# INFLUENCE OF YOGIC PRACTICES ON PATIENTS WITH ANKYLOSING SPONDYLITIS

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**FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ARTS**


**BY**

**ARUMAY JANA**

**DEPARTMENT OF PHYSICAL EDUCATION**

**(FACULTY OF ARTS)**

**JADAVPUR UNIVERSITY**

**JADAVPUR**

**KOLKATA- 700032**


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Dedicated to My Father

Late Ajay Kumar Jana

# CERTIFICATE

Certified that the Thesis entitled "**INFLUENCE OF YOGIC PRACTICES ON PATIENTS WITH ANKYLOSING SPONDYLITIS**" Submitted by me for the award of the Degree of Doctor of Philosophy in Arts at Jadavpur University is based upon my work carried out under the supervisions of **Dr. Asish Paul,** Associate Professor, Department of Physical Education, Jadavpur University & **Dr. Pradyot Sinhamahapatra,** Associate Professor, Department of Clinical Immunology and Rheumatology, Institute of Postgraduate Medical Education & Research, Kolkata (IPGMER, SSKM). And that neither this thesis nor any part of it has been submitted before for any degree or diploma anywhere/elsewhere.

Countersigned by the Supervisor(s) Candidate

Dated: Dated:

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Date: .....

Place: (Arumay Jana)

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| | |
|---|---|
| **AS** | Ankylosing Spondylitis |
| **BASDAI** | Bath Ankylosing Spondylitis Disease Activity Index |
| **BASFI** | Bath Ankylosing Spondylitis Functional Index |
| **ESR** | Erythrocyte Sedimentation Rate |
| **CRP** | C - reactive protein |
| **TNF-alpha** | Tumour Necrosis Factor alpha |
| **BMI** | Body Mass Index |
| **HRQoL** | Health Related Quality of Life |
| **FABPA** | Fear Avoidance Belief in Physical Activity |
| **FABWA** | Fear Avoidance Belief in Work Activity |
| **SF 36** | Short Form-36 |
| **PC** | Pain Catastrophizing |
| **CBC** | Complete Blood Count |
| **ELISA** | Enzyme-linked immunoassay |
| **$kg/m^2$** | Kilogram Per Square Meter |
| **ng/L** | Nanograms per litre |
| **mg/L** | Milligrams per liter |
| **mm/hr** | Millimeters per hour |
| **µg/dL** | Microgram per decilitre |
| **g/dl** | Grams per decilitre |
| **thou/$mm^3$** | Thousand per cubic millimetre |
| **mmHg** | Millimetre of mercury |

**Influence of Yogic Practices on Patients with Ankylosing Spondylitis**

# CHAPTER -I

## *INTRODUCTION*

# CHAPTER-I

# INTRODUCTION

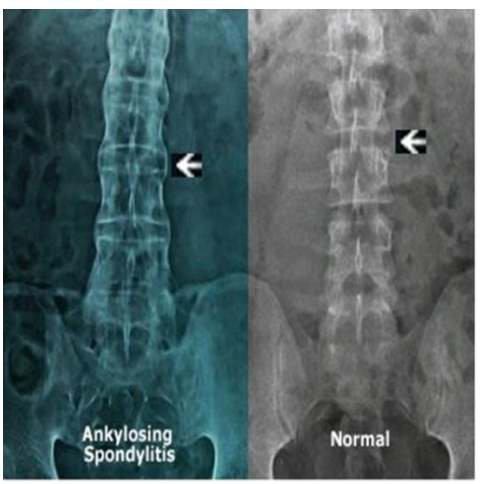
This chapter includes the general introduction, problem statement, study objective, delimitations, limitations, hypothesis, definition, term explanation, and importance of the current investigation.

## 1.1 General Introduction

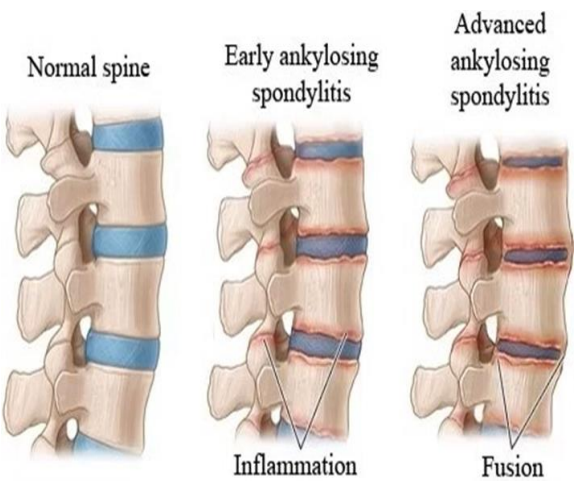
Lower back pain is one of the most usual public health problems. It is related to problems with the lumbosacral spine. It may also occur due to a herniated disc of the vertebral column, compressed nerve fibre, weakness of the muscles, dysfunction of the core organs of the pelvis and abdomen, strain of ligaments, and inflammation in bone and joint structure. In the present day, it is a world-threatening issue concerning health. 'The Global Burden of Disease 2010' study found that lower back pain had the highest rank in terms of disability in years lived with disability (YLD) and sixth place in disability-adjusted life years (DALYs) among the top ten diseases. The global point of manifestation of lower back pain was 9.4%, and in 1990, there were 58.2 million DALYs; by 2010, there were 83 million (Hoy et al., 2014). In Western countries like the USA, 10%–50% of people suffer from lower back pain, and similarly, one-year prevalence rates in adults range from 36% to 64% in non-western countries like Tibet, China, Turkey, Africa, etc. (Bindra S. 2015).

Ankylosing spondylitis (AS) is a rheumatic disease characterized by chronic inflammatory back pain. It is a condition of impaired movement of the sacroiliac joint, spinal peripheral joint, and spine. The term 'ankylos' means to unite or grow together of vertebra; 'spondylos'' means vertebra; and 'itis' means inflammation. In the 2009 assessment of 'spondyloarthritis in international society', spondyloarthritis is categorized into non-radiographic axial and ankylosing spondylitis. Globally, around 39% of patients have chronic lower back pain due to inflammation of the lower spine (Hoy et al., 2014). The prevalence rate of AS is 1.4% globally. In Europe, 1.50 million people, and in Asia, 5 million people, suffer from ankylosing spondylitis (Dean et al., 2014). According to Global Data's "Pharmaceutical Intelligence Centre," in India, the current estimated diagnosed prevalence of AS is 1.65 million. From now until 2028, it is expected to increase annually by 2.95% to reach 2.0 million (Edavalath M. 2010; Golder & Schachna, 2013; Dean, 2014).

Ankylosing Spondylitis (AS) is mostly affects the axial skeleton, namely the sacroiliac joints (SIJs), the spine, and the soft tissues that surround them. Shorten spinal mobility and inflammation on low back is common in AS patients. Peripheral joint arthritis in AS is correlated with the severity of the illness. On both sides of the SIJs, bone condensation and cartilage thinning are also seen. As the illness worsens, bony ankylosis of the SIJs and the lumbar spine joints—commonly referred to as the "bamboo spine"—may develop. Although it is rare at other sites, end-stage arthritis can occasionally occur in the hip joints, leading to ankylosis. Uveitis is a frequent condition of AS (Srivastava et al., 2023).




**Pic.1: X-ray of Spine**




**Pic. 2: Inflammation areas in Spine**

Ankylosing spondylitis is also an autoimmune type of arthritis where the body attacks its healthy tissues. Research shows that 90% of people with AS have a major susceptibility to carrying the HLA-B27 gene, which is a category of proteins that mistakenly engulf healthy cells instead of foreign, harmful substances in the body's immune system. The rate of prevalence of this gene varies from place to place in the population (Tsui et al., 2014; Zaarour et al., 2021). Research studies indicate that there are no permanent solutions for autoimmune diseases, but symptoms can be managed through medication along with lifestyle management (Chandrashekara, 2012). In the pain pathway, afferent nerve fibres carry signals to the medial thalamus of the forebrain, including the somatosensory cortex. After recognizing the signals in the brain, they transmit signals through the descending pathway to the reflex organs via the spinal cord (Yam et al., 2018). The chronic sensation of pain affects other body systems, especially the endocrine system, which elevates the level of stress hormones. Vice versa, the persistent pain gets worse and elevated perception of pain as catastrophizing can also trigger a stress response, which frequently takes the form of anxiety and avoidance of stimuli that cause pain (Hannibal et al., 2014). The period of fatigue, sleep disturbance, and psychological

problems has increased in AS patients. Psychological distress promotes negative influences on quality of life and work productivity.

Ankylosing Spondylitis is a category of sub type of arthritis that produces pain and stiffness in the spine. This enduring state is usually onset in the lower back. But it can also spread out to the neck or impairs joints in other parts of the body. "Ankylosis" means fused bones or other hard tissue. "Spondylitis" refers to inflammation of the vertebrae or spinal bones. Severe cases can leave the spine deformed. It restricts spinal mobility and increases functional disability.

Ankylosing spondylitis is an arthritis-associated disease of the Spondyloarthritis (SpA) family. Among these patients with spondyloarthritis (SpA), non-radiographic axial SpA (nr-axSpA) and ankylosing spondylitis (AS) are the two most usual diseases. Axial SpA and peripheral SpA are two categories of diseases in the SpA family, with some patients exhibiting both. Axial SpA primarily affects the spine, while peripheral SpA affects joints, heels, and fingers (David, 2023).

AS with radiological signs of sacroiliitis called "radiographic axial spondyloarthritis." The modified New York criterion has AS classified as primarily affecting men for a long time. The ratio of male female is primarily predicted 10:1 but later on literature reported the ratio has reduced to 3:1 (West, 1949; Kennedy et al., 1993). A recent study noted that the ratio is further decline to 1.03:1 by the end of 2016 (Baumberger, 2017). In this context, the prevalence AS cannot be estimated to criteria of sex differences of nr-axSpA (Sieper & Heijde, 2013). It occurs in the early twenties and rarely after 45 years of age (Edavalath, 2010).

Although the actual cause of AS is obscure, it is known to arise from a complex interaction between hereditary and environmental variables, much like other autoimmune illnesses. Research shows that 90 percent of people with AS have a major susceptibility to carrying the HLA-B27 gene. The rate of prevalence of this gene varies from place to place in the population (Tsui et al., 2014; Zaarour et al., 2021). Additionally, studies found that over 100 gene loci were associated with AS, although they only took around 30% of AS heredity into account. Two prime agents i.e. Major Histocompatibility Antigen (MHC) class I allele HLA-B27 is predicted an association with AS; as a result, HLA-B27 is still the most familiar biomarker for the foreboding of AS, even though only 1-2% of populations have this variant. In addition, high levels of CRP and ESR are also found in the serum of patients with AS (Zhu

et al., 2019; Ranganathan et al., 2017). Ankylosing spondylitis influence other organs and quality of life of the patients through following symptoms of dactylitis ranged 25–50%, presence of uveitis ranged 25–40%, inflammatory bowel disease seen 26%, and 10% symptoms of psoriasis (Moon, 2014).

### 1.1.2 Pathophysiology of Ankylosing Spondylitis

The pathogenesis of AS is not clearly identified. Ankylosing spondylitis (AS) is a potentially disabling form of seronegative spondyloarthritis. Inflammatory spinal pain and spinal immobility are key symptoms of ankylosing spondylitis. The entheses, where a tendon, ligament, capsule, or fascia insertion is linked to the bone, are primarily affected by the condition. At the entheses, three processes are seen: the production of syndesmophytes, or spurs; bone degradation; and inflammation (enthesitis). Initially, enthesitis was thought to be the distinguishing feature of ankylosing spondylitis. The articular or joint tissues in the area are destroyed as the condition worsens. Through fusion, bone takes the place of both the old and new cartilage. This results in stiffness and immobility as well as fusion, or fusing, of the joint bones. Numerous pathophysiologies are thought to be the root causes of AS. Although tumor necrosis factor plays a significant role in mediating inflammatory processes, bone erosion and the development of syndesmophytes are not directly impacted by this pro-inflammatory cytokine. The most important cause of AS is hypothesized to be genetic, HLA-B27 gene encoding being considered as main culprit (Tam et al. 2010). It is perhaps interplay between the T-cell immune response and class I MHC molecule HLA-B27 and (Alberts et al., 2002). The HLA B27 represents an antigen to the CD8+ T cells, and this in switch activates the immune system to onslaught the fibrocartilage or cartilage (Braun et al., 2000). Bacterial contaminations are also recommended to be triggering events in some cases, including greater production of IL10 (interleukin 10) by CD8+ T cells and low levels of TNFα and interferon (Trandem, et al 2011; Zhu et al., 2109). A meta-analysis study reported that deficiency of vitamin D may be connected to AS development (Cai et al., 2015). The negative association between the vitamin D level and disease activity showed by ESR, C-reactive protein (CRP) levels and BASDAI, (Pokhai, et al., 2015). Still, the cause of little amount of vitamin D levels in patients with AS still not clear.

Biochemical substances are the vital processes occurring in living organisms. It helps the immune system which is supposed to fight against diseases. Cytokines are small proteins that make up a part of the immunogenic and pathogenic recognition and response system in the human body. One of the immune system's reactions to infection and abnormal diseases

like autoimmunity is inflammation. The tiny protein cytokines that are generated by damaged or infected cells are intimately linked to the inflammatory response. Pro-inflammatory and anti-inflammatory cytokines are both recognized. Pro-inflammatory cytokines that contribute to the development of pathological pain include IL-1β, IL-6, and TNF-α. IL-4, IL-10, IL-11, IL-13, and interleukin (IL)-1 receptor antagonist are important anti-inflammatory cytokines. Pro-inflammatory cytokines are elevated during inflammatory irritation, while anti-inflammatory cytokines are decreased. There is compelling evidence that some cytokines activate nociceptive sensory neurons directly, contributing to the development and maintenance of pathologic pain. Certain inflammatory cytokines are also complicated in nerve injury/inflammation raised central sensitization (Zhang et al., 2007). Neuropeptides, neuronal signalling molecules, are crucial for various brain functions, including pain relief, and are involved in communication between neurons.

Elevated levels of plasma CRP and IL-6 were found to predict factors for symptomatic lumbar osteoarthritis in post-menopausal women (Suyasa et al. 2018). The association of CRP and chronic low back pain predicted but the act of CRP still not cleared yet (Ngaiho et al., 2019). Hashem et al., (2018) found that CRP was significantly correlated with ESR and body mass index (BMI) of patients with specific inflammatory back pain and non-specific low back pain. These patients have good responses to non-steroidal anti-inflammatory drugs (NSAIDs) and have higher erythrocyte sedimentation rate (ESR)/C-reactive protein (CRP) levels (Liao et al., 2011). The state of inflammation was detected through a high level of inflammatory markers such as C-reactive protein, interleukin 6, and tumor necrosis factor (Pearson et al., 2003).

The inflammatory cytokines control their own negative feedback loop. Collectively, these loops may result in a decrease in anti-inflammatory cytokines and an increase in pro-inflammatory cytokines.Cortisol has ability to decrease the pro-inflammation cytokines, which in turn reduce the inflammatory responses, contributing to various diseases (Tian et al. 2014). High psychological demands can increase plasma cortisol levels, making muscles vulnerable to mechanical loads, and psychosocial factors may influence the consequences and prognosis of lower back pain (Hartvigsen et al., 2004). When depression and ankylosing spondylitis coexist, they might be seen as two symptom complexes that negatively impact one another. It is also interlinked with psychological variables including trait and state anxiety, sensitivity, somatosensory amplification, catastrophizing and dysfunctional stress coping.

Cortisol, a hormone synthesized from cholesterol in the adrenal cortex, regulates stress response and homeostasis, affecting metabolic, immune, and memory functions. The hypothalamus-pituitary-adrenal and sympathetic nervous system axis regulate cortisol levels, inhibiting pro-inflammatory cytokine secretion and promoting anti-inflammatory cytokine secretion. Cortisol resistance can lead to increased pro-inflammatory cytokines and decreased anti-inflammatory cytokines, contributing to various diseases (Tian et al., 2014). High psychological demands can increase plasma cortisol levels, making muscles vulnerable to mechanical loads, and psychosocial factors may influence the consequences and prognosis of lower back pain (Hartvigsen et al., 2004). CLBP, a stress factor, and depression can be considered symptom complexes that mutually negatively impact each other (Ellegaard, 2012). Back pain is linked to psychological factors like internalizing, anxiety sensitivity, somatosensory amplification, catastrophizing, and dysfunctional stress coping (Kroner-Herwig, 2017). A review of the epidemiologic literature has shown that several workplace psychosocial factors can affect work-related back and upper extremity disorders (Occupational Stress, 2001). Apart from the lower back pain other musculoskeletal pain is occurring (Fibromyalgia, carpal tunnel syndrome, tension neck Syndrome, thoracic outlet compression, rotator cuff tendonitis, trigger finger/thumb, epicondylitis, radial tunnel syndrome) may be improper secretion of biochemical substances.

### 1.1.3 International Status:

The global burden of disease (2010) study found that lower back pain has the highest rank in terms of disability in years lived with disability (YLD) and sixth place in disability-adjusted life years (DALYs) among the top ten diseases. The global point of prevalence of lower back pain was 9.4%, and DALYs rose from 58.2 million in 1990 to 83 million in 2010 (Hoy et al.). According to a report by the ICMR, the change in the rate of DALYs (disability-adjusted life years) in cases of lower back pain almost doubled in 1990 (1.2%) and 2016 (2.3%). Ankylosing spondylitis (AS) is one of the important, although uncommon, causes of low back pain. This disease occurs at a young age, below forty years, leading to significant pain, stiffness, and limitations of daily vocational as well as vocational activities, thus resulting in a loss of productivity and economic loss. Globally, around 39% of patients suffer from chronic low back pain due to inflammation of the lower spine, and globally, the prevalence rate is 1.4%. The study indicates that the disease's uppermost prevalence is in North America, followed by Europe, Asia, Latin America, and Africa, with an adjusted estimate of 18/10000 in the Asian population (Dean et al., 2014).

### 1.1.4 National Status:

According to global reports on AS by Dean et al., currently estimated at 1.65 million, the diagnosed prevalence of AS in India is expected to increase at an annual growth rate of 2.95% to 2.0 million by 2028. According to studies, AS affects men two to three times as frequently as it does women. It is usually diagnosed in people under 40, with symptoms appearing between the ages of 20 and 30. In India, one out of every 100 young individuals has an AS patient (Nokhla, 2021). One study found that in Kerala, five lakh people suffer from ankylosing spondylitis. Most patients with AS face significant challenges in diagnosis, with only 12% visiting a rheumatologist and 31% correctly diagnosed, often due to sedentary lifestyle, posture, pregnancy-induced pain, or mechanical injury (Reddy et al., 2020).

### 1.1.5 Morbidity and Health Burden:

Global age-standardized mortality rates (Global ASMAR) were 0.13 [0.11–0.14] deaths per million inhabitants of AS. In Indian young adults aged 20–30, AS affects 1 in 100 of the adult population (Fakih et al.). The patient and society are troubled by the acute and chronic clinical signs of ankylosing spondylitis (AS). The burden of the disease is amplified by extra-articular exhibition comorbidities such as psoriasis, inflammatory bowel disease, and uveitis. Significant healthcare costs associated with prescription drugs and healthcare provider bills hurt societies and lower people's quality of life.

### 1.1.6 What is Yoga?

Yoga is a traditional ancient Indian art based on harmonizing the development of the body, mind, and spirit. Generally, people commonly mistake the actual ideology of yoga. Think that only some kinds of asana, or pranayama, are called yoga. Rather, it is a medium to control our lives or directed towards humanity. Yoga is a holistic practice that combines physical and mental exercises, promoting health, reduced greed, and efficient life management. Hatha yoga, a branch, focuses on physical and mental well-being through postures, breathing techniques, and meditation, resulting in a healthy body and mind.

Yoga has two main aspects. The first is philosophical, and the other is a scientific aspect. In the context of philosophy, yoga aims to know the ultimate reality of life. According to the father of yoga, Darshana, Patanjali said that yoga is restraining the mind stuffs from pleasing various forms or vrittis, or modifications. Controlling the senses and mind is one of

the key principles of yoga. Other texts, like the Bhagabat Gita, describe yoga as equanimity of the mind and perfection in action.

In a scientific sense, yoga is a systematic sequence of practices to achieve holistic health. Each part of yoga gives wholesome development to the human body. Swami Vivekananda mentioned in Raja Yoga that 'Yoga is not magic or asceticism but a scientific and practical way to empower the body, mind, and soul'. His commentary on the Patanjali yoga sutras is based on scientific principles. He showed that the practice of yoga was not only restricted to sadhakas or monks. It could be done anywhere and by any person to be healthier and build a good nation and well-being. Later on, hatha yogis unfolded the scientific reality. In the early twentieth century, Swami Kuvalayananda started scientific research on yoga and various systems of the human body. The studies found that yoga is a process of purification of not only the body, mind, and spirit but also beyond the spirit. Recent trends of yoga at the onset of health and fitness, but nowadays people are going to its core principles of spirituality.

Sometimes we are misled, that yoga is purely a religious activity, but it is also an activity of self-realization beyond religion. Yoga, a tool for self-transformation, promotes an aware connection with oneself, the ultimate truth (connection of jivatma and paramatma). It can be practiced in various streams like bhakti, jnana, karma, raja yoga, tantra, mantra, kundalini, hatha, and laya yoga. All streams have their different ways to awaken these connections to supreme self. Disease, as described in the sutras of Patanjali, particularly in the nine antarayas, is said to impede spiritual practice, growth, and freedom from suffering (Stephens, 2017). Disease, as described in the sutras of Patanjali, particularly in the nine antarayas, is said to obstacles to spiritual practice, growth, and freedom from suffering (Stephens, 2017).

### 1.1.7 Why Yoga?

Yoga is an integrative and holistic approach to the development of every aspect of the health domain. Yoga practices are frequently employed as a preventative measure as opposed to a treatment for illness. It is a kind of preventive mind-body treatment that can assist in controlling various aspects of illness. Yogic practices emphasize controlling one's food, social attitudes, and personal habits to bring about positive changes in the entire metabolic process. They go beyond simple exercise regimens and abstinence. Since it takes a truly integrated approach to treat the individual as a whole, greater outcomes should be predicted

than from any other method that tends to prioritize a single disease presentation while neglecting other concurrent alterations that may also be present.

Yoga is a body-mind medicine that offers a very simple, approachable, and useful manual for cultivating a vibrantly healthy body, mind, and spirit. It makes a huge contribution to human potential and healing. Doctors typically view illness as a malfunction of the physical apparatus and identify the source of the problem, but they may overlook a patient's mental, emotional, or behavioural issues. Although the theory is false, most medical researchers still use it as their guiding concept when conducting research.

There are two approaches to treating disease: the first is identifying the contributing elements, eliminating them, and letting the body heal itself. The second is to support the body in its attempts to defeat the offenders and emerge triumphant after a valiant and successful battle. The body can successfully fend off the attacks of the offending substances because it possesses the innate ability to generate particular immunity.

In yoga, the emphasis is on strengthening the body's and mind's natural defence mechanisms rather than addressing and eliminating personal offenses. To assist the body and mind in regaining homeostatic balance, illness treatment focuses on the development of these inner, inherent powers. By doing this, it draws particular attention to the different reconditioning and elimination processes that the body naturally engages in, i.e., strengthening one's ability to adapt and adjust. According to those viewpoints, yoga may be an anti-adverse medication to improve fitness and preserve patients' and the general public's natural physiological functioning balance.

### 1.1.8 Yoga Techniques

Yoga is a product of the perennial wisdom of India. It is a collection of varied practices and efforts reflecting an integrated way of living. Yogic techniques have the power to neutralize ill effects. The integrated lifestyle system is comprised of different distinctive practices, especially eight practices called Ashtanga yoga. Ashtanga means eight limbs of yoga. Yoga, as defined by Pantanjali in the Yoga Sutras, is an eight-limbed path containing of: yamas (ethical values), niyamas (moral adherences), asana (physical postures), pranayama (control of breathing), pratyhara (withdrawal of the senses), which are part of the external limbs (bahiranga yoga), and dharana (concentration), dhyana (meditation), and samadhi (enlightenment), which are part of the internal limbs (antaranga yoga) (Satchidananda, 2010). Generally, people start yoga with asana (physical postures) practice, but before that, all

elements of yamas (ethical restraints) and niyamas (moral conduct) need to be set. Each part of these limbs sets the ideal physical posture.

The quality of mind state is crucial to healing any kind of disease. When the person set a positive mind-state, recover more quickly, whereas if the mind-state is negative, recovery rate may be delayed. Yoga has immense power to heal all catastrophic states of the mind that are directed toward the purity of the inner self. In this journey towards purity, human values such as honesty, tolerance, justice, self-control, compassion, freedom, etc. develop, which make an individual ideal not only for themselves but also for society and the nation as a whole. The paths of Jnana yoga, Karma yoga, Bhakti yoga, and Raja yoga lead to wisdom and proper spiritual development that make individuals understand real human values. The continuous practice of yoga restrains negative thoughts and builds healthy habits. Yoga promotes mental serenity, well-being, relaxation, self-confidence, efficiency, attentiveness, irritability reduction, and an optimistic outlook on life (Arora, 2008).

Many people identifying yoga deals with asana, a part of exercises, regulation of breathing, or concentration of mind called as mediation, but these are the few components of yoga. The total text given importance to each components of yoga, including self-values social ethics, conscious breathing, meditation, lifestyle and pure diet, visualization, and the proper chanting, among many others. The first two limbs of Ashtanga yoga are very essential for preparing the soil for practicing asanas, pranayama, and so on, but most people generally skip that part.

The therapeutic part of yoga, or “Yoga Chikitsa,” is a condition of physical and mental easiness, directly interlinked with spiritual well-being. In addition to treating illness, it also enables one to comprehend the fundamental reasons for disease, which contributes to the development of a positive state of health. As part of the patient's unique treatment plan, yoga therapy should ideally be a tailored, personalized, and holistic approach that considers the patient's family, support system, workplace, culture, and mental, physical, and spiritual health. A yoga practitioner may recommend particular breathing exercises (pranayamas), poses (asanas), or meditation for a patient who is depressed. They may also offer additional lifestyle recommendations, such as those related to moral principles, wholesome routines, self-esteem, etc. This type of treatment is entirely non-pharmacological, does not have the possible side effects of drugs, and can assist the patient long after their consultation with the doctor has ended (Stephens, 2017).

### 1.1.9 Physiological Changes through Yoga

It is a common misconception that yoga is primarily about increasing flexibility. Hatha yoga (more bodily practice), increase muscle strength, bone rigidity that keeps right postural alignment, improve muscles endurance and balance. However, yoga also includes mindfulness-based practices like focused concentration, self-reflection, and meditation. Yoga is not limited to the treatment and prevention of conditions including hormone imbalances, diabetes, high blood pressure, menstrual disorders, and heart disease. It assists individuals in achieving a state of wellness in which they can comprehend the fundamental reason for their ailments.

The influences of yoga posture on the human body are very wide-ranging and long-lasting. The all body system like musculoskeletal, immune system, nervous system, respiratory, circulatory, and digestive systems are increased their work proficiency by regular yoga practice. Every bodily system is in harmony with every other system. After completing asanas, the body becomes more flexible and capable of adapting to changes in its surroundings. Asanas assist in bringing the sympathetic and parasympathetic nervous systems into equilibrium. Studies have demonstrated the wide-ranging and long-lasting effects of yoga on the human body. We are aware that every bodily system functions in unison with another. Every yoga technique has both broad and targeted effects.

### 1.1.10 Musculoskeletal System

Research on yoga has shown that practicing it enhances a practitioner's strength, dexterity, and musculoskeletal coordination. The majority of the poses used in yoga are isometric movements, which provide the muscles with a stretch that is optimally maintained. A series of asanas entails assuming a pose and then counter-posing, which calls for the coordinated action of antagonistic and synergistic muscles. This improves orthostatic tolerance and increases steadiness, strength, endurance, flexibility, and anaerobic power. The muscles and bones are loaded by the body's weight. This capacity extra load carrying improve strength the bones and prevents age associated weakness which a effective preventive measures of osteoporosis (Lu, 2016). Yoga is more effective than other modes of physical activity in recovering from work-related musculoskeletal disorders because of its more controlled nature and its positive effect on psychological stress and strain (Koneru et al., 2015).

Yoga is effective non drug medicine for musculoskeletal pain in various professional working sectors like the hygiene profession (Monson, 2017), the jewelry industry (Biman et

al., 2021), professional computer users (Telles, et al., 2009), the nursing population in hospital settings (Patil, et al., 2018), home-office workers (Garcia et al., 2021), a metallurgic company (Ribas et al., 2021), etc. Yoga has been linked to reduce pain-related disability, improved flexibility, functional capacity, mobility, muscular strength, and quality of life in individuals with various musculoskeletal disorders (Pravalika et al., 2022). A meta-analysis study found that yoga may improve muscle strength, balance, and flexibility, i.e., physical fitness parameters, in elderly people (Shin, 2021). Yoga can alleviate pain by decreasing sympathetic activity, stress markers, reducing inflammatory response and increasing muscle strength, suppleness, and heart and lung capacity (Stephens, 2017; Batrakoulis, 2022). Through strengthening ligaments, muscles, and joints, as well as enhancing joint movement coordination, yoga seeks to revitalize the neuromuscular system (Deepeshwar et al., 2018; Balaji et al., 2012).

### 1.1.11 Other Body Organ Systems:

Empirical evidence from scientific studies demonstrates the profound influence of yoga and meditation on the nervous system's operation. In addition to helping practitioners relax, yoga also helps them become more attentive and develop other cognitive skills. The effects of yoga on sympathetic and parasympathetic regulation and circulation are a big part of the effects of a yoga practice. New research shows that the sympathetic nervous system is really important to the tolerance of stress. Some of the activities need to tolerate challenges to smoothly transition back to a more parasympathetic dominant state. Yogic activities are an excellent way to train these shifts in the nervous system. Pranayama activities, which involve stretching the lung tissue, cause slow-adapting receptors and hyperpolarizing currents to produce inhibitory signals. According to Jerath et al. (2006), reduced metabolism and parasympathetic dominance result from inhibitory impulses synchronizing brain neuronal elements from the cardiorespiratory region, which involves vagi or both branches of vagal nerves. According to a small-sample study, practicing yoga regularly improves psychological well-being and parasympathetic dominance during both phases of the menstrual cycle. This effect is likely caused by balancing the neuro-endocrine axis (Kanojia et al., 2013). Long-term yoga practice diminishes sympathetic activity, improves parasympathetic activity, reduces stress, and prevents lifestyle-associated disorders in the future (Shobana et al., 2022).

According to Madanmohan et al. (2008), both male and female volunteers who practice yoga for six weeks see a significant rise in respiratory pressure and endurance as well as a reduction in the sweating response. A study with a small sample reported that one-

year yoga training improves the expansion of respiratory muscles and increases voluntary breath-holding time. The study also suggested that yoga can be used to prevent cardiovascular and respiratory diseases (Loganathan et al., 2019). Yoga practice significantly increased maximum expiratory pressure, inspiratory pressure, breath holding time after expiration, and breath-holding time after inspiration after 12 weeks (Madanmohan et al., 1992). According to Joshi et al. (1992), practicing pranayama for six weeks improved ventilator functions. Daily practice of yoga by young students has been reported to improve their lung function and life patterns for people with exercise-induced Problems of bronchospasm can be induced by practicing yoga exercises (Thirupathi & Subramaniam, 2016).

In our contemporary society, the prevalence of lifestyle-related disorders like obesity, hypertension, and coronary artery disease is startlingly rising. A yogic way of living has gained prominence in the management and prevention of various illnesses. Persistent yoga practice mitigates the decline in cardiovascular functioning associated with aging (Bharshankar et al., 2003). Bernotiene et al. (2020) reported that 12 hatha yoga poses may help prevent strain on the cardiovascular system, and a longer RR interval may aid stress-related health problems. A combination of physical pose (asana), breathing regulation (pranayama), and meditation has clinical benefits such as reducing intensity of cardiovascular diseases, morbidity, and rate of mortality, though there were some methodical drawbacks in those studies (Guddeti et al., 2019). Three months of a residential yoga practice along with a restricted vegetarian diet reduced body mass index, total serum and LDL cholesterol, fibrinogen, and blood pressure significantly (Schmidt et al., 1997; Chauhan et al., 2017).

The body is successfully cleansed. Stress, poor eating habits, and unhealthy lifestyles all contribute to the removal of toxins. Yoga can help with age-related problems like sleeplessness and constipation. This suggests that seniors can incorporate yoga into their regular routine to help with constipation and sleep-related quality of life (Shree Ganesh et al., 2021). The practice of yogasana can change the pattern of lifestyle, be effective against various digestive issues, and help improve the digestive system (Sneha, 2017). With constant practice, yoga can develop blood flow, inhibit constipation and bloating, and help with the controlling of chronic conditions like irritable bowel syndrome (IBS) and gastroeso phageal reflux disease (Kavuri et al., 2015; Kaswala et al., 2013). Lipid levels had improved following yoga instruction. It can be the result of elevated hepatic lipase and lipoprotein lipase at the cellular level, which influences lipoprotein metabolism and boosts adipose tissue

absorption of triglycerides (Delmonte, 1985). It's possible that greater insulin receptor expression in muscles due to muscular relaxation, growth, and better blood flow will boost muscle uptake of glucose and lower blood sugar levels (Chandratreya, 2012). The blood supply to the different interior organs is improved by the movement. Each asanas movements are beneficial to a certain organ, such as the liver, gall bladder, pancreas, etc. (E-Ryt, 2019).

Scientific literature shows that yoga has many great ways to support the immune system. Towards the pathogens right now, the immune and lymphatic impacts of a yoga practice are precious modalities. Asana and pranayama positively act on lymphatic circulation through more specific movements to target the lymph nodes. Yoga most likely affects the hypothalamus and anterior pituitary systems via the cerebro-cortico-limbic pathways. Yoga prevents cellular immunity from being weakened and autonomic alterations and is beneficial for circulating levels of cytokines (Gopal et al., 2011). One review article shows yoga can be used as an additional intervention for people who are at risk of developing inflammatory disorders or who already have them. It takes longer to see consistent benefits from yoga practice, particularly with regard to circulating inflammatory markers (Falkenberg et al., 2018). In a pilot study on industrial workers who practiced yoga, found increment of anti-inflammatory cytokines and reduce pro-inflammatory cytokines (Rajbhoj et al., 2015). Yoga-based lifestyle appears a very effective alternative therapy which positively influence on metabolic risk variables (HDL, LDL, and cholesterol) as well as inflammatory indicators (CRP, IL-6, and TNF-alpha).

### 1.1.12 What is Immunity?

The body's defence system against pathogens such as viruses, bacteria, parasites, and tumor cells is the immune system, which is a vast network of cells, tissues, organs, and other materials. The main components of the immune system are white blood cells and lymph system organs and tissues, including the tonsils, spleen, lymph nodes, lymph arteries, and bone marrow. There are two categories of immunity- 1) innate immunity 2) acquired immunity. The previous interaction with the invader has no effect on the inherent immunity. It works against all without identifying the particular identities of the intruders. Four different forms of defensive barriers are considered to be part of innate immunity: inflammatory, phagocytic, or endocytic; physiologic (temperature, low pH, certain chemical mediators); and anatomic (skin, mucous membrane). Every antigen has a unique mechanism for specific or acquired immunity. Because a weapon meant for one invader won't work against another, it's referred to as a specialized weapon. Specific immunity displays four characteristic attributes:

antigen specificity, diversity, immunologic memory, and self- or non-self-identification. The specific immunity may be active or passive. Passive immunity occurs due to the transfer or introduction of antibodies from outside, e.g., the injection of serum containing specific antibodies. Active immunity is developed within the body by lymphocytes against antigens introduced into the body. It develops after infection by a microbe and the introduction of antigen by any means into the body. Active immunity, once developed in the body, is remembered by the concerned cells for a long time. The active immunity that is produced within the body is again of two types, depending on the nature of the invaders. These are called cell-mediated immunity (CMI) and humoral immunity (HI). In humoral immunity, antibodies are produced, but in cell-mediated immunity, the lymphocytes themselves act.

### 1.1.13 Autoimmune Disease

The immune system defends the body against illness and infection by combating foreign invaders like viruses, bacteria, and other microorganisms. When the immune system fails to distinguish between potentially harmful antigens and healthy tissue, it can lead to autoimmune disease. This ensues when the immune system erroneously marks its healthy cells inside organs and tissues due to a breakdown in immunologic tolerance to auto-reactive immune cells. Autoimmune illnesses have unclear causes. Predisposing variables related to infection, environment, or genetics are strongly linked to several autoimmune illnesses. Scientists have identified around 80 different forms of autoimmune disorders. They can impact practically any body part. For example type-1 diabetes and rheumatoid arthritis are conditions where the immune system attacks the pancreas and various body parts, including joints, lungs, and eyes (DiMeglio et al., 2018). Many different types of illnesses range from organ-specific, where T cells and antibodies respond to self-antigens found in a particular tissue, to systemic, which is characterized by reactivity to an antigen or antigens dispersed throughout the body tissues (Smith & Germolec, 1999).

Autoimmune diseases primarily affect women. Roughly 80% of all patients diagnosed with autoimmune diseases are women (Invernizzi et al, 2009) A case report of 1481 patients from both rheumatologic and orthopedic units, found that the ratio of females getting affected with autoimmune diseases was high and the ratio of females: male was found to be 2.25:1. Almost 30 types of arthritis are reported, including rheumatoid arthritis (39%), fibromyalgia (13%), spondyloarthropathy (9%), systemic lupus erythematosus (6%), psoriatic arthritis (6%), Sjogren's syndrome (5%), reactive arthritis (5%), osteoarthritis (3%), and gout (3%)

(Prem Kumar et al., 2014). Autoimmune disorders tend to affect women in the time of period and pregnancy (Angum et al., 2020).

### 1.1.14 Mechanisms of Autoimmune Diseases

Multiple distinct events combine to form an autoimmune disease rather than a single, catastrophic event. Numerous theories have been put forth to explain how T-cells trigger the development of autoimmune diseases. A permissive genetic impact is crucial, but altered self-reactivity can also result from other triggers, including bacterial, viral, or chemical insults. A mutation in the lymphocytes may cause altered cells to arise, which may then identify the host as alien and trigger the onset of autoimmunity. In the case of immunological regularity, power is compromised, and self-antigen acts strangely. Autoimmune disorders have three main stages. 1) Most patients in the early stages of the illness are not aware of any clinical symptoms (subclinical). 2) During the propagation phase, when tissue damage from cytokine synthesis and self-perpetuating inflammation is prevalent, patients present with clinical illness. 3) The resolution of autoimmune reactions occurs through the inhibition of the immune response or the activation of inhibitory pathways (Rosenblum et al., 2015).

### 1.1.15 Association with Autoimmune Disorder

The pathogenesis of autoimmune diseases is associated with three factors, i.e., genes, the immune system, and the environment in which the patient lives. The genes are predispositions or genetic susceptibilities. Several genome-wide connotation studies have recommended a part for numerous genetic polymorphisms in different autoimmune diseases (Zenewicz et al., 2010). The longest-standing and strongest relationships have been found with specific HLA alleles; nevertheless, the precise roles played by various HLA alleles in the growth of autoimmune illnesses remain unknown. Cytokine and cytokine receptor genetic polymorphisms are coupled to many different autoimmune diseases (Goris & Liston, 2012). Environmental factors, including toxic chemicals, dietary components, gut dysbiosis, and infections, account for nearly 70% of autoimmune diseases (Vojdani, et al., 2014).

Through numerous research initiatives, ‘the National Institute of Environmental Health Sciences’ (NIEHS) and ‘the National Toxicology Program’ (NTP) are focusing on identifying the genetic and environmental roots of autoimmune illness. Their research demonstrates that:

- Sunlight is associated with autoimmune disease. According to Shah (2013), there could be a link between sun exposure and the onset of juvenile dermatomyositis, an autoimmune condition that causes skin rashes and muscular weakness.
- Childhood poverty interconnected to rheumatoid arthritis in adulthood: childhood lower socioeconomic position and adult rheumatoid arthritis. The combined effect of both a personal and paternal history of smoking was equalled by the effects of a lower adult education level and a lower childhood socioeconomic position (Parks, 2013).
- Agricultural chemicals and rheumatoid arthritis Meyer (2017) suggests that male farm labourers may get rheumatoid arthritis as a result of exposure to specific pesticides.
- Organic mercury may trigger an autoimmune disease. According to an NIEHS study, methyl mercury exposure—even at levels typically regarded as safe—may be connected to the emergence of autoimmune antibodies in women who are fertile. According to Pollard (2019) these antibodies can cause autoimmune ailments such as multiple sclerosis, lupus, rheumatoid arthritis, and inflammatory bowel disease
- Genetic issues in autoimmune muscle disease: The main hereditary threat factors for autoimmune muscle disease in Caucasian populations in Europe and the US have been found by NIEHS researchers (Miller, 2015).
- Gene atmosphere interaction in rheumatoid arthritis: The workings of a gene-environment interaction may help to explain why exposure to environmental toxins such as cigarette smoke increases the hereditary risk of rheumatoid arthritis (Fu, 2018).
- The part of nourishment in the progress of autoimmune disease In older populations, vitamin D may be crucial for preventing immunological dysfunction (Meier, 2016). Certain micronutrients in food may either make lupus symptoms better or worse. Strickland (2013).

### 1.1.16 Current research on treatments in Ankylosing Spondylitis:

#### 1.1.16.1 Pharmacological Treatments:

The judgement of AS is more often overdue 5-6 years from the onset. It has been commonly diagnosed through modified New York criteria, where the diagnosis of sacroiliitis requires MRI scans, which can reveal inflammation of the sacroiliac joint, but early detection is not

possible with X-ray exams. The progression of disease activity of ankylosing spondylitis differs from individual to individual. A few of them advance with significant impairment. Taking everything into account, the goals of treating AS are to reduce pain, improve physical function through events of regular living and effort, and postpone the structural deterioration that causes physical disabilities. Non-pharmacological and Pharmacological treatment both are effective for AS. In the pharmacological aspect, there are five types of medications commonly used to treat ankylosing spondylitis. These are non-steroidal anti-inflammatory drugs (NSAIDs), analgesics, biologics (TNF blockers and interleukin inhibitors, steroids, and Disease modifying ant rheumatic drugs (DMARDs) (Moon & Kim, 2014). NSAIDs and exercise are the first mark of dealing for patients with lively ankylosing spondylitis and on-demand NSAIDs plus physical treatment in case of stable AS. Studies have reported that long-term use of NSAIDs to a higher risk of high blood pressure (Johnson, 1997; Ruschitzka et al., 2017). Other studies reported traditional NSAIDs are safe have no renal side effects and are better for gastrointestinal tolerability (2018). In certain clinical situations, DMARDs are advised as a second-line therapeutic option. Patients with peripheral symptoms can use NSAIDs with low doses of DMARDs. In case of symptoms of uveitis, inflammatory bowel disease (IBD) prefers monoclonal tnf inhibitor (TNFi) drugs; in some cases, TNFi with low doses of DMARDs is used. In the case of patients with contraindications or no response to TNFi then patients are referred to 3$^{rd}$ line therapy called biologics drugs (TNF blockers and interleukin inhibitors) (Srivastava, 2023; Prem Kumar et al., 2014; Kalliopi et al., 2021). In case of significant mobility problems shown in the hip joint due to extreme joint damage then better treat surgery by replacement of the hip joint (Lin, 2019).

### 1.1.16.2 Non-pharmacological treatment

There are plentiful non-pharmacological managements have been found to ease AS-related stiffness and pain that increases axial and outlying joint suppleness. However, utmost of the revisions recommend that the long-term management of AS calls for a blend of pharmacological therapy along with physical therapy and psychosocial interventions. Any single therapy (either pharmacological or non-pharmacological) could not be sufficient to maintain the quality of life of AS patients. The primary challenge in managing AS is minimizing its impact on patients and the healthcare system, with supervised non-pharmacological therapy potentially increasing exercise efficacy and resulting in quicker and longer-lasting improvement (Srivastava, 2023).

The security and efficacy of non-pharmacological intrusions show positive results in patients with Ankylosing Spondylitis. In terms of lowering pain, functional ability, and disease activity, supervised physical therapy is superior to standard care for those by ankylosing spondylitis. No significant developments were found between administered physiotherapy and household workout programs (Gravaldi, 2022). Patient education, appropriate medication, and consistent workouts are the foundations of Non-pharmacological management in AS (Braun et al., 2011).

### 1.1.16.2.1. Physical therapy:

Exercise to uphold or recover muscular forte is suggested to be comprised as portion of the physiotherapy program for AS patients (Ozgocmen et al. 2012; Brophy et al., 2013). Stiffness and condensed kinesis have been delineated as key features of AS. Multi-modal workout programs include elasticity mechanisms to their program. Chest wall mobility restricted due to skeletal ankylosis in the thoracic joints. Respiratory exercises, when combined with other exercises, can significantly enhance chest wall expansion and functional capacity. Respiratory exercises, when combined with other exercises, can significantly enhance chest wall expansion and functional capacity (Ince et al. 2006).

### 1.1.16.2.2 Balneotherapy:

Traditional physical therapy incorporates spa services called balneotherapy. It used to treat rheumatic illnesses since ancient times. A spa treatment that involves heat exposure can have the physiological effect of increasing tissue blood circulation. Exposure to heat accelerates the elimination of harmful substances from inflamed tissues and encourages the flow of new blood through them, both of which aid in tissue healing.

### 1.1.16.2.3 Chiropractic therapy:

Chiropractic therapy is an alternative medicine that focuses on diagnosing and treating musculoskeletal disorders, especially those related to the spine. Chiropractors use hands on manipulation and adjustments of the spine and other parts of the body to improve alignment, relieve pain, and enhance overall function. While some research suggests that chiropractic therapy may be beneficial for certain circumstances such as back pain, neckline pain, and headaches, its effectiveness can vary depending on the individual and the specific condition being treated. It's important for individuals considering chiropractic therapy to consult with a qualified healthcare provider to determine if it's an appropriate treatment option for their

specific needs. A 2015 publication reported, "Treatment Guidelines in Axial Spondyloarthritis," ‘the American College of Rheumatology’, ‘the Spondylitis Association of America’, and Spartan sturdily endorse in contradiction of by high-velocity shoves to operate the spine in patients with AS who have backbone osteoporosis or spinal amalgamation. Spinal manipulation is not recommended for patients with axial spondyloarthritis because of the possibility of undetected osteoporosis along with the adverse effects of adjusting joints that are actively inflamed. Rigorous caution should be taken before beginning chiropractic treatment for Axial Spondyloarthritis.

### 1.1.16.2.4 Spa therapy:

The spa offers a premium massage treatment used for relaxation and stress relief. It is the usage of water for remedial action by bathing in hot water. According to a small study, weekly group physical therapy and medication treatment are not as effective as a 3-week sequence of united spa-exercise rehabilitation (van Tubergen et al., 2005). Ciprian et al. (2013) found that individuals with AS receiving TNF inhibitor treatment showed a definite, long-lasting clinical improvement when spa therapy and physiotherapy were combined.

### 1.1.16.2.5 Pilates:

The benefits of Pilates training include increased core strength, longer and leaner muscles, improved mobility, balance, strength, flexibility, posture, and ease of movement. It also helps prevent injuries. A small sample RCT study found that 12 weeks of treatment with pilates exercise significantly improved the BASFI score, and after 24 weeks, a noteworthy alteration was found compared to the disease control group that explained the therapeutic worth of pilates to patients with AS (Altan, 2011).

### 1.1.16.2.6 Tai chi:

Tai chi stands a form of physical workout and easing based on Chinese philosophy that enhances mental and physical well-being. In a 40-patient controlled clinical experiment, it was discovered those eight weeks of home-based tai chi and 60 minutes of tai chi twice a week enhanced disease activity and flexibility in AS patients (Lee, 2008). Tai chi is a safe substitute exercise that can be used to lower illness action, increase spinal suppleness, and enhance fineness of lifecycle for patients with AS, according to the results of another RCT study (Cetin, 2020).

### 1.1.16.2.7 Massage:

Massage therapy involves kneading, rubbing, tapping, and stroking the body's soft tissues. Massage therapy may aid in pain relief, relaxation, and stress reduction. It is evidenced that practice 11 months 7 massages across 28 days massage shows promise as a management for symptoms associated with AS (Chunco, 2011). Therapeutic massage shows promise as a treatment for signs related with AS. Another study shows massage has reduced the BASDAI and pain intensity of the lower back score of ankylosing spondylitis patients (Romanowski, 2017).

### 1.1.16.2.8 Swimming:

Swimming is one of the precise forms of exercise that improves fitness, flexibility, and strength in a safe, low-impact environment. The right stroke and good techniques help to increase the spinal mobility of many people with axial SpA. The spine softly rotates while the entire body, including the neck, stays stretched. A study reported that water-based exercises produced better improvements in pain scores and quality of life for patients with AS than home-based exercise (Dundar, 2014).

### 1.1.16.2.9 Lifestyle Management:

Researchers have discovered that altering one's lifestyle can help control AS symptoms. Giving up smoking is preferable for respiratory problems. Walking and sitting with good posture can help avoid some of the postural issues associated with ankylosing spondylitis. For this, physical treatment can be helpful. Apply heat and cold. Heating pads can ease stiffness, and ice packs can help reduce edema. Showers and warm baths can also be beneficial. Consuming a balanced diet and an abundance of processed, fried, and high-fat meals in one's diet might exacerbate inflammation. Incorporate anti-inflammatory foods such as whole grains, fruits, and vegetables into your meals. Regular physical activity is beneficial to the entire body and can help maintain flexibility and reduce discomfort, in addition to the previously suggested exercises.

### 1.1.16.2.10 Yoga:

Both pharmaceutical and non-pharmacological therapies are used in the current management of AS. Drug therapy that reduces inflammation and relieves pain is provided by the pharmacological intervention. Research indicates that anti-inflammatory drugs and anti-tumor necrosis factor alpha (anti-TNF) rehabilitation greatly lessen symptoms. But these

expensive medicines are associated with a complex hazard of cardiovascular sickness as well as other side effects.

### 1.1.17 Yoga in Inflammatory Back Pain:

Research on yoga for inflammatory back pain has shown promising results. Numerous studies have shown that yoga can assist people with inflammatory back pain diseases like ankylosing spondylitis feel less pain and perform better (Colgrove et al., 2020; H. Cho et al., 2015). Yoga's combination of gentle stretching, strengthening, and relaxation techniques can help improve signs and recover the complete wellness for those suffering from inflammatory back pain. However, it's vital to discuss with a healthcare professional before starting any innovative exercise regimen, including yoga, especially for individuals with inflammatory conditions.

### 1.1.18 Yoga in Rheumatoid Diseases:

Yoga is beneficial for managing the symptoms of rheumatoid disease by improving flexibility, strength, and overall well-being. However, it's crucial to consult with a healthcare professional or a qualified yoga instructor who can tailor the practice to specific needs and limitations. Gentle and modified poses, along with breath work and relaxation techniques, can help alleviate the pain and stiffness associated with rheumatoid disease. Patients with RA may benefit from yoga in terms of improved grip strength, disease activity, and physical function. Nevertheless, the overall data indicated that yoga did not significantly improve RA patients' discomfort, painful joints, swollen joint count, or inflammatory cytokines (Ye X. et al., 2020; Puksic et al., 2021).

### 1.1.19 How Yoga Can Help to Ankylosing Spondylitis Patients?

In addition to medication therapy, non-pharmacological measures include physical activity (Regnaux et al., 2019; Tricás-Moreno et al., 2016; Millner et al., 2015), physiotherapy (Gravaldi, 2022), Tai Chi (Lee et al., 2007; Cetin et al., 2020), aquatic exercise (Karapolat, 2009; Dundar, 2014), etc. have affirmative complementary effects on disease activity in AS controlling. Yoga possessed a multifaceted ways that promotes well living. It consists of mind-body exercises including yoga poses (asanas), breathing exercises (pranayamas), purification procedures (sudhhi kriyas), meditation (dhyana), and adhering to a yogic diet. Numerous studies have demonstrated the health advantages of yoga in a range of medical settings, with rheumatoid arthritis, anywhere it facilitates physical activity (Silva et al., 2021;

Ye et al., 2020), as an as an alternative to other non-drug therapies for chronic low back pain (Holtzman, 2013; Tilbrook, 2011; Cramer, 2013; Beggs, 2012), and multiple sclerosis (Cramer, 2014; Kimberly, 2022). Yoga has immune-modulation properties (Shah et al., 2022; Basu-Ray et al., 2022; Falkenberg, 2018). It enhances life quality and lowers systemic inflammation (Rajbhoj et al., 2016; Estevao et al., 2022). According to Dang and Sahay (1999), yoga enhances insulin sensitivity and boosts the livers and tissues' use and metabolism of glucose (Manjunatha, 2005). Yoga helps to prevent cardiovascular and respiratory diseases (Loganathan et al., 2019) and increase cardiorespiratory fitness (Sovova, 2015). Previous research indicated that yoga lowers the cardiovascular risk profile by elevating parasympathetic activity and reducing the initiation of the hypothalamic-pituitary-adrenal (HPA) and sympatho-adrenal system (Innes and Vincent, 2007). Neurotransmitters, hormones, and cytokines play bidirectional roles in connections between the central nervous system (Arora & Bhattacharjee 2008). Several papers depict the effectiveness of yoga on chronic mental disorders such as schizophrenia, stress, anxiety, depression, attention deficit hyperactivity disorder, and patients with functional disorders (Nagendra, 2013; Sathyanarayanan, 2019). Previous research indicated that yoga lowers the cardiovascular risk profile by elevating parasympathetic activity and reducing the initiation of the hypothalamic-pituitary-adrenal (HPA) and sympatho-adrenal system (Singh et al., 2021).

### 1.1.20 Research Evidence on Yoga for AS:

Yoga is a scientific discipline that concentrates on physical health and mental well-being. In past studies, it was shown that yoga partake an important role to play in lowering spinal pain, but only in a biochemical aspect. Yoga is a therapeutic aspect that prevents and cures low back pain. It improves mental, bodily, and social states, which leads to better health, reduced materialism, and effective use of human existence. A branch of yoga called "hatha yoga" is concerned with both physical and mental health. Asanas, or physical postures, pranayama, or breathing exercises, and dhyana, or meditation, are some of its techniques. The creation of a sound, healthy body and mind is the ultimate goal. The patient's emotional condition affects how they perceive pain as well. A variety of non-pharmacologic methods may influence this. The use of various non-pharmacologic methods, such as yoga, meditation, and other practices, as supplemental therapy for various disease processes has gained popularity in recent years. Studies on people with rheumatoid arthritis exist.

The outcomes of a recent meta-analysis state that “yoga may be beneficial for improving physical function, disease activity, and grip strength in patients with RA.

However, the balance of evidence showed that yoga had no significant effect on improving pain, tender joints, swollen joint count, and inflammatory cytokines in patients suffering from RA" (Ye X, 2020). In a recent small study of yoga in ankylosing spondylitis by Singh J et al., after two weeks, there was a noticeable improvement in both the symptom score and the analgesic medication score when compared to the baseline. Another study by Singh J et al. found significant improvements were observed in BASDAI, anxiety, and depression compared to baseline, as well as in BASDAI, BASFI, anxiety, and AS-QoL when equated to the control group afterward three months of online-based yoga intervention and medical care.

### 1.1.21 Why Yoga is better for Ankylosing Spondylitis?

Research studies indicate that there are no permanent solutions for autoimmune diseases, but symptoms can be managed through medication along with lifestyle management (Chandrashekara, 2012). In the pain pathway, afferent nerve fibers carry signals to the medial thalamus of the forebrain, including the somatosensory cortex. After recognizing the signals in the brain, they transmit signals through the descending pathway to the reflex organs via the spinal cord (Yam et al., 2018). The chronic sensation of pain affects other body systems, especially the endocrine system, which elevates the level of stress hormones. Vice versa, long-lasting pain-induced stress is triggered by a sharp insight of pain as catastrophizing, often resulting in fear and evasion of pain-provoking stimuli. (Hannibal et al., 2014). The period of fatigue, sleep disturbance, and psychological problems has increased in AS patients. Psychological strain exacerbates negative consequences on life satisfaction and productivity at work.

A discipline of mind-body techniques is yoga. It includes exercises, breathing exercises, mindfulness exercises, relaxation exercises, and lifestyle management skills. It has a wide range of positive health impacts on both clinical and non-clinical populations. Numerous musculoskeletal issues, including osteoarthritis, neck discomfort, and back pain, are improved by this technique. For people with persistent low back pain, it works well to increase spinal flexibility, movement, and pain control. Yoga induces parasympathetic nervous activity that helps regulate the HPA axis for the production of stress hormones. It also inhibits the action of the hypoactive GABA system, which is associated with threat perception, emotional regulation, and the secretion of stress hormones. Control of stress hormones decreases pro-inflammatory cytokines while increasing anti-inflammatory cytokines. Yoga practice can benefit chronic inflammatory diseases like multiple sclerosis

and rheumatoid arthritis by reducing inflammation through F-Kβ down regulation. However, its effects on Aspergillosis patients have not been extensively studied.

Yogic lifestyle patterns, i.e., ahar (yogic diet), bihar (yogic relaxation), achar (conduct), bichar (positive thinking), and byabahara (behavior), etc., can reduce the disease activity of patients. The components of yoga, i.e., asana, pranayama, kriya, and meditation, improve cell resistance and immunity in AS patients. Synchronized practices of body and mind are strictly followed in yoga practices, which are most of the time overlooked in physical therapy. Yoga works from the psyche level to the somatic level; in the case of AS, it is very necessary to have a positive mind set up to cope with the disease activities. Yoga practice is a combination of various non-pharmacologic therapies that have no side effects and are also cost-effective. Online yoga practices are also an innovative approach considering the feasibility of the patients, particularly during COVID-19 (Acar et al. 2022).

Yoga is combination of philosophy, science, and art that are ingrained in India. It is not a religious practice; it is a way of practicing self-realization that leads in the direction of the higher self. Swami Vivekananda, in his commentary on the Patanjali Yoga Sutra, said that yoga is the limiting of mind-stuff from pleasing various mal-thought waves (Vrittis). The controls of mind activities not only wield towards spiritual development but also develop human personality by fostering both physical wellbeing and mental happiness. The components of yoga are a mind-body-spiritual alternative and a complementary, affordable medicine for various chronic health conditions. Ashtanga yoga's eight limbs serve as a guide for moral behavior, self-discipline, and the development of moral values for leading an expressive and determined life. Ashtanga yoga focuses on health and recognizing the inner side of one's entity in every area of the practice. While any one of the eight limbs can be utilized independently, using them all at once improves the patient's worth of life. A yogic lifestyle may be a coping strategy to control negative thoughts of pain, reduce the worst possessions, and progress the value of life of patients with back pain. The study focused not only on yogic lifestyle management for AS patients but also on other lifestyle-related disorders that can be managed, which build a healthy society and increase productivity. From that perspective, investigators were aiming to find out the efficacy of an integrated approach to a yoga practice rehabilitation program in improving the quality of life among individual with ankylosing spondylitis.

## 1.2 Statement of the Problem:

Research studies indicate that there are no permanent solutions for AS but symptoms can be managed through medication along with lifestyle management. Numerous studies have shown that yoga is beneficial for a range of medical issues like mechanical back pain, rheumatoid arthritis, and fibromyalgia but very little evidence in AS. On the other hand practice of yoga has no side effects as well cost-effective. So the problem is accordingly stated as **-"Influence of Yogic Practices on Patients with Ankylosing Spondylitis".**

## 1.3 Objectives of the Study:

1. To find out the effect of yoga on selected disease activity and functional index, inflammatory markers, blood count, general health, psychological and HRQoL variables in patients with AS.
2. To compare the effect of Yogic Practices on Patients with Ankylosing Spondylitis between yoga practices group (medicine with yoga practice) and control group (medicine with conventional exercise) with respect to selected disease activity and functional index, inflammatory markers, blood count, general health, psychological and HRQoL variables.
3. To comparison of the changes between the yoga and control groups at pre- test weeks and at post 12 week test and 12 weeks and at post 24 week test selected disease activity and functional index, inflammatory markers, blood count, general health, psychological and HRQoL variables in patients with AS.

## 1.4 Hypothesises:

The investigator applied the null hypothesis for the investigation after reviewing related literature due to limited review and no directional hypothesis.

**$H_0$1**-There would be no significant difference between yoga practice group and control group in disease activity, functional limitation, inflammatory markers, blood count, general health, psychological and HRQoL variables at pre-test, 12 weeks and 24 weeks.

**$H_0$2**-There would be no significant difference between pre-test and post 12 weeks, and post12 weeks to post 24 weeks in yoga practice group with respect to disease activity, functional limitation inflammatory markers, blood count, general health, psychological and HRQoL variables.

**$H_0$3**-There would be no significant difference between pre-test and post 12 weeks, and post 12 weeks to post 24 weeks in disease activity, inflammatory markers, blood count, general health, psychological and HRQoL variables in control group.

**$H_0$4**-There would be no significant changes between the yoga and control groups at pre- test weeks and at post 12 week test and post 12 weeks to post 24 weeks in disease activity, functional limitation, inflammatory markers, blood count, general health, psychological and HRQoL variables.

## 1.5 Significance of the Study:

- The study helps to prepare a yoga activities programme for the peoples those are suffers or rehabilitate from AS.
- Those patients who are earlier diagnosed to AS, they may follow the yogic activities to prevent their worst condition.
- The Yoga activities haven't drugged related side effects rather it have composite effect to elevate positive status in all domains of heath.
- The study could play important role for the expansion of scientific yogic activities not only AS patients but also other patients with rheumatoid disorders.
- The study may help to promote holistic health status of the society which is cost effective and increase productivity of the society.
- Yogic activities is a package which can help to lessen problem in physically, psychologically of AS patients.
- It also builds a positive behavioural practice to AS patients that promotes to quality of life.
- The study develops moral values of the patients through imparting yoga activities.

## 1.6 Definition and Terms:

**Yoga:**

Yoga is a traditional Indian discipline that uses asanas, pranayamas, kriyas, bandhas, chanting, meditation, and other techniques to bring the mind and body into harmony. It offers various bodily and psychological health benefits, promoting suppleness, forte, and relaxation and stress release.

**Ankylosing Spondylitis:**

Ankylosing spondylitis (AS) is a type of inflammatory arthritis that mostly affects the spinal column, causing inflammation of the vertebrae. This can lead to pain, stiffness, and eventually, fusion of the spine. It can also impact on other joints, tendons, and ligaments.

**BASDAI:**

BASDAI or Bath Ankylosing Spondylitis Disease activity is a survey tool used to assess disease activity in individuals with ankylosing spondylitis (AS). It includes questions related to symptoms such as fatigue, spinal pain, joint pain, enthesitis, and morning stiffness.

**BASFI:**

The BASFI, or Bath Ankylosing Spondylitis Functional Index, is another tool used in the assessment of ankylosing spondylitis (AS). BASFI focuses on the impact of AS on a person's functional ability. It includes questions about daily activities, such as dressing, bending, and reaching, allowing healthcare professionals to gauge the impact of the disease on a person's overall functionality.

**TNF-alpha:**

Tumor Necrosis Factor-alpha (TNF-alpha) is a cytokine, or a signalling protein, involved in the inflammatory response. It plays a vital part in the immune system by promoting inflammation, which is a normal and necessary part of the body's defence against infection and injury.

**Depression:**

Depression is a mental health disorder categorized by tenacious state of mind of sad, loss of attention or desire in activities, changes in sleep and appetite, fatigue, and difficulty concentrating.

**Fear Avoidance Belief:**

Fear avoidance beliefs are cognitive perceptions and attitudes individuals may have about their pain or injury, leading them to avoid certain activities due to fear of exacerbating their symptoms. In the context of musculoskeletal pain, these beliefs can contribute to a cycle of pain, avoidance, and physical deconditioning.

**Pain Catastrophizing:**

Pain catastrophizing refers to an exaggerated negative mental state in response to actual or anticipated pain. Individuals experiencing pain catastrophizing tend to magnify the severity of their pain, feel helpless about it, and expect the worst possible outcomes. This cognitive process can contribute to increased pain perception, disability, and emotional distress.

**HRQoL:**

HRQOL stands for Health-Related Quality of Life. It's a measure that assesses an individual's overall well-being, considering various aspects of their health, bodily, psychological and societal functioning, and the impact of any health conditions on their daily life.

# CHAPTER -II

## *REVIEW OF RELATED LITERATURE*

# CHAPTER-II

# REVIEW OF RELATED LITERATURE

The investigator conducted a literature review to select a topic, formulate a hypothesis, and deduce a problem. They consulted various books, periodicals, and journals to gather relevant facts and findings for better understanding and justifying the study.

## 2.1. Selection of Studies for Review:

A review was carried out by searching for keywords such as yoga, low back pain, inflammatory back pain, rheumatic disorders, and ankylosing spondylitis in three databases, using Medline/PubMed, Google Advanced Scholar, and the Cochrane Library. Direct experimental trials including randomized controlled trials (RCTs) were comprised in this work. Overall 727 studies were identified through database searching. After screening 729 studies, 617 studies were excluded due to duplicates, results from secondary data, not related to aim and unavailability of full text articles. Thus 112 studies were included for evaluation in the present study.

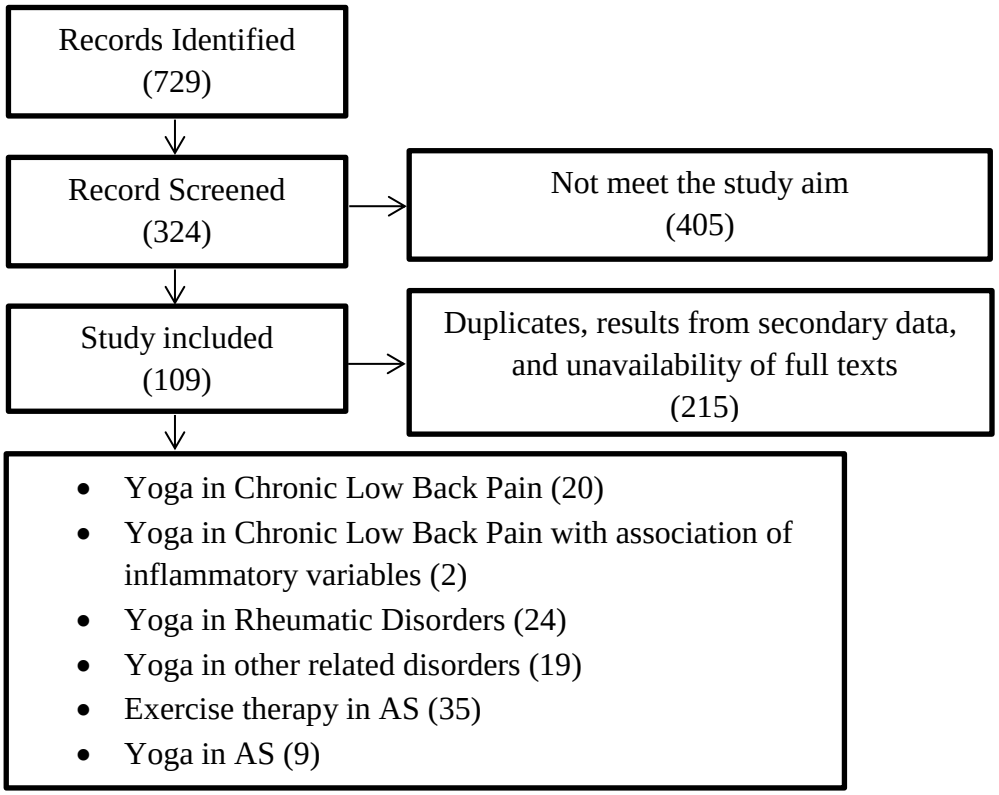



**Fig. 1: Study Selection Flowchart**

The determination of this review of selected literature was related to studies relating to the topic under study and to form the collected review into expressive sub units as listed below:

a) Study on Yoga in chronic low back pain

b) Yoga in Chronic Low Back Pain with association of inflammatory variables

c) Study on Yoga in rheumatic disorder

d) Study on Yoga in other related disorders

e) Study on Exercise therapy in Ankylosing Spondylitis

f) Study on Yoga in Ankylosing Spondylitis

### 2.1.1. Studies of Yoga in Low Back Pain

1. **McCarthy et al. (2022)** found that yoga may reduce disability in veterans with CLBP. Fatigue and pain were found to be significant mediators of yoga's effect on disability. The study suggests that yoga may reduce pain and fatigue, contributing to reduced disability. The finding that fatigue mediates the relationship between yoga and disability is novel and suggests that fatigue should be considered in yoga research for specific populations like military veterans with chronic pain.

2. **Williams et al. (2005)** compared an educated control group for chronic low back pain with Iyengar yoga therapy. The experiment ran for sixteen weeks. According to the study, there were notable decreases in pain severity, functional impairment, and pain medication use in the yoga group. The majority of self-referred patients with mild chronic low back pain will adhere to Iyengar yoga therapy and report improvements in functional and medical pain-related outcomes, suggesting that it may be a viable substitute for conventional medicine.

3. **Singphow et al. (2022)** examined the influence of yoga on spinal flexibility, stress, anxiety, and depression in individuals with chronic low back pain (CLBP) who use computers. Two groups of eighty computer users were created: forty were assigned to yoga, and another forty to physical activity. Exercise regimen intended for LBP (1 hour per day, three days per week for 16 weeks). The outcomes demonstrated that yoga enhanced spinal mobility while notably lowering stress, anxiety, and depression

levels. According to the study, yoga is superior to physical activity in helping computer users with CLBP reduce stress, anxiety, and sadness.

4. **Patil et al. (2018)** were evaluated total 88 South Indian women nurses (aged 32.75 yrs), and it was found that integrated yoga treatment outperformed physical exercise in improving the social, psychological, and physical health areas of quality of life. For six weeks, the yoga group did yoga for an hour every day, five days a week, while the physical exercise group engaged in physical activity. According to the study, yoga should be included in lifestyle interventions for nursing personnel who have CLBP.

5. **Lee et al. (2014)** examined the connection between yoga and pain, serotonin and BDNF in premenopausal women with chronic low back pain. After 12 weeks results showed that yoga practice led to decreased VAS, improved back flexibility, increased BDNF, and maintained serotonin levels. Additionally, the yoga group maintained a lower depression level, suggesting that BDNF may be a key factor in the beneficial effects of yoga on chronic lower back pain.

6. **Tekur et al. (2008)** examined the impact of physical activity and a residential yoga practice on pain and spinal suppleness in individuals with persistent low back pain (CLBP). While the control group engaged in physical activity, the intervention comprised a one-week intense residential yoga program. Measures of spinal flexibility improved and ODI scores were expressively lower in the yoga group, with the yoga group exhibiting a higher degree of improvement. The study found that, compared to a physical exercise regimen, a residential intensive yoga-based lifestyle program enhanced spine flexibility and decreased pain-related impairment in patients with CLBP.

7. **Tekur et al. (2010)** undertook a study at Bengaluru, India's SVYASA Holistic Health Centre to examine the impact of an inhabited, short-range, intense yoga program on the quality of life for eighty individuals suffering from chronic lower back pain (CLBP). Yoga improved quality of life and spinal flexibility more than physical therapy exercises, according to the study, which also identified a negative association between stress and quality of life in CLBP patients. Yoga may be a more successful treatment for CLBP, according to the study.

8. **Arya et al. (2022)** checked the effects of medical yoga treatment (MYT) on the pain and well-being of chronic low back pain (CLBP) patients. Results showed that MYT

significantly decreased subjective pain rating and improved the Nociceptive Flexion Reflex threshold. The study also found that MYT improved the regulation of descending pain and quality of life compared to standard care. Overall, the study suggests that MYT is a more effective treatment for chronic low back pain and stress than standard care.

9. **Tilbrook et al. (2011**) compared to standard therapy, yoga improved back function at 3, 6, and 12 months in a UK study comparing it to normal care for chronic or recurring low back pain. At three and six months, but not at twelve, the yoga group's pain self-efficacy scores were greater. At three, six, and twelve months, the research revealed that the yoga group scored higher on general health and reduced back discomfort. A total of 156 yoga practitioners and 157 participants receiving normal treatment reported side events, the majority of which were increased discomfort.

10. **Sherman et al. (2013)** contrasted yoga with rigorous stretching and self-care, and discovered that the effects of yoga or stretching on back-related dysfunction were mediated by physiological, psychological, cognitive, and emotional components. Stretching was found to contribute to relaxation, improved awareness, and the health advantages of breathing, whereas yoga was most strongly mediated by hours of back exercise and increased self-efficacy. Qualitative data indicates that these advantages might operate through quite different pathways, nevertheless.

11. **Saper et al. (2017)** conducted a 12-week study involving 320 low-income, racially diverse adults with nonspecific chronic low back pain and found that yoga was non-inferior to physical therapy for function and pain. The study involved 12 weekly yoga classes, 15 PT visits, or an educational book and newsletters. The maintenance phase compared yoga drop-in classes versus home practice and PT booster sessions versus home practice. Results showed that yoga was not superior to education for either outcome. Yoga and PT were similar for most secondary outcomes, and improvements were maintained at 1 year.

12. **Neyaz et al. (2019)** compared Hatha yoga therapy and conservative therapeutic exercises (CTEs) for dropping back pain intensity and dysfunction in patients with chronic non-directed low-back pain (CNLBP) was conducted at a tertiary care hospital. The study involved 70 patients aged 18-55 with persistent CNLBP for 12 weeks and pain rating≥4. Both yoga and CTE groups showed significant improvement

in back pain intensity and dysfunction at 6- and 12-week follow-ups. No significant differences were noted in pain intensity or back-related dysfunction between the two groups. Improvements in pill consumption and perceived recovery were also comparable between the groups. The study concluded that yoga provided similar improvement compared to CTEs in patients with CNLBP.

13. **Michalsen et al. (2021)** with a randomized controlled trial compared yoga and eurythmy therapy to conventional physiotherapy in patients with chronic low back pain. Results showed no significant differences between the three groups. Physical disability decreased, pain intensity and bothersomeness decreased, and quality of life increased. Participants in the eurythmy arm showed more benefits than physiotherapy and yoga. Within-group analyses showed improvements in SF-12 mental score for yoga and eurythmy therapy only.

14. **Bhatta et al. (2015)** directed a study in Bengaluru, India and found that a seven-day intensive residential IAYT program reduced disability, depression, and pain in patients with Chronic Lower Back Pain (CLBP). The program included Asanas, Pranayama, meditation, and philosophical yoga sessions. The study also found significant changes in the modified Roland-Morris Disability Questionnaire, Beck Depression Inventory, and Straight Leg Raising Test. The findings suggest yoga may be a vital tool in managing CLBP, but further randomized control trials are needed.

15. **Poojari et al. (2023)** with a controlled randomized trial compared the integrated approach of yoga therapy (IAYT) with usual care for managing chronic low back pain. The study involved 29 adult patients with non-specific CLBP, who were divided into two groups: the control group received usual care, and the yoga group received IAYT as an adjunct. The results showed a significant decrease in VNRS score and functional ability, with the yoga group showing a more significant reduction in pain over time. The yoga group also showed significant improvements in DN4, PDQ, PCS, HADS, and Euro QOL. The study concluded that IAYT therapy improved the psychological machineries of pain and quality of life in chronic low back pain patients.

16. **Starkweather et al. (2024)** investigated the influence of yoga on chronic low back pain (CLBP) by examining whether the effects are mediated by improved emotional regulation (ER) skills, the extent to which these effects are related to specific aspects

of ER, and the role of pain sensitization as a mediator or moderator. The study will enroll 204 adults with CLBP and administer yoga or a control stretching and strengthening intervention over 12 weeks. The primary outcome will be the mean change in pain severity, with the primary mechanism of action being improved ER. Secondary outcomes include pain sensitivity, physical strength and flexibility, pain interference, and quality of life. The findings will inform intervention trials involving yoga as a modality for relieving pain and improving function.

