pain is still in its early stages (Miller et al., 2017).

Due to a continuous war like situation in the middle East, the last two decades had yielded a new generation of military Veterans suffering from arthritis, PTSD, and other comorbidities. There is a public health need to understand the health needs of Veterans, including the use of yoga as an alternative medicine. This may not only help reduce the economic load of disability on the American tax payers, but may also improve the quality of life of the ex-servicemen and help them adjust to civil lives. Many studies are ongoing regarding the connection between yoga, arthritis, and health but there is a need to do more research in determining the precise role that yoga may play in Veterans suffering from arthritis. Some researchers have stressed the use of Complementary and Alternative System of Medicine (CAM) providing relief to various health needs of Veterans including back pain, and PTSD. Scientific research has already reached the inference that regular practice of yoga by Veterans might lead to better mental health and lesser use of opioids by Veterans (Miller et al., 2017). However, there is a paucity of research establishing an association between arthritis and yoga in Veterans. Therefore, the purpose of this study was to examine the association between arthritis and yoga in Veterans. The aims and objectives of our research were to determine (1) the prevalence of arthritis, (2) the prevalence of exercise or some form of physical activity, and (3) the prevalence of performing yoga among Veterans in the United States. Additionally, this study examined the association between arthritis and exercise and performance of yoga among Veterans in the United States. This was a cross-sectional, secondary data analysis of the BRFSS data of 2019 to answer the fore-mentioned research questions. The statistical analysis included chi square tests, logistic, and multiple logistic regressions using Statistical Analysis Software (SAS).

Chapter 2 – Background and Significance

India is an ancient country with a very rich cultural heritage. The ancient Indian texts like Vedas, Shastras and Upanishads describe yoga as a means to achieve harmony between mind, body, and the environment. Yoga is a Sanskrit word that comes from the root “Yug” or “Yoke” that means to join or combine (Basavaraddi, 2015). It essentially refers to mind, body harmony, or a union of body with the spiritual self or the soul.

History of Yoga

The history of yoga dates back to the dawn of Indian civilization. Yoga is the ‘immortal cultural’ contribution of the ancient Indian civilization, the Indus Valley Civilization dating back to around 2700 BC. It is the art of self-realization in order to lead to self-liberation. The mythological, Lord Shiva, the all-powerful, is considered to be the first guru of Yoga. ‘Yog-Sadhana’ refers to meditation and the spiritual aspect of yoga. ‘Suryanamaskara’ refers to the praise of the Sun, the God without which life would not have been possible on Earth. Yoga is both the science and art of healthy living. The practice of yoga is essential for bringing about a harmony between mind and body. It plays an important role in the spiritual well-being of humans and provides holistic approach to healing. Yoga plays a major part in health promotion, disease prevention, and treatment. The word yoga implies the union of individual consciousness with the universal consciousness, or in a way, surrendering of human spirit to the spirit of god or the universe (Basavaraddi, 2015).

Two thousand years ago, Patanjali, the father of yoga, wrote a treatise on yogic philosophy, called, “The Yoga Sutras”. There in, Patanjali described yoga as that “which restrains the thought process and makes the mind serene”. According to Patanjali, Yama and Niyama are the yogic ethics that keep the mind, body, and spirit clean. The term ‘Asana’ refers

to the various physical postures for the body suggested in yoga. The term ‘Pranayama’ refers to the various breathing techniques suggested in yoga. Though yoga is thought to play a major role in self-realization and spirituality, it also aids in prevention and treatment of many diseases of the human body. Yoga is the ultimate healer (Garfinkel & Schumacher, 2000).

Nayak and Shankar (2004) wrote that yoga has been practiced in India for the last 5000 years and is unique in the sense that it is not related to religion but to spirituality. It teaches humans how to discipline the mind and the body through exercise and meditation. They added that there are mainly two types of yoga which are the most popular in the West and they are Hatha yoga and Raja yoga. According to the authors, yoga involves physical postures called Asanas and breathing techniques called Pranayamas. Nirmala and Kamala (2004) also concluded that regular practice of yoga leads to a better physiology and a better control of autonomic nervous system, marked by better harmony between body systems and ultimately, better health.

Yoga was brought to America in the 19th century by Swami Vivekananda and has propagated and spread to the entire world. The system of yoga is based on the fact that the synchronization of mind, body, and spirit is required for the good health of an individual. Consequently, yoga is now an important component of Integrative Medicine (IM) (Trehwela, 2015) and has become an integral part of the Complementary and Alternate System of Medicine (CAM) (Garfinkel & Schumacher, 2000).

Health Benefits of Yoga in the General Population

Svastha means the functioning of the body in harmony with the mind and an attempt to reach the goal of self-realization. It hints at “ease” being the state of health and “dis–ease” being in a state of not being “at ease”. According to the Yogic principles, disease means the “absence of vibrant health”, and not merely the presence of disease. As per the ancient text of “Yoga

Sutras of Patanjali”, yoga is defined as the complete “inhibition of the modifications of the mind”. It is an act of living in the present moment, while suspending the sadness of the past and the anxiety of the future. It is mainly a mix of Asana, Pranayama, and Dhyana i.e. correct posture, correct breathing practice, and correct focus or concentration (Stephens, 2017).

General Health Benefits of Yoga

Chronic diseases are of a major public health concern in the 21st century. These cannot be controlled only by medication. The control of chronic disorders requires major lifestyle modifications, behavioral adjustments, proper diet, and exercise. Stress and underlying chronic inflammation play a major role in the development of chronic illness, and yoga can help heal and prevent them. Yogic Asanas, Pranayama’s, and mindfulness, provide a very good treatment methodology for controlling blood sugar levels in diabetics, blood pressure in patients with cardiovascular disease, body flexibility in patients with arthritis, and improves immunity in cancer patients (Stephens, 2017). Thus, yoga provides a low tech, safe, easy, and cost-effective treatment for many patients with chronic disorders. Thus, comes the term ‘Medical Yoga’ which refers to the application of yoga in the prevention and treatment of chronic disorders (Stephens, 2017). Medical yoga is the healing technique that involves the physical, spiritual, mental, and respiratory aspects of yoga for maximum benefits (Stephens, 2017). ‘Medical Yoga’ or ‘Yoga Chikitsa’ is the dynamic state of physical and mental ease, coupled with spiritual well-being achieved through the practice of yoga (Stephens, 2017, para 4).

Chronic disorders are hard to treat because they are multifactorial in origin. The prognosis of chronic disorders is affected by genes, lifestyle, diet, and physical activity. Yoga can prove to be a good antidote for chronic ill-health because it is an individualized, personalized, and holistic approach that targets the lifestyle, behavioral adaptations, dietary

changes, and family support, integrated with yogic asana (postures), Pranayamas (breathing exercises), and Sadhna (meditation) (Stephens, 2017). The effects of such treatments are longer lasting than the effects of medication. Yoga changes the patient's viewpoint of disease. It emphasizes the importance of proactive management of a disease (Stephens, 2017).

Therapeutic yoga should be gentle to start. Yoga stimulates the parasympathetic system and eases the body, it prepares the body for rest and digestion, and thus fight the stress which is sympathetic overdrive. Yoga helps to bring down the sympathetic tone by increasing the parasympathetic tone. Yoga depresses the body by increasing vagal tone. It helps improve the cardiovascular function, controls blood glucose levels, reduce serum cortisol levels, and enhance the blood circulation to the brain (Stephens, 2017). The breathing exercises improve respiratory function. Various contemporary studies show the usefulness of yoga for arthritis, backache, dyslipidemia, obesity, and hypertension. Yoga is beneficial for children with Attention Deficit Hyperactivity Disorder, and in the elderly with Alzheimer's (Stephens, 2017). Many studies are demonstrating that yoga can increase the health of people. The cure for many chronic diseases and prevention of many others, lies in the mental, physical, and spiritual harmony that is brought about by yoga (Stephens, 2017). This review article by Ina Stephens is a pivotal article in our literature research.

In the year 2001, a study was conducted at Swami Vivekananda Yoga Research Institute in Bangalore, India by Manoj Dash and Shirley Telles. Dash and Telles (2001) conducted a study at the Swami Vivekananda Yoga Research Institute regarding the improvement in hand grip strength in normal volunteers and patients with rheumatoid arthritis, following yoga therapy. They found that the subjects showed a significant increase in hand grip strength after 15 days of yogic exercises and Pranayamas. All categories of subjects in this study,

(normal males, normal females, men with arthritis, women with arthritis, and children) showed this trend. Women with arthritis had almost a three times increase in their hand grip strength following yogic exercises than their male counterparts. This study highlighted the role of yoga in normal individuals as well as in patients of arthritis (Dash & Telles, 2001).

Chronic low back pain (CLBP) is one of the most common causes of disability in the active adult population. About 40 % of the population suffering from chronic low back pain use Complementary and Alternative Medicine (CAM). The use of yoga for chronic pain is becoming the latest trend in the West. There are many randomized clinical trials (RCTs) studying the effect of yoga on chronic low back pain. Holtzman and Beggs (2013) conducted a metanalysis of around 150 RCTs conducted to find the efficacy of yoga in the treatment of chronic low back pain. The types of yoga used in the trials were Iyengar, Hatha, and Viniyoga, and pain as an outcome was examined in most studies. The results of the study indicated that there is a definitive evidence of yoga being an effective therapy to reduce pain as well as functional disability in patients with chronic low back pain (Holtzman & Beggs, 2013).