17. **Nambi et al. (2014)** compared the effects of traditional exercise therapy with Iyengar yoga therapy on HRQOL and pain intensity in patients with nonspecific persistent low back pain. A total of sixty participants were randomized into two groups: the Iyengar yoga group (n = 30) and the exercise group (n = 30). Patients' HRQOL improved and their discomfort significantly decreased in both groups. The visual analogue scale (VAS) revealed a 72.81% reduction in the yoga group and a 42.50% reduction in the exercise group. These findings imply that, when it comes to nonspecific chronic back pain, Iyengar yoga outperforms general exercise in terms of pain reduction and HRQOL improvement.

18. **Marshall et al. (2022)** studied Yoga, physical rehabilitation, and educational interventions for the cognitive evaluation of chronic low back pain (cLBP) in an RCT-based fashion. The Pain Self-Efficacy Questionnaire (PSEQ), Coping Strategies Questionnaire (CSQ), and Fear-Avoidance Beliefs Questionnaire (FABQ) were used to assess cognitive assessment. Using the education group and the baseline as references, the results were computed using multiple imputation and linear regression to estimate changes in cognitive appraisal within and across groups at 12 and 52 weeks. After 12 weeks, all three groups displayed developments in PSEQ, with the gains from PT and yoga being clinically significant. Catastrophizing (CSQ) improvements at 12 weeks were highest in the PT and yoga groups. There were minimal FABQ changes. At either time point, no statistically significant alterations between the groups on the PSEQ, CSQ, or FABQ. At 52 weeks, many of the alterations that were seen at 12 weeks persisted. Improvements in self-efficacy and catastrophizing were linked to all three therapies in persons with cLBP who were low-income and of varied racial backgrounds.

19. **Groessl et al., (2017)** studied the health advantages of yoga among veterans of the armed forces and discovered that it has few adverse effects. 150 veterans from a

significant California Veterans Affairs Medical Center participated in the trial and were randomized to either delayed yoga instruction or yoga. For 12 weeks, yoga classes with qualified instructors focused on physical postures, movement, and breathing methods were held twice a week. At six months, the Roland-Morris Disability Questionnaire ratings of yoga practitioners were found to be significantly lower than those of those in delayed treatment. The results lend weight to the idea of offering yoga classes to veterans more broadly.

20. **De Giorgio et al. (2018)** attempted to assess the efficacy of a back school program in conjunction with yoga as an intervention for those with non-specific persistent low back pain. A randomized assignment was made to place 70 subjects in the Hatha Yoga program or the experiment group. A significant decrease in anxiety, kinesiophobia, back pain impairment, and quality of life was detected in the interference group. At the conclusion of the training weeks, both groups displayed statistically significant alterations in psychological indicators and quality of life.

### 2.1.2 Studies of Yoga in Chronic Low Back Pain with association of inflammatory variables

21. **Colgrove et al. (2019)** inspected the viability of offering yoga involvement to a group that is primarily underserved and to evaluate the processes that underlie yoga intervention's ability to reduce CLBP pain. The within-subject, wait-listed crossover design was quasi-experimental. For 12 weeks, people with low incomes practiced yoga twice a week. Three stages of outcome measurements were conducted: baseline, pre-intervention (six to twelve weeks after baseline), and post-intervention. Tumor necrosis factor (TNF)-α protein levels in plasma, pain, disability, core strength, and flexibility were among the outcome assessments. Pain scores showed significant improvements before and after the yoga session. Notable enhancements were observed in the Oswestry Disability Questionnaire scores, as well as in the flexibility of the hip and spinal flexors, the strength of the core muscles, and the decrease in TNF-α plasma protein levels after practicing yoga. N-acetylaspartate levels in the dorsolateral prefrontal cortex and thalamus are interestingly elevated, according to brain imaging research. According to the study's findings, yoga helps lower pain and disability in a population of low-income CLBP patients by improving their flexibility and core strength. Variations in TNF-α protein levels warrant additional research.

22. **H. Cho et al. (2015)** in a Non-RCT based study involving premenopausal women with Chronic Lower Back Pain (CLBP) found that yoga practice significantly improved their inflammatory variables, stress levels, and back-related function. The study used the Roland-Morris Disability Questionnaire, SOSI, cortisol, TNF-α, and C-reactive protein to measure CLBP before and after 12 weeks. The yoga group showed significant improvements in RMDQ and back flexibility, while the control group showed no significant changes.

### 2.1.3 Studies of Yoga in Rheumatic Disorders

23. **Ganesan (2020)** conducted a study at JIPMER's outpatient clinic and found that a 12-week yoga program significantly reduced disease activity and improved sympathovagal balance in newly diagnosed RA patients. The study divided 166 patients into two groups: 83 in the yoga group (YG) and 83 in the control group (CG). The yoga group experienced a greater decline in IL-1α and cortisol levels than the control group. The findings suggest that yoga therapy can be a valuable treatment for RA patients.

24. **Pukšić (2021)** aimed to estimate yoga program could improve physical and psychological functioning and health-related quality of life in individuals with rheumatoid arthritis (RA). A randomized controlled experiment was conducted, pitting the yoga group against the education control group. The 12-week yoga program, modeled after the Yoga in Daily Life approach, was preferred by both groups for fatigue, depression, and anxiety. However, the program did not improve the course of RA, and there were noticeable improvements in fatigue and mood at post-intervention and follow-up.

25. **Yadav et al. (2012)** in a nonrandomized pre-post design study, aimed to appraise the effectiveness of an intervention in lowering stress and inflammation in patients with chronic inflammatory diseases as well as overweight/obese subjects. Eighty-six (86) patients (44 female, 42 male, 40.07 ± 13.91 years) participated in the study, and the pretested intervention program comprised postures, breathing exercises, group discussions, lectures, and personalized advice. The outcome measures included a decrease in inflammation (tumor necrosis factor [TNF]-α) and stress (plasma cortisol and β-endorphin) between day 0 and day 10. Between day 10 and baseline, the mean level of β-endorphins increased ($p=0.024$) while the mean level of cortisol decreased

(p=0.001). Additionally, there was a decrease in mean levels of TNF-α (p=0.002) and IL-6 (p=0.036) from baseline to day 10. They came to the conclusion that among patients with chronic illnesses, a brief yoga-based lifestyle intervention lowered the markers of stress and inflammation as early as 10 days.

26. **Gautam, S. et al. (2020)** evaluated the impact of yoga-based lifestyle intervention (YBLI) on psycho-neuro-immune markers, gene expression patterns, and quality of life (QOL) in RA patients. Total 66 patients were divided into yoga and non-yoga groups. Results showed significant improvements in markers, reduced disease activity, and improved QOL in physical health, psychological and social relationships domains. Yoga practice reduced inflammatory cytokines, elevated mind-body communicative markers, and normalized transcript levels, indicating that YBLI improves clinical outcomes and decreases systemic inflammation.

27. **Gautam, S. et al. (2019)** studied 72 active RA patients and found that yoga-based Mind-Body Intervention (MBI) significantly reduced disease-specific inflammatory markers and depression severity in patients. The yoga group experienced a significant decrease in disease activity score 28, erythrocyte sedimentation rate (DAS28ESR), and health assessment questionnaire disability index (HAQ-DI) compared to the control group. Additionally, the yoga group experienced a significant time-dependent decline in depression symptoms. The study suggests that yoga can be used as a complementary/adjunct therapy in severe autoimmune inflammatory arthritis with a major psychosomatic component.

28. **Evans, S. et al. (2013)** compared the impact of a 6-week Iyengar yoga program on the HRQoL of young adults with RA to a usual-care waitlist control group. Results showed significant improvement in HRQoL, pain disability, general health, mood, fatigue, acceptance of chronic pain, and self-efficacy. Almost half of the yoga group reported clinically meaningful symptom improvement. The program's uncontrolled effects and maintenance of treatment effects were maintained at follow-up.

29. **Ward et al. (2018)** aimed to assess the possibility of a relax-based yoga intervention for rheumatoid arthritis. Participants were recruited from a hospital database and randomized to either eight weekly 75-min yoga classes or usual care. Results showed high recruitment rates, retention, protocol adherence, participant satisfaction, and adverse events. The yoga program was found to be feasible and safe for participants

with rheumatoid arthritis-related pain and functional disability. Adverse events were minor and not unexpected. This pilot study supports further exploration of yoga as a complex intervention for managing rheumatoid arthritis.

30. **Badsha et al. (2009)** inspected the impact of a 2days/week Raja yoga program on rheumatoid arthritis (RA) disease activity in Dubai, UAE. A total of 47 patients were enrolled: 26 yoga and 21 controls. Results showed significant improvements in disease activity indices, health assessment questionnaire, and quality of life for yoga-induced RA patients. The study suggests that longer treatment duration could lead to more significant improvements.

31. **Moonaz et al. (2015)** studied 75 inactive adults with rheumatoid arthritis or knee osteoarthritis and found that yoga can improve physical health, mood, stress, self-efficacy, health-related quality of life, and RA disease activity. The study found that yoga was associated with higher physical component summary (PCS), walking capacity, positive affect, and lower depression scales. The study also found significant improvements in balance, grip strength, and flexibility among yoga participants. The study suggests that yoga can safely increase physical activity in sedentary individuals with arthritis, improving their physical and psychological health and HRQOL.

32. **Evans et al. (2011)** conducted a study on young adults with rheumatoid arthritis (RA) found that an Iyengar yoga program can improve their quality of life. The participants reported that yoga helped with energy, relaxation, and mood, and that it impacted their physical and psychospiritual well-being. The study supports a biopsychosocial model, suggesting that yoga benefits patients through both physiological and psychospiritual changes. The study highlights the need for safe, effective complementary treatments for young adults with RA.

33. **Bhandari & Singh (2009)** examined the impact of yoga package (YP) on pain intensity, inflammation, stiffness, pulse rate, blood pressure, lymphocyte count, creatinine, and uric acid levels in Rheumatoid Arthritis (RA) patients. Results showed a significant positive association between pain intensity and YP, and a significant reduction in stiffness, PR, and UA levels towards normalcy. However, insignificant reductions were observed for the number of inflamed joints and CRP.

34. **Nair et al., (2023)** explored the effectiveness of a 10-day all-inclusive yoga & naturopathy-based lifestyle intervention model (HOPE-YN) in improving

musculoskeletal health, vitality, and strength, flexibility, pain, and treatment satisfaction among MSD patients. The study involved 57 participants aged 29-65, who underwent the program, which included diet, yoga, massage, and holistic consultations. Results showed significant improvement in MSK-HQ, health, vitality, pain, STS, and TUG scores. Treatment satisfaction was associated with developments in energy, TUG, and STS marks. The study suggests the HOPE-YN program may recover devotion to lifestyle programs.

35. **Pandya (2020)** aimed to explore the effects of yoga, an anti-inflammatory diet, and self-monitoring on children with chronic rheumatic diseases. 22 children aged over 8 years were divided into two groups: experimental and control. Participants were advised monthly follow-ups for the next four months. The experimental group received yoga training, a 45-minute daily home practice, and a strict diet chart. The study found that yoga, an anti-inflammatory diet, and self-monitoring significantly improved children's health.

36. **Ebnezar et al., (2012)** showed a study involving 150 participants with knee osteoarthritis (OA) and found that integrated yoga therapy, which included yogic loosening and strengthening practices, asanas, relaxation, pranayama, and meditation, was more effective than physiotherapy exercises in reducing pain, morning stiffness, state and trait anxiety, blood pressure, and pulse rate in patients with OA knees. The yoga group showed better reductions in resting pain, morning stiffness, state and trait anxiety, blood pressure, and pulse rate compared to the control group. The integrated approach of yoga therapy was found to be more effective than physiotherapy exercises.

37. **Evans et al. (2013)** intended to evaluate the impact of a 6-week Iyengar yoga program on the health-related quality of life (HRQoL) of young adults with rheumatoid arthritis (RA). The program, designed to improve pain, disability, and psychological functioning, showed significant improvement in HRQoL, pain disability, general health, mood, fatigue, acceptance of chronic pain, and self-efficacy. The study concluded that a brief Iyengar yoga intervention is a feasible and safe adjunctive treatment for young people with RA, leading to improved HRQoL, pain disability, fatigue, and mood.

38. **Trivedi & Mishra (2014)** compared traditional Indian Yoga as a unified mind-body healing approach for fibromyalgia treatment found that it significantly improved the FM Impact Questionnaire (FIQ) score and other secondary outcomes. The study involved 50 patients and a control group, with the yoga group receiving 60-minute group sessions three times a week. The results showed that the yoga group had sustained and durable benefits in FIQ score quality of sleep and quality of life after a year. The study concluded that Classical Indian Yoga is highly effective in managing fibromyalgia.

39. **Kumar (2014)** studied on 50 arthritis patients and found that a Yogic intervention significantly decreased uric acid levels. The experimental group underwent a three-month Yogic training program, resulting in improved immunity and endurance capacity. This suggests that a comprehensive Yoga therapy program can enhance the benefits of standard medical management of arthritis and serve as an effective complementary or integrative therapy.

40. **Manik (2017)** designed a study for check the consequence of yogic practices on lumber spondylitis. The study conducted at AIIMS Bhubaneswar with 172 patients, age range 21-29 years. They were engaged with selected yoga practices consisted of Pawanmuktasana series (loosening and stretching) asana, pranayama and relaxation technique of yoga nidra. The results of the study observed that yoga therapy is instant receive practice group, short term group and long term practice group was significant differences found and better effect on long term practice group. The study concluded that yoga therapy has got the better result of pain in lumber spondylitis.

41. **Singh et al. (2011)** considered an objective in a study to find out the influence of yogic package on rheumatoid arthritis. Total eighty subjects were randomly selected for the study and they received a given protocol of yogic practices for one and half hours daily for 7 weeks. The following parameters were evaluated –pain intensity, inflammation, stiffness, pulse rate, blood pressure, lymphocyte count, C- reactive protein, serum uric acid. The study observed that statistically significant passive effect of yogic practices on all selected RA parameters.

42. **Shete et al. (2017)** examined to see how yoga practices affected the lipid profile, high-sensitivity-C-reactive protein (hs-CRP), interleukin (IL)-6, and tumor necrosis factor (TNF)-α in adult who appeared healthy but were exposed to work-related risks.

Two groups of 48 participants with occupational hazards, ages ranging from 30-58 years (41.5 ± 5.2), were randomly assigned. For three months, the experimental group received one hour of yoga instruction six days a week. Highly significant changes in cholesterol ($P < 0.001$), high-density lipoprotein ($P < 0.001$), low-density lipoprotein (LDL) ($P < 0.01$), hs-CRP ($P < 0.01$), IL-6 ($P < 0.001$), and TNF-α ($P < 0.001$) were found in the experimental group according to the results of the within-group comparison. Significant differences were found in cholesterol ($P < 0.01$), LDL ($P < 0.05$), IL-6 ($P < 0.01$), TNF-α ($P < 0.01$), and hs-CRP ($P < 0.01$) when the experimental and control groups were compared.

43. **Pitchai et al., (2020)** investigated the effectiveness of yoga in managing adhesive capsulitis, a multidimensional disability. The study involved 40 participants aged 35-60, divided into two groups: yogasana (yogasana) and physiotherapy (physiotherapy). Pain, joint mobility, and functional disabilities were measured at baseline and after four weeks. Results showed significant improvement in pain, joint mobility, and functional disabilities in both groups. Yogasana was found to be statistically significant in improving shoulder abduction mobility, shoulder flexion, and shoulder internal rotation, though not statistically significant due to small effect size response. Both techniques improved functional status in adhesive capsulitis.

44. **Ebnezar et al., (2011)** evaluated the effectiveness of incorporating integrated yoga therapy into therapeutic exercises for knee joint osteoarthritis (OA). Participants aged 35-80 years were randomly assigned to receive yoga or physiotherapy exercises (intervention (40 minutes per day) for 2 weeks (6 days per week), with follow-up for 3 months) after transcutaneous electrical stimulation and ultrasound treatment. Both groups practiced supervised. The yoga group showed better results on the Short Form-36, both at 15th and 90th days. The study concluded that an integrated yoga therapy approach is more effective than therapeutic exercises in improving knee disability and quality of life in OA patients.

45. **Deepeshwar et al. (2018)** aimed to inspect the effect of integrated yoga therapy (IAYT) on individuals with knee osteoarthritis. The participants were divided into two groups: yoga group (31 participants) and control group (35 participants). Results showed significant reductions in TUG, right and left flexion, and improvements in LHGS and right extension from baseline in yoga group. This suggests improved muscular strength, flexibility, and functional mobility.

46. **Sugumar (2018)** examined the management of kundalini yoga practices on patients with cervical vertebral ankloysis. In this study 40 patients form the two groups, among of them 20 patients received kundalini Kriya yoga for 6 days in week for 3 months. Both groups were completed questionnaires using visual analogue scale for measuring pain severity. The consequence of the work shows that kundalini Kriya yoga group significantly changes in visual analogue score than the control group.

### 2.1.4 Studies of Yoga in others related disorders

47. **Wolff et al. (2013)** examined how yoga therapies affected patients' quality of life and blood pressure in cases of hypertension. The 83 individuals in the study ranged in age from 20 to 80. Three groups of participants were created: one for an instructor-led yoga session, one for at-home yoga, and one for control. The yoga class group did not experience any change in their self-rated quality of life or blood pressure after 12 weeks. On the other hand, diastolic blood pressure decreased and self-rated quality of life significantly improved in the yoga at home group. According to the study, yoga poses can be utilized in primary care as an additional blood pressure treatment.

48. **Bahçecioğlu Turan & Tan, (2020)** examined the impact of yoga on asthma patients' respiratory functions, symptom control, and quality of life. It involved 112 patients, with 56 in the experimental group and 56 in the control group. Results showed a statistically significant difference in respiratory function and symptom control scores between the experimental and control groups. Yoga positively influenced these aspects.

49. **Vadiraja et al. (2009)** associated the influence of a cohesive yoga program with brief supportive therapy in breast cancer outpatients undergoing adjuvant radiotherapy. Eighty-eight stage II and III outpatients were randomly assigned to receive yoga or brief supportive therapy. The intervention consisted of 60-minute daily yoga sessions, while the control group received supportive therapy once in 10 days. Assessments included EORTCQoL C30 functional scales and PANAS. Results showed significant improvement in positive affect, emotional function, and cognitive function, and a decrease in negative affect.

50. **Bieber et al. (2021)** investigated the effect of a 3-month physical yoga intervention on patients with major depressive disorder (MDD). The intervention group received vigorous Ashtanga-Yoga three times a week, while the waiting-list control group

received treatment as usual. Depression scores, positive and negative effects, and remission rates were tested. Results showed an improvement in BDI-II scores for both groups over time, with positive affects improving over time. Remission rates showed a significant improvement in the yoga group compared to the control group. The study suggests a trendsetting additive effect of Ashtanga-Yoga on psychopathology and mood, with greater improvement at the beginning of the intervention.

51. **Cheung et al. (2018)** investigated the feasibility and acceptability of Hatha yoga for Parkinson's disease (PD) patients. The program, which included weekly 60-minute group classes, was implemented for 12 weeks. Results showed no significant differences in blood oxidative stress markers between the two groups. Motor function was better in the treatment group, but sleep and outlook in PDQUALIF were worse. The study found that health problems were the main barrier to yoga practice. The study concluded that yoga is feasible and acceptable for improving motor function in PD, but further research is needed to determine its impact on oxidative stress and non-motor symptoms.

52. **Ankolekar et al. (2019)** intended to evaluate the properties of yoga on controlling blood pressure in pre-hypertensive individuals in India. Security personnel were divided into control and intervention groups, with the intervention group trained in yoga. Results showed a decrease in weight and blood pressure but no statistically significant difference. However, the intervention group showed a significant improvement in self-rated quality of life. Yogasanasa and meditation could potentially improve quality of life and control blood pressure in pre-hypertensive individuals.

53. **Keerthi (2017)** conducted a randomized control trial to determine the effect of yoga therapy on Quality of Life (QoL) and Indian Diabetes Risk Score (IDRS) in normotensive prediabetic and diabetic young Indian adults. The study involved 310 participants aged 18-45 years, divided into healthy controls, prediabetics, and diabetics. Results showed significant improvement in QoL scale and reduction in IDRS in all groups. Yoga therapy combined with standard treatment for 12 weeks improved QoL and attenuated diabetes risk in Indian prediabetics and diabetics compared to standard treatment alone.

54. **Brämberg et al., (2017)** evaluated the effects of yoga on sickness absenteeism among a working population found that kundalini yoga and strength training did not

significantly reduce sickness absenteeism compared to evidence-based advice. However, those who practiced yoga or strength training at least two times a week significantly reduced sickness absenteeism. The study suggests that methods to increase adherence to treatment recommendations should be developed and applied in exercise interventions to improve the overall health outcomes of the working population.

55. **Monson et al., (2017)** explored the effect of two weekly yoga sessions on musculoskeletal pain in dental hygiene students. A sample of 77 students was divided into treatment and control groups. The yoga group participated in 60-minute sessions for 13 weeks, while the control group did not. The results showed a significant decrease in musculoskeletal pain in the yoga group, while the control group did not. The study supports the practice of yoga as a complementary health approach to improve the health and longevity of dental hygiene careers.

56. **Hartfiel et al. (2017)** evaluated the cost-effectiveness of yoga for managing musculoskeletal conditions in NHS employees. Results showed that yoga improved HRQL, reduced disability associated with back pain, and reduced sickness absence due to musculoskeletal conditions. The incremental cost per quality-adjusted life year (QALY) was £2103 per QALY, with a 95% probability of being cost-effective. Yoga was the dominant treatment compared to usual care, with participants missing only 2 working days due to musculoskeletal conditions.

57. **Joshi & Bellad (2011)** evaluated the effectiveness of yoga in improving symptoms of upper limb musculoskeletal disorders (MSDs) in computer users. 60 participants were divided into yoga with counselling and counselling groups for 12 weeks. Results showed a significant reduction in symptom severity and functional status scores, decreased self-reported symptoms, and improved weakness in yoga with counselling group.

58. **Metri et al. (2023)** intended to explore the effects of workplace yoga on musculoskeletal pain, anxiety, depression, sleep, and quality of life among female teachers with chronic musculoskeletal pain. The participants were divided into a yoga group and a control group. The yoga group showed a significant reduction in pain intensity and disability, as well as improvements in anxiety, depression, stress, sleep,

and fatigue. The study recommends yoga for preventing work-related health issues and promoting wellbeing among teachers.

59. **Mirzaei et al. (2021)** investigated the consequence of yoga on chronic musculoskeletal pain in elderly females in Rafsanjan, Iran. The intervention group received three weekly yoga sessions for eight weeks, while the control group did not receive any special intervention. Results showed that the intervention group experienced a decrease in pain at the end of the fourth and eighth weeks, suggesting that yoga exercises could be a complementary method for pain control.

60. **Yurtkuran et al. (2007)** directed a study in 2004; found that a yoga-based exercise program significantly improved pain, fatigue, sleep disturbance, and biochemical markers in hemodialysis patients. The program, which involved 30 minutes of yoga twice a week for three months, was found to be more effective than the control group for all variables except calcium, phosphorus, HDL-cholesterol, and triglyceride levels. The study concluded that a simplified yoga-based rehabilitation program is a safe and effective treatment modality for end-stage renal disease patients.

61. **Liu et al. (2021)** examined the bodily stresses of yoga posture, focusing on the electromyogram and joint movements of force (JMOFs) of inferior extremes. Eleven yoga instructors performed five poses: Chair, Tree, Warrior 1, 2, and 3. Results showed significant differences in hip, knee, and ankle JMOFs and muscle activation. Chair pose had the highest muscle activation, while Warrior 2 had the highest in the vastus lateralis. Warrior 3 was suggested for hamstring rehabilitation, while Tree pose was useful for beginners with insufficient stability. The study highlights the importance of proper exercise planning for musculoskeletal rehabilitation.

62. **Curtis et al. (2017)** assessed the influence of a specialized yoga practice on pain, psychological, and mindfulness variables in individuals with spinal cord injuries (SCI). The study involved 23 participants, randomized to either Iyengar yoga (IY) group or a 6-week wait-list control (WLC) group. Results showed that the IY group had lower depression scores and higher self-compassion scores compared to the WLC group. The intervention reduced depressive symptoms, increased self-compassion, and fostered greater mindfulness.

63. **Schmid et al. (2019**) aimed to assess the assistances of yoga for long-lasting pain patients. Participants were randomized to yoga or usual care, and the primary outcome

was the Brief Pain Inventory (BPI). Results showed significant improvements in multiple measures, including decreased BPI interference scores, body responsiveness, and pain management scores. Yoga appeared feasible and positively influenced outcomes.

64. **Lazaridou et al. (2019)** studied on women with Fibromyalgia (FM) and found that daily yoga practice can reduce symptoms, improve mood, sleep, and self-confidence. Participants reported reductions in pain and stress, as well as positive impacts on mood, sleep, and self-confidence. The study also identified barriers to yoga practice, such as physical/body perceptual changes, practices affecting pain, emotional changes, practice motivators and barriers, and the importance of social connection with other FM patients.

65. **Allsop et al. (2022)** mentioned the 2 arm random comparative effectiveness trial in which troupers with fibromyalgia taken part, namely pain outcomes associating yoga vs. organised exercise. One 12-week yoga-based program or an organized workout regimen was assigned at random to the participants. The degree of fibromyalgia as a whole was the main objective; other secondary outcomes were self-efficacy, feelings of pain, exhaustion, sleep, and sadness and anxiety. Both patients with fibromyalgia and professionals seeking novel treatment options are the goals of this experiment.

### 2.1.5 Studies of Exercise in Ankylosing Spondylitis

66. **Ince et al. (2006)** inspected the outcomes of twelve weeks multimodal exercise regimen in individuals with AS. The study included a convenience sample of thirty AS patients (18 males and 12 females), whose mean age was 34.9 years (SD=6.28). Controlled trial conducted at random. For three months, the exercise regimen comprised three sessions of 50 minutes each of multimodal exercise, which included aerobic, stretching, and pulmonary activities. Patients with AS were treated medically in both groups; however, the exercise group additionally got the exercise program. At the conclusion of the three-month exercise program, the control group's spinal motions had not changed considerably, whereas the exercise groups had improved significantly.

67. **Botsolou et al. (2018)** aimed to found out to contribution of physiotherapy and medication to the AS patient’s pain relief and functional ability. Forty five AS patients selected from Greece, age ranged 19-85 years old. EQ-5D-3L, BASDAI and

BASFI questions were used. Result of the study shows that mean value of BASDAI score of that group not received any kind of physiotherapy and medication was 4.36 and in BASFI score 4.80. The mean value of functional ability without medication and no physiotherapy appears lower in group physiotherapy plus medication but statically not significant. In case of anxiety 21.4% underwent physiotherapy with medication and 58.3% with moderate anxiety. They concluded that patients with AS often report to medication in combination with physical therapy at the time of mild mobility problem. Physical therapy seems to help improve quality of life those patients.

68. **Adshead et al. (2015)** examined the different combined care pathway on inflammatory back pain patients. The study primarily stress on education programme and secondary care of local; community management by physiotherapy, exercise on low back pain patient. Total 222 patients, over 5 years of disease duration traded for 6 months for early inflammatory back pain service (EIBPS). EIBPS is combined programme of medical management with TNF-alpha inhibitors, NSAIDs, physiotherapy, exercises, educational campaign, care of local community. These non –drugs therapies are most cost effective and positive pathway for management of low back pain.

69. **Rosu et al.(2014)** aimed to find out effectiveness multimodal exercise programme and specific pulmonary function training technique of Mc. kenzie and Heekcher on AS patient's functional and disease activity. Total 96 patients divided into two groups. One considered as treatment group and received 50 minutes daily combined exercise programme and pulmonary training 3 times/week for 48 weeks. Other group received only classical kinetic programme. Result of study shows that after 48 weeks of training significant improvement was found in pain, lumber spine mobility, BASFI, BASDAI, BASMI scores and chest expansion and figure flex distance variables in AS patient of treatments group. But no significance difference found in vital capacity. The study concluded that multimodal training, combining Pilates, Mckenzie & Heckscher exercises should be included in the routine management of patients with AS for better control of function, disease activity and pulmonary function.

70. **Jung et al. (2019)** done a case history on 32 years old male patients with AS who were underwent a composite model of therapy by Dahn Taekwondo Spondylitis improvement programme (DTSIP) which is a standard western medicine practice and

complementary and alternative medicine exercise based on yoga and taekwondo. The subject perform said exercise model for 5 times per week for 90 minutes for 28 weeks. The result exhibited that blood CRP, ESR; platelet decreased 29.7% from initial to post exercise. Decreased blood leukocyte count decreased by 11%, BASMI, tragus to wall pass, lumber side flexion, lumber flexion and inter malleolar distance (IMD) were improved.

71. **Plassalent et al. (2010)** studied on determining the kind and degree of exercise utilized by AS content based and participants' perception of workout. An exercise inventory questionnaire and exercise benefits and barriers (EBBS) were employed to 61 patients with AS. Higher benefits score range (29-116) indicates more passive perception of exercise and barriers range (14-56) in perception to exercise. Mean age of the subject 38 years and disease age 14.7 years. They were continued their exercise by walking and stretching 3 times per week. The result of the study shows that EBBS score 87.1 and reported increment of benefits and cardiovascular system and barriers score 29.2 reported to barrier of exercise was that it trainees due to exercise.

72. **Subhramanian (2017)** conducted long initial case study on a patient with AS. The main of the study to find out effectiveness of physioball based on exercises in contribution of yoga and gravity. After 1 year yoga follow up subjects BASDAI score reduce near by 32 % (62-42). The study concluded that specific physioball (swiss ball) is improved the mobility of motor power and better posture by maintaining balance on peripheral joints and enhanced quality of life.

73. **Husakova et al. (2017)** studied on intensive exercise for axial spondyloarthritis (axSpA) patients and quality of life of those patients. Total 46 patients were involved in the study the subjects were divided into 2 groups -non-radiographic axial spondyloarthritis and AS patients. In the study out of 46 patients, 23 people received exercise 60 minutes, twice in week and daily home based exercise done up to 24 weeks, The result of the study shows that significant improvement in ASDAS-CRP, but no differences shows in ASDAS-CRP and BASDAI between two groups. In view of assessment of pain during the last 7 days improved of for non-radiographic axial spondyloarthritis patients in global assessment but AS patients quality of life was not changed after the interventions. But the European quality of life was changed in all axSpA but significantly improved only non-radiographic axial spondyloarthritis subgroup but not in AS. The study concluded that intensive exercises give a beneficial

effect on disease activity and patients self-reported outcomes in both subtypes of axSpA.

74. **Oksuz et al. (2018)** Investigated on the properties of dissimilar workout process on useful studies and endure capacity in patients with AS. Total 31 patients appointed as per arrival. Two groups were formed -1-16 group–I and 17-31 group–II. Group-I received aerobic training and clinical Pilates exercise and group –II received only aerobic training. They engaged in exercises for 8 weeks, 3 days per week under supervision of expert physiotherapist. The result of the study found that disease activity level, respiratory muscles strength was significantly improved in both groups. Those were taken both clinical Pilates and aerobic exercise training significantly improved in BASMI score, upper extremities flexibility, forced vital capacity , fatigue severity and sleep quality of AS patients.

75. **Ayhan (2011)** studied on long term effects of comprehensive inpatients rehabilitations on function and disease activity in patients with chronic RA and AS. The model of inpatients rehabilitations (IRM) provided by the physiatrist, physical therapist, rehabilitation house and clinical psychologist. Total 120 subjects with RA and AS mean age 51 years, those are not practiced any kind of physical therapy for last 2 years. Two groups were formed from 120 subjects, 60 of them RA and 60 AS patients. The data were recorded at baseline and 15 months later. The measured elements were Disease Activity Score (DAS 28), Health Assessment Questionnaire (HAQ) for RA patients, BASDAI and BASFI questionnaire for AS patients. The subject's disease duration 8.5 years in case of RA patients and 8.7 years in AS patients. DAS 28, HAQ scores were better in IRM group than Home Exercise Model (HEM) group. The study concluded that rehabilitation care was useful for patients with RA in contrast to patients with AS. It is totally opposed to the drug therapy.

76. **Karhan et al. (2016)** studied on the effects of exergames on pain, disease activity, functional capacity and quality of life in patients with AS. Exergames is a type of virtual body movement game based on technology and promotes on active lifestyle. Total 60 patients involved, 30 for experiment and 30 for control. The exergames was given to patients 5 times in a week for 8 weeks (40 sessions). VAS, BASDAI, BASFI and ASQOL were measured as variables. Result of the study exhibit that significant improvement in all the parameters.

77. **Lee et al. (2008**) investigated the effects of tai-chi on disease activity, flexibility and depression in patients with ankylosing spondylitis. Twenty patients were allocated for treatment and twenty for no treatment. The treatment continues up to 8 weeks twice per week for 60 minutes per day of home based tai-chi. All outcomes of diseases activity and flexibility significantly improved in compare to those were not taken any kind of treatment. The finding of the study suggested that tai-chi can improve disease activity and flexibility in patients with ankylosing spondylitis.

78. **Altan et al. (2012)** investigated to effects of pilates training on pain, functional status and quality of life in patients with AS. The study was randomized controlled and single blind trail. Total 55 patients enrolled in rheumatology clinic in network. They were assigned into two groups. Groups -1, 30 patients received pilates exercise programs for 1 hour per day 3 times in a week for 12 weeks. And group -2 25 patients continued standard treatment programmes. The data were recorded at baseline-12 weeks and follow up for another 12 weeks (at 24 weeks from baseline). The evacuation was done by using BASFI, BASDAI, BASMI and ASQOL questionnaire. The result of the study shows that in group -1, BASFI at 12 weeks (p=0.031) and at week 24 (p=0.007) significant improvement than group -2. In case of BASMI at week 12(p=0.005), BASDAI (p=0.036), chest expansion (0.002) in also statically significant. But in case of ASQOL no significance difference was found (p=0.920). At 24 week for BASMI significant improved compare to baseline. (p=0.009) in group -1, worsening for BASDAI in group-2 while no significant changes for other parameters. In comparison of the group 1 and group 2 both post treatment (12 & 24 week) percent changes and differences scores relative to pretreatment values found significant difference for BASDAI at week 12 (p=0.003) and BASMI at week 24 (p= 0.013) in favour of group 1. They suggested that pilates exercises an effective and safe method to improve physical capacity in AS patients.

79. **Ghosh and Mondal (2019)** performed a RCT based experiment to evaluate the effect on physical function and reduction in spinal pain after a supervised rehabilitation programme in patients with Ax-spA, at baseline and 3 months. The study was done at department of physical medicine and rehabilitation, R.G Kar medical college, Kolkata. Total 63 patients with Ax-spA, age ranged 18-45 years and randomly allocated into two groups. One group continued with SRP protocol activities and other group was for control. The control group put on home exercise programme for 3

months. The SRP protocol was based on exercise with supervision thrice in week, life style modification, counseling, joint protection technique, energy conservation technique, environmental modification, cognitive behavioral therapy and physical modalities for pain management. Physical function was measured by BASFI questionnaire and spinal pain was measured by numeric rating scale. The result of the study shows that after 3 months BASFI improved significantly in both groups, whereas intergroup analysis shows that BASFI ($P<0.001$) spinal pain (0.001) significant improvement in the intervention group compare to the control group.

80. **Tricas-Moreno et al. (2016)** done a case study to find out the effect a physical therapy approach in a young football player with AS. The patient's refectory to treatment with anti-inflammatory medication, lumber pain & joint, muscles and functional disorder. The patients treated with orthopedic joint mobilization, dry needles, exercise protocol was 3 day per week for 1 hour for each session, including aerobic training on treadmill, strength training and stretching exercises. Along with patients start with 1 day per week of day sauna bath for 10 minutes after physical activity. The study concluded that the combined mode of physical therapy promoted the remissions of the AS diseases of the young footballer.

81. **Costa et al. (2004)** studied on mental health status, fatigue severity, disease related variables and leisure time physical activity in patients with Spondyloarthritis. Total sixty six patients fulfilled their response by BASDAI, BASFI and Health related quality of life (SF-36). The results of the study exhibits that BASDAI fatigue mean score was 5.5. Disease activity functional ability and worse mental health contributed to greater fatigue ($R^2=0.56$). The relationship between exercise duration and fatigue intensity was moderated by mental health status. For patients with poorer mental health score did not influence fatigue severity. The study concluded that integrative regular leisure physical activity into comprehensive treatment of Spondyloarthritis may be useful for modulating fatigue.

82. **Souza et al. (2017)** done an experiment on progressive strength training by using swiss ball to AS patients. They evaluated one replication maximum test (1RM), BASMI, BASFI and HAQ-S, SF-36, 6 minutes' walk test, BASDAI, ASDAS, ESR, CRP parametrs at baseline and 4, 8, 12 and 16 weeks after. Total 60 patients divided into two groups. Intervention group performed eight exercises with swiss ball for 16 weeks. The statistical results of the study shows that strength (1RM) $p<0.005$, 6

minutes' walk p<0.001, these are better results for the intervention group. But no significance differences were found in BASFI, HAQ, BASMI, SF-36, TUG, ASDSAS, ESR, CRP parameters. They concluded that progressive strength training by using swiss ball is effective for improving muscles strength and walking performance of AS patients.

83. **Altan et al. (2006)** compared the balenotherapy and exercise therapy for developing physical function and quality of life of AS patients. Total 60 patients selected for the study. Among of them 30 patients received balenotherapy in a therapeutic pool for 30 minutes and general exercise once a day for 3 weeks. Rest of 30 patients continued only exercise therapy for 3 weeks. The patients were evaluated at before starting the experiment then 3 weeks and 24 weeks later. The evaluation parameters were BASDAI, BASFI, DFI, tragus-wall distance, chest expansion, modified schobber tests finger trip head distance and Nottingham health profile (NHP). Fifty four patients completed these protocol as per scheduled. Comparisons of the groups showed significantly superior results for the balenotherapy group in all parameters. BASDAI, NHP, BASFI, DFI, MST, TWD, CE at 3 weeks. But the comparisons on the basis of post treatment in global evaluation and MST significant at 24 weeks. According to the study's findings, balenotherapy improves disease activity and functional measures in AS patients right away following treatment.

84. **Analay et al. (2003)** experimented on intensive group of exercise on patients with AS. It is double blind study and fifty one patients randomly allocated into two groups. The study conducted at Istanbul medical department. Group 1 or experimental group practiced intensive exercise with normal education programme under supervision of physiotherapist for six week. And the control group taken education programmes and practice exercises at home. The main outcome measures were-visual analogue scale for pain, Beck Depression scale and BASFI. The results shows that positive changes in patients under taking group exercise at six week and three month after treatment in favor of group 1 or experimental group. They concluded that précised intensive exercises is better than home based exercise at reducing impairment associated with AS.

85. **Oskay et al. (2018)** evaluated the consequence of pilates exercise on kinesiophobia, disease activity, functional status and quality of life in patient with AS. Total 21 patients received modified Pilates training for 6 weeks. The age of the patients 46.6+-

11.8 years old and disease duration was 68 months. After 6 weeks of modified Pilates training mobility, disease activity and functional scores improved (p=<0.05) and also quality of life, depression and kinesphobia levels showed significant improvement in those patients.

86. **Karapolat et al. (2009)** compared the influence of conventional workout and swimming and walling on pulmonary function, aerobic capacity, quality of life, Bath indexes and psychological symptoms of AS patients. Total 3 groups were formed with 15 patients in each group. Group 1 performed conventional exercise and swimming. Group 2 performed conventional exercise with walking and group 3 performed only conventional exercises. The results of the study exhibit that there were significant increases in Pvo2 and 6 MWT after treatment in groups 1 and 2 (p=<0.05). Forced expiration volume in one second (FEV1,ml), forced vital capacity (FVC) AND vital capacity improved in all three groups. Along with statistical improvement was observed in energy, emotional, recreational and physical mobility sub scores in three exercise groups after completion of the exercise programme (p<0.05). The study concluded that swimming, walking and conventional exercise beneficial effects on the quality of life, pulmonary function and functional capacity of AS patient.

87. **Hsieh et al. (2014)** intended to find the influence of house hold based exercise in compare to range of motion home exercise (ROM) in patients with AS. Nineteen patients divided in to two groups. One group completed programme included range of motion, strengthening and aerobic exercises with 9 subjects. And other group performed by ROM programme consists of daily range of motion exercise only. The subjects followed the exercises instruction for 3 months. The assessments included in this study were cardiopulmonary test, pulmonary function test, spinal mobility measurement, chest expansion, BASFI test. After exercise, the combination group showed significant improvement in peak oxygen (p=0.008). BASFI (p=0.028) in compare to ROM group. Significant improvement in finger to floor distance after 3 months exercise was found only combination group (p=0.033). The study concluded that combined home exercise is more effective than range of motion home exercise alone in aerobic capacity and functional ability.

88. **Niedermann et al. (2013)** studied on perceived consequence of cardiovascular working out on fitness and perceived disease activity in people with AS. Two groups were formed for experiment. The experiment group performed 3 cardiovascular

training units per week and weekly usual care of flexibility training. Control group contained regular discussion on coping strategies. The physical fitness was measured by sub-maximal bicycle test. All analysis controlled for sex, age, body mass index, physical activity level and BASDAI questionnaire. The training group reported exercising at least 3 times per week at the 3 month followed up. The fitness level in the training group was significantly higher in the control group (p=0.001). The mean BASDAI score was 0.31 points lower (p=0.31) in the training group, reaching significance for the peripheral pain sub score (p=0.01) but not for the back pain or fatigue.

89. **Buize et al. (2019)** studied on the effect of breathing exercises, cold exposure and meditation in patient with axial spondyloarthritis. The study was randomized, one way crossover clinical part of concept trail. Twenty four patients with moderately active axpa (ASDAS >201) & hs CRP-I 5 mg/ml were included and 13 patients selected for intervention for 8 weeks serum calprotectin levels ESR over the BASDAI and quality of life (SF-36) and Hospital anxiety and depression (HADS) were assessed before and after 8 weeks of intervention. The study result reported that ESR significantly decline in group (p=0.040) and control group 0.406. ASDAS-CRP declined from 3.1 to 2.3 in the intervention group. And also similar trend was observed for serum calprotectin (p=0.064) in intervention group and control group (p=0.182) but not for hsCRP but statistically not significant. The study concluded that significant decrease in ESR levels and ASDAS-CRP upon add-on training programme (breathing exercise, cold exposure & meditation in Axial Spondyloarthritis (AxSpA) patients**.**

90. **Passalent et al. (2010)** conducted a cohort study to look at how much and what kind of exercise people with ankylosing spondylitis (AS) did, as well as how the patients felt about it. Exercise is cited as the main component of complete management in AS management recommendations. Patients were given the Exercise Benefits and Barriers Scale (EBBS) and an exercise inventory questionnaire. The questionnaires were completed by sixty-one AS patients. The mean duration of the condition was 14.7 years, and the mean age was 38.0 years. The most often reported forms of exercise were walking (twice per week) and stretching (twice per week), with reports of 35.0% and 32.8%, respectively. Exercise is beneficial to patients with AS, as evidenced by average EBBS benefits ratings that are comparable to those of historical

controls with related disorders.

91. **Silva et al. (2012)** evaluated the effects of global posture reeducation and compare to conventional self-stretching and breathing exercise of AS patients. Total 38 patients enrolled in the group. Twenty two patients engaged with GPR programme (position that stretched the shortened muscle chains). Control group engaged with conventional exercise programme. Both group continued the exercise programme for 4 months. The result of the study showed that statistically significant improvement in morning stiffness (p=0.013), spine mobility parameters, except finger, floor distance (p=0.118) in chest expansion (p=0.028) and in the physical aspect component of the SF-36 (p=0.001). The study conducted that the individual treatment with GPR seems to be have better clinical outcomes than group treatment with conventional segmental self-stretching and breathing exercise for AS patients.

92. **Taspinar et al. (2015)** evaluated the impact of calisthenics exercises on psychological status in patients with AS and multiple sclerosis (MS). Total 40 patients for each disease divided into two equal groups of 20 patients. Group 1 taken hospital base calisthenics exercise programme and group 2 done home based exercise programme. After 8 week completion in the AS patients, home-base exercise group showed significant improvements in ESR. The hospital based exercise group showed significant improvement in BASMI scores, Hospital anxiety and depression scale – anxiety (HADS-A) scores. In MS patients both exercise group showed significant improvement in 10 minutes walking test, Berg Balance Scale (BBS), HADS-A, MS international quality of life scores. The study concluded that positive effect of exercise on rheumatic chronic inflammatory (AS) and neurologic (MS) processes also associated with disability.

93. **Edavath (2010**) studied on a single case report on ayurvedic treatment of AS. From the ayurvedic prespective, they viwed and treat of ‘Amavata’ which may effectively managed when intervention is started in early stages of diseases. Niruhu Bam with Balaguduchyadi yoga (a form of ayurvedic medicine) combined by Shamana treatment with Rasnerandadi Kwatha and Simhanda guggulu have been found effective for reduce of pain and disease activity of AS patients.

94. **Nath et al. (2023)** focused on non-drug and drug therapies for the treatment of AS. Uncertainty surrounds the etiology of AS; early inflammatory processes and

ossification cause local osteitis. It raises morbidity and mortality, which affects patients' quality of life. One of the best indicators for AS diagnosis is HLA-B27. The assessment of disease activity and evaluation of therapy efficacy are done using CRP and ESR. NSAIDs and DMARDs, for example, are ineffective on their own in managing disease symptoms and signs. However, when paired with physical therapy, patients' quality of life significantly improves. The development of biologics that block important inflammatory cytokines like TNF inhibitors has significantly improved the prognosis for AS patients. When combined with other pain relievers, biologics help stop the progression of the disease.

95. **Adamopoulos (2002)** interested to look into how exercise affected patients with chronic heart failure (CHF) in terms of circulating proinflammatory cytokines and the soluble apoptotic mediators Fas (sFas) and Fas ligand (sFasL). Twenty-four stable congestive heart failure patients had their plasma levels of tumor necrosis factor-alpha (TNF-alpha), soluble TNF receptors I and II (sTNF-RI and sTNF-RII, respectively), interleukin-6 (IL-6), soluble IL-6 receptor (sIL-6R), sFas, and sFasL evaluated. In patients with CHF, physical training resulted in a significant increase in VO2max $p < 0.001$) and a significant decrease in plasma levels of TNF-alpha $p < 0.001$), sTNF-RI $p < 0.005$), sTNF-RII $p = 0.06$), IL-$p < 0.005$), sIL-6R ($p < 0.01$), sFas $p = 0.05$), and sFasL $p < 0.05$). On the other hand, there was no discernible change in circulating cytokines and apoptotic markers in the control group following physical training.

96. **Xie et al. (2019)** assessed the efficiency and safety of Baduanjin qigong, a traditional Chinese exercise, for treating ankylosing spondylitis (AS). A pilot RCT showed that the 12-week Baduanjin qigong training group showed reduced fatigue, intensity, and duration of morning stiffness compared to the no-treatment group. Additionally, the exercise group exhibited higher patient global assessment scores.

97. **Wang et al. (2022)** investigated the loyalty, effectiveness, and security of a wearable technology-assisted combined home-based exercise program for patients with ankylosing spondylitis (AS). The research was conducted at the Chinese People's Liberation Army General Hospital, involving 77 patients who had no regular exercise habits and had been stable in drug treatment for the preceding month. The intervention group received moderate-intensity aerobic exercise and functional exercise, controlled by a Mio FUSE Heart Rate Monitor wristband. The primary outcome was the difference in the Ankylosing Spondylitis Disease Activity Score

(ASDAS). The study found significant differences in primary and secondary outcomes, with the intervention group showing less difficulty in ASAS HI-motivation. The study suggests that this technology-assisted combined home-based exercise program can improve the clinical outcomes of patients with AS without regular exercise habits, with good adherence and safety profile.

98. **van Tubergen et al. (2001)** studied among 120 Dutch patients with ankylosing spondylitis (AS) found that combined spa-exercise therapy, along with standard drug treatment and weekly group physical therapy, can improve functional ability, global well-being, pain, and morning stiffness. The study involved three groups: one treated in a spa resort in Bad Hofgastein, Austria, and the other in Arcen, Netherlands. The patients continued their usual drug treatment and group physical therapy for another 37 weeks. The results showed a significant time-effect and time-by-treatment interaction, with more improvement observed in group 1 compared to controls. The study suggests that a 3-week course of combined spa-exercise therapy, in addition to drug treatment and group physical therapy alone, can provide beneficial effects for at least 40 weeks.

99. **Marcu et al. (2020)** studied on the effectiveness of various therapeutic methods in improving the quality of life of patients with ankylosing spondylitis. A randomized, longitudinal, controlled trial was conducted on 92 patients over 6 years. The study found that the combination therapy group showed a moderately high association between functional status improvement and wellness increase. The combination therapy, which included etoricoxib, showed significant improvements in functional status and wellness scores. The study concluded that etoricoxib can facilitate the application of individualized exercise programs.

100. **Baglan-Yendur (2019)** aimed to investigate the effects of mobilization of sacroiliac joint with mechanical correction on pain (Mulligan concept) in patients with AS. It is a case study of two patients with sacroiliac joint (AS) showed that eight sessions of mulligan concept mobilization led to decreased pain, increased functional performance, and mobility in the first eight sessions, suggesting that this concept may be effective in improving pain, function, and mobility.

### 2.1.6 Studies of Yoga in Ankylosing Spondylitis:

101. **Singh et al. (2021)** studied the effectiveness of a 2 week controlled yoga practices on spinal suppleness in AS patients was evaluated in this retrospective study. A South Indian yoga center provided twenty-four (24) male AS patients, mean age 38.3 years who participated in a 2 weeks controlled yoga retreat 2015 to 2020. Yoga postures, breathing exercises, meditation, stable nourishment, and prayerful gatherings made up the yoga intervention. The heart rate, systolic blood pressure, and sit-and-reach test post-test scores were all shown to be considerably (P<.05) lower than the baseline. Within two weeks, there was a notable improvement in both the analgesic medication score and the symptom score.

102. **Singh et al. (2023)** did a study involving 120 AS patients and found that a three-month tele-yogic intervention significantly improved disease activity, functional index, inflammatory markers, quality of life, and mental health measures. The yoga intervention group showed significant improvement in BASDAI, anxiety, and depression compared to the control group. The study concluded that tele-yoga intervention is feasible and effective in treating AS.

103. **Singh et al. (2022)** developed a yoga module for AS patients, involving a three-stage process. Six yoga experts prepared a list of 64 practices, and 41 were included in the module. The modules were validated by 41 yoga experts with at least five years of experience. The final yoga module was administered to 19 AS patients, and the results showed the module is feasible, acceptable, and easy to practice. The study recommends following the module for 30 minutes daily under expert supervision.

104. **Sushma et al. (2022)** did a case study on fifty nine years old male patient suffering from AS with positive HLA-B27 for 40 years sought Ayurvedic treatment for relapse of pain, stiffness, fatigue, intermittent constipation and disturbed sleep. Ayurvedic diagnosis was Amavata. The patient was managed as outpatient for eleven days and hospitalised for thirty three days. Internal medicines and external therapies with diet modification, lifestyle adjustments, counselling, Yoga and IAM Technique (Integrated Amrita Meditation Technique) were administered during the hospital stay. At yearly follow up, C - reactive protein was reduced to 15.7 mg/L from the baseline value of 37.5 mg/L, and ESR from 103 Mm/h to 8 mm/h indicating reduction in inflammation. The dose of NSAID and DMARD (Disease Modifying Antirheumatic

Drug) could be reduced from once in twenty-four hours to once in eighty-four hours and steroids from twice daily to once in a week. There was significant reduction in pain and stiffness. Integration of Ayurveda and Yoga with conventional treatment can reduce drug dependence and improve quality of life in AS.

105. **Acar et al. (2022)** looked into how tele-yoga affected patients with ankylosing spondylitis disease activity, functional limitation, spine flexibility, quality of sleep, anxiety, stress, depression and overall wellness. This study reported on the basis of preliminary results. The study included 36 volunteer AS patients (15 female and 20 male) who applied to the Division of Rheumatology and Immunology, Department of Internal Medicine, Dokuz Eylül University. Using the block randomization method, participants were randomly assigned to either the waiting-list control group (n = 18, mean age 44.9 ±8.01 years) or the tele-yoga group (n=18, mean age 43.22±8.54 years). Patients in the tele-yoga group engaged in three days a week, for eight weeks, one-hour tele-yoga sessions with a maximum of five participants per group via Zoom, an online video-conference tool. Examinations were conducted both before and following an eight-week yoga program. The waiting list control group did not get any assistance; instead, participants were encouraged to carry on with their regular activities and prescription regimens. The Pittsburgh Sleep Quality Index (PSQI), the Short Form-36 (SF-36), the Hospital Anxiety and Depression Scale (HADS), the Perceived Stress Scale (PSS) inventory, the Bath AS Disease Activity Index (BASDAI) for disease activity, the Bath AS Functional Index (BASFI) for functionality, and the Bath AS Mobility Index (BASMI) for spinal mobility were all used. In the tele-yoga group, all measures showed substantial improvement ($p<0.05$) when compared to control group.

106. **Singh et al. (2022)** studied the case of an eighteen years old teenager who had AS for a year. The patient had followed the prescribed yoga regimen on a regular basis for three weeks. Pre- and post-assessment using x-rays and biochemical tests revealed that the patient's joint motions had improved, his pain had decreased, and his sleep quality had improved. It was discovered that the yoga intervention, which includes certain yogic sukshma vyayama, chosen yogasana, and pranayama along with a changed diet and way of life, was highly successful. According to the findings, these exercises significantly improved his spine mobility and returned his C-reactive protein (CRP) level to a normal range. The progress that was made both before and after yoga

sessions was also shown on the x-ray. It demonstrates that there was less lumber spine stiffness than previously, which also prevented patients from experiencing muscular spasms.

107. **Acar et al. (2023)** studied continuously, tele-yoga on physical efficiency, disease score, spinal suppleness, elasticity, muscles endurance, exercise capacity, balance, sleep quality, stress, depression, anxiety, quality of life, and mindfulness in patients with ankylosing spondylitis (AS). Sixty patients were randomly assigned to the tele-yoga group (TYG) or wait-list control group (CG). Results showed significant improvements in BASFI, disease activity, spinal mobility, flexibility, muscular endurance, balance, sleep quality, stress, depression, and QoL compared to the CG. Tele-yoga practice appears to be a safe and promising intervention for AS patients.

108. **Yu et al., (2020)** aimed to develop an online pain management program for ankylosing spondylitis patients, incorporating mindfulness-informed exercises and cognitive-behavioral therapy (CBT) elements. Thirty patients participated in a five-week program, which included breathing and body scanning exercises, mindful walking, positive thinking, and dysfunctional thinking management. Participants completed questionnaires and received instructions from a counseling psychologist. The results showed that the program improved sleep quality and reduced pain interference, but not significantly reduced pain intensity. Both male and female patients could benefit from the program. The study also identified challenges faced by local patients in practicing mindfulness-informed exercises.

109. **Buijze et al. (2019)** evaluated the safety and anti-inflammatory effects of an add-on training program involving breathing exercises, cold exposure, and meditation in patients with axial spondyloarthritis. The trial involved 24 patients with moderately active axial spondyloarthritis and hs-CRP ≥5mg/L. The intervention period lasted for 8 weeks, with no significant differences in adverse events between groups. However, during the 8-week intervention period, there was a significant decline in ESR levels and ASDAS-CRP in the intervention group. A similar trend was observed for serum calprotectin, but not for hs-CRP. The study concluded that the add-on training program met its primary endpoint with no safety signals, and there was a significant decrease in ESR levels and ASDAS-CRP in the intervention group. These findings suggest the need for full-scale randomized controlled trials of this novel therapeutic approach in patients with inflammatory conditions.

**Table no. 1: Reviews on Yoga in Ankylosing Spondylitis and Rheumatic Diseases**

| Year | Study Tittle | Author (s) | Participants | Intervention Duration | Findings |
|---|---|---|---|---|---|
| **2009** | 'Effect of Yogic Package on Rheumatoid Arthritis' | Bhandari & Singh | 80 (23-48 years) **Rheumatoid Arthritis** | 40day (90 minutes/ Each day day) | The most of inflammatory joints was not significantly ($p>0.05$) reduced Pain intensity, mean heart rate, blood pressure, serum uric acid, CRP, lymphocyte count, , and were all significantly reduced ($p<0.05$). |
| **2009** | 'The benefits of yoga for rheumatoid arthritis: results of a preliminary, structured 8-week program' | Badsha et al. | 47 (18 years) **Rheumatoid Arthritis** | 8 weeks (1 hour, 12 session) | HAQ scores and emotional health-related Quality of life (QOL) role restrictions) ($p<0.05$), Insignificant changes in Quality of life variables ($p>0.05$). |
| **2011** | 'Effect of an integrated approach of yoga therapy on quality of life in osteoarthritis of the knee joint: A randomized control study' | Ebnezar et al. | 235 (59.49 ± 10.10 years) **Osteoarthritis** | 2 weeks (40 minutes, 6 days/week), 3 months follow up | Short Form-36 significant in all domains ($p<0.05$). |
| **2011** | 'Now I see a brighter day": expectations and perceived benefits of an Iyengar yoga intervention for young patients with rheumatoid arthritis. Journal of yoga & physical therapy' | Evans et al. | 5 (28 years) **Rheumatoid Arthritis** | 6 weeks (90-min, 2/week) | Improvements were seen in wellbeing, range of motion, physiological awareness, acceptance, coping mechanisms, self-efficacy, and mindfulness. |
| **2012** | 'Efficacy of a short-term yoga-based lifestyle intervention in reducing stress and inflammation: preliminary results' | Yadav et al. | 86 (40.07±13.91 years) **Stress & Inflammation** | 10 days | Significant reductions in cortisol, β-endorphins, IL-6, and TNF-α were seen ($p<0.05$). |
| **2012** | 'Effect of integrated yoga therapy on pain, morning stiffness and anxiety in osteoarthritis of the knee joint: A randomized control study' | Ebnezar et al. | 250 (59.56 ± 9.54 years) **Osteoarthritis** | 15 days (40 minutes/day) followed 3 months home practice(40 minutes/day) | Pain while at rest, stiffness in the morning, feeling uneasy, the blood pressure diastolic, the blood pressure's systolic Significantly lower pulse rate ($p<0.05$). |
| **2013** | 'Impact of iyengar yoga on quality of life in young women | Evans et al. | 26 (28.3±3.9 years) **Rheumatoid Arthritis** | 6 weeks (2 times/week) | SF-36: General health, SF-36: Vitality, PDI, HAQ: Health, Psychological functioning, BSI: Global |

| Year | Study Tittle | Author (s) | Participants | Intervention Duration | Findings |
|---|---|---|---|---|---|
| | with rheumatoid arthritis' | | | | severity, CPAQ: Total, ASES pain, GIS found significant difference ($p<0.05$)<br>SF-36: Bodily pain, Mental health, and depression HAQ: Disability, DAS28, anxiety found insignificant ($p>0.05$) |
| **2013** | 'Impact of Iyengar Yoga on Quality of Life in Young Women With Rheumatoid Arthritis. The Clinical Journal of Pain' | Evans et al. | 26 (mean age 28 years)<br>**Rheumatoid Arthritis** | 6 weeks (90-min, 2/week) | Significant improvement ($p<0.05$) was observed in HRQoL overall health, pain disability, and weekly assessments of pain, anxiety, and depression. |
| **2014** | 'Impact of Yogic practices on some bio-chemical parameters of Arthritis patients. International Journal of Yoga and Allied Sciences' | Kumar | 50 (30-60 years)<br>**Rheumatoid Arthritis** | 3 months (90-min, daily/week) | ESR and RA factor significant decreased $p<0.05$. |
| **2014** | 'The Efficacy of Classical Indian Yoga in the Treatment of Fibromyalgia: A Randomized Controlled Trial' | Trivedi & Mishra | 100 (55± 11 years)<br>**Fibromyalgia** | 6 months (90-min, 3/week) | Significant improvements ($p<0.05$) are observed in the 'FM Impact Questionnaire (FIQ) score, pain scale (VAS) global evaluation, physical function, depression, and health status'. |
| **2015** | 'Yoga in Sedentary Adults with Arthritis: Effects of a Randomized Controlled Pragmatic Trial' | Moonaz et al. | 75 (52±12 years)<br>**Arthritis** | 8 weeks (60-min classes and 1 home practice/week) | 'SF-36, PCS, Reach and sit, Positive affect, negative affect, perceived stress, and CES-D are examples of psychological function. SF-36: Function of the body, At the post-test, the roles of physical, pain, vitality, and mental health' were significant ($p<0.05$). not significant in terms of general health, emotional role, social function, or self-efficacy ($p>0.05$). |
| **2017** | 'Effect of Selected Yogic Practices on Pain and Disability in Patients with Lumbar Spondylitis. International Journal of Yoga' | Manik et al. | 172 (29 ± 14.81 years)<br>**Lumbar Spondylitis** | 1 hour/15days/ 1 months | Significant effects in all three groups- immediate relief, short-term, and long-term (LTPG) ($p<0.05$), better in LTPG. |
| **2017** | 'Effect of yoga training on inflammatory cytokines and C- | Shete, et al. | 48 (41.5 ± 5.2 years)<br>**Occupational** | 3 months (60 minutes, 6 | Significantly ($p < 0.001$), the following factors are associated with high cholesterol: HDL, LDL, hs- |

| Year | Study Tittle | Author (s) | Participants | Intervention Duration | Findings |
|---|---|---|---|---|---|
| | reactive protein in employees of small-scale industries' | | **Hazards** | days/week) | CRP, IL-6, and TNF-α. |
| **2018** | 'Effect of simplified Kundalini yoga in the management of cervical spondylosis' | Sugumar & Ponnuswamy | 40 (25-45 years) **Cervical Spondylosis** | 3 months (60 minutes, 6 days/week) | Neck pain and stiffness of neck improved significantly (p,0.05). |
| **2018** | 'Effect of Yoga Based Lifestyle Intervention on Patients with Knee Osteoarthritis: A Randomized Controlled Trial' | Deepeshwar et al. | 66 (60.2 ± 8.2 years) **Knee Osteoarthritis** | 7 days (everyday twice ) | Significant p< 0.05 were obtained for the 'Timed Up and Go Test (TUG), Sit-to-Stand (STS), and Goniometer variables' (Right Extension, Right Flexion, Left Extension, and Left Flexion). |
| **2018** | 'Yoga for the management of pain and sleep in rheumatoid arthritis: a pilot randomized controlled trial. Musculoskeletal care' | Ward et al. | 26 (54±11 years **Rheumatoid Arthritis** | 8 weeks (75 minutes weekly) | Significant improvements were observed in the yoga group (p<0.05) in the following measures: 'EQ-5D-3 L (EuroQol EQ-5D-3 L), CDAI (Clinical Disease Activity Index), HADS (Hospital Anxiety and Depression Scale), HAQ-DI (Health Assessment Questionnaire Disability Index), and ISI (Insomnia Severity Index)'. |
| **2019** | 'An add-on training program involving breathing exercises, cold exposure, and meditation attenuates inflammation and disease activity in axial spondyloarthritis – A proof of concept trial' | Buijze et al. | 24 **Axial Spondyloarthritis** | 8 weeks | 'ESR, ASDAS-CRP BASDAI, SF-36 PCS SF-36 MCS' significantly improved (p<0.05). 'hsCRP, Calprotectin, EQ-5D, EQ-5D VAS, HADS-Anxiety and HADS-depression' found no significant (p>0.05). |
| **2019** | 'Impact of yoga based mind-body intervention on systemic inflammatory markers and co-morbid depression in active Rheumatoid arthritis patients: A randomized controlled trial' | Gautam et al., | 72 **Rheumatoid Arthritis** | 8 weeks | 'CRP, ESR, Serotonin , BDNF , endorphins, IL-17A, TNF-α, TGF- β, HLA-G, DAS28ESR, HAQ-DI' found statistical significant (p<0.05). |
| **2020** | 'Effect of Yoga Therapy on Disease Activity, Inflammatory Markers, and Heart Rate Variability in Patients with | Ganesan et al. | 166 **Rheumatoid Arthritis** | 12 weeks (30 min, 3 times/week) | 'Cortisol, TNF-α, IL-1α, IL-6, and the low-frequency component expressed as LFnu, or the low-frequency/high-frequency (LF-HF) ratio', all considerably decreased (p < 0.05). |

| Year | Study Tittle | Author (s) | Participants | Intervention Duration | Findings |
|---|---|---|---|---|---|
| | Rheumatoid Arthritis' | | | | |
| **2020** | 'Functional status in adhesive capsulitis – yoga vs. physiotherapy: a quasi-experimental study' | Pitchai et al. | 40 (45.4 ± 7.78 years) **Adhesive Capsulitis** | 4 weeks | Improving shoulder abduction mobility significantly ($p<0.05$) insignificant in 'shoulder flexion and shoulder internal rotation' ($p>0.05$) |
| **2020** | 'The Impact of Yoga, Anti-Inflammatory Diet & Self-Monitoring In Children With Rheumatic Diseases. Annals of the Rheumatic Diseases' | Pandya | 22 **Rheumatic Diseases** | 4 weeks (45 minutes /day) | Very helpful effects include yoga, anti-inflammatory diet, and self-monitoring. |
| **2020** | 'A preliminary study of an online pain management programme for patients with ankylosing spondylitis' | Yu et al. | 60 (age 49 ±10.39 years) **Ankylosing Spondylitis** | 5 weeks | 'Pain Catastrophizing Scale score' (PCS) decreased significantly ($p<0.05$) but 'Brief Pain Inventory, Ryff's Psychological Well-being Scale, Pain Self-Efficacy Questionnaire, Cognitive and Affective Mindfulness Scale-Revised' remain not significant ($p>0.05$). |
| **2020** | 'Effect of an 8-Week Yoga-Based Lifestyle Intervention on Psycho-Neuro-Immune Axis, Disease Activity, and Perceived Quality of Life in Rheumatoid Arthritis Patients: A Randomized Controlled Trial' | Gautam et al., | 66 **Rheumatoid Arthritis** | 8 weeks (120 min, 5 times/week) | There were significant improvements ($p<0.05$) in the 'psycho-neuro-immune axis, DAS28-ESR, physical health, psychological, and social connections' domains. There was also significant 'up regulation of TGF-β and down regulation of IL-6, TNF-α, and CTLA4', but no significant changes ($p > 0.05$) in the environmental health domain. |
| **2021** | 'Potential Role of Yoga in the Management of Ankylosing Spondylitis: A Retrospective Study' | Singh, J. et al. | 24 (age 38.3 ± 10.5 years) **Ankylosing Spondylitis** | 2 weeks | 'BMI, systolic blood pressure, and heart rate were not significant; however, the sit-and-reach test revealed that the heart rate and systolic blood pressure' were significant ($p<0.05$). |
| **2021** | 'Effects of Yoga in Daily Life program in rheumatoid arthritis: A randomized controlled trial' | Pukšić et al. | 57 (55.3 ±11 years) **Rheumatoid Arthritis** | 24 weeks (90 min, 2 times/week) | The 'Hospital Anxiety and Depression Scale (HADS) and fatigue' significant differences ($p<0.05$), insignificant change in the SF-36 (all $p > 0.05$). |
| **2022** | 'Designing, validation, and feasibility of a yoga module for | Singh, J. et al. | 25 (age 35.5 ± 10.7) **Ankylosing** | 1 months | Pain and flexibility improved |

| Year | Study Tittle | Author (s) | Participants | Intervention Duration | Findings |
|---|---|---|---|---|---|
| | patients with ankylosing spondylitis' | | **Spondylitis** | | |
| **2022** | 'Role of Selected Yoga Practices in The Treatment of Ankylosing Spondylitis: A Case Study' | Singh, SK et al. | 1 (18 years) **Ankylosing Spondylitis** | 3 weeks | Reported in enhancement of spinal mobility, CRP and improvements in X-ray report |
| **2022** | 'Integrative approach combining Ayurveda, counselling, Yoga and meditation with conventional management of Ankylosing Spondylitis - A case report' | Sushma et al. | 1 (age 59) **Ankylosing Spondylitis** | 44 days | ESR (103 mm/h to 8 mm/h) and CRP (37.5 mg/L-15 mg/L) reduced reported |
| **2022** | 'Ankylosing Spondylitis and Tele-Yoga during Covid-19 Pandemic: Preliminary Results of A Randomized Controlled Trial' | Acar et al. | 36 (age 44.9 ±8.01 years) **Ankylosing Spondylitis** | 8 weeks | PSQI, SF-36, HADS, PSS BASDAI BASFI, BASMI, spinal mobility found improvement ($p<0.05$). |
| **2023** | 'Impact of holistic, patient-centric yoga & naturopathy-based lifestyle modification program in patients with musculoskeletal disorders: A quasi-experimental study' | Nair et al. | 57 (29-65 years) **Musculoskeletal Disorders** | 10 days | 'Musculoskeletal-related Health Quality (MSK-HQ), health, vitality, pain, sit-to-stand (STS), and time-up-and-go (TUG)' significant improvements ($p<0.05$). |
| **2023** | 'Tele-yoga in the management of ankylosing spondylitis amidst COVID pandemic: A prospective randomized controlled trial' | Singh, J. et al. | 109 **Ankylosing Spondylitis** | 3 Months | 'BASDAI, BASFI, Anxiety, AS-QoL' statistically significant ($p<0.05$) |
| **2023** | 'The Effects of Tele-Yoga in Ankylosing Spondylitis Patients: A Randomized Controlled Trial' | Acar et al. | 60 **Ankylosing Spondylitis** | 8 weeks | 'Balance, spinal mobility, flexibility, muscular endurance, disease activity, sleep quality, stress, depression, and quality of life' improved significantly ($p<0.05$) |

## 2.2 Summary of the Review

Through searching with keywords on low back pain, inflammatory back pain, rheumatic disorders, other related disorders, ankylosing spondylitis, exercise, and the yogic effect, studies with random and non-random control experiment indicate that yoga can reduce pain and disability. Numerous studies showed that yoga possibly will be an effective complementary therapy to progress the all aspect of heath domains in patients with low back pain and rheumatoid disorders. Several studies reported that, apart from back problems, yoga may help to manage disorders like hypertension, asthma, diabetes, fibromyalgia, cancer, hemodialysis, psychological disorders, and musculoskeletal disorders. In this review, several studies were found on various exercise interventions for ankylosing spondylitis. Those studies reported that spinal movement exercises can improve disease movement, functional limitation, and inflammation in patients with ankylosing spondylitis. Very few studies were found of yoga in ankylosing spondylitis. Among those studies were very small numbers of subjects, and no robust evidence was found of yogic effects on disease activity, inflammatory response, psychological state, or overall quality of life of the ankylosing spondylitis patients. According to the results of exercise interventions in AS and the significant influence of yoga on chronic low back pain (either mechanical or inflammatory), rheumatoid disorders, and other disorders, it has been hypothesized that yogic practices may be effective in reducing disease activity, functional ability, inflammation, negative thoughts, and developing physical and physiological functions in AS patients that improve patients' quality of life.

# CHAPTER -III

## *METHODOLOGY*

# CHAPTER-III

# METHODOLOGY

In this chapter a description of the investigation methodology has been provided. The topic, criterion measure, tools and equipment utilized, the process for gathering data, and the statistical process for data analysis have all been explained.

### 3.1 THE SUBJECTS:

Subjects were selected from those who were come for treatment of Ankylosing Spondylitis at OPD of Clinical Immunology and Rheumatology, IPGMER; Kolkata, along with they were engaged in different occupational activities. The subjects of the study were examined and quantified with the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and Bath Ankylosing Spondylitis Functional Index (BASFI) questionnaires and confirmed with the certificates of registered medical practitioners at Institute of Postgraduate Medical Education and Research (S.S.K.M.), Kolkata. A total of 50 male patients were selected from the outpatient department (OPD) of Clinical Immunology and Rheumatology, the Institute of Postgraduate Medical Education and Research (S.S.K.M.), Kolkata, who were suffering from ankylosing spondylitis for over 3 months and came for treatment in the hospital. Twenty-five patients were given medicines with yogic practice, considered as the yoga group, and the remaining twenty-five patients were considered a control group, receiving only medicine as a conventional treatment procedure (medicine with physiatric exercises). The patient's age range was 18–40 years.

## 3.2 INCLUSIONS CRITERIA FOR SUBJECT'S SELECTION:

- In this study, patients' with ankylosing spondylitis for over 3 months were included.
- After the approval of ethics committee of the Jadavpur University and the IPGMER, a total of 50 male subjects were selected from the outpatient department (OPD) of Clinical Immunology and Rheumatology, the Institute of Postgraduate Medical Education and Research (S.S.K.M.), Kolkata, who were suffering from ankylosing spondylitis and came for treatment in the hospital. Twenty-five subjects were given medicine with yogic practice, and considered a yoga group, and the remaining twenty subjects were considered a control group and received conventional treatments only.
- The age ranges of the subjects were 18–40 years.

- The subjects of the study were selected by the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and Bath Ankylosing Spondylitis Functional Index (BASFI) questionnaires and confirmed with the certificates of registered medical practitioners at SSKM Hospital.

## 3.3 EXCLUSION CRITERIA FOR SUBJECT'S SELECTION:

1. Associated other causes of back pain, such as disk herniation problems, neuropathic pain, dysfunction of internal organs of the pelvis and abdomen, and strain of ligaments
2. Comorbidity like serious cardiopulmonary disease, which precludes yoga and exercise
3. Musculoskeletal conditions that contraindicate or complicate yoga and exercises
4. Psychiatric diseases or the inability to comprehend commands
5. Smokers and drinkers

## 3.4 DESIGN OF THE STUDY:

For the experiment, the study adopted a randomized repeated measures group design. Equal numbers of subjects were assigned randomly in two groups of twenty-five (25) each. One group is named a yoga group, and the other is a control group. The yoga group continued with their regular medicine along with selected yogic practices for 24 weeks. Each yoga practice session is scheduled for 1 hour and 5 days/week. The whole practice consisted of selected yogic postures, breathing, and meditation. The control group followed only conventional medical treatments of AS patients which include regular medicine along with physiatric exercises recommended by experts of department of Physical Medicine and Rehabilitation (PMR) of IPGMER, Kolkata. Both groups continued their medicine as per the prescription of a registered expert rheumatologist of SSKM hospital. The design is shown in the below diagram:

## Experimental Group Design

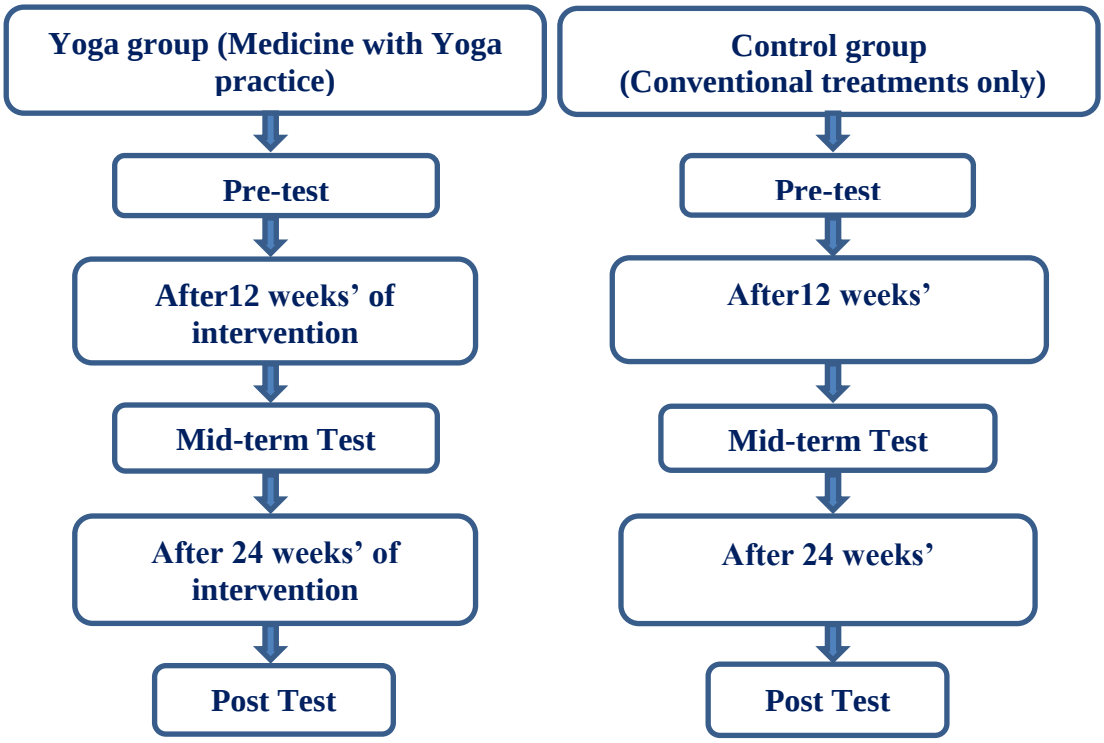



**Fig. 2: Study Design**

## 3.5 SELECTION OF VARIABLES:

**Table no.2: Selection of Variables**

| Disease Activity and Functional Index | Inflammatory Markers | Blood Count Variables | General Health Variables | Psychological Variables | Health-related Quality of Life (HRQoL) |
|---|---|---|---|---|---|
| BASDAI | TNF-alpha | Haemoglobin | Blood pressure | Fear Avoidance Beliefs (FAB) | SF-36, Health Survey |
| | | Total Leukocyte Count | | | |
| BASFI | C-reactive protein (CRP) | Segmented Neutrophils | Resting Heart rate | Pain Catastrophizing | |
| | | Lymphocytes | | | |
| | Erythrocyte sediment rate (ESR) | Monocytes | BMI | Depression | |
| | | Eosinophil | | | |
| | | Basophils | | | |
| | Morning Cortisol | Platelet Count | | | |

## 3.6 CRITERION MEASURES:

**Table no.3: Demographic Profile**

| Variables | Test/ Instruments | Units of Measurement |
|---|---|---|
| **Age** | Identity Proof Card | Year |
| **Height** | Stadiometer | cm |
| **Weight** | Weighing Machine | kg |
| **Body Mass Index** | BMI was estimated by body mass divided by the square of the body height | $kg/m^2$ |

**Table no- 4 Criterion Measures**

| Category of Variables | Variables | Test/ Instruments | Units of Measurement |
|---|---|---|---|
| **Disease Activity and Functional Index** | BASDAI | Bath Ankylosing Spondylitis Disease Activity Index questionnaire | - |
| | BASFI | Bath Ankylosing Spondylitis Functional Index questionnaire | - |
| **Inflammatory Markers** | TNF-alpha | Inflammatory markers parameters TNF-alpha was detected through ELISA (Enzyme-linked immune sorbent assay) test by help of biochemical expert. | ng/L |
| | C-reactive Protein (CRP) | Immunoturbidimetry | mg/L |
| | Erythrocyte Sediment Rate (ESR) | Electrical Impendence & VCS, Westergen | mm/hr |
| | Cortisol Level | ECLIA | µg/dL |
| **Blood Count** | Haemoglobin | Electrical Impendence & VCS, Westergen | g/dl |
| | Total Leukocyte Count | Electrical Impendence & VCS, Westergen | $thou/mm^3$ |
| | Segmented Neutrophils | Electrical Impendence & VCS, Westergen | % |
| | Lymphocytes | Electrical Impendence & VCS, Westergen | % |
| | Monocytes | Electrical Impendence & VCS, Westergen | % |
| | Eosinophil | Electrical Impendence & VCS, Westergen | % |

| Category of Variables | Variables | Test/ Instruments | Units of Measurement |
|---|---|---|---|
| | Basophils | Electrical Impendence & VCS, Westergen | % |
| | Platelet Count | Electrical Impendence & VCS, Westergen | thou/$mm^3$ |
| **General Health** | Heart Rate | Heart Rate was measured by digital sphygmomanometer. | beats/Minutes |
| | Blood Pressure | Blood pressure was measured by digital sphygmomanometer. | mmHg |
| | BMI | Weight (in kg)/Heighi$^2$ (in meters) | $kg/m^2$ |
| **Psychological Variables** | Fear Avoidance Beliefs (FAB) | Fear Avoidance Beliefs was measured by Fear Avoidance Beliefs Questionnaire (FABQ).This questionnaire was developed by Waddle et al(1993) | - |
| | Pain Catastrophizing | Pain Catastrophizing was measured by Pain Catastrophizing Scale (PCS) by Michael JL Sullivan (2009). | - |
| | Depression | Depression was measured by Hamilton Depression Rating Scale (1960) | - |
| **Health-related Quality of Life (HRQoL)** | Health Survey (RAND SF-36) | Health Survey (RAND SF-36) was estimated by RAND 36-Item Health Survey questionnaire, 1992) | - |

### 3.7 RELIABILITY OF DATA:

Reliability of the test depends upon various factors, such as instruments reliability, also reliability & competency of testers.

#### 3.7.1 Reliability of Instruments:

A digital sphygmomanometer (Model No-Omron: HEM-7051-C12), weighing machine (Krups countess weighing machine, 125 kg), stadiameter (Anthropometric rod), ELISA kits (G-Bioscience, catalog no. ITE020302), depression scale (Hamilton Depression Rating Scale, 1960), fear avoidance beliefs (FAB) questionnaire (developed by Waddle et al., 1993), pain catastrophizing questionnaire (developed by Michael JL Sullivan, 2009), and Short Form-36 HRQoL questionnaire (Rand-SF36, 1992) were used in the study. The above instruments were widely used for different projects and were thereby considered reliable.

#### 3.7.2 Tester's Reliability:

The data were collected by the help of qualified academicians, lab assistants and research scholar himself with collaboration of others research scholars of Institute of Postgraduate Medical Education & Research (S.S.K.M), Kolkata.

## 3.8 Enrolment of the Patients

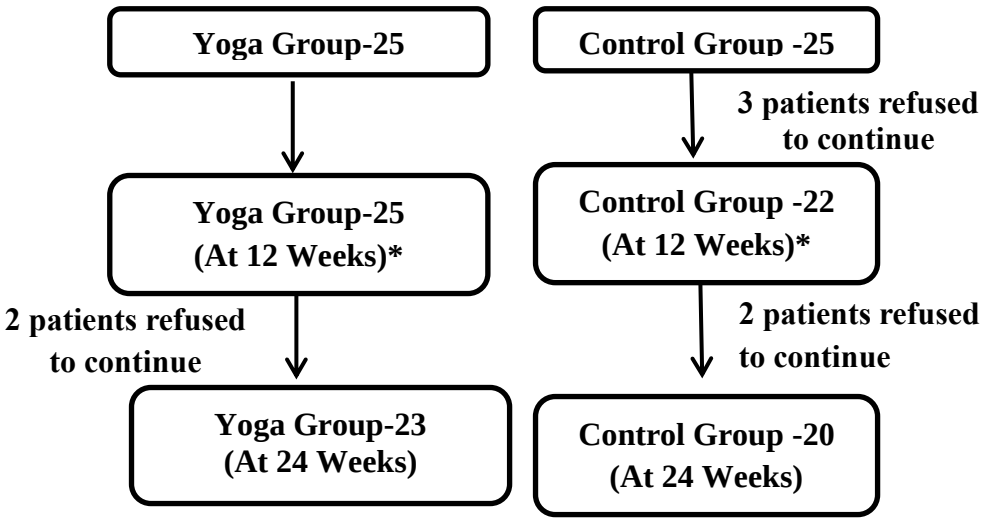



**Fig. 3: Enrolment of the Patients**

***The data of 2 patients from each group were not taken due to their unavailability on the schedule date of data collection (due to other health issue) but they continued their yoga practice as earlier up to 24 weeks with their medicines as prescribed by respective doctors.**

### 3.9 PROCEDURE OF DATA COLLECTION:

Disease activity and functional index of the patients were measured by standardized BASDAI and BASFI questionnaire. After that health related quality of life measured by standardized Health Survey (RAND SF-36) questionnaire. For measuring psychological variables standardized questionnaire Fear Avoidance Beliefs (FAB), Pain Catastrophizing and Depression were used. After that investigator cross check the lab based health parameters by morning serum cortisol level, blood count profile, Heart rate, Blood pressure, BMI, TNF-alpha, C-reactive protein (CRP), Erythrocyte sediment rate (ESR). For the experiment group, the investigator was shooting a self-demonstrated video of all yogic practices including Asana, Pranayama, and Meditations. In the video there were some instructions related with the particular asanas, pranayamas and meditation. The video was provided by memory drive or by sharing via phone to each participant. A separate sheet of still images for each practice and sequence of practice was provided to the participants for their better understanding. They were instructed to practice for one hour per day for at least 5 days in a week. They were monitored regularly by a virtual mode and monthly physical interaction. The control group followed the conventional medical treatments only. Within 12 weeks, 3 patients of the control group refused to continue, and the data of 2 patients from each group were not taken due to their unavailability on the schedule date of data collection, but they continued their yoga practice programme as earlier up to 24 weeks with their medicines as prescribed by respective doctors. The experiments tenure was of 24 weeks. Data was recorded after 12 weeks and after 24 weeks.

#### 3.9.1 Bath Ankylosing Spondylitis Disease Activity Index (BASDAI)

The gold standard for monitoring and measuring disease activity in people with ankylosing spondylitis is the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and, consequently, their functional status. In between 30 and 2 minutes, the BASDAI is a quick and easy index to complete. Six items make up this self-reported questionnaire, which is focused on five main symptoms: weariness, back discomfort, joint pain or swelling, localized tenderness, and stiffness in the morning. On visual analog scales of ten centimetres, each question is answered. A number of 0 denotes the absence of any symptoms, while a score of 10 represents very severe symptoms. To compute the mean score, the scores for questions 1-4 are summed. The mean for questions 5 and 6 is calculated. Then summed score of 1-4 added to the mean measurement (score) of questions 5 and 6. The average is then calculated

by dividing this sum by 5. The BASDAI score is this. The degree of the patient's disability indicates an increase in their BASDAI score.

**Reliability:**

The reliability of the BASDAI was statistically significant ($p<0.001$). Good test-retest reliability was reported for all scale responses**.**

**Validity:**

It is proven that the BASDAI is better than an earlier disease activity index in terms of the symptoms it takes into account and how they are weighted. This could be a result of the suggestions made by AS sufferers during the index's development. Calin et al.'s (1999) assessment of the validity of the BASDAI went further. They found that the content validity of the BASDAI is excellent.

**Responsiveness:**

The BASDAI revealed a significant ($p=0.009$) 16.4% score development after a 3-week physiotherapy course, indicating a sensitivity to change. In summary, the BASDAI is sensitive to clinical changes, reflects the full range of the illness, is very dependable, and is easy to use (Garret S et al., 1994).

### 3.9.2 Bath Ankylosing Spondylitis Functional Index (BASFI)

A series of ten questions called the Bath Ankylosing Spondylitis Functional Index (BASFI) is used to assess the level of functional limitation experienced by individuals with Ankylosing Spondylitis (AS). AS patients play a big role in the selection of the 10 questions. The final two questions evaluate the patient's capacity to manage daily life, while the first eight questions focus on everyday actions that are reliant on on functional movement including bending, reaching, position, and standing, turning, shifting and mounting steps with or without bar. Every item receives a score between 0 and 10 (Calin et al., 1994).

The ten items that make up the BASFI are linked to daily living activities and are rated on a scale of 0 (no functional deficiencies) to 10 (maximal deficiency). Each question has a numeric response scale (NRS) or a 10 cm horizontal VAS for answers. A score of 0 means the task was simple, while a score of 10 means the participant couldn't complete the exercise (Calin et al., 1994).

After adding up each question's score from 1 to 10, divide the total by 10. The mean of the discrete scores is used to calculate the overall index score. A greater degree of functional restriction is indicated by a higher score.

**Reliability:**

There was sufficient outstanding test-retest consistency when patients were evaluated based on how they performed eight items from the BASFI that represented activities of daily living (Van Weely et al., 2009).

**Validity:**

The investigators found that the BASFI's concept validity and internal consistency reliability were satisfactory (Madsen et al., 2010).

**Responsiveness:**

In comparison to the 6% (P = 0.03) improvement shown by the Dougados functional index in the time of the physiotherapy management over the same three weeks period, there was a 20% (P = 0.004) improvement in function throughout that time (Calin et al., 1994).

### 3.9.3 CRP (C - reactive protein)

The patients were asked to sit at comfortable position. 2.5 ml bloods were taken by an expert staff of IPGMER, Kolkata. Then bloods were pouring into clot vial and stored in room temperature. Then vials were submitted to Dr. Lal paths labs (Bhawanipur CC branch, Kolkata- 700025 which is the reputed blood test laboratory in India. They tested Serum CRP by method of Immunoturbidimetry.

### 3.9.4 Estimation of Erythrocyte Sedimentation Rate (ESR):

The patients were asked to sit at comfortable position. 2.5 ml bloods were taken by an expert staff of IPGMER, Kolkata. Then bloods were pouring into EDTA vial and stored in room temperature. Then vials were submitted to Dr. Lal paths labs (Bhawanipur CC branch, Kolkata- 700025 which is the reputed blood test laboratory in India. They tested ESR by method of Electrical Impendence & VCS, Westergen.

### 3.9.5 TNF-alpha:

**Detection Method:** Enzyme-linked Immunoassay (ELISA)

**Kit Description:** Human Tumor Necrosis Factor Alpha ELISA Kit (ImmunoTag, G-Bioscience, Catalogue No.: ITE020302)

**Range:** 3ng/L - 900ng/L

**Sensitivity:** 1.52ng/L

**Laboratory:** Research Laboratory, Department of Clinical Immunology and Rheumatology, IPGMER, Kolkata.

**Reagent Preparation**

From patients initially had 9–10 mL of blood drawn, after which the serum was left to clot at chamber temperature for 10–20 minutes. Centrifuge for 20 minutes at 2000–3000 RPM. The samples were then kept in a freezer at -40 degrees Celsius. Before use, all reagents were brought to room temperature. Reconstitute 120 µl of the standard (960 ng/L) with 120 µl of standard diluent to create a 480 ng/L standard stock solution. It is customary to sit with modest agitation for 15 minutes prior to producing dilutions. The 480 ng/L standard stock solutions was serially diluted 1:2 with standard diluent to create 240 ng/L, 120 ng/L, 60 ng/L, and 30 ng/L solutions. These duplicate standard points were then created. The zero standards are represented by the standard diluent (0 ng/L). Any solution that was left over was frozen at -20°C.

**Assay Procedure**

First, standard solutions and samples were used to prepare all of the reagents. All reagents were then stored at room temperature. The experiment was run at room temperature. After calculating how many strips would be needed for examine, the strips were placed into the frames and put to use. First, the standard well received 50 µl supplied to it. Subsequently, 40µl of the sample was added to the wells, monitored by the addition of 10µl of anti-TNF Alpha antibody and 50µl of streptavidin-HRP to both the sample and standard wells (not the blank control wells). After methodically combining, seal the plate. At 37°C, incubate for 60 minutes. The plate was cleaned five times using wash buffer following the removal of the sealant. For every wash, immerse wells in a minimum of 0.35 ml of wash buffer for 30 to 60 seconds. Aspirate every well in the automated washing system, then fill each well to the brim with wash buffer and repeat the process five times. Blot the plate onto absorbent material such as paper towels. Subsequently, 50µl of substrate solution A and 50µl of substrate solution B were applied to each well. The plate protected with a fresh sealer should be hatched for 10 minutes at 37°C in the dark. After adding 50µl of Stop Solution to every well,

the blue hue turned yellow. Using a micro plate reader set to 450 nm, the optical density (OD value) of each well was measured within 10 minutes of adding the stop solution.

**Calculation of Result**

The tester created a standard curve by plotting the average OD for each standard against the concentration and drawing a best-fit curve through the graph points.

### 3.9.6 Serum Cortisol:

The patients were requested to sit in a comfortable position. 2.5 ml of blood was taken by an expert staff of IPGMER, Kolkata. Then blood was poured into a clot vial and stored at room temperature. Then vials were submitted to Dr. Lal Paths Labs (Bhawanipur CC branch, Kolkata-700025), which is the reputed blood test laboratory in India. They tested complete blood count parameters by using the method of ECLIA (morning serum). The test reports were collected within 2 days from the centre.

### 3.9.7 Blood Count Variables:

The patients were asked to sit at comfortable position. 2.5 ml bloods were taken by an expert staff of IPGMER, Kolkata. Then bloods were pouring into EDTA vial and stored in room temperature. Then vials were submitted to Dr. Lal paths labs (Bhawanipur CC branch, Kolkata- 700025 which is the reputed blood test laboratory in India. They tested complete blood count parameters (Haemoglobin, Total Leukocyte Count Segmented Neutrophils, Lymphocytes, Monocytes, Eosinophil, Basophils and Platelet Count) by method of Electrical Impendence & VCS, Westergen.

### 3.9.8 Heart Rate and Blood Pressure:

**Purpose:** To record the heart at rest beats per minute and blood pressure in mm hg.

**Equipment:** The heart rate and blood pressure of the subjects were recorded using the OMRON Automatic Blood Pressure Monitor Model: ‘SEM-1 (HEM-7051-C12), Serial No. 20090717056LF’, manufactured by ‘OMRON Healthcare Co., Ltd.’, Japan.

**Procedure:**

- Patients were asked to rest their arms, palms facing up, and stay still.
- The BP cuff is placed at about the same level as the heart.
- Then put the cuff on a bare arm.

- The bottom edge of the cuff is placed 1 inch above the bent elbow.
- After that, check the position of the cuff over the artery.
- After pressing the START button, the cuff filled with air.
- It became tight and hurt a little, but only for a few seconds.
- As the device let air out, numbers and a tiny heart symbol flashed.
- Finally, the values shown on the monitor were recorded.

### 3.9.9 Depression:

The scale should only be applied to people who have an established diagnosis of emotional disorders. It has 17 factors that cover the majority of symptoms seen in all forms of depression. Four further factors are included on the form where ratings are recorded: derealisation, paranoid symptoms, obese symptoms, and diurnal fluctuation. This scale has 17 items, including depression, hypochondriasis, suicide, and guilt, various forms of insomnia, retardation, and somatic symptoms. The following precautions about rating the items have to be kept in consideration:

(1) Rating should be done by asking questions about features of depression.

(2) Questions should be asked indirectly; the number of direct questions should be kept to a minimum.

(3) Such questions should be asked in different ways.

The rating scale was done based on the parameters given for each item. Which differs from item to item, e. g. Item No. 1: Depression: pessimism about the future; tendency to weep was given 1 point; occasional weeping was given 2 points; frequent weeping was given 3 points; and severe symptoms were allotted 4 points. Likewise, the rest of the items could be rated. Finally, all the ratings were added to get a final score indicative of the severity of depression. The range of scores could be 0-62. The severity was reflected by a higher score.

### 3.9.10 Fear Avoidance Beliefs:

The 16-item FABQ was developed by Waddell et al. (1993) exactly for patients with LBP. Every item has a seven-category assessment system with options ranging from "completely disagree" to "completely agree." Fear-avoidance beliefs for work (FABQ-WA) and fear-avoidance beliefs for physical activity (FABQ-PA) are the two subscales. 0 to 24 is the score

for the former, and 0 to 42 for the latter. A third total score (FABQ-total) was derived using the summation of four of the five items (2, 3, 4, and 5) in the FABQ-PA and seven of the eleven items (6, 7, 9, 10, 11, 12, and 15) in the FABQ-WA, according to Waddell et al. (1993). A high score directs a high grade of fear-avoidance beliefs. The total possible score runs from 0 to 6.

### 3.9.11 Pain Catastrophizing:

Pain Catastrophizing (PC) is a set of thirteen questions labelling different opinions and feelings that may be connected with pain, developed by Michael J.L. Sullivan in 2009. Patients were probed to indicate the mark to which they have the above opinions and feelings when they are feeling pain using the 0 (not at all) to 4 (all the time) scale. A total score is produced (ranging from 0-52). The PCS has been shown to have satisfactory to excellent internal consistency (PCS =.87–.93). Three things were measured by this questionnaire, i.e., feelings of rumination, magnification, and helplessness.

### 3.9.12 Health-related Quality of Life (HRQoL)

A Cronbach's alpha coefficient for the Short Form 36 was testified in the article "Development of a Specific Quality of Life Instrument for Patients with Skin Cancer: The Skin Cancer Index" by Minjung Kathy Chae, which was published in Frontiers in Surgery in 2021 (Chae, 2021). In this study, the SF-36's Cronbach's alpha value was reported as $\alpha = 0.90$, showing strong internal consistency and reliability.

**Validity:**

Results showed that 83% of associations between SF-36 scales and measures of functioning, disease activity, and symptoms of illness went beyond the predetermined threshold ($r \geq |0.40|$), supporting the convergent validity of the SF-36 (Yarlas et al., 2018).

**Responsiveness:**

Studies reveal that, when compared to comparable general health measures, the SF-36 responds to change the best among workers with musculoskeletal illnesses (Beaton et al. 1997).

## 3.10 TRAINING PROGRAMME:

After the selection of the participants, the medical practitioner and investigator instructed the participants to come to the hospital for the collection of baseline (pre-test) data. Yoga group

and control group participants were called on different days. The control group was directed to follow their normal daily schedule and to take the prescribed medicine(s) only. For the experiment group, the investigator was given a self-demonstrated video of all yogic practices, including asana, pranayama, and meditations, to the participants via a mobile phone-supported OTG-based memory drive. In this video, two junior scholars acted as demo participants with their due consent. The investigator showed this video to all the participants. Thereafter, the investigator gave some general and specific instructions to the participants, like dos and don'ts, time of practice, way of practice, benefits, etc. Although in the video there were some instructions related to the particular asanas, pranayamas, and meditation, A separate sheet of still images for each practice and sequence of practice was also provided to the participants for their better understanding. In case of any hesitation regarding the practices shown in the video, the investigator and his associates made video calls from time to time to clear the doubts through demonstration, and the investigator also checked the continuous practice of participants and took their feedback. In case of remains unclear to video calls, the particular participant/s have instructed to either coming to the hospital or the investigator visited his house, strictly following COVID protocols and other necessary measures in both cases. The participants were instructed to come to the hospital after regular intervals of one month in order to get some ideas and information about their progress. The investigator was noting their feelings and other feedback. A midterm orientation program was conducted for yoga group patients to checking their correct practice of yoga postures at 6 weeks. The program motivated the patients, and they freely expressed their problems to the investigators. After the completion of 12 weeks of practice, the medical practitioner and investigator collected post-test data at the hospital. Yoga group and control group participants came on different days. All test data was collected by strictly maintaining COVID protocols. The information provided by the participants was kept confidential by the investigators.

## 3.11 MEDICATION:

All patients in both groups were prescribed yogic practices along with drugs prescribed by the rheumatologist at IPGME&R, Kolkata. The following drugs were used:

Analgesics were used as:

Paracetamol: up to 1.5 mg/day

Etoricoxib: 60–90 mg/day

Naproxen: 500–1000 mg/day

No patients in either group received analgesics (NSAIDS) for more than 2 weeks. The patients did not take analgesics 72 hours or 3 days prior to data collection. The disease modifying anti rheumatic drugs (DMARDs) were taken by patients at 500 mg–2000 mg/day (Sulfasalazine), 7.5–15 mg/week (Methotrexate), and 10 mg/day (Tofacitinib). Some patients in the control group took biologic drugs. All patients were on regular meditation, as the rheumatologist advised, at a stable dose. However, they had been taking the drugs prior to inclusion in the study.

## 3.12 List of practices in Yoga techniques for patient with Ankylosing Spondylitis:

Prayer--Modified Surya Namaskar --Simple Yoga Asana (susksma vayama) Makarasana—Niralambasana—Bhujangasana—Ardhasalbhasana—Majrasana Leg Up- Hand Raise--Crocodile Variation: Ekpadauttanasana (both leg)—Pavanmuktasana—Setubandhanasana—Standing Pose: Side bending Chakrasana---Konasana—Katichakrasana-Tadasana Sitting Pose: Parvatasana—Uttanmandukasana—Kapalbhati—Pranayamas: Bhramari--Anulom-Vilom—Shetali--Shavasana with breath awareness--OM Chanting- Body awareness meditation at Shavasana (For deep relaxation-Closing Prayer.

## 3.13 YOGA PRACTICE SCHEDULE:

In this study total 6 yoga practice schedules were designed for the patients. The schedules were changed every 4 weeks.

**Table no. 5: 1-4 Weeks Yoga schedule**

| Sl no | Name of the Practice | Frequency | Time in Minutes (Including Rest) |
|---|---|---|---|
| **1** | **Prayer** | 1 | **2** |
| 2 | **Sukshma Vyama (Loosening and Strengthening Practices)** | | **10** |
| 2 a | Neck Bending | 5 | 2 |
| 2 b | Hand Stretch (up) | 3 | 1 |
| 2 c | Hand Stretch (sidewise) | 3 | 1 |
| 2 d | Shoulder Rotation (Clock and anti-clock wise) | 5 each | 2 |
| 2 e | Hip Rotation (Clock and anti-clock wise) | 5 each | 1 |
| 2 f | Knee Movement | 5 | 1 |
| 2 g | Ankles up & down | 5 | 2 |
| **3** | **Modified 12 Pose Suryanamaskar** (Pranamasana, Ardhchakrasana, Tadasana, Aswasanchalasana, Dandasana, Ashtangasana, Bhujangasana, Dandasana, Aswasanchalasana, | 3 | **15** |

| Sl no | Name of the Practice | Frequency | Time in Minutes (Including Rest) |
|---|---|---|---|
| | Tadasana, Ardhchakrasana and Pranamasana) | | |
| 4. | **Asanas** | | **30** |
| 4.1 | **Standing Pose Asanas** | | |
| 4.1.a | Side Bending Chakrasana (both side) | 4 each | 6 |
| 4.1.b | Trikonasana (both side) | 4 each | 6 |
| 4.1.c | Katichakrasana (both side) | 4 each | 6 |
| 4.2 | **Supine lying Pose** | | |
| 4.2.a | Shavasana | 1 | 1 |
| 4.2.b | Utttanpadasana (left leg) | 1 | 1 |
| 4.2.c | Utttanpadasana (right leg) | 1 | 1 |
| 4.2.d | Utttanpadasana (both leg) | 1 | 1 |
| 4.2.e | Jatharaparivarita Asana (both side) | 3 | 6 |
| 4.2.f | Setubandhanasana | 2 | 2 |
| **5** | **Chanting** | **5** | **2** |
| **6** | **Closing Prayer** | **1** | **1** |
| **Total** | | | **60 Minutes** |

**Table no.6: 5-8 Weeks Yoga schedule**

| Sl no | Name of the Practice | Frequency | Time in Minutes (Including Rest) |
|---|---|---|---|
| **1** | **Prayer** | 1 | **2** |
| 2 | **Sukshma Vyama (Loosening and Strengthening Practices)** | | **10** |
| 2 a | Neck Bending | 5 | 2 |
| 2 b | Hand Stretch (up) | 3 | 1 |
| 2 c | Hand Stretch (sidewise) | 3 | 1 |
| 2 d | Shoulder Rotation (Clock and anti-clock wise) | 5 each | 2 |
| 2 e | Hip Rotation (Clock and anti-clock wise) | 5 each | 1 |
| 2 f | Knee Movement | 5 | 1 |
| 2 g | Ankles up & down | 5 | 2 |
| **3** | **Modified 12 Pose Suryanamaskar** (Pranamasana, Ardhchakrasana, Tadasana, Aswasanchalasana, Dandasana, Ashtangasana, Bhujangasana, Dandasana, Aswasanchalasana, Tadasana, Ardhchakrasana and Pranamasana) | 3 | **15** |
| 4. | **Asanas** | | **30** |
| 4.1 | **Supine lying Pose** | | |
| 4.1.a | Shavasana | 1 | 1 |
| 4.1.b | Utttanpadasana (left leg) | 2 | 2 |
| 4.1.c | Utttanpadasana (right leg) | 2 | 2 |
| 4.1.d | Utttanpadasana (both leg) | 2 | 2 |
| 4.1.e | Jatharaparivarita Asana (both side) | 2 | 4 |
| 4.1.f | Setubandhanasana | 2 | 2 |
| 4.2 | **Prone Lying Pose** | | |
| 4.2.a | Makarasana | 1 | 2 |

| Sl no | Name of the Practice | Frequency | Time in Minutes (Including Rest) |
|---|---|---|---|
| 4.2.b | Nirlambasana | 2 | 2 |
| 4.2.c | Bhujangasana | 3 | 4 |
| 4.2.d | Ardha Shalbhasana (left leg) | 3 | 3 |
| 4.2.e | Ardha Shalbhasana (right leg) | 3 | 3 |
| 4.2.f | Purna Shalbhadana | 2 | 3 |
| **5** | **Chanting** | **5** | **2** |
| **6** | **Closing Prayer** | **1** | **1** |
| **Total** | | | **60 Minutes** |

**Table no.7: 9-12 Weeks Yoga schedule**

| Sl no | Name of the Practice | Frequency | Time in Minutes (Including Rest) |
|---|---|---|---|
| **1** | **Prayer** | 1 | **2** |
| 2 | **Sukshma Vyama (Loosening and Strengthening Practices)** | | **10** |
| 2 a | Neck Bending | 5 | 2 |
| 2 b | Hand Stretch (up) | 3 | 1 |
| 2 c | Hand Stretch (sidewise) | 3 | 1 |
| 2 d | Shoulder Rotation (Clock and anti-clock wise) | 5 each | 2 |
| 2 e | Hip Rotation (Clock and anti-clock wise) | 5 each | 1 |
| 2 f | Knee Movement | 5 | 1 |
| 2 g | Ankles up & down | 5 | 2 |
| **3** | **Modified 12 Pose Suryanamaskar** (Pranamasana, Ardhchakrasana, Tadasana, Aswasanchalasana, Dandasana, Ashtangasana, Bhujangasana, Dandasana, Aswasanchalasana, Tadasana, Ardhchakrasana and Pranamasana) | 2 | **10** |
| 4. | **Asanas** | | **22** |
| 4.1 | **Supine lying Pose** | | |
| 4.1.a | Utttanpadasana (both leg) | 2 | 2 |
| 4.1.b | Jatharaparivarita Asana (both side) | 1 | 2 |
| 4.1.c | Setubandhanasana | 1 | 1 |
| 4.2 | **Prone Lying Pose** | | |
| 4.2.a | Bhujangasana | 2 | 2 |
| 4.2.b | Ardha Shalbhasana (left leg) | 1 | 1 |
| 4.2.c | Ardha Shalbhasana (right leg) | 1 | 1 |
| 4.2.d | Purna Shalbhadana | 2 | 3 |
| 4.3 | **Sitting Pose Asana** | | |
| 4.3.a | Padmasana | 1 | 2 |
| 4.3.b | Parvataana | 2 | 2 |
| 4.3.c | Uttan Mandukasana | 2 | 2 |
| 4.3.d | Ardha Ushtrasana | 2 | 2 |
| **5** | **Kapalbhati Kriya** | **3 round** | **6** |
| **6** | **Anulom-Vilom Pranayama** | **5** | **5** |
| **7** | **Chanting** | **10** | **4** |
| **8** | **Closing Prayer** | **1** | **1** |
| **Total** | | | **60 Minutes** |

**Table no. 8: 13-16 Weeks Yoga schedule**

| Sl no | Name of the Practice | Frequency | Time in Minutes (Including Rest) |
|---|---|---|---|
| **1** | **Prayer** | 1 | **2** |
| 2 | **Sukshma Vyama (Loosening and Strengthening Practices)** | | **10** |
| 2 a | Neck Bending | 5 | 2 |
| 2 b | Hand Stretch (up) | 3 | 1 |
| 2 c | Hand Stretch (sidewise) | 3 | 1 |
| 2 d | Shoulder Rotation (Clock and anti-clock wise) | 5 each | 2 |
| 2 e | Hip Rotation (Clock and anti-clock wise) | 5 each | 1 |
| 2 f | Knee Movement | 5 | 1 |
| 2 g | Ankles up & down | 5 | 2 |
| **3** | **Modified 12 Pose Suryanamaskar** (Pranamasana, Ardhchakrasana, Tadasana, Aswasanchalasana, Dandasana, Ashtangasana, Bhujangasana, Dandasana, Aswasanchalasana, Tadasana, Ardhchakrasana and Pranamasana) | 2 | **10** |
| 4 | **Asanas** | | **17** |
| 4.1 | **Supine lying Pose** | | |
| 4.1.a | Jatharaparivarita Asana (both side) | 1 | 2 |
| 4.1.b | Setubandhanasana | 1 | 1 |
| 4.2 | **Prone Lying Pose** | | |
| 4.2.a | Bhujangasana | 2 | 2 |
| 4.2.b | Ardha Shalbhasana (left leg) | 1 | 1 |
| 4.2.c | Ardha Shalbhasana (right leg) | 1 | 1 |
| 4.2.d | Purna Shalbhadana | 2 | 2 |
| 4.3 | **Sitting Pose Asana** | | |
| 4.3.a | Parvataana | 2 | 2 |
| 4.3.b | Uttan Mandukasana | 2 | 2 |
| 4.3.c | Ardha Ushtrasana | 2 | 2 |
| 4.3.d | Vakrasana (both side) | 1 | 2 |
| 5 | **Kapalbhati Kriya** | **3 rounds** | **6** |
| 6 | **Pranayama** | | **10** |
| 6.1.a | Anulom-Vilom | 3 | 3 |
| 6.1.b | Bhramari | 3 | 3 |
| 6.1.c | Shitali | 2 | 2 |
| 6.1.d | Bhrastika | 2 | 2 |
| **7** | **Chanting** | **10** | **4** |
| **8** | **Closing Prayer** | **1** | **1** |
| **Total** | | | **60 Minutes** |

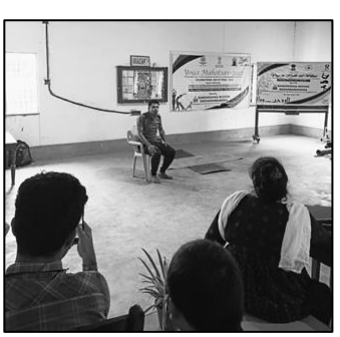
**Table no. 9: 17-20 Weeks Yoga schedule**

| Sl no | Name of the Practice | Frequency | Time in Minutes (Including Rest) |
|---|---|---|---|
| **1** | **Prayer** | 1 | **2** |
| 2 | **Sukshma Vyama (Loosening and Strengthening Practices)** | | **10** |
| 2 a | Neck Bending | 5 | 2 |
| 2 b | Hand Stretch (up) | 3 | 1 |
| 2 c | Hand Stretch (sidewise) | 3 | 1 |
| 2 d | Shoulder Rotation (Clock and anti-clock wise) | 5 each | 2 |
| 2 e | Hip Rotation (Clock and anti-clock wise) | 5 each | 1 |
| 2 f | Knee Movement | 5 | 1 |
| 2 g | Ankles up & down | 5 | 2 |
| **3** | **Modified 12 Pose Suryanamaskar** (Pranamasana, Ardhchakrasana, Tadasana, Aswasanchalasana, Dandasana, Ashtangasana, Bhujangasana, Dandasana, Aswasanchalasana, Tadasana, Ardhchakrasana and Pranamasana) | 1 | **5** |
| 4 | **Asanas** | | **16** |
| 4.1 | **Supine lying Pose** | | |
| 4.1.a | Jatharaparivarita Asana (both side) | 1 | 2 |
| 4.1.b | Setubandhanasana | 1 | 1 |
| 4.2 | **Prone Lying Pose** | | |
| 4.2.a | Bhujangasana | 3 | 3 |
| 4.2.b | Ardha Shalbhasana (left leg) | 1 | 1 |
| 4.2.c | Ardha Shalbhasana (right leg) | 1 | 1 |
| 4.2.d | Purna Shalbhadana | 3 | 3 |
| 4.3 | **Sitting Pose Asana** | | |
| 4.3.a | Ardha Ushtrasana | 1 | 1 |
| 4.3.b | Majrasana | 2 | 2 |
| 4.3.c | Shasankasan | 2 | 2 |
| **5** | **Kapalbhati Kriya** | **3 rounds** | **6** |
| **6** | **Pranayama** | | **10** |
| 6.1.a | Anulom-Vilom | 3 | 3 |
| 6.1.b | Bhramari | 3 | 3 |
| 6.1.c | Shitali | 2 | 2 |
| 6.1.d | Bhrastika | 2 | 2 |
| **7** | **Body awareness meditation at Shavasana (For deep relaxation)** | **1** | **10** |
| **8** | **Closing Prayer** | **1** | **1** |
| **Total** | | | **60 Minutes** |

**Table no.10: 21-24 Weeks Yoga schedule**

| Sl no | Name of the Practice | Frequency | Time in Minutes (Including Rest) |
|---|---|---|---|
| **1** | **Prayer** | 1 | **2** |
| 2 | **Sukshma Vyama (Loosening and Strengthening Practices)** | | **10** |
| 2 a | Neck Bending | 5 | 2 |
| 2 b | Hand Stretch (up) | 3 | 1 |
| 2 c | Hand Stretch (sidewise) | 3 | 1 |
| 2 d | Shoulder Rotation (Clock and anti-clock wise) | 5 each | 2 |
| 2 e | Hip Rotation (Clock and anti-clock wise) | 5 each | 1 |
| 2 f | Knee Movement | 5 | 1 |
| 2 g | Ankles up & down | 5 | 2 |
| **3** | **Modified 12 Pose Suryanamaskar** (Pranamasana, Ardhchakrasana, Tadasana, Aswasanchalasana, Dandasana, Ashtangasana, Bhujangasana, Dandasana, Aswasanchalasana, Tadasana, Ardhchakrasana and Pranamasana) | 1 | **5** |
| 4 | **Asanas** | | **11** |
| 4.1 | **Supine lying Pose** | | |
| 4.1.a | Jatharaparivarita Asana (both side) | 1 | 2 |
| 4.1.b | Setubandhanasana | 1 | 1 |
| 4.2 | **Prone Lying Pose** | | |
| 4.2.a | Bhujangasana | 2 | 2 |
| 4.2.b | Purna Shalbhadana | 2 | 2 |
| 4.2.c | **Sitting Pose Asana** | | |
| 4.2.d | Ardha Ushtrasana | 2 | 2 |
| 4.3 | Shasankasan | 2 | 2 |
| 4.3.a | **Kapalbhati Kriya** | **3 rounds** | **6** |
| 4.3.b | **Pranayama** | | **10** |
| 4.3.c | Anulom-Vilom | 3 | 3 |
| **5** | Bhramari | 3 | 3 |
| **6** | Shitali | 2 | 2 |
| 6.1.a | Bhrastika | 2 | 2 |
| **7** | **Body awareness meditation at Shavasana (For deep relaxation)** | **1** | **15** |
| **8** | **Closing Prayer** | **1** | **1** |
| **Total** | | | **60 Minutes** |

**Pic. 3**



**Pic. 4**

**Pic. 5**

**Pic. 3, 4 & 5: Yoga Orientation Programme**

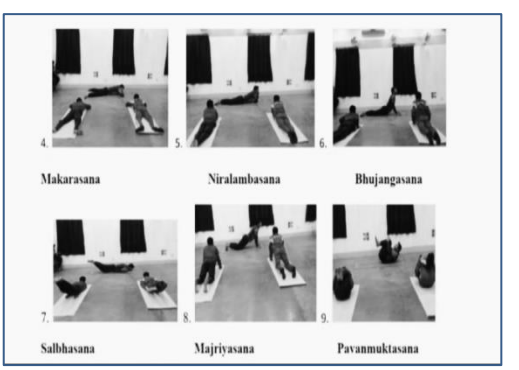
**Pic.6** **Pic.7**

**Pic. 6 &7: Blood separation in centrifuges device**

**Pic. 8** **Pic. 9**

**Pic. 8: Collection of Serum**

**Pic. 9: Patient's Response**

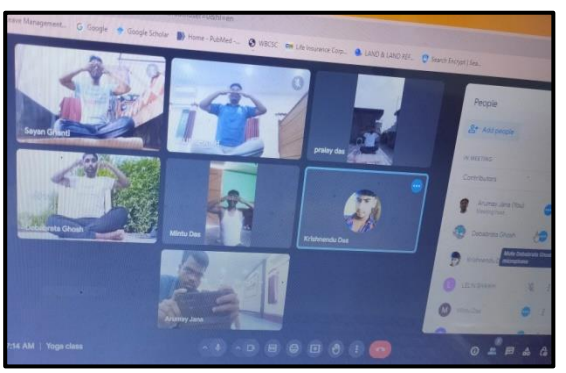



**Pic. 10** **Pic. 11**

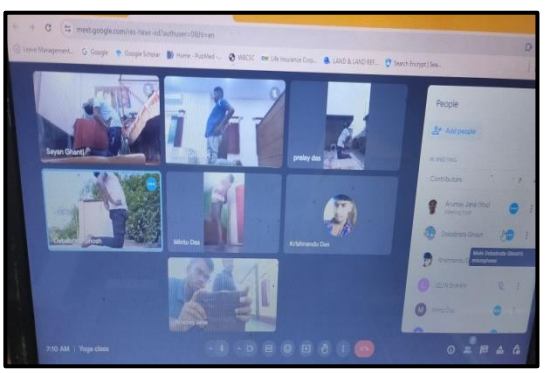
**Pic. 10 &11: Selected Asanas (Postures) for patients with AS**

Pic. 12

Pic. 13



Pic. 14



Pic. 15

**Pic. 12-15: Online Monitoring of the Patients**

## 3.14 STATISTICAL PROCEDURE

These statistical procedures were applied in order to analyse the data that was gathered.

After checking the normality of the data, non-parametric statistics were applied in this study.

- The Mean, Standard Deviation (SD) and Mean Rank each group data set were calculated.
- First quartile ( Q1), Median and third quartile (Q3) of each group data set were computed.
- Between two independent groups difference was tested by the Mann-Whitney U test.
- For the paired comparison of a group (within a group), the Wilcoxon signed rank test was adopted.
- The level of significance was set at 0.05 level of confidence, which, in the opinion of the investigator, was deemed adequate.

# CHAPTER -IV

## *RESULTS*

# CHAPTER-IV

# RESULTS

Statistical presentation of results, analysis and clarification of the results in the light of the existing knowledge of field and testing of hypothesis formulated in the beginning of this thesis has been presented in this chapter.

## 4.1. The Data:

Finally, in this study, a total of 43 patients (age 27.3±9.52 years), among which yoga group=23 and control group=20 patients data were considered and statistical calculation were done using SPSS 22.0 software. The normality of the two groups' data was calculated by considering the value of $z_{sk}$ and $z_{ku}$. The z-scores of skewness ($z_{sk}$) were calculated through dividing the skew value by its standard error and also the z-score of kurtosis ($z_{ku}$), were calculated through dividing the kurtosis value by its standard error. The results of the z scores of skewness and kurtosis were found that either skewness or kurtosis was greater than $\pm$1.96, and likely to violate the assumption of normality of data. Thus non-parametric statistics were adopted for analysis.

The median, first quartile (Q1), and third quartile (Q3) were measured for the interquartile range in the data set. Independent group variables were tested by the Mann-Whitney U test, and within a group comparison, the Wilcoxon signed rank test was adopted. Additionally, the mean and standard deviation (SD) of each data set are also shown in the tables.

## 4.2 Between Group Comparisons at pre-test:

### 4.2.1 Disease Activity Index and Functional Index Variables:

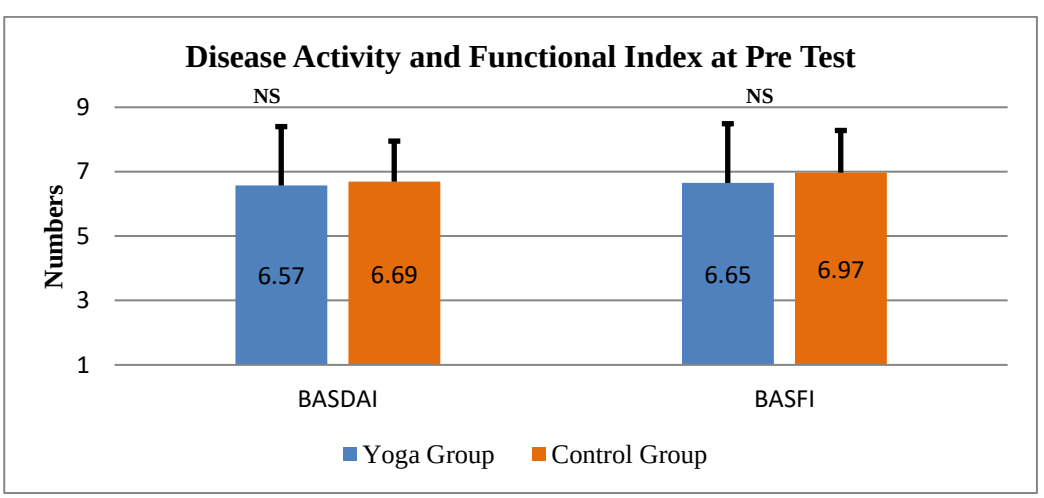
**$H_01$*:*** There exists no significant difference between yoga group and control group in Disease Activity Index and Functional Index and functional activity at pre-test

**Table no. 11: Comparison of Disease Activity Index and Functional Index of Yoga Group and Control Group at Pre-test**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| **BASDAI** | Yoga Group | 6.57±1.36 | 7.00 | 5.30 | 7.70 | 21.87 | 227.00 | .942 |
| | Control Group | 6.69±1.35 | 6.90 | 5.60 | 7.82 | 22.15 | | |
| **BASFI** | Yoga Group | 6.65±1.41 | 7.10 | 6.10 | 7.60 | 20.35 | 192.00 | .354 |
| | Control Group | 6.97±1.62 | 7.30 | 6.12 | 7.95 | 23.90 | | |

***p-value < 0.05 is significant***

Table no 11 shows that for comparing the yoga group and control group, the Mann-Whitney U test was conducted with respect to Disease Activity Index and Functional Index. It was found that BASDAI of yoga group mean 6.57±1.36, median 7.00, Q1=5.30, Q3=7.70 and mean rank is 21.87. Control group mean 6.69±1.35, median 6.90, Q1=5.60, Q3=7.82 and mean rank is 22.15. The calculated U is =227.00, and the 'p'=.942 (p>0.05). In case of BASFI yoga group mean 6.65±1.41, median 7.10, Q1= 6.10, Q3 7.60 and mean rank is 20.35. Control group mean 6.97±1.62, median 7.30, Q1= 6.12, Q3=7.95 and mean rank is 23.90. The calculated U is =192.00, and the 'p'=.354(p>0.05). So, the **Null Hypothesis is accepted** in both variables of Disease Activity Index and Functional Index and functional Activity at pre-test, which means that there are no significant differences between the yoga group and control group patients considering their Disease Activity Index and Functional Index (BASDAI) and functional Activity (BASFI).




***NS=Not Siginificant***

**Fig. 4: Graphical representations of Disease Activity Index and Functional Index variables of yoga group and control group at pre-test**

### 4.2.2 Inflammatory Markers Variables:

**$H_0$2*:*** There exists no significant difference between yoga group and control group in Inflammatory Markers variables at pre-test

**Table no. 12: Comparison of Inflammatory Marker Variables of Yoga Group and Control Group at Pre-test**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| ESR (mm/hr) | Yoga Group | 36.17±17.52 | 32 | 23 | 47 | 19.65 | 176.00 | .188 |
| | Control Group | 39.75±10.56 | 38.50 | 32.50 | 46 | 24.70 | | |
| CRP (mg/L) | Yoga Group | 11.98±13.45 | 6.63 | 2.61 | 19.36 | 19.33 | 168.50 | .134 |
| | Control Group | 24.01±24.91 | 13.42 | 3.66 | 47.22 | 25.08 | | |
| TNF-alpha (ng/L) | Yoga Group | 155.37± 64.94 | 128.47 | 120.28 | 156.52 | 20.48 | 195.00 | .394 |
| | Control Group | 159.60 ±71.66 | 136.24 | 125.15 | 169.74 | 23.75 | | |
| Cortisol (µg/dL) | Yoga Group | 8.49± 4.06 | 7.81 | 7.32 | 9.73 | 19.07 | 162.50 | .100 |
| | Control Group | 9.96±4.81 | 9.22 | 7.58 | 11.67 | 25.38 | | |

***p-value < 0.05 is significant***

Table no 12 shows that for comparing the yoga group and control group, the Mann-Whitney U test was conducted with respect inflammatory markers variables. It was found that ESR of yoga group mean 36.17±17.52, median 32, Q1=23, Q3=47 and mean rank is 19.65. Control group mean 39.75±10.56, median 38.50, Q1=32.50 and Q3=46 and mean rank is 24.70. The calculated U is =176.00, and the 'p'=.188 (p>0.05).

In case of CRP of yoga group mean 11.98±13.45, median 6.63, Q1=2.61, Q3=19.36 and mean rank is 19.33. Control group mean 24.01±24.91, median 13.42, Q1=3.66, Q3= 47.22 and mean rank is 25.08. The calculated U is =168.50 and the 'p'=.134 (p>0.05). Hence, Mann-Whitney U is not significant at a 0.05 level of significance.

In case of TNF-alpha of yoga group mean 155.37±64.94, median 128.47, Q1=120.28, Q3=156.52 and mean rank 20.48. Control group mean 159.60±71.66, median 136.24, Q1=125.15, Q3=169.74 and mean rank is 23.75. The calculated U is=195.00, and the 'p'=.394 (p>0.05).

Cortisol of yoga group means 8.49± 4.06, median 7.81, Q1=7.32, Q3=9.73 and mean rank is 20.48. Control group mean 9.96±4.81, median 9.22, Q1= 7.58, Q3=11.67 and mean rank 25.38. The calculated U is =162.50, and the 'p'=.100 (p>0.05).

So, the **Null Hypothesis is accepted** in all inflammatory markers variables, which means that there are no significant differences between the yoga group and control group patients considering their ESR, CRP, TNF-alpha and Cortisol.

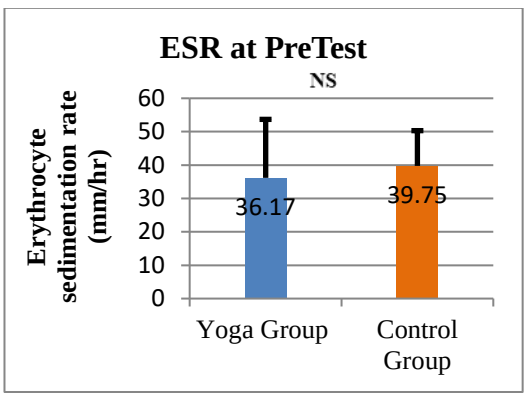



**Fig. 5**

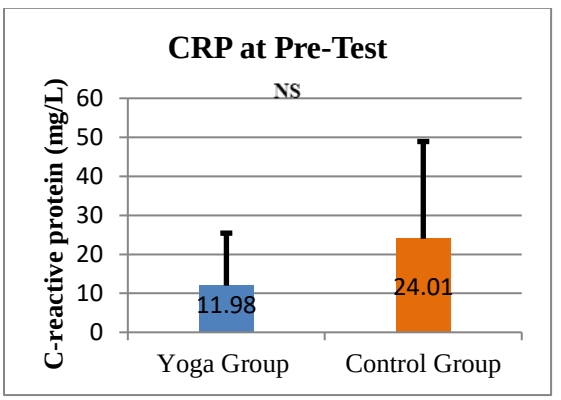
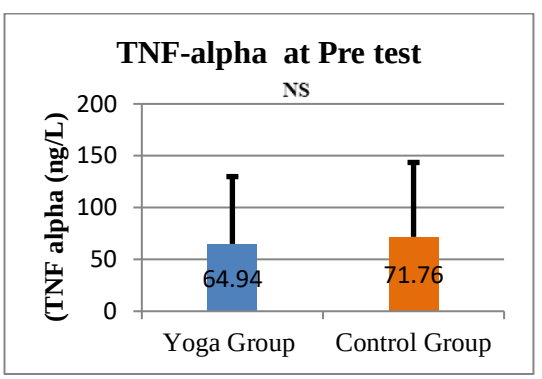



**Fig. 6**




***NS=Not Siginificant***

**Fig. 7**

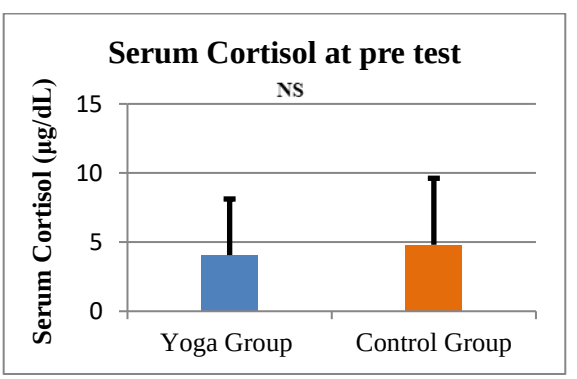



**Fig. 8**

**Fig. 5-8: Between group comparison of inflammatory markers variables of yoga group and control group at pre-test. 5) Erythrocyte sedimentation rate; 6) C-reactive protein; 7) TNF-alpha; 8) Serum Cortisol**

### 4.2.3 Blood Count Variables:

**$H_03$:** There exists no significant difference between yoga group and control group in complete blood count variables at pre-test

**Table no. 13: Comparison of Blood Count Variables of Yoga Group and Control Group at Pre-test**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Haemoglobin (g/dl) | Yoga Group | 13.36 ±1.41 | 13.60 | 12.30 | 14.40 | 23.78 | 189.00 | .318 |
| | Control Group | 13.01 ±1.09 | 12.90 | 12.05 | 14.07 | 19.95 | | |
| Total Leukocyte Count (thou/$mm^3$) | Yoga Group | 7.56 ±2.19 | 6.90 | 6 | 8.90 | 19.30 | 168.00 | .131 |
| | Control Group | 8.43 ±2.53 | 8.10 | 7.20 | 10.17 | 25.10 | | |
| Segmented Neutrophils (%) | Yoga Group | 63.80 ±9.74 | 64.30 | 56.50 | 72.50 | 22.41 | 220.50 | .817 |
| | Control Group | 64.15± 7.55 | 63.90 | 58.27 | 70.87 | 21.53 | | |
| Lymphocytes (%) | Yoga Group | 25.2 ± 7.69 | 22.80 | 18.80 | 30.50 | 22.76 | 212.50 | .670 |
| | Control Group | 24.03 ±6.46 | 23.50 | 19.90 | 28.45 | 21.13 | | |
| Monocytes (%) | Yoga Group | 6.76 ±1.97 | 7.20 | 4.80 | 8.20 | 23.96 | 185.00 | .273 |
| | Control Group | 6.51± 3.01 | 5.90 | 4.77 | 7.80 | 19.75 | | |
| Eosinophil (%) | Yoga Group | 3.59 ±3.26 | 2.60 | 1.2 | 4.7 | 20.28 | 190.50 | .336 |
| | Control Group | 4.85 ±3.99 | 4.30 | 1.32 | 7.12 | 23.98 | | |
| Basophils (%) | Yoga Group | 0.63 ±0.30 | .60 | .40 | .80 | 22.50 | 218.50 | .778 |
| | Control Group | 0.62± 0.37 | .50 | .32 | 1 | 21.43 | | |
| Platelet Count (thou/$mm^3$) | Yoga Group | 187.69±47.25 | 170 | 152 | 215 | 19.02 | 161.50 | .095 |
| | Control Group | 226.3 ±91.54 | 185.50 | 158.75 | 276.75 | 25.43 | | |

***p-value < 0.05 is significant***

Table 13 shows that for comparing the yoga group and control group, the Mann-Whitney U test was conducted with respect blood count variables. It was found that haemoglobin of yoga group mean 13.36±1.41, median 13.60, Q1=12.30, Q3=14.40 and mean rank is 23.78. Control group mean 13.01±1.09, median 12.90, Q1=12.05, Q3=12.90 and mean rank is 19.95. The calculated U is=189.00 and the 'p'=.318 (p>0.05).

In case of total leukocyte count of yoga group mean 7.56 ±2.19, median 6.90, Q1=6 Q3=8.90 and mean rank is 19.30. Control group mean 8.43±2.53, median 8.10, Q1=7.20, Q3=10.17 and mean rank 25.10. The calculated U is=168.00, and the 'p'=.131 (p>0.05).

In case of segmented neutrophils of yoga group mean 63.80±9.74, median 64.30, Q1=56.50, Q3=72.50 and mean rank is 22.41. Control group mean 64.15±7.55, median 63.90, Q1=58.27, Q3= 70.87 and mean rank is 21.53. The calculated U is=220.50, and the 'p'=.817 (p>0.05). Hence, Mann-Whitney U is not significant at a 0.05 level of significance.

In case of lymphocytes of yoga group mean 25.2 ±7.69, median 22.80, Q1=18.80, Q3=30.50 and mean rank is 22.76. Control group mean 24.03±6.46, median 23.50, Q1= 19.90, Q3=28.45 and mean rank is 21.13. The calculated U is =212.50, and the 'p'=.670 (p>0.05).

In case of monocytes of yoga group mean 6.76±1.97, median 7.20, Q1=4.80, Q3=8.20 and mean rank is 23.96. Control group mean 6.51±3.01, median 5.90, Q1=4.77, Q3=7.80 and mean rank is 19.75. The calculated U is =185.00, and the 'p'=.273 (p>0.05).

In case of eosinophil of yoga group mean 3.59±3.26, median 2.60, Q1=1.2, Q3=4.7 and mean rank is 20.28. Control group mean 4.85±3.99, median 4.30, Q1=1.32, Q3=7.12 and mean rank is 23.98. The calculated U is =190.50, and the 'p'=.336 (p>0.05).

In case of basophils of yoga group mean 0.63 ±0.30, median 0.60, Q1=.40, Q3=.80 and mean rank is 22.50. Control group mean .62±0.37, median 0.50, Q1=.32, Q3=1 and mean rank is 21.43. The calculated U is =218.50, and the 'p'=.778 (p>0.05).

In case of platelet count yoga of yoga group mean 187.69±47.25, median 170, Q1= 152, Q3=215 and mean rank is 19.02. Control group mean 226.3±91.54, median 185.50, Q1= 158.75, Q3= 276.75 and mean rank 25.43. The calculated U is=161.500, and the 'p'=.095 (p>0.05).

So, the **Null Hypothesis is accepted** in all blood count variables, which means that there are no significant differences between the yoga group and control group patients considering their haemoglobin total leukocyte count, segmented neutrophils, lymphocytes, monocytes, eosinophil, basophils and platelet count.

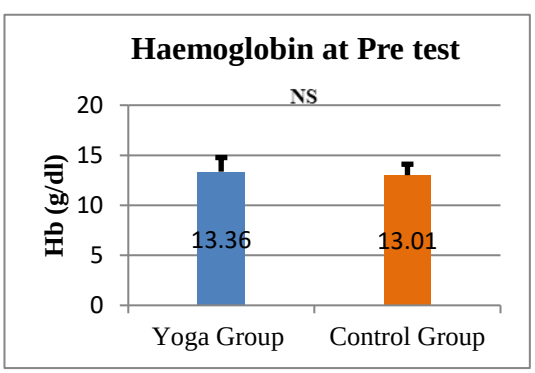



**Fig. 9**

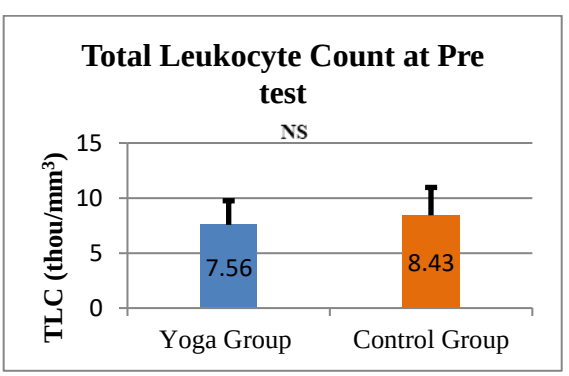



**Fig. 10**

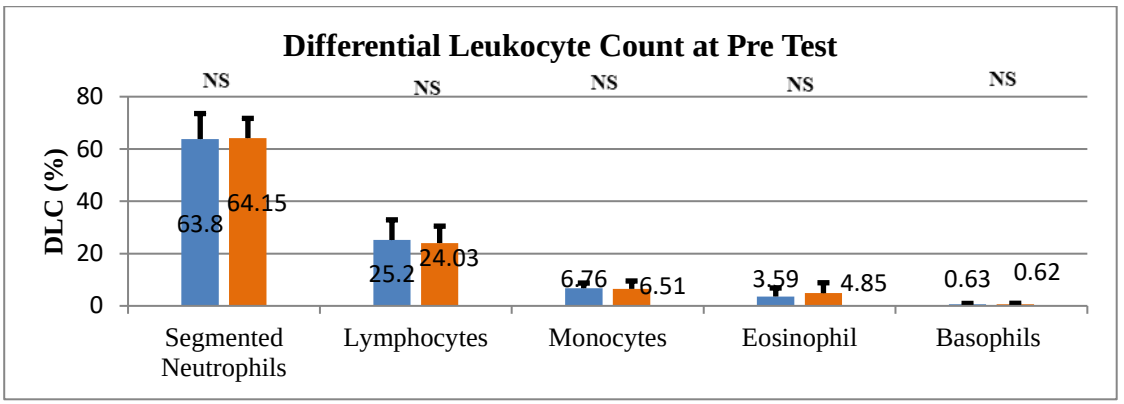
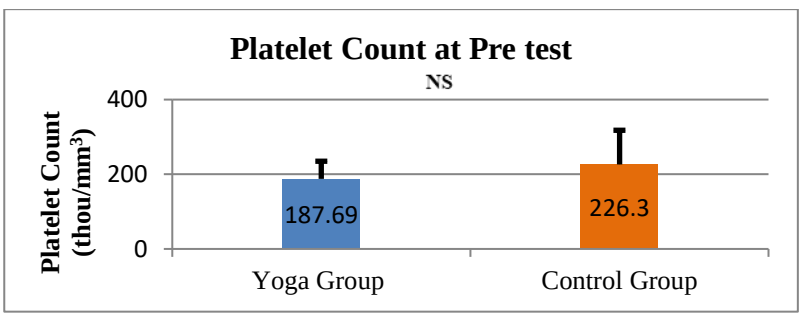



**Fig. 11**




***NS=Not Siginificant***

**Fig. 12**

**Fig. 9-12: Graphical representation of blood count variables of yoga group and control group at pre-test. 9) Haemoglobin; 10) Total Leukocyte Count; 11) Differential Leukocyte Count; 12) Platelet Count**

### 4.2.4 General Health Variables:

**$H_04$:** There exists no significant difference between yoga group and control group in general health variables at pre-test

**Table no.14: Comparison of General Health Variables of Yoga Group and Control Group at Pre-test**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Systolic BP (mmHg) | Yoga Group | 116.47±13.1 | 113 | 107 | 125 | 21.02 | 207.50 | .583 |
| | Control Group | 117.25±9.26 | 118.50 | 109.25 | 124.25 | 23.13 | | |
| Diastolic BP (mmHg) | Yoga Group | 75.47 ± 9.82 | 73 | 67 | 84 | 21.48 | 218.00 | .770 |
| | Control Group | 76.5 ± 7.59 | 76.50 | 70 | 82 | 22.60 | | |
| Resting Heart Rate (beats/minutes) | Yoga Group | 79.30±10.90 | 81 | 70 | 88 | 20.41 | 193.50 | .374 |
| | Control Group | 83.4 ±14 | 85 | 74.50 | 90.25 | 23.83 | | |
| BMI ($kg/m^2$) | Yoga Group | 22.84 ± 3.58 | 22.80 | 19.50 | 25.20 | 23.13 | 204.00 | .527 |
| | Control Group | 22.14± 3.41 | 22.20 | 19.12 | 24.92 | 20.70 | | |

***p-value < 0.05 is significant***

Table no. 14 shows that for comparing the yoga group and control group, the Mann-Whitney U test was conducted with respect general health variables. It was found that systolic blood pressure of yoga group mean 116.47±13.1, median 113, Q1=107 Q3=125 and mean rank is 21.02. Control group mean 117.25±9.26, median 118.50, Q1= 109.25, Q3= 124.25 and mean rank 23.13. The calculated U is =207.50, and the 'p'=.583 (p>0.05).

In case of diastolic blood pressure of yoga group mean 75.47±9.82, median 73, Q1= 67, Q3= 84 and mean rank is 21.48. Control group mean 76.5±7.59, median 76.50, Q1=70, Q3=82 and mean rank 22.60. The calculated U is=218.00, and the 'p'=.770 (p>0.05).

In case of resting heart rate of yoga group mean 79.30±10.90, median 81, Q1= 70, Q3= 88 and mean rank 20.41. Control group mean 83.4±14, median 85, Q1= 74.50, Q3= 90.25 and mean rank 23.83. The calculated U is =193.50, and the 'p'=.374 (p>0.05).

In case of body mass index yoga group of yoga group mean 22.84±3.58, median 22.80, Q1=19.50, Q3=25.20 and mean rank is 23.13. Control group mean 22.14±3.41, median 22.20, Q1=19.12, Q3= 24.92 and mean rank 20.70. The calculated U is =204.00, and the 'p'=.527 (p>0.05). So, the **Null Hypothesis is accepted** in all general health variables, which means that there are no significant differences between the yoga group and control group patients considering their systolic blood pressure, diastolic blood pressure, resting heart rate and body mass index.

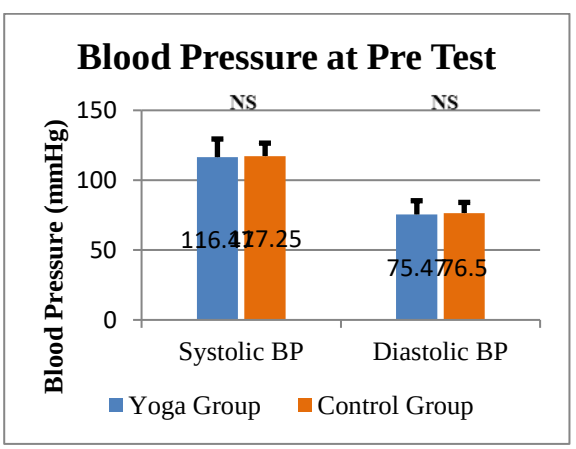



**Fig. 13**

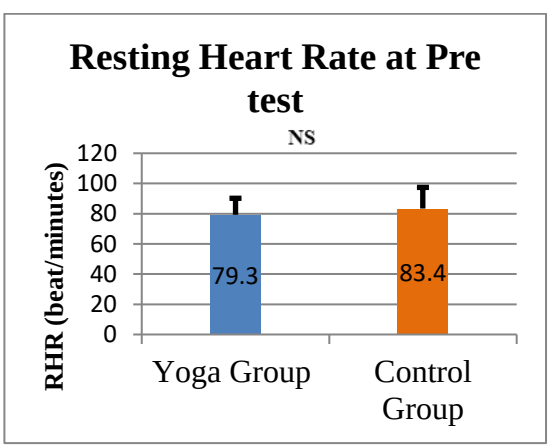
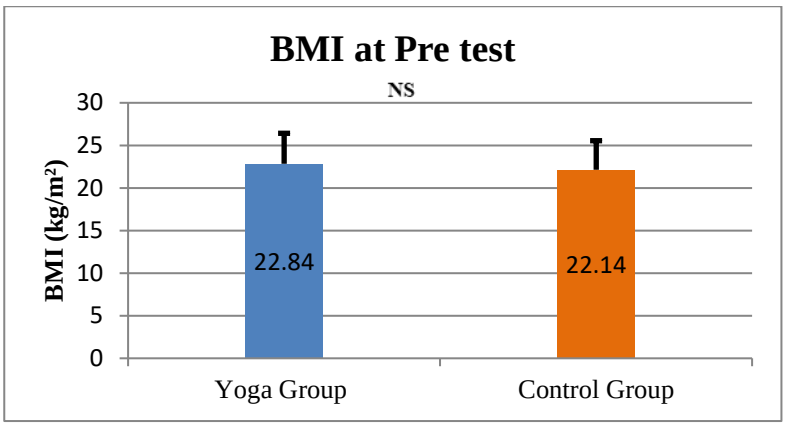



**Fig. 14**




***NS=Not Siginificant***

**Fig. 15**

**Fig. 13-15: Graphical representation of general health variables of yoga group and control group at pre-test. 13) Blood Pressure; 14) Resting Heart Rate; 15) Body Mass Index (BMI)**

### 4.2.5 Psychological Variables:

**$H_05$*:*** There exists no significant difference between yoga group and control group in psychological variables at pre-test

**Table no.15: Comparison of Psychological Variables of Yoga Group and Control Group at Pre-test**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Depression | Yoga Group | 21.13±6.33 | 19 | 17 | 22 | 22.33 | 222.50 | .854 |
| | Control Group | 20.5 ±5.84 | 19.50 | 17 | 23.50 | 21.63 | | |
| Fear Avoidance Belief in Physical Activity | Yoga Group | 17.43±3.69 | 18 | 16 | 20 | 21.57 | 220.00 | .806 |
| | Control Group | 17.65±3.78 | 18.50 | 16 | 20 | 22.50 | | |
| Fear Avoidance Belief in Work Activity | Yoga Group | 34.34±4.32 | 35 | 33 | 37 | 21.89 | 227.50 | .951 |
| | Control Group | 34.75±3.30 | 35.50 | 33 | 36.75 | 22.13 | | |
| Pain Catastrophizing | Yoga Group | 22.69±5.08 | 22 | 20 | 26 | 20.54 | 196.50 | .413 |
| | Control Group | 23.85±5.08 | 24 | 20.25 | 27 | 23.68 | | |

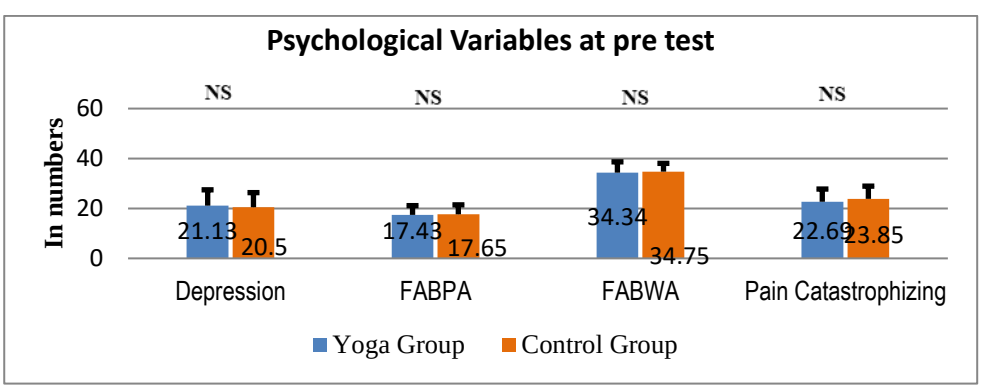
***p-value < 0.05 is significant***

Table no. 15 shows that for comparing the yoga group and control group, the Mann-Whitney U test was conducted with respect general health variables. It was found that depression of yoga group mean 21.13±6.33, median 19, Q1=17, Q3=22 and mean rank 22.33.

Control group mean 20.5±5.84, median 19.50, Q1= 17 and Q3=23.50 and mean rank is 21.63. The calculated U is =222.50, and the 'p'=.854 (p>0.05). In case of Fear Avoidance Belief in Physical Activity, of yoga group mean 17.43± 3.69, median 18, Q1=16, Q3=20 and mean rank is 21.57. Control group mean 17.65±3.78, median 18.50, Q1=16, Q3=20 and mean rank is 22.50. The calculated U is =220.00, and the 'p'=.806 (p>0.05). Hence, Mann-Whitney U is not significant at a 0.05 level of significance.

In case of Fear Avoidance Belief in Work Activity of yoga group mean 34.34±4.32, median 35, Q1=33, Q3=37 and mean rank 21.89. Control group mean 34.75±3.30, median 35.50, Q1=33, Q3=36.75 and mean rank is 22.13. The calculated U is =227.50, and the 'p'=.951 (p>0.05). In case of pain catastrophizing of yoga group mean 22.69 ±5.08, median 22, Q1=20 Q3= 26 and mean rank 20.54. Control group mean 23.85±5.08, median 24, Q1=20.25, Q3= 27 and mean rank 23.68. The calculated U is =196.50, and the 'p'=.413 (p>0.05).

The **null hypothesis is accepted** in all psychological variables, which means that there are no significant differences between the yoga group and control group patients considering their depression, Fear Avoidance Belief in Physical Activity, Fear Avoidance Belief in Work Activity and pain catastrophizing.




***NS=Not Siginificant***

**Fig. 16: Graphical representations of psychological variables of yoga group and control group at pre-test**

### 4.2.6 HRQoL Variables

**$H_0$6*:*** There exists no significant difference between yoga group and control group in quality of life variables at pre-test

**Table no.16: Comparison of HRQoL Dimensions of Yoga Group and Control Group at Pre-test**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Physical Functioning | Yoga Group | 68.47±7.89 | 70 | 60 | 75 | 23.33 | 199.500 | .449 |
| | Control Group | 65.75±9.49 | 65 | 61 | 73 | 20.48 | | |
| Role limitation-Physical | Yoga Group | 60.86±16.55 | 50 | 50 | 75 | 22.72 | 213.500 | .663 |
| | Control Group | 57.5±21.61 | 50 | 50 | 75 | 21.18 | | |
| Role limitation-Emotional | Yoga Group | 56.56±21.40 | 67 | 33 | 67 | 22.46 | 219.500 | .776 |
| | Control Group | 55 ±22.59 | 67 | 33 | 67 | 21.48 | | |
| Vitality | Yoga Group | 53.56± 6.18 | 55 | 50 | 55 | 21.24 | 212.500 | .661 |
| | Control Group | 54.35 ±5.44 | 55 | 50 | 58.75 | 22.88 | | |
| Mental Health | Yoga Group | 44.52 ±6.52 | 44 | 40 | 48 | 19.70 | 177.000 | .190 |
| | Control Group | 47.7 ±6.39 | 48 | 44 | 52 | 24.65 | | |
| Social Functioning | Yoga Group | 72.52±12.80 | 75 | 65 | 80 | 24.04 | 183.000 | .245 |
| | Control Group | 69 ±11.65 | 65 | 65 | 75 | 19.65 | | |
| Pain | Yoga Group | 51 ±7.70 | 45 | 45 | 58 | 25.22 | 156.000 | .059 |
| | Control Group | 45.3± 9.18 | 45 | 38.50 | 54.25 | 18.30 | | |
| General Health | Yoga Group | 60± 9.53 | 60 | 55 | 65 | 22.96 | 208.000 | .582 |
| | Control Group | 58 ±10.56 | 62.50 | 51.25 | 65 | 20.90 | | |
| Health Change | Yoga Group | 34.78±12.47 | 25 | 25 | 50 | 19.33 | 168.500 | .093 |
| | Control Group | 43.75±17.90 | 50 | 25 | 50 | 25.08 | | |

***p-value < 0.05 is significant***

Table no. 16 shows that for comparing the yoga group and control group, the Mann-Whitney U test was conducted with respect HRQoL variables. It was found that physical functioning of yoga group mean 68.47±7.89, median 70, Q1=60, Q3=75 and mean rank is 23.33. Control group mean 65.75±9.49, median 65, Q1=61, Q3=73 and mean rank is 20.48. The calculated U is =199.500, and the 'p'=.449 (p>0.05).

In case of role limitation-Physical of yoga group mean 60.86±16.55, median 50, Q1=50, Q3= 75 and mean rank is 22.72. Control group mean 57.5±21.61, median 50, Q1= 50, Q3= 75 and mean rank is 21.18. The calculated U is =213.500, and the 'p'=.663 (p>0.05).

In case of role limitation-emotional of yoga group mean 56.56±21.40, median 67, Q1= 33, Q3= 67 and mean rank is 22.46. Control group mean 55±22.59, median 67, Q1= 33, Q3= 67 and mean rank 21.48. The calculated U is =219.500, and the 'p'=.776 (p>0.05).