Chronic low back pain, affects almost one-fourth of Americans. Sciatica is a very common cause of back pain. Back pain leads to a loss of work days and not only leads to functional disability, but also to psychological problems including depression. Around 20 percent of people suffering from back pain also suffer from depression. Yoga might help heal both symptoms together. The past ten years have seen a rapid rise in the use of yoga as a treatment of chronic back ache (Chang, Holt, Sklar, & Groessl, 2016). Surveys conducted by CDC especially support this notion. One such survey in 2007 showed that yoga was the seventh most common CAM therapy being used to treat back pain (Chang, Holt, Sklar, & Groessl, 2016). A systematic review of literature was conducted to understand the role of yoga as an intervention

in the treatment of back pain (Chang, Holt, Sklar, & Groessler, 2016). The interventions were similar in all the studies and included weekly or biweekly yoga sessions for 60 to 90 minutes. The results from all studies showed the reduction of pain, functional disability, and improvement in movement in all the yoga groups over the controls groups. The study inferred that the performance of yoga reduces distress and analgesic requirements while elevating mood (Chang, Holt, Sklar, & Groessler, 2016).

General Health Benefits of Yoga in Veterans

The Veterans Health Administration (VHA) has considered the possibility of using CAM to care for Veterans. The Integrative Health and Wellness (IHW) is one such program, that offers I-rest, yoga, acupuncture, chair yoga, and integrative health education. A study was conducted with the aim of developing a CAM program (Holliday, Hull, Eickhoff, Sullivan, & Reinhard, 2014). The participating Veterans suffered from mental depression, insomnia, stress, decreased quality of life, and painful daily living. The outcome was measured in the form of self-reported questionnaires. The conclusion drawn was that IHP as part of CAM, can prove beneficial in improving the health of the Veterans (Holliday, Hull, Eickhoff, Sullivan, & Reinhard, 2014).

Another study was conducted with the objective of understanding the views of Veterans regarding the therapeutic applications of yoga (Hurst et al, 2018). This qualitative analysis resulted in the emergence of six main themes, which included: positive effects of yoga on mental and physical health; the aspects of yoga that aid in health benefits; the factors that promote yoga in military; and the factors that hinder the application of yoga in military and Veterans. The study concluded that yoga is a correct intervention for the treatment of mental and physical health of current and ex-military men and should be promoted as a CAM (Hurst et al., 2018).

In 2017, Groessl et al., published a randomized control trial highlighting the application of yoga for the treatment of chronic low back pain in military Veterans. The primary and secondary outcomes measured were Rolando-Morris Disability Questionnaire and Pain Intensity scale. The research concluded that yoga does play an important role in reduction of pain and opioid use in Veterans and should be promoted as an intervention to improve the overall health status of Veterans (Groessl et al., 2017).

The prevalence of chronic pain in the military ranges between 25% to 82%. The active and retired military personnel from Operation Iraqi Freedom experience a high level of chronic pain. Chronic pain usually occurs along with PTSD (Miller et al., 2017). Veterans suffering from co-occurring chronic pain and PTSD suffer from mood fluctuations and disability. Yoga was found to provide solace to such patients. Many patients with chronic pain and comorbid PTSD are prescribed opioids for the long term. The opioids pose the risk of addiction and overdose as well as other side effects. The Veteran Health Organizations and the Wounded Warrior Projects are becoming more and more open to the CAM methods for treatment of chronic pain and stress conditions. A systematic review conducted by Miller et al., (2017) was based on the use of yoga as a therapy for chronic pain and stress. Yoga was the intervention in all the studies, and dependent variables included back pain, depression, emotional outbursts, anger, chronic stress states, narcotic medication ingestion, insomnia, indigestion, and troublesome bad memories. The review concluded that yoga provides optimistic results in the treatment of chronic pain and chronic stress in both Veterans and non-Veterans, albeit further research is needed to determine how yoga can be used to produce even better results (Miller et al., 2017).

In 2011, the Veteran's Health Administration or VHA, is the nation's largest integrated health care system and vital to cater to the health care needs of ex-servicemen started offering

Complementary and Integrative Health (CIH) services. Following the Comprehensive, Addiction and Recovery Act of 2016 (CARA), the VHA has expanded its health care services based on the CIH approach. Because of a new policy directive in May 2017, the VHA has expanded its CIH services to include an array of alternative non-pharmacological treatment for Veterans suffering from PTSD, chronic pain, anxiety, depression, and other chronic physical and mental conditions. These include: tai chi, meditation, acupuncture, therapeutic massage, guided imagery, biofeedback, hypnotherapy, and yoga (Taylor, Hoggatt & Kligler, 2019). Research conducted by Taylor, Hoggatt and Kligler in 2019 collected data from a large group of Veterans regarding their view on the application, their interest in the use of CIH, and how satisfied they were with CIH. They also observed whether CIH use was associated with reduction in pain and disability and how much the Veterans benefitted from the therapy. It was observed 44% used massage therapy; chiropractic was used by 37%; mindfulness by 34%; meditation by 24%; and yoga was used by 25% of the people assessed. The most common reasons why CIH was used were stress and pain reduction. In total, 84% people wished to master at least one CIH approach. About 50% of the participants were interested in learning six CIH approaches, namely massage therapy, acupuncture, chiropractic, acupressure, reflexology, and progressive relaxation. The study concluded that most of the CIH approaches are safe and result in the improvement in health. Many of the Veterans thought CIH was useful in reduction of pain and stress but there was a gap. Many of the Veterans knew about the usefulness of CIH approaches but did not actually use them. Hence, there was a need for the health care providers of the Veterans to inform and assist their patients in making the right choices regarding the use of complementary and alternate approaches (Taylor, Hoggatt & Kligler, 2019).

Hurst and colleagues examined the opinions of Veterans regarding the role of yoga in the improvement of quality of life in chronic diseases. A dozen yoga instructors and two dozen military personnel/ Veterans participated in the study and commented upon their experience with yoga, how they felt after doing yoga, what benefits they were getting from yoga, what relief from symptoms of disease they were receiving. The qualitative analysis of the data revealed the physical and mental health benefits from yoga, the facilitators required, and the barriers present in the effective, safe and useful yoga practice. The study concluded that there were indeed physical and mental benefits of yoga for military personnel, both those serving and retired, suffering from chronic health conditions (Hurst et al., 2018).

Groessler and colleagues (2008) examined the efficacy and cost effectiveness of yoga as an intervention in Veterans with chronic low back ache. The participants for the study were selected from the VA and were asked to fill the questionnaire at the beginning of the program and again after ten weeks of practicing yoga. The questions asked were regarding the physical and mental well-being, like pain, depression, quality of life, energy levels, and program satisfaction. The results of the program were in the affirmative, suggesting that the Veterans were quite satisfied with their instructor and did experience an improvement in their health condition (Groessler, Weingart, Aschbacher, Pada, & Baxi, 2008).

As seen in previous studies, military Veterans experience lower quality of life and higher health care costs as a result of higher prevalence of chronic low back pain. These symptoms may differ across genders. A quasi-experimental study with a pre-post design was conducted by Groessler, Weingart, Johnson, and Baxi, in 2012, to compare and contrast the effect of yoga on male and female Veterans experiencing CLBP. The participants in the clinical yoga program were asked about various parameters at the beginning of the study and after 10 weeks in

the study. The observed parameters included, Pain (Pain Severity Scale), Depression, energy/fatigue, and Health Related Quality of Life (SF-12). The results depicted that women Veterans showed a greater improvement in symptoms of depression, pain, energy levels and mental health in comparison to their male counterparts. The study, hence concluded that women Veterans benefit more from yoga than men (Groessl, Weingart, Johnson, & Baxi, 2012).

Highland et al., in 2018 devised a study to test the preliminary efficacy and feasibility of the Restorative Exercise and Strength Training for Operational Resilience and Excellence (RESTORE) program among service members with CLBP. The researchers hypothesized that the RESTORE group would show clinically significant improvement in primary and secondary pain outcomes in the six months following the intervention as compared to the control group. A significant improvement in pain was observed in the RESTORE group as compared to the control group. The Restore group showed clinically meaningful improvement in all secondary outcomes at 3-month and symptom burden at 6-month follow up. They concluded that RESTORE may indeed be a clinically meaningful non-pharmacological intervention for CLBP (Highland et al., 2018).

Exercise and Yoga for Arthritis in the General Population

According to the American College of Rheumatology, exercise can be one of the most important tools of treatment for arthritis. Patients with arthritis who perform regular exercise experience less symptoms of arthritis like pain, tenderness, and stiffness. They sleep and work better. However, the right kind of exercise is important in arthritis. The type of exercises that can have a positive impact on decreasing the pain and disability caused by arthritis include, flexibility exercises, strengthening exercises, aerobic exercises, and body awareness exercises. Physical activities that combine leisure and recreation like golf, tennis, yoga and tai chi provide

flexibility to the body. Muscle strengthening exercises increase the strength of the muscles and hence provide more support to the joints. Aerobic exercises using large muscles of the body in a rhythmical and repetitive manner and improve cardiorespiratory function. These include walking, aerobic dance, treadmills, swimming, lawn mowing, raking leaves, and playing golf to name a few. It is recommended by WHO that adults should perform 150 minutes of moderate intensity exercise a week to maintain a state of optimum health. Another type of exercise is, body awareness exercise. Body awareness exercises help improve posture, balance and sense of position, and coordination and relaxation of the body. Some examples of such exercises are tai chi and yoga. Mindfulness is an important component of body awareness exercises and also the vital aspect in this type of exercise being helpful in improving overall function in the patients of arthritis (American College of Rheumatology, Dec, 2020).

Performance of regular exercise is shown to postpone or reduce disability in patients with arthritis. Other benefits of exercise in patients with arthritis include improved movement, independence in function, quality of life, cardiorespiratory function, muscle strength, and reduce arthralgias, and reduce the risk of the development of chronic disease. Public health is recently turning its focus in this direction. It has been observed that people with arthritis are more sedentary (31%) than people who do not have arthritis (26%). The people with arthritis related functional limitations are even more likely to be sedentary (prevalence being 47%).