In case of vitality of yoga group mean 53.56±6.18, median 55, Q1=50, Q3=55 and mean rank 21.24. Control group mean 54.35±5.44, median 55, Q1= 50, Q3= 58.75 and mean rank is 22.88. The calculated U is =212.500, and the 'p'=.661 (p>0.05).

In case of mental health count of yoga group mean 44.52 ±6.52, median 44, Q1=40, Q3= 48 and mean rank is 19.70. Control group mean 47.7±6.39, median 48, Q1=44, Q3=52 and mean rank 24.65. The calculated U is =177.000, and the 'p'=.190 (p>0.05).

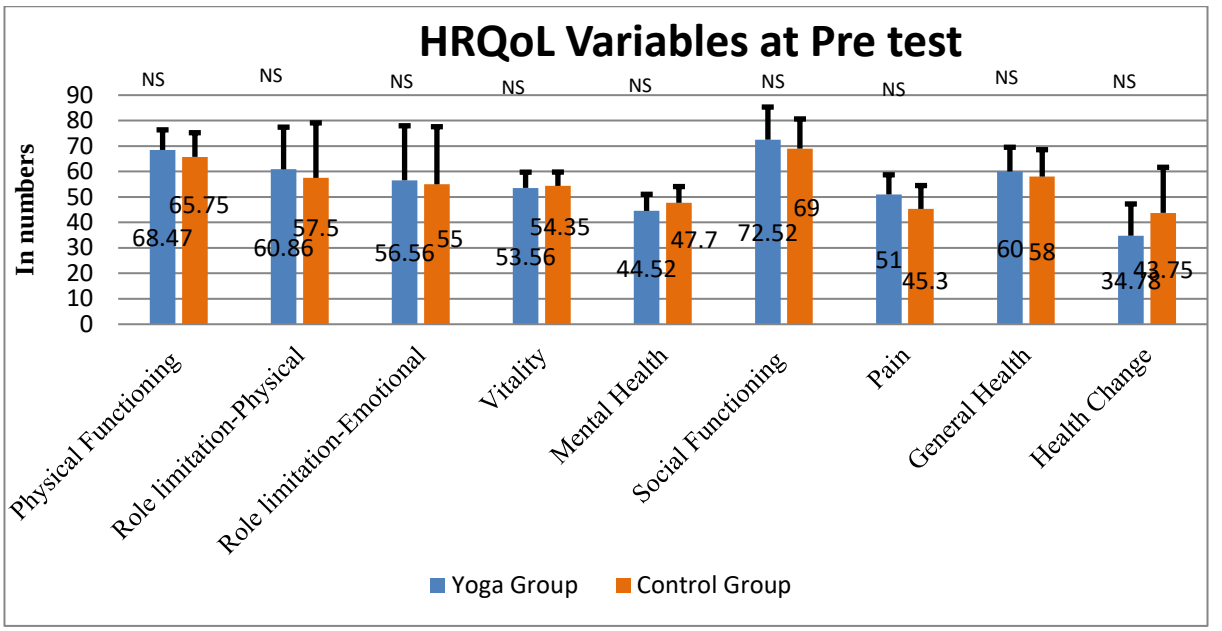
Social functioning of yoga group mean 72.52±12.80, median 75, Q1= 65, Q3= 80 and mean rank 24.04. Control group mean 69±11.65, median 65, Q1=65, Q3= 75 and mean rank 19.65. The calculated U is =183.000, and the 'p'=.245 (p>0.05).

In case of pain of yoga group mean 51±7.70, median 45, Q1=45, Q3=58 and mean rank 25.22. Control group mean 45.3±9.18, median 45, Q1=38.50, Q3= 54.25 and mean rank 18.30. The calculated U is =156.000, and the 'p'=.059 (p>0.05).

In case of general health of yoga group mean 60±9.53, median 60, Q1=55, Q3=65 and mean rank 22.96. Control group mean 58±10.56, median 62.50, Q1=51.25, Q3= 65 and mean rank 20.90. The calculated U is =208.000, and the 'p'=.582 (p>0.05).

In case of health change of yoga group mean 34.78±12.47, median 25, Q1=25, Q3=50 and mean rank is19.33. Control group mean 43.75±17.90, median 50, Q1= 25, Q3=50 and mean rank is 25.08. The calculated U is=168.500, and the 'p'=.093 (p>0.05).

So, the **null hypothesis is accepted** in all HRQoL domains, which means that there are no significant differences between the yoga group and control group patients considering their HRQoL domains.




***NS=Not Siginificant***

**Fig.17: Graphical representation of HRQoL variables of yoga group and control group at pre-test**

## 4.3. Between Group Comparisons at Post 12 Weeks:

### 4.3.1 Disease Activity Index and Functional Index:

**$H_0$7*:*** There exists no significant difference between yoga group and control group in Disease Activity Index and Functional Index variables at post 12 weeks

**Table no. 17: Comparison of Disease Activity Index and Functional Index Score of Yoga Group and Control Group at Post 12 weeks**

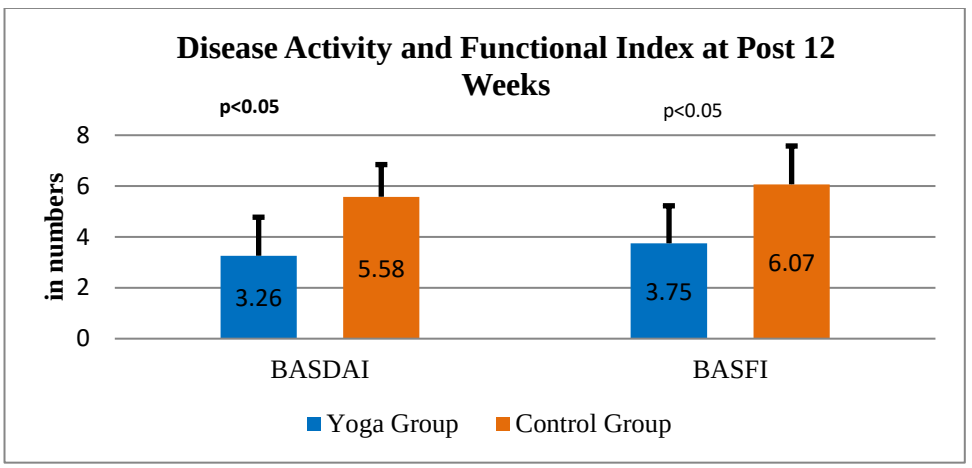
| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| BASDAI | Yoga Group | 3.26±1.51 | 3.10 | 2.10 | 4 | 14.43 | 56.00 | **.000*** |
| | Control Group | 5.58±1.26 | 5.95 | 4.72 | 6.45 | 30.70 | | |
| BASFI | Yoga Group | 3.75±1.47 | 3.80 | 2.60 | 4.20 | 14.65 | 61.00 | **.000*** |
| | Control Group | 6.07±1.50 | 6.05 | 5.22 | 7.07 | 30.45 | | |

****p-value < 0.05 is significant***

Table no. 17 shows that BASDAI of yoga group mean 3.26 ±1.51, median 3.10, Q1= 2.10, Q3 4 and mean rank is 14.43. Control group mean 5.58±1.26, median 5.95, Q1= 4.72, Q3= 6.45 and mean rank is 30.70. The calculated U is =56.00, and the 'p'=.000 ($p<0.05$). BASFI of yoga group mean 3.75±1.47, median 3.80, Q1=2.60, Q3= 4.20 and mean rank

14.65. Control group mean 6.07±1.50, median 6.05, Q1= 5.22, Q3=7.07 and mean rank 30.45. The calculated U is =61.00, and the 'p'=.000 (p<0.05).

So, the **Null Hypothesis is rejected** in both variables of disease activity index and Functional Index. The means of the yoga group in disease activity index and functional index are **lower** than the control group at post-12 weeks.




***p<0.05= Significant***

**Fig. 18: Graphical representations of Disease Activity Index and Functional Index variables of yoga group and control group at post 12 weeks**

## 4.3.2 Inflammatory Markers Variables:

**$H_0$8*:*** There exists no significant difference between yoga group and control group in Inflammatory Markers variables at post 12 weeks

**Table no.18: Comparison of Inflammatory Markers of Yoga Group and Control Group at Post 12 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| ESR (mm/hr) | Yoga Group | 19.56±11.82 | 18 | 10 | 30 | 15.17 | 73.00 | **.000*** |
| | Control Group | 34.55 ±9.17 | 34 | 28 | 38 | 29.85 | | |
| CRP (mg/L) | Yoga Group | 8.99 ±10.04 | 4.69 | 1.45 | 14.48 | 14.83 | 65.00 | **.000*** |
| | Control Group | 23.09 ± 9.99 | 20.67 | 16.30 | 30.73 | 30.25 | | |
| TNF-alpha (ng/L) | Yoga Group | 104.24±19.53 | 106.22 | 92.56 | 117.44 | 18.13 | 141.00 | **.030*** |
| | Control Group | 156.33±52.88 | 140.45 | 129.62 | 162.60 | 26.45 | | |
| Cortisol (µg/dL) | Yoga Group | 7.81± 2.86 | 8.05 | 6.81 | 9.63 | 21.45 | 219.00 | .789 |
| | Control Group | 8.25± 2.21 | 7.55 | 7.05 | 9.86 | 22.18 | | |

****p-value < 0.05 is significant***

Table no. 18 shows that ESR of yoga group mean 19.56±11.82, median 18, Q1=10, Q3= 30 and mean rank 15.17. Control group mean 34.55±9.17, median 34, Q1=28 and Q3=28 and mean rank 29.85. The calculated U is =73.000, and the 'p'=.000 (p<0.05).

In case of CRP of yoga group mean 8.99±10.04, median 4.69, Q1=1.45, Q3=14.48 and mean rank 14.83. Control group mean 23.09±9.99, median 20.67, Q1=16.30, Q3=30.73 and mean rank 30.25. The calculated U is =65.000, and the 'p'=.000 (p<0.05).

In case of TNF-alpha of yoga group mean 104.24±19.53, median 106.22, Q1=92.56, Q3=117.44 and mean rank 18.13. Control group mean 156.33±52.88, median 140.45, Q1= 129.62, Q3=162.60 and mean rank 26.45. The calculated U is =141.000, and the 'p'=.030 (p<0.05).

Cortisol of yoga group mean 7.81±2.86, median 8.05, Q1=6.81, Q3=9.63 and mean rank 21.45.Control group mean 8.25±2.21, median 7.55, Q1=7.05, Q3= 9.86 and mean rank 22.18. The calculated U is =219.000, and the 'p'=.789 (p>0.05).

So, the **Null Hypothesis is rejected** in ESR, CRP, TNF-alpha and **null Hypothesis is accepted** in cortisol. The means of the yoga group in ESR, CRP, and TNF-alpha are **lower** than the control group at post 12 weeks.

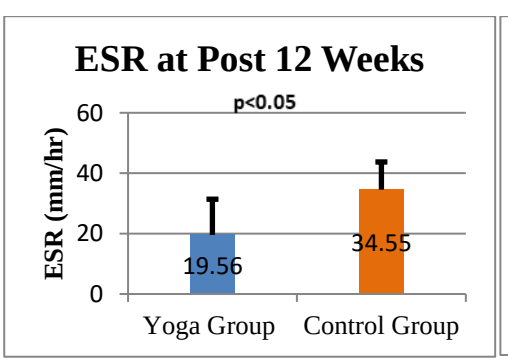



**Fig. 19**

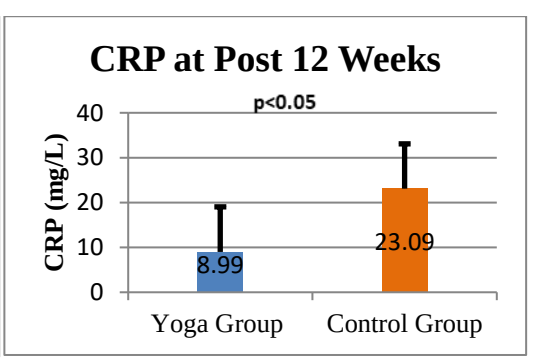
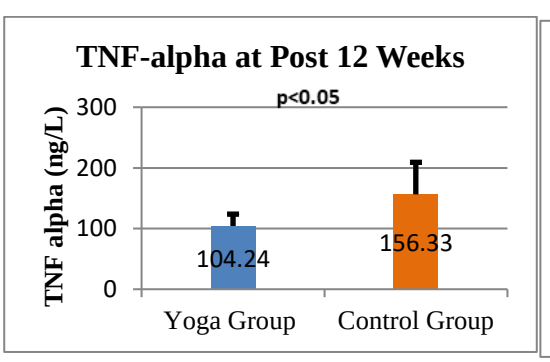



**Fig. 20**




***p<0.05= Significant, NS=No Significant***

**Fig. 21**

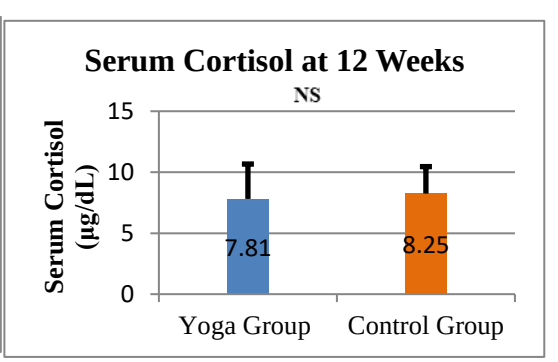



**Fig. 22**

**Fig. 19-22: Graphical representation of inflammatory markers variables of yoga group and control group at post 12 weeks. 19) ESR; 20) CRP; 21) TNF-alpha; 22) Serum Cortisol**

## 4.3.3 Blood Count Variables:

**$H_0$9*:*** There exists no significant difference between yoga group and control group in complete blood count variables at post 12 weeks

**Table no.19: Comparison of Blood Count Score of Yoga Group and Control Group at Post 12 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Haemoglobin (g/dl) | Yoga Group | 12.97±1.15 | 13 | 12.30 | 13.70 | 22.54 | 217.50 | .761 |
| | Control Group | 12.83±1.39 | 13.20 | 11.55 | 13.90 | 21.38 | | |
| Total Leukocyte Count (thou/$mm^3$) | Yoga Group | 6.41 ±1.41 | 6.60 | 5.70 | 7.30 | 15.73 | 93.00 | **.001*** |
| | Control Group | 8.44±2.34 | 8.09 | 6.69 | 9.57 | 27.85 | | |
| Segmented Neutrophils (%) | Yoga Group | 63.88±7.31 | 63.50 | 59.30 | 69.30 | 21.80 | 225.50 | .913 |
| | Control Group | 64.35±7.54 | 65.05 | 57.10 | 70.10 | 22.23 | | |
| Lymphocytes (%) | Yoga Group | 26.14±5.85 | 24.60 | 21.60 | 31 | 23.04 | 206.00 | .559 |
| | Control Group | 24.7±5.89 | 24.65 | 21.32 | 26.65 | 20.80 | | |
| Monocytes (%) | Yoga Group | 5.90±2.06 | 5.90 | 4.90 | 6.70 | 19.91 | 182.000 | .242 |
| | Control Group | 6.36 ±1.56 | 6.45 | 5.60 | 7.42 | 24.40 | | |
| Eosinophil (%) | Yoga Group | 3.50 ±2.93 | 2.60 | 1.10 | 6.10 | 22.00 | 230.000 | 1.000 |
| | Control Group | 3.82 ±3.88 | 1.55 | 1.10 | 7.49 | 22.00 | | |
| Basophils (%) | Yoga Group | .50 ±0.32 | .40 | .30 | .70 | 21.22 | 212.000 | .659 |
| | Control Group | 0.59 ±037 | .50 | .30 | .90 | 22.90 | | |
| Platelet Count (thou/$mm^3$) | Yoga Group | 178.26±24.52 | 184 | 154 | 196 | 16.13 | 95.000 | **.001*** |
| | Control Group | 246.95 ±7.67 | 233.50 | 181.25 | 316 | 28.75 | | |

***p-value < 0.05 is significant***

Table no. 19 shows that haemoglobin in the yoga group was 12.97 ±1.15, median 13, Q1=12.30, Q3=13.70 and the mean rank 22.54. Control group mean 12.83±1.39, Q1=11.55, Q3=13.90 and mean rank 21.38. The calculated U is =217.500, and the 'p'=.761 (p > 0.05).

In the case of the total leukocyte count of the yoga group mean 6.41±1.41, median 6.60, Q1= 5.70, Q3= 7.30 and mean rank 15.73. The control group mean 8.44±2.34, median 8.09, Q1=6.69, Q3=9.57 and mean rank 27.85. The calculated U is =93.000, and the 'p'=.001 (p<0.05).

In case of segmented neutrophils of the yoga group mean 63.88±7.31, median 63.50, Q1=59.30, Q3=69.30 and mean rank 21.80. The control group mean 64.35±7.54, median 65.05, Q1=57.10, Q3=70.10 and mean rank 22.23. The calculated U is =225.500, and the 'p'=.913 (p>0.05).

In case of lymphocytes of the yoga group mean 26.14±5.85, median 24.60, Q1= 21.60, Q3=31 and mean rank 23.04. The control group mean 24.7±5.89, median 24.65, Q1=21.32, Q3=26.65 and mean rank 20.80. The calculated U is =206.000, and the 'p'=.559 (p>0.05).

In case of monocytes of the yoga group mean 5.90 ±2.06, median 5.90, Q1=4.90, Q3= 6.70 and mean rank 19.91. The control group mean 6.36±1.56, median 6.45, Q1=5.60, Q3= 7.42 and mean rank 24.40. The calculated U is =182.000, and the 'p'=.242 (p>0.05).

In case of eosinophil of the yoga group mean 3.50±2.93, median 2.60, Q1=1.10, Q3= 6.10 and mean rank 22. The control group mean 3.82±3.88, median 1.55, Q1=1.10, Q3= 7.49 and mean rank 22. The calculated U is =230.000, and the 'p'=1.000 (p>0.05).

In case of basophils of the yoga group mean 0.50±0.32, median .40, Q1=.30, Q3=.70 and mean rank 21.22. The control group mean 0.59±037, median .50, Q1=.30, Q3=.90 and mean rank 22.90. The calculated U is =212.000, and the 'p'=.659 (p>0.05).

In case of platelet count of the yoga group mean 178.26±24.52, median 184, Q1= 154, Q3=196 and mean rank 16.13. The control group mean 246.95±7.67, median 233.50, Q1=181.25, Q3=316 and mean rank 28.75. The calculated U is =95.000, and the 'p'=.001 (p<0.05).

So, the **Null Hypothesis is accepted** in haemoglobin, segmented neutrophils, lymphocytes, monocytes, eosinophil and basophils and **Null Hypothesis is rejected in** total

leukocyte count and platelet count. The means of the yoga group in total leukocyte count and platelet count are **lower** than the control group at post 12 weeks.

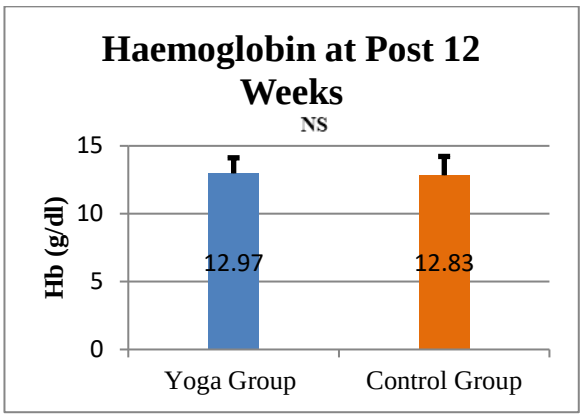



**Fig. 23**

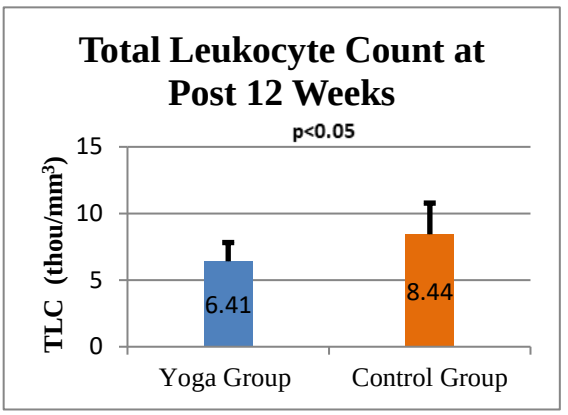



**Fig. 24**

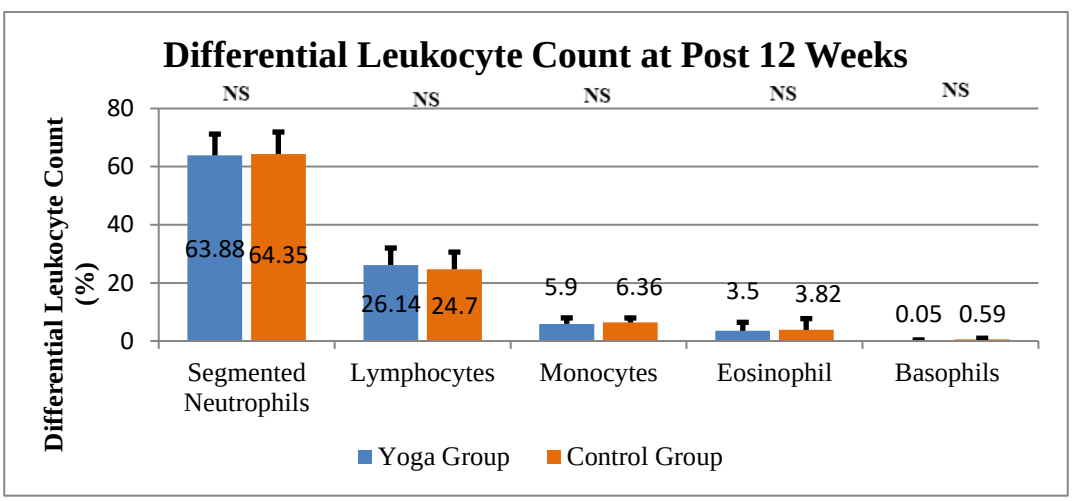
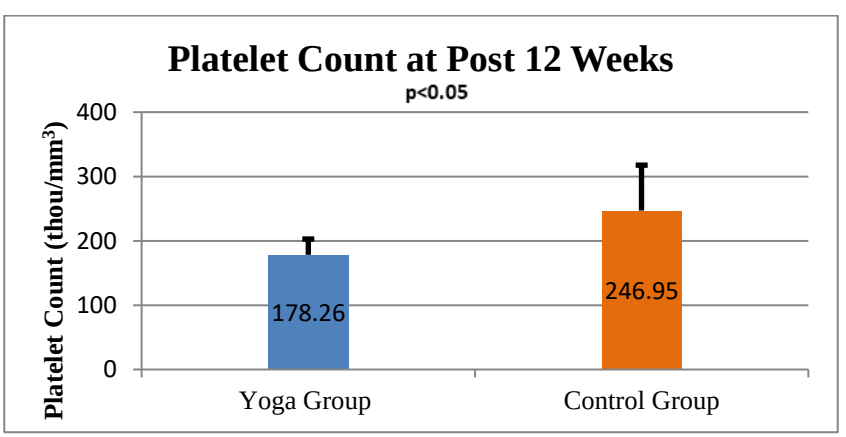



**Fig. 25**




***p<0.05= Significant, NS=Not Significant***

**Fig. 26**

**Fig. 23-26: Graphical representation of blood count variables of yoga group and control group at post 12 weeks. 23) Haemoglobin; 24) Total Leukocyte Count; 25) Differential Leukocyte Count; 26) Platelet Count**

### 4.3.4 General Health Variables:

**$H_0$10*:*** There exists no significant difference between yoga group and control group in general health variables at post 12 weeks

**Table no.20: Comparison of General Health Variables of Yoga Group and Control Group at Post 12 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Systolic BP (mmHg) | Yoga Group | 110.21±12.87 | 109 | 101 | 118 | 21.96 | 229.00 | .981 |
| | Control Group | 109.8±10.91 | 110 | 100 | 118 | 22.05 | | |
| Diastolic BP (mmHg) | Yoga Group | 69.52±8.34 | 68 | 63 | 75 | 19.89 | 181.50 | .237 |
| | Control Group | 73.15±8.79 | 72.50 | 66 | 80 | 24.43 | | |
| Resting Heart Rate (beats/minutes) | Yoga Group | 76.65±9.74 | 76 | 71 | 81 | 20.33 | 191.50 | .348 |
| | Control Group | 81.5±15.82 | 78 | 70 | 92.25 | 23.93 | | |
| BMI ($kg/m^2$) | Yoga Group | 22.52±3.28 | 22.80 | 19.60 | 25 | 21.93 | 228.50 | .971 |
| | Control Group | 22.46±3.27 | 22.65 | 20.10 | 25.62 | 22.08 | | |

***p-value < 0.05 is significant***

Table no. 20 shows that systolic blood pressure in the yoga group 110.21±12.87, median 109, Q1=101, Q3=118 and mean rank 21.96. Control group mean 109.8±10.91, median 110, Q1=100, Q3=118 and mean rank 22.05. The calculated U is =229.00, and the 'p'=.981 (p>0.05).

In case of diastolic blood pressure the yoga group 69.52±8.34, median 68, Q1= 63, Q3=75 and mean rank 19.89. Control group mean 73.15±8.79, median 72.50; Q1=66, Q3= 80 and mean rank 24.43. The calculated U is =181.50, and the 'p'=.237 (p > 0.05).

In case of resting heart rate the yoga group 76.65±9.74, median 76, Q1=71, Q3=81 and mean rank 20.33. Control group mean 81.5±15.82, median 78, Q1=70, Q3= 92.25 and mean rank 23.93. The calculated U is =191.50, and the 'p'=.348 (p > 0.05). Hence, Mann-Whitney U is not significant at the 0.05 level of significance.

In case of body mass index the yoga group was 22.52±3.28, median 22.80, Q1=19.60, Q3=25 and mean rank 21.93. Control group mean 22.46±3.27, median 22.65, Q1=20.10, Q3=25.62 and mean rank 22.08. The calculated U is =228.50, and the 'p'=.971 ($p > 0.05$).

So, the **Null Hypothesis is accepted** in systolic blood pressure, diastolic blood pressure, resting heart rate and body mass index variables.

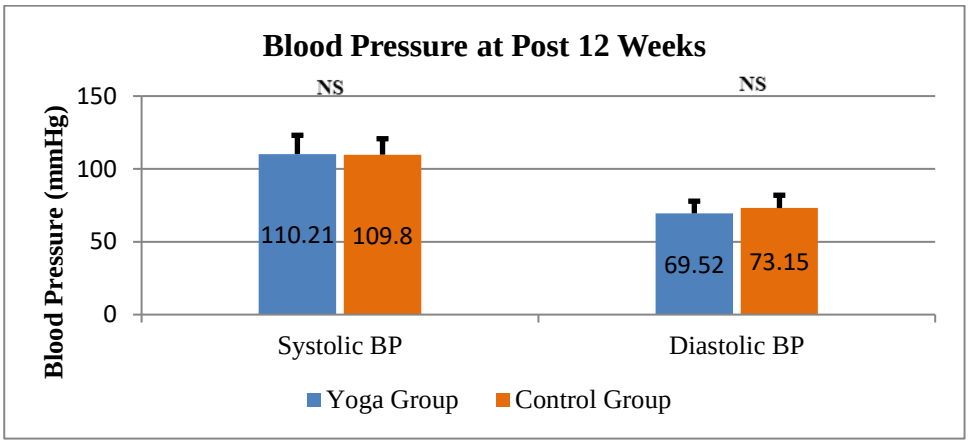
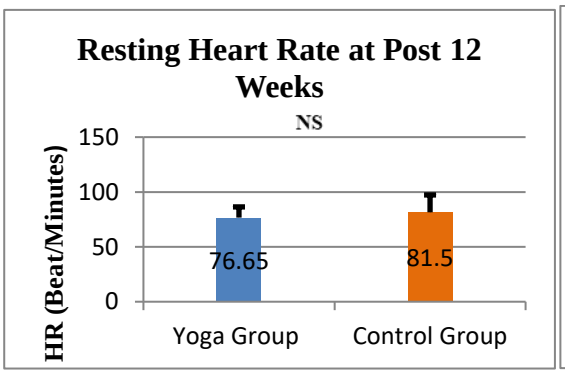



**Fig. 27**




***NS=Not Significant***

**Fig. 28**

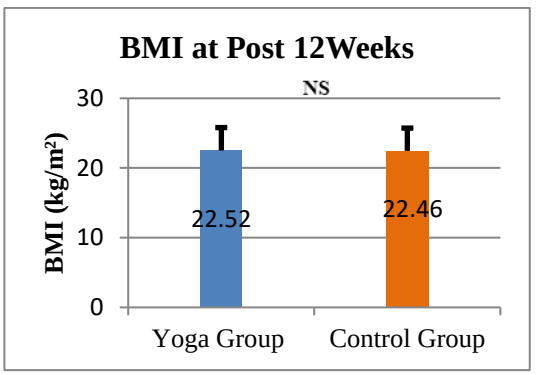



**Fig. 29**

**Fig. 27-29: Graphical representation of general health variables of yoga group and control group at post 12 weeks. 27) Blood Pressure 28) Resting Heart Rate 29) Body Mass Index**

## 4.3.5 Psychological Variables:

**$H_0$11*:*** There exists no significant difference between yoga group and control group in psychological variables at post 12 weeks

**Table no. 21: Comparison of Psychological Variables of Yoga Group and Control Group at Post 12 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Depression | Yoga Group | 14.30±5.41 | 15 | 9 | 18 | 15.65 | 84.00 | **.000*** |
| | Control Group | 21.75±6.47 | 21 | 16.25 | 25 | 29.30 | | |
| Fear Avoidance Belief in Physical Activity | Yoga Group | 13.52±4.67 | 15 | 9 | 17 | 15.59 | 82.50 | **.000*** |
| | Control Group | 18.9±3.52 | 18 | 16.25 | 22 | 29.38 | | |
| Fear Avoidance Belief in Work Activity | Yoga Group | 25.13±7.92 | 25 | 22 | 32 | 15.35 | 77.00 | **.000*** |
| | Control Group | 33.4±3.48 | 34 | 30.50 | 36 | 29.65 | | |
| Pain Catastrophizing | Yoga Group | 19.69±7.03 | 21 | 13 | 24 | 15.80 | 87.50 | **.001*** |
| | Control Group | 27.65±5.85 | 27.50 | 23.25 | 32 | 29.13 | | |

***p-value < 0.05 is significant***

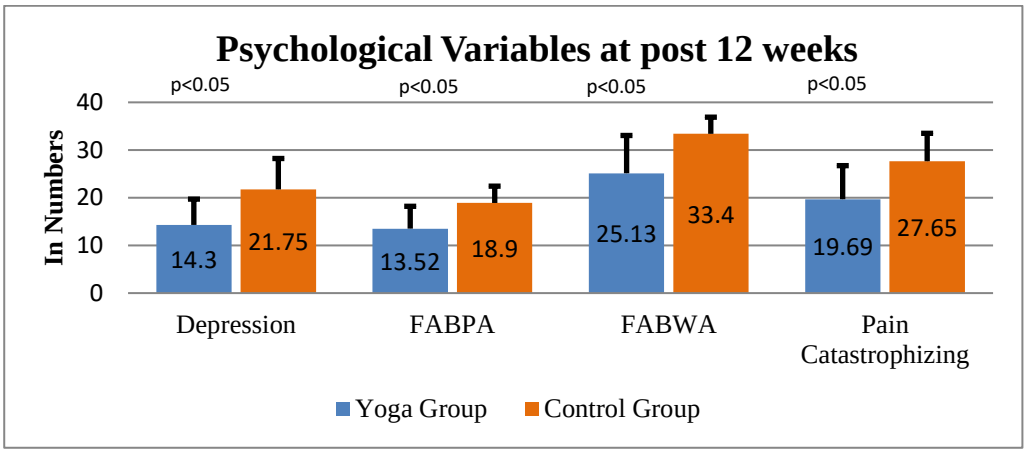
Table no. 21 shows that depression in the yoga group 14.30 ±5.41, median 15, Q1=9, Q3=18 and mean rank 15.65. Control group mean 21.75±6.47, median 21 Q1=16.25, Q3= 25 and mean rank 29.30. The calculated U is =84.00, and the 'p'=.000 (p>0.05).

In case of Fear Avoidance Belief in Physical Activity, in the yoga group 13.52 ±4.67, median 15, Q1=9, Q3=17 and mean rank 15.59. Control group mean 18.9±3.52, median 18, Q1=16.25, Q3=22 and mean rank 29.38. The calculated U is =82.50, and the 'p'=.000 (p<0.05).

In case of Fear Avoidance Belief in Work Activity in the yoga group 25.13 ±7.92, median 25, Q1=22, Q3=32 and mean rank 15.35. Control group mean 33.4±3.48, median 34, Q1=30.50, Q3=36 and mean rank 29.65. The calculated U is =77.00, and the 'p'=.000(p<0.05).

In case of pain catastrophizing in the yoga group 19.69 ±7.03, median 21, Q1=13, and Q3=24 and mean rank 15.80. Control group mean 27.65±5.85, median 27.50, Q1=23.25, Q3=32 and mean rank 29.13. The calculated U is =87.50, and the 'p'=.001 (p<.05).

So, the **Null Hypothesis is rejected** in all psychological variables i.e. depression, Fear Avoidance Belief in Physical Activity, Fear Avoidance Belief in Work Activity and pain catastrophizing variables. The means of the yoga group in all psychological variables are **lower** than the control group at post 12 weeks.




***p<0.05= Significant***

**Fig. 30: Graphical representations of psychological variables of yoga group and control group at post 12 weeks**

## 4.3.6 Health Related Quality of life (HRQoL):

**$H_0$12:** There exists no significant difference between yoga group and control group in health related quality of life variables at post 12 weeks

**Table no.22: Comparison of Health Related Quality of life (HRQoL) Dimensions of Yoga Group and Control Group at Post 12 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| **Physical Functioning** | Yoga Group | 77.82±10.09 | 75 | 70 | 85 | 27.98 | 92.500 | **.001*** |
| | Control Group | 67.25±7.15 | 70 | 61.25 | 75 | 15.13 | | |
| **Role limitation-Physical** | Yoga Group | 83.69±14.31 | 75 | 75 | 100 | 30.41 | 36.500 | **.000*** |
| | Control Group | 51.25±15.12 | 50 | 50 | 50 | 12.33 | | |
| **Role limitation-Emotional** | Yoga Group | 85.60±19.58 | 100 | 67 | 100 | 28.50 | 80.500 | **.000*** |
| | Control Group | 51.7±27.68 | 67 | 33 | 67 | 14.53 | | |
| **Vitality** | Yoga Group | 62.26±6.83 | 65 | 55 | 65 | 28.76 | 74.500 | **.000*** |
| | Control Group | 53.2±5.73 | 55 | 50 | 55 | 14.23 | | |
| **Mental Health** | Yoga Group | 59.52±5.60 | 58 | 54 | 64 | 31.80 | 4.500 | **.000*** |
| | Control Group | 44.2±6.92 | 46 | 21 | 48 | 10.73 | | |
| **Social Functioning** | Yoga Group | 81.52±10.04 | 80 | 75 | 85 | 26.78 | 120.000 | **.007*** |
| | Control Group | 72.15±11.32 | 72.50 | 65 | 80 | 16.50 | | |
| **Pain** | Yoga Group | 67.56±11.38 | 70 | 60 | 75 | 28.85 | 72.500 | **.000*** |
| | Control Group | 52.45±9.17 | 47.50 | 45 | 58 | 14.13 | | |

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| **General Health** | Yoga Group | 67.60±10.85 | 70 | 60 | 75 | 25.54 | 148.500 | **.044*** |
| | Control Group | 61.25±9.85 | 65 | 55 | 68 | 17.93 | | |
| **Health Change** | Yoga Group | 65.12±26.90 | 75 | 50 | 75 | 26.65 | 123.000 | **.006*** |
| | Control Group | 47.5±17.95 | 50 | 25 | 50 | 16.65 | | |

***p-value < 0.05 is significant***

Table no. 22 shows that physical functioning in the yoga group 77.82±10.09, median 75, Q1=70, and Q3=85 and mean rank 27.98. Control group mean 67.25±7.15, median 70, Q1= 61.25, Q3= 75 mean rank 15.13. The calculated U is =92.500, and the 'p'=.001(p<0.05).

In case of role limitation-Physical in the yoga group 83.69±14.31, median 75, Q1=75, Q3=100 and mean rank 30.41. Control group mean 51.25±15.12, median 50, Q1=50, Q3=50 and mean rank 12.33. The calculated U is =36.500, and the 'p'=.000 (p<0.05).

In case of role limitation-emotional in the yoga group 85.60±19.58, median 100, Q1=67, Q3=100 and mean rank 28.50. Control group mean 51.7±27.68, median 67, Q1= 33, Q3=67 and mean rank 14.53. The calculated U is =80.500, and the 'p'=.000 (p<0.05).

In case of vitality in the yoga group 62.26 ±6.83, median 65, Q1=55, and Q3=65 the mean rank was 28.76. Control group mean 53.2±5.73, median 55, Q1=50, Q3=55 and mean rank 14.23. The calculated U is =74.500, and the 'p'=.000 (p<0.05).

In case of mental health in the yoga group 59.52±5.60, median 58, Q1=54, Q3=64 and mean rank 31.80. Control group mean 44.2±6.92, median 46, Q1=21, Q3=48 and mean rank 10.73. The calculated U is =4.500, and the 'p'=.000 (p<0.05).

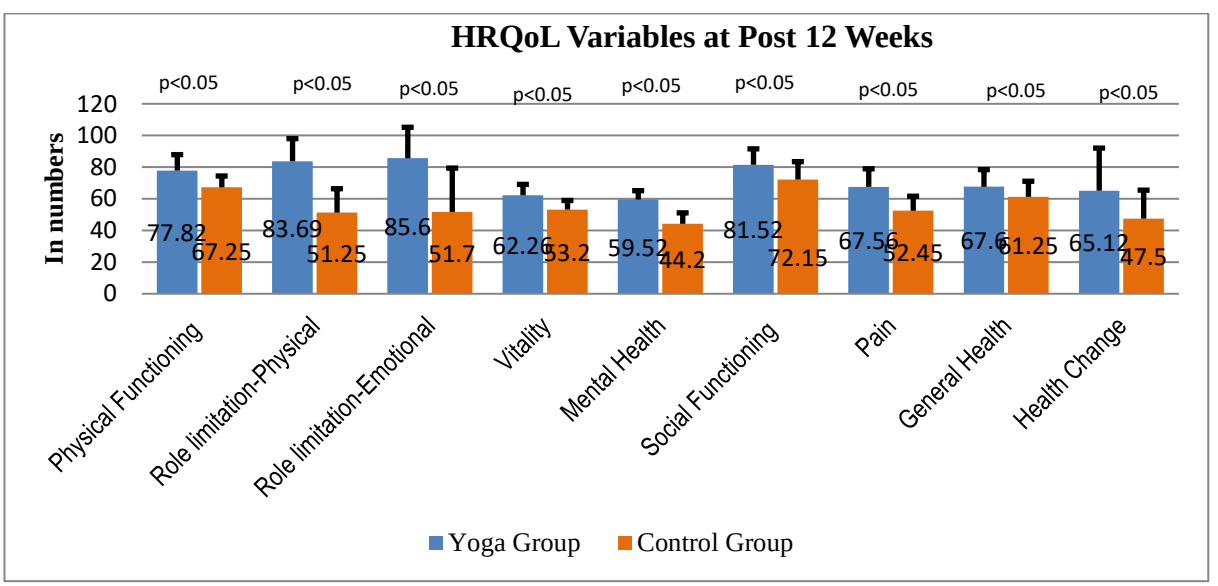
In case of social functioning in the yoga group mean 81.52±10.04, median 80, Q1= 75, Q3= 85 and mean rank 26.78. Control group mean 72.15±11.32, median 72.50, Q1=65, Q3=80 and mean rank 16.50.The calculated U is =120.000, and the 'p'=.007 (p<0.05).

In case of pain in the yoga group 67.56±11.38, median 70, Q1=60, and Q3=75 and mean rank 28.85. Control group mean 52.45±9.17, median 47.50, Q1=45, Q3=58 and mean rank 14.13. The calculated U is =72.500, and the 'p'=.000 (p<0.05).

In case of general health in the yoga group 67.60±10.85, median 70, Q1=60, Q3=75 and mean rank 25.54. Control group mean 61.25±9.85, median 65, Q1=55, Q3=68 and mean rank 17.93. The calculated U is =148.500, and the 'p'=.044 (p<0.05).

In case of health change in the yoga group was 65.12±26.90, median 75, Q1=50, and Q3=75 and mean rank 26.65. Control group mean 47.5±17.95, median 50, Q1=25, Q3=50 and mean rank 16.65. The calculated U is =123.000, and the 'p'=.006 (p<0.05).

So, the **Null Hypothesis is rejected in** all HRQoL variables i.e. physical functioning, role limitation-physical, role limitation-emotional, vitality, mental health, social functioning, pain, general health, and health change. The means of the yoga group in all HRQoL variables are **higher** than the control group at post 12 weeks.




***p<0.05= Significant***

**Fig. 31: Graphical representations of HRQoL variables of yoga group and control group at post 12 weeks**

## 4.4 Between Group Comparisons at Post 12 Weeks

### 4.4.1 Disease Activity Index and Functional Index:

**$H_0$13*:*** There exists no significant difference between yoga group and control group in Disease Activity Index and Functional Index variables at post 24 weeks

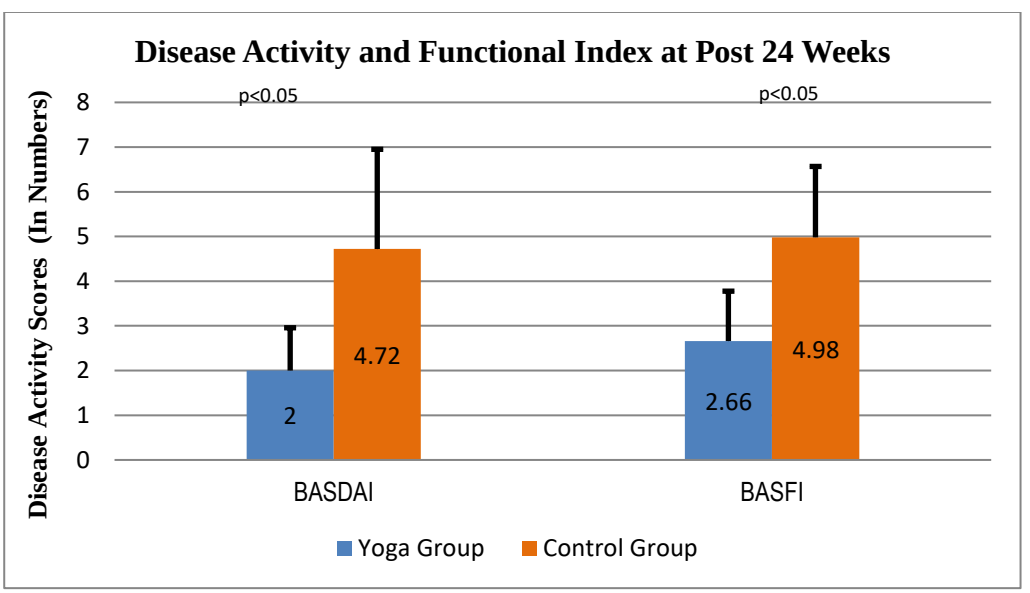
**Table no.23: Comparison of Disease Activity Index and Functional Index Score of Yoga Group and Control Group at Post 24 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| **BASDAI** | Yoga Group | 2±0.95 | 1.80 | 1.20 | 2.80 | 15.04 | 70.00 | **.000*** |
| | Control Group | 4.72±2.23 | 4.95 | 2.67 | 6.72 | 30.00 | | |
| **BASFI** | Yoga Group | 2.66±1.11 | 2.60 | 2.10 | 3.20 | 14.26 | 52.00 | **.000*** |
| | Control Group | 4.98±1.58 | 4.90 | 3.60 | 6.42 | 30.90 | | |

***p-value < 0.05 is significant***

The table no. 23 shows that the BASDAI of the yoga group mean 2±0.95, median 1.80, Q1= 1.20, Q3= 2.80 and mean rank is 15.04. The control group mean 4.72±2.23, median 4.95, Q1= 2.67, Q3= 6.72 and mean rank 30. The calculated U is =70.00, and the 'p'=.000 (p<0.05). BASFI of the yoga group mean 2.66±1.11, median 2.60, Q1=2.10, Q3= 3.20 and mean rank 14.26. Control group mean 4.98±1.58, median 4.90, Q1= 3.60, Q3=6.42 and mean rank 30.90. The calculated U is =52.00, and the 'p'=.000 (p<0.05).

So, **Null Hypothesis is rejected** in BASDAI and BASFI variables. The means of the yoga group in disease activity index and functional index variables are **lower** than the control group at post 24 weeks.




***p<0.05= Significant***

**Fig. 32: Graphical representation of Disease Activity Index and Functional Index variables of yoga group and control group at post 24 weeks**

## 4.4.2 Inflammatory Markers Variables:

**$H_0$14:** There exists no significant difference between yoga group and control group in Inflammatory Markers variables at post 24 weeks

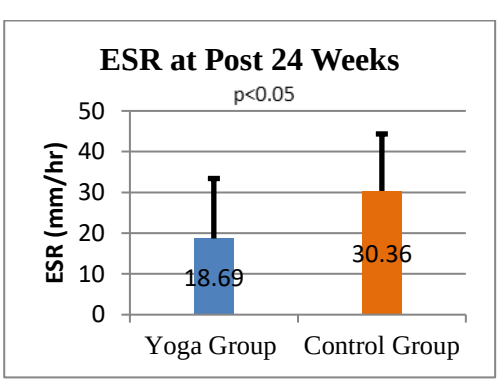
**Table no. 24: Comparison of Inflammatory Markers of Yoga Group and Control Group at Post 24 weeks**

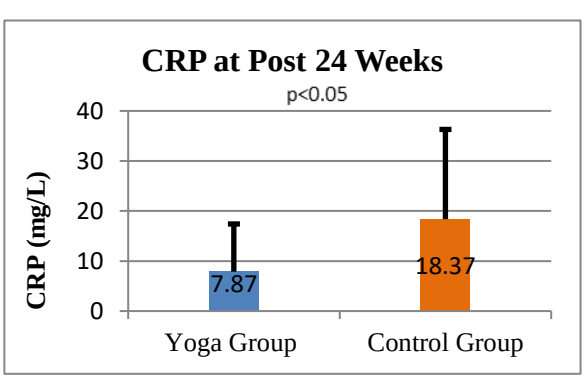
| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| ESR (mm/hr) | Yoga Group | 18.69±14.72 | 14 | 10 | 33 | 17.13 | 118.00 | **.006*** |
| | Control Group | 30.36±13.99 | 31 | 19.75 | 36 | 27.60 | | |
| CRP (mg/L) | Yoga Group | 7.87 ± 9.53 | 3.13 | .83 | 15.24 | 17.02 | 115.50 | **.005*** |
| | Control Group | 18.37±17.93 | 12.91 | 7.32 | 25.73 | 27.73 | | |

***p-value < 0.05 is significant***

The table no. 24 shows that ESR of the yoga group mean 18.69±14.72, median 14, Q1=10, Q3=33 and mean rank is 17.13. The control group mean 30.36±13.99, median 31, Q1= 19.75, Q3= 36 and mean rank is 27.60. The calculated U is =118.00, and the 'p'=.006 (p<0.05). CRP of the yoga group mean 7.87±9.53, median 3.13, Q1=.83, Q3= 15.24 and mean rank 17.02. Control group mean 18.37±17.93, median 12.90, Q1=7.32, Q3=25.73 and mean rank 25.73. The calculated U is =115.50, and the 'p'=.005 (p<0.05).

**Null Hypothesis is rejected** in ESR and CRP variables of inflammatory markers. The means of the yoga group in ESR and CRP are **lower** than the control group at post 24 weeks.




***p<0.05= Significant***

**Fig. 33** **Fig. 34**

**Fig. 33-34: Graphical representation of inflammatory markers variables of yoga group and control group at post 24 weeks. 33) ESR; 34) CRP**

## 4.4.3 Blood Count Variables:

**$H_0$15*:*** There exists no significant difference between yoga group and control group in complete blood count variables at post 24 weeks

**Table no.25: Comparison of Blood Count Score of Yoga Group and Control Group at Post 24 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Haemoglobin (g/dl) | Yoga Group | 13.51±1 | 13.70 | 12.80 | 14.30 | 26.13 | 135.00 | **.021*** |
| | Control Group | 12.76±1.83 | 12.65 | 11.80 | 13.27 | 17.25 | | |
| Total Leukocyte Count (thou/$mm^3$) | Yoga Group | 7.15±1.67 | 7.20 | 6 | 8.70 | 19.76 | 178.50 | .210 |
| | Control Group | 8.01±1.81 | 7.80 | 6.55 | 9.10 | 24.58 | | |
| Segmented Neutrophils (%) | Yoga Group | 63.69±8.77 | 65 | 58.80 | 70.20 | 23.02 | 206.50 | .567 |
| | Control Group | 62.63±7.47 | 63.75 | 59.55 | 68.47 | 20.83 | | |
| Lymphocytes (%) | Yoga Group | 26.03±7.17 | 25.20 | 21.20 | 31.70 | 21.43 | 217.00 | .752 |
| | Control Group | 27.3±6.39 | 26.60 | 22.80 | 29.60 | 22.65 | | |
| Monocytes (%) | Yoga Group | 6.17±2.97 | 6.30 | 2.90 | 9.10 | 21.50 | 218.500 | .779 |
| | Control Group | 6.54±2.50 | 6.20 | 4.82 | 8.17 | 22.58 | | |
| Eosinophil (%) | Yoga Group | 3.44±2.64 | 2.80 | 1.20 | 5.50 | 24.50 | 172.500 | .161 |
| | Control Group | 2.69±3.04 | 1.30 | .90 | 3.52 | 19.13 | | |
| Basophils (%) | Yoga Group | 0.70±0.75 | .500 | .40 | .70 | 21.57 | 220.000 | .805 |
| | Control Group | 0.59±0.24 | .550 | .40 | .70 | 22.50 | | |
| Platelet Count (thou/$mm^3$) | Yoga Group | 181.65±32.93 | 163 | 154 | 214 | 17.11 | 117.500 | **.006*** |
| | Control Group | 224.3±63.28 | 191 | 173 | 273 | 27.63 | | |

***p-value < 0.05 is significant***

Table no.25 shows that haemoglobin of the yoga group mean 13.51±1, median 13.70, Q1= 12.80, Q3= 14.30 and mean rank is 26.13. The control group mean 12.76±1.83, median 12.65, Q1= 11.80, Q3=13.27 and mean rank 17.5. The calculated U is =135.000, and the 'p'=.021 ($p<0.05$).

In case of total leukocyte count of the yoga group mean 7.15±1.67, median 7.20, Q1=6, Q3 8.70 and mean rank is 19.76. The control group mean 8.01±1.81, median 7.80, Q1= 6.55 Q3=9.10 and mean rank 24.58. The calculated U is =178.500, and the 'p'=.210 ($p>0.05$).

In case of segmented neutrophils of the yoga group mean 63.69±8.77, median 65, Q1=58.80, Q3 70.20 and mean rank is 23.02. The control group mean 62.63±7.47, median 63.75, Q1= 59.55, Q3=68.47 and mean rank 20.83. The calculated U is =206.500, and the 'p'=.567($p>0.05$). Hence, Mann-Whitney U is not significant at a 0.05 level of significance.

In case of lymphocytes of the yoga group mean 26.03±7.17, median 25.20, Q1=21.20, Q3 31.70 and mean rank is 21.43. The control group mean 27.35±6.39, median 26.60, Q1= 22.80, Q3=29.60 and mean rank 22.65. The calculated U is =217.000, and the 'p'=.752 ($p>0.05$).

In case of total monocytes count of the yoga group mean 6.17±2.97, median 6.30, Q1= 2.90, Q3 9.10 and mean rank is 21.50. The control group mean 6.54±2.50, median 6.20, Q1= 4.82, Q3= 8.17 and mean rank 22.58. The calculated U is =218.500, and the 'p'=.779 ($p>0.05$). Hence, Mann-Whitney U is not significant at a 0.05 level of significance.

In case of eosinophil yoga group of the yoga group mean 3.44±2.64, median 2.80, Q1= 1.20, Q3 5.50 and mean rank is 24.50. The control group mean 2.69±3.04, median 1.30, Q1= .90, Q3= 3.52 and mean rank 19.13. The calculated U is =172.500, and the 'p'=.161 ($p>0.05$).

In case of basophils of the yoga group mean 0.70±0.75, median .500, Q1=.40, and Q3=.70 and mean rank is 21.57. The control group mean 0.59±0.24, median .550, Q1=.40, Q3=.70 and mean rank 22.50. The calculated U is =220.000, and the 'p'=.805 ($p>0.05$).

In case of platelet count of the yoga group mean 181.65±32.93, median 163, Q1= 154, Q3 214 and mean rank is 17.11. The control group mean 224.3±63.28, median 191, Q1=173, Q3= 273 and mean rank 27.63. The calculated U is =117.500, and the 'p'=.006 ($p<0.05$).

So, the **Null Hypothesis is rejected in** haemoglobin and platelet count and **Null Hypothesis is accepted** in total leukocyte count, segmented neutrophils, lymphocytes, monocytes, eosinophil and basophils. The mean of the yoga group in haemoglobin is **higher** and **lower** in platelet count than the control group at post 24 weeks.

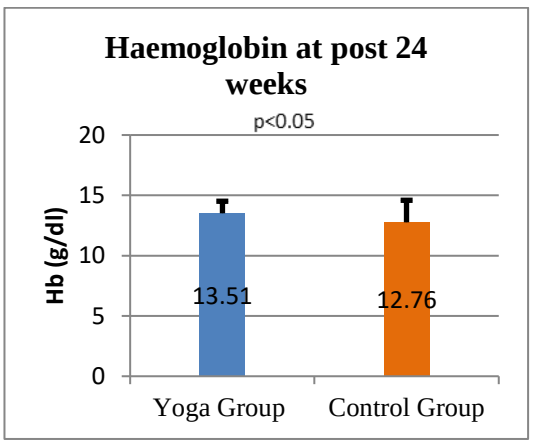



**Fig. 35**

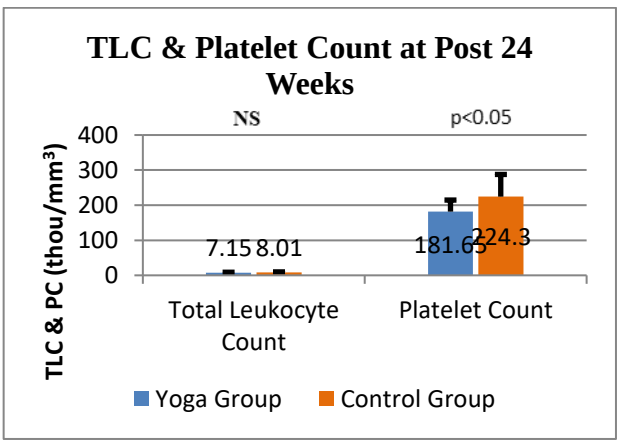
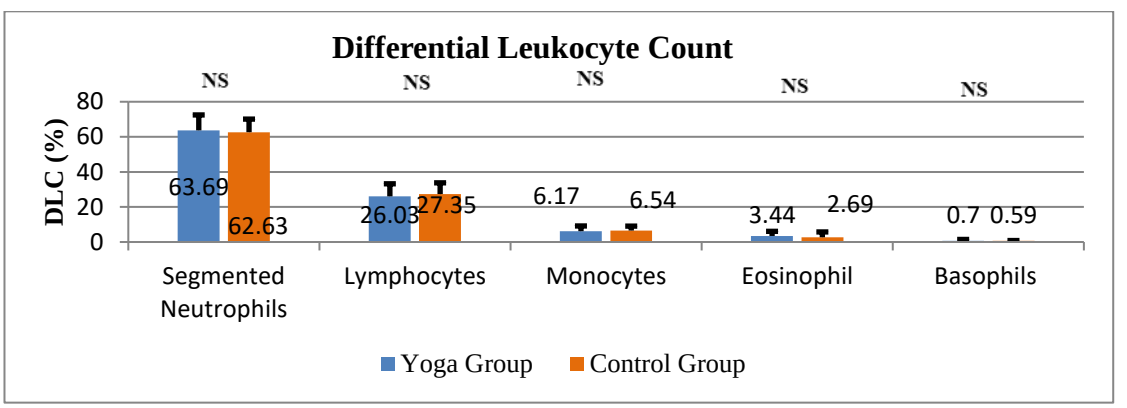



**Fig. 36**




***p<0.05= Significant, NS=Not Significant***

**Fig. 37**

**Fig. 35-37: Graphical representation of blood count variables of yoga group and control group at post 24 weeks. 35) Haemoglobin; 36) Total Leukocyte Count and Platelet Count; 37) Differential Leukocyte Count**

## 4.4.4 General Health Variables:

**$H_0$16*:*** There exists no significant difference between yoga group and control group in general health variables at post 24 weeks

**Table no. 26: Comparison of General Health Variables of Yoga Group and Control Group at Post 24 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Systolic BP (mmHg) | Yoga Group | 113.39±16.46 | 111 | 99 | 124 | 23.76 | 189.50 | .324 |
| | Control Group | 103.45±23.91 | 107.50 | 99.75 | 115.75 | 19.98 | | |
| Diastolic BP (mmHg) | Yoga Group | 73.47±11.11 | 69 | 65 | 80 | 23.11 | 204.50 | .534 |
| | Control Group | 70.5±7.60 | 70.50 | 64 | 77 | 20.73 | | |
| Resting Heart Rate (beats/minutes) | Yoga Group | 79.73±11.77 | 81 | 68 | 89 | 20.41 | 193.50 | .374 |
| | Control Group | 83.35±11.51 | 79 | 75 | 93 | 23.83 | | |
| BMI ($kg/m^2$) | Yoga Group | 22.61±3.05 | 22.50 | 20.40 | 24.70 | 21.37 | 215.50 | .724 |
| | Control Group | 22.84±3.43 | 23.65 | 20.55 | 24.75 | 22.73 | | |

***p-value < 0.05 is significant***

The table no 26 shows that systolic blood pressure of the yoga group mean 113.39±16.46, median 111, Q1= 99, Q3= 124 and mean rank is 23.76. The control group mean 103.45±23.91, median 107.50, Q1=99.75, Q3=115.75 and mean rank 19.98. The calculated U is=189.50, and the 'p'=.324 (p>0.05).

In case of diastolic blood pressure of the yoga group mean 73.47±11.11, median 69, Q1=65, Q3=80 and mean rank 23.11. The control group mean 70.5±7.60, median 70.50, Q1=64, Q3=77 and mean rank 20.73. The calculated U is =204.50, and the 'p'=.534 (p>0.05).

In case of resting heart of the yoga group mean 79.73 ±11.77, median 81, Q1= 68, Q3 89 and mean rank is 20.41. The control group mean 83.35±11.51, median 79, Q1=75, Q3=93 and mean rank 23.83. The calculated U is =193.50, and the 'p'=.374 (p>0.05).

In case of body mass index of the yoga group mean 22.61±3.05, median 22.50, Q1= 20.40, Q3 24.70 and mean rank is 21.37. The control group mean 22.84±3.43, median 28,

Q1= 20.55, Q3= 24.75 and mean rank 22.73. The calculated U is =215.500, and the 'p'=.724 ($p<0.05$).

So, the **Null Hypothesis is accepted** in systolic blood pressure, diastolic blood pressure, resting heart rate and body mass index.

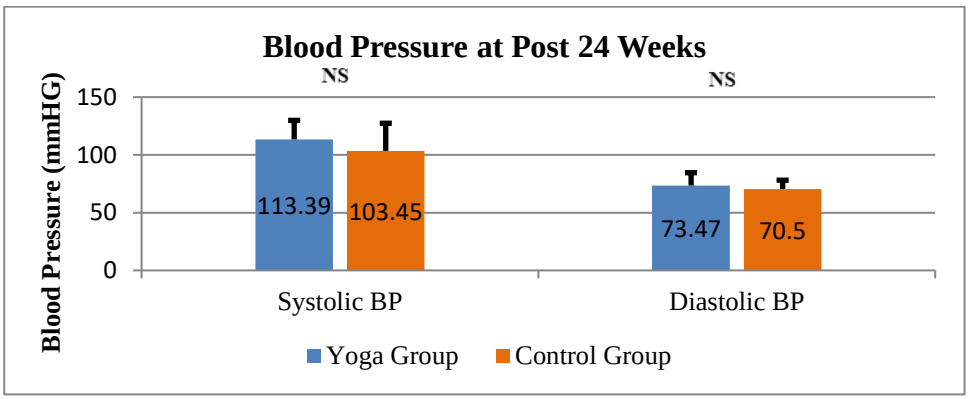
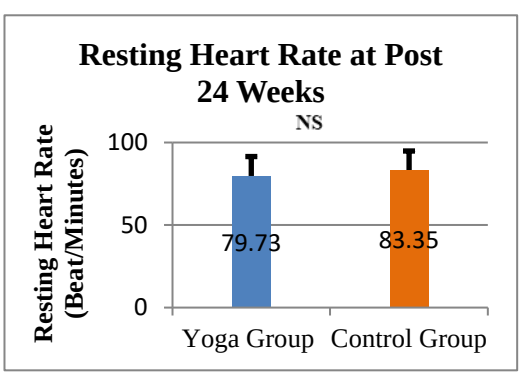



**Fig. 38**




***NS=No Significant***

**Fig. 39**

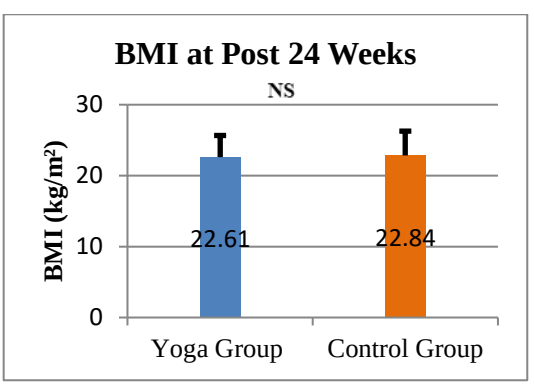



**Fig. 40**

**Fig. 38-40: Graphical representation of general health variables of yoga group and control group at post 24 weeks. 38) Blood Pressure; 39) Resting Heart Rate; 40) BMI**

## 4.4.5 Psychological Variables

**$H_0$17:** There exists no significant difference between yoga group and control group in psychological variables at post 24 weeks

**Table no. 27: Comparison of Psychological Variables of Yoga Group and Control Group at Post 24 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Depression | Yoga Group | 12.82±3.65 | 13 | 10 | 16 | 14.52 | 58.00 | **.000** |
| | Control Group | 21±6.17 | 19.50 | 17 | 27.25 | 30.60 | | |
| Fear Avoidance | Yoga Group | 11.91±4.11 | 12 | 9 | 15 | 14.48 | 57.00 | **.000** |

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Belief in Physical Activity | Control Group | 18.35±3.60 | 18.50 | 16 | 21.50 | 30.65 | | |
| Fear Avoidance Belief in Work Activity | Yoga Group | 21.91±6.45 | 22 | 20 | 26 | 14.46 | 56.50 | **.000** |
| | Control Group | 30.8±4.37 | 32 | 28 | 34 | 30.68 | | |
| Pain Catastrophizing | Yoga Group | 16.82±6.24 | 16 | 10 | 22 | 14.15 | 49.50 | **.000** |
| | Control Group | 27.05±5.39 | 28 | 24.52 | 31.50 | 31.03 | | |

***p-value < 0.05 is significant***

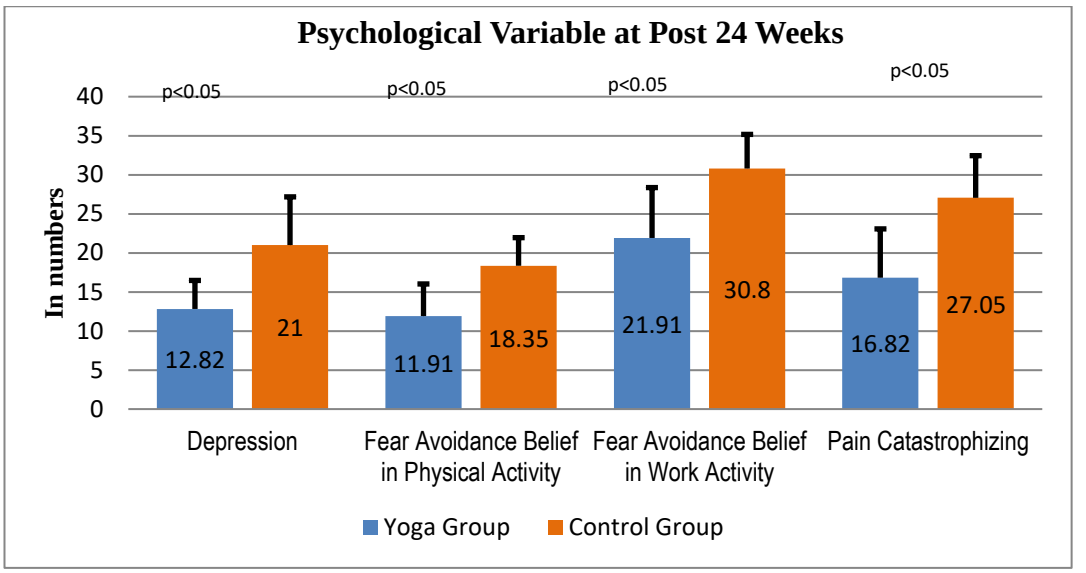
Table no. 27 shows that depression of the yoga group mean 12.82±3.65, median 13, Q1= 10, Q3=16, and mean rank is 14.52. The control group mean 21±6.17, median 19.50, Q1= 17, Q3=27.25 and mean rank 30.60. The calculated U is=58.00, and the 'p'=.000 ($p<0.05$).

In case of Fear Avoidance Belief in Physical Activity, of the yoga group mean 11.91±4.11, median 12, Q1=9, Q3=15 and mean rank is 14.48. The control group mean 18.35±3.60, median 18.50, Q1=16, Q3=21.50 and mean rank 30.65. The calculated U is =57.00, and the 'p'=.000 ($p<0.05$). Hence, Mann-Whitney U is not significant at a 0.05 level of significance.

In case of Fear Avoidance Belief in Work Activity of the yoga group mean 21.91±6.45, median 22, Q1=20, Q3=26 and mean rank 14.46. The control group mean 30.8±4.37, median 32, Q1=28, Q3=34 and mean rank 30.68. The calculated U is =56.50, and the 'p'=.000 ($p<0.05$).

In case of pain catastrophizing of the yoga group mean 16.82±6.24, median 16, Q1= 10, Q3= 22 and mean rank is 14.15. The control group mean 27.05±5.39, median 28, Q1= 24.52, Q3= 31.50 and mean rank 31.03. The calculated U is =49.50, and the 'p'=.000 ($p>0.05$).

So, the **Null Hypothesis is rejected** in all psychological variables i.e. depression, Fear Avoidance Belief in Physical Activity, Fear Avoidance Belief in Work Activity and pain catastrophizing. The means of the yoga group in psychological variables are **lower** than the control group at post 24 weeks.




**p<0.05=Significant**

**Fig. 41: Graphical representation of psychological variables of yoga group and control group at post 24 weeks**

## 4.4.6 Health Related Quality of Life:

**$H_0$18*:*** There exists no significant difference between yoga group and control group in quality of life variables at post 24 weeks

**Table no.28: Comparison of HRQoL Dimensions of Yoga Group and Control Group at Post 24 weeks**

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Physical Functioning | Yoga Group | 79.13±10.40 | 80 | 70 | 85 | 28.43 | 82.00 | **.000*** |
| | Control Group | 65.75±9.90 | 65 | 55 | 75 | 14.60 | | |
| Role limitation-Physical | Yoga Group | 86.95±14.82 | 100 | 75 | 100 | 29.63 | 54.50 | **.000*** |
| | Control Group | 60.24±12.40 | 50 | 50 | 75 | 13.23 | | |
| Role limitation-Emotional | Yoga Group | 88.52±16.07 | 100 | 67 | 100 | 28.07 | 90.50 | **.000*** |
| | Control Group | 61.75±22.53 | 67 | 33 | 67 | 15.03 | | |
| Vitality | Yoga Group | 66.07±4.63 | 65 | 60 | 70 | 29.52 | 57.00 | **.000*** |
| | Control Group | 56.6±6.79 | 55 | 50 | 62.50 | 13.35 | | |
| Mental Health | Yoga Group | 64.82±5.29 | 64 | 62 | 70 | 29.74 | 52.000 | **.000*** |
| | Control Group | 51.3±8.61 | 48 | 46 | 56 | 13.10 | | |
| Social Functioning | Yoga Group | 84.34±8.82 | 85 | 75 | 90 | 28.87 | 72.000 | **.000*** |
| | Control Group | 72.9± 7.38 | 75 | 68.50 | 75 | 14.10 | | |
| Pain | Yoga Group | 72.30± 7.85 | 75 | 65 | 75 | 28.52 | 80.000 | **.000*** |
| | Control Group | 61.15± 8.75 | 65 | 54.25 | 68 | 14.50 | | |

| Variables | Groups | Mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| General Health | Yoga Group | 73.26± 7.77 | 75 | 65 | 80 | 28.02 | 91.500 | **.001*** |
| | Control Group | 63.75± 7.58 | 65 | 56.25 | 68.75 | 15.08 | | |
| Health Change | Yoga Group | 73.91±23.20 | 75 | 75 | 75 | 27.26 | 109.000 | **.002*** |
| | Control Group | 51.25±27.47 | 50 | 50 | 75 | 15.95 | | |

***p-value < 0.05 is significant***

The table no. 28 shows that physical functioning of the yoga group mean 79.13±10.40, median 80, Q1= 70, Q3=85 and mean rank is 28.43. The control group mean 65.75±9.90, median 65, Q1= 55 and Q3=75 mean rank 14.60. The calculated U is =82.000, and the 'p'=.000 ($p<0.05$).

In case of role limitation-Physical of the yoga group mean 86.95±14.82, median 100, Q1=75, Q3=100 and mean rank is 29.63. The control group mean 60.24±12.40, median 50, Q1=50, Q3=75 and mean rank 13.23. The calculated U is =54.500, and the 'p'=.000 ($p<0.05$).

In case of role limitation-emotional of the yoga group mean 88.52±16.07, median 100, Q1=67, Q3=100 and mean rank is 28.07. The control group mean 61.75±22.53, median 67, Q1=33, Q3=67 and mean rank 15.03. The calculated U is =90.500, and the 'p'=.000 ($p<0.05$).

In case of vitality of the yoga group mean 66.07±4.63, median 65, Q1= 60, Q3=70 and mean rank 29.52. The control group mean 56.6±6.79, median 55, Q1= 50, Q3= 62.50 and mean rank 13.35. The calculated U is =57.000, and the 'p'=.000 ($p<0.05$).

In case of mental health of the yoga group mean 64.82±5.29, median 64, Q1=62, Q3=70 and mean rank 29.74. The control group mean 51.3±8.61, median 48, Q1=46, Q3=56 and mean rank13.10. The calculated U is =52.000, and the 'p'=.000 ($p<0.05$).

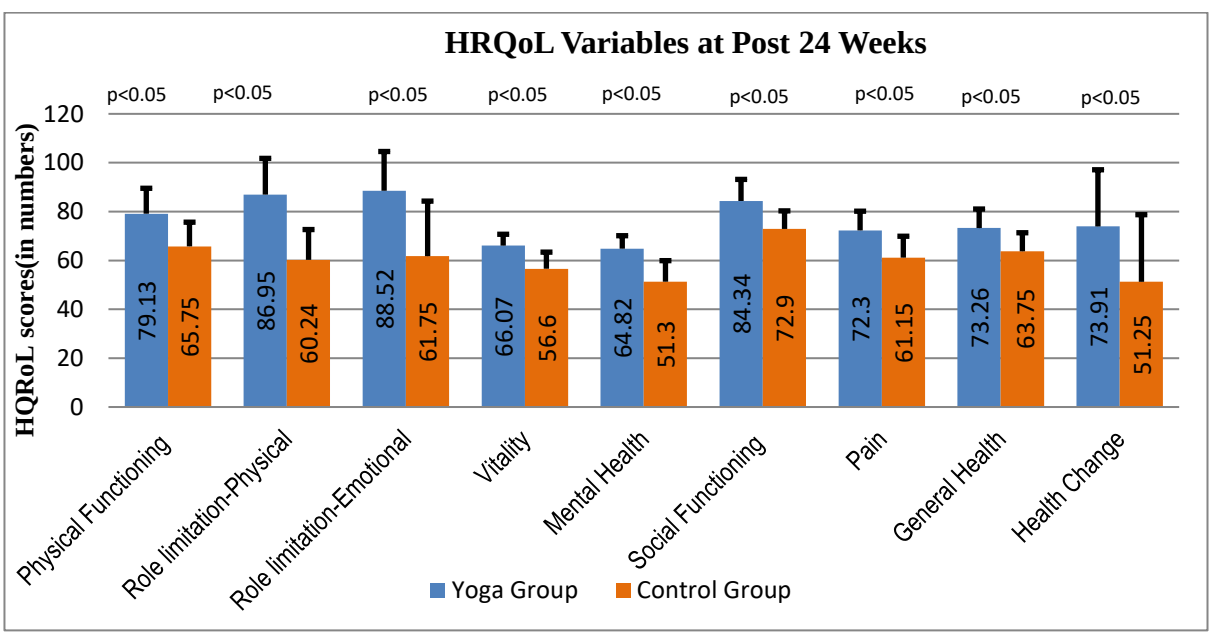
In case of social functioning of the yoga group mean 84.34±8.82, median 85, Q1=75, Q3= 90 and mean rank is 28.87. The control group mean 72.9±7.38, median 75, Q1= 68.50, Q3=75 and mean rank 14.10. The calculated U is =72.000, and the 'p'=.000 ($p<0.05$).

In case of pain of the yoga group mean 72.30±7.85, median 75, Q1= 65, Q3= 75 and mean rank 28.52. The control group mean 61.15±8.75, median 65, Q1= 54.25, Q3= 68 and mean rank 14.50. The calculated U is =80.000, and the 'p'=.000 ($p<0.05$).

In case of general health of the yoga group mean 73.26±7.77, median 75, Q1=65, Q3=80 and mean rank is 28.02. The control group mean 63.75±7.58, median 65, Q1=56.25, Q3=68.75 and mean rank 15.08. The calculated U is =91.500, and the 'p'=.001 ($p<0.05$).

In case of health change of the yoga group mean 73.91±23.20, median 75, Q1=75, Q3=75 and mean rank is 27.26. The control group mean 51.25±27.47, median 50, Q1=50, Q3=75 and mean rank 15.95. The calculated U is =109.000, and the 'p'=.002 ($p<0.05$). Hence, Mann-Whitney U is significant at a 0.05 level of significance.

So, the **Null Hypothesis is rejected** in all HRQoL variables i.e. physical functioning, role limitation-physical, role limitation-emotional, vitality, mental health**,** social functioning, pain, general health, and health change. The means of the yoga group in all HRQoL variables are **higher** than the control group at post 24 weeks.




**p<0.05=Significant**

**Fig. 42: Graphical representation of HRQoL variables of yoga group and control group at post 24 weeks**

## 4.5 Within Group Comparisons between Pre-test and Post 12 weeks both the Groups

### 4.5.1 Disease Activity Index and Functional Index Variables:

**$H_0$19-** There exists no significant difference between pre-test and post 12 weeks in yoga group with respect to disease activity index and functional index

**$H_0$20-** There exists no significant difference between pre-test and post 12 weeks in control group with respect to disease activity index and functional index

**Table no. 29: Within group comparison of pre-test and post 12 weeks of yoga group and control group with respect to Disease Activity Index and Functional Index**

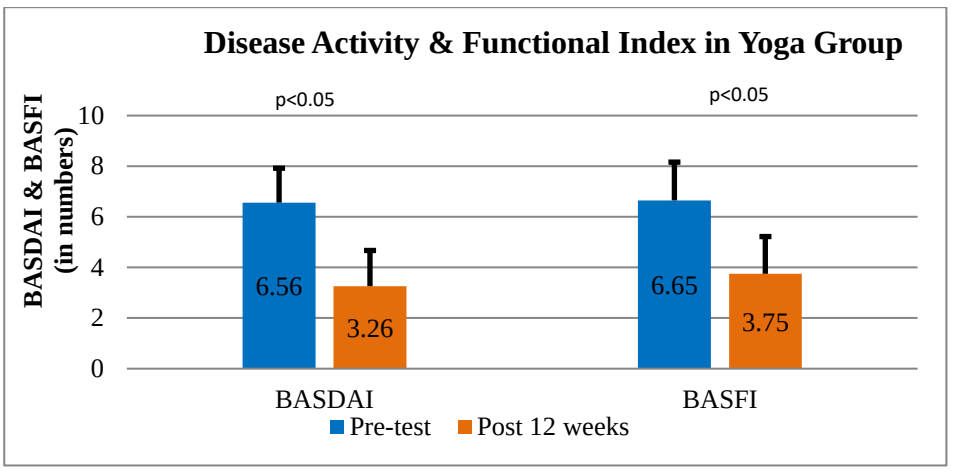
| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| BASDAI | Yoga | Pre-test | 6.56±1.36 | 7.00 | 5.30 | 7.70 | 12 | 4.198 | **.000*** |
| | | Post 12 weeks | 3.26±1.51 | 3.10 | 2.10 | 4 | 0 | | |
| | Control | Pre-test | 6.69±1.35 | 6.90 | 5.60 | 7.82 | 11.29 | 3.249 | **.001*** |
| | | Post 12 weeks | 5.58±1.26 | 5.95 | 4.72 | 6.45 | 6.00 | | |
| BASFI | Yoga | Pre-test | 6.65±1.41 | 7.10 | 6.10 | 7.60 | 12.86 | 4.017 | **.000*** |
| | | Post 12 weeks | 3.75±1.47 | 3.80 | 2.60 | 4.20 | 3.00 | | |
| | Control | Pre-test | 6.97±1.62 | 7.30 | 6.12 | 7.95 | 11.06 | 2.689 | **.007*** |
| | | Post 12 weeks | 6.07±1.50 | 6.05 | 5.22 | 7.07 | 8.25 | | |

***p-value < 0.05 is significant***

The table no. 29 shows that for within group comparison of the pre-test and post-12 weeks in the yoga group for disease activity index and functional index, the Wilcoxon Signed Ranks Test was conducted. It was found that BASDAI of the pre-test mean 6.56± 1.36, median 7, Q1=5.30, Q3=5.70 and mean rank 12. Post 12 week mean 3.26±1.51, median 3.10, Q1=2.10, Q3= 4 and mean rank 0. The calculated Z is 4.198, and the 'p'=.000 ($p<0.05$). BASDAI in the control group, pre-test mean 6.69±1.35, median 6.90, Q1=75.60, Q3=7.82 and mean rank is 11.29. Post-12 weeks mean 5.58±1.26, median 5.95, Q1=4.72, Q3=6.45 and mean rank is 6.00. The calculated Z is 3.249, and the 'p'=.001 ($p<0.05$).

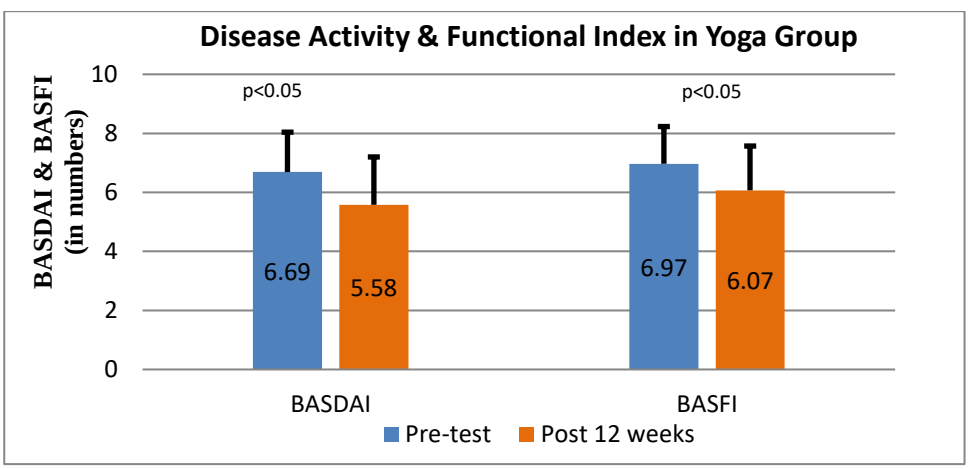
In case of BASFI, yoga group pre-test mean 6.65±1.41, median 7.10, Q1=6.10, Q3=7.60 and mean rank 12.86. Post 12 weeks mean 3.75±1.47, median 3.80, Q1=2.60, Q3=4.20 and mean rank 3. The calculated Z is 4.017, and the 'p'=.000 ($p<0.05$). BASFI in control group, pre-test mean 6.97±1.62, median 7.30, Q1= 6.12, Q3= 7.95 and mean rank is 11.06. Post 12 weeks mean 6.07±1.50, median 6.05, Q1= 5.22, Q3= 7.07 and mean rank is 8.25. The calculated Z is 2.689, and the 'p'=.007 ($p<0.05$).

So, the **Null Hypothesis is rejected** in both variables of disease activity index and functional index with respect of yoga group. The means of the post-12 weeks in the yoga group in Disease Activity Index and Functional Index variables are **lower** than the pre-test. **Null Hypothesis is rejected** in both variables with respect of control group also. The means of the post-12 weeks in the control group in disease activity index and functional index variables are **lower** than the pre-test.




**p<0.05=Significant**

**Fig. 43: Graphical representation of pre-test and post 12 weeks of yoga group with respect to Disease Activity Index and Functional Index variables**




**p<0.05=Significant**

**Fig.44: Graphical representation of pre-test and post 12 weeks of control group with respect to Disease Activity Index and Functional Index variables**

## 4.5.2 Inflammatory Markers Variables:

**$H_0$21-** There exists no significant difference between pre-test and post 12 weeks in yoga group with respect to inflammatory markers variables

**$H_0$22-** There exists no significant difference between pre-test and post 12 weeks in control group with respect to inflammatory markers variables

**Table no. 30: Within group comparison of pre-test and post 12 weeks of yoga group and control group with respect to inflammatory markers variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| ESR (mm/hr) | Yoga | Pre-test | 36.17±17.52 | 32 | 23 | 47 | 11.90 | 4.011 | **.000*** |
| | | Post 12 weeks | 19.56±11.82 | 18 | 10 | 30 | 3.0 | | |
| | Control | Pre-test | 39.75±10.56 | 38.50 | 32.50 | 46 | 11 | 1.831 | .067 |
| | | Post 12 weeks | 34.55± 9.17 | 34 | 28 | 38 | 9.33 | | |
| CRP (mg/L) | Yoga | Pre-test | 11.98±13.45 | 6.63 | 2.61 | 19.36 | 11.63 | 2.524 | **.012*** |
| | | Post 12 weeks | 8.99 ±10.04 | 4.69 | 1.45 | 14.48 | 13.75 | | |
| | Control | Pre-test | 24.12±24.091 | 13.42 | 3.66 | 47.22 | 16 | .336 | .737 |
| | | Post 12 weeks | 23.09 ±9.99 | 20.67 | 16.30 | 30.73 | 8.14 | | |
| TNF-alpha (ng/L) | Yoga | Pre-test | 155.37±64.94 | 128.47 | 120.28 | 156.52 | 13.63 | 20.48 | **.015*** |
| | | Post 12 weeks | 104.24±19.53 | 106.22 | 92.56 | 117.44 | 8.29 | | |
| | Control | Pre-test | 159.60±71.66 | 136.24 | 125.15 | 169.74 | 10.92 | .971 | .332 |
| | | Post 12 weeks | 156.33±52.88 | 140.45 | 129.62 | 162.60 | 9.88 | | |
| Cortisol (µg/dL) | Yoga | Pre-test | 8.49 ± 4.06 | 7.81 | 7.32 | 9.73 | 12.17 | .243 | .808 |
| | | Post 12 weeks | 8.25 ± 2.21 | 8.05 | 6.81 | 9.63 | 11.82 | | |
| | Control | Pre-test | 9.96 ± 8.81 | 9.22 | 7.58 | 11.67 | 10.86 | 1.755 | .079 |
| | | Post 12 weeks | 7.81±2.86 | 7.55 | 7.05 | 9.86 | 9.67 | | |

***p-value < 0.05 is significant***

The table no. 30 shows that for within group comparison of the pre-test and post-12 weeks in the yoga group for disease activity index and functional index variables, the Wilcoxon Signed Ranks Test was conducted. It was found that ESR of the yoga group pre-test mean 36.17±17.52, median 32, Q1=23 and Q3=47 and mean rank 11.90. Post 12 week

mean 19.56±11.82, median 18, Q1=10, Q3=30 and mean rank 3. The calculated Z is 4.011, and the 'p'=.000 (p<0.05). ESR in the control group pre-test mean 39.75±10.56, median 38.50, Q1= 32.50, Q3= 46 and mean rank is 11. Post-12 weeks mean 34.55±9.17, median 34, Q1=28, Q3= 38 and mean rank 9.33. The calculated Z is 1.831, and the 'p'=.067 (p>0.05).

CRP in the yoga group pre-test mean 11.98±13.45, median 6.63, Q1=2.61, Q3=19.36 and mean rank is 11.63. Post 12 weeks mean 8.99±10.04, median 4.69, Q1= 1.45, Q3=14.48 and mean rank 13.75. The calculated Z is 2.524, and the 'p'=.012 (p<0.05). CRP in the control group pre-test mean 24.12±24.091, median 13.42, Q1=3.66, Q3= 47.22 and mean rank is 16. Post-12 weeks mean 23.09 ±9.99, median 20.67, Q1= 16.30, Q3= 30.73 and mean rank 8.14. The calculated Z is .336, and the 'p'=.737 (p>0.05).

TNF-alpha in the yoga group pre-test mean 155.37±64.94, median 128.47, Q1= 120.28, Q3= 156.52 and mean rank is 13.63. Post 12 week mean 104.24±19.53, median 106.22, Q1=92.56, Q3=117.44 and mean rank 8.29. The calculated Z is 20.48, and the 'p'=.015 (p<0.05). TNF-alpha in the control group pre-test mean 159.60±71.66, median 136.24, Q1=125.15, Q3=169.74 and mean rank is 10.92. Post-12 weeks mean 156.33±52.88, median 140.45, Q1=129.62, Q3=162.60 and mean rank 9.88. The calculated Z is .971, and the 'p'=.332 (p>0.05).

Cortisol in the yoga group pre-test mean 8.49±4.06, median 7.81, Q1=7.32, Q3=9.73 and mean is 12.17. Post 12 week mean 8.25±2.21, median 8.05, Q1=6.81, Q3=9.63 and mean rank 11.82.The calculated Z is 2.524, and the 'p'=.243 (p>0.05). Cortisol in the control group pre-test mean 9.96 ±8.81, median 9.22, Q1=7.58, Q3=11.67 and mean rank is 10.86. Post-12 weeks mean 7.81±2.86, median 7.55, Q1=7.05, Q3=9.86 mean rank 9.67. The calculated Z is 1.755, and the 'p'=.079 (p>0.05.

So, the **Null Hypothesis is rejected** in ESR, CRP and TNF-alpha and **accepted** in Cortisol with respect to yoga group. The means of the post-12 weeks in the yoga group in Disease Activity Index and Functional Index variables are **lower** than the pre-test.

**Null Hypothesis is accepted** in all variables with respect to control group.

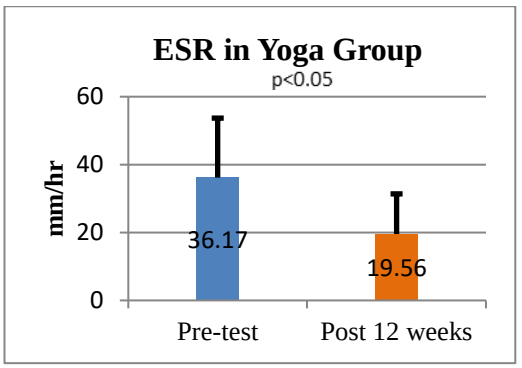



**Fig. 45**

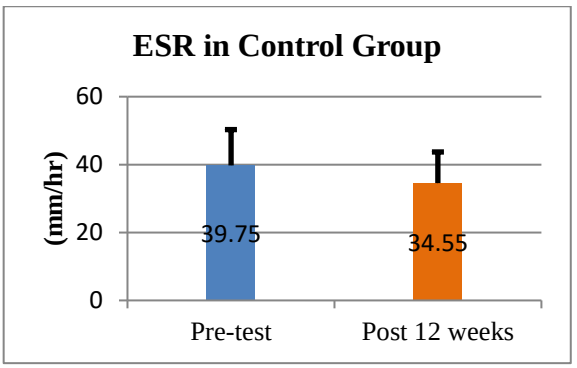



**Fig. 46**

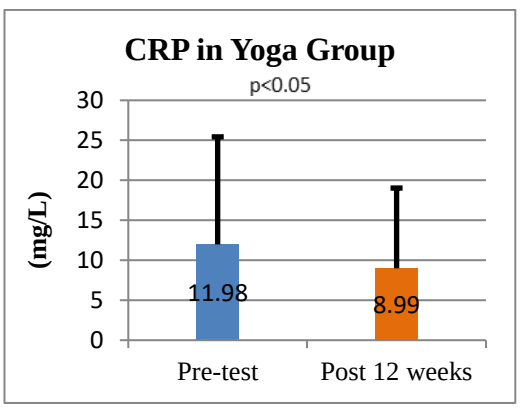



**Fig. 47**

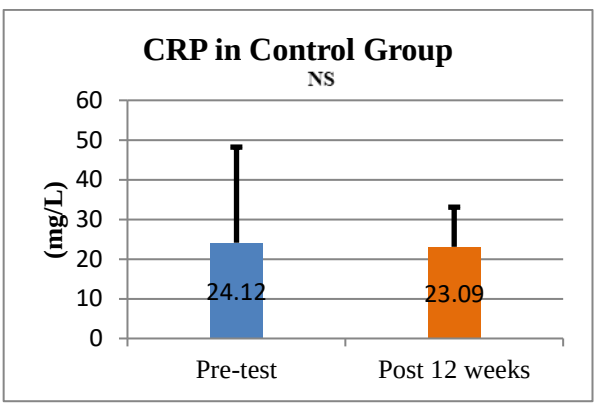



**Fig. 48**

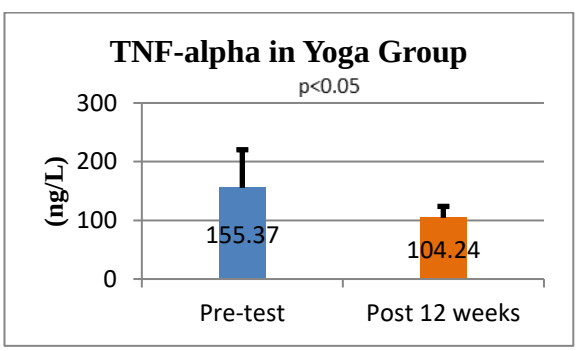



**Fig. 49**

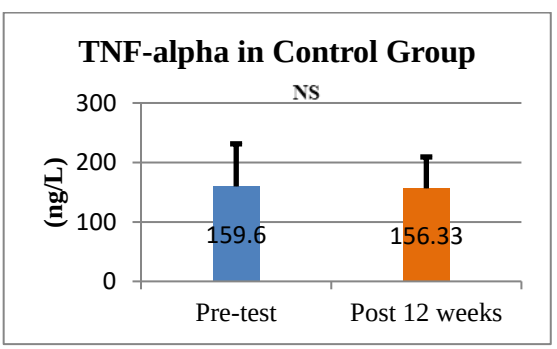
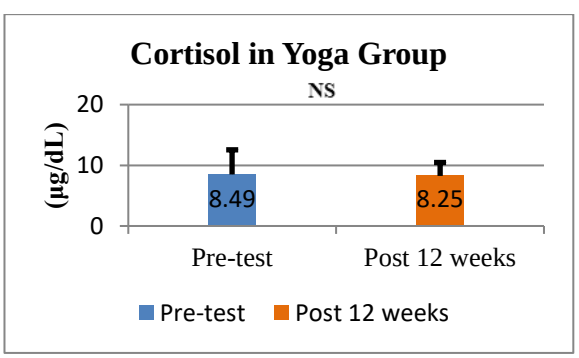



**Fig. 50**




***p<0.05=Significant, NS=Not Significant***

**Fig. 51**

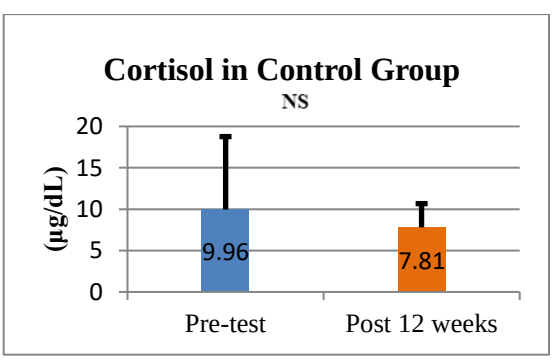



**Fig. 52**

**Fig. 45-52: Graphical representation of pre-test and post 12 weeks of yoga and control group with respect to inflammatory markers variables. 45) ESR in Yoga Group; 46) ESR in control group; 47) CRP in yoga group; 48) CRP in control group; 49) TNF-alpha in yoga group; 50) TNF-alpha in control group; 51) Cortisol in yoga group; 52) Cortisol in control group**

## 4.5.3 Blood Count Variables:

**$H_0$23-** There exists no significant difference between pre-test and post 12 weeks in yoga group with respect to blood count variables

**$H_0$24-** There exists no significant difference between pre-test and post 12 weeks in control group with respect to blood count variable.

**Table no. 31: Within group comparison of pre-test and post 12 weeks of yoga group and control group with respect to blood count variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| Haemoglobin (g/dl) | Yoga | Pre-test | 13.36±1.14 | 13.60 | 12.30 | 14.40 | 12.42 | 2.111 | **.0.35*** |
| | | Post 12 weeks | 12.97±1.15 | 13 | 12.30 | 13.70 | 6.93 | | |
| | Control | Pre-test | 13.01±1.09 | 12.90 | 12.05 | 12.90 | 12.50 | 19.95 | .840 |
| | | Post 12 weeks | 12.83±1.39 | 13.20 | 11.55 | 13.90 | 8.18 | | |
| Total Leukocyte Count (thou/$mm^3$) | Yoga | Pre-test | 7.56 ±2.19 | 6.90 | 6 | 8.90 | 10.91 | 1.559 | .119 |
| | | Post 12 weeks | 6.41 ±1.41 | 6.60 | 5.70 | 7.30 | 13.08 | | |
| | Control | Pre-test | 8.43 ±2.53 | 8.10 | 7.20 | 10.17 | 10.41 | .355 | .723 |
| | | Post 12 weeks | 8.44±2.34 | 8.09 | 6.69 | 9.57 | 10.61 | | |
| Segmented Neutrophils (%) | Yoga | Pre-test | 63.80±9.74 | 64.30 | 56.50 | 72.50 | 12.17 | .243 | .808 |
| | | Post 12 weeks | 63.88 ±7.31 | 63.50 | 59.30 | 69.30 | 11.82 | | |
| | Control | Pre-test | 64.15±7.55 | 63.90 | 58.27 | 70.87 | 10.90 | .149 | .881 |
| | | Post 12 weeks | 64.35±7.54 | 65.05 | 57.10 | 70.10 | 10.10 | | |
| Lymphocytes (%) | Yoga | Pre-test | 25.02 ±7.69 | 22.80 | 18.80 | 30.50 | 11.50 | .700 | .484 |
| | | Post 12 weeks | 26.14±5.85 | 24.60 | 21.60 | 31 | 12.38 | | |
| | Control | Pre-test | 24.3±6.46 | 23.50 | 19.90 | 28.45 | 9.15 | .504 | .614 |
| | | Post 12 weeks | 24.7±5.89 | 24.65 | 21.32 | 26.65 | 11.85 | | |
| Monocytes (%) | Yoga | Pre-test | 6.76±1.97 | 7.20 | 4.80 | 8.20 | 12.54 | 1.141 | .254 |
| | | Post 12 weeks | 5.90±2.06 | 5.90 | 4.90 | 6.70 | 11.17 | | |
| | Control | Pre-test | 6.51±3.01 | 5.90 | 4.77 | 7.80 | 12.13 | .299 | .765 |
| | | Post 12 weeks | 6.36±1.56 | 6.45 | 5.60 | 7.42 | 9.42 | | |
| Eosinophil (%) | Yoga | Pre-test | 3.59±3.26 | 2.60 | 1.2 | 4.7 | 11.00 | .487 | .626 |
| | | Post 12 weeks | 3.50±2.93 | 2.60 | 1.10 | 6.10 | 13.56 | | |
| | Control | Pre-test | 4.85±3.99 | 4.30 | 1.32 | 7.12 | 10.13 | .616 | .538 |
| | | Post 12 weeks | 3.82±3.88 | 1.55 | 1.10 | 7.49 | 11.06 | | |

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| Basophils (%) | Yoga | Pre-test | 0.63±0.30 | .60 | .40 | .80 | 10.73 | .930 | .352 |
| | | Post 12 weeks | 0.55±0.32 | .40 | .30 | .70 | 9.00 | | |
| | Control | Pre-test | 0.62 ±0.37 | .50 | .32 | 1 | 6.59 | .233 | .816 |
| | | Post 12 weeks | 0.59±0.37 | .50 | .30 | .90 | 12.70 | | |
| Platelet Count (thou/$mm^3$) | Yoga | Pre-test | 187.69±47.25 | 170 | 152 | 215 | 12.23 | .639 | .523 |
| | | Post 12 weeks | 178.26 ±24.52 | 184 | 154 | 196 | 11.70 | | |
| | Control | Pre-test | 226.3±91.54 | 185.50 | 158.75 | 276.75 | 9.56 | 1.064 | .287 |
| | | Post 12 weeks | 246.95± 70.67 | 233.50 | 181.25 | 316 | 11.13 | | |

***p-value < 0.05 is significant***

The table no. 31 shows that for within group comparison of the pre-test and post-12 weeks in the yoga group for blood count variables, the Wilcoxon Signed Ranks Test was conducted. It was found that haemoglobin of the yoga group pre-test mean 13.36±1.14, median 13.60, Q1= 12.30, Q3= 14.40 and mean rank 12.42. Post 12 week mean 12.97±1.15, median 13, Q1=12.30, Q3=13.70 and mean rank 6.93. The calculated Z is 2.111, and the 'p'=.035 (p<0.05). Haemoglobin in the control group pre-test mean 13.01±1.09, median 12.90, Q1=12.05, Q3=12.90 and mean rank is 12.50. Post-12 weeks mean 12.83±1.39, median 13.20, Q1=11.55, Q3=13.90 and mean rank 8.18. The calculated Z is 19.95, and the 'p'=.840 (p>0.05).

In case of Total Leukocyte Count, yoga group pre-test mean 7.56±2.19, median 6.90, Q1=6, Q3=8.90 and mean rank 10.91. Post 12 week mean 6.41±1.4, median 6.60, Q1=5.70, Q3=7.30 and mean rank 13.08. The calculated Z is 1.559, and the 'p'=.119(p>0.05). Total Leukocyte Count in control group pre-test mean 8.43±2.53, median, 8.10, Q1=7.2, Q3=10.17 and mean rank is 10.41. Post-12 weeks mean 8.44±2.34, median 8.09, Q1=6.69, Q3=9.57 and mean rank 10.61. The calculated Z is .355, and the 'p'=.723 (p>0.05).

In case of Segmented Neutrophils in yoga group pre-test mean 63.80±9.74, median 64.30, Q1= 56.50, Q3= 72.50 and mean rank 12.17. Post 12 week mean 63.88±7.31, median 63.50, Q1=59.30, Q3=69.30 and mean rank is 11.82. The calculated Z is .243, and the 'p'=.808 (p>0.05). Segmented Neutrophils in control group pre-test mean 64.15±7.55, median 63.90, Q1=58.27, Q3=70.87 and mean rank is 10.90. Post 12 week mean 64.35±7.54, median 65.05, Q1=57.10, Q3= 70.10 and mean rank is 10.10. The calculated Z is .149, and the 'p'=.881 (p>0.05).

In case of Lymphocytes, yoga group pre-test mean 25.02 ±7.69, median 22.80, Q1=18.80, Q3=30 and mean rank is 11.50.50. Post 12 week mean 26.14±5.85, median 24.60, and Q1=21.60, Q3=31 and mean rank 12.38. The calculated Z is .700, and the 'p'=.484 (p>0.05). Lymphocytes in control group, pre-test mean 24.3±6.46, median 23.50, Q1=19.90, Q3=28.45 and mean rank 9.15. Post 12 week mean 24.7±5.89, median 24.65, Q1=21.32, Q3=26.65 and mean rank 11.85. The calculated Z is .504 and the 'p'=.614 (p<0.05).

In case of Monocytes, yoga group pre-test mean 6.76±1.97, median 7.20, Q1=4.80, Q3= 8.20 and mean rank is 12.54. Post 12 week mean 5.90±2.06, median 5.90, and Q1=4.90 and Q3=6.70 and mean rank is 11.17. The calculated Z is 1.141, and the 'p'=.254 (p>0.05). Monocyte in control group pre-test mean 6.51± 3.01, median 5.90, Q1=4.77, Q3=7.80 and mean rank 12.13. Post 12 week mean 6.36 ±1.56, 6.45, Q1=5.60, Q3=7.42 and mean rank 9.42. The calculated Z is .299, and the 'p'=.765 (p>0.05).

In case of Eosinophil, yoga group pre-test mean 3.59 ±3.26, median 2.60, Q1=1.2, Q3=4.70 and mean rank 11.00. Post 12 week mean 3.50 ±2.93, median 2.60, Q1=1.10, Q3=6.10 and mean rank 13.56. The calculated Z is .487, and the 'p'=.626 (p>0.05). Eosinophil in control group, pre-test mean 4.85 ±3.99, median 4.30, Q1=1.32, Q3=7.12 and mean rank is 10.13. Post 12 week mean 3.82±3.88, median 1.55, Q1=1.10, Q3= 7.49 and mean rank 11.06. The calculated Z is .616, and the 'p'=.538 (p<0.05).

In case of Basophils, yoga group pre-test mean 0.63±0.30, median .60, Q1=.40, Q3=.80 and mean rank is 10.13. Post 12 week mean 0.55±0.32, median .40, Q1=.30, Q3=.70 and mean rank 9.00. The calculated Z is .930, and the 'p'=.352 (p>0.05). Basophil in control group pre-test mean 0.62±0.37, median .50, Q1=.32 Q3=1 and mean rank is 6.59. Post 12 week mean 0.59 ±0.37, median .50, Q1=.30, Q3= .90 and mean rank 12.70. The calculated Z is .233, and the 'p'=.816 (p>0.05).

In case of Platelet Count, yoga pre-test mean 187.69±47.25, median 170, Q1=152, Q3= 215 and mean rank 12.23. Post 12 week mean 178.26±24.52, median 154, Q1=154 and Q3= 196 mean rank is 11.70. The calculated Z is .639, and the 'p'=.523 (p>0.05). Platelet Count in control group pre-test mean 226.3±91.54, median 185.50, Q1=158.75, Q3=276.75 and mean rank 9.56. Post 12 week mean 246.95±70.67, median 233.50, Q1=181.25, Q3=316 and mean rank 11.13. The calculated Z is 1.064, and the 'p'=.287 (p>0.05).

So, the **Null Hypothesis is rejected** in haemoglobin but accepted in other blood count variables with respect to yoga group. And the **Null Hypothesis is accepted** in all blood count variables with respect to control group. The mean of the post-12 weeks in the yoga group in haemoglobin is **lower** than the pre-test.

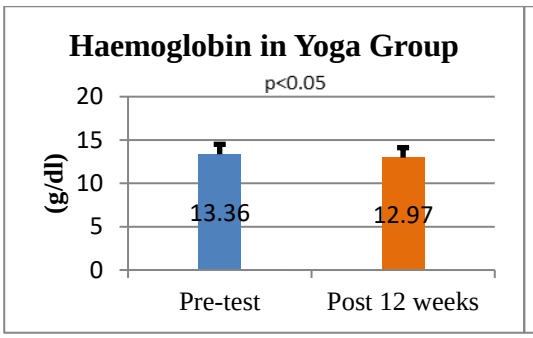



**Fig. 53**

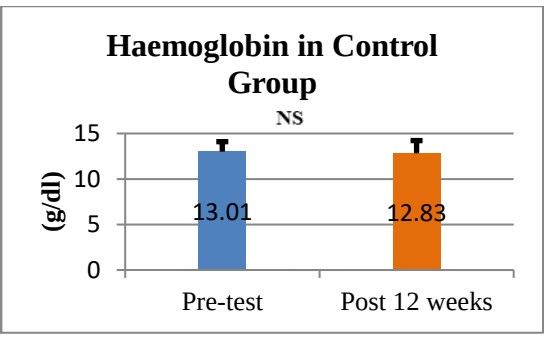



**Fig. 54**

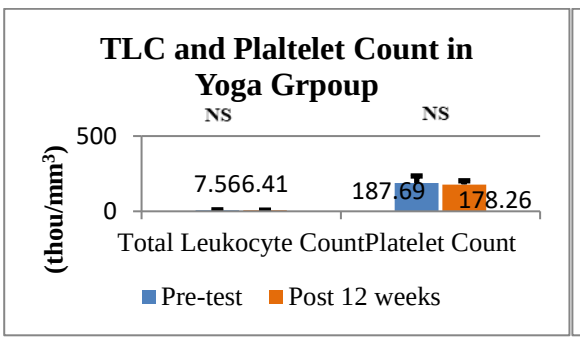



**Fig. 55**

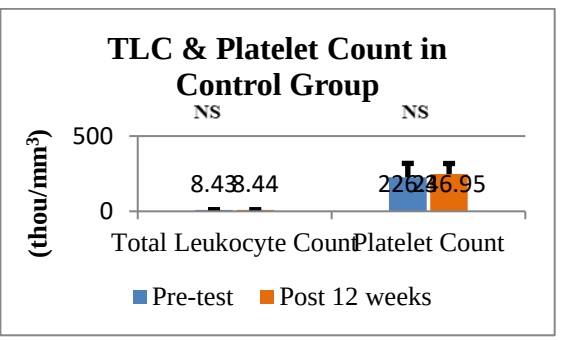



**Fig. 56**

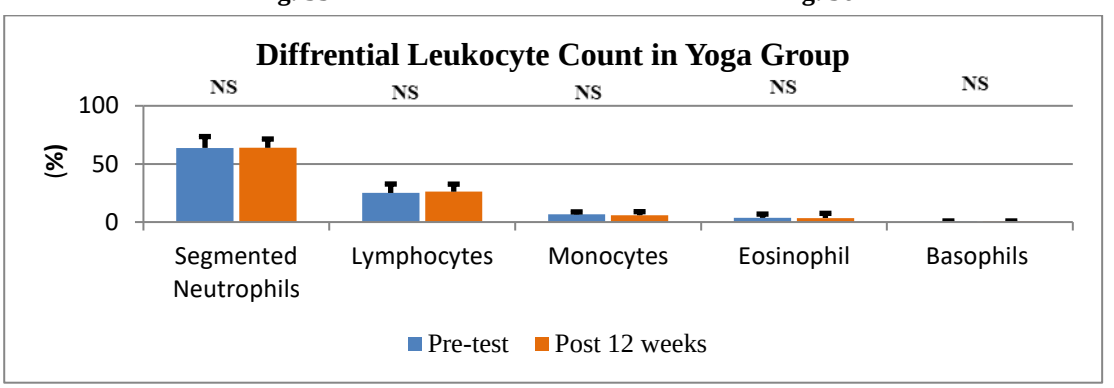
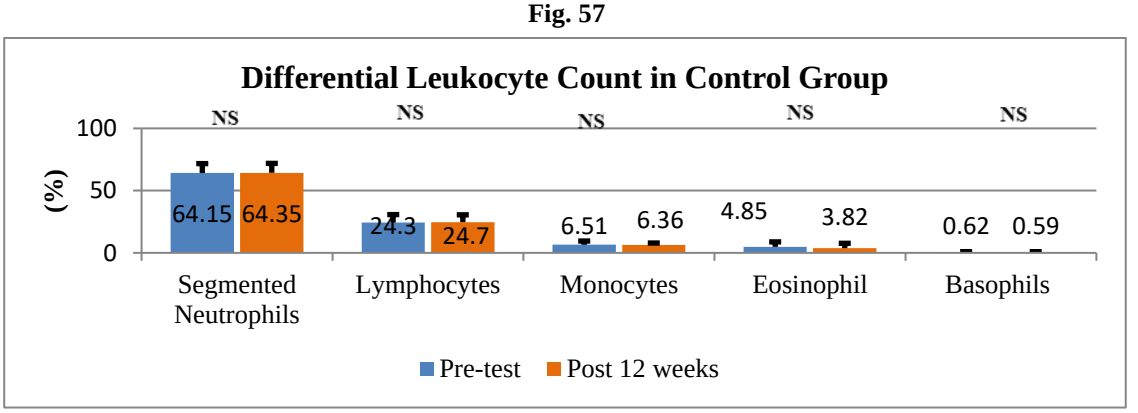



**Fig. 57**




***p<0.05=Significant, NS=No Significant***

**Fig. 58**

**Fig. 53-58: Graphical representation of pre-test and post 12 weeks of yoga and control group with respect blood count variables. 53) Haemoglobin in yoga group; 54) Haemoglobin in control group; 55) TLC and Platelet count in yoga group; 56) TLC and Platelet count in control group; 57) Differential Leukocyte Count in yoga group; 58) Differential Leukocyte Count in control group**

## 4.5.4 General Health Variables:

**$H_0$25-** There exists no significant difference between pre-test and post 12 weeks in yoga group with respect to general health variables

**$H_0$26-** There exists no significant difference between pre-test and post 12 weeks in control group with respect to general health variables.

**Table no.32: Within group comparison of pre-test and post 12 weeks of yoga group and control group with respect to general health variables**

| Variables | Group | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| Systolic BP (mmHg) | Yoga | Pre-test | 116.47 ± 13.01 | 113 | 107 | 125 | 12.92 | 2.876 | **.004*** |
| | | Post 12 weeks | 110.21± 12.87 | 109 | 101 | 118 | 8.70 | | |
| | Control | Pre-test | 117.25 ±9.26 | 118.50 | 109.25 | 124.25 | 12.50 | 3.550 | **.000*** |
| | | Post 12 weeks | 109.8± 10.91 | 110 | 100 | 118 | 2.50 | | |
| Diastolic BP (mmHg) | Yoga | Pre-test | 75.47± 9.82 | 73 | 67 | 84 | 12.71 | 2.907 | **.004*** |
| | | Post 12 weeks | 69.52± 8.34 | 68 | 63 | 75 | 7.40 | | |
| | Control | Pre-test | 76.5± 7.59 | 76.50 | 70 | 82 | 11.69 | 2.308 | **.021*** |
| | | Post 12 weeks | 73.15 ±8.79 | 72.50 | 66 | 80 | 6.33 | | |
| Resting Heart Rate (beats/Minutes) | Yoga | Pre-test | 79.30 ±10.90 | 81 | 70 | 88 | 12.71 | 1.218 | .223 |
| | | Post 12 weeks | 76.65± 9.74 | 76 | 71 | 81 | 10.89 | | |
| | Control | Pre-test | 83.4 ±14 | 85 | 74.50 | 90.25 | 10.96 | .991 | .322 |
| | | Post 12 weeks | 81.5 ±15.82 | 78 | 70 | 92.25 | 9.81 | | |
| BMI ($kg/m^2$) | Yoga | Pre-test | 22.84± 3.58 | 22.80 | 19.50 | 25.20 | 10.90 | 2.196 | **.028*** |
| | | Post 12 weeks | 22.52 ±3.28 | 22.80 | 19.60 | 25 | 9.30 | | |
| | Control | Pre-test | 22.14 ±3.41 | 22.20 | 19.12 | 24.92 | 8.50 | 1.383 | .167 |
| | | Post 12 weeks | 22.46± 3.27 | 22.65 | 20.10 | 25.62 | 11.83 | | |

***p-value < 0.05 is significant***

The table no. 32 shows that for within group comparison of the pre-test and post-12 weeks in the yoga group for general health variables, the Wilcoxon Signed Ranks Test was conducted. It was found that systolic blood pressure of the yoga group pre-test mean 116.47±13.01, median 113, Q1=107, Q3=125 and mean rank 12.92. Post 12 week mean

110.21±12.87, median 109, Q1=101, Q3=118 and mean rank 8.70. The calculated Z is 2.876, and the 'p'=.004 ($p<0.05$). Systolic blood pressure in the control group pre-test mean 117.25 ±9.26, median 118.50, Q1=109.25, Q3=124.25 and mean rank is 12.50. Post-12 weeks mean 109.8±10.91, 110, Q1=100, Q3=118 and mean rank 2.50. The calculated Z is 3.550, and the 'p'=.000 ($p>0.05$).

In case of diastolic blood pressure, yoga group pre-test mean 75.47± 9.82, median 73, Q1= 67, Q3=84 and mean rank 12.71. Post 12 week mean 69.52±8.34, median 68, Q1=63, Q3=75 and mean rank 7.40. The calculated Z is 2.907, and the 'p'=.004 ($p<0.05$). Diastolic blood pressure in control group pre-test mean 76.5± 7.59, median 76.50, Q1=70, Q3=82 and mean rank is 11.69. Post 12 week mean 73.15±8.79, median 72.50, Q1= 66, Q3=80 and mean rank 6.33. The calculated Z is 2.308, and the 'p'=.021($p<0.05$).

In case of resting heart rate, yoga group pre-test mean 79.30 ±10.90, median 81, Q1= 70, Q3= 88 and mean rank 12.71. Post 12 week mean 76.65±9.74, median 76, Q1=71, Q3=81 and mean rank 10.89. The calculated Z is 1.218, and the 'p'=.223 ($p>0.05$). Resting heart rate in control group pre-test mean 83.4±14, median 85, Q1= 74.50, Q3= 90.25 and mean rank 10.96. Post 12 week mean 81.5 ±15.82, median 78, Q1= 70, Q3= 92.25 and mean rank 9.81. The calculated Z is .991, and the 'p'=.322 ($p>0.05$).

In case of BMI, yoga group pre-test mean 22.84±3.58, median 22.80, Q1=19.50, Q3=25.20 and mean rank 10.90. Post 12 week mean 22.52±3.28, median 22.80, Q1=19.60, Q3=25 and mean rank 9.30. The calculated Z is 2.196, and the 'p'=.028 ($p<0.05$). BMI in control group pre-test mean 22.14±3.41, median 22.20, Q1=19.12, Q3=24.92 and mean rank 8.50. Post 12 week mean 22.46±3.27, median 22.65, Q1= 20.10, Q3=25.62 and mean rank 11.83. The calculated Z is 1.383, and the 'p'=.167 ($p>0.05$).

So, the **Null Hypothesis is rejected** in systolic blood pressure, diastolic blood pressure and BMI but **accepted** in resting heart rate with respect to yoga group. The means of the post-12 weeks in the yoga group in systolic blood pressure, diastolic blood pressure and BMI is **lower** than the pre-test.

**Null Hypothesis is rejected** in systolic blood pressure, diastolic blood pressure but **accepted** in resting heart rate and BMI with respect to control group also. The mean of the post-12 weeks in the control group in systolic blood pressure and diastolic blood pressure is **lower** than the pre-test.

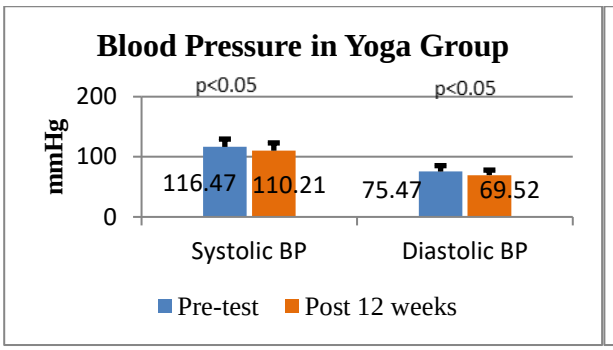



Fig. 59

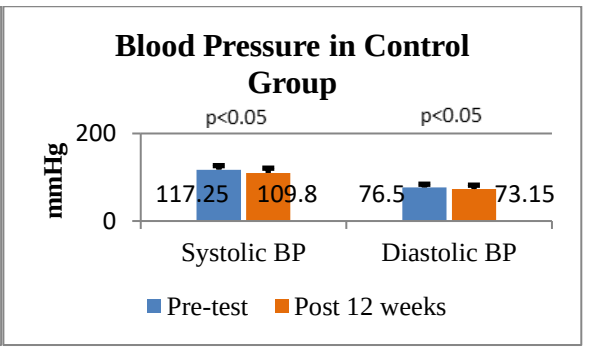



Fig. 60

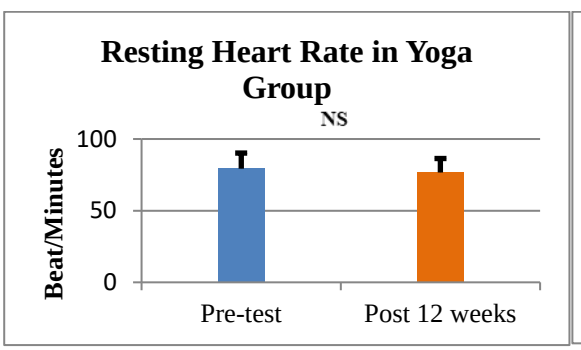



Fig. 61

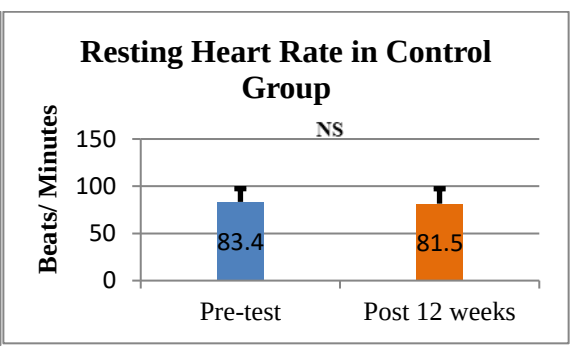
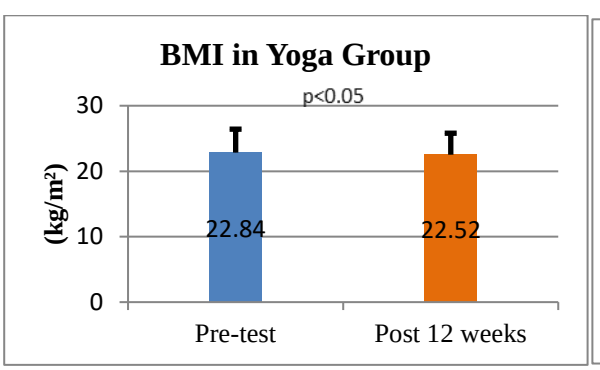



Fig. 62




*p<0.05=Significant, NS=No Significant*

Fig. 63

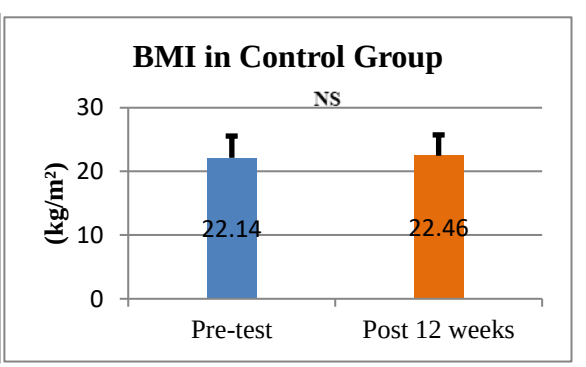



Fig. 64

**Fig.59-64: Graphical representation of pre-test and post 12 weeks of yoga group and control group with respect to general health variables. 59) Blood Pressure in yoga group; 60) Blood pressure in control group; 61) Resting Heart Rate in yoga group; 62) Resting Heart rate in control group; 63) BMI in yoga group; 64) BMI in control group**

## 4.5.5 Psychological Variables:

**$H_0$27-** There exists no significant difference between pre-test and post 12 weeks in yoga group with respect to psychological variables

**$H_0$28-** There exists no significant difference between pre-test and post 12 weeks in control group with respect to psychological variables.

**Table no.33: Within group comparison of pre-test and post 12 weeks of yoga group and control group with respect to psychological variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| **Depression** | Yoga | Pre-test | 21.13 ±6.33 | 19 | 17 | 22 | 12.67 | 3.898 | **.000*** |
| | | Post 12 weeks | 14.30± 5.41 | 15 | 9 | 18 | 5.00 | | |
| | Control | Pre-test | 20.5± 5.84 | 19.50 | 17 | 23.50 | 10.14 | 1.277 | .202 |
| | | Post 12 weeks | 21.75 ±6.47 | 21 | 16.25 | 25 | 10.69 | | |
| **Fear Avoidance Belief in Physical Activity** | Yoga | Pre-test | 17.43± 3.69 | 18 | 16 | 20 | 12.67 | 3.909 | **.000*** |
| | | Post 12 weeks | 13.52 ±4.67 | 15 | 9 | 17 | 5.00 | | |
| | Control | Pre-test | 17.65 ±3.78 | 18.50 | 16 | 20 | 7.56 | 1.397 | .162 |
| | | Post 12 weeks | 18.9 ±3.52 | 18 | 16.25 | 22 | 11.77 | | |
| **Fear Avoidance Belief in Work Activity** | Yoga | Pre-test | 34.34± 4.32 | 35 | 33 | 37 | 13.40 | 3.958 | **.000*** |
| | | Post 12 weeks | 25.13 ±7.92 | 25 | 22 | 32 | 2.67 | | |
| | Control | Pre-test | 34.75± 3.30 | 35.50 | 33 | 36.75 | 8.65 | 1.711 | .087 |
| | | Post 12 weeks | 33.4 ±3.48 | 34 | 30.50 | 36 | 10.13 | | |
| **Pain Catastrophizing** | Yoga | Pre-test | 22.69± 5.08 | 22 | 20 | 26 | 12.90 | 2.179 | **.029*** |
| | | Post 12 weeks | 19.69± 7.03 | 21 | 13 | 24 | 8.50 | | |
| | Control | Pre-test | 23.85± 5.08 | 24 | 20.25 | 27 | 4.83 | 2.661 | **.008*** |
| | | Post 12 weeks | 27.65± 5.85 | 27.50 | 23.25 | 32 | 12.38 | | |

***p-value < 0.05 is significant***

The table no. 33 shows that for within group comparison of the pre-test and post-12 weeks in the yoga group for psychological variables, the Wilcoxon Signed Ranks Test was conducted. It was found that depression of the yoga group pre-test mean 21.13 ±6.33, median 19, Q1=17, Q3=22 and mean rank 12.67. Post 12 week mean 14.30± 5.41, median 15, Q1=9, Q3=18 and mean rank 5. The calculated Z is 3.898, and the 'p'=.000 ($p<0.05$). Depression in

the control group pre-test mean 20.5± 5.84, median 19.50, Q1=17, Q3=23.50 and mean rank 10.14. Post-12 weeks mean 21.75±6.47, median 16.25, Q1=16.25, Q3=25 and mean rank 10.69. The calculated Z is 1.277, and the 'p'=.202 (p>0.05).

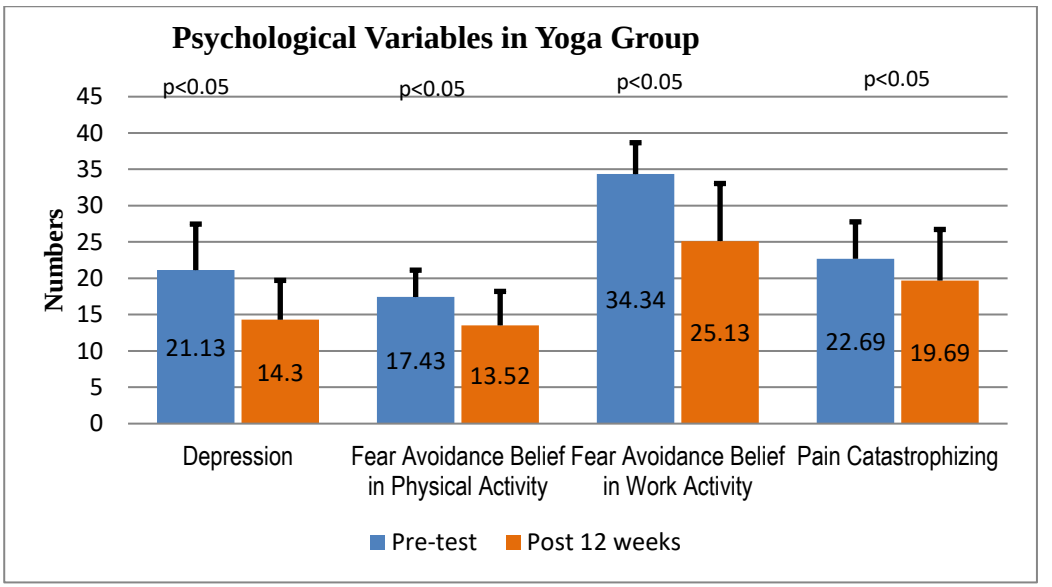
In case of fear avoidance belief in physical Activity yoga group pre-test mean 17.43±3.69, median 18, Q1=16, Q3=20 and mean rank 12.67. Post 12 week mean 13.52 ±4.67, median 15, Q1=9 Q3=17 and mean rank 5. The calculated Z is 3.909, and the 'p'=.000 (p<0.05). Fear avoidance belief in physical Activity in control group pre-test mean 17.65±3.78, median 18, Q1=16, Q3=20 and mean rank 7.56. Post 12 week mean 18.9±3.52, median 18, Q1=16.25, Q3=22 mean rank 11.17. The calculated Z is 1.397, and the 'p'=.162 (p>0.05).

In case of fear avoidance belief in work Activity, yoga group pre-test mean 34.34±4.32, median 35, Q1= 33, Q3= 37 and mean rank 13.40. Post 12 week mean 25.13±7.92, median 25, Q1= 22, Q3= 32 and mean rank 2.67. The calculated Z is 3.958, and the 'p'=.000 (p<0.05). Fear avoidance belief in work Activity rate in control group pre-test mean 34.75±3.30, median 35.50, Q1=33, Q3=36.75 and mean rank 8.65. Post 12 week mean 33.4±3.48, 34, Q1=30.50, Q3=36 and mean rank 10.13. The calculated Z is 1.711, and the 'p'=.087 (p>0.05).

In case of pain catastrophizing, yoga group pre-test mean 22.69±5.08, median 22, Q1=20, Q3=26 and mean rank 12.90. Post 12 week mean 19.69±7.03, median 21, Q1=13 and Q3= 24 mean rank is 8.50. The calculated Z is 2.179, and the 'p'=.029 (p<0.05). Pain catastrophizing in control group pre-test mean 23.85±5.08, median 24, Q1=20.25 Q3=27 and mean rank is 4.83. Post 12 week mean 27.65±5.85, median 27.50, Q1=23.25, Q3=32 and mean rank 12.38. The calculated Z is 2.661, and the 'p'=.008 (p<0.05).

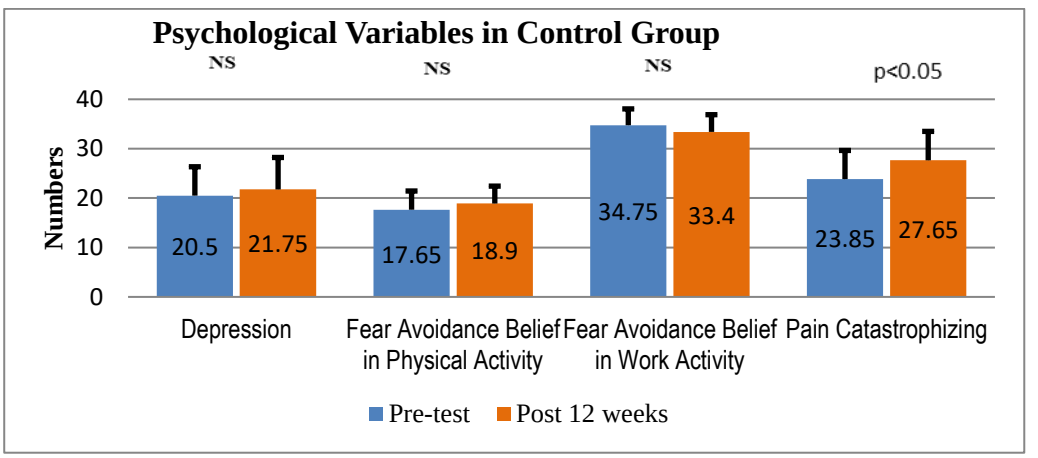
So, the **Null Hypothesis is rejected** in all psychological variables with respect to yoga group. The means of the post-12 weeks in the yoga group in all psychological variables are **lower** than the pre-test.

**Null Hypothesis is accepted** in all psychological variables with respect to control group.




***p<0.05=Significant***

**Fig. 65: Graphical representation of pre-test and post 12 weeks of yoga group with respect to psychological variables**




***NS=Not Significant*** ***p<0.05=Significant***

**Fig. 66: Graphical representation of pre-test and post 12 weeks of control group with respect to psychological variables**

## 4.5.6 HRQoL Variables:

**$H_0$29-** There exists no significant difference between pre-test and post 12 weeks in yoga group with respect to HRQoL variables

**$H_0$30-** There exists no significant difference between pre-test and post 12 weeks in control group with respect to HRQoL variables.

**Table no. 34: Within group comparison of pre-test and post 12 weeks of yoga group and control group with respect to HRQoL variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| Physical Functioning | Yoga | Pre-test | 68.47±7.89 | 70 | 60 | 75 | .00 | 3.668 | **.000*** |
| | | Post 12 weeks | 77.82±10.09 | 75 | 70 | 85 | 9.00 | | |
| | Control | Pre-test | 65.75±9.49 | 65 | 61 | 73 | 9.29 | .157 | .875 |
| | | Post 12 weeks | 67.25±7.15 | 70 | 61.25 | 75 | 7.89 | | |
| Role limitation-Physical | Yoga | Pre-test | 60.86±16.55 | 50 | 50 | 75 | 6.00 | 3.463 | **.001*** |
| | | Post 12 weeks | 83.69±14.31 | 75 | 75 | 100 | 9.19 | | |
| | Control | Pre-test | 57.5± 21.61 | 50 | 50 | 75 | 7.56 | 1.032 | .302 |
| | | Post 12 weeks | 51.25±15.12 | 50 | 50 | 50 | 7.40 | | |
| Role limitation-Emotional | Yoga | Pre-test | 50.56±21.40 | 67 | 33 | 67 | .00 | 3.697 | **.000*** |
| | | Post 12 weeks | 85.60±19.58 | 100 | 67 | 100 | 9.00 | | |
| | Control | Pre-test | 55 ±22.59 | 67 | 33 | 67 | 7.00 | .226 | .821 |
| | | Post 12 weeks | 51.7± 27.68 | 67 | 33 | 67 | 8.17 | | |
| Vitality | Yoga | Pre-test | 53.56 ±6.18 | 55 | 50 | 55 | .00 | 3.303 | **.001*** |
| | | Post 12 weeks | 62.26± 6.83 | 65 | 55 | 65 | 7.50 | | |
| | Control | Pre-test | 54.35 ±5.44 | 55 | 50 | 58.75 | 4.33 | 1.150 | .250 |
| | | Post 12 weeks | 53.2 ±5.73 | 55 | 50 | 55 | 5.00 | | |
| Mental Health | Yoga | Pre-test | 44.5±6.52 | 44 | 40 | 48 | .00 | 4.204 | **.000*** |
| | | Post 12 weeks | 59.52± 5.60 | 58 | 54 | 64 | 12.00 | | |
| | Control | Pre-test | 47.7± 6.39 | 48 | 44 | 52 | 7.78 | 1.723 | .085 |
| | | Post 12 weeks | 44.2 ±6.92 | 46 | 21 | 48 | 5.25 | | |
| Social Functioning | Yoga | Pre-test | 72.5±12.80 | 75 | 65 | 80 | 10.50 | 2.826 | **.005*** |
| | | Post 12 weeks | 81.52±10.04 | 80 | 75 | 85 | 9.38 | | |
| | Control | Pre-test | 69 ±11.65 | 65 | 65 | 75 | 3.25 | 1.270 | .204 |
| | | Post 12 weeks | 72.15±11.32 | 72.50 | 65 | 80 | 4.30 | | |
| Pain | Yoga | Pre-test | 51±7.70 | 45 | 45 | 58 | 4.75 | 3.690 | **.000*** |
| | | Post 12 weeks | 67.5±11.38 | 70 | 60 | 75 | 11.66 | | |

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| | Control | Pre-test | 45.3 ±9.18 | 45 | 38.50 | 54.25 | 10.00 | 2.485 | **.013*** |
| | | Post 12 weeks | 52.45±9.17 | 47.50 | 45 | 58 | 6.75 | | |
| General Health | Yoga | Pre-test | 60 ±9.53 | 60 | 55 | 65 | 2.50 | 2.736 | **.006*** |
| | | Post 12 weeks | 67.6±10.85 | 70 | 60 | 75 | 6.35 | | |
| | Control | Pre-test | 58±10.56 | 62.50 | 51.25 | 65 | 7.13 | 1.199 | .230 |
| | | Post 12 weeks | 61.25 ±9.85 | 65 | 55 | 68 | 6.94 | | |
| Health Change | Yoga | Pre-test | 34.78±12.47 | 25 | 25 | 50 | 6.00 | 3.553 | **.000*** |
| | | Post 12 weeks | 65.21±26.90 | 75 | 50 | 75 | 11.00 | | |
| | Control | Pre-test | 73.75±17.90 | 50 | 25 | 50 | 7.33 | .584 | .559 |
| | | Post 12 weeks | 47.5±17.95 | 50 | 25 | 50 | 4.71 | | |

***p-value < 0.05 is significant***

The table no. 34 shows that for within group comparison of the pre-test and post-12 weeks in the yoga group for HRQoL variables, the Wilcoxon Signed Ranks Test was conducted. It was found that physical functioning of the yoga group pre-test mean 68.47±7.89, median 70, Q1= 60, Q3=75 and mean rank .00. Post 12 week mean 77.82±10.0, median 75, Q1=70, Q3=85 and mean rank 9. The calculated Z is 3.668, and the 'p'=.000 ($p<0.05$). Physical functioning in the control group pre-test mean 65.75± 9.49, median 65, Q1=61, Q3=73 and mean rank 9.29. Post-12 weeks mean 67.25±7.15, median 70, Q1=61.25, Q3=75 and mean rank 7.89. The calculated Z is .157, and the 'p'=.175 ($p>0.05$).

In case of role limitation-physical, yoga group pre-test mean 60.86±16.55, median 50, Q1= 50, Q3=75 and mean rank 6.00. Post 12 week mean 83.69 ±14.31, median 75, Q1=75, Q3=100 and mean rank 9.19. The calculated Z is 3.463, and the 'p'=.001 ($p<0.05$).. Role limitation-physical in control group pre-test mean 57.5±21.61, median 50, Q1=50, Q3=7 and mean rank 7.565. Post 12 week mean 51.25±15.12, median 50, Q1=50, Q3=50 mean rank 7.40. The calculated Z is 1.032, and the 'p'=.302 ($p>0.05$).

In case of Role limitation-Emotional, yoga group pre-test mean 50.56±21.40, median 67, Q1=33, Q3=67 and mean rank .00. Post 12 week mean 85.60 ±19.58, median 100, Q1= 67 and Q3=100 and mean rank 9. The calculated Z is 3.697, and the 'p'=.000 ($p<0.05$). Role limitation-emotional in control group, pre-test mean 55 ±22.59, median 67, Q1=33, Q3=67

and mean rank 7. Post 12 week mean 51.7±27.68, median 67, Q1=33, Q3=67 and mean rank is 8.17. The calculated Z is .226, and the 'p'=.821 (p>0.05).

In case of Vitality, yoga group pre-test mean 53.56 ±6.18, median 55, Q1=50, Q3=55 and mean rank .00. Post 12 week mean 62.26± 6.83, median 65, Q1=55, Q3=65 and mean rank 7.50. The calculated Z is 3.303, and the 'p'=.001 (p<0.05). Vitality in control group pre-test mean 54.35±5.44, median 55, Q1=50, Q3=58.75 and mean rank is 4.33. Post 12 week mean 53.2±5.73, median 55, Q1= 50, Q3=55 and mean rank 5. The calculated Z is 1.150, and the 'p'=.250 (p>0.05).

In case of mental health, yoga group pre-test mean 44.5±6.52, median 44, Q1=40, Q3=48 and mean rank .00. Post 12 week mean 59.52±5.60, median 58, Q1=54, Q3=64 and mean rank 12. The calculated Z is 4.204, and the 'p'=.000 (p<0.05). Mental health in control group pre-test mean 47.7± 6.39, 48, Q1= 44, Q3=52 and mean rank 7.78. Post 12 week mean 44.2 ±6.92, median 46, Q1=21 and Q3=48 and mean rank 5.25. The calculated Z is 1.723, and the 'p'=.085 (p>0.05).

In case of social functioning, yoga group pre-test mean 72.5±12.80, median 75, Q1=65, Q3=80 and mean rank 10.50. Post 12 week mean 81.52±10.04, median 80, Q1=75, Q3=85 and mean rank 9.38. The calculated Z is 2.826, and the 'p'=.005 (p<0.05). Social functioning in control group pre-test mean 69±11.65, median 65, Q1=65, Q3= 75 and mean rank 3.25. Post 12 week mean 72.15±11.32, median 72.50, Q1=65, Q3=80 and mean rank 4.30. The calculated Z is 1.270, and the 'p'=.204 (p>0.05).

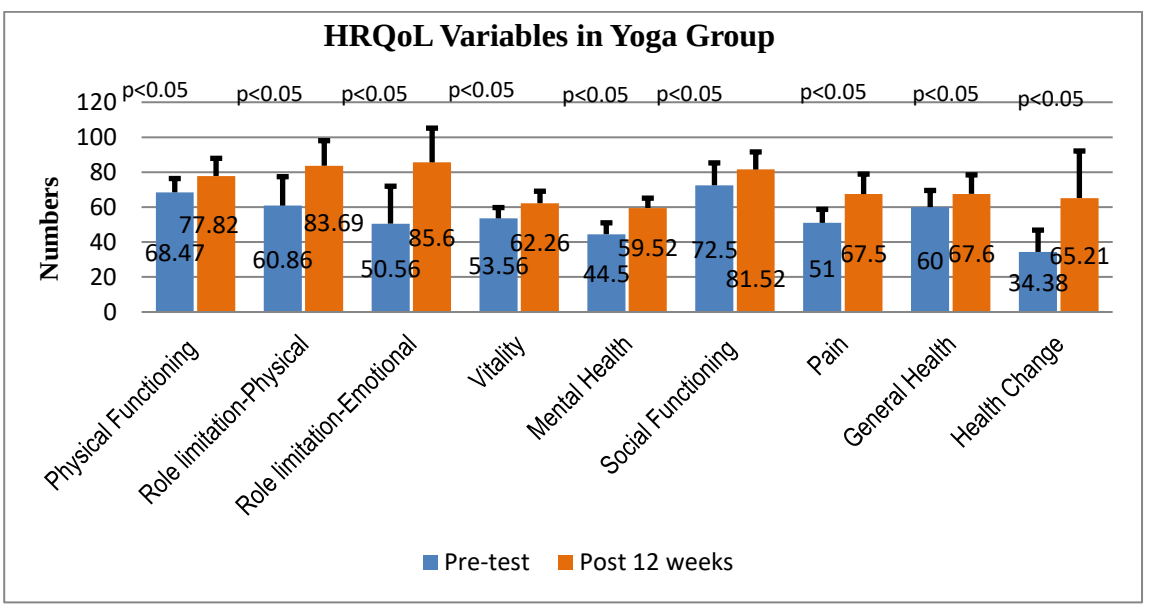
In case of Pain, yoga group pre-test mean 51± 7.70, median 45, Q1= 45, Q3= 58 and mean rank 4.75. Post 12 week mean 67.5±11.38, median 70, Q1= 60, Q3= 75 and mean rank 11.66. The calculated Z is 3.690, and the 'p'=.000 (p<0.05). Pain in control group pre-test mean 45.3 ±9.18, median 45, Q1=38.50, Q3=54.25 and mean rank is 10.00. Post 12 week mean 52.45±9.17, median 47.50, Q1= 45, Q3=58 and mean rank 6.75. The calculated Z is 2.485, and the 'p'=.013(p<0.05).

In case of General Health, yoga group pre-test mean 60 ±9.53, median 60, Q1=55, Q3=65 and mean rank 2.50. Post 12 week mean 67.6±10.85, median 70, Q1= 60, Q3=75 and mean rank 6.35. The calculated Z is 2.736, and the 'p'=.006 (p<0.05). General Health in control group pre-test mean 58±10.56, median 62.50, Q1= 51.25, Q3= 65 and mean rank 7.13. Post 12 week mean 61.25±9.85, median 65, Q1=55, Q3= 68 and mean rank 6.94. The calculated Z is 1.199, and the 'p'=.230 (p>0.05).

In case of health change, yoga group pre-test mean 34.78±12.47, median 25, Q1=25, Q3= 50 and mean rank 6.00. Post 12 week mean 65.21±26.90, median 75, Q1= 50, Q3= 75 and mean rank 11.00. The calculated Z is 3.553, and the 'p'=.000 ($p<0.05$). Health change in control group pre-test mean 73.75±17.90, median 50, Q1=25, Q3=50 and mean rank is 7.33. Post 12 week mean 47.5±17.95, median 50, Q1=25, Q3=50 and mean rank 4.71. The calculated Z is .584, and the 'p'=.559 ($p>0.05$).

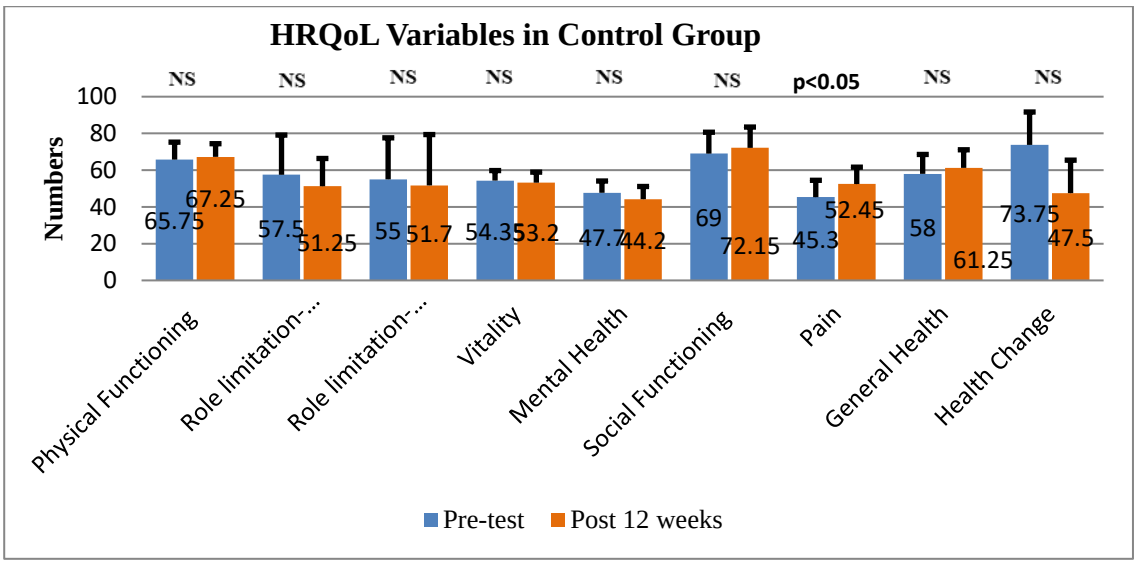
So, the **Null Hypothesis is rejected** in all HRQoL variables with respect to yoga group. And the means of the post-12 weeks in the yoga group in all HRQoL variables are **lower** than the pre-test.

**Null Hypothesis is rejected** in pain and **accepted** in rest of HRQoL variables with respect to control group. The mean of the post-12 weeks in the control group in pain is **higher** than the pre-test.




***p<0.05=Significant***

**Fig.67: Graphical representation of pre-test and post 12 weeks of yoga group with respect to HRQoL variables**




***p<0.05=Significant, NS=No Significant***

**Fig.68: Graphical representation of pre-test and post 12 weeks of control group with respect to HRQoL variables**

## 4.6. Within Group Comparisons between Post-12 Weeks and Post- 24 Weeks for the groups

### 4.6.1 Disease Activity Index and Functional Index:

**$H_0$ 31-** There exists no significant difference between post 12 weeks and post 24 weeks in yoga group with respect to disease activity index and functional index variables

**$H_0$32-** There exists no significant difference between post 12 weeks and post 24 weeks in control group with respect to disease activity index and functional index variables

**Table no.35: Within group comparison of post 12 weeks and post 24 weeks of yoga group and control group with respect to Disease Activity Index and Functional Index variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| BASDAI | Yoga | Post 12 weeks | 3.26±1.51 | 3.10 | 2.10 | 4 | 13.06 | 2.951 | **.003*** |
| | | Post 24 weeks | 2± 0.95 | 1.80 | 1.20 | 2.80 | 8.20 | | |
| | Control | Post 12 weeks | 5.58±1.26 | 5.95 | 4.72 | 6.45 | 12.45 | 1.195 | .232 |
| | | Post 24 weeks | 4.72±2.23 | 4.95 | 2.67 | 6.72 | 8.11 | | |
| BASFI | Yoga | Post 12 weeks | 3.75±1.47 | 3.80 | 2.60 | 4.20 | 13.65 | 2.860 | **.004*** |
| | | Post 24 weeks | 2.66±1.11 | 2.60 | 2.10 | 3.20 | 7.33 | | |

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| | Control | Post 12 weeks | 6.04±1.50 | 6.05 | 5.22 | 7.07 | 11.54 | 2.110 | **.035*** |
| | | Post 24 weeks | 4.98±1.58 | 4.90 | 3.60 | 6.42 | 8.08 | | |

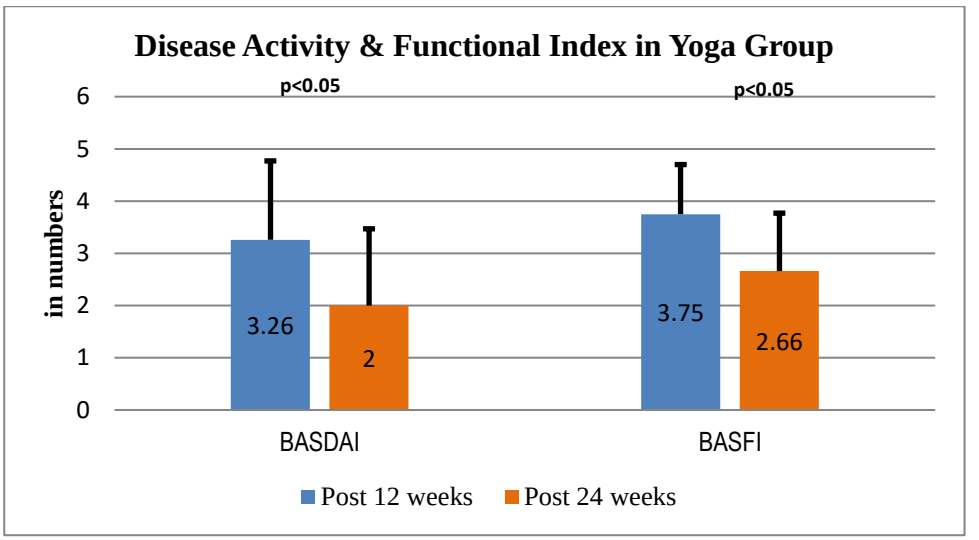
***p-value < 0.05 is significant***

The table no. 35 shows that for within group comparison of the post 12 weeks and post 24 weeks in the yoga group for Disease Activity Index and Functional Index variables the Wilcoxon Signed Ranks Test was conducted. It was found that BASDAI of the post 12 week mean 3.26±1.51, median 3.10, Q1= 2.10, Q3=4.00 and mean rank 13.06. Post 24 week mean 2± 0.95, median 1.80, Q1=1.20 Q3=2.80 and mean rank 8.20. The calculated Z is 2.951, and the 'p'=.003 ($p<0.05$). BASDAI in the control group, post 12 week mean 5.58±1.26, 5.95, Q1=4.72, Q3=6.45 and mean rank 12.45. Post 24 weeks mean 4.72±2.23, median 44.95, Q1= 2.67, Q3= 1.195 and mean rank is 8.11. The calculated Z is 1.195, and the 'p'=.232 ($p>0.05$).

In case of BASFI, yoga group post 12 week mean 3.75±1.47, median 3.80, Q1=2.60, Q3= 4.20 and mean rank 13.65. Post 24 weeks mean 2.66 ±1.11, median 2.60, Q1=2.10, Q3=3.20 and mean rank is 7.33. The calculated Z is 2.860, and the 'p'=.004 ($p<0.05$). BASFI in control group, post 12 week mean 6.04±1.50, median 6, Q1=5.22, Q3= 7.07 and mean rank is 11.54. Post 24 weeks mean 4.98±1.58, median 4.90, Q1=3.60, Q3=6.42 mean rank 8.08. The calculated Z is 2.110, and the 'p'=.035($p<0.05$).

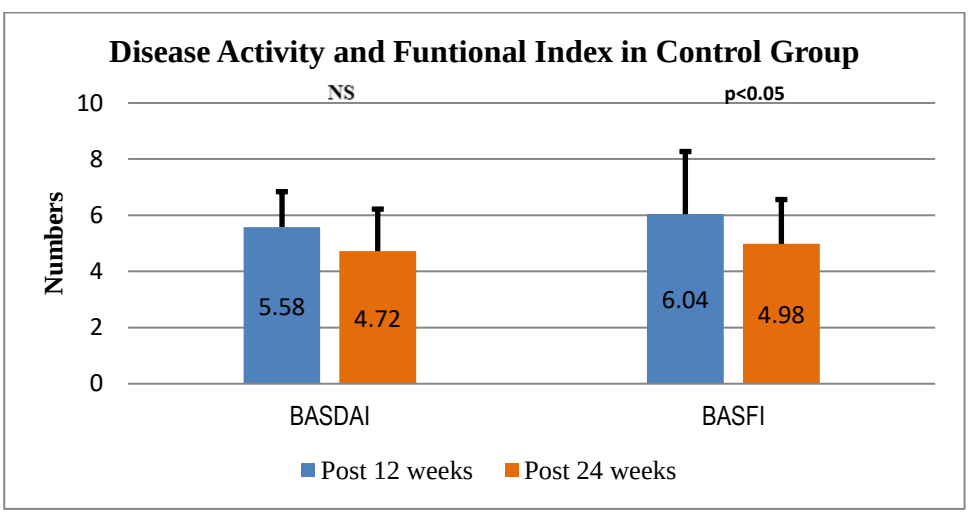
So, the **Null Hypothesis is rejected** in BASDAI and **accepted** in BASFI with respect to yoga group. The mean of the post-24 weeks in the yoga group in BASDAI is **lower** than the post-12 weeks.

**Null Hypothesis is rejected** in both variables with respect to control group. The means of the post-24 weeks in the control group in BASDAI and BASFI are **lower** than the post-12 weeks.