(Der Ananian, Wilcox, Saunders, Watkins, & Evans, 2006). A qualitative study using focus groups of sedentary people with arthritis was conducted to study the effect of various factors affecting their exercise. The study also aimed at comparing and contrasting these influences in arthritis subjects who do not perform regular exercise and who do. The results showed that most of the people affected with arthritis who did not exercise at all or performed insufficient exercise,

mentioned physical pain to be the reason for not exercising. Nevertheless, people who performed insufficient exercise, claimed that the reduction in pain because of exercise encourages them to exercise more. This was also claimed by the group who exercised regularly. However, the people who had arthritis and did not perform any exercise were skeptical about the role of exercise in pain reduction. This study concluded that in order to give a better quality of life to patients with arthritis, exercise is important to reduce their pain. Since exercise is an important factor in pain reduction, specific steps should be taken to enhance the performance of exercise in patients with arthritis. Health care providers should also be involved in these strategies (Der Ananian, Wilcox, Saunders, Watkins, & Evans, 2006).

OA related knee pain can limit physical activity in elderly. It is recommended clinically that exercise and physical activity are the most vital parts of treatment of OA. Physical activity in patients with OA leads to a reduction in pain, improves physical function, reduces the risk of co-morbidities, and improves quality of life. Nonetheless, majority of the patients with OA do not follow these clinical guidelines and do not perform regular physical activity (Quike et al., 2017). Research was conducted by Quike et al., to study how the attitudes and beliefs about exercise and physical activity are related to knee pain in OA. The authors conducted a secondary data analyses of the randomized control trials of interventions based on exercise in patients with OA. They concluded that there was a positive association between exercise self-efficacy, positive outcome expectations, and higher current and future physical activity levels (Quicke, Foster, Ogollah, Croft, & Holden, 2017).

The prevalence of doctor-diagnosed arthritis in the adult population of United States is 54 Million i.e. 23%, according to the BRFSS data of 2013-2015 (Barbour et al., 2018). It was also observed that the prevalence of arthritis in the American population varied across various

States & counties, and rural & urban communities. Arthritis leads to limitations in physical activity and disabling joint pain in 15 million people in the United States. It is projected that by the year 2040, 78.4 million adults in the United States will be affected by severe joint pain. The chronic condition of osteoarthritis is highly detrimental to the quality of life of those affected, and the estimated cost incurred on the US Health care system by this disease state is \$ 300 billion per annum (Barbour et al., 2018). Thus, there is an urgent need by public health professionals to understand the problem of arthritis in detail so as to implement evidence-based interventions to decrease the morbidity burden of arthritis in the American population. The public health professionals target towards improving physical activity in such patients. A study conducted by Barbour et al. (2018), highlighted the role of physical activity in patients with arthritis. Out of the total 50 states, 13 states carried out a course on physical activity for management of arthritis. The median participation percentage was 14.5%; with about 60% of patients being advised by health care providers to participate in physical activity and perform exercise; 44.5 % of subjects were obese or overweight and were advised to lose weight in order to improve symptoms of arthritis. They found that performance of regular physical activity reduced pain and enhance function by about 40% in patients with arthritis. People who suffer from arthritis may not be able to exercise regularly for various reasons (Barbour et al., 2018). Some simple reasons can be lack of time and interest, while others specific to their disease can be pain, functional inability, sadness, lack of confidence and fear of fall or injuring themselves. The implementation of interventions like self-management skills lead to an improvement in the symptoms like pain, improved function, reduced fear of fall or injury, and elevated mood by about 10-20%, (Barbour et al., 2018).

Kolinski et al., in 2005, performed a pilot study to find out the effect of Iyengar yoga in patients with OA of the knee. The inclusion criteria for participants were based on the

guidelines of the American College of Rheumatology which stress exercise instead of drug therapy for the treatment of OA. Iyengar yoga was used as an intervention. Parameters that were assessed both before and after the intervention to gauge its success included: Western Ontario and McMaster Universities Arthritis Index (WOMAC), Arthritis Impact Measurement Scale (AIMS 2), Patient Global Assessment (GA), Visual Analog Scale (VAS), Physician GA, and 50-foot Walk Time. There was a significant improvement in all parameters after the eight-week long yoga therapy thus leading to the conclusion that yoga provides a good treatment option for patients of OA of the knee (Kolinski et al., 2005).

Rheumatoid arthritis (RA) is a chronic disease that can cripple a person in the prime of his/her life and thus have a negative effect on his/her Health-Related Quality of Life (HRQOL). Patients with RA suffer from painful, swollen, and tender joints that can result in disability and loss of HRQOL while also a decrease in life expectancy. If there is a very early (in adolescent) onset of RA, it can lead to depression, social isolation, and disability. In cases of RA, even despite extensive pharmacological or surgical interventions, patients need life style modifications, including diet and exercise to reduce the stress and disability limitation. Hence, there is a need to examine the role of yoga as a complementary form of medicine in people with RA. A small pilot study was conducted by Evans et al., (2010) examined the role of Iyengar yoga as an intervention in reducing pain and disability and enhancing quality of life in patients with RA. The results showed a tremendous improvement in RA symptoms and functioning but not pain thus leaving a gap and need for a full scale RCT (Evans et al., 2010).

A research project conducted in Dubai, studied the effect of a biweekly Raj Yoga Program on RA disease activity. The health indices observed were Health Assessment Questionnaire (HAQ), Quality of Life, and Disease Activity Scale-28 (DAS-28). Data were

collected at the beginning of the study and after 12 sessions of yoga in patients with RA. This pilot study reported that there was a significant improvement in DAS28 and HAQ after 12 sessions of yoga and the authors predicted that yoga therapy for longer durations could result in even more improvement of the health indices (Badsha, Chhabra, Leibman, Mofti, & Kong, 2009).

In 2011, Haaz and Bartlett performed a systematic review of literature on the role of yoga as an intervention for the treatment of arthritis. All the eleven studies included in the literature review were published between 1980 and 2010 and were based on quantitative data analysis. This research aimed at evaluating existing studies for evidence in support of the effect of yoga on the clinical, physiological, psychological, and social aspects on patients with arthritis. The clinical trials that were included in the study used Pranayama or breathing exercises, Asana or physical exercise, and meditation or relaxation techniques as an intervention for patients with arthritis. Five of the ten studies focused on RA patients, two on OA patients, and two included both patients with RA and OA. The studies were mainly randomized controlled trials, and the intervention included Iyengar, Hatha, Raj, or Kundalini yoga. The study findings included clinical, functional, and psychosocial outcomes. The clinical outcomes data were collected using the WOMAC pain function, GA, Stiffness, Hand Function, Ring Size, Health Assessment Questionnaire-Disability Index (HAQ_DI), DAS-28, Tenderness and Swelling in joints, Pain in joints. The physical outcomes were measured using grip strength and balance. The psychosocial outcomes were measured in terms of improved self-efficacy for yoga, Quality of life, self-efficacy for yoga, improvement in physical and emotional roles, energy levels, pain, mental health, energy, depressive symptoms, cortisol, awakening cortisol, improved vitality, mental health, chronic pain, acceptance, and mindfulness.

It was observed that there was a considerable and consistent improvement in tenderness and swelling in joints in patients with RA, in all the three studies which assessed this criterion. There was an improvement in pain in six of the eight studies. There was an improvement in disability in three out of the four studies. Self-efficacy was assessed in two studies and it showed an improvement in both of them. Mental health and energy also showed an improvement in two of the three studies examined. Hand grip improvement was seen to show improvement in only RA but not OA. Yoga produces better results as far as the clinical outcome were concerned, albeit with the psychological, social, and functional aspects being multifactorial in causation, they are more difficult to change (Haaz & Bartlett, 2011).

Another study conducted by Evans et al. (2012) assessed the effect of Iyengar yoga on the quality of life of female patients with RA. The results of the study indicated that Iyengar yoga, if performed regularly, does improve the symptoms of RA. The improvement was mainly seen in HRQOL, mood, and fatigue. (Evans, Lung, Tsao, & Zeltzer, 2012). Additionally, a systematic review of literature on the role of yoga in RA patients found that yoga is an effective additional therapy for the treatment of RA, and it is the most beneficial when all the components of yoga are practiced, including Asana, Pranayama, Saadhna, and Dhyana (Telles & Singh, 2012). A systematic review by Sharma (2014), examined the application of Yoga as a treatment for arthritis. The various interventions were conducted in hospital settings, community settings, residential yoga camp, and included chair yoga, and Iyengar yoga. The assessment of the improvement brought about by the intervention in all studies lead to the conclusion that yoga is an effective intervention for arthritis (Sharma, 2014).

Moonaz et al. (2015), studied the role of integral based Hatha yoga in patients with arthritis who were not previously exercising regularly. The outcomes measurements included

Short Form-36(SF-36), and Physical Outcome Summary (POS): fitness, mood, stress, self-efficacy, HRQOL, and RA disease activity. All of the measurements showed an improvement with performance of yoga, hence taking the researchers towards the conclusion that yoga does, indeed, help to improve physical and mental activity in individuals with arthritis (Moonaz, Bingham, Wissow, & Bartlett, 2015).

Cheung, Park, and Wyman (2016) conducted a systematic review to examine the physical, mental, psychological, and social impact of the performance of yoga in patients with osteoarthritis. Twelve studies included almost 600 subjects with OA who participated in various yoga interventions. The results showed that yoga proved to be a successful intervention to decrease pain, stiffness, and swelling in the patients with OA (Cheung, Park & Wyman, 2016).