***p<0.05=Significant***

**Fig. 69: Graphical representation of post 12 weeks and post 24 weeks of yoga group with respect to Disease activity index and functional index variables**




***p<0.05=Significant, NS=Not Significant***

**Fig. 70: Graphical representation of post 12 weeks and post 24 weeks of control group with respect to Disease Activity Index and Functional Index variables**

## 4.6.2 Inflammatory Markers Variables:

**$H_0$33-** There exists no significant difference between pre-test and post 12 weeks in yoga group with respect to inflammatory markers variables

**$H_0$34-** There exists no significant difference between pre-test and post 12 weeks in control group with respect to inflammatory markers variables

**Table no. 36: Within group comparisons of post 12 weeks and post 24 weeks of yoga group and control group with respect to inflammatory markers variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| ESR (mm/hr) | Yoga | Post 12 weeks | 19.56±11.82 | 18 | 10 | 30 | 12.54 | .381 | .703 |
| | | Post 24 weeks | 18.69±14.72 | 14 | 10 | 33 | 11.41 | | |
| | Control | Post 12 weeks | 34.55±9.17 | 34 | 28 | 38 | 11 | 1.047 | .295 |
| | | Post 24 weeks | 30.36±13.99 | 31 | 19.75 | 36 | 8.63 | | |
| CRP (mg/L) | Yoga | Post 12 weeks | 8.99±10.04 | 4.69 | 1.45 | 14.48 | 12.21 | .259 | .796 |
| | | Post 24 weeks | 7.87±9.53 | 3.13 | .83 | 15.24 | 11.77 | | |
| | Control | Post 12 weeks | 23.09±9.99 | 20.67 | 16.30 | 30.73 | 10.71 | 1.680 | .093 |
| | | Post 24 weeks | 18.37±17.93 | 12.91 | 7.32 | 25.73 | 10 | | |

***p-value < 0.05 is significant***

The table no, 36 shows that for within group comparison of the post 12 weeks and post 24 weeks in the yoga group for Disease Activity Index and Functional Index variables, the Wilcoxon Signed Ranks Test was conducted. It was found that ESR of the yoga group at post 12 weeks mean 19.56±11.82, median18, Q1=10, Q3= 30 and mean rank is 12.54. Post 24 week mean 18.69±14.72, median 14, Q1=10, Q3=33 and mean rank 11.41. The calculated Z is .381, and the 'p'=.703 (p>0.05). ESR in the control group post 12 week mean 34.55±9.17, median 34 Q1=28, Q3=28 and mean rank is 11. Post 24 weeks mean 30.36 ±13.99, median 31, Q1=19.75, Q3=36 mean rank 8.63. The calculated Z is 1.047, and the 'p'=.295 (p>0.05).

CRP in the yoga group post 12 week mean 8.99±10.04, median 4.69, Q1=1.45, Q3=14.48 and mean rank is 12.21. Post 24 week mean 7.87±9.53, median 3.13, Q1=.83, Q3= 15.24 and mean rank 11.77. The calculated Z is .259, and the 'p'=.796 (p>0.05). CRP in the control group post 12 week mean 23.09±9.99, median 20.67, Q1=16.30, Q3=30.73 and mean rank is 10.71. Post 24 weeks mean 18.37±17.93, median 12.91, Q1=7.32, Q3=25.73 and mean rank 10. The calculated Z is 1.680, and the 'p'=.093 (p>0.05).

So, the **Null Hypothesis is accepted** in both variables of inflammatory variables with respect to yoga group. **Null Hypothesis is accepted** in both variables with respect to control group also.

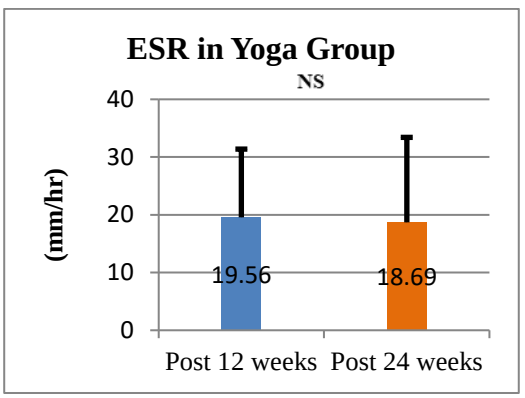



**Fig. 71**

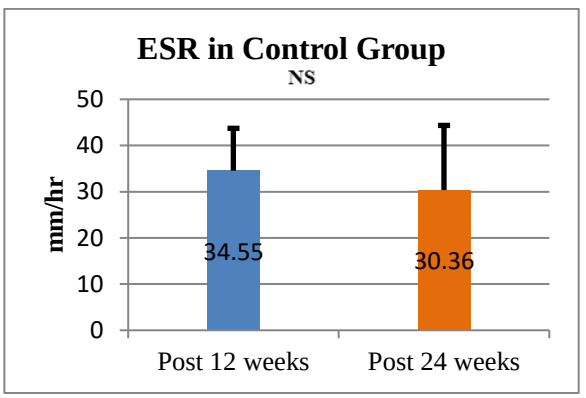



**Fig. 72**

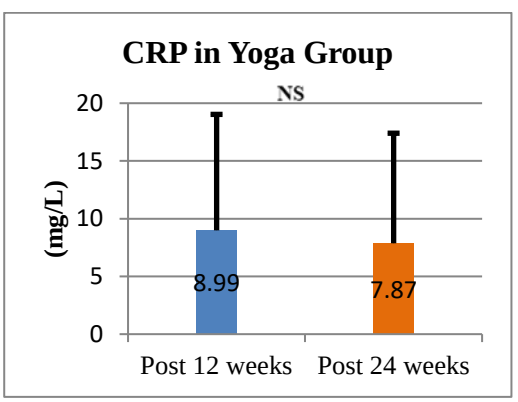
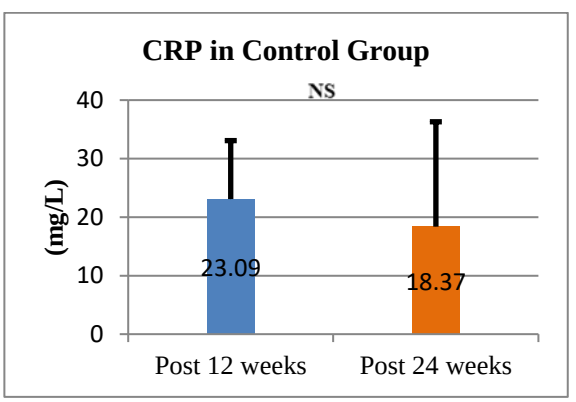



**Fig. 73**




***NS=Not Significant***

**Fig. 74**

**Fig. 71-74: Graphical representation of post 12 weeks and post 24 weeks of yoga and control group with respect to inflammatory variables. 71) ESR in yoga group; 72) ESR in control group; 73) CRP in yoga group; 74 CRP in control group**

## 4.6.3 Blood Count Variables:

**$H_0$35-** There exists no significant difference between post 12 weeks and post 24 weeks in yoga group with respect to blood count variables

**$H_0$36-** There exists no significant difference between post 12 weeks and post 24 weeks in control group with respect to blood count variables.

**Table no.37: Within group comparison of post 12 weeks and post 24 weeks of yoga group and control group with respect to blood count variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| Haemoglobin (g/dl) | Yoga | Post 12 weeks | 12.97 ±1.15 | 13 | 12.30 | 13.70 | 8.31 | 1.704 | .088 |
| | | Post 24 weeks | 13.51± 1 | 13.70 | 12.80 | 14.30 | 12.65 | | |
| | Control | Post 12 weeks | 12.83± 1.39 | 13.20 | 11.55 | 13.90 | 9.41 | .342 | .732 |
| | | Post 24 weeks | 12.76± 1.30 | 12.65 | 11.80 | 13.27 | 10.81 | | |
| Total Leukocyte Count (thou/$mm^3$) | Yoga | Post 12 weeks | 6.41± 1.41 | 6.60 | 5.70 | 7.30 | 10.57 | 1.705 | .088 |
| | | Post 24 weeks | 7.15 ±1.67 | 7.20 | 6 | 8.70 | 11.93 | | |
| | Control | Post 12 weeks | 8.44 ±2.34 | 8.09 | 6.69 | 9.57 | 11.41 | .766 | .444 |
| | | Post 24 weeks | 8.01 ±1.81 | 7.80 | 6.55 | 9.10 | 9.39 | | |
| Segmented Neutrophils (%) | Yoga | Post 12 weeks | 63.88± 7.31 | 63.50 | 59.30 | 69.30 | 11.04 | .167 | .867 |
| | | Post 24 weeks | 63.69 ±8.77 | 65 | 58.80 | 70.20 | 13.05 | | |
| | Control | Post 12 weeks | 64.35± 7.54 | 65.05 | 57.10 | 70.10 | 10.91 | .560 | .575 |
| | | Post 24 weeks | 62.63± 7.47 | 63.75 | 59.55 | 68.47 | 10.00 | | |
| Lymphocytes (%) | Yoga | Post 12 weeks | 26.14 ±5.85 | 24.60 | 21.60 | 31 | 10.58 | .335 | .738 |
| | | Post 24 weeks | 26.03 ±7.17 | 25.20 | 21.20 | 31.70 | 13.55 | | |
| | Control | Post 12 weeks | 24.7 ±5.89 | 24.65 | 21.32 | 26.65 | 12.70 | 1.549 | .121 |
| | | Post 24 weeks | 27.35± 6.39 | 26.60 | 22.80 | 29.60 | 9.77 | | |
| Monocytes (%) | Yoga | Post 12 weeks | 5.90± 2.06 | 5.90 | 4.90 | 6.70 | 13.00 | .639 | .523 |
| | | Post 24 weeks | 6.17± 2.97 | 6.30 | 2.90 | 9.10 | 11.36 | | |
| | Control | Post 12 weeks | 6.36± 1.56 | 6.45 | 5.60 | 7.42 | 9.32 | .093 | .926 |
| | | Post 24 weeks | 6.54 ±2.50 | 6.20 | 4.82 | 8.17 | 11.94 | | |
| Eosinophil (%) | Yoga | Post 12 weeks | 3.50± 2.93 | 2.60 | 1.10 | 6.10 | 13.25 | .195 | .846 |
| | | Post 24 weeks | 3.44± 2.64 | 2.80 | 1.20 | 5.50 | 10.04 | | |
| | Control | Post 12 weeks | 3.82 ±3.88 | 1.55 | 1.10 | 7.49 | 11.55 | .822 | .411 |
| | | Post 24 weeks | 2.69± 3.04 | 1.30 | .90 | 3.52 | 9.22 | | |
| Basophils (%) | Yoga | Post 12 weeks | 0.55 ±0.32 | .40 | .30 | .70 | 9.23 | .131 | .896 |
| | | Post 24 weeks | 0.70 ±0.75 | .500 | .40 | .70 | 12.06 | | |
| | Control | Post 12 weeks | 0.59± 0.37 | .50 | .30 | .90 | 8.95 | .141 | .888 |
| | | Post 24 weeks | 0.59± 0.24 | .550 | .40 | .70 | 11.44 | | |
| Platelet Count (thou/$mm^3$) | Yoga | Post 12 weeks | 178.26±24.52 | 184 | 154 | 196 | 11.23 | .097 | .922 |
| | | Post 24 weeks | 181.65±32.93 | 163 | 154 | 214 | 11.77 | | |
| | Control | Post 12 weeks | 246.95±70.67 | 233.50 | 181.25 | 316 | 15.38 | .672 | .502 |
| | | Post 24 weeks | 224.3±63.28 | 191 | 173 | 273 | 7.25 | | |

***p-value < 0.05 is significant***

The table no. 37 shows that for within group comparison of the post-12 weeks and post-24 weeks in the yoga group for blood count variables, the Wilcoxon Signed Ranks Test was conducted. It was found that haemoglobin of the yoga group post 12 week mean 12.97 ±1.15, median 13, , Q1=12.30, Q3=13.70 and mean rank 8.31. Post 24 week mean 13.51±1, median 13.70, Q1=12.80, Q3=14.30 and mean rank 12.65. The calculated Z is 1.704, and the 'p'=.088 (p>0.05). Haemoglobin in the control group post 12 week mean 12.83± 1.39, median 13.20, Q1=11.55, Q3= 13.90 and mean rank is 9.41. Post 24 weeks mean 12.76±1.30,

median 12.65, Q1=11.80 Q3=13.27 and mean rank is 10.81. The calculated Z is .342, and the 'p'=.732(p>0.05).

In case of Total Leukocyte Count, yoga group post 12 week means 6.41± 1.41, median 6.60, Q1=5.70, Q3=7.30 and mean rank is 10.57. Post 24 week mean 7.15 ±1.67, median 7.20, Q1= 6, Q3=8.70 and mean rank is 11.93. The calculated Z is 1.705, and the 'p'=.088 (p>0.05). Total Leukocyte Count in control group post 12 week mean 8.44±2.34, median 8.09, Q1=6.69, Q3=9.57 and mean rank 11.41. Post 24 weeks mean 8.01±1.81, median 7.80, Q1=6.55 Q3=9.10 and mean rank 9.39. The calculated Z is .766, and the 'p'=.444 (p>0.05).

In case of Segmented Neutrophils in yoga group post-12 week mean 63.88±7.31, median 63.50, Q1=59.30, Q3=69.30 and mean rank 11.04. Post 24 week mean 63.69±8.77, median 65, Q1=58.80, Q3=70.20 and mean rank 13.05. The calculated Z is .167, and the 'p'=.867 (p>0.05). Segmented Neutrophils in control group post 12 week mean 64.35±7.54, median 65.05, Q1=57.10, Q3=70 and mean rank is 10.91.10. Post 24 week mean 62.63±7.47, 63.75, Q1=59.55, Q3=68.47 and mean rank 10.00. The calculated Z is .560, and the 'p'=.575 (p>0.05).

In case of Lymphocytes, yoga group post 12 week mean 26.14±5.85, median 24.60, Q1=21.60, Q3=31 and mean rank 10.58. Post 24 week mean 26.03 ±7.17, median 25.20, Q1=21.20, Q3=31.70 and mean rank 13.55. The calculated Z is .335, and the 'p'=.738 (p>0.05). Lymphocytes in control group, post 12 week mean 24.7±5.89, median 24.65, Q1=21.32, Q3=26.65 and mean rank 12.70. Post 24 week mean 27.35±6.39, median 26.60, Q1=22.80, Q3=29.60 and mean rank 9.77. The calculated Z is 1.549, and the 'p'=.121 (p>0.05).

In case of Monocytes, yoga group post 12 week means 5.90± 2.06, median 5.90, Q1=4.90, Q3=6.70 and mean rank 13. Post 24 week mean 6.17±2.97, median 6.30, Q1= 2.90, Q3= 9.10 and mean rank 11.36. The calculated Z is .639, and the 'p'=.523 (p>0.05). Monocytes in control group post 12 week mean 6.36±1.56, median 6.45, Q1=5.60, Q3= 7.42 and mean rank 9.32. Post 24 week mean 6.54 ±2.50, median 6.20, Q1=4.82, Q3=8.17 and mean rank 11.94. The calculated Z is .093, and the 'p'=.926 (p>0.05).

In case of Eosinophil, yoga group posts 12 week mean 3.50±2.93, median 2.60, Q1= 1.10, Q3=6.10 and mean rank 13.25. Post 24 week mean 3.44± 2.64, median 2.80, Q1=1.20, Q3=5.50 and mean rank 10.04. The calculated Z is .195, and the 'p'=.846 (p>0.05).

Eosinophil in control group, post 12 week mean 3.82 ±3.88, median 1.55, Q1=1.10, Q3=7.49 and mean rank 11.55. Post 24 week mean 2.69±3.04, median 1.30, Q1=.90, Q3=3.52 and mean rank 9.22. The calculated Z is .822, and the 'p'=.411 (p>0.05).

In case of Basophils, yoga group post 12 week mean 0.55 ±0.32, median.40, Q1=.30, Q3=.70 and mean rank 9.23. Post 24 week mean 0.70±0.75, median .50, Q1=.40, Q3=.70 and mean rank is 12.06. The calculated Z is .131, and the 'p'=.896 (p>0.05). Basophil in control group post 12 week mean 0.59± 0.37, median .550, Q1=.30, Q3=.90 and mean rank 8.95. Post 24 week mean 0.59± 0.24, median .550, Q1= .40, Q3=.70 and mean rank 11.44. The calculated Z is .141, and the 'p'=.888(p>0.05).

In case of platelet count yoga group posts 12 week mean 178.26±24.52, median184, Q1=154, Q3=196 and mean rank 11.23. Post 24 week mean 181.65±32.93, median 163, Q1=154. Q3=214 and mean rank 11.77. The calculated Z is .097, and the 'p'=.922 (p>0.05). Platelet counts in control group post 12 week mean 246.95± 70.67, median 233.50, Q1=181.25, Q3=316 and mean rank 15.38. Post 24 week mean 224.3±63.28, median 191, Q1=173, Q3=273 and mean rank 7.25. The calculated Z is .672, and the 'p'=.502 (p>0.05).

So, the **Null Hypothesis is accepted** in all blood count variables with respect to yoga group. **Null Hypothesis is accepted** in all blood count variables with respect to control group also.

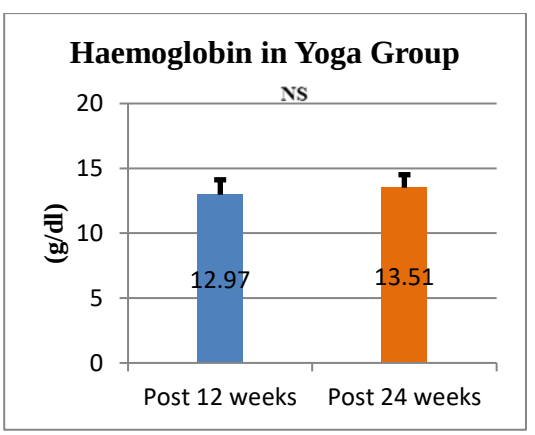



Fig. 75

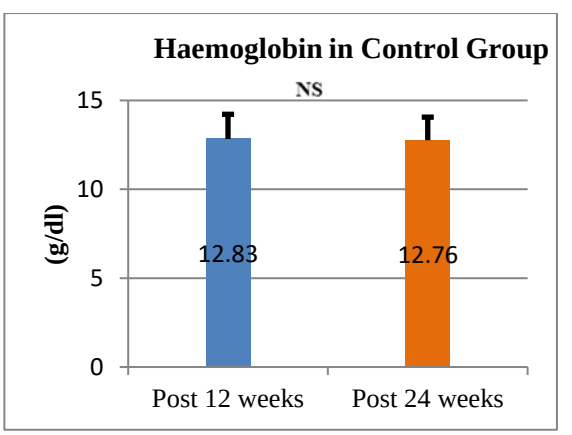



Fig. 76

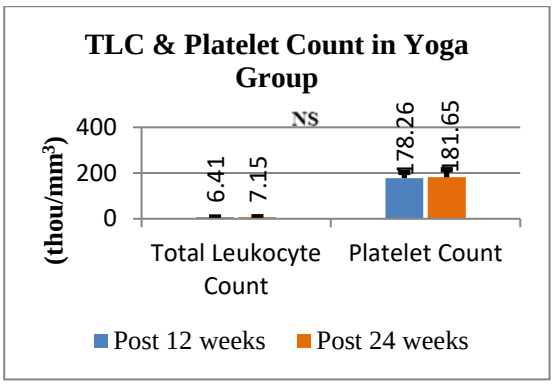



**Fig. 77**

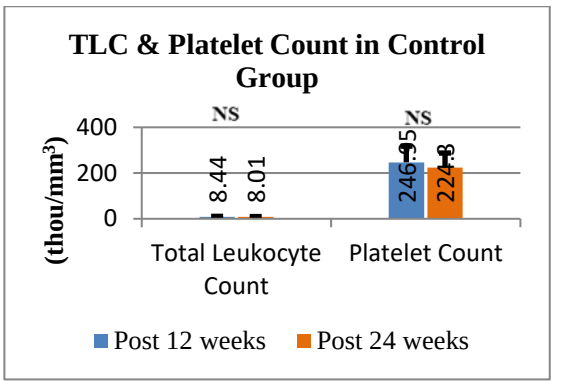
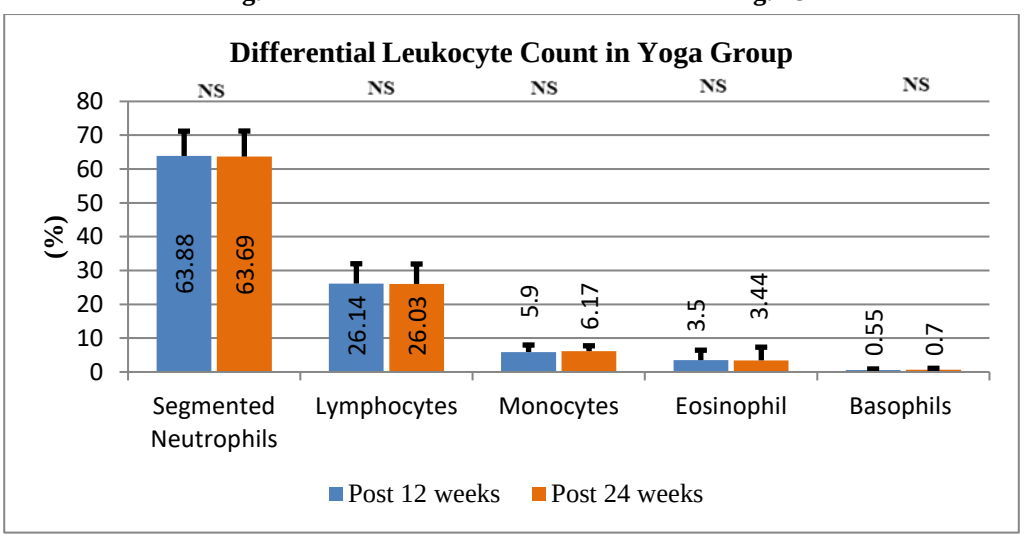
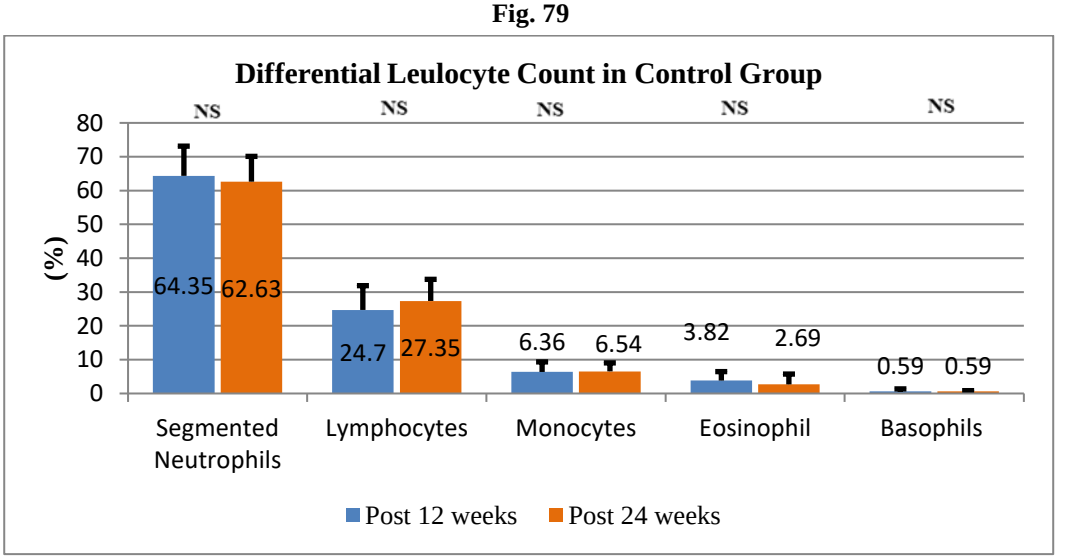



**Fig. 78**




***NS=Not Significant***

**Fig. 79**




***NS=Not Significant***

**Fig. 80**

**Fig. 75-80: Graphical representation of post 12 weeks and post 24 weeks of yoga and control group with respect to blood count variables. 75) Haemoglobin in yoga group; 76) Haemoglobin in control group; 77) TLC and Platelet count in yoga group; 78) TLC and Platelet count in control group; 79) Differential Leukocyte Count in yoga group; 80) Differential Leukocyte Count in control group**

## 4.6.4 General Health Variables:

**$H_0$37-** There exists no significant difference between post 12 weeks and post 24 weeks in yoga group with respect to general health variables

**$H_0$38-** There exists no significant difference between post 12 weeks and post 24 weeks in control group with respect to general health variables.

**Table no. 38: Within group comparison of post 12 weeks and post 24 weeks of yoga group and control group with respect to general health variables**

| Variables | Group | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| Systolic BP (mmHg) | Yoga | Post 12 weeks | 110.21±12.87 | 109 | 101 | 118 | 11.89 | .633 | .527 |
| | | Post 24 weeks | 113.39±16.46 | 111 | 99 | 124 | 11.23 | | |
| | Control | Post 12 weeks | 109.8 ±10.91 | 110 | 100 | 118 | 11.67 | .850 | .395 |
| | | Post 24 weeks | 103.45±23.91 | 107.50 | 99.75 | 115.75 | 7.33 | | |
| Diastolic BP (mmHg) | Yoga | Post 12 weeks | 69.52 ±8.34 | 68 | 63 | 75 | 10.50 | 1.381 | .167 |
| | | Post 24 weeks | 73.47±11.11 | 69 | 65 | 80 | 12.07 | | |
| | Control | Post 12 weeks | 73.15± 8.79 | 72.50 | 66 | 80 | 10.79 | .915 | .360 |
| | | Post 24 weeks | 70.05 ±7.60 | 70.50 | 64 | 77 | 10.06 | | |
| Resting Heart Rate (beats/Minutes) | Yoga | Post 12 weeks | 76.65± 9.74 | 76 | 71 | 81 | 10.90 | .882 | .378 |
| | | Post 24 weeks | 79.73 ±11.77 | 81 | 68 | 89 | 12.85 | | |
| | Control | Post 12 weeks | 81.5± 15.82 | 78 | 70 | 92.25 | 9.75 | .280 | .779 |
| | | Post 24 weeks | 83.35± 11.51 | 79 | 75 | 93 | 11.25 | | |
| BMI ($kg/m^2$) | Yoga | Post 12 weeks | 22.52± 3.28 | 22.80 | 19.60 | 25 | 14.50 | .338 | .820 |
| | | Post 24 weeks | 22.61± 3.05 | 22.50 | 20.40 | 24.70 | 10.39 | | |
| | Control | Post 12 weeks | 22.46 ±3.27 | 22.65 | 20.10 | 25.62 | 9.67 | .672 | .501 |
| | | Post 24 weeks | 22.84 ±3.43 | 23.65 | 20.55 | 24.75 | 11.18 | | |

***p-value < 0.05 is significant***

The table no. 38 shows that for within group comparison of the posts 12 week and post 24 weeks in the yoga group for general health variables, the Wilcoxon Signed Ranks Test was conducted. It was found that systolic blood pressure of the yoga group posts 12 week mean 110.21±12.87, median 109, Q1=101, Q3=118 and mean rank 11.89. Post 24 week mean 113.39 ±16.46, median111, Q1=99, Q3=124 and mean rank 11.23. The calculated Z is .633, and the 'p'=.527 (p>0.05). Systolic blood pressures in the control group posts 12 week mean 109.8±10.91, median 110, Q1=100, Q3=118 and mean rank 11.67. Post 24 weeks mean 103.45±23.91, median 107.50, Q1= 99.75, Q3=115.75 and mean rank 7.33. The calculated Z is .850, and the 'p'=.395 (p>0.05).

In case of diastolic blood pressure, yoga group posts 12 week mean 69.52 ±8.34, median 68, Q1=63, Q3=75 and mean rank 10.50. Post 24 week mean 73.47±11.11, median 69, Q1=65 Q3= 80 and mean rank 12.07. The calculated Z is 1.381, and the 'p'=.167 (p>0.05). Diastolic blood pressures in control group posts 12 week mean 73.15±8.79, median72.50, Q1=66, Q3=80 and mean rank 10.79. Post 24 week mean 70.05±7.60, median70.50, Q1=64 and Q3=77 and mean rank 10.06. The calculated Z is .915, and the 'p'=.360 (p>0.05).

In case of resting heart rate, yoga group posts 12 week mean 76.65±9.74, median 76, Q1=71, Q3=81 and mean rank 10.90. Post 24 week mean 79.73±11.77, median 81, Q1=68, Q3=89 and mean rank 12.85. The calculated Z is .882, and the 'p'=.378 (p>0.05). Resting heart rate in control group posts 12 week mean 81.5± 15.82, median 78, Q1=70, Q3=92.25 and mean rank 9.75. Post 24 week mean 83.35±11.51, median 79, Q1=75, Q3=93 and mean rank 11.25. The calculated Z is .280, and the 'p'=.779 (p>0.05).

In case of BMI, yoga group posts 12 week mean 22.52±3.28, median 22.80, Q1=19.60, Q3=25 and mean rank 14.50. Post 24 week mean 22.61±3.05, median 22.50, Q1=20.40, Q3=24.70 and mean rank 10.39. The calculated Z is .338, and the 'p'=.820 (p>0.05). BMI in control group posts 12 week mean 22.46±3.27, median 22.65, Q1=20.10, Q3=25.62 and mean rank 9.67. Post 24 week mean 22.84±3.43, median 23.65, Q1=20.55, Q3=24.75 and mean rank 11.18. The calculated Z is .672, and the 'p'=.501 (p>0.05).

So, the **Null Hypothesis is accepted** in all general health variables with respect to yoga group. **Null Hypothesis is accepted** in all general health variables with respect to control group also.

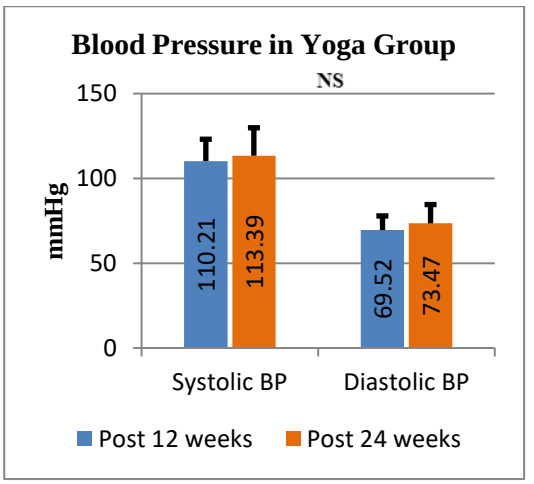



**Fig. 81**

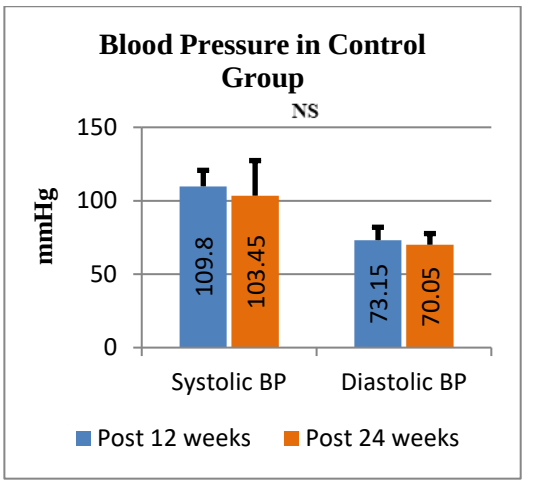



**Fig. 82**

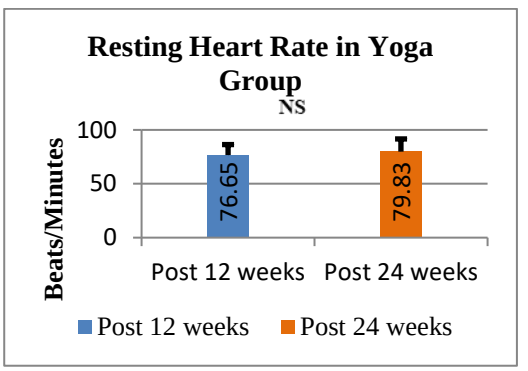



**Fig. 83**

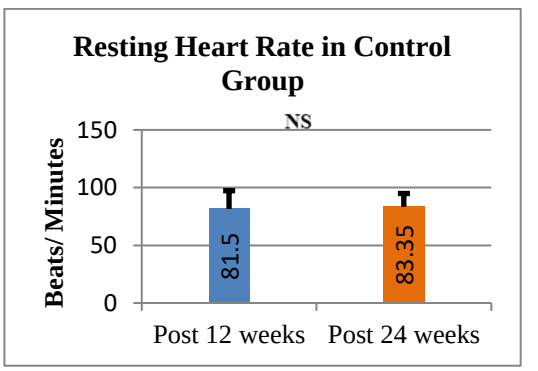



**Fig. 84**

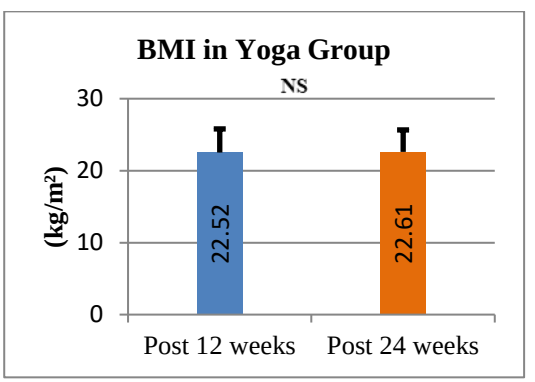
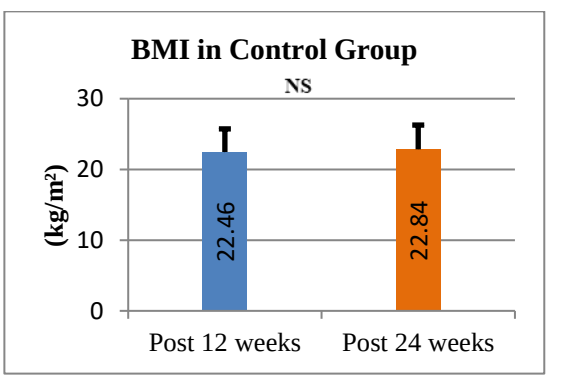



**Fig. 85**




***NS=Not Significant***

**Fig. 86**

**Fig. 81-86: Graphical representation of post 12 weeks and post 24 weeks of yoga and control group with respect to general health variables. 81) Blood Pressure in yoga group; 82) Blood Pressure in control group; 83) Resting Heart rate in yoga group; 84) Resting Heart rate in control group; 85) BMI in yoga group; 86) BMI in control group**

## 4.6.5 Psychological Variables:

**$H_0$39-** There exists no significant difference between post 12 weeks and post 24 weeks in yoga group with respect to psychological variables

**$H_0$40-** There exists no significant difference between post 12 weeks and post 24 weeks in control group with respect to psychological variables.

**Table no.39: Within group comparison of post 12 weeks and post 24 weeks of yoga group and control group with respect to psychological variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p value |
|---|---|---|---|---|---|---|---|---|---|
| Depression | Yoga | Post 12 weeks | 14.30± 5.41 | 15 | 9 | 18 | 13.13 | 2.742 | **.006*** |
| | | Post 24 weeks | 12.82±3 .65 | 13 | 10 | 16 | 7.17 | | |
| | Control | Post 12 weeks | 21.75±6 .47 | 21 | 16. 25 | 25 | 11.57 | .213 | .831 |
| | | Post 24 weeks | 21 ±6.17 | 19.50 | 17 | 27.2 5 | 7.20 | | |
| Fear Avoidance Belief in Physical Activity | Yoga | Post 12 weeks | 13.52±4 .67 | 15 | 9 | 17 | 13.88 | 3.128 | **.002*** |
| | | Post 24 weeks | 11.91± 4.11 | 12 | 9 | 15 | 5.17 | | |
| | Control | Post 12 weeks | 18.9 ±3.52 | 18 | 16. 25 | 22 | 11.71 | .261 | .794 |
| | | Post 24 weeks | 18.35±3 .60 | 18.50 | 16 | 21.5 0 | 7.10 | | |
| Fear Avoidance Belief in Work Activity | Yoga | Post 12 weeks | 25.13±7 .92 | 25 | 22 | 32 | 14.21 | 3.169 | **.002*** |
| | | Post 24 weeks | 21.91±6 .45 | 22 | 20 | 26 | 5.75 | | |
| | Control | Post 12 weeks | 33.4 ±3.48 | 34 | 30. 50 | 36 | 9.85 | 1.862 | .063 |
| | | Post 24 weeks | 30.8 ±4.37 | 32 | 28 | 34 | 8.60 | | |
| Pain Catastrophizing | Yoga | Post 12 weeks | 19.69±7 .03 | 21 | 13 | 24 | 13.47 | 3.604 | **.000*** |
| | | Post 24 weeks | 16.82±6 .24 | 16 | 10 | 22 | 5.00 | | |
| | Control | Post 12 weeks | 27.65±5 .85 | 27.50 | 23. 25 | 32 | 9.70 | .081 | .936 |
| | | Post 24 weeks | 27.05 ±5.39 | 28 | 24. 52 | 31.5 0 | 10.33 | | |

***p-value < 0.05 is significant***

The table no. 39 shows that for within group comparison of the post-12 weeks and post-24 weeks in the yoga group for psychological variables, the Wilcoxon Signed Ranks Test was conducted. It was found that depression of the yoga group post-12 weeks mean 14.30±5.41, median 15, Q1=9, Q3=18 and mean rank 13.13. Post 24 week mean 12.82±3.65, median 13, Q1=10, Q3=16 and mean rank 7.17. The calculated Z is 2.742, and the 'p'=.006 ($p<0.05$). Depressions in the control group post-12 weeks mean 21.75± 6.47, median 21, Q1=16.25, Q3=25 and mean rank 11.57. Post-24 weeks mean 21±6.17, median 19.50, Q1=17, Q3=27.25 and mean rank 7.20. The calculated Z is .213, and the 'p'=.831 ($p>0.05$).

In case of fear avoidance belief in physical Activity, yoga group post-12 weeks mean 13.52±4.67, median 15, Q1=9, Q3=17 and mean rank 13.88. Post 24 week mean 11.91±4.11, median 12, Q1=9, Q3=15 and mean rank 5.17. The calculated Z is 3.128, and the 'p'=.002 ($p<0.05$). Fear avoidance belief in physical Activity in control group post-12 weeks mean 18.9±3.52, median18, Q1=16.25, Q3=22 and mean rank 11.71. Post 24 week mean 18.35±3.60, median 18.50, Q1=16, Q3= 21.50 and mean rank 7.10. The calculated Z is .261, and the 'p'=.794 ($p>0.05$).

In case of fear avoidance belief in work Activity, yoga group post-12 weeks mean 25.13± 7.92, median 25, Q1=22, Q3=32 and mean rank 14.21. Post 24 week mean 21.91±6.45, median 22, Q1= 20, Q3= 26 and mean rank 5.75. The calculated Z is 3.169, and the 'p'=.002 ($p<0.05$). Fear avoidance beliefs in work Activity rate in control group post-12 weeks mean 33.4±3.48, median 34, Q1=30.50, Q3=36 and mean rank 9.85. Post 24 week mean 30.8±4.37, median 32, Q1=28, Q3=34 and mean rank 8.60. The calculated Z is 1.862, and the 'p'=.063 ($p>0.05$).

In case of pain catastrophizing, yoga group post-12 weeks mean 19.69± 7.03, median 21, Q1=13, Q3=24 and mean rank 13.47. Post 24 week mean 16.82±6.24, median 16, Q1=10, Q3= 22 and mean rank 10. The calculated Z is 3.604, and the 'p'=.000 ($p<0.05$). Pain catastrophizing in control group post-12 weeks mean 27.65± 5.85, median 27.50, Q1=23.25, Q3=32 and mean rank 9.70. Post 24 week mean 27.05±5.39, median 28, Q1=24.52, Q3=31.50 and mean rank 10.33. The calculated Z is .081, and the 'p'=.936($p>0.05$).

So, the **Null Hypothesis is rejected** in all psychological variables with respect to yoga group. The means of the post-24 weeks in the yoga group in in all psychological variables are **lower** than the post-12 weeks.

**Null Hypothesis is accepted** in all psychological variables with respect to control group.

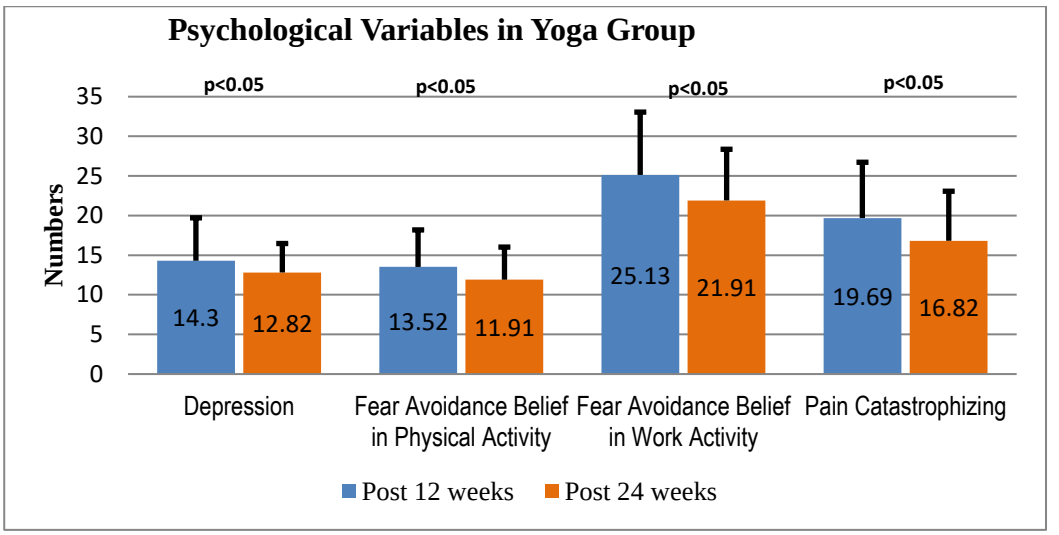
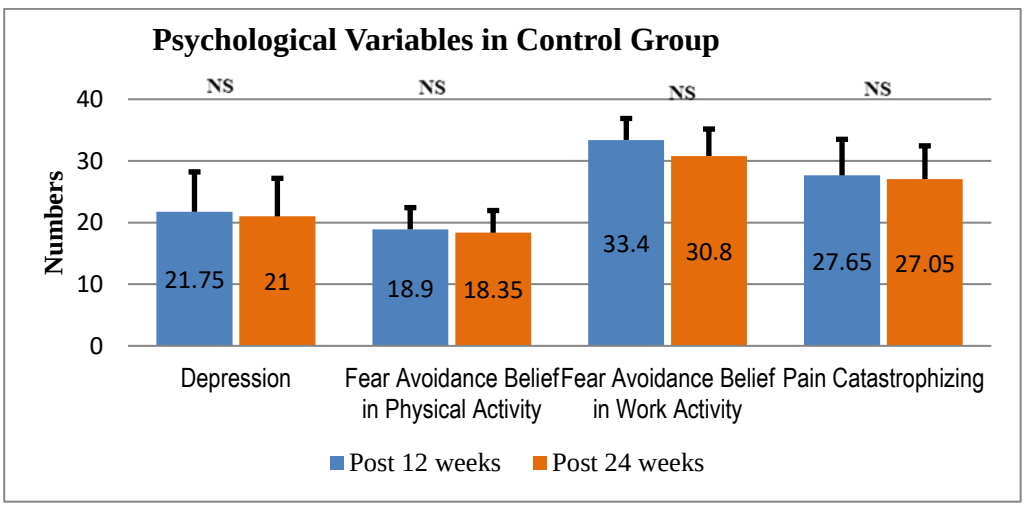



**Fig. 87: Graphical representation of post 12 weeks and post 24 weeks of yoga group with respect to psychological variables**




***p<0.05=Significant, NS=Not Significant***

**Fig. 88: Graphical representation of post 12 weeks and post 24 weeks of control group with respect to psychological variables**

## 4.6.6. HRQoL Variables:

**$H_0$41-** There exists no significant difference between post 12 weeks and post 24 weeks in yoga group with respect to HRQoL variables

**$H_0$42-** There exists no significant difference between post 12 weeks and post 24 weeks in control group with respect to HRQoL variables.

**Table no.40: Within group comparison of post 12 weeks and post 24 weeks of yoga group and control group with respect to HRQoL variables**

| Variables | Groups | Time | Mean | Median | Q1 | Q3 | Mean Rank | Z | p-value |
|---|---|---|---|---|---|---|---|---|---|
| Physical Functioning | Yoga | Post 12 weeks | 77.82±10.09 | 75 | 70 | 85 | 6.08 | .641 | .522 |
| | | Post 24 weeks | 79.13±10.40 | 80 | 70 | 85 | 7.79 | | |
| | Control | Post 12 weeks | 67.25±7.15 | 70 | 61.25 | 75 | 8.61 | .496 | .620 |
| | | Post 24 weeks | 65.75±9.90 | 65 | 55 | 75 | 8.36 | | |
| Role limitation-Physical | Yoga | Post 12 weeks | 83.69±14.31 | 75 | 75 | 100 | 3.00 | 1.342 | .180 |
| | | Post 24 weeks | 86.95±14.82 | 100 | 75 | 100 | 3.00 | | |
| | Control | Post 12 weeks | 51.25±15.12 | 50 | 50 | 50 | 5.50 | 1.732 | .083 |
| | | Post 24 weeks | 60.25±12.40 | 50 | 50 | 75 | 7.67 | | |
| Role limitation-Emotional | Yoga | Post 12 weeks | 85.60±19.58 | 100 | 67 | 100 | 2.00 | 1.134 | .257 |
| | | Post 24 weeks | 88.52±16.07 | 100 | 67 | 100 | 2.67 | | |
| | Control | Post 12 weeks | 51.7±27.68 | 67 | 33 | 67 | 4.50 | 1.361 | .174 |
| | | Post 24 weeks | 61.75±22.53 | 67 | 33 | 67 | 6.86 | | |
| Vitality | Yoga | Post 12 weeks | 62.26±6.83 | 65 | 55 | 65 | 3.25 | 27.52 | **.006*** |
| | | Post 24 weeks | 66.04±4.63 | 65 | 60 | 70 | 7.68 | | |
| | Control | Post 12 weeks | 53.2±5.73 | 55 | 50 | 55 | 7.17 | 1.306 | .192 |
| | | Post 24 weeks | 55.6±6.79 | 55 | 50 | 62.50 | 9.30 | | |
| Mental Health | Yoga | Post 12 weeks | 59.52±5.60 | 58 | 54 | 64 | .00 | 3.630 | **.000*** |
| | | Post 24 weeks | 64.82±5.29 | 64 | 62 | 70 | 9.00 | | |
| | Control | Post 12 weeks | 44.2±6.92 | 46 | 21 | 48 | 5.67 | 28.28 | **.005*** |
| | | Post 24 weeks | 51.3±8.61 | 48 | 46 | 56 | 9.71 | | |
| Social Functioning | Yoga | Post 12 weeks | 81.52±0.04 | 80 | 75 | 85 | 4.00 | 2.289 | **.022*** |
| | | Post 24 weeks | 84.34±8.82 | 85 | 75 | 90 | 6.44 | | |
| | Control | Post 12 weeks | 72.15±11.32 | 72.50 | 65 | 80 | 7.56 | .390 | .697 |
| | | Post 24 weeks | 72.9±7.38 | 75 | 68.50 | 75 | 9.44 | | |
| Pain | Yoga | Post 12 weeks | 67.56±11.38 | 70 | 60 | 75 | 4.50 | 3.081 | **.002*** |
| | | Post 24 weeks | 72.30±7.85 | 75 | 65 | 75 | 7.73 | | |
| | Control | Post 12 weeks | 52.45±9.17 | 47.50 | 45 | 58 | 7.60 | 2.506 | **.012*** |
| | | Post 24 weeks | 61.15±8.75 | 65 | 54.25 | 68 | 11.47 | | |
| General Health | Yoga | Post 12 weeks | 67.60±10.85 | 70 | 60 | 75 | 3.00 | 2.853 | **.004*** |
| | | Post 24 weeks | 73.26±7.77 | 75 | 65 | 80 | 6.82 | | |
| | Control | Post 12 weeks | 61.25±9.85 | 65 | 55 | 68 | 5.40 | .956 | .339 |
| | | Post 24 weeks | 63.75±7.58 | 65 | 56.25 | 68.75 | 7.29 | | |
| Health Change | Yoga | Post 12 weeks | 65.21±26.90 | 75 | 50 | 75 | 7.50 | 1.647 | .099 |
| | | Post 24 weeks | 73.91±23.20 | 75 | 75 | 75 | 5.67 | | |
| | Control | Post 12 weeks | 47.07±17.95 | 50 | 25 | 50 | 10.00 | .431 | .666 |
| | | Post 24 weeks | 51.25±24.47 | 50 | 50 | 75 | 7.60 | | |

***p-value < 0.05 is significant***

The table no. 40 shows that for within group comparison of the post-12 weeks and post-24 weeks in the yoga group for HRQoL variables, the Wilcoxon Signed Ranks Test was conducted. It was found that physical functioning of the yoga group post 12 weeks mean 77.82±10.09, median 75, Q1=70, Q3=85 and mean rank 6.08. Post 24 week mean

79.13±10.40, median 80, Q1=70, Q3=85 and mean rank 7.79. The calculated Z is .641, and the 'p'=.522 (p>0.05). Physical functioning in the control group post 12 weeks mean 67.25±7.15, median 70, Q1= 61.25, Q3=75 and mean rank 8.61. Post 24 weeks mean 65.75± 9.90, median 65, Q1=55, Q3=75 and mean rank 8.36. The calculated Z is .496, and the 'p'=.520 (p>0.05).

In case of role limitation-physical, yoga group post 12 weeks mean 83.69±14.31, median 75, Q1=75, Q3=100 and mean rank 3.00. Post 24 week mean 86.95±14.82, median 100, Q1=75, Q3=100 and mean rank 3. The calculated Z is 1.342, and the 'p'=.180 (p>0.05). Role limitation-physical in control group post 12 weeks mean 51.25±15.12, median 50, Q1=50, Q3=50 and mean rank 5.50. Post 24 week mean 60.25±12.40, median 50, Q1=50, Q3=75 and mean rank 7.67. The calculated Z is 1.732, and the 'p'=.083(p>0.05).

In case of Role limitation-Emotional, yoga group post 12 weeks mean 85.60±19.58, median 100, Q1=67, Q3=100 and mean rank 2.00. Post 24 week mean 88.52±16.07, median 100, Q1=67, Q3=100 and mean rank 2.67. The calculated Z is 1.134, and the 'p'=.257 (p>0.05). Hence, the Wilcoxon Signed Ranks Test is not significant at a 0.05 level of significance. Role limitation-Emotional in control group, post 12 weeks mean 51.7±27.68, median 67, Q1=33, Q3=67 and mean rank 4.50. Post 24 week mean 61.75±22.53, median 67, Q1=33, Q3=67 mean rank 6.86. The calculated Z is 1.361, and the 'p'=.174 (p>0.05).

Vitality yoga group posts 12 weeks mean 62.26 ±6.83, median 65, Q1= 55, Q3= 65 and mean rank 3.25. Post 24 week mean 66.04 ±4.63, median 65, Q1=60, Q3=70 and mean rank 7.68. The calculated Z is 27.52, and the 'p'=.006 (p<0.05). Hence, the Wilcoxon Signed Ranks Test is significant at a 0.05 level of significance. Vitality in control group post 12 weeks mean 53.2±5.73, median 55, Q1=50, Q3=55 and mean rank 7.17. Post 24 week mean 55.6± 6.79, median 55, Q1=50, Q3=62.50 and mean rank 9.30. The calculated Z is 1.306, and the 'p'=.192 (p>0.05).

In case of mental health, yoga group posts 12 weeks mean 59.52±5.60, median 58, Q1=54, Q3=64 and mean rank .00. Post 24 week mean 64.82±5.29, median 64, Q1=62, Q3=70 mean rank 9. The calculated Z is 3.630, and the 'p'=.000 (p<0.05). Hence, the Wilcoxon Signed Ranks Test is significant at a 0.05 level of significance. Mental health in control group, post 12 weeks mean 44.2±6.92, median 46, Q1=21, Q3=48 and mean rank 5.67. Post 24 week mean 51.3±8.61, median 48, Q1=46, Q3= 56 and mean rank 9.41. The calculated Z is 28.28, and the 'p'=.005 (p<0.05).

In case of social functioning, yoga group posts 12 weeks mean 81.52±0.04, median 80, Q1=75, Q3=85 and mean rank 4.00. Post 24 week mean 84.34±8.82, median 85, Q1=75, Q3=90 and mean rank 6.44. The calculated Z is 2.289, and the 'p'=.022 ($p<0.05$). Hence, the Wilcoxon Signed Ranks Test is significant at a 0.05 level of significance. Social functioning in control group posts 12 weeks mean 72.15±11.32, median 72.50, Q1=65, Q3=80 mean rank 7.56. Post 24 week mean 72.9±7.38, median 75, Q1= 68.50, Q3= 75 and mean rank 9.44. The calculated Z is .390, and the 'p'=.697 ($p>0.05$).

In case of Pain, yoga group posts 12 weeks mean 67.56±11.38, median 70, Q1=60, Q3=75 mean rank 4.50. Post 24 week mean 72.30±7.85, median 75, Q1=65, Q3=75 and mean rank 7.73. The calculated Z is 3.081, and the 'p'=.002 ($p<0.05$). Pain in control group posts 12 weeks mean 52.45±9.17, median 47.50, Q1=45, Q3=58 and mean rank 7.60. Post 24 week mean 61.15±8.75, median 65, Q1=54.25, Q3= 68 and mean rank 11.47. The calculated Z is 2.506, and the 'p'=.012 ($p<0.05$).

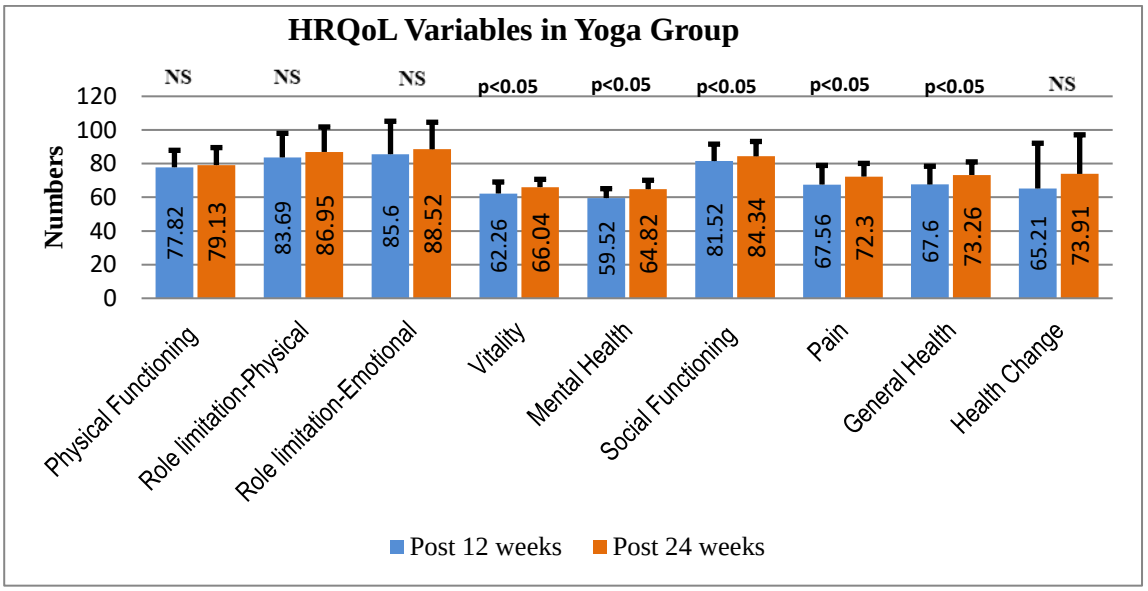
In case of General Health, yoga group posts 12 weeks mean 67.60±10.85, median 70, Q1=60, Q3=75 and mean rank 3.00. Post 24 week mean 73.26±7.77 median 75, Q1=65 and Q3=80 and mean rank 6.82. The calculated Z is 2.853, and the 'p'=.004 ($p<0.05$). General Health in control group posts 12 weeks mean 61.25±9.85, median 65, Q1=55, Q3=68 and mean rank 5.40. Post 24 week mean 63.75±7.58, median 65, Q1= 56.25, Q3= 68.75 and mean rank 7.29. The calculated Z is .956, and the 'p'=.339 ($p>0.05$).

In case of health change, yoga group posts 12 weeks mean 65.21±26.90, median 75, Q1=50, Q3=75 and mean rank 7.50. Post 24 week mean 73.91±23.20, median 75, Q1=75, Q3=75 and mean rank 5.67. The calculated Z is 1.647, and the 'p'=.099 ($p>0.05$). Health changes in control group posts 12 weeks mean 47.07±17.95, median 50, Q1=25, Q3=50 and mean rank 10.00. Post 24 week mean 51.25±24.47, median 50, Q1=50, Q3=75 and mean rank 7.60. The calculated Z is .431, and the 'p'=.666 ($p<0.05$).

So, the **Null Hypothesis is rejected** in vitality, mental health, social functioning and pain but **Null Hypothesis is accepted** in physical functioning**,** role limitation-physical, role limitation-emotional and health change in HRQoL variables with respect to yoga group. The means of the post-24 weeks in the yoga group in vitality, mental health, social functioning and pain are **higher** than the post-12 weeks.

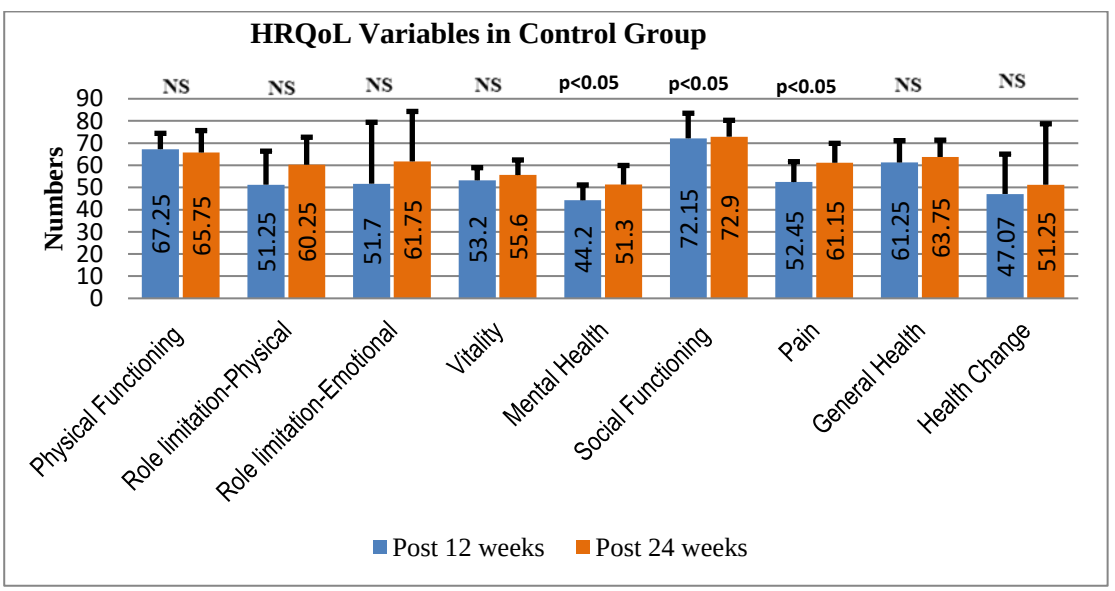
The **Null Hypothesis is rejected** in mental health and pain but **Null Hypothesis is accepted** in physical functioning**,** role limitation-physical, role limitation-emotional, mental

health, pain and health change in HRQoL variables with respect to control group. The means of the post-24 weeks in the control group in mental health and pain are **higher** than the post-12 weeks.




***p<0.05=Significant, NS=Not Significant***

**Fig. 89: Graphical representation of post 12 weeks and post 24 weeks of yoga group with respect to HRQoL variables**




***p<0.05=Significant, NS=Not Significant***

**Fig. 90: Graphical representation of post 12 weeks and post 24 weeks of control group with respect to HRQoL variables**

## 4.7. Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test:

### 4.7.1 Disease Activity Index and Functional Index:

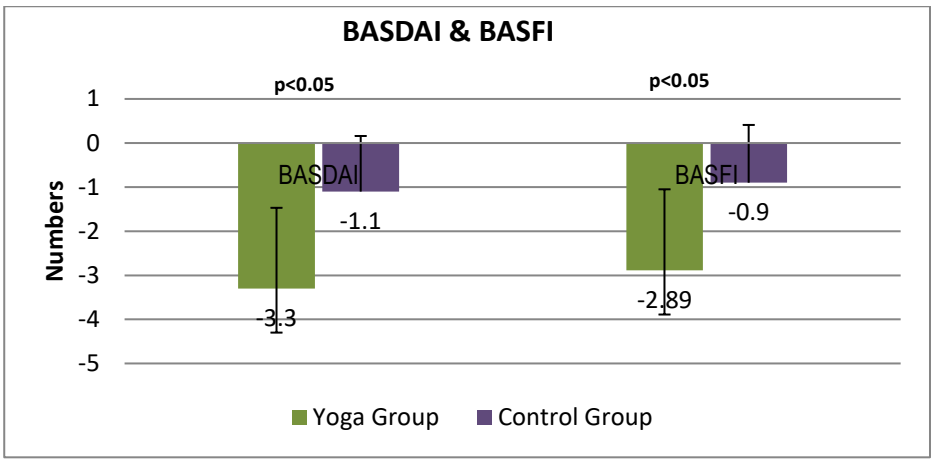
**$H_0$43*:*** There exists no significant difference between yoga group and control group in changes score with respect of Disease Activity Index and Functional Index

**Table no-41 Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in Disease Activity Index and Functional Index**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| **BASDAI** | Yoga Group | -3.30 ±1.83 | -3.20 | -1.80 | -4.40 | 28.80 | 73.50 | **.000*** |
| | Control Group | -1.10± 1.26 | -1.00 | -.275 | -1.77 | 14.18 | | |
| **BASFI** | Yoga Group | -2.89 ± 1.84 | -3.50 | -1.40 | -4.50 | 28.15 | 88.50 | **.001*** |
| | Control Group | -0.9± 1.31 | -.80 | -.225 | -1.975 | 14.93 | | |

****p-value < 0.05 is significant***

The table no. 41 shows that for comparing of the changes between the yoga and control groups at pre-test and at post 12 weeks test, the Mann-Whitney U test was conducted for disease activity index and functional index. The BASDAI of the yoga group changes score mean -3.30±1.83, median-3.20, Q1=-1.80, Q3=-4.40 and mean rank is 28.80. The control group mean -1.10±1.26, median -1.00, Q1=-.275, Q3=-1.77 and mean rank 14.18. The calculated U is =73.50, and the 'p'=.000 ($p<0.05$). BASFI of the yoga group changes score mean -2.89±1.84, median -3.50, Q1=-1.40, Q3=-4.50 and mean rank 28.15. Control group changes score mean -0.9± 1.31, median -.80, Q1=-.225, Q3=-1.975 and mean rank 14.93. The calculated U is =88.500, and the 'p'=.001 ($p<0.05$). **Null Hypothesis is rejected** in BASDAI and BASFI variables. The change scores means in the yoga group in BASDAI and BASFI are **negatively higher** than the control group.




***p<0.05=Significant***

**Fig. 91: Graphical representation of Comparison of the changes between the yoga and control groups at pre-test and at post 12 week test in Disease Activity Index and Functional Index**

## 4.7.2 Inflammatory Markers Variables:

**$H_0$44*:*** There exists no significant difference between yoga group and control group in changes score with respect to inflammatory markers variables

**Table no.42: Comparison of change scores of pre-test to post 12 weeks between Yoga and Control Group with respect to Inflammatory Markers Variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| ESR (mm/hr) | Yoga Group | -16.60± 12.75 | -18 | -3 | -26 | 26.37 | 129.50 | **.014*** |
| | Control Group | -5.2± 12.86 | -5 | 4.25 | -14 | 16.98 | | |
| CRP (mg/L) | Yoga Group | -2.99 ±5.88 | -1.77 | -.029 | -5.73 | 25.61 | 147.00 | **.043*** |
| | Control Group | -.091 ±17.85 | 3.68 | 9.94 | -13.26 | 17.85 | | |
| TNF-alpha (ng/L) | Yoga Group | -51.13 ±64.47 | -18.32 | -2.44 | -26.06 | 25.57 | 148.00 | **.046*** |
| | Control Group | 3.27±61.21 | -5.01 | 1.63 | -14.23 | 17.90 | | |
| Cortisol (µg/dL) | Yoga Group | -2.15 ±5.88 | .44 | 3.28 | -2.63 | 19.30 | 168.00 | .131 |
| | Control Group | -0.24 ±4.18 | -1.81 | 1.59 | -4.16 | 25.10 | | |

****p-value < 0.05 is significant***

The table no. 42 shows that for comparing of the changes between the yoga and control groups at pre-test and at post 12 weeks test, the Mann-Whitney U test was conducted for inflammatory markers variables. The ESR of the yoga group changes score mean -16.60±12.75, median -18, Q1=-3, Q3=-26 and mean rank is 26.37. The control group changes

score mean-5.2± 12.86, median-5 mean rank 16.98, Q1=4.25 and Q3=-14. The calculated U is =129.500, and the 'p'=.014 (p<0.05).

In case of CRP, of the yoga group changes score mean-2.99 ±5.88, median -1.77, Q1= -.029, Q3= -5.73 and mean rank is 25.61. The control group changes score mean -.091±17.85, median 3.68, Q1=9.94, Q3=-13.26 and mean rank 17.85. The calculated U is =147.00, and the 'p'=.043 (p<0.05).

In case of TNF-alpha, of the yoga group changes score mean-51.13±64.47, median-18.32, Q1=-2.44, Q3=-26.06 and mean rank is 25.57. The control group changes score mean 3.27±61.21, median -5.01, Q1= 1.63, Q3=-14.23 and mean rank 17.90. The calculated U is =148.00, and the 'p'=.046 (p<0.05).

In case of Cortisol, of the yoga group changes score mean-2.15 ±5.88, median .44, Q1= 3.28, Q3= -2.63 and mean rank is 19.30. The control group changes score mean -0.24 ±4.18, median -1.81, Q1=1.59, Q3=-4.16 and mean rank 25.10. The calculated U is =168.00, and the 'p'=.131 (p>0.05).

So, the **Null Hypothesis is rejected** in ESR, CRP and TNF-alpha. **Null Hypothesis is accepted** in cortisol. The change scores means in the yoga group in ESR, CRP, and TNF-alpha are **negatively higher** than in the control group.

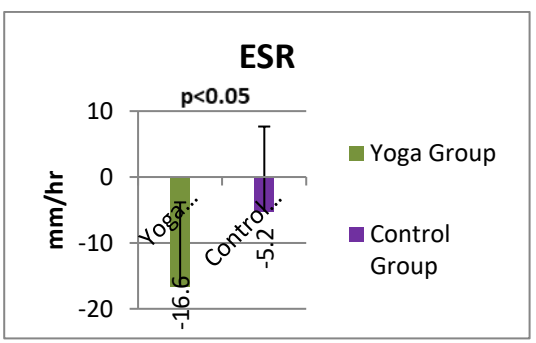



Fig. 92

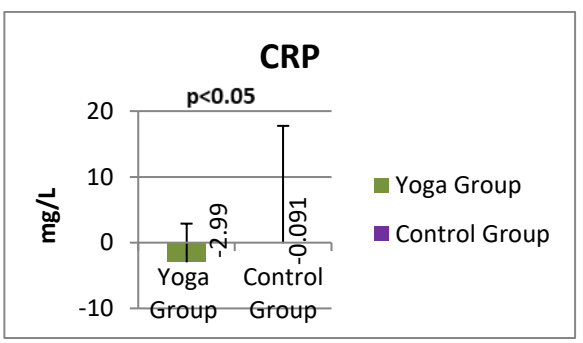



Fig. 93

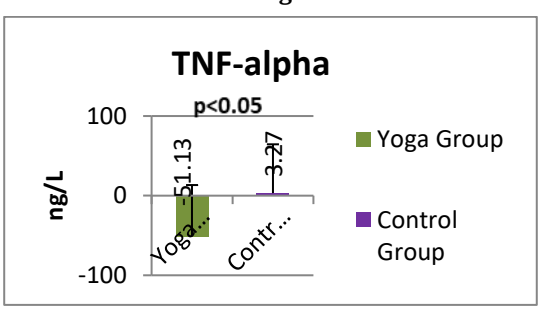



Fig. 94

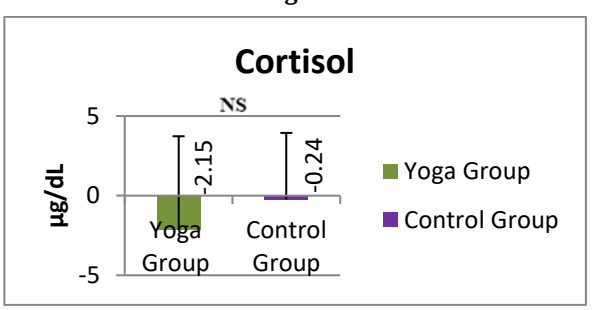



Fig. 95

***p<0.05=Significant, NS=No Significant***

**Fig. 92-95: Graphical representation of Comparison of the changes between the yoga and control groups at pre-test and at post 12 week test in inflammatory markers variables. 92) ESR; 93) CRP; 94) TNF-alpha; 95) Cortisol**

## 4.7.3 Blood Count Variables:

**$H_0$45*:*** There exists no significant difference between yoga group and control group in changes score with respect of blood count variables

**Table no.43: Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in blood count variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Haemoglobin (g/dl) | Yoga Group | -0.39± 0.8 | -.200 | .100 | -1.00 | 24.02 | 183.500 | .257 |
| | Control Group | 0.18 ±1.22 | .165 | .475 | -.800 | 19.68 | | |
| Total Leukocyte Count (thou/$mm^3$) | Yoga Group | -1.15± 2.51 | -1.20 | 1.30 | -2.31 | 23.30 | 200.000 | .465 |
| | Control Group | 0.01± 3.90 | -.85 | 2.30 | -3.00 | 20.50 | | |
| Segmented Neutrophils (%) | Yoga Group | 0.08±12.72 | -2.80 | 7.90 | -8.90 | 22.37 | 221.500 | .836 |
| | Control Group | 0.02±11.80 | -.15 | 9.20 | -9.40 | 21.58 | | |
| Lymphocytes (%) | Yoga Group | 0.94±9.64 | 2.20 | 9.30 | -5.00 | 21.89 | 227.500 | .951 |
| | Control Group | 0.67±10.11 | .40 | 9.50 | -3.72 | 22.13 | | |
| Monocytes (%) | Yoga Group | -0.86± 2.95 | -1.10 | 1.80 | -3.10 | 23.74 | 190.000 | .330 |
| | Control Group | -0.15± 3.85 | 1.00 | 2.20 | -1.90 | 20.00 | | |
| Eosinophil (%) | Yoga Group | -0.08± 4.31 | -.200 | 2.50 | -3.20 | 21.02 | 207.500 | .584 |
| | Control Group | -1.03± 5.27 | -.800 | 4.10 | -4.67 | 23.13 | | |
| Basophils (%) | Yoga Group | -0.08± 4.32 | .000 | .100 | -.400 | 21.78 | 225.000 | .903 |
| | Control Group | -0.03± 0.52 | -.200 | .375 | -.375 | 22.25 | | |
| Platelet Count (thou/$mm^3$) | Yoga Group | -9.43±52.42 | -2.00 | 29 | -38 | 24.52 | 172.000 | .158 |
| | Control Group | 20.656±7.13 | 37.50 | 115 | -69 | 19.10 | | |

****p-value < 0.05 is significant***

The table no. 43 shows that for comparing of the changes between the yoga and control groups at pre-test and at post 12 weeks test, the Mann-Whitney U test was conducted for inflammatory markers variables. The Haemoglobin of the yoga group changes score mean -0.39± 0.8, median -.200, Q1=.100, Q3=-1.00 and mean rank is 24.02. The control group changes score mean 0.18±1.22, median 165, Q1=.475, Q3=-0.80 and mean rank 19.68. The calculated U is =183.500, and the 'p'=.257 (p>0.05).

In case of total leukocyte count of the yoga group changes score mean-1.15± 2.51, median -1.20, Q1= 1.30, Q3= -2.31 and mean rank is 23.30. The control group changes score mean 0.01±3.90, median -.85, Q1=2.30, Q3=-3 and mean rank 20.50. The calculated U is =200.00, and the 'p'=.465 (p>0.05).

In case of segmented of the yoga group changes score mean 0.08±12.72, median -2.80, Q1=7.90, Q3=-8.90 and mean rank is 22.37. The control group changes score mean 0.02± 11.80, median -.15, Q1=9.20 Q3=-9.40 and mean rank 21.58. The calculated U is =221.500, and the 'p'=.836 (p>0.05).

In case of lymphocytes of the yoga group changes score mean 0.94±9.64, median 2.20, Q1=9.30, Q3=-5.00 and mean rank is 21.89. The control group changes score mean 0.67 ±10.11, median .40, Q1=9.50, Q3=-3.72 and mean rank 22.13. The calculated U is =227.500, and the 'p'=.951 (p>0.05).

In case of total monocytes count of the yoga group changes score mean-0.86±2.95, median -1.10, Q1= 1.80, Q3=-3.10 and mean rank is 23.74. The control group changes score mean -0.15±3.85, median 1.00, Q1= 2.20, Q3=-1.90 and mean rank 20.00. The calculated U is =190.000, and the 'p'=.330 (p>0.05).

In case of eosinophil of the yoga group changes score mean -0.08±4.31, median -.200, Q1= 2.50, Q -3.20 and mean rank is 21.02. The control group changes score mean-1.03± 5.27, median -.800, Q1= 4.10, Q3= -4.67 and mean rank 23.13. The calculated U is =207.500, and the 'p'=.584 (p>0.05). Hence, Mann-Whitney U is not significant at a 0.05 level of significance.

In case of basophils of the yoga group changes score mean -0.08± 4.32, median .000, Q1= .100, Q3=-.400 and mean rank is 21.78. The control group changes score mean -0.03± 0.52, median -.200, Q1=.375 and Q3=-.37 mean rank 22.255. The calculated U is =225.000, and the 'p'=.903 (p>0.05).

In case of platelet count of the yoga group changes score mean -9.43±52.42, median -2.00, Q1= 29, Q3=-38 and mean rank is 24.52. The control group changes score mean 20.65 6±7.13, median 37.50, Q1=115, Q3=-69 and mean rank 19.10. The calculated U is =172.000, and the 'p'=.158 (p>0.05).

So, **Null Hypothesis is accepted** in all blood count variables.