Arthritis in Veterans

In 2006, an article published in the Journal of Rheumatology presented invaluable research on the prevalence of arthritis and symptoms of arthritis among the US non-Veterans, Veterans, and Veterans getting health care from the department of Veteran Affairs (Dominick, Golightly & Jackson, 2006). Using the BRFSS data from 2000, the study compared the prevalence and symptomatology of arthritis between Veterans and non-Veterans; and Veterans receiving health care from VA, and Veterans not receiving health care from the VA. The data analysis showed that there was a higher likelihood of US Veterans reporting doctor-diagnosed arthritis than non-Veterans (32% vs 22%; $p < 0.001$). Furthermore, the Veterans receiving health care from the VA were also more likely to report doctor diagnosed arthritis than the non-VA users (43% vs 30%; $p < 0.001$). The study concluded that the Veteran population was definitely suffering from a higher morbidity of arthritis and that the VA affairs was treating it more than the other health care organizations. The trends predicted a rise in the decades to come and also

stressed the importance of exercise and other supporting systems in the treatment of arthritis (Dominick, Golightly & Jackson, 2006).

An analysis of the BRFSS data from 2011, 2012, 2013 was conducted to determine the prevalence of doctor diagnosed and self-reported arthritis in Veterans and non-Veterans, men and women, and across various states. It was observed that arthritis was more prevalent among Veterans than non-Veterans. One in four Veterans had arthritis. The prevalence of arthritis in female Veterans (31.3%) was higher than their male counterparts (25.8%). The prevalence of arthritis in veterans was found to be the highest in West Virginia (32.7%) and lowest in Hawaii (18.8%). The study concluded that Veterans comprise an essential component of the population bearing the morbidity burden for arthritis. There is a need to work on interventions like physical activity in order to improve the quality of life and health in veterans. Arthritis needs to be dealt with in unconventional ways in order to reduce the burden of arthritis among Veterans in the USA (Murphy et al., 2014).

A retrospective cohort study was performed with Afghanistan and Iraq war Veterans to find the prevalence of arthritis in Veterans who receive health care from the VA and also to find out the comorbidity burden in such patients. The patients were divided into three groups: Veterans with arthritis, Veterans with arthritis and back pain, Veterans without any pain diagnosis. The overall incidence of arthritis in Veterans was found to be 11.8% with a higher likelihood for co-morbidities in Veterans with arthritis and back pain as compared to Veterans without any pain. It was observed that Veterans with arthritis used more opioid medication (Rivera, Amuan, Morris, Johnson, & Pugh, 2017).

Exercise and Yoga for Arthritis in Veterans – Gap in Literature

The Veterans with OA who report to Veteran Affairs, are more likely to have limited functions (63%) than those who do not use VA (42%) (Allen et al., 2019). Physical therapy and other interventions based on exercise are considered to be essential for the treatment of the OA of the knee but are not used properly. A clinical trial conducted by Allen et al in 2019, examined a Stepped Exercise Program for patients with OA of the Knee (STEP-KOA). The first step involved a free access to internet-based exercise program for three months; the second step involved coached physical activity sessions, twice a week for three months; those not responding to step 2 were taken to Step 3, that involved in-person sessions of physical therapy. The outcome was measured in the form of improvement WOMAC and improvement in physical function. The trial concluded that STEP-KOA is a unique and effective exercise-based technique to treat patients of OA with the knee, and hence prevent despair and disability in them (Allen et al., 2019).

A study by Hoerster et al. (2015) aimed at determining whether the Veterans met the physical activity guidelines recommended by CDC. The physical activity guidelines included physical activities involving transportation, leisure, and recreation. This was a cross sectional study and it concluded that there was a need for physicians to stress physical activity for their patients. Furthermore, the study attempted to identify the various correlations of physical activity at an individual or a contextual level among the Veterans who used the VA. If the contextual factors responsible for less physical activity in Veterans are properly dealt with, it might lead to a reduction of the total disease burden on the Veteran's Affairs. This study also brought forth the importance of the doctors not only to address individual factors, but also to address the social

and neighborhood factors that affect physical activity in Veterans. The study reinforces the development of various interdisciplinary actions to tackle this complex problem (Hoerster et al., 2015).

The review of the available literature depicts that both yoga as well as arthritis have been studied in detail over the past two decades. Much research has been devoted to the history of yoga, the health benefits of yoga, and also to the application of yoga as therapy for those with arthritis. Many scientists have also highlighted the gravity of the problem of arthritis in Veterans. Some researchers have stressed the use of CAM in providing relief to various health needs of Veterans including back pain and PTSD. Scientific research has already reached the inference that regular practice of yoga by Veterans might lead to better mental health and lesser use of opioids by Veterans. However, there is paucity of research in the area of the health benefits of yoga in Veterans who have arthritis. Literature shows that yoga is very effective in reducing the symptoms of arthritis, improving the HRQOL, and reducing arthritis related disability in the general population but there are no studies to prove the health benefits of yoga in Veterans with arthritis. Many studies have also shown that Veterans have higher prevalence of arthritis than general population, so yoga should be implemented as a treatment program for Veterans with arthritis. Our study is a cross-sectional study, that aims at finding out the prevalence of exercise and yoga in Veterans who have arthritis, and finding the association between arthritis and exercise, and arthritis and yoga in Veterans. Our study attempted to understand what proportions of Veterans who have arthritis are engaging in exercise and yoga, which has been shown to be helpful for improving the symptoms associated with arthritis in the general population. The inculcation of exercise or yoga in the therapeutic regimens of veterans might solve the problem

of disability arising from arthritis in Veterans, and also in turn improve their overall quality of life. Our study may pave the way for future longitudinal studies in the same arena.

Chapter 3 – Materials and Methods

Study Design and Settings

A secondary data analysis of the Behavioral Risk Factor Surveillance System (BRFSS) survey from 2019 was conducted. The BRFSS collects health related data in the United States via a random digit dial telephone survey conducted in all 50 states in the USA as well as the district of Columbia and territories including Puerto Rico. The survey targets adults 18 years of age and older who are not institutionalized. Both landlines and cell phones are utilized for this survey (CDC, 2019). BRFSS is a collaborative effort between the state governments and the CDC. The main objective of the BRFSS is a homogeneous state wise data collection from individuals regarding their sociodemographic characteristics, chronic diseases, behavioral risk factors, access to health care, availability and utilization of preventive services, and disability. The main purpose behind the collection of BRFSS data is to improve the provision of preventive services to the field of public health for health education and health promotion.

The BRFSS questionnaire is divided into three parts: the core component, the optional module, and the state added questions. The core section contains questions that are used by all the states. This section includes questions pertaining to chronic diseases and their contributing health risk behaviors. Some examples include questions related to asthma, diabetes, hypertension, arthritis, and risk behaviors such as tobacco use, alcohol intake, and physical inactivity. The core section also includes questions related to demographic factors such as age, gender, Veteran status, race/ethnicity, income, education level, employment, and marital status. The optional module asks questions regarding some special disease states such as cancers or pre-diabetes and shingles, and it is up to the states to determine whether or not to include this section in their questionnaire. Usually the CDC suggests which questions should be included in this

section and the states select out of that list. The State added questions is the third module of the questionnaire and these questions are added at the state level. CDC does not edit, add, or delete anything from these questions.

Aims and Objectives

1. To determine the prevalence of arthritis among Veterans in the United States.
2. To determine how many Veterans, perform exercise or some form of physical activity.
3. To determine how many Veterans, perform yoga.
4. To determine the association between Veterans who have arthritis and perform some form of exercise.
5. To determine the association between Veterans who have arthritis and perform yoga in the United States

Research questions:

- 1). Is there an association between having arthritis and performing exercise among Veterans?
- 2). Is there an association between having arthritis and performing yoga in Veterans?

Rationale:

Physical activity has been found to have a protective role in many chronic disorders like cardiovascular disease, diabetes etc. Studying the role of physical activity in osteoarthritis is important. Some studies reveal that performance of heavy physical exercise may actually enhance the onset of osteoarthritis in the individuals having a genetic predisposition to it. However, some gentle exercises that are joint friendly and actually strengthen the muscles, may delay the erosion of the cartilage in the long run. These exercise regimens include swimming, cycling, light walk, and tai chi and yoga. The mindfulness in yoga, the breathing exercises in

yoga, and the Asanas or postures devised to suit the anatomy and physiology of human body, make it a unique form of exercise which may delay the onset of arthritis in human beings. Many studies have shown that performance of yoga by people who have arthritis helps to reduce the symptoms of arthritis in them. Yoga has also been seen to improve the quality of life in patients of arthritis. Yoga may help reduce the chances of disability arising from arthritis. Hence, yoga may prove to be an important tool in the treatment of arthritis. Our study is an attempt in that direction. Veterans being more vulnerable to injury and stress, the meditation and relaxation exercises such as yoga may prove to be more beneficial in them.

Null Hypothesis:

- 1). There is no association between having arthritis and performing any form of exercise among Veterans.
- 2). There is no association between having arthritis and performing yoga among Veterans.

Alternative hypothesis:

- 1). There is an association between having arthritis and performing some form of exercise among Veterans
- 2). There is an association between having arthritis and performing yoga among Veterans.

Participants

The participants for this study included those who self-identified as Veterans. Survey participants were asked: “Have you ever served on active duty in the United States Armed Forces, either in the regular military or in a National Guard or Military Reserve Unit?”.

All the participants who answered “Yes” were retained. In 2019, 53,230 participants answered “Yes” to the Veteran question. Because 16% of the Veterans in the study were of reproductive age (18-34), pregnant women were excluded leaving a sample size of 52,856.

Variables

The following variables were included in the study to address the research aims and objectives: Arthritis, Exercise, Yoga, Age, Income, Education, Gender, Employment, Marital status, and Race, overweight/ obese, current smoker status. We tried to exclude the pregnant women. These variables are described as follows:

Table 1

Variables from BRFSS data to be studied in data analysis.