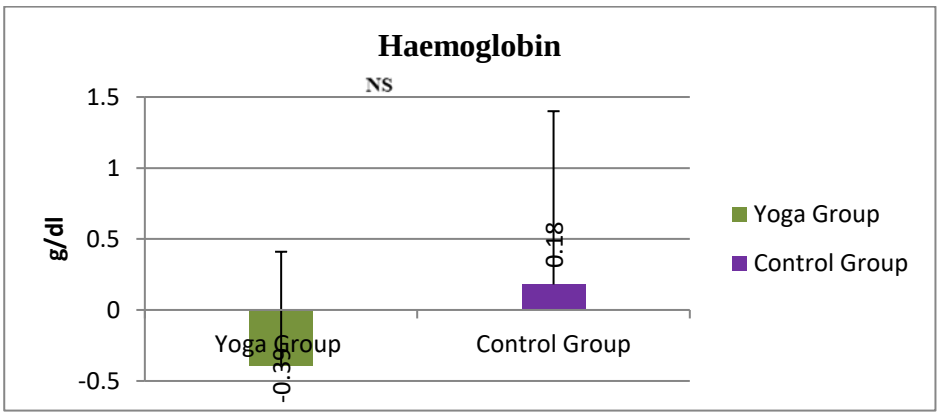



**Fig. 96**

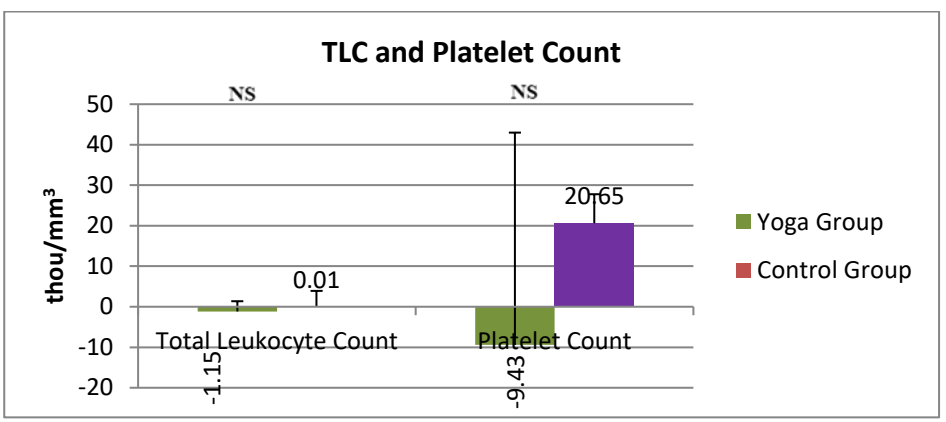
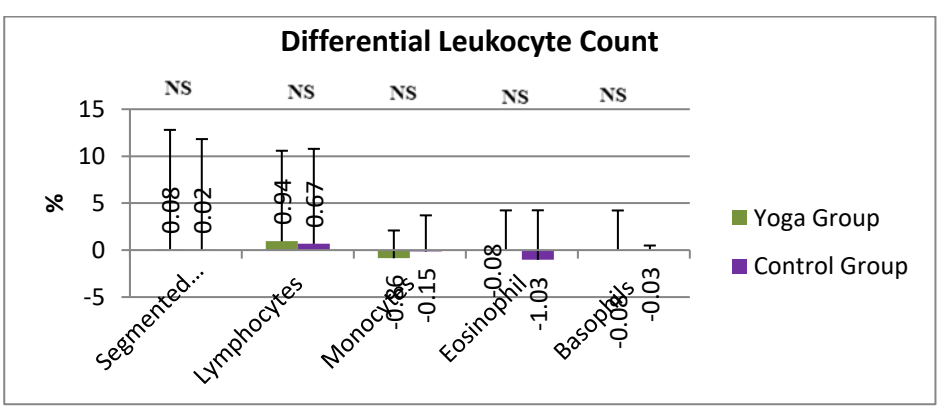



**Fig. 97**




***NS=Not Significant***

**Fig. 98**

**Fig. 96-98: Graphical representation of c Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in blood count variables. 96) Haemoglobin; 97) TLC and Platelet Count; 98) Differential Leukocyte Count**

## 4.7.4 General Health Variables:

**$H_0$46:** There exists no significant difference between yoga group and control group in changes score with respect of general health variables

**Table no.44: Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in general health variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Systolic BP (mmHg) | Yoga Group | -6.26± 8.19 | -9.00 | -1.00 | -13.00 | 21.50 | 218.500 | .779 |
| | Control Group | -7.45± 6.20 | -7.50 | -3.00 | -12.00 | 22.58 | | |
| Diastolic BP (mmHg) | Yoga Group | -5.95± 9.11 | -5.00 | .00 | -12 | 24.22 | 179.000 | .212 |
| | Control Group | -3.35 ±5.25 | -2.00 | 17.50 | -9.00 | 19.45 | | |
| Resting Heart Rate (beats/minutes) | Yoga Group | -2.65±10.74 | -5.00 | 4.00 | -11.00 | 22.17 | 226.000 | .922 |
| | Control Group | -1.9 ±13.78 | -3.00 | 3.50 | -10.75 | 21.80 | | |
| BMI ($kg/m^2$) | Yoga Group | -0.31 ±0.63 | -.30 | .00 | -.700 | 25.74 | 144.000 | **.036*** |
| | Control Group | 0.32± 0.97 | .50 | 1.10 | -.63 | 17.70 | | |

***p-value < 0.05 is significant***

The table no. 44 shows that for comparing of the changes between the yoga and control groups at pre-test and at post 12 weeks test, the Mann-Whitney U test was conducted for general health variables. The systolic blood pressure of the yoga group changes score mean -6.26± 8.19, median -9.00, Q1=-1.00, Q3=-13.00 and mean rank is 21.50. The control group changes score mean -7.45±6.20, median -7.50, Q1=-3.00, Q3=-12 and mean rank 22.58. The calculated U is =218.500, and the 'p'=.779 (p>0.05).

In case of diastolic blood pressure of the yoga group changes score mean-5.95± 9.11, median -5.00, Q1= .00, Q3=-12.00 and mean rank is 24.22. The control group changes score mean -3.35 ±5.25, median -2.00, Q1=17.50, Q3=-9.00 and mean rank 19.45. The calculated U is =179.000, and the 'p'=.212 (p>0.05).

In case of resting heart of the yoga group changes score mean -2.65± 10.74, median -5.00, Q1= 4.00, Q3= -11.00 and mean rank is 22.17. The control group changes score mean -

1.9 ±13.78, median -3.00, Q1=3.50, Q3=-10.75 and mean rank 21.80. The calculated U is =226.000, and the 'p'=.922 (p>0.05).

In case of body mass index of the yoga group changes score mean-0.31 ±0.63, median -.30, Q1=.00, Q3=-.700 and mean rank is 25.74. The control group changes score mean 0.32± 0.97, median -.50, Q1=1.10, Q3= -0.63 and mean rank 17.70. The calculated U is =144.000, and the 'p'=.036 (p<0.05).

So, the **Null Hypothesis is accepted** in systolic blood pressure, diastolic blood pressure, resting heart rate and **rejected** in case of body mass index. The change scores mean in the yoga group in BMI is **negatively higher** than the control group.

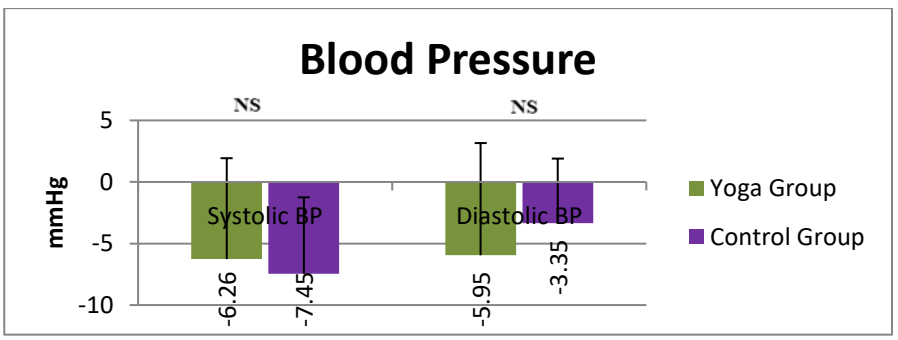



**Fig. 99**

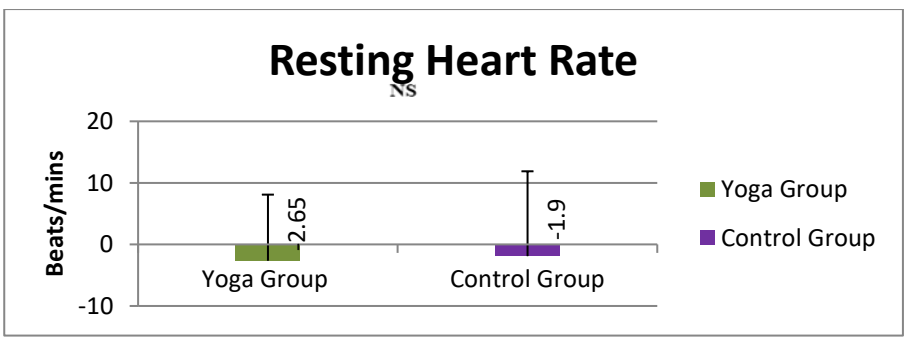
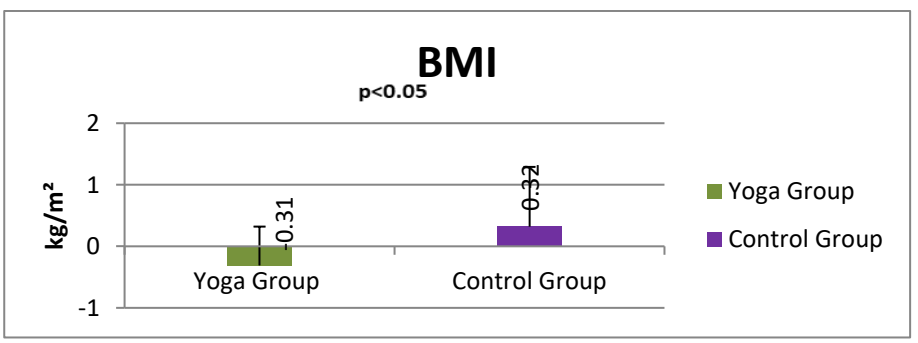



**Fig. 100**




***p<0.05=Significant, NS=No Significant***

**Fig. 101**

**Fig. 99-101: Graphical representation of Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in general health variables. 99) Blood Pressure; 100) Resting Heart Rate; 101) BMI**

## 4.7.5 Psychological Variables:

**$H_0$47*:*** There exists no significant difference between yoga group and control group in changes score with respect of psychological variables

**Table no.45: Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in psychological variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Depression | Yoga Group | -6.82±5.20 | -7.00 | -3.00 | -9.00 | 30.17 | 42.000 | **.000*** |
| | Control Group | 1.25±3.27 | 1.00 | 3.75 | -2.00 | 12.60 | | |
| Fear Avoidance Belief in Physical Activity | Yoga Group | -3.91±3.31 | -4.00 | -2.00 | -7.00 | 29.37 | 60.500 | **.000*** |
| | Control Group | 1.25 ±3.56 | 1.00 | 3.75 | -1.75 | 13.53 | | |
| Fear Avoidance Belief in Work Activity | Yoga Group | -9.21±6.86 | -10.00 | -4.00 | -14.00 | 28.70 | 76.000 | **.000*** |
| | Control Group | -1.35±3.45 | -2.00 | .00 | -.375 | 14.30 | | |
| Pain Catastrophizing | Yoga Group | -3± 6.68 | -4.00 | 1.00 | -8.00 | 27.93 | 93.500 | **.001*** |
| | Control Group | 3.8±5.91 | 3.50 | 6.75 | -1.00 | 15.18 | | |

***p-value < 0.05 is significant***

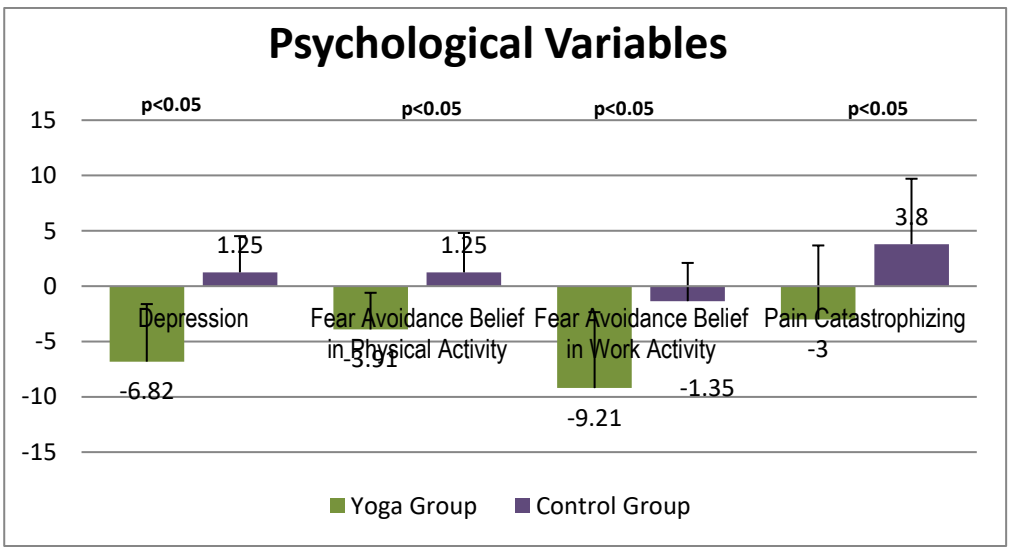
The table no. 45 shows that for comparing of the changes between the yoga and control groups at pre-test and at post 12 weeks test, the Mann-Whitney U test was conducted for psychological variables. The depression of the yoga group changes scores mean -6.82±5.20, median -7.00, Q1=-3.00, Q3=-9.00 and mean rank is 30.17. The control group changes score mean1.25± 3.27, median 1.00, Q1= 3.75, Q3=-2.00 and mean rank 12.60. The calculated U is =42.000, and the 'p'=.000($p<0.05$).

In case of Fear Avoidance Belief in Physical Activity of the yoga group changes score mean-3.91± 3.31, median -4.00, Q1=-2.00, Q3=-7.00 and mean rank is 29.37. The control group changes score mean1.25 ±3.56, median 1.00, Q1=3.75, Q3=-1.75 and mean rank 13.53. The calculated U is =60.500, and the 'p'=.000 ($p<0.05$).

In case of Fear Avoidance Belief in Work Activity of the yoga group changes score mean-9.21±6.86, median -10.00, Q1=.00, Q3= -14.00 and mean rank is 28.70. The control group changes score mean-1.35±3.45, median -2.00, Q1=.00, Q3=-.375 and mean rank 14.30. The calculated U is =76.000, and the 'p'=.000 ($p<0.05$).

In case of pain catastrophizing of the yoga group changes score mean -3±6.68, median -4.00, Q1=1.00, Q3=-8.00 and mean rank is 27.93. The control group changes score mean 3.8±5.91, median -3.50, Q1=6.75, Q3=-1.00 and mean rank 15.18. The calculated U is =93.500, and the 'p'=.001 (p<0.05).

So, the **Null Hypothesis is rejected** in all psychological variables i.e. depression, Fear Avoidance Belief in Physical Activity, Fear Avoidance Belief in Work Activity and pain catastrophizing. The change scores mean in the yoga group in all psychological variables are **negatively higher** than the control group.




***p<0.05=Significant***

**Fig. 102: Graphical representation of Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in psychological variables**

## 4.7.6 HRQoL Variables:

**$H_0$48*:*** There exists no significant difference between yoga group and control group in changes score with respect of HRQoL variables

**Table no.46: Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in HRQoL variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Physical Functioning | Yoga Group | 9.34±9.45 | 5.00 | 20.00 | .00 | 26.73 | 135.50 | **.019*** |
| | Control Group | 1.5 ±11.70 | 0.00 | 5.00 | -8.75 | 17.89 | | |
| Role limitation-Physical | Yoga Group | 22.82±21.20 | 25.00 | 50.00 | .00 | 28.73 | 95.50 | **.001*** |
| | Control Group | -6.25±26.74 | 0.00 | 18.75 | -25.00 | 16.15 | | |

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Role limitation Emotional | Yoga Group | 29.04±20.94 | 33 | 34.00 | .00 | 28.05 | 109.00 | **.003*** |
| | Control Group | -3.3±28.62 | 0.00 | 33.00 | -33.00 | 16.74 | | |
| Vitality | Yoga Group | 8.69±8.83 | 5.00 | 17.00 | .00 | 29.70 | 76.00 | **.000*** |
| | Control Group | -1.15±3.48 | 0.00 | .00 | -4.00 | 15.30 | | |
| Mental Health | Yoga Group | 15±8.09 | 12.00 | 20.00 | 8.00 | 33.00 | 10.00 | **.000*** |
| | Control Group | -5.7±9.56 | 0.00 | .00 | -8.50 | 12.43 | | |
| Social Functioning | Yoga Group | 9 ±12.67 | 10.00 | 20.00 | .00 | 26.63 | 137.500 | **.019*** |
| | Control Group | 3.15±10.48 | 0.00 | 3.75 | .00 | 17.98 | | |
| Pain | Yoga Group | 16.56±13.97 | 20 | 30.00 | 5.00 | 27.00 | 130.000 | **.014*** |
| | Control Group | 7.15±11.61 | 5.00 | 15.75 | .00 | 17.65 | | |
| General Health | Yoga Group | 7.60±11.36 | .00 | 15.00 | .00 | 23.75 | 195.000 | .372 |
| | Control Group | 3.25±11.16 | .00 | 12.50 | .00 | 20.48 | | |
| Health Change | Yoga Group | 30.43±28.15 | 25.00 | 50.00 | 25.00 | 28.00 | 110.000 | **.002*** |
| | Control Group | 3.75±24.70 | 0.00 | 25.00 | .00 | 16.78 | | |

***p-value < 0.05 is significant***

The table no. 46 shows that for comparing of the changes between the yoga and control groups at pre-test and at post 12 weeks test, the Mann-Whitney U test was conducted for HRQoL variables. The physical functioning of the yoga group changes score mean 9.34±9.45, median 5.00, Q1=20.00, Q3=.00 and mean rank is 26.73. The control group changes score mean1.5 ±11.70, median 0.00, Q1=5.00, Q3=-8.75 and mean rank 17.89. The calculated U is =135.500, and the 'p'=.019($p<0.05$).

In case of role limitation- of the yoga group changes score mean 22.82±21.20, median 25.00, Q1= -50.00, Q3=.00 and mean rank is 28.73. The control group changes score mean -6.25±26.74, median 0.00, Q1=18.75, Q3=-25.00 and mean rank 16.15. The calculated U is =95.500, and the 'p'=.001($p<0.05$).

In case of role limitation-emotional of the yoga group changes score mean 29.04± 20.94, median 33.00, Q1=34.00, Q3=.00 and mean rank is 28.05. The control group changes score mean-3.3±28.62, median 0.00, Q1=33.00, Q3=-33.00 and mean rank 16.74. The calculated U is =109.000, and the 'p'=.003($p<0.05$).

In case of vitality of the yoga group changes score mean 8.69 ±8.83, median 5.00, Q1=17.00, Q3=.00 and mean rank is 29.70. The control group changes score mean 1-1.15± 3.48, median 0.00, Q1=.00, Q3=-4.00 and mean rank 15.30. The calculated U is =76.000, and the 'p'=.000($p<0.05$).

In case of mental health of the yoga group changes score mean15±8.09, median 12.00, Q1=20.00, Q3=8.00 and mean rank is 33.00. The control group changes score mean-5.7±9.56, median 0.00, Q1=.00, Q3=-8.50 and mean rank 12.43. The calculated U is =10.000, and the 'p'=.000($p<0.05$).

In case of social functioning of the yoga group changes score mean 9±12.67, median 10.00, Q1=-20.00, Q3=.00 and mean rank is 26.30. The control group changes score mean3.15±10.48, median 0.00, Q1=3.75, Q3= -.00 and mean rank 17.98. The calculated U is =137.500, and the 'p'=.019($p<0.05$).

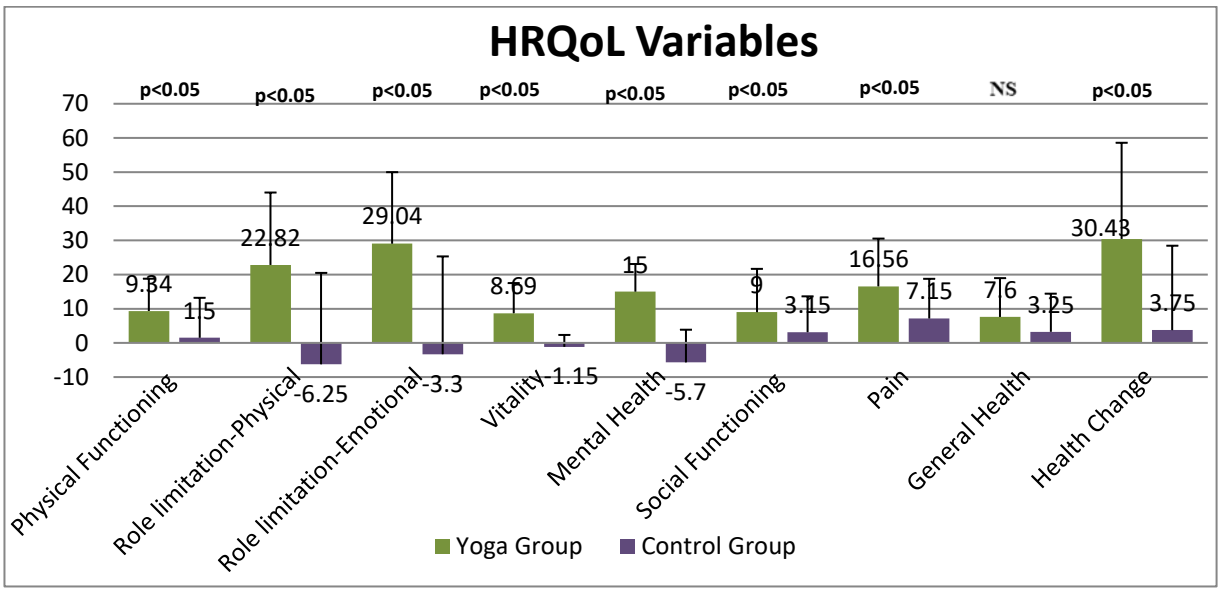
In case of pain yoga of the yoga group changes score mean16.56±13.97, median 20, Q1=30.00, Q3=5.00 and mean rank is 27.00. The control group changes score mean 7.15 ±11.61, median 5, Q1=15.75, Q3=.00 and mean rank 17.65. The calculated U is =130.000, and the 'p'=.014($p<0.05$).

In case of general health of the yoga group changes score mean 7.60 ±11.36, median 0.00, Q1=-15.00, Q3=.00 and mean rank is 23.75. The control group changes score mean 3.25±11.16, median 0.00, Q1=12.50, Q3=-.00 and mean rank 20.48. The calculated U is =195.000, and the 'p'=.372($p>0.05$).

In case of health change of the yoga group changes score mean 30.43±28.15, median 25.00, Q1=-50.00, Q3=25.00 and mean rank is 28.00. The control group changes score mean 3.75±24.70, median 0.00, Q1=25.00, Q3=.00 and mean rank 16.78. The calculated U is =110.000, and the 'p'=.002($p<0.05$).

So, the **Null Hypothesis is accepted** in general health **and Null Hypothesis is rejected** in other HRQoL variables i.e. physical functioning, role limitation-physical, role limitation-emotional, vitality, mental health, social functioning, pain and health change. The change scores means in the yoga group in physical functioning, role limitation-physical, role

limitation-emotional, vitality, mental health, social functioning, pain and health change are **positively higher** than the control group.




***p<0.05=Significant, NS=No Significant***

**Fig. 103: Graphical representation of Comparison of the changes between the yoga and control groups at pre-test and at post 12 weeks test in HRQoL variables**

## 4.8. Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 week test:

### 4.8.1 Disease Activity Index and Functional Index:

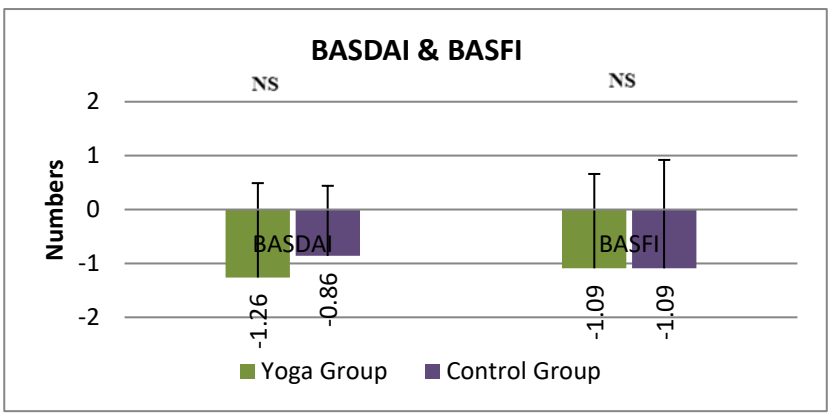
**$H_0$49*:*** There exists no significant difference between yoga group and control group in changes score with respect to Disease Activity Index and Functional Index

**Table no.47: Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in disease activity index and functional index**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| BASDAI | Yoga Group | -1.26±1.75 | -1.30 | -.30 | -1.90 | 23.80 | 188.500 | .312 |
| | Control Group | -0.86±1.30 | -1.00 | .80 | -3.80 | 19.93 | | |
| BASFI | Yoga Group | -1.09±1.75 | -1.10 | .20 | -1.80 | 21.37 | 215.500 | .724 |
| | Control Group | -1.09±2.01 | -1.40 | .57 | -2.57 | 22.73 | | |

***p-value < 0.05 is significant***

The table no. 47 shows that for comparing of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test, the Mann-Whitney U test was conducted for disease activity index and functional index variables. The BASDAI of the yoga group changes score mean -1.26±1.75, median -1.30, Q1=-.30, Q3= -1.90 and mean rank is 23.80. The control group changes score mean -0.86±1.30, median -1.00, Q1=.80, Q3=-3.80 and mean rank 19.93. The calculated U is =188.500, and the 'p'=.312 (p>0.05). BASFI of the yoga group changes score mean-1.09±1.75, median -1.10, Q1=.20, Q3=-1.80 and mean rank 21.37. Control group changes score mean -1.09± 2.01, median -1.40, Q1=.57, Q3=-2.57 and mean rank 22.73. The calculated U is =215.500, and the 'p'=.724 (p>0.05). **Null Hypothesis is accepted** in BASDAI and BASFI variables.




***NS=Not Significant***

**Fig.104: Graphical representations of Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in Disease Activity Index and Functional Index**

## 4.8.2 Inflammatory Markers Variables:

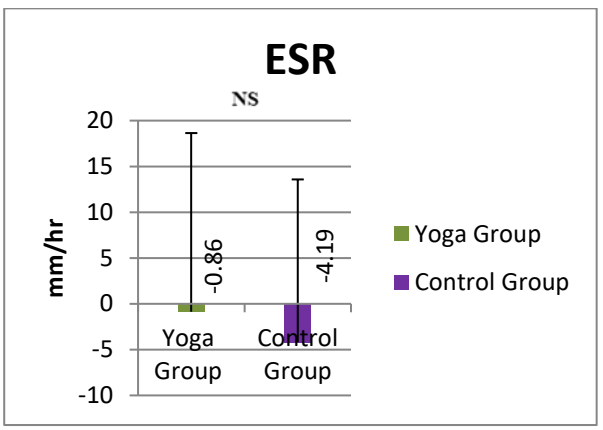
**$H_0$50*:*** There exists no significant difference between yoga group and control group in changes score with respect of inflammatory markers variables

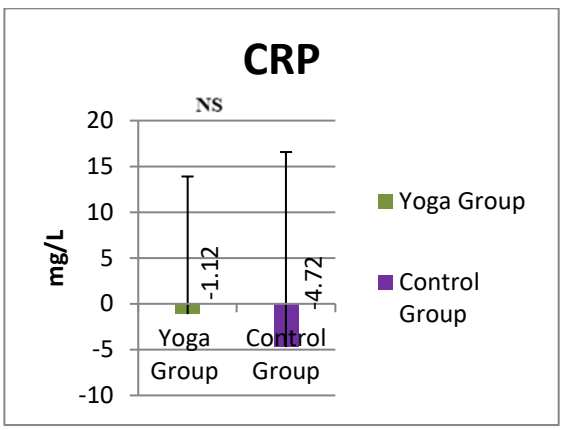
**Table no.48: Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in Inflammatory Markers Variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| ESR (mm/hr) | Yoga Group | -0.86± 19.50 | -6.00 | 11.00 | -12.00 | 20.93 | 205.50 | .551 |
| | Control Group | -4.19 ± 17.77 | -2.00 | 5.00 | -21.25 | 23.23 | | |
| CRP (mg/L) | Yoga Group | -1.12± 15.02 | .12 | 9.10 | -13.29 | 19.48 | 172.00 | .158 |
| | Control Group | -4.72 ±21.29 | -2.00 | 2.60 | -15.81 | 24.90 | | |

***p-value < 0.05 is significant***

The table no. 48 shows that for comparing of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test, the Mann-Whitney U test was conducted for inflammatory markers variables. The ESR of the yoga group changes score mean -0.86± 19.50, median -6.00, Q1=11.00, Q3=-12 and mean rank is 20.93. The control group changes score mean -4.19±17.77, median -2.00, Q1=5.00, Q3=-21 and mean rank 23.23. The calculated U is =205.500, and the 'p'=.551 (p>0.05). In case of CRP, of the yoga group changes score mean -1.12±15.02, median .12, Q1=9.10, Q3= -13.29 and mean rank is 19.48. The control group changes score mean -4.72 ±21.29, median -2.00, Q1=2.60, Q3=-15.81 and mean rank 24.90. The calculated U is =172.000, and the 'p'=.158 (p>0.05). So, the **Null Hypothesis is accepted** in ESR and CRP as Inflammatory Markers variables.




***NS=Not Significant***

**Fig. 105** **Fig. 106**

**Fig. 105-106: Graphical representation Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 week test in nflammatory markers variables. 105) ESR; 106) CRP**

## 4.8.3 Blood Count Variables:

**$H_0$51*:*** There exists no significant difference between yoga group and control group in changes score with respect of blood count variables**.**

**Table no.49: Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in blood count variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Haemoglobin (g/dl) | Yoga Group | 0.53 ±1.35 | .40 | 1.50 | -.29 | 24.33 | 183.50 | .257 |
| | Control Group | -0.06 ±1.76 | -.24 | 1.19 | -1.12 | 19.98 | | |
| Total Leukocyte Count (thou/$mm^3$) | Yoga Group | 0.73 ±2.21 | .70 | 2.60 | -.90 | 19.22 | 166.00 | .119 |
| | Control Group | -0.43 ±2.76 | -.55 | .85 | -1.30 | 25.20 | | |

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Segmented Neutrophils (%) | Yoga Group | -0.19 ±9.99 | -.50 | 9.20 | -9.90 | 21.17 | 211.00 | .644 |
| | Control Group | -1.72± 11.65 | -1.00 | 5.37 | -11.10 | 22.95 | | |
| Lymphocytes (%) | Yoga Group | 0.1± 7.44 | -.40 | 6.70 | -5.60 | 23.67 | 191.50 | .349 |
| | Control Group | 2.65± 9.53 | 1.35 | 7.80 | -1.00 | 20.08 | | |
| Monocytes (%) | Yoga Group | 0.27 ±4.08 | 1.10 | 2.50 | -2.20 | 21.52 | 219.000 | .789 |
| | Control Group | 0.18 ±3.03 | -.55 | 3.17 | -1.35 | 22.55 | | |
| Eosinophil (%) | Yoga Group | -0.06 ±3.59 | .20 | 1.50 | -2.80 | 20.52 | 196.000 | .408 |
| | Control Group | -1.13± 5.52 | -.25 | 1.32 | -5.09 | 23.70 | | |
| Basophils (%) | Yoga Group | 0.15 ±0.88 | .000 | .30 | -.30 | 21.24 | 212.500 | .669 |
| | Control Group | 00 ±0.47 | -.10 | .35 | -.30 | 22.88 | | |
| Platelet Count (thou/$mm^3$) | Yoga Group | 3.39 ±39.52 | .000 | 24.00 | -28.00 | 21.22 | 212.000 | .661 |
| | Control Group | -22.65± 80.02 | 9.90 | 25.50 | -98.00 | 22.90 | | |

***p-value < 0.05 is significant***

Table no. 49 shows that for comparing of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test, the Mann-Whitney U test was conducted for inflammatory markers variables. The Haemoglobin of the yoga group changes score mean 0.53±1.35, median .40, Q1=1.50, Q3=-.29 and mean rank is 24.33. The control group changes score mean -0.06 ±1.76, median -.24, Q1=1.19, Q3= -1.12 and mean rank 19.98. The calculated U is =183.500, and the 'p'=.257 (p>0.05).

In case of total leukocyte count of the yoga group changes score mean 0.73 ±2.21, median .70, Q1=2.60, Q3=-.90 and mean rank is 19.22. The control group changes score mean -0.43 ±2.76, median -.55, Q1=.85, Q3=-1.30 and mean rank 25.20. The calculated U is =166.000, and the 'p'=.119 (p>0.05).

In case of segmented of the yoga group changes score mean -0.19 ±9.99, median -.50, Q1=9.20, Q3= -9.90 and mean rank is 21.17. The control group changes score mean -1.72± 11.65, median -1.00, Q1=5.37, Q3=-11.10 and mean rank 22.95. The calculated U is =211.000, and the 'p'=.644 (p>0.05).

In case of lymphocytes of the yoga group changes score mean 0.1± 7.44, median -.40, Q1=6.70, Q3=-5.60 and mean rank is 23.67. The control group changes score mean 2.65± 9.53, median 1.35, Q1=7.80, Q3=-1.00 and mean rank 20.08. The calculated U is =191.500, and the 'p'=.349 (p>0.05).

In case of monocytes count of the yoga group changes score mean 0.27±4.08, median 1.10, Q1=2.50, Q3=-2.20 and mean rank is 21.52. The control group changes score mean

0.18 ±3.03, median -.55, Q1=3.17, Q3=-1.35 and mean rank 22.55. The calculated U is =219.000, and the 'p'=.789 (p>0.05).

In case of eosinophil of the yoga group changes score mean -0.06 ±3.59, median .20, Q1=1.50, Q3= -2.80 and mean rank is 20.52. The control group changes score mean -1.13± 5.52, median -.25, Q1=1.32, Q3=-5.09 and mean rank 23.70. The calculated U is =196.000, and the 'p'=.408 (p>0.05).

In case of basophils of the yoga group changes score mean 0.15 ±0.88, median 0.00, Q1= .30, Q3=-.30 and mean rank is 21.24. The control group changes score mean .00±0.47; median -.10, Q1=.35, Q3=-.30 and mean rank 22.88. The calculated U is =212.500, and the 'p'=.669 (p>0.05).

In case of platelet count of the yoga group changes score mean 3.39±39.52, median .00, Q1=24.00, Q3= -28.00 and mean rank is 21.22. The control group changes score mean-22.65±80.02, median 9.90, Q1=25.50, Q3= 98 and mean rank 22.90. The calculated U is =212.000, and the 'p'=.661 (p>0.05).

So, the **Null Hypothesis is accepted** in all blood count variables i.e. haemoglobin, total leukocyte count, segmented neutrophils, lymphocytes, monocytes, eosinophil, basophils and platelet count.

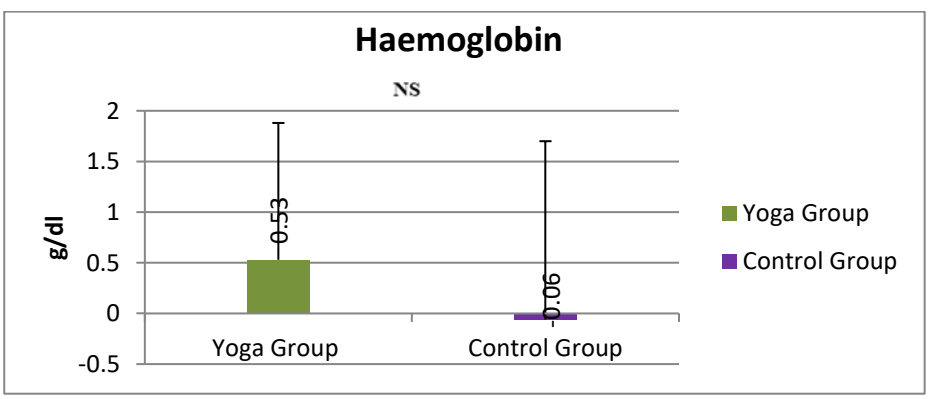



**Fig. 107**

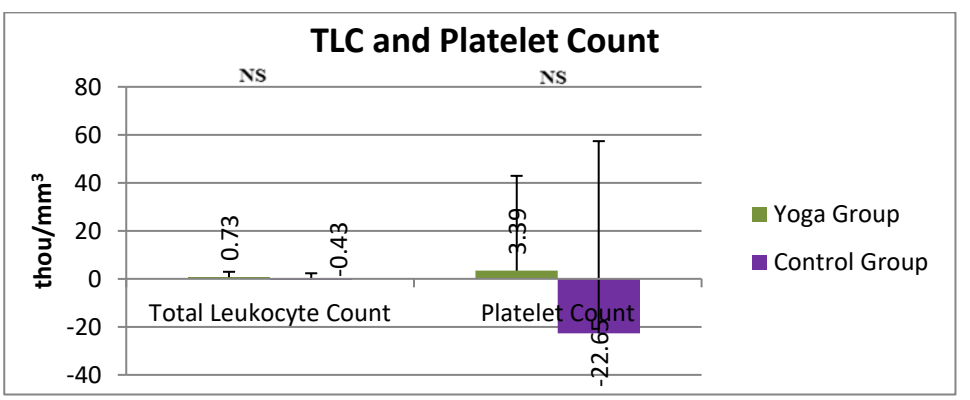
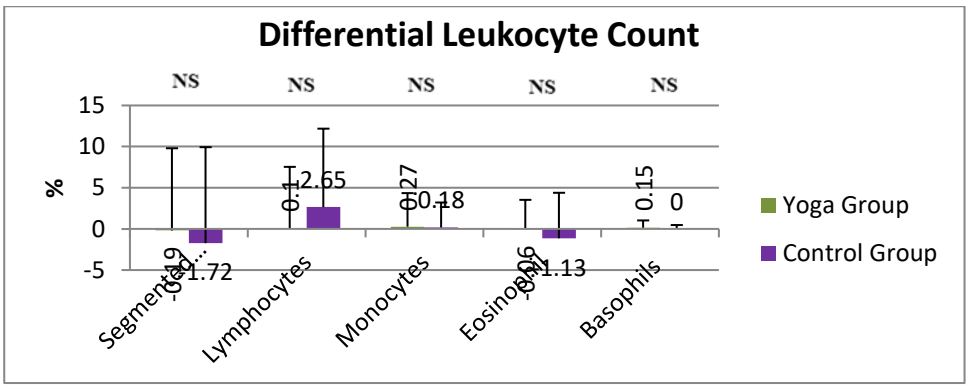



**Fig. 108**




***NS=Not Significant***

**Fig. 109**

**Fig. 107-109: Graphical representation of Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in blood count variables. 107) Haemoglobin; 108) TLC and Platelet Count; 109) Differential Leukocyte Count**

## 4.8.4 General Health Variables:

**$H_0$52*:*** There exists no significant difference between yoga group and control group in changes score with respect of general health variables

**Table no.50: Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in general health variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Systolic BP (mmHg) | Yoga Group | 3.17± 22.19 | 6.00 | 18.00 | -15.00 | 19.98 | 183.50 | .257 |
| | Control Group | -6.35±23.85 | .000 | 8.75 | -12.50 | 24.33 | | |
| Diastolic BP (mmHg) | Yoga Group | 3.95 ±14.31 | 4.00 | 17.00 | -4.00 | 18.91 | 159.00 | .084 |
| | Control Group | -2.65±10.99 | -3.50 | 6.75 | -11.00 | 25.55 | | |
| Resting Heart Rate (beats/minutes) | Yoga Group | 3.08 ±17.42 | 7.00 | 17.00 | -10.00 | 22.02 | 229.50 | .990 |
| | Control Group | 1.85± 20.42 | -.50 | 20.75 | -12.75 | 21.98 | | |
| BMI ($kg/m^2$) | Yoga Group | 0.09± 4.84 | 2.20 | 3.60 | -3.90 | 22.83 | 211.00 | .644 |
| | Control Group | 0.38 ±5.01 | 1.20 | 4.77 | -2.82 | 21.05 | | |

***p-value < 0.05 is significant***

The table no. 50 shows that for comparing of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test, the Mann-Whitney U test was conducted for general health variables. The systolic blood pressure of the yoga group changes score mean3.17± 22.19, median 6.00, Q1=18.00, Q3=-15.00 and mean rank is 19.98. The control group changes score mean -6.35± 23.85, median 0.00, Q1=8.75, Q3=-12.50 and mean rank 24.33. The calculated U is =183.500, and the 'p'=.257 (p>0.05).

In case of diastolic blood pressure of the yoga group changes score mean 3.95 ±14.31, median 4.00, Q1=17.00, Q3=-4.00 and mean rank is 18.91. The control group changes score mean -2.65±10.99, median -3.50, Q1=6.75, Q3=-11.00 and mean rank 25.55. The calculated U is =159.000, and the 'p'=.084 (p>0.05).

In case of resting heart of the yoga group changes score mean 3.08±17.42, median 7.00, Q1=17.00, Q3=-10.00 and mean rank is 22.02. The control group changes score mean1.85± 20.42, median -.50, Q1= 20.75, Q3=-12.75 and mean rank 21.98. The calculated U is =229.500, and the 'p'=.990 (p>0.05).

In case of body mass index of the yoga group changes score mean 0.09± 4.84, median 2.20, Q1=3.60, Q3=-3.90 and mean rank is 22.83. The control group changes score mean 0.38 ±5.01, median 1.20, Q1=4.77, Q3=-2.82 and mean rank 21.5. The calculated U is =211.000, and the 'p'=.644 (p>0.05).

So, the **Null Hypothesis is accepted** in all general health variables i.e. systolic blood pressure, diastolic blood pressure, resting heart rate and body mass index.

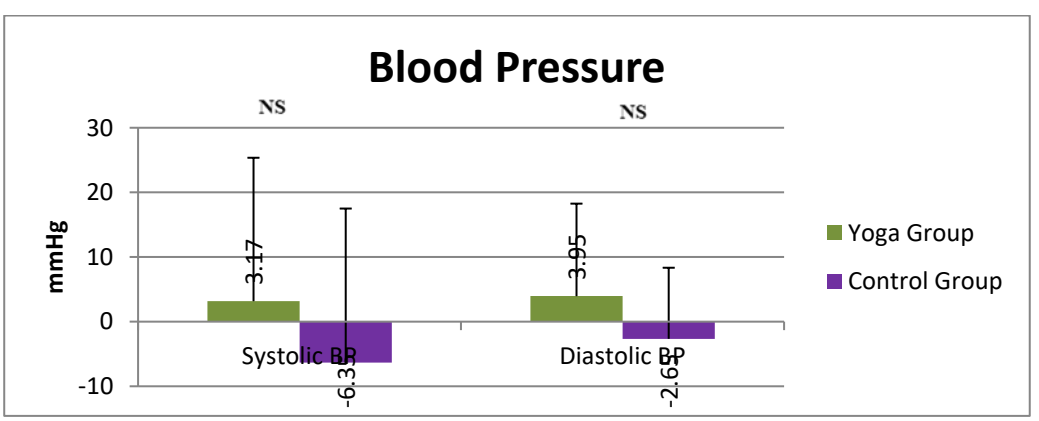



**Fig. 110**

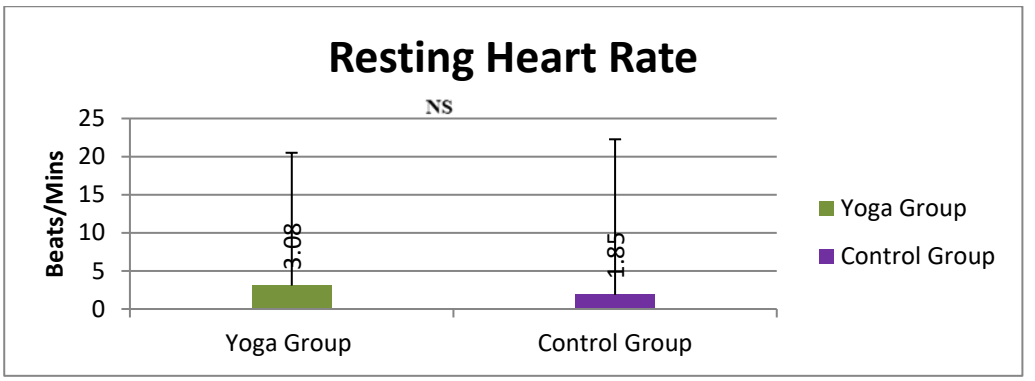
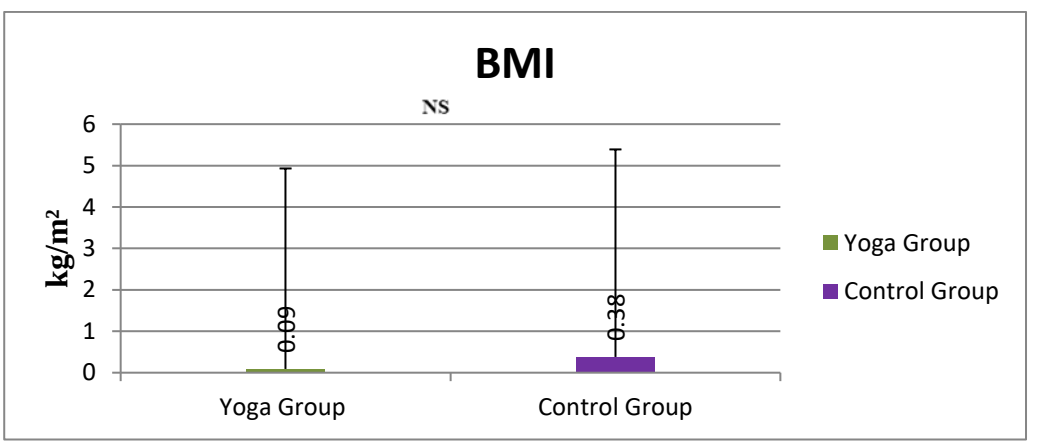



**Fig. 111**




***NS=Not Significant***

**Fig. 112**

**Fig. 110-112: Graphical representation of Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in general health variables. 110) Blood Pressure 111) Resting Heart Rate 112) BMI**

## 4.8.5 Psychological Variables:

**$H_0$53*:*** There exists no significant difference between yoga group and control group in changes score with respect of psychological variables

**Table no.51: Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 week test in psychological variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Depression | Yoga Group | -1.47 ±2.27 | -2.00 | 1.00 | -3.00 | 24.24 | 178.500 | .208 |
| | Control Group | -0.75± 7.81 | .50 | 4.00 | -5.00 | 19.43 | | |
| Fear Avoidance | Yoga Group | -1.60± 2.06 | -2.00 | 1.00 | -3.00 | 24.57 | 171.000 | .149 |

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| Belief in Physical Activity | Control Group | -0.55± 6.03 | .50 | 4.00 | -5.00 | 19.05 | | |
| Fear Avoidance Belief in Work Activity | Yoga Group | -3.21± 3.82 | -4.00 | 1.00 | -6.00 | 23.37 | 198.500 | .440 |
| | Control Group | -2.26± 5.65 | -4.00 | 1.50 | -5.75 | 20.43 | | |
| Pain Catastrophizing | Yoga Group | -2.86± 2.66 | -4.00 | -1.00 | -5.00 | 25.09 | 159.000 | .082 |
| | Control Group | -0.6±8.15 | -.50 | 5.50 | -4.75 | 18.45 | | |

***p-value < 0.05 is significant***

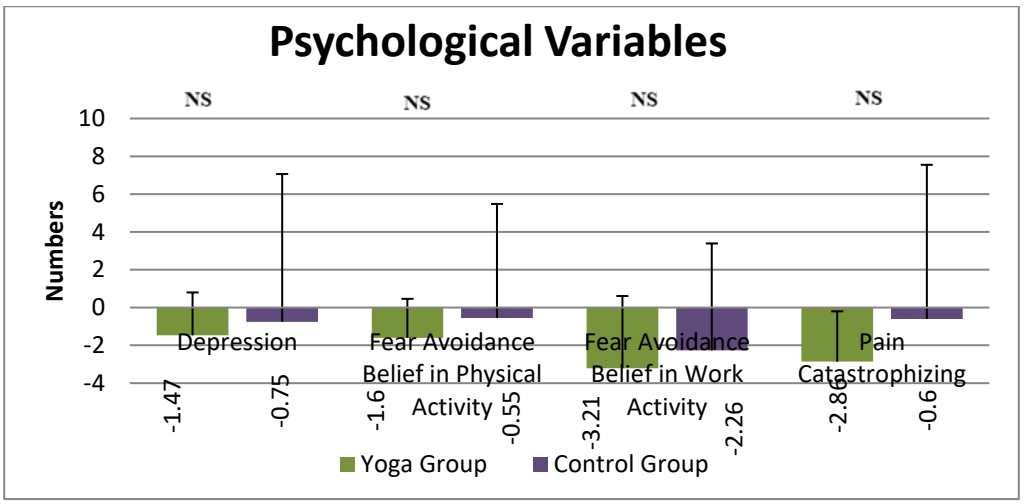
The table no. 51 shows that for comparing of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test, the Mann-Whitney U test was conducted for psychological variables. The depression of the yoga group changes score mean -1.47 ±2.27, median -2.00, Q1=1.00, Q3=-3.00 and mean rank is 24.24. The control group changes score mean-0.75± 7.81, median .50, Q1=4.00, Q3=-5.00 and mean rank 19.43. The calculated U is =178.500, and the 'p'=.208(p>0.05).

In case of Fear Avoidance Belief in Physical Activity of the yoga group changes score mean-1.60± 2.06, median -2.00, Q1=1.00, Q3=-3.00 and mean rank is 24.57. The control group changes score mean -0.55± 6.03; median .50, Q1=4, Q3=-5.00 and mean rank 19.05. The calculated U is =171.000, and the 'p'=.149 (p>0.05).

In case of Fear Avoidance Belief in Work Activity of the yoga group changes score mean -3.21±3.82, median -4.00, Q1=.00, Q3=-6.00 and mean rank is 23.37. The control group changes score mean -2.26±5.65, median -4.00, Q1=1.50, Q3=-5.75 and mean rank 20.43. The calculated U is =198.500, and the 'p'=.440 (p>0.05).

In case of pain catastrophizing of the yoga group changes score mean -2.86± 2.66, median -4.00, Q1=-1.00, Q3=-5.00 and mean rank is 25.09. The control group changes score mean-0.6± 8.15, median -.50, Q1=5.50, Q3=-4.75 and mean rank 18.45. The calculated U is =159.000, and the 'p'=.082 (p>0.05).

So, the **Null Hypothesis is accepted** in all psychological variables i.e. depression, Fear Avoidance Belief in Physical Activity, Fear Avoidance Belief in Work Activity and pain catastrophizing.




***NS=Not Significant***

**Fig. 113: Graphical representation of Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in psychological variables**

## 4.8.6 HRQoL Variables:

**$H_0$54*:*** There exists no significant difference between yoga group and control group in changes score with respect of HRQoL variables

**Table no.52: Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in HRQoL variables**

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| **Physical Functioning** | Yoga Group | 1.30± 8.28 | .000 | 5.00 | -5.00 | 23.53 | 199.50 | .448 |
| | Control Group | -1.5 ±11.59 | .000 | 8.75 | -10.00 | 20.67 | | |
| **Role limitation-Physical** | Yoga Group | 3.26± 11.44 | .000 | .00 | .00 | 23.61 | 193.00 | .311 |
| | Control Group | 9± 23.54 | .000 | 25.00 | .00 | 20.15 | | |
| **Role limitation-Emotional** | Yoga Group | 2.91 ±13.86 | .000 | .00 | .00 | 22.98 | 207.50 | .519 |
| | Control Group | 10.5 ±32.89 | .000 | 34.00 | .00 | 20.88 | | |
| **Vitality** | Yoga Group | 3.78± 5.71 | .000 | 10.00 | .00 | 20.83 | 203.00 | .502 |
| | Control Group | 2.4± 7.32 | .50 | 6.50 | -4.50 | 23.35 | | |
| **Mental Health** | Yoga Group | 5.30± 4.93 | 4.00 | 8.00 | .00 | 22.39 | 221.00 | .825 |
| | Control Group | 7.1 ±11 | 4.00 | 11.50 | .00 | 21.55 | | |
| **Social Functioning** | Yoga Group | 2.82± 5.39 | .000 | 5.00 | .00 | 20.72 | 200.500 | .459 |

| Variables | Groups | Changes scores mean | Median | Q1 | Q3 | Mean Rank | Mann-Whitney U | p-value |
|---|---|---|---|---|---|---|---|---|
| | Control Group | 0.75± 12.89 | .000 | 10.00 | -5.00 | 23.48 | | |
| **Pain** | Yoga Group | 4.73± 6.44 | 5.00 | 9.00 | .00 | 24.72 | 167.500 | .124 |
| | Control Group | 8.7± 12.80 | 10.00 | 20.00 | .50 | 18.88 | | |
| **General Health** | Yoga Group | 5.65± 8.29 | .000 | 10.00 | .00 | 19.78 | 179.000 | .193 |
| | Control Group | 2.5 ±10.45 | .000 | 10.00 | -3.75 | 24.55 | | |
| **Health Change** | Yoga Group | 8.6±932.51 | .000 | 25.00 | .00 | 21.46 | 217.500 | .750 |
| | Control Group | 3.75 ±31.70 | 12.50 | 25.00 | -25.00 | 22.63 | | |

***p-value < 0.05 is significant***

The table no. 52 shows that for comparing of the changes between the yoga and control groups at post 12 weeks and at post 12 weeks test, the Mann-Whitney U test was conducted for HRQoL variables. The physical functioning of the yoga group changes score mean 1.30± 8.28, median .000, Q1=5.00, Q3=-5.00 and mean rank is 25.53. The control group changes score mean -1.5 ±11.59, median .000, Q1=8.75, Q3=-10.00 and mean rank 20.67. The calculated U is =199.500, and the 'p'=.448(p>0.05).

In case of role limitation- physical of the yoga group changes score mean 3.26±11.44, median .000, Q1=.00, Q3=.00 and mean rank is 23.61. The control group changes score mean -9±23.54, median .000, Q1= 25.00, Q3= .00 and mean rank 20.15. The calculated U is =193.000, and the 'p'=.311(p<0.05).

In case of role limitation-emotional of the yoga group changes score mean 2.91 ±13.86, median .000, Q1=.00, Q3=.00 and mean rank is 22.98. The control group changes score mean10.5±32.89, median .000, Q1=34.00, Q3=.00 and mean rank 20.88. The calculated U is =207.500, and the 'p'=.519(p<0.05).

In case of vitality of the yoga group changes score mean 3.78±5.71, median .000, Q1= 10.00, Q3=.00 and mean rank is 20.83. The control group changes score mean 2.4±7.32, median .50, Q1=6.50, Q3=-4.50 and mean rank 23.35. The calculated U is =203.000, and the 'p'=.502(p>0.05).

In case of mental health of the yoga group changes score mean 5.30±4.93, median 4.00, Q1=8.00, Q3=.00 and mean rank is 22.39. The control group changes score mean 7.1 ±11, median 4.00, Q1=11.50, Q3=.00 and mean rank 21.55. The calculated U is =221.000, and the 'p'=.825(p>0.05).

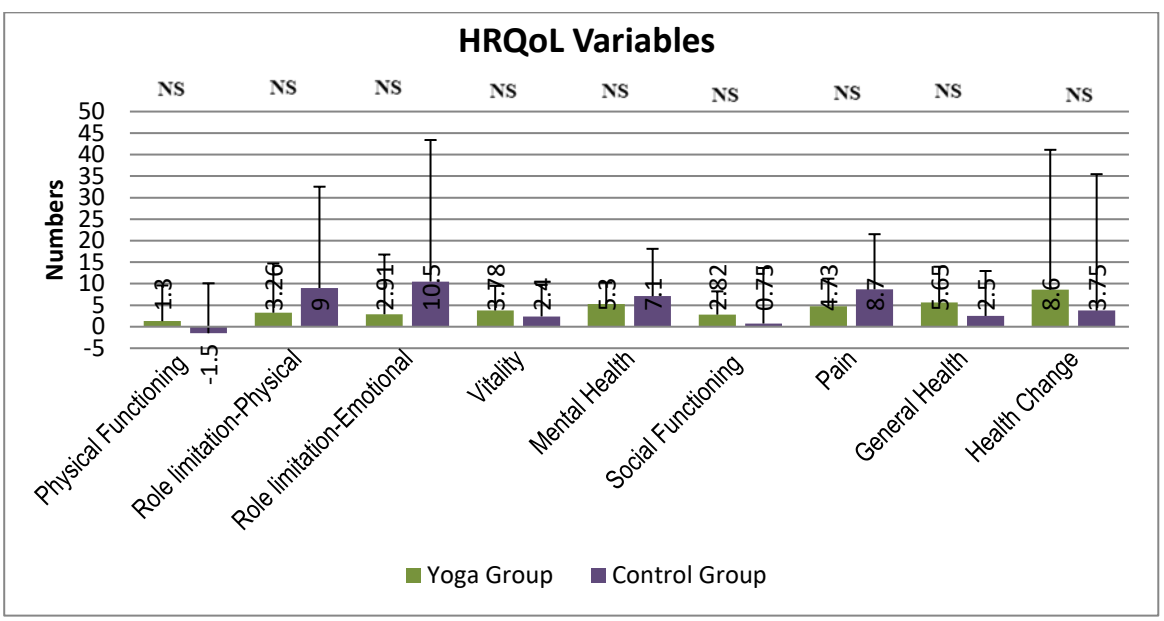
In case of social functioning of the yoga group changes score mean 2.82±5.39, median .000, Q1=5.00, Q3=.00 and mean rank is 20.72. The control group changes score mean 0.75±12.89, median .000, Q1=10.00, Q3=-5.00 and mean rank 23.48. The calculated U is =200.500, and the 'p'=.459(p>0.05).

In case of pain yoga of the yoga group changes score mean 4.73±6.44, median 5.00, Q1=9.00, Q3=.00 and mean rank is 24.72. The control group changes score mean 8.7±12.80, median 10.00, Q1=20.00, Q3=.05 and mean rank 18.88. The calculated U is =167.500, and the 'p'=.124 (p>0.05).

In case of general health of the yoga group changes score mean 5.65±8.29, median .000, Q1= 10.00, Q3= .00 and mean rank is 19.78. The control group changes score mean 2.5 ±10.45, median .000, Q1=10.00, Q3=-375 and mean rank 24.55. The calculated U is =179.000, and the 'p'=.193(p>0.05).

In case of health change of the yoga group changes score mean 8.6±32.51, median .000, Q1=25.00, Q3= .00 and mean rank is 21.46. The control group changes score mean 3.75 ±31.70, median 12.50, Q1=25.00, Q3=-25 .00 and mean rank 22.63. The calculated U is =217.500, and the 'p'=.750(p>0.05).

So, the **Null Hypothesis is accepted** in **all** HRQoL variables i.e. physical functioning, role limitation-physical, role limitation-emotional, vitality, mental health, social functioning, pain, general health and health change.




***NS=Not Significant***

**Fig. 114: Graphical representation of Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 weeks test in HRQoL variables**

## 4.9. Comparative Changes of Pre-Test, Post-12 Weeks and Post-24 Weeks

### 4.9.1 Disease Activity Index and Functional Index:

**Table no.53: Comparative changes of pre-test, post 12 weeks and post 24 weeks in Disease Activity Index and Functional Index variables of Yoga and Control Group**

| Variables | Groups | Mean | | |
|---|---|---|---|---|
| | | Pre-test | Post 12 weeks | Post 24 weeks |
| BASDAI | Yoga Group | 6.57±1.36 | 3.26 ±1.51 | 2 ±0.95 |
| | Control Group | 6.69±1.35 | 5.58 ±1.26 | 4.72 ±2.23 |
| BASFI | Yoga Group | 6.65±1.41 | 3.75 ± 1.47 | 2.66 ±1.11 |
| | Control Group | 6.97±1.62 | 6.07 ± 1.50 | 4.98 ±1.58 |

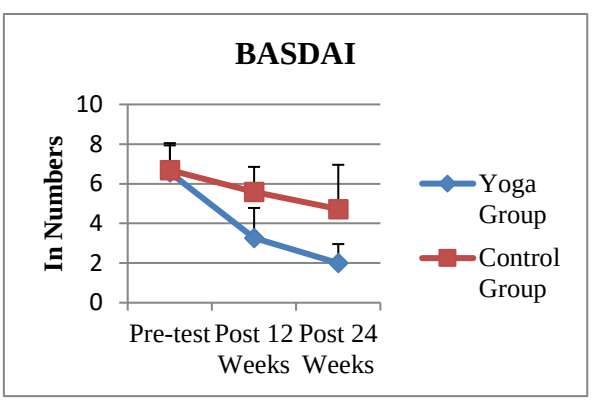



Fig. 115

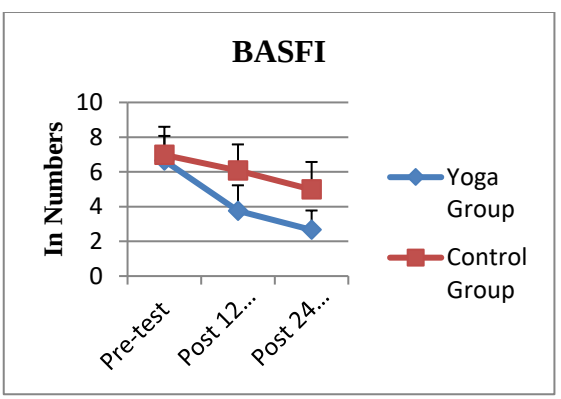



Fig. 116

**Fig. 115-116: Graphical representation of comparative changes of pre-test, post 12 weeks and post 24 weeks in Disease Activity Index and Functional Index variables of yoga and control Group. 131) BASDAI; 132) BASFI**

### 4.9.2 Inflammatory Markers Variables:

**Table no. 54: Comparative changes of pre-test, post 12 weeks and post 24 weeks in Inflammatory Markers variables of Yoga and Control Group**

| Variables | Groups | Mean | | |
|---|---|---|---|---|
| | | Pre test | Post 12 weeks | Post 24 weeks |
| ESR (mm/hr) | Yoga Group | 36.17±17.52 | 19.56 ± 11.82 | 18.69 ±14.72 |
| | Control Group | 39.75±10.56 | 34.55 ±9.17 | 30.36 ±13.99 |
| CRP (mg/L) | Yoga Group | 11.98±13.45 | 8.99 ±10.04 | 7.87 ± 9.53 |
| | Control Group | 24.01±24.91 | 23.09 ± 9.99 | 18.37 ±17.93 |
| TNF-alpha (ng/L) | Yoga Group | 155.37±64.94 | 104.24± 19.53 | - |
| | Control Group | 159.60 ±71.66 | 156.33 ±52.88 | - |
| Cortisol (µg/dL) | Yoga Group | 8.49±4.06 | 7.81± 2.86 | - |
| | Control Group | 9.96±4.81 | 8.25± 2.21 | - |

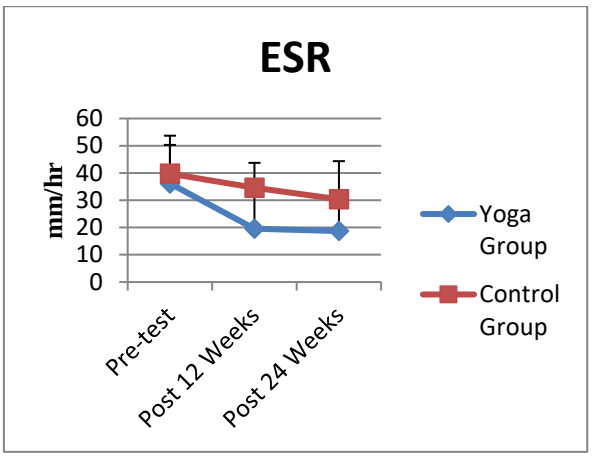



Fig. 117

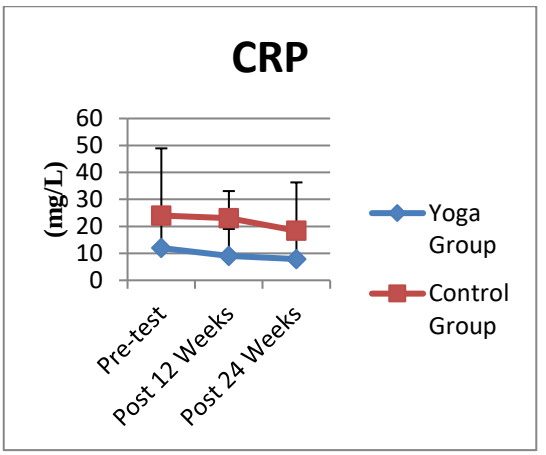



Fig. 118

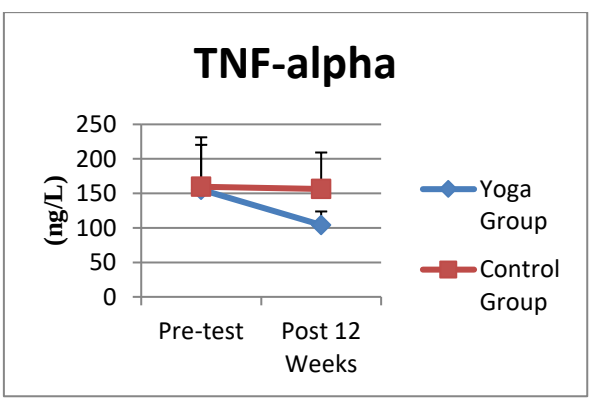



Fig. 119

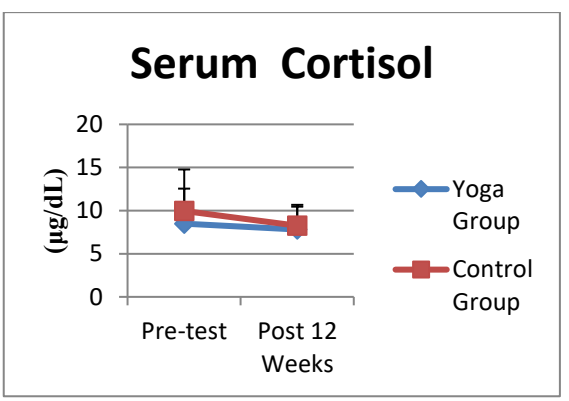



Fig. 120

**Fig. 117-120: Graphical representation of comparative changes of pre-test, post 12 weeks and post 24 weeks inflammatory marker variables of yoga and control Group. 117) ESR; 118) CRP; 119) TNF-alpha 120) Serum Cortisol**

## 4.9.3 Blood Count variables:

**Table no.55: Comparative changes of pre-test, post 12 weeks and post 24 weeks in Blood Count variables of Yoga and Control Group**

| Variables | Groups | Mean | | |
|---|---|---|---|---|
| | | Pre test | Post 12 weeks | Post 24 weeks |
| Haemoglobin (g/dl) | Yoga Group | 13.36 ±1.41 | 12.97 ±1.15 | 13.51 ± 1 |
| | Control Group | 13.01±1.09 | 12.83 ±1.39 | 12.76 ±1.83 |
| Total Leukocyte Count (thou/$mm^3$) | Yoga Group | 7.56 ±2.19 | 6.41 ±1.41 | 7.15 ± 1.67 |
| | Control Group | 8.43±2.53 | 8.44 ± 2.34 | 8.01 ± 1.81 |
| Segmented Neutrophils (%) | Yoga Group | 63.80±9.74 | 63.88 ± 7.31 | 63.69 ± 8.77 |
| | Control Group | 64.15±7.55 | 64.35 ±7.54 | 62.63 ± 7.47 |
| Lymphocytes (%) | Yoga Group | 25.2±7.69 | 26.14 ± 5.85 | 26.03 ± 7.17 |
| | Control Group | 24.03±6.46 | 24.7 ± 5.89 | 27.35 ± 6.39 |

| Variables | Groups | Mean | | |
|---|---|---|---|---|
| | | Pre test | Post 12 weeks | Post 24 weeks |
| Monocytes (%) | Yoga Group | 6.76 ±1.97 | 5.90 ± 2.06 | 6.17 ±2.97 |
| | Control Group | 6.51±3.01 | 6.36 ± 1.56 | 6.54 ± 2.50 |
| Eosinophil (%) | Yoga Group | 3.59 ±3.26 | 3.50 ±2.93 | 3.44 ± 2.64 |
| | Control Group | 4.85 ±3.99 | 3.82 ±3.88 | 2.69 ±3.04 |
| Basophils (%) | Yoga Group | 0.63 ±0.30 | .50 ±0.32 | 0.70 ± 0.75 |
| | Control Group | 0.62±0.37 | 0.59 ±037 | 0.59 ± 0.24 |
| Platelet Count (thou/mm$^3$) | Yoga Group | 187.69±47.25 | 178.26 ±24.52 | 181.65 ± 32.93 |
| | Control Group | 226.3±91.54 | 246.95 ± 7.67 | 224.3 ±63.28 |

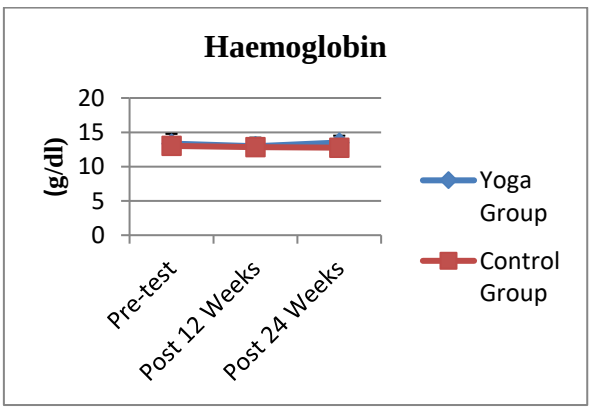



Fig. 121

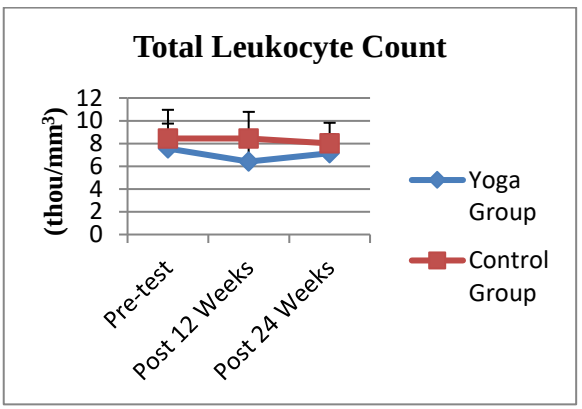



Fig. 122

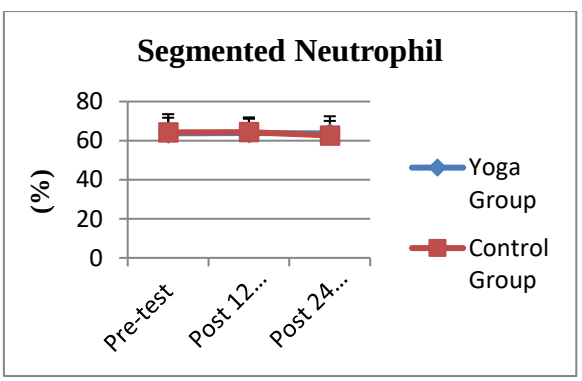



Fig. 123

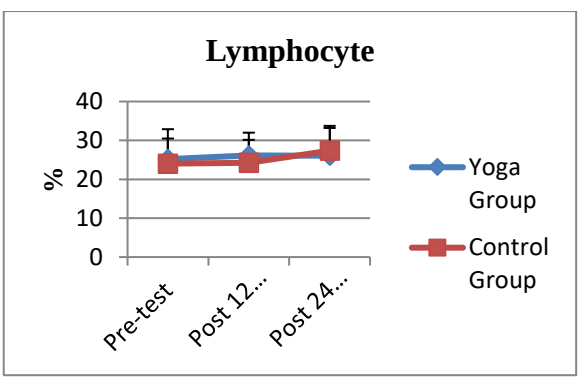



Fig. 124

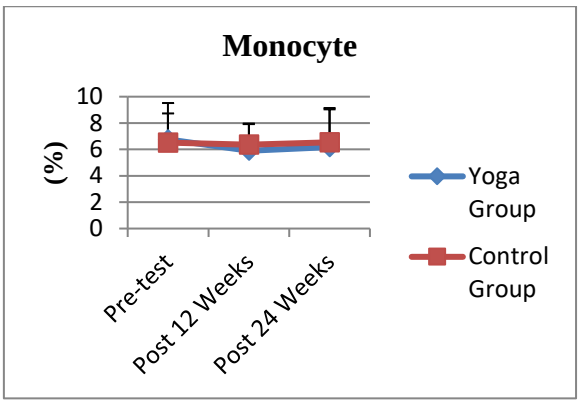



Fig. 125

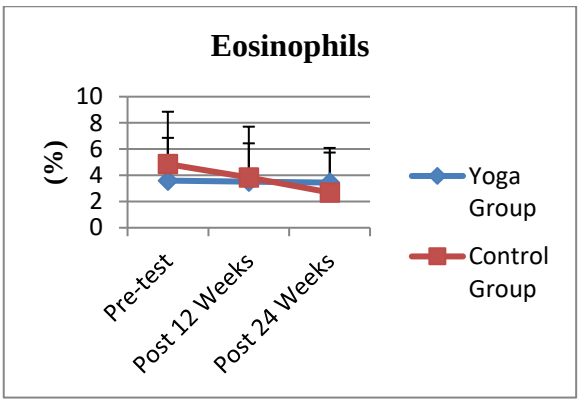



Fig. 126

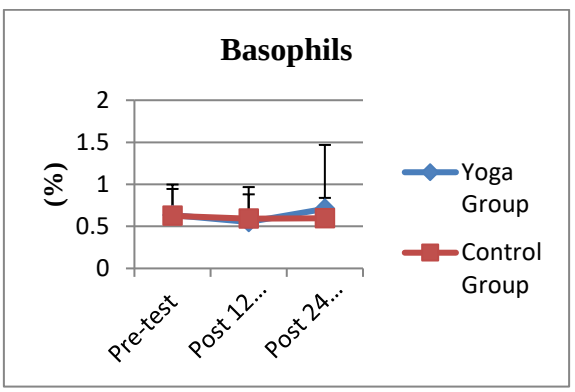



Fig. 127

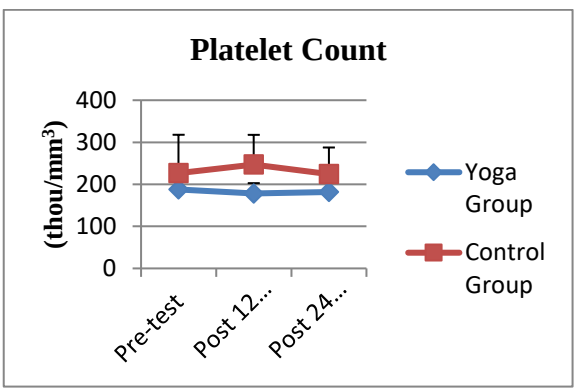



Fig. 128

**Fig. 121-128: Graphical representation of comparative changes of pre-test, post 12 weeks and post 24 weeks in blood count variables of yoga and control Group. 121) Haemoglobin; 122) Total Leukocyte Count; 123) Segmented Neutrophils; 124) Lymphocyte; 125) Monocyte; 126) Eosinophil; 127) Basophils; 128) Platelet Count**

## 4.9.4 General Health Variables:

**Table no. 56: Comparative changes of pre-test, post 12 weeks and post 24 weeks in General Health variables of Yoga and Control Group**

| Variables | Groups | Mean | | |
|---|---|---|---|---|
| | | Pre test | Post 12 weeks | Post 24 weeks |
| Systolic BP (mmHg) | Yoga Group | 116.47± 13.1 | 110.21 ±12.87 | 113.39 ±16.46 |
| | Control Group | 117.25 ± 9.26 | 109.8 ± 10.91 | 103.45 ±23.91 |
| Diastolic BP (mmHg) | Yoga Group | 75.47 ± 9.82 | 69.52 ± 8.34 | 73.47 ±11.11 |
| | Control Group | 76.5 ± 7.59 | 73.15 ± 8.79 | 70.5 ±7.60 |
| Resting Heart Rate (beats/minutes) | Yoga Group | 79.30± 10.90 | 76.65 ± 9.74 | 79.73 ±11.77 |
| | Control Group | 83.4 ± 14 | 81.5 ±15.82 | 83.35 ±11.51 |
| BMI ($kg/m^2$) | Yoga Group | 22.84± 3.58 | 22.52 ± 3.28 | 22.61 ±3.05 |
| | Control Group | 22.14± 3.41 | 22.46 ±3.27 | 22.84 ±3.43 |

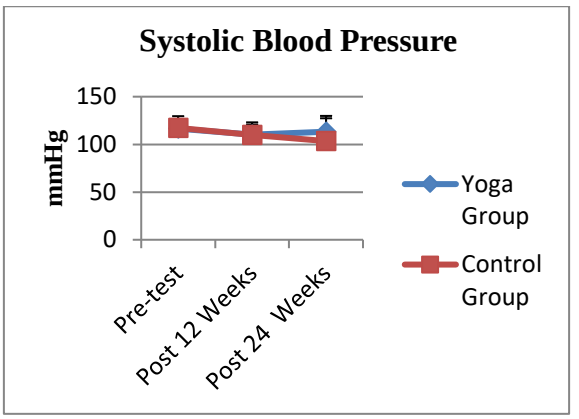



Fig. 129

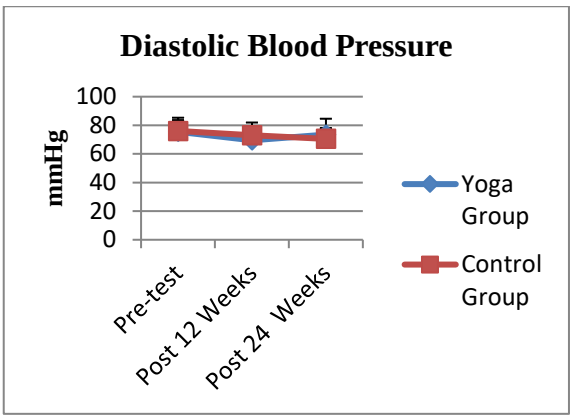



Fig. 130

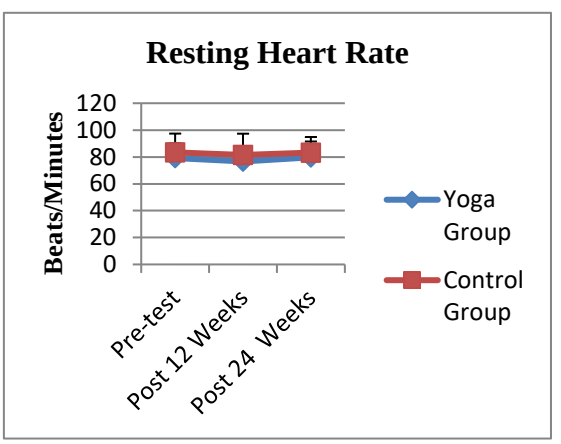



Fig. 131

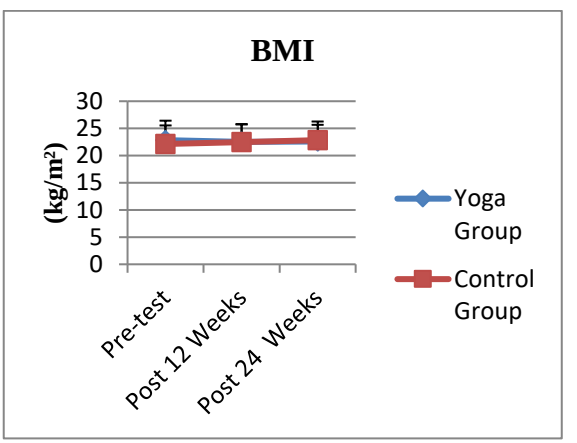



Fig. 132

**Fig. 129-132: Graphical representation of comparative changes of pre-test, post 12 weeks and post 24 weeks in General Health variables of Yoga and Control Group. 129) Systolic Blood Pressure; 130) Diastolic Blood Pressure; 131) Resting Heart Rate; 132) BMI**

## 4.9.5 Psychological Variables:

**Table no. 57: Comparative changes of pre-test, post 12 weeks and post 24 weeks in Psychological variables of Yoga and Control Group**

| Variables | Groups | Mean | | |
|---|---|---|---|---|
| | | Pre test | Post 12 weeks | Post 24 weeks |
| Depression | Yoga Group | 21.13±6.33 | 14.30 ±5.41 | 12.82 ±3.65 |
| | Control Group | 20.5 ±5.84 | 21.75 ±6.47 | 21 ± 6.17 |
| Fear Avoidance Belief in Physical Activity | Yoga Group | 17.43±3.69 | 13.52 ± 4.67 | 11.91 ±4.11 |
| | Control Group | 17.65±3.78 | 18.9 ±3.52 | 18.35 ± 3.60 |
| Fear Avoidance Belief in Work Activity | Yoga Group | 34.34 ±4.32 | 25.13 ±7.92 | 21.91 ± 6.45 |
| | Control Group | 34.75±3.30 | 33.4 ±3.48 | 30.8 ± 4.37 |
| Pain Catastrophizing | Yoga Group | 22.69 ±5.08 | 19.69 ±7.03 | 16.82 ± 6.24 |
| | Control Group | 23.85±5.08 | 27.65 ±5.85 | 27.05 ± 5.39 |

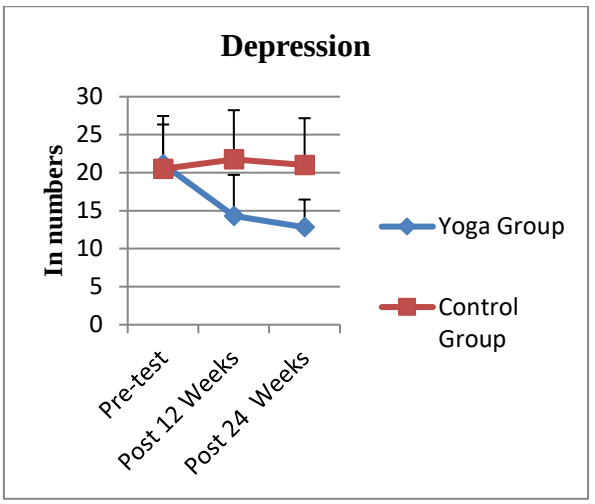



Fig. 133

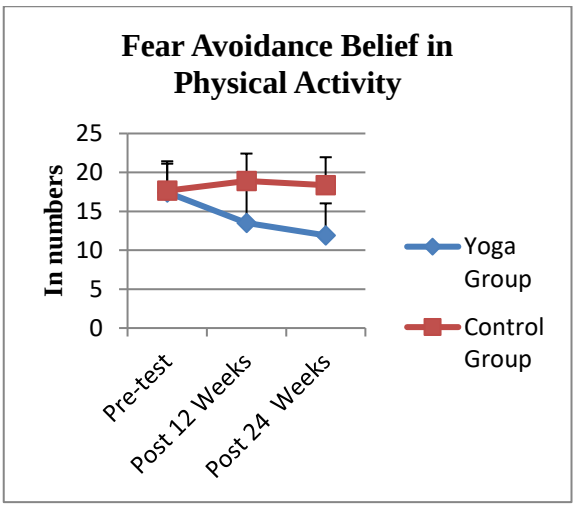



Fig. 134

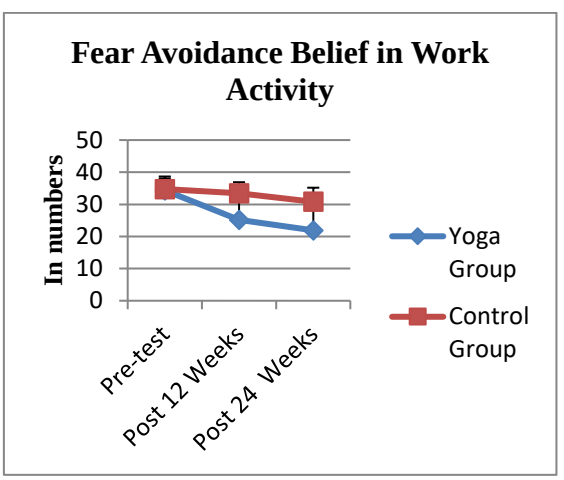



Fig. 135

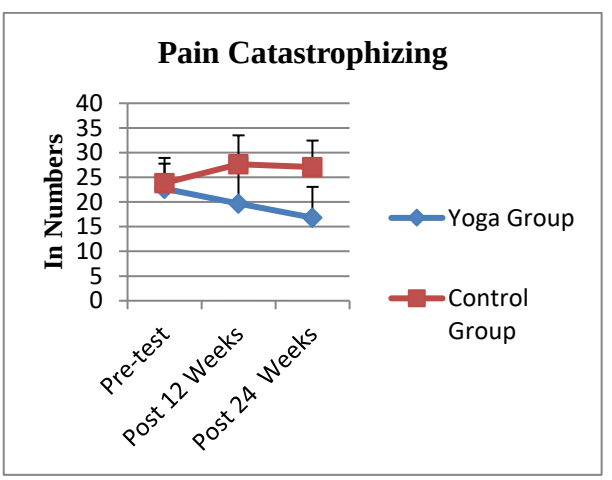



Fig. 136

**Fig. 133-136: Graphical representation of comparative changes of pre-test, post 12 weeks and post 24 weeks in psychological variables of yoga and control group. 149) Depression; 150) Fear Avoidance Belief in Physical Activity; 151) Fear Avoidance Belief in Work Activity; 152) Pain Catastrophizing**

## 4.9.6 HRQoL Variables:

**Table no. 58: Comparative changes of pre-test, post 12 weeks and post 24 weeks in HRQoL variables of Yoga and Control Group**

| Variables | Groups | Mean | | |
|---|---|---|---|---|
| | | Pre test | Post 12 weeks | Post 24 weeks |
| Physical Functioning | Yoga Group | 68.47±7.89 | 77.82 ±10.09 | 79.13 ± 10.40 |
| | Control Group | 65.75±9.49 | 67.25 ± 7.15 | 65.75 ± 9.90 |
| Role limitation-Physical | Yoga Group | 60.86±16.55 | 83.69 ±14.31 | 86.95 ±14.82 |
| | Control Group | 57.5 ±21.61 | 51.25 ±15.12 | 60.24 ± 12.40 |

| Variables | Groups | Mean | | |
|---|---|---|---|---|
| | | Pre test | Post 12 weeks | Post 24 weeks |
| Role limitation-Emotional | Yoga Group | 56.56±21.40 | 85.60 ± 19.58 | 88.52 ± 16.07 |
| | Control Group | 55 ±22.59 | 51.7 ± 27.68 | 61.75 ± 22.53 |
| Vitality | Yoga Group | 53.56±6.18 | 62.26 ±6.83 | 66.07 ± 4.63 |
| | Control Group | 54.35±5.44 | 53.2 ±5.73 | 56.6 ± 6.79 |
| Mental Health | Yoga Group | 44.52±6.52 | 59.52 ±5.60 | 64.82 ± 5.29 |
| | Control Group | 47.7±6.39 | 44.2 ± 6.92 | 51.3 ±8.61 |
| Social Functioning | Yoga Group | 72.52±12.80 | 81.52 ± 10.04 | 84.34 ± 8.82 |
| | Control Group | 69±11.65 | 72.15 ±11.32 | 72.9 ± 7.38 |
| Pain | Yoga Group | 51±7.70 | 67.56 ±11.38 | 72.30 ± 7.85 |
| | Control Group | 45.3±9.18 | 52.45 ± 9.17 | 61.15 ± 8.75 |
| General Health | Yoga Group | 60±9.53 | 67.60 ± 10.85 | 73.26 ± 7.77 |
| | Control Group | 58 ±10.56 | 61.25 ± 9.85 | 63.75 ± 7.58 |
| Health Change | Yoga Group | 34.78±12.47 | 65.12 ± 26.90 | 73.91 ±23.20 |
| | Control Group | 43.75±17.90 | 47.5 ±17.95 | 51.25 ± 27.47 |

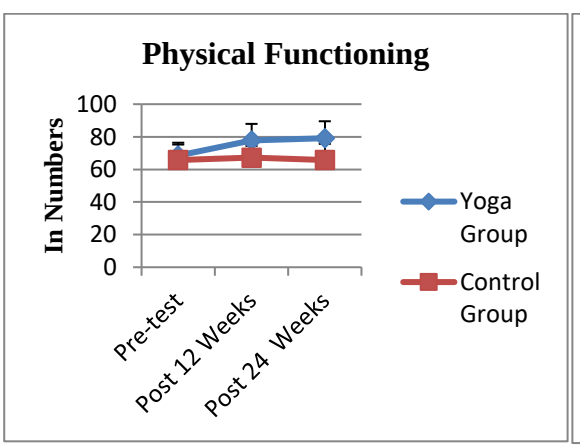
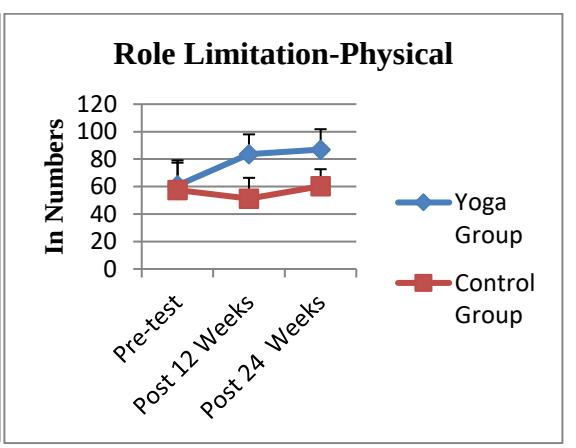



Fig. 137

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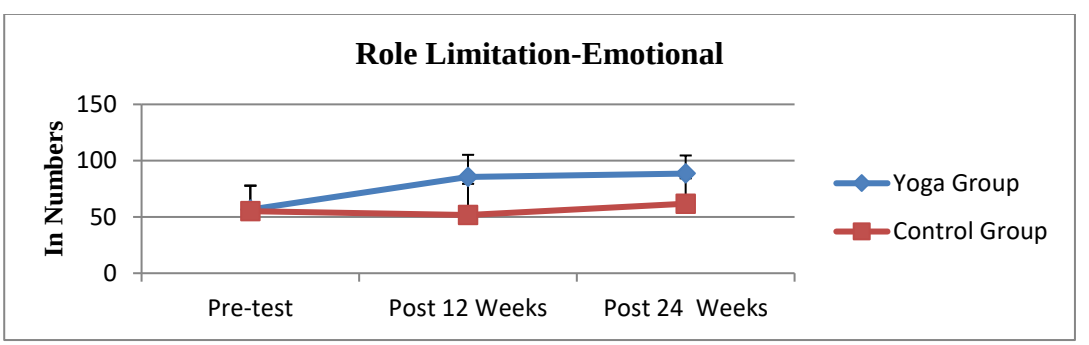



Fig. 139

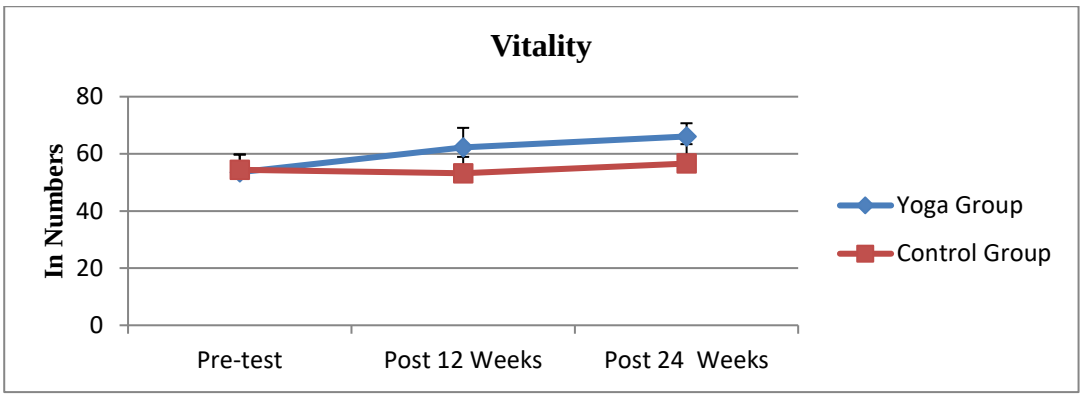



**Fig. 140**

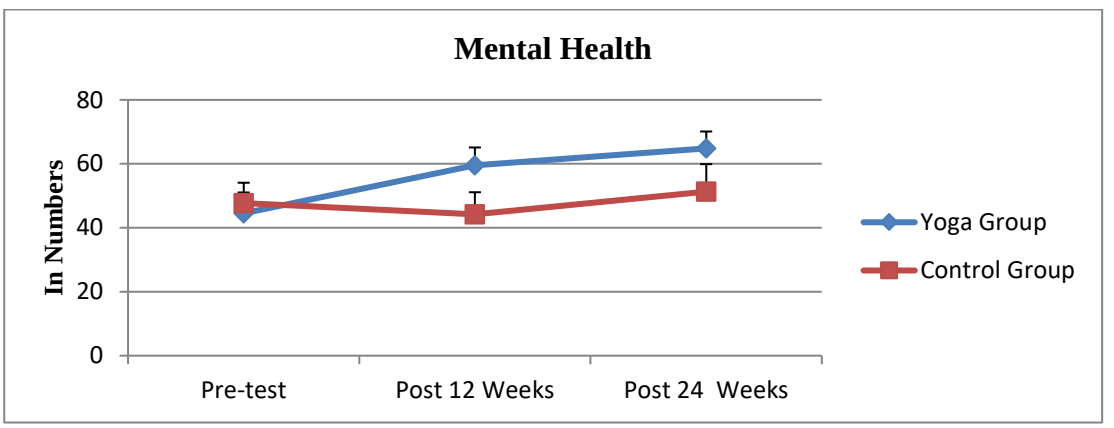



**Fig. 141**

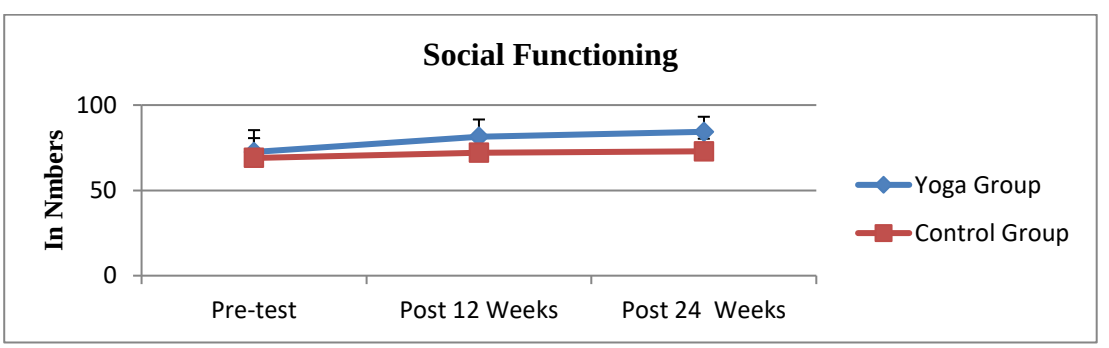
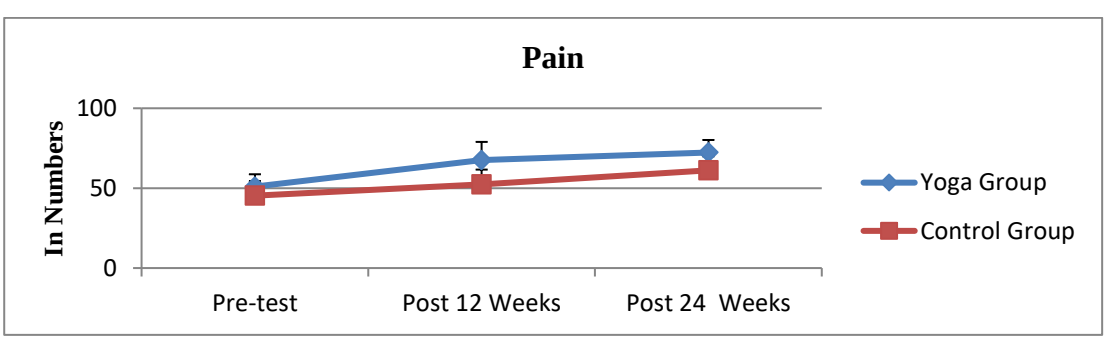



**Fig. 142**

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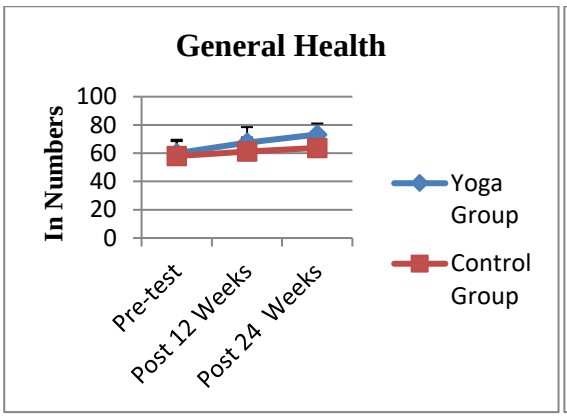


Fig. 144

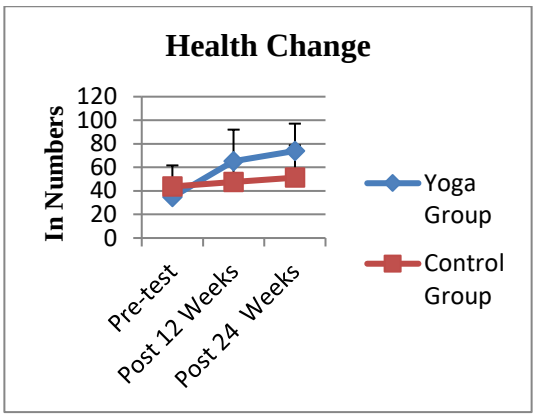


Fig. 145

**Fig. 137-145: Graphical representation of comparative changes of pre-test, post 12 weeks and post 24 weeks in HRQoL variables of yoga and control group. 137) Physical Functioning 138) Role Limitation-Physical 139) Role Limitation-Emotional 140) Vitality 141) Mental Health 142) Social Functioning 143) Pain 144) General Health 145) Health Change**

# CHAPTER -V

## *DISCUSSIONS*

# CHAPTER-V

# DISCUSSIONS

The outcomes of the study shows that the useful effects of yoga on selected disease activity, functional limitation, inflammatory markers, psychological and HRQoL variables in patients with AS.

Based on a review of past literature, yoga is a comprehensive technique that is affordable and widely used as a complementary treatment for a variety of health-related issues and similar / slightly different results have been obtained in those studies.

## 5.1 Discussion on Disease Activity and Functional Index:

The result of the disease activity and Functional Index (BASDAI, BASFI) shows that significant differences were found between the yoga group and the control group in disease activity at 12 weeks as well as at 24 weeks. Within group comparison, significant differences were found between the pre-test and post-test at 12 weeks, post-12 weeks, and post-24 weeks in the yoga group and also in the control group. Significant differences were found between the yoga and control groups in the change score from pre-test to post-test at 12 weeks, but no significant difference was found from post-test to post-24 weeks.

The results of the present study show that yoga practice groups significantly improved disease activity and functional activity scores compared to the control group. The present study results found similarities to earlier studies-the practice of yogasana (postures) increases spinal flexibility (Singphow et al., 2022; Lee et al., 2014), muscle suppleness, the core strength of the muscles (Colgrove et al., 2019), and reduces pain, disability, fatigue, stiffness and awareness on the proper posture (Evans, 2013; Nagarathna, 2012). Yoga rehabilitation is effective in functional anatomy, pain relief, and reducing fatigue and swelling as a 16-week treatment for patients with chronic musculoskeletal pain (Sharma et al., 2019). An integrated approach to yoga therapy is better at reducing pain, morning stiffness, and functional mobility (Ebnezar, 2012; Chawla, 2015; Kan, 2016). Enhancements of core muscle strength, endurance and spinal mobility might have had a reciprocal effect, lowering functional restrictions in day-to-day activities. Stretching and strengthening of the muscles in the back, abdomen, and buttocks mainly focuses in exercise to treat ankylosing spondylitis. Specifically backbends improve the strength of these muscles and enhance the thoracic spine,

sacrum, and shoulder girdle's range of motion. Yoga postures are also following these principles with additional synchronisation of movements. Couple of studies reported that tele-rehabilitation based yoga improves disease activity and functional index scores over 8 weeks of yoga practice which directly supports the present study findings (Acar et al., 2023; Singh, 2023).

In this study, significant differences were found in the yoga group because selected yogic postures (asanas), shuskma vayama (loosening movements of joints), and surya namaskar (modified sun salutation) primarily target the spine and their associated joints, which improve mobility of the joint, maintain the proper alignment of the muscles, increase strength, stretch the muscles by increasing circulation of blood, reduce stiffness and tenderness of the joint and muscles, and down-regulate pain. Yoga asana, pranayama and meditation alleviate pain sensation. Longer slow comfortable stretch of asana, deep breathing and deep relaxation reduce pain perception by encouraging cognitive detachment, which lessens the affective component of pain sensitivity and improves interoception.

In present study shows that along with yoga group, control group also significantly improved in BASDAI and BASFI but not significance in psychological parameters and quality of life due to the control group were receiving physiatrics care recommended by physical medicine and rehabilitation (PMR) was mainly targeted to revive body functions, including spinal mobility, fatigue, joint pain/swelling, morning stiffness physical discomfort and bodily pain and overlooked the mental state of AS patients. The improvement in yoga group was higher. The reasons could be, the components of yoga more focused on mental care and motivation along with body function. Yoga works from the psyche level to the somatic level which includes different postures, breathing techniques, mindfulness, relaxation, and deals with lifestyle management skills. Yoga induces parasympathetic nervous activity that helps regulate the HPA axis for the production of stress hormones. It also inhibits the action of the hypoactive GABA system, which is associated with threat perception, emotional regulation, and the secretion of stress hormones, control of stress hormones, decreases pro-inflammatory cytokines while increasing anti-inflammatory cytokines. According to the results, in terms of improvement in physical aspects, it is not clear yoga is better than exercise, needs to be checked in future studies.

## 5.2 Discussion on Inflammatory Markers Variables:

The result of the inflammatory marker variables shows a significant difference between the yoga group and the control group at post-12 weeks in the inflammatory marker variables as well as at post-24 weeks. Within group comparisons, a significant difference was found between pre-test and post-test 12 weeks in the yoga group with respect to ESR, CRP, and TNF-alpha, but no significant difference was found in serum cortisol in the yoga group. No significant difference was found in the control group pre-test and post-test at 12 weeks in all inflammatory marker variables. No significant difference was found between post-12 weeks and post-24 weeks in both groups. Significant differences were found between the yoga group and the control group in the changes in the pre-test to post-test scores with respect to ESR, CRP, and TNF alpha. No significant difference was found between the yoga group and the control group in the change in score from 12 weeks to 24 weeks with respect to inflammatory marker variables.

It is observed that yoga practice groups shows significant improvements in inflammatory markers, i.e., C-reactive protein (CRP), erythrocyte sediment rate (ESR), and TNF-alpha, but control groups showed no significant improvements in C-reactive protein (CRP) and erythrocyte sediment rate (ESR). Earlier literature found that yoga exercise can help lessen inflammation and progress the range of motion in musculoskeletal illnesses by lowering of the nuclear factor κ β. (Singh et al., 2021). Similarly C-reactive protein (CRP) was reduced in a 14-week-designed yoga practice found in a case study (Satyendra Kumar Singh et al., 2022) that directly supports the findings. Regular yoga emphasizes the importance of natural healing measures to limit inflammation (Chawla et al., 2015). Yoga associated lifestyle involvement seems to be an extremely promising substitute modalities that favourably alters inflammatory markers (Shete et al., 2017). Systematic yogic relaxation positively decreases the level of ESR in male and female subjects (Kumar, 2012). A three-month yoga program implemented on healthy people in the age range of 20–35 years decreased total leucocyte count and ESR after practicing yoga. It can be recommended as a combined therapy in various clinical conditions (Geetanjali, 2013). According to a dissimilar study, industrial workers who practice yoga for 12 weeks have an elevation in anti-inflammatory cytokines and a reduction in pro-inflammatory cytokines (Rajbhoj, 2015). When diseases are associated with classical inflammatory markers, such C-reactive protein (CRP), and certain cytokine parameters, including IL-1β, IL-6, TNF-α, and INF-γ, yoga can be utilized as adjuvant therapy (Estevao, 2022).Physical activity reduces inflammation

through endothelial function that reduces the peripheral inflammation associated with endothelial dysfunction. Exercise also improves endothelial function by preserving nitric acid availability (Adamopoulus et al., 2002). Ten days of yoga associate lifestyle involvement condensed the indicators of stress (cortisol) and inflammatory markers in patients with chronic inflammatory diseases (Yadav, 2012). Disease activity significantly decreased after 12 weeks of yoga practice, as did IL-1α, IL-6, TNF-α, and cortisol (Ganesan et al., 2020). Physical activity increases antioxidant defence, which reduces LDL and prevents inflammation (Powers et al., 1999; Berliner et al., 1995).The present results are consistent with the outcomes of earlier investigations that indicated reductions in inflammatory indicators.

According to the above results on CRP, ESR and TNF-alpha the yoga group is expressively better than the control group because yoga is a compact package of stimulation and relaxation that activates parasympathetic nerve activity and decreases sympathetic nerve activity, which may reduce inflammation, particularly pro-inflammatory parameters. Synchronization of postures, control of breathing, and concentration of mind induce anti-inflammatory parameters. Along with a yogic lifestyle, it may have increased the beneficial impact on inflammation. In the present study, the morning serum cortisol level found no significant decrease because it may have affected the collection time of the sample. The study faced limitations to the early morning reports of the patients due to the distance from the hospital to the patients' houses, an average of 50 km. That is why exclude to measure morning cortisol at 24 weeks.

Previously, the yoga interventions of 3 months (Singh, J et al., 2023) and 8 weeks (Acar et al., 2023) on AS patients were found to improve disease activity, functional activity, anxiety, and quality of life. Both studies have no records of following up after the intervention. Along with both studies, no such effect was reported on the inflammatory markers of AS patients, which is very important for management in AS. In this present study, the investigators conducted long-term intervention up to 24 weeks and found a significant reduction in inflammatory marker parameters such as CRP, ESR, and TNF-alpha.

## 5.3 Discussion on Blood Count Variables:

The result of blood count variables shows that at 12 weeks, a significant difference was found between the yoga group and the control group in total leukocyte count and platelet count variables, but insignificant difference was found in haemoglobin, segmented neutrophils,

lymphocytes, monocytes, eosinophil, and basophils variables. Significant difference was found between the yoga group and the control group in haemoglobin and platelet count, but insignificant difference was found in the case of total leukocyte count, segmented neutrophils, lymphocytes, monocytes, eosinophil, and basophils at 24 weeks. Within the group, except haemoglobin, no significant difference was found in other blood count variables between pre-test and post-test 12 weeks in the yoga group. In the control group, no significant difference was found between pre-test and post-test 12 weeks in all blood count variables. Insignificant difference was found between post-12 weeks and post-24 weeks with respect to blood count variables in both groups. A significant difference was found between the yoga group and the control group in the changes in the pre-test to post-test scores only in haemoglobin. And there were insignificant differences in changes from 12 weeks to 24 weeks.

One study reported that significant increase haemoglobin percentage and platelet count but WBC profile did not significantly change following a 90-day yoga program (Sharma et al. 2016; Banerjee, et al. 2019). The results support present study findings. Another study found that over the course of the six weeks, sudarshan kriya and pranayama were shown to increase neutrophils, platelet counts, mean cell volume (MCV), packed cell volume (PCV), and decreased lymphocyte count but haemoglobin and red blood cell parameters were unchanged (Subramanian, 2012). Yadav et al. (2010) reported the experimental group displayed a significantly decrease in albumin levels and an increase in haemoglobin and ESR but no significant found in platelet count which supports present study results. Research on a few particular yoga poses was shown to have no impact on the parameters related to haematological health. WBC count was decline due to hypoxia in the period of yoga exercise which raises erythroied series in bone marrow. According to a different method, yoga may transit WBCs while they are at rest and reduce a number of cytokines that are involved in leucopoiesis (vyas et al., 2002). Another study reported significant increase of red blood cells in yoga group (Sheetal & Manohar, 2015) but WBC counted more in control group (Rayat & Paul, 2018). In this study haemoglobin significantly higher in yoga group at 24 weeks in compare to control group and significant reduction was found in leukocytes count at 12 weeks. These findings are in accordance with (Agnihotri et al., 2014). In case within comparison pre-test to post 12 weeks shows that the yoga group significantly reduce haemoglobin.

In case haemoglobin count yoga practices group significantly reduce it may deficiency of minerals in diet in that period but haemoglobin increases but not significantly at 24 weeks. Most of the studies reported platelet count increase due to yoga practice but present study contrary to previous studies results, need to further investigation with larger samples in all blood count variables for better results.

## 5.4 Discussion on General Health Variables:

The results of the general health variables shows that no significant difference was found between the yoga group and the control group in all general health variables at 12 weeks, the same as at 24 weeks. Within group comparison, a significant difference was found between the pre-test and post-test 12 weeks in the yoga group with respect to systolic BP, diastolic BP, and BMI, but no significant difference was found in heart rate. In the control group, a significant difference was found between pre-test and post-test 12 weeks in systolic BP and diastolic BP, but no significant difference was found in heart rate or BMI. No significant difference was found between post-12 weeks and post-24 weeks in both groups. In the change score comparison, pre-test to post-12-week BMI found a significant difference, but insignificant difference was found in the rest of the general health variables. Insignificant difference was found between the yoga group and the control group in the change score from 12 weeks to 24 weeks with respect to all general health variables.

It was observed that yoga practices groups showed significant decrease in resting systolic blood pressure, resting diastolic blood pressure and BMI compare 12 weeks to pre-test whereas resting heart rate shows no significant improvement and results also showed that significant decrease in systolic blood pressure, diastolic blood pressure in control group but no significant improvement in resting heart rate and BMI. As compared to changes score between yoga and control group found significant changes in BMI but insignificant changes in systolic blood pressure, diastolic blood pressure and resting heart. Similar results found in a study of two-week residential yoga intervention found that the post scores of systolic blood pressure significantly lower and insignificant changes heart rate, diastolic blood pressure (Singh et al., 2021). Another study reported asana, which may lessen fat deposits in adipose tissue, and systolic and diastolic blood pressures were noticeably let down in people who practiced yoga for a 30-day period (Chauhan et al., 2017; Telles et al., 2010). Krishna et al., 2014 reported that yoga therapy group significant decrease in blood pressure and heart rate.

Yoga helps cleansing the vein and arteries by doing Kriya yoga and pranayama that may cause of reduce blood pressure. Asana, pranayama, and meditation practice have an effect on the parasympathetic and sympathetic nervous systems, which can affect heart rate and blood pressure. Rigorous practices of different postures particularly suryanamaskar, back bending poses and kapalbhati kriya helps to burn the fat components of the body that may reason behind reduce BMI in yoga group in this study.

## 5.5 Discussion on Psychological Variables:

The result of psychological variables shows that a significant difference was found between the yoga group and the control group at 12 weeks as well as 24 weeks. Within group comparison, significant differences were found between pre-test and post-12 weeks as well as post-12 and post-24 weeks in the yoga group, but no significant difference was found in the control group, neither between pre-test and post-12 weeks nor between post-12 and post-24 weeks. Significant differences were found between the yoga group and the control group in the changes in the score of the pre-test to the post-test at 12 weeks, but no significant changes were found from the post-test at 24 weeks with respect to all psychological variables.

The current outcomes of the study similar to following studies effects of 8 week tele-yoga significantly improvements in sleep quality, depression, anxiety, stress (Acar et al., 2022). Similar results were found in a case study that suggested consistent yoga practice, when followed according to a predetermined regimen, would have a highly good psychological impact on ankylosing spondylitis patients (Satyendra S.K. et al., 2022). Several studies are also supported present study results, practice of yoga have positive psychological effects mostly in the parts of anxiety (Cramer, 2018; Hofmann, 2016) depression (Kinser et al., 2012; Smith et al., 2007). Another study also clinched with present study documented that regular yoga practices were associated with in changes in self-efficacy, fear avoidance belief, catastrophizing thought as well as positive set up coping strategy against pain among low-income, racially diverse adults (Marshall et al., 2022). Patients under pain catastrophizing showed higher levels of pain intensity, more negative emotions related to their pain, and increased psychological anguish (Severeijns et al., 2001; Taub et al., 2017; Suso-Ribera et al., 2017; Parr et al., 2012). Through interception and proprioceptive integration, yoga improves positive body awareness, which lowers the anticipation of pain and, thus, lowers the sensitivity to it. It is possible to lessen the catastrophizing that comes with pain and the reluctance to move, which helps break the cycle of pain reinforcement

(Chopra et al., 2023). Yoga is useful tool for a pain coping strategies such as positive thinking and proper relaxation (Curtis et al. 2011; Carson et al. 2010).

Yoga is body-mind medicine. The ultimate goal of yoga is to realize the self through the control of the mind. Eight-limb of yoga suggests how to achieve the goal of happiness. Asana, pranayama, and meditation are ways of controlling the mind. These three components of yoga reduce catastrophe activities of the mind through the control of the hypothalamic pituitary adrenal axis, the hypothalamic pituitary gonadal axis, and the sympathetic adrenal medullary system, which are directly related to the immune system. In this study, these three components were systematically implemented for the patients, which may change their psychological state and help them cope with the disease.

## 5.6 Discussion on HRQoL Variables:

The result of the health-related quality of life (HRQoL) domains shows that a significant difference was found between the yoga group and the control group at 12 weeks and the same at 24 weeks. Within group comparison, a significant difference was found between the pre-test and post-test 12 weeks in the yoga group with respect to all HRQoL domains. A significant difference was found between post-12 weeks and post-24 weeks in vitality, mental health, social functioning, pain, and general health domains of HRQoL in the yoga group. In the control group, except for pain, insignificant difference was found between pre-test and post-test 12 weeks in other domains of HRQoL, and insignificant difference was found between post-test 12 weeks and post-24 weeks only in the pain and mental health domains of HRQoL. A significant difference was found between the yoga group and the control group in the change in score from pre-test to post-test 12 weeks with respect to HRQoL domains, except in general health. Insignificant difference was found between the yoga group and the control group in the change in score from 12 weeks to 24 weeks in all HRQoL domains.

According to consequences of the existing study, the result is constant with the findings of Singh et al., (2021) study, who reported that yoga practices such as relaxing, breathing; posture and yogic cleansing recover their health related quality of life. Another a study reported that 8 week tele-yoga practice improves quality of life of AS patients (Acar et al, 2023). Yoga enhances all the domains of the SF-36 (Benavidez and Hart, 2017; Bhardwaj & Sharma, 2020 Tekur, 2010; Woodyard, 2011; Tulloch et al., 2018). Psychosocial variables could be significant and intricate correlates of the various clinical manifestations of pain (Klapow et al., 1995. Pain has an impact on social interaction and psychological health that is

very detrimental effect on health related quality of life ( Backman et al., 2006; Batmaz et al. 2013).

The outcomes of the study show that the yoga group significantly changes health-related quality of life because it is well-known that yoga is stronger armour for health and happiness. Regular practice of yoga helps in maintaining good body stature, vigour, a healthy mind, positive behaviour toward others, and a calm soul. It helps relieve stress and improves the quality of deep sleep. This asanas stretches whole body parts, i.e., the knees, ankles, and hips, and strengthens the spine and the upper and lower back by increasing circulation in the spine and pelvis. Pranayama induces control of the nerve activities that calm the mind. Body awareness meditation in corpse poses may purify, liberate, and unite the body, mind, and soul.

Yoga is a holistic approach that improves every dimension of quality of life (Ebnezar 2011; Moonaz, 2015). In present study also found significant improvement in quality of life because asanas (postures) work mostly in the physical dimension by slow and intensive contraction and stretching, which improve blood circulation to the organs and improve the pressure and balance of the muscles. Pranayama (breathing) stimulates internal organs as well as induces vital force in the body. Yogic shat kriyas (six cleansing processes) help to cleanse physical and mental impurities. Dhyana meditation elevates calmness, peace and balance emotional states which lead to achieve spiritual bliss.

## 5.7 Virtually Monitored Yoga Practice as an Alternative Modality:

Although the study objectives were not set to observe the comparison of Yoga under online guidance versus regular physically monitored Yoga practice, an observation from the consequences of the study also specify that virtual-mode yoga practice can be an effective therapy. Online yoga practice is very beneficial for patients because they practice it at home, which saves them travel time and expenses and helps them save time for their professional activities. It is more feasible to maintain social distance during a global threat like the COVID-19 pandemic. On the other hand, the virtual class also had disadvantages. Almost half of the patients had digital illiteracy to access the Google Meet application before the intervention, and poor networks in remote areas and the cost of internet data also had issues. During an online practice yoga session, the instructor was incapable of correcting the faulty movements of the participants physically but rather used demonstration and command

methods for correction. Traditional face-to-face yoga sessions and online yoga sessions need to be checked for differences in effect in future studies.

Earlier studies, in tele-yoga in AS patients either structured or non-structured yoga session monitored through only in the time of practice session (Singh, J et al., 2023; Acar et al., 2023). Additionally in this study, the investigator used one-hour integrated yoga sessions, which comprised asanas, pranayama, kriya, and relaxation—all of the mainstays of yoga treatment. In addition to being virtually observed, the patients in the yoga group were also given access to self-demonstrated videos of these integrated yogic practices shortly after the pre-test, and they also had monthly in-person interactions with the patients to discuss their practices. Investigator also provide to participants a sheet of still photos of each yoga pose and the order in which they should be performed to help them better grasp the poses.

## 5.8 Comparative effect of yoga at 24 weeks and 12 weeks:

The effects of yoga are categorized according to the duration of practice, i.e., immediate effect, short-term (a few months) effect, and long-term effect (more than a year). Immediately after yoga practices, stress levels and brain function are reduced, and in the short term, yoga practices improve musculoskeletal pain, a sense of balance, and relief from anxiety. Longer duration or regular practice of yoga improves bone health, alleviates chronic pain, boosts immunity, enhances emotional balance, and improves overall quality of life. Studies with lengthier observation are recommended to check the rate of improvement. The present study found that disease activity, functional ability, inflammatory markers, psychological variables, and health-related quality of life improve rapidly from the initial to 12 weeks; after that, the rate of improvement slows down at 24 weeks. It may be that improvement stayed at the plateau stage. In this study, investigator did not check the rate of remission of yogic effect and intermittent effect of yoga. It appears that to better understand the rate of remission and intermittent effect of the yoga further studies are warranted.

Medicine is a vital element in recovering from so many physical and mental diseases. On the contrary, full medical treatment is less effective for diseases that are associated with the emotional, intuitive, and personality traits of humans. The holistic approach of yoga deals with such conditions where medicine alone does not impact that kind of disease, although it is unable to complete the elimination of physical diseases. So, yoga can be used as a balancing therapy along with medicine to be more effective in treating chronic diseases, especially rheumatic conditions.

In low income country like India, most people have financial limitations about their capacity to purchase costly medications. Patients with rheumatic disorders spend a major part of their income on medicine and making reports along with lose their working hours. Apart from that medicine have some adverse reactions to major organs like the heart, lungs, and liver. Yoga is a part of therapy that is cost-effective, self-administered complementary therapeutic intervention in rheumatic and possibly other physical ailments.

# CHAPTER -VI

## *SUMMARY, CONCLUSION AND RECOMMENDATION*

**6.1 SUMMARY**

**6.2 CONCLUSION**

**6.3 RECOMMENDATION**

**6.4 SUGGESTION**

**6.5 LIMITATION**

# CHAPTER-VI

# SUMMARY, CONCLUSION AND RECOMMENDATION

In this chapter the summary of all the previous chapters have been presented. The conclusions drawn and the recommendations proposed have also been included here.

## 6.1 SUMMARY:

Ankylosing spondylitis (AS) is a long-lasting, multisystem inflammatory disorder involving the joints and ligaments of the spine. Over time, the inflammation in the joints and tissues of the spine occurs stiffness and restrict the mobility of the spine. Yoga is an older and traditional discipline invented in India to yoke the body, mind, and spirit. Generally, it is supposed to deal only with mind and spirit, but the scriptures of the Patanjali Yoga Sutra convince us that it treats the body and mind as a whole. Yoga works in different body systems to maintain a state of homeostasis. In the present day, it is considered an effective complementary and alternative therapy used in various diseases. Yoga is also effective for rheumatic disorders, but as to whether it may be effective in AS, no such robust clinical trials have been found.

This study is intended to find out the effect of yoga on selected disease activity, inflammatory markers, blood count, general health, psychological, and HRQoL variables in patients with AS. After the approval of ethics committee of the Jadavpur University and the IPGMER, a total of 50 male subjects were selected from the OPD of the Institute of Postgraduate Medical Education and Research (S.S.K.M.), Kolkata, who were suffering from ankylosing spondylitis. They were randomized into a yoga group ($n$ = 25) and a control group ($n$ = 25), whose ages ranged between 20 and 40 years (27.3 ± 9.52 years). Within 12 weeks, 3 patients of the control group refused to continue, and the data of 2 patients from each group were not taken due to their unavailability on the schedule date of data collection, but they continued their yoga practice programme as earlier up to 24 weeks with their medicines as prescribed by respective doctors. And after the end of 24 weeks, two patients have refused to continue in both groups. Finally, after 24 weeks, present study considered 23 patients from the yoga practice group and 20 from the control group to fulfil the criteria of the study at 24 weeks. The control group followed conventional medical treatment with exercises recommended by PMR practitioners (Physical Medicine and Rehabilitation). For the yoga group, the self-demonstrated videos of all the expert's recommended yoga practices were

served to the participants via a mobile phone-supported OTG-based memory drive and instructed for each yoga practice session scheduled for 1 hour per day and 5 days per week. The yoga practices of patients were monitored through a blended mode of online video calling and face-to-face interaction. The data were analyzed through non-parametric statistics. The statistical significance of the difference between the mean ranks of independent variables was tested by Mann-Whitney U, and for the paired comparison of mean ranks in the same group variables The Wilcoxon Signed Ranks test was adopted. The significance level was set at a 0.05 level of confidence by using the Statistical Package for the Social Sciences (SPSS).

- **Between group comparison of Yoga and Control group at pre-test**

At baseline, between yoga group and control group no significant mean differences were found in disease activity and functional index ($p>0.05$), inflammatory markers ($p>0.05$), blood count ($p>0.05$), general health ($p> 0.05$), psychological ($p>0.05$) and HRQoL variables ($p>0.05$).

- **Between group comparison of Yoga and Control group at Post 12 weeks**

At post 12weeks, significant differences were exits between the yoga group and the control group in disease activity and functional variables ($p<0.05$), inflammatory marker variables ($p<0.05$), psychological variables ($p<0.05$), and HRQoL variables ($p<0.05$) and total leukocyte count and platelet count in blood count variables. Rest of blood count variables remain not significant ($p>0.05$). General health variables were found insignificant ($p>0.05$) at 12 weeks. The means of the yoga group in disease activity variables, ESR, CRP, TNF-alpha, total leukocyte count, platelet count and all psychological variables are lower than the control group at post 12 weeks. The means of the yoga group in HRQoL variables are higher than the control group at post 12 weeks. The results indicated that yoga group is improved in disease activity variables, ESR, CRP, TNF-alpha, total leukocyte count, platelet count, all psychological and HRQoL variables.

- **Comparison of Yoga and Control group at Post 24 weeks**

Significant differences were found between the yoga group and the control group in all disease activity and functional index variables ($p<0.05$), inflammatory markers variables ($p<0.05$), psychological variables ($p<0.05$), and HRQoL variables ($p<0.05$) at 24 weeks. The means of the yoga group are lower than the control group in disease activity and functional index, inflammatory markers, psychological factors, and HRQoL variables. Significant differences were exits between the yoga group and the control group in haemoglobin

($p<0.05$) and platelet count variables ($p<0.05$), but insignificant differences were found in the cases of total leukocyte count ($p>0.05$), segmented neutrophils ($p>0.05$), lymphocytes ($p>0.05$), monocytes ($p>0.05$), eosinophil ($p>0.05$), and basophils ($p>0.05$) at 24 weeks. The mean of the yoga group is higher than the control group in haemoglobin and lower in platelet count. The results indicated that yoga group is significantly improved in disease activity BASDAI, BASDAI, ESR, CRP, TNF-alpha, haemoglobin, all psychological and HRQoL variables.

- **Within Group Comparison (Pre-test & Post 12 weeks)**

Significant differences were found between the pre-test and post-12 weeks in the yoga group concerning disease activity and functional index variables ($p<0.05$). The mean scores after 12 weeks were lower than the pre-test in BASDAI and BASFI. The same results were also found in the control group ($p<0.05$). It indicates disease activity and functional limitation were reduced significantly at 12 weeks in compare to pre-test in both groups. Significant differences were found between pre-test and post- 12 weeks in the yoga group in ESR, CRP and TNF-alpha ($p<0.05$), but insignificant difference was found in morning cortisol ($p>0.05$). The means scores after 12 weeks were lower than the pre-test in ESR, CRP, and TNF-alpha. It indicates ESR, CRP, and TNF-alpha were reduced significantly at 12 weeks in compare to pre-test in yoga group. In the control group, no significant difference was establish in all inflammatory marker variables ($p>0.05$). No significant difference was found between the pre-test and post- 12 weeks in the yoga group in total leukocyte count, segmented neutrophils, lymphocytes, monocytes, eosinophil, basophils, and platelet count ($p<0.05$), but a significant difference was found in haemoglobin ($p > 0.05$). The mean score after 12 weeks was inferior to the pre-test for haemoglobin. It indicates that haemoglobin significantly reduce at 12 weeks in yoga group. In the control group also, insignificant difference was found in all blood count variables ($p > 0.05$). Significant difference were found between the pre-test and post-test 12 weeks in the yoga group in systolic BP, diastolic BP, and BMI ($p<0.05$), but no significant difference was found in resting heart rate ($p>0.05$). The mean scores after 12 weeks are lower than pre-tests in systolic BP, diastolic BP, and BMI. It indicates that in yoga group significantly reduce blood pressure and BMI at post 12 weeks. Significant differences were found between the pre-test and post-test 12 weeks in the control group with respect to systolic BP and diastolic BP ($p<0.05$), but no significant difference was found in heart rate and BMI ($p>0.05$). The mean scores after 12 weeks were lower than the pre-test in systolic BP and diastolic BP. It indicates that in control group significantly reduce

blood pressure at post 12 weeks. Significant difference was found between the pre-test and post-test 12 weeks in the yoga group with respect to all psychological variables ($p<0.05$). The mean scores after 12 weeks are lower than the pre-test in all psychological variables. It indicates that in yoga group significantly reduce in all psychological parameters at post 12 weeks in compare to pre-test. No significant difference was found in the control group with respect to all psychological variables ($p>0.05$). Significant differences were originate between pre-test and post 12 weeks in yoga group with respect to all HRQoL variables ($p<0.05$). The Mean scores of post 12 weeks were higher than pre-test in all HRQoL variables. It indicates that in yoga group significantly improved in all HRQoL variables at post 12 weeks in compare to pre-test. No significant difference found between pre-test and post 12 weeks in control group with respect to physical functioning, role limitation physical, role limitation emotional, vitality/energy, mental health, social functioning, general health and health change($p>0.05$). But significant difference found in pain ($p<0.05$). The Mean score of post 12 weeks is higher than pre-test in pain.

- **Within Group Comparison (Post 12 weeks & Post 24 weeks)**

Significant differences were found between post-12 weeks and post-24 weeks in the yoga group with respect to the disease activity variables ($p<0.05$). The mean scores post-24 weeks were lower than post-12 weeks in BASDAI and BASFI. Significant difference was found between post-12 weeks and post-24 weeks in the control group with respect to BASFI ($p<0.05$), but insignificant difference was exists in BASDAI ($p>0.05$). The mean score of post-24 weeks was lower than post-12 weeks in BASFI. It indicates that in yoga group significantly reduce in BASDAI and BASFI scores at post 24 weeks in compare to 12 weeks, control group also reduce significantly in BASFI. No significant differences were found between post-12 weeks and post-24 weeks with respect to inflammatory markers, blood count, and general health variables ($p>0.05$) in both groups. Significant differences were found between post-12 weeks and post-24 weeks in the yoga group with respect to all psychological variables ($p<0.05$). The mean scores of post-24 weeks were lower than post-12 weeks in all psychological variables. It indicates that in yoga group significantly improved in all psychological variables at post 24 weeks in compare to 12 weeks. No significant differences were found between post-12 weeks and post-24 weeks in the control group with respect to all psychological variables ($p>0.05$). Significant differences were establish between post-12 weeks and post-24 weeks in the yoga group with respect to vitality/energy, mental health, social functioning, pain, and general health ($p<0.05$), but no significant differences

were found in physical functioning, role limitation-physical, role limitation-emotional, or health change of HRQoL variables ($p>0.05$). The mean scores of post 24 weeks were higher than post 12 weeks in vitality, mental health, social functioning, pain, and general health. It indicates that in yoga group significantly improved in vitality, mental health, social functioning, pain, and general health variables at post 24 weeks in compare to 12 weeks. Significant differences were found between post 12 weeks and post 24 weeks in the control group with respect to mental health and pain ($p<0.05$), but insignificant difference was found in other HRQoL variables ($p>0.05$). The mean scores of post-24 weeks are higher than post-12 weeks in mental health and pain. It indicates that in control group also significantly improved in mental health and pain at post 24 weeks in compare to 12 weeks.

- **Comparison of the changes between the yoga and control groups at pre-test weeks and at post 12 week test**

A significant difference was found between yoga and control group in the change scores means from pre-test to post-test 12 weeks with respect to disease activity and functional index variables ($p<0.05$). The change scores mean of the yoga group were negatively higher than the control group in BASDAI and BASFI. It indicates that in yoga group significantly better in BASDAI and BASFI in changes than control group. Significant differences were found between the yoga group and the control group in the changes scores means from pre-test to post- 12 weeks with respect to ESR, CRP, and TNF alpha ($p<0.05$). The changes scores means of the yoga group were negatively upper than the control group. It indicates that in yoga group significantly better in ESR, CRP, and TNF alpha in changes than control group. Insignificant differences were found between the yoga group and the control group in the change scores from pre-test to post- 12 weeks with respect to blood count variables ($p>0.05$). Significant differences were found between the yoga group and the control group in the changes scores means from pre-test to post-12 weeks with respect to BMI ($p<0.05$), but insignificant differences were found in systolic blood pressure, diastolic blood pressure and resting heart rate ($p>0.05$). The changes mean score of the yoga group was negatively greater than the control group in BMI. It indicates that in yoga group significantly better in BMI in changes score than control group. Significant differences were establish between the yoga group and the control group in the change scores means from the pre-test to the post-test 12 weeks with respect to all psychological variables ($p<0.05$). The change scores means of the yoga group were negatively upper than the control group in all psychological variables. It indicates that in yoga group was significantly better in all

psychological variables in changes score than control group. Significant differences were found between the yoga group and the control group in the change scores means from pre-test to post-test 12 weeks with respect to HRQoL variables ($p<0.05$) except in general health ($p>0.05$). The changes scores means of the yoga group were positively higher than the control group in all significant HRQoL variables. It indicates that yoga group significantly better in changes scores in all HRQoL variables than control group except in general health variables.

- **Comparison of the changes between the yoga and control groups at post 12 weeks and at post 24 week test**

No significant differences were exits between the yoga group and the control group in the change scores from 12 weeks to 24 weeks in disease activity ($p>0.05$), inflammatory markers ($p>0.05$), blood count ($p>0.05$), general health ($p>0.05$), psychological ($p>0.05$), and HRQoL variables ($p>0.05$).

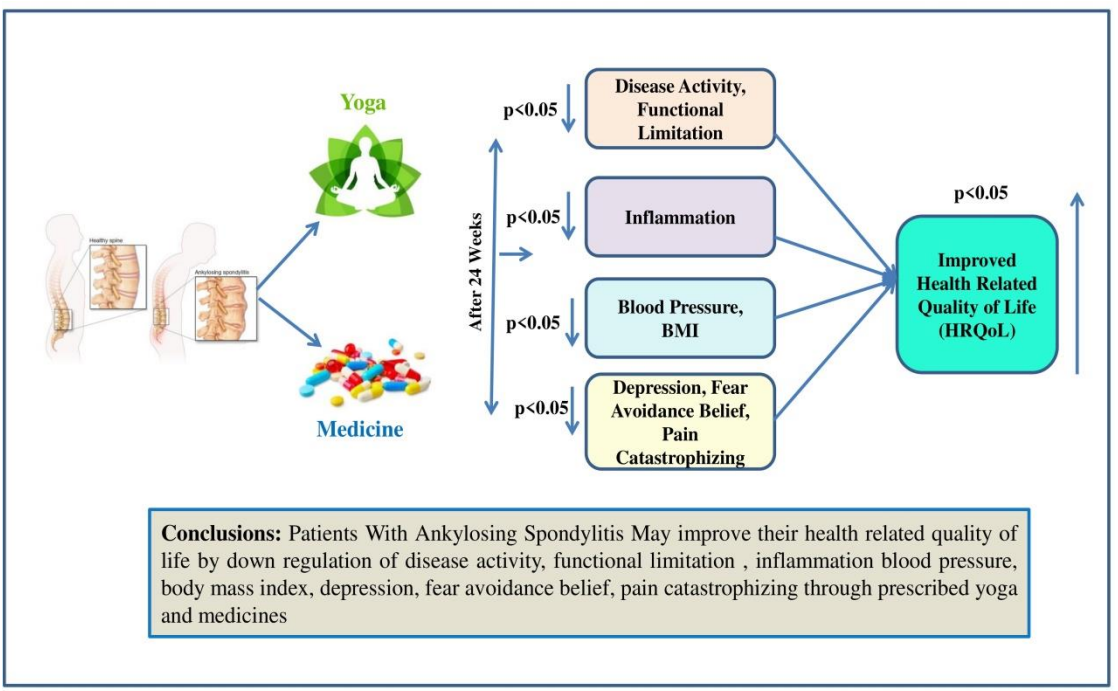


**Fig. 146: Visual Abstract**

## 6.2 CONCLUSIONS:

According to the outcomes, yoga practice appears to be effective in improving disease activity, physical function, body mass index (BMI), and inflammation in patients with AS. In addition, this holistic approach yoga may be beneficial in reducing depression, fear-avoidance beliefs, pain catastrophizing, and improving health-related quality of life

(HRQoL). Virtual-mode yoga lessons may be an effective policy for increasing contact to yoga likened with traditional yoga classes. It is an effective additional method for AS and should be well thought-out as part of inclusive disease management.

## 6.3 RECOMMENDATIONS:

On the basis of conclusions it may be recommended that the different agencies who are attached with the treatment, rehabilitation and quality developmental program for human being undoubtedly can consider the Yoga as a complimentary way of interventions in case of AS and as well as different other related problems.

## 6.4 SUGGESTIONS:

1) A similar study may be extended to other relevant variables with a large number of patients selected from different hospitals in West Bengal.
2) Studies of a similar nature may be planned with face-to-face yoga treatment for AS patients for better results.
3) The study suggests that it would be better to have a long follow-up to check the rate of remission of the yogic effect.
4) A study on the development of an effective yoga module for AS patients may be done.

## 6.5 LIMITATIONS:

This study has few limitations. The total numbers of participants in this study were small. Yoga in Ankylosing Spondylitis is a very new and interesting area of research. So, it was taken as a pilot study. The study limited to only male patients. It would have been better to measure TNF-alpha at the end of 24 weeks. However the exact quantity and quality of physiatric care could not have been assessed.

**Influence of Yogic Practices on Patients with Ankylosing Spondylitis**

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## Image Source:


1) Image Source: Physio https://inlinephysio.com.au/a-focus-on-ankylosing-spondylitis/

2) Image Source: www.spine-health.com and Inline

**Influence of Yogic Practice on Patients with Ankylosing Spondylitis**

# APPENDICES

# Appendices

## Subjects Record Proforma

| **Demographics** | | |
|---|---|---|
| **Name** | **Age** | **Sex** |
| | | |
| Address | **Phone** | |
| | | |

| Occupation | Extra-curricular activities | Any other relevant information |
|---|---|---|
| | | |

| **Basic Parameters** | | | | |
|---|---|---|---|---|
| Heart Rate | Blood Pressure | Height | Weight | BMI |
| | | | | |

**Diagnosis: Ankylosing Spondylitis**
**Baseline data**

| **Duration of back pain** | | |
|---|---|---|
| **Diagnosis (years)** | | |
| Baseline Clinical features | Back pain | Arthritis |
| | Dactylitis | Enthesitis |
| | Uveitis | |
| | Others | |
| Baseline Laboratory | HLA B27 | |
| | X-ray | |
| | MRI | |
| | CRP | |

**Exclusion of other diseases**

**Give answers on your Own**

1. Are you having heart diseases? Yes/No if yes, specify……..

2. Are you having psychiatric problem? Yes/No if yes, specify…….

3. Are you suffering from pulmonary diseases? Yes/No if yes, specify……..

4. Are you suffering from digestion problem? Yes/No if yes, specify……

5. Do you having any surgery history in your body? Yes/No if yes, specify……

6. Are you having kidney problems? Yes/No if yes, specify……

7. Do you have any skin problem? Yes/No if yes, specify……..

8. Do you have any eye problem? Yes/No if yes, specify……..

9. Are you having any past injury? Yes/No if yes, specify……

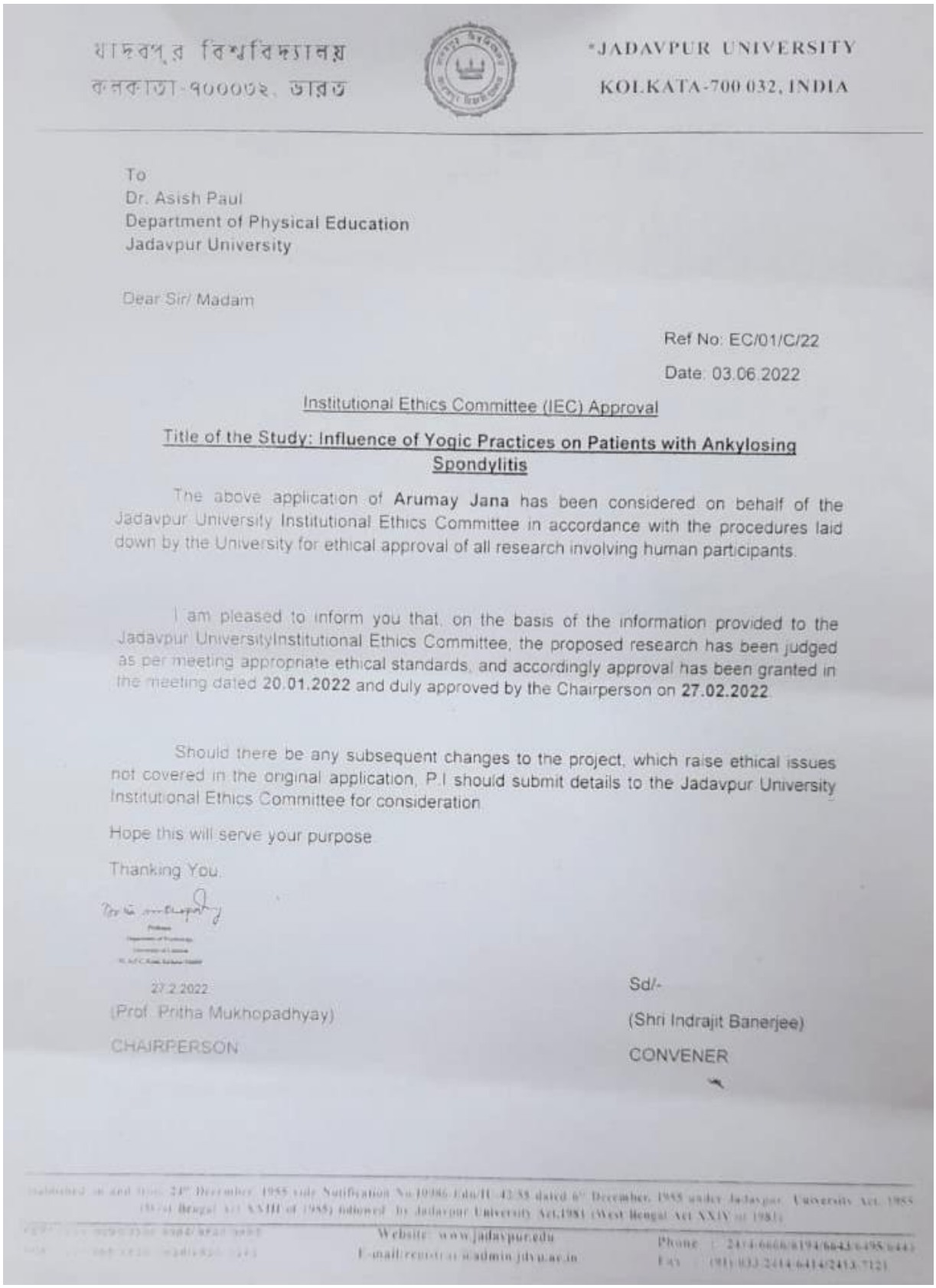
10. Do you smoke or drink alcohol? Yes/No if yes, specify …….

11. Have you any illness in past? Yes/No if yes, specify ……

# Follow Up Data Sheet

| | Scales | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Visits** | **Date** | **BASDAI** | **BASFI** | **ESR** | **CRP** | **TNF** | **Cortisol** | **Blood Count** | **Depression** | **Fear** | **Pain** | **SF36** |
| Study onset Day 0 | | | | | | | | | | | | |
| Visit 1 Week 4 | | | | | | | | | | | | |
| Visit 2 Week 8 | | | | | | | | | | | | |
| Visit 3 Week 12 | | | | | | | | | | | | |
| Visit 4 Week 16 | | | | | | | | | | | | |
| Visit 5 Week 20 | | | | | | | | | | | | |
| Visit 6 Week 24 | | | | | | | | | | | | |
| Out of schedule visit | | | | | | | | | | | | |

## Study Ethical Clearance Letter of Jadavpur University



যাদবপুর বিশ্ববিদ্যালয়
কলকাতা-৭০০০৩২, ভারত

JADAVPUR UNIVERSITY
KOLKATA-700 032, INDIA

To
Dr. Asish Paul
Department of Physical Education
Jadavpur University

Dear Sir/ Madam

Ref No: EC/01/C/22

Date: 03.06.2022

Institutional Ethics Committee (IEC) Approval

**Title of the Study: Influence of Yogic Practices on Patients with Ankylosing Spondylitis**

The above application of **Arumay Jana** has been considered on behalf of the Jadavpur University Institutional Ethics Committee in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to the Jadavpur UniversityInstitutional Ethics Committee, the proposed research has been judged as per meeting appropriate ethical standards, and accordingly approval has been granted in the meeting dated **20.01.2022** and duly approved by the Chairperson on **27.02.2022**

Should there be any subsequent changes to the project, which raise ethical issues not covered in the original application, P.I should submit details to the Jadavpur University Institutional Ethics Committee for consideration

Hope this will serve your purpose

Thanking You

27.2.2022
(Prof. Pritha Mukhopadhyay)
CHAIRPERSON

Sd/-
(Shri Indrajit Banerjee)
CONVENER

established on and from 24th December 1955 vide Notification No.10386 Edn/IU-42/55 dated 6th December, 1955 under Jadavpur University Act, 1955 (West Bengal Act XXIII of 1955) followed by Jadavpur University Act,1981 (West Bengal Act XXIV of 1981)

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# Study Ethical Clearance Letter of IPGMER, Kolkata

**Institute of Post Graduate Medical Education & Research**
**244, A.J.C. Bose Road, Kolkata – 700020.**
**IPGME&R Research Oversight Committee**
**(Institutional Ethics Committee)**

Memo No. IPGME&R/IEC/2022/456 Date: 17.10.2022

**Dr. Prodyut Sinha Mahapatra**
**Associate Professor**
**Department of Rheumatology**
**IPGME&R, Kolkata**

Dear Dr. Mahapatra,

A meeting of the Institutional Ethics Committee of IPGME&R, Kolkata, was held on 03.09.2022 at 12:00 Noon in the Office of the Dean, IPGME&R, Kolkata. In this meeting, and in a subsequent scrutiny on 17.10.2022, the members considered the protocol related to your project:

**Influence of yogic practices on patients with ankylosing spondylitis.**

The following additional documents were scrutinized

- Informed consent documents in English.
- Informed consent documents in Hindi.
- Informed consent documents in Bengali.
- Schedule of yoga exercises to be followed.

After deliberations and review the committee took the following decision regarding your project:

**Approved**

Kindly note the following points:

- We understand that the Co-Investigators for your project will be Dr. Asish Paul, Associate Professor, Dept. of Physical Education, Jadavpur University and Mr. Arumay Jana, PhD Scholar in the same department. Study participants will be recruited from your clinic.
- We further understand that your study does not have any commercial sponsor.
- This approval will remain valid for data collection under this project in its present form.

It is placed on record that the decision regarding your proposal was unanimous and therefore did not require any voting procedure. List of members who attended this meeting is provided on the next page. Members absent have reviewed the same documents and have not sent any note of dissent or objection regarding your proposal. It is also recorded that neither you nor any other member of your research team participated in the decision-making process.

Additional points, if any, mentioned on Page 2 are also to be noted.

Continued on Page 2

Continued from Page 1

**Additional points to be noted**

- The Committee expects that any amendments to the Study Protocol, Informed Consent documents or other relevant documents would be brought to its notice.
- A brief project completion report is to be submitted to the IPGME&R Research Oversight Committee. If project duration exceeds 1 year from commencement, a brief annual progress report should also be submitted.
- IPGME&R Research Oversight Committee is registered with Central Drugs Standard Control Organization (CDSCO), Government of India, in consonance with Rule 122D of the revised Drugs & Cosmetics Rules 1945 – Registration No. ECR/35/Inst/WB/2013/RR-19. It functions in accordance with New Drugs and Clinical Trials Rules 2019 under the Drugs & Cosmetic Act and Indian Council of Medical Research (ICMR) guidelines.

**List of institutional ethics committee members who attended the meeting on 03.09.2022**

| SN | Name & role in the committee | Gender | Designation |
|---|---|---|---|
| 1 | **Prof. Amal Kanti Das** [Basic Medical Scientist] | Male | Professor, Dept. Pharmacology, IPGME&R |
| 2 | **Prof. Bijay Kumar Majumdar** [Clinician] | Male | Consultant Plastic Surgeon; Former Head, Department of Plastic Surgery, IPGME&R |
| 3 | **Prof. Biman Kanti Ray** [Clinician] | Male | Professor, Dept. Neurology, Bangur Institute of Neuroscience, IPGME&R |
| 4 | **D. Amal Kumar Santra** [Basic Medical Scientist] ACTING CHAIRPERSON | Male | Scientist, Formerly of Department of Gastroenterology, IPGME&R |
| 5 | **Prof. Bobby Paul** [Public Health Expert] | Female | Professor, Dept. of Preventive & Social Medicine, All India Institute of Hygiene & Public Health, Kolkata |
| 6 | **Dr. Sananda Pati** [Clinician – Pediatrician] | Female | Assistant Professor, Department of Pediatrics, IPGME&R |
| 7 | **Mr. Debdut Mukherjee** [Legal expert] | Male | Advocate, Calcutta High Court |
| 8 | **Mr. Arunangshu Shekhar Jana** [Social worker] | Male | Social worker, Mahendraganj, Dist. South 24 Parganas |
| 9 | **Dr. Nila Majumdar** [Lay person] | Female | Bengali teacher, Kolkata |
| 10 | **Prof. Avijit Hazra** [Pharmacologist & Member secretary] | Male | Professor, Department of Pharmacology, IPGME&R |

Avijit Hazra 17/10/2022

**Dr. Avijit Hazra – Member Secretary**
**IPGME&R Research Oversight Committee**

Member Secretary
Institutional Ethics Committee
Institute of Postgraduate Medical
Education & Research [IPGME&R
Kolkata-700020

# Consent Proforma (English)

**Influence of Yogic Practices on Patients with Ankylosing Spondylitis**

Study to be conducted by:

**Departments of Physical Education, Jadavpur University, Raja SC Mallick Road, Kolkata-700032**

**And Institute of Postgraduate Medical Education & Research (IPGME&R) and SSKM Hospital**

**244A and B, A.J.C. Bose Road, Kolkata – 700020**

You are being invited to participate in a clinical research study. The following information is for you to understand why the research is being done and what it will involve. Please take time to read it carefully and discuss with friends, relatives and your family doctor if you wish. Please feel free to ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Please sign the Informed Consent Form only if you are fully satisfied with the information given to you and you understand the procedures involved in the study.

**What is the purpose of this study?**

The purpose of this study is to evaluate influence of yogic practices on ankylosing spondylitis. Yogic exercise is now popular and it is established that yogic practice is cost effective, energetic, and increases quality of life. The yogic exercises are separately to be treated as complementary/supplementary medicine along with regular anti-inflammatory medicines suggested by medical expert. Generally, doctors use non-steroidal anti-inflammatory drugs or biologic medications to treat ankylosing spondylitis. Apart from medicine, specific form of yogic practices like-asana (posture), pranayama (control of breathing), Dhyana (meditation) is to be helpful for patients suffer from ankylosing spondylitis.

**Why have I been chosen?**

This study is being conducted in patients who have complained about low back pain, low back stiffness and physical disability because of ankylosing spondylitis. The subjects will have to be of age between 18 to 40 years male. You have been selected because you have this problem and satisfy the other selection criteria for the trial.

**Do I necessarily have to take part?**

No, it is up to you to decide whether or not to take part. If you decide to take part you will be asked to sign a consent form. Even after you have decided to take part, you are still free to withdraw anytime you choose without giving us a reason. A decision to withdraw, or a decision not to take part, will not affect the quality of care you receive.

**What happens during the study?**

Once you agree to participate in the trial and the doctor is assured that you are suffering from Ankylosing spondylitis you will be evaluated through physical examination and laboratory evaluation.

You will continue your regular treatment as prescribed by the doctor (rheumatologist). Along with medicine, you will receive yogic exercises used as complementary and supplementary medicine. After completing the scheduled treatment, you will again be assessed through psychological assessment by questionnaire, physical examination and laboratory tests to ensure your wellbeing.

**What do I have to do?**

You will have to carefully follow the instructions for medication and yogic practice. After enrolment, you will be observed for 1 week, and will then be expected to take medicines as per direction of corresponding doctor and yogic practices with empty stomach. This practice should be done for 1 hour daily in the morning or evening for 12 weeks. Specific form of yogic practices like-asana (posture), pranayama (control of breathing), Dhyana (meditation) is to be given as per prepared protocol.

You will be required to visit your doctor at the end of every alternate week, i.e. after each 15 days, after starting yoga practice. You should inform your doctor in case you take any other medicine.

Before starting the yoga practice, the researcher will perform all the yoga exercises through online video call. And also show and explain step by step how to practice. After showing the online video call what should be done and what should not be done, give the full video of the yoga exercises to everyone by pen drive. Also provide illustrated descriptions of these yoga exercises to everyone. All those patients will be given their contact numbers so that they can be contacted directly through voice calls and video calls to get information about their communication habits. If there is a need to change the type and dosage of yoga within the specified time period of practice, you will get that information through telecommunication.

**What are the drugs that are being given in this trial?**

You will continue drugs prescribed by your treating doctor. No additional medicine would be given for the trial. Only yogic exercises would be practiced for the trial as complementary therapy.

**What are the side effects and risks from the treatment?**

The combination of drug and yogic exercises is widely used in all over the globe without reports of adverse reactions. Gradually the joint mobility develops.

**Are there any other possible disadvantages of taking part?**

Rather than disadvantage, some inconvenience is involved. You will have to come to the clinic on predetermined dates. The study requires you to have blood tests for which it will be necessary to insert a needle in your vein. After the study is over, we do not have provisions for continued free supply of the drugs or continuation of yogic exercises.

**What are the possible benefits of taking part?**

Yogic practices are expected to provide benefit such as being free from pain, increased flexibility, relief from stress, and thus better day to day life.

If the information obtained from this study helps us in improving the treatment of ankylosing spondylitis, you will have the satisfaction of contributing to the difficult task of evaluating a combination