Variable	BRFSS Question	Categorical Response	Recorded as
Participants Veterans (VETERAN3)	“Have you ever served on active duty in the United States Armed Forces, either in the regular military or in a National Guard or Military Reserve Unit?”.	Yes, No, refused to answer, I don’t know	Only those who answered yes will be retained
Dependent Variable Arthritis (HAVART H4)	“Ever told) (you had) some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?” (Arthritis diagnoses include: rheumatism, polymyalgia rheumatica; osteoarthritis (not osteoporosis); tendonitis, bursitis, bunion, tennis elbow; carpal tunnel syndrome, tarsal tunnel syndrome; joint infection, etc.)	Yes, No, refused to answer, I don’t know	Yes = 0, No = 1, Refused to answer & I don’t know = missing Dichotomous Variable
Independent Variable Yoga 1) (EXERAN Y2)	1) “During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?”	1) Yes, No, refused to answer, I don’t know	1) Yes = 0, No = 1, Refused to answer & I don’t know = missing
2) (EXTRAC T11 AND EXTRAC	2) “What type of physical activity or exercise did you spend the most time doing during the past month?” AND “What other type of physical activity gave you the next most exercise during the past month?”	2) List of 76 responses with Yoga = 69	2) Yoga = 0 Other response = 1

T21)			3) Recoded to a new variable: Yoga = 0 PA other than yoga = 1 No PA = 2
Covariates			
Age (_AGEG5 YR)	Continuous variable that was recoded for the following groups: 18-24, 25-34, 35-44, 45-54, 55-64, and 65+		Categorical Variable
Income (INCOME)	“Is your household income from all the sources...and the answer choices run as follows: Value 1: less than \$10,000; Value 2: \$10,000-\$15,000; Value 3: \$15,000-\$20,000; Value 4: \$ 20,000-\$25,000; Value 5: \$ 25,000- \$ 35,000; Value 6: \$ 35,000-\$50,000; Value 7: \$50,000-\$ 75,000; Value 8: \$75,000 or more	Responses from each bracket counted. Value 77: said “don’t know”; Value 99: refused to answer;”.	Value 77 and 99 shall be coded as “missing”. Categorical Variable
Education EDUCA	“What is the highest grade or year of school you completed?”. The answer choices include: Value 1 as “never attended school or only kindergarten”; Value 2 as “Grades 1 through 8 (elementary)”; Value 3 as “Grades 9 through 11(some high school)”; Value 4 as “Grades 12 or GED (High school graduate)”; Value 5 as “College 1 year to 3 years (some college or technical school)”; Value 6 as “College 4 years or more (college graduate)”; Value 9 include those who refused to answer and were coded as “missing”.	Responses in each category counted. Value 9 is who refused to answer.	Recoded as 0=college graduate, 1=some college, 2=high school graduate, 3=not a high school graduate. Those who refused to answer shall be coded as “missing”. Categorical Variable
Employment	“Are you currently...? With answer choices as, “Employed for wages”, “self- employed”, “out of work	Responses from each	Recoded as 0=employed

EMPLOY 1	for 1 year or more”, “out of work for less than 1 year”, a homemaker, a student, retired, unable to work. Those who refused to answer shall be coded as “missing	category counted, and also those who refused to answer.	, 1=unemployed, 2=LOF, 3=unable to work. Those who refused to answer shall be coded as “missing Categorical Variable
Race/ethnicity _RACEG R3	“Five-level race/ethnicity category”. The answer choices include: White only, Black only, Non-Hispanic, Other race only, Non-Hispanic, Multiracial, Non-Hispanic, Hispanic, Don’t know/ Not sure/ Refused. Those who “don’t know”, or are “not sure” or “refused to answer” shall be coded as “missing”.	Responses in each category counted. Those who don’t know and refused to answer also noted.	Those who “don’t know”, or are “not sure” or “refused to answer” shall be coded as “missing”. Categorical Variable
Sex _SEX	“Calculated sex variable”.	Male or female	Male shall be coded as “0”, and female as “1”. Dichotomous Variable
Marital status MARITAL	Are you, “It includes the answer options as: “married”, “divorced”, “widowed”, “separated”, “never married”, “a member of an unmarried couple”.	Responses from each category counted and noted, and also those who refused to answer.	Those who refused to answer shall be coded as “missing”. Categorical Variable

Smoker status _RFSMO K3	Adults who are current smokers	Responses from each category counted and noted, and also those who have refused to answer	Those who answered “yes” were recoded as “0” and those who answered “no” were recoded as “1”
Overweight/ obese status _RFBMI5	Adults who have a body mass index greater than 25.00 (overweight/ obese)	Responses from both categories counted and noted, including those who refused to answer	All those who answered “yes” were recoded as “0” and all those who recoded as “No” were coded as “1”

Data Analysis

Data analysis was completed using The Statistical Analysis Software (SAS). A diagnoses of arthritis was considered the independent variable. The performance of exercise and yoga were considered the dependent variables. The other covariates used in this analysis are mentioned in the above section. Data were weighted based on the weighting methodology provided by the CDC which recommends that researchers conducting complex sampling analyses from the core-only section use the variable `_LLCPWT` for weighting, `_STSTR` for stratification, and the variable `_PSU` for clustering (CDC, 2020). Descriptive statistics were performed using the Chi Square analyses. Logistic regression analyses were performed to calculate odds ratios to determine the odds of exercising or performing yoga among Veterans who had been diagnosed with arthritis. Where odds ratios were significant, multiple logistic regression was performed to control for significant covariates (i.e. covariates that were related

to exercise or yoga at the $p \leq 0.10$). P values less than 0.05 were considered statistically significant.

Ethical review

We conducted a secondary data analysis of BRFSS data that is publicly available online and so did not collect any primary data for our research. The Institutional Review Board (IRB) of the University of Nevada, Las Vegas consider that de-identified data that are available publicly are excluded from IRB review because it is not considered to be human subjects research.

Chapter 4: Results

Demographic Characteristics

Descriptive characteristics of the sample are provided in table 2. The majority of the participants were male (88%), had some college (38%) or a college degree (28%), were in the 65+ age group (42%), were white (73%), were employed (80%), and were married (61%). The

differences in frequency and weighted percentages of the Veterans who have arthritis and those who do not have arthritis with respect to the various demographic variables are also presented in Table 1. Of the 52,856 Veterans questioned, 33.76% (weighted) had arthritis. The prevalence of arthritis in Veterans was significantly associated with the demographic characteristics of educational attainment, age, income, employment, marital status, and overweight. The current smoking status of Veterans was not significantly associated with the prevalence of arthritis in Veterans. Veterans diagnosed with arthritis were more likely to be White (79%) and less likely to be Black (11%) or Hispanic (5%) than Veterans who were not diagnosed with arthritis (70%, 13%, and 11%, respectively). Nearly 60% of Veterans with arthritis were 65+ years of age. Veterans diagnosed with arthritis were less likely to be employed (67%) and more likely to be unable to work (22%) compared with Veterans who were not diagnosed with arthritis (85% and 5%, respectively). Nearly 80% of Veterans with arthritis were overweight or obese compared to 71% of those without arthritis. Forty-one percent of Veterans without arthritis were in the higher income bracket (\$75,000+) compared with 33% of those who had been diagnosed with arthritis.

Table 2

Demographic Characteristics of Arthritis in Veterans

Variable	Arthritis		Total	
	Yes	No		
	N (weighted %)	N (weighted %)	N (weighted %)	
Total Arthritis	21178 (33.76)	31678 (66.24)	52856	
				χ^2 , p-value

Sex				4, 0.045
Male	18989 (89.12)	18547 (87.91)	47536 (88.32)	
Female	2189 (10.88)	3131 (12.09)	5320 (11.68)	
Educational Attainment				49.9, < 0.001,
College graduate	7699 (27.01)	12699 (29.15)	20398 (28.42)	
Did not graduate high school	897 (6.65)	949 (4.18)	1846 (5.02)	
High school graduate	5601 (27.31)	8236 (29.29)	13837 (28.62)	
Some college	6927 (39.01)	9693 (37.38)	16620 (37.93)	
Age				979, <0.001
18-24	44 (0.71)	1042 (8.30)	1086 (5.74)	
25-34	313 (3.82)	2482 (14.93)	2795 (11.18)	
35-44	759 (6.75)	2824 (13.87)	3583 (11.47)	
45-54	1697 (11.06)	3856 (14.35)	5553 (13.24)	
55-64	3686 (19.46)	4835 (14.44)	8521 (16.13)	
65+	14679 (58.21)	16639 (34.10)	31318 (42.24)	
Race / ethnicity				128, <0.001
White	17238 (78.50)	24862 (69.83)	42100 (72.74)	
Black	1367 (10.87)	2243 (13.36)	3610 (12.52)	
Other	813 (3.44)	1476 (4.78)	2289 (4.33)	
Multi	540 (1.86)	731 (1.47)	1271 (1.60)	
Hispanic	623 (5.33)	1598 (10.57)	2221 (8.81)	
Income				100, <0.001
> 75K	5484 (33.22)	10360 (41.33)	15844 (38.59)	
< 10K	418 (2.53)	473 (1.80)	891 (2.05)	
10-25K	3490 (18.35)	4072 (14.01)	7562 (15.47)	
25-50K	5148 (27.41)	6931 (24.47)	12079 (25.46)	
50-75K	3313 (18.48)	5006 (18.40)	8319 (18.43)	
Employment				460, <0.001
Employed	5420 (67.47)	14196 (84.93)	19616 (80.40)	
Unemployed	502 (6.94)	815 (4.69)	1317 (5.28)	
Out of the labor force	200 (3.13)	614 (5.26)	814 (4.71)	
Unable to work	1984 (22.46)	1073 (5.12)	3057 (9.61)	
Marital Status				329, <0.001
Married	12500 (63.36)	18559 (59.66)	31059 (60.92)	
Divorced	3453 (15.56)	4683 (12.92)	8136 (13.81)	
Widowed	3201 (10.91)	3542 (6.61)	6743 (8.06)	
Separated	393 (2.37)	517 (2.11)	910 (2.20)	
Single	1199 (6.15)	3474 (15.86)	4673 (12.57)	
Partnered	306 (1.64)	658 (2.84)	964 (2.43)	
Current smoker				0.19, 0.671
Yes	2943 (16.23)	4346 (15.94)	7289 (16.04)	
No	17557 (83.77)	26190 (84.05)	43747 (83.96)	

Overweight/obese				114, <0.001
Yes	16139 (79.84)	21878 (71.34)	38017 (74.23)	
No	4318 (20.16)	8581 (28.66)	12899 (25.77)	

χ^2 = Chi-square statistic; Bold χ^2 and p-value = significant at p-value ≤ 0.05

Demographic characteristics of exercise in Veterans are displayed in Table 3. Out of the 50,961 Veterans who answered the question about the performance of some form of exercise, 75% answered in the affirmative. The difference in weighted frequencies between the Veterans who exercise and those who do not is also shown in Table 2. Most of the Veterans who exercised were males (75%), were younger, had income above \$75K per annum (43%), were college graduates (32%), were employed (83%), were non-smokers (86%), and were either overweight or obese (75%). The prevalence of exercise among Veterans showed a significant association with the demographic characteristics of educational attainment, age, income, employment, current smoker status and overweight. Veterans who were college graduates (32%) were more likely to exercise than Veterans who were not (19%). Younger Veterans (between the ages of 18-35 years) were more likely to exercise than those in the older age brackets. There was a significant difference in Veterans who exercised (43%) than who did not (26%) if their income was above \$75K. Veterans who exercise were more likely to be employed (83%) than Veterans who did not exercise (69%). Veterans who do not exercise are significantly more likely to not be able to work (21%) than those who do exercise (7%). Veterans who were smokers were less likely to exercise (14%) than Veterans who did not smoke (22%). Veterans who were not obese or overweight were more likely to exercise (26%) than those who were obese or overweight (23%).

Table 3

Demographic Characteristics of Exercise in Veterans

Variable	Exercise		Total	
	Yes	No		
	N (weighted %)	N (weighted %)	N (weighted %)	
Total Exercise	37443 (75.34)	13518 (24.66)	50961	χ^2 , p-value
Sex				4, 0.040
Male	33682 (88.09)	12180 (89.44)	45862 (88.43)	
Female	3761 (11.91)	1338 (10.56)	5099 (11.57)	
Educational Attainment				357, <0.001
College graduate	16135 (31.77)	3634 (19.25)	19769 (28.68)	
Did not graduate high school	982 (3.70)	772 (8.80)	1754 (4.96)	
High school graduate	8636 (26.10)	4594 (36.33)	13230 (28.62)	
Some college	11604 (38.43)	4472 (35.62)	16076 (37.74)	
Age				194, <0.001
18-24	907 (6.59)	119 (2.46)	1026 (5.57)	
25-34	2249 (12.64)	415 (6.42)	2664 (11.11)	
35-44	2709 (11.93)	725 (9.96)	3434 (11.44)	
45-54	4066 (13.44)	1259 (12.30)	5325 (13.16)	
55-64	5939 (15.51)	2264 (18.30)	8203 (16.20)	
65+	21573 (39.89)	8736 (50.56)	30309 (42.52)	
Race / ethnicity				8, 0.09
White	29988 (73.10)	10782 (74.42)	40770 (73.42)	
Black	2414 (11.82)	963 (12.62)	3377 (12.02)	
Other	1603 (4.23)	601 (3.86)	2204 (4.14)	
Multi	944 (1.69)	299 (1.44)	1243 (1.63)	
Hispanic	1592 (9.16)	515 (7.65)	2107 (8.79)	
Income				425, <0.001
> 75K	12836 (42.72)	2688 (25.74)	15524 (38.64)	
< 10K	501 (1.50)	349 (3.66)	850 (2.02)	
10-25K	4574 (12.78)	2794 (23.78)	7368 (15.42)	
25-50K	8265 (23.96)	3566 (30.00)	11831 (25.41)	
50-75K	6183 (19.04)	1988 (16.82)	8171 (18.51)	
Employment				290, < 0.001
Employed	14761 (83.58)	4074 (69.13)	18835 (80.32)	
Unemployed	920 (5.01)	354 (6.36)	1274 (5.32)	
Out of the labor force	613 (4.96)	173 (3.58)	786 (4.65)	
Unable to work	1494 (6.45)	1453 (20.94)	2947 (9.72)	
Marital Status				122, < 0.001
Married	22806 (62.29)	7191 (57.53)	29997 (61.11)	
Divorced	5413 (12.86)	2420 (16.65)	7833 (13.80)	
Widowed	4305 (6.97)	2229 (11.60)	6534 (8.11)	
Separated	598 (2.09)	278 (2.33)	876 (2.15)	
Single	3402 (13.35)	1068 (9.88)	4470 (12.49)	

Partnered	669 (2.45)	256 (2.00)	925 (2.34)	
Current smoker				94, <0.001
Yes	4561 (14.16)	2632 (21.50)	7193 (15.97)	
No	32684 (85.84)	10788 (78.50)	43462 (84.03)	
Overweight/obese				10, 0.001
Yes	27124 (73.68)	10151 (76.57)	37275 (74.39)	
No	9532 (26.32)	3038 (23.43)	12570 (25.61)	

χ^2 = Chi-square statistic; Bold χ^2 and p-value = significant at p-value ≤ 0.05

The demographic characteristics of yoga in Veterans are given in Table 4. It was observed that out of the 36,125 Veterans who answered the type of physical activity questions, only 416(1.64 %) performed yoga. Table 3. provides the frequency and the weighted percentage of Veterans who perform yoga and who do not perform yoga with regards to the demographic variables including sex, educational attainment, age, race/ ethnicity, income, employment, marital status, current smoker, and overweight or obese. Only sex, employment, educational attainment, and overweight/obesity were significantly associated with performance of yoga. A higher percentage of Veterans who performed yoga were women (49%) compared to Veterans who do not perform yoga (12%). The Veterans who performed yoga were more likely to be out of the labor force (18%), college graduates (46%), and less likely to be overweight/obese (63%) than Veterans who did not perform yoga (5%, 32%, and 74%, respectively). Other demographic variables including age, race, marital status and current smoker status did not show a significant association with performance of yoga in Veterans.

Table 4

Demographic Characteristics of Yoga in Veterans

Variable	Yoga		Total	
	Yes	No		
	N (weighted %)	N (weighted %)	N (weighted %)	

Yoga	417 (1.64)	35718 (98.84)	36125	χ^2 , p-value
Sex				86, <0.001
Male	268 (51.41)	32210 (88.50)	32478 (88.07)	
Female	149 (48.59)	3498 (11.50)	3647 (11.93)	
Educational Attainment				19, <0.001
College graduate	255 (46.33)	15396 (31.67)	15651 (31.84)	
Did not graduate high school	3 (0.39)	926 (3.66)	929 (3.62)	
High school graduate	35 (11.10)	8220 (26.08)	8255 (25.91)	
Some college	124 (42.18)	11091 (38.60)	11215 (38.64)	
Age				6, 0.331
18-24	4 (11.38)	863 (6.57)	867 (6.63)	
25-34	31 (15.10)	2139 (12.53)	2170 (12.56)	
35-44	47 (16.98)	2581 (11.81)	2628 (11.87)	
45-54	58 (15.96)	3862 (13.41)	3920 (13.44)	
55-64	89 (13.80)	5668 (15.63)	5757 (15.61)	
65+	188 (26.80)	20595 (40.04)	20783 (39.88)	
Race / ethnicity				6, 0.155
White	336 (71.15)	28605 (73.16)	28941 (73.13)	
Black	22 (7.50)	2300 (11.86)	2322 (11.81)	
Other	15 (2.55)	1533 (4.27)	1548 (4.24)	
Multi	15 (1.22)	898 (1.70)	913 (1.69)	
Hispanic	20 (17.58)	1529 (9.02)	1549 (9.12)	
Income				6, 0.243
> 75K	172 (40.69)	12360 (42.96)	12532 (42.93)	
< 10K	4 (0.23)	478 (1.51)	482 (1.49)	
10-25K	40 (11.54)	4349 (12.64)	4389 (12.63)	
25-50K	89 (33.17)	7906 (23.80)	7995 (23.92)	
50-75K	60 (14.36)	5940 (19.10)	6000 (19.04)	
Employment				11, 0.013
Employed	193 (70.11)	14086 (83.90)	14279 (83.70)	
Unemployed	14 (5.14)	873 (4.89)	887 (4.89)	
Out of the labor force	10 (17.81)	588 (4.90)	598 (5.08)	
Unable to work	21 (6.95)	1408 (6.31)	1429 (6.32)	
Marital Status				8, 0.149
Married	226 (54.85)	21825 (62.48)	22051 (62.39)	
Divorced	78 (14.08)	5146 (12.82)	5224 (12.84)	
Widowed	33 (4.16)	4099 (6.99)	4132 (6.96)	
Separated	12 (1.97)	560 (2.04)	572 (2.04)	
Single	53 (22.54)	3230 (13.23)	3283 (13.34)	
Partnered	10 (2.39)	636 (2.45)	646 (2.45)	
Current smoker				0.33, 0.568
Yes	52 (12.06)	4315 (14.02)	4367 (14.00)	
No	364 (87.94)	31216 (85.98)	31580 (86.00)	
Overweight/obese				5, 0.025

Yes	236 (62.57)	25981 (73.66)	26217 (73.53)	
No	170 (37.43)	9038 (26.34)	9208 (26.47)	

χ^2 = Chi-square statistic; Bold χ^2 and p-value = significant at p-value ≤ 0.05

Univariate analysis

The univariate analysis for arthritis and exercise in Veterans revealed 69% of the Veterans who had arthritis performed some form of exercise while 31% did not exercise. Nearly 80% of Veterans who did not have arthritis did some form of exercise with about 20% being non-exercisers. The odds ratio for exercise in Veterans with arthritis was 0.62, with a 95% confidence interval of 0.57-0.67, thus indicating that Veterans who have arthritis are 38 percent less likely to exercise than Veterans who do not have arthritis. The results revealed a significant negative association between arthritis and exercise in Veterans.

The univariate analysis for arthritis and yoga showed that a small percent of Veterans with and without arthritis performed yoga. Of Veterans with arthritis, 1.15% performed yoga and 98.85% did not perform yoga. Of Veterans without arthritis 1.18% performed yoga and 98.82% did not. The odds ratio between Veterans who had arthritis and performed yoga was 0.98 (C.I = 0.63- 1.52), that was interpreted as not being significant. Thus, we could not establish a significant positive or negative association between arthritis and performance of yoga in Veterans. Henceforth, we did not proceed with the multiple regression analysis for yoga and arthritis in Veterans.

Multiple Logistic Regression: Adjusted Odds Ratios.

Table 5 represents the results of the multiple logistic regression analysis for exercise among Veterans with arthritis. All covariates were included in this analysis as they were associated with exercise among Veterans. After adjusting for the covariates, the odds of exercising of Veterans with arthritis were not different than those without arthritis. However,

Compared with Veterans who had a college degree, those who did not graduate from high school were 0.5 times less likely to exercise as those who graduate from high school and 0.8 times as likely as those who attended some college. Compared with younger Veterans (18-24 years old) all other age groups were less likely to exercise. Compared with Veterans who made \$75,000, Veterans in all other income brackets were less likely to exercise. Veterans who were unable to work were less likely to exercise than Veterans who were employed. Lastly, Veterans who did not smoke were 1.4 times more likely to exercise than those who did smoke. The Veterans who were not obese or overweight were slightly (1.14) more likely to exercise than those who were obese or overweight.

Table 5

Multiple Logistic Regression for Exercise among Veterans

	Adjusted Odds Ratio	95% Confidence Interval	
Arthritis			
Yes	Ref	Ref	Ref
No	1.129	0.982	1.297
Sex			
Male	Ref	Ref	Ref
Female	0.930	0.772	1.119
Educational Attainment			
College graduate	Ref	Ref	Ref
Did not graduate high school	0.321	0.221	0.468
High school graduate	0.507	0.424	0.606
Some college	0.776	0.661	0.912
Age			
18-24	Ref	Ref	Ref
25-34	0.555	0.359	0.857
35-44	0.288	0.187	0.442
45-54	0.290	0.187	0.450
55-64	0.264	0.169	0.411
65+	0.221	0.143	0.344
Race / ethnicity			

White	Ref	Ref	Ref
Black	0.894	0.717	1.115
Other	1.044	0.738	1.476
Multi	1.283	0.911	1.806
Hispanic	1.034	0.780	1.370
Income			
>75K	Ref	Ref	Ref
<10K	0.560	0.370	0.848
10-25K	0.468	0.368	0.595
25-50K	0.555	0.460	0.669
50-75K	0.765	0.638	0.916
Employment			
Employed	Ref	Ref	Ref
Unemployed	0.949	0.679	1.324
Out of the labor force	0.966	0.658	1.418
Unable to work	0.543	0.438	0.672
Marital Status			
Married	Ref	Ref	Ref
Divorced	1.115	0.942	1.320
Widowed	0.911	0.664	1.251
Separated	1.089	0.695	1.707
Single	1.176	0.928	1.490
Partnered	0.880	0.640	1.233
Current smoker			
Yes	Ref	Ref	Ref
No	1.406	1.189	1.664
Overweight/obese			
Yes	Ref	Ref	Ref
No	1.147	0.970	1.355

Bold = statistically significant

Table 6 demonstrates the results of multiple logistic regression for yoga among Veterans.

All the covariates that were associated with yoga and arthritis among Veterans were

included in this analysis. These included, gender or sex, educational attainment,

employment, and overweight or obesity. Compared to college graduate, Veterans who did not

graduate from high school and high school graduates were less likely to do yoga. Compared to

male Veterans, female Veterans were five times more likely to perform yoga.

Table 6

Multiple Logistic Regression for Yoga among Veterans

	Adjusted Odds Ratio	95% Confidence Interval	
Arthritis			
Yes	Ref	Ref	Ref
No	0.844	0.454	1.571
Sex			
Male	Ref	Ref	Ref
Female	5.273	3.193	8.709
Educational Attainment			
College graduate	Ref	Ref	Ref
Did not graduate high school	0.096	0.018	0.513
High school graduate	0.230	0.093	0.571
Some college	0.757	0.440	1.302
Employment			
Employed	Ref	Ref	Ref
Unemployed	1.450	0.559	3.764
Out of the labor force	2.631	0.719	9.633
Unable to work	1.583	0.676	3.703
Overweight/obese			
Yes	Ref	Ref	Ref
No	1.145	0.618	2.213

Table 7 shows the various parameter estimates for our data analysis. The various parameters

demonstrated include degrees of freedom, parameter estimate, standard error, t value, $Pr > t$,

tolerance and variance inflation. The tolerance and variance inflation indicate that there was no multicollinearity.

Table 7

Parameter Estimates

Variable	Degrees of	Parameter estimate	Standard error	t value	Pr> t 	Tolerance	Variance inflation
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	freedom						
Intercept	1	0.95813	0.01230	77.88	<0.0001		0
Marital stat	1	0.00546	0.00210	2.60	0.0093	0.88806	1.12605
Education	1	-0.00821	0.00243	3.37	0.0007	0.92471	1.08142
Age2	1	-0.08233	0.00223	36.88	<0.0001	0.88277	1.13280
Income	1	-0.00900	0.00198	4.55	0.0034	0.91333	1.09489
Race	1	0.00806	0.00275	2.93	<0.0001	0.96485	1.03643
Employment	1	-0.09136	0.00316	28.94	<0.0001	0.91613	1.09155
Sex	1	-0.05409	0.00885	6.11	<0.0001	0.96719	1.03392
Smoker	1	0.04167	0.00794	5.25	<0.0001	0.93937	1.06455
Overweight	1	0.07844	0.00736	10.66	<0.0001	0.96714	1.03398

Chapter 5: Discussion

In our sample population of 52, 856 Veterans, the prevalence of arthritis was 33.76 %, and depicted a significant association with the demographic characteristics of educational attainment, age, income, employment, marital status, and overweight. In 2012, the prevalence of arthritis in USA was around 21% which has increased to 24% in 2021 (CDC, 2021). There are 58.5 million known cases of arthritis with a projection of 78 million by the year 2040 (CDC,

2021), with 37 % of people with arthritis being disabled (Sharma, 2014,). Analysis of BRFSS data from 2011, 2012 and 2013 revealed that the prevalence of arthritis was higher in Veterans than in non-Veterans. Twenty-five percent of male and 31.3 percent of female Veterans had arthritis (Murphy et al., 2014). This study found that, just as arthritis is increasing among the general adult population in the U.S., it is also increasing among Veterans.

Our research showed a rather high prevalence of performing any exercise or physical activity in the past month among Veterans. The prevalence of exercise in Veterans was 75%, and was significantly associated with the demographic characteristics of educational attainment, age, income, employment, current smoker status and overweight. An analysis of the BRFSS data from 2003 compared physical activity in Veterans and non-Veterans and revealed that the prevalence in meeting physical activity guidelines among Veterans was 46.0%, which was significantly ($p < 0.0001$) higher than non-Veterans at 42.0 %. Moreover, the prevalence of physical inactivity was significantly lower in Veterans (16%) as compared to non-Veterans (20%) (Littman, Forsberg, & Koepsell, 2009). Our finding of a higher prevalence of exercise or physical activity among Veterans is due to analyzing a different question (any exercise or physical activity in the past month rather than meeting the physical activity guidelines).

The results of our research revealed a significant negative association between arthritis and exercise in Veterans. The odds ratio for exercise in Veterans with arthritis was 0.62. It indicated that Veterans who have arthritis are 38 % less likely to exercise than Veterans who do not have arthritis. According to CDC, about one in four US adults have arthritis, (23.7%) (CDC, 2022). The number of people in the United States who have doctor diagnosed arthritis is around 58.5 million. It is observed that the prevalence of arthritis is higher in women (23.5%)

than in men (18.1%). Arthritis is seen more frequently in people who have poor health (40.5%) than in people who have very good health, that is (15.4%) (CDC, 2022). There is convincing evidence that in the general population, arthritis is much less frequent (18.1%) in people who meet the physical activity requirements recommended by CDC than who are less active (23.1%) or inactive (23.6%). (CDC, 2022). Arthritis is a debilitating and disabling disease, so it can have a huge impact on the capacity of an individual to perform normal physical activity (CDC, 2022). Out of the 58.5 Million people who have doctor diagnosed arthritis, around 43%, that is, 23.7 Million have some form of limitations in routine life activities (CDC, 2022). Regular exercise or physical activity is very useful in reducing the pain, tenderness, and stiffness in patients of arthritis. The overall prevalence of doctor diagnosed arthritis is expected to rise in the years to come. It is projected that by the year 2040, about 78.4 million adults who are more than 18 years of age are expected to have doctor diagnosed arthritis. This equals 25.9 % of the total adult population projected at that time. It is projected that by the year 2040, out of those 78.4 million who will be diagnosed with arthritis, 34.6 million, (43.2%) will experience some form of arthritis-attributable activity limitations (CDC, 2022).

In our research, we observed that out of the 36,125 Veterans who answered the type of physical activity questions, only 416 (1.64 %) performed yoga. The demographic characteristics of sex, employment, educational attainment, and overweight/obesity were significantly associated with performance of yoga. The Veterans who performed yoga were more likely to be female, out of the labor force, and college graduates, and not overweight or obese. Of Veterans with arthritis, 1.15% performed yoga; whereas, of Veterans without arthritis 1.18% performed yoga. The odds ratio between Veterans who had arthritis and performed yoga was 0.98 (C.I = 0.63- 1.52), that was interpreted as not being significant. The results of our data

analysis revealed that there is not a significant difference between prevalence of performance of yoga in Veterans who have arthritis and who do not have arthritis. There are no studies in the literature that have been conducted on the specific subject of yoga in arthritis in Veterans, yet a systematic review conducted by Miller et al. (2017) compiles the results of a few studies that have been conducted in the field of chronic pain in Veterans and the utilization of complementary and alternative system of medicine for that. The use of Yoga as a CIH approach to treat chronic pain is becoming more popular in the military with each passing day (Miller et al., 2017). Non-opioid alternatives to treat pain in Veterans include yoga as one of the modalities. The number of VHA facilities that offered Complementary and Integrative Health (CIH) has increased by 8.7 % between 2011 and 2015 (Miller et al., 2017). The number of facilities that offer yoga as a treatment modality for back pain, fibromyalgia, and headaches has also doubled. Yoga has been well inculcated into the pain management regimens for military men and women, and yoga classes are available at VHAs and with wounded Warrior Projects (Miller et al., 2017). It is seen that military men and women like CIH treatment. In a research conducted with around 400 Veterans, 99% of them were ready to use CIH, and 82% had already participated in at least one such modality. Though the provision of yoga services for Veterans has increased in the recent times, their utilization by Veterans is still low (Denneson, Corson, & Dobscha, 2011) Results of a study revealed that although 36% of military personnel used at least one CIH approach, yet yoga was used by only 6.8% of them (Goertz et al., 2013). Another study supported this fact that yoga classes were available at VHA but their utilization by Veterans or active military personnel was not optimum. The reason for this stagnation in the use of yoga services should draw our attention to the need to reconstruct the VHA's pain management model

in content, and style as well as delivery to Veterans and active duty members (US department of Veteran Affairs, 2015).

Overall, the life time prevalence of yoga in the general population in the US had reached a high of 13.2 % in 2012, with a twelve-month prevalence in 2012 being 8.9% (Cramer et al., 2016). Chronic low back pain (CLBP) is one of the most common causes of disability in the active adult population. About 40 % of the population suffering from chronic low back pain use Complementary and Alternative Medicine (CAM). The use of yoga for chronic pain is becoming the latest trend in the West. There is a definitive evidence of yoga being an effective therapy to reduce pain as well as functional disability in patients with chronic low back pain (Holtzman & Beggs, 2013). Around 20 percent of people suffering from back pain also suffer from depression. Yoga might help heal both symptoms together. The past ten years have seen a rapid rise in the use of yoga as a treatment of chronic back (Chang, Holt, Sklar, & Groessl, 2016). Surveys conducted by CDC especially support this notion. One such survey in 2007 showed that yoga was the seventh most common CAM therapy being used to treat back pain (Chang, Holt, Sklar, & Groessl, 2016).

The Veterans Yoga Project is an example of yoga programs for Veterans. The mission of the Veterans Yoga Project (VYP) is to help Veterans, families of military personnel and their communities to recover from trauma and be resilient. The project envisions a future where all Veterans who have suffered traumatic physical or mental experiences, get access to a range of mind-body practices in order to have complete recovery and resilience. The project aims at providing these tools and training to the related individuals in Safe, Predictable, and Controlled environments (SPaCe). The VYP is an organization that works at the grassroots level to educate and reach out to the Veterans to improve their health and wellbeing. The motto of the project is

to serve those who serve the nation. Around 100 free yoga classes are conducted by the instructors trained under the VYP project. Other contributing and collaborating partners include Veterans, active military personnel, Veteran student organization, and non-profit organizations. These free yoga classes help to improve resilience and provide relief to Veterans with severe mental and physical symptoms (<https://veteransyogaproject.org/>). Although, it is a wonderful project, there is no focus on Veterans with arthritis in the project. We wish to turn the attention of the VA towards this particular aspect, so that more and more Veterans with arthritis can benefit from it yoga.

Limitations

There are some limitations to this study. BRFSS data is subject to self-reporting bias, recall bias, and selection bias. The BRFSS survey is conducted over the telephone. So many people who cannot be reached by phone cannot participate in the survey, thus leading to a selection bias. The presence of answering machines, leads to passive refusal to participate in the survey. Another limitation was recall bias or self-reporting bias. The questions were closed ended, but the answers were self-reported, so leaving room for recall bias and reporting bias. There can also be under reporting or over reporting of symptoms. Though the BRFSS data uses good weighting methodologies, still it might contain some misrepresentation. Hence, we also expect our study to have some misrepresentation bias. The design of the study being cross-sectional, temporal bias is inherent in the study. We did not expect the results to guide us towards the causation of the association between arthritis and yoga in Veterans. Analysis of BRFSS data of 2019, yielded around 53,000 Veterans as participants for our study and out of those only 400 performed yoga. Thus, a small sample size reduced the power of our results.

Importance of our study

Our study touches a very practical topic, vital for the health of Veterans with arthritis, and other Veterans at large. Ours is a cross sectional study, which showed to some extent that Veterans with arthritis are less likely to exercise but the results were not significant when adjusted for other covariates. Our study can be followed up by some longitudinal studies in the future like prospective cohort studies that can follow up Veterans participating in Veterans yoga projects for a few years and observe the incidence of arthritis in the Veterans who perform yoga and those who do not. These studies can play a role in examining the role of yoga as a protective factor for arthritis. Regular performance of yoga may actually delay the onset of arthritis in those genetically predisposed to it. Retrospective cohort studies can also be conducted based on the previously collected data to analyze it and draw conclusions regarding the preventive role of yoga and exercise in people genetically predisposed to it.

Conclusions

Our research paves the way for future longitudinal studies aimed at finding the role of yoga in Veterans with arthritis. Yoga is considered to be a part of Integrated Health and Wellness Programs and Complementary and Alternative Medicine Programs (Holliday, Hull, Eickhoff, Sullivan, & Reinhard, 2014) and patients with arthritis in the general population benefit by performance of yoga. Our study points out that only 1 % Veterans with arthritis perform yoga. Studies like ours might turn the attention of Veteran health programs towards Veterans suffering from arthritis, and ultimately inculcate yoga as a part of CAM in the treatment of Veterans with arthritis. Veterans who have arthritis should perform yoga regularly, as a treatment for symptoms of arthritis and to improve the health-related quality of life indices. It will not only curtail the progress of the disease and reduce the chances of subsequent disability, but also help

them lead lives free of pain and stress. Thus, our study is important as it points out that more work needs to be done in this arena to promote yoga practice among Veterans with arthritis.

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Curriculum Vitae

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Education

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M.D.(Physiology) 2000 -- October 2003 Patiala, India	Government Medical College	October
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Professional Experience

General Practitioner 2013 -- October 2017 (Self-employed)	Anu Clinic and Massage Point Amritsar, Punjab-143105, India	December
Chief Medical Officer -- August 2011 New Delhi, 110052, India	Durga Mandir Charitable Clinic	August 2008
Senior Resident- Physiology -- October 2005 New Delhi, 110052, India	Maulana Azad medical College	October 2003
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Responsibilities for medical, dental & nursing students	Taking practical demonstrations in Physiology	
Instructor as MD Student in 2000 -- October 2003. Physiology	Government Medical College Patiala-147001, India.	October,
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Research Experience

MPH- EOH 2019—Spring 2022	UNLV, Las Vegas, Nevada, USA	Fall
Thesis Title	Association between Yoga and Arthritis in Veterans.	
Thesis Guide	Dr. Jennifer Pharr, Associate Professor,	

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Study Design Cross sectional, secondary data analysis of BRFSS data of 2019

MD- Physiology Government Medical College, October
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Thesis Title Receiver Operating Characteristic Curve
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Thesis Guide Dr Jasjeet Kaur Dhillon, Professor,
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Research Publications

1. Singh KD, Dhillon JK, Arora AN, Gill BS. Receiver Operation Characteristic Curve Analysis of BMI and Percentage Body Fat in Type 2 Diabetics of Punjab. *Indian journal of physiology and pharmacology*. 2004 Jan 1;48(1):73-80.

Paper Presentations and Talks

1. “Receiver operating characteristic curve analysis of anthropometry and % body fat in type2 diabetes mellitus in Punjab”. presented at Appicon-2002, the annual conference of the Association of Physiologist and Pharmacologists of India, held at CSM Medical University, Lucknow, India, 17th -20th December 2002.
2. The poster presentation of the paper entitled “Type 2 diabetic males have higher sub scapular skin fold ratio than the type 2 diabetic females”, at the Golden Appicon - the Golden Jubilee conference of the Association of Physiologist and Pharmacologists of India, held at the National Institute of Mental health and Neuro Sciences, Bangalore India, 19th -22nd December 2004.

Conferences and Workshops Attended

1. APPICON-2000, the annual conference of the Association of Physiologists and Pharmacologists of India, held at B.M. Patil Medical College, Bijapur, India from 13th–17th December, 2000.

2. APPICON-2002, the annual conference of the Association of Physiologists and Pharmacologists of India, held at King George's Medical College, Lucknow, India from 17th–20th December, 2002.
3. Competence building for writing up Research proposals for funding: a workshop jointly sponsored by the Indian Council of Medical Research and W.H.O at Desert Medicine Research Center, Jodhpur, Rajasthan, India from 18th-20th March, 2004.
4. Fifteenth International AIDS Conference, Bangkok 2004, attended through live web casting at Maulana Azad Medical College, New Delhi, India from 11th July to 16th, July 2004.
5. Golden APPICON - the Golden Jubilee conference of the Association of Physiologists and Pharmacologists of India, held at the National Institute of Mental health and Neuro Sciences, Bangalore India, 19th–22nd December, 2004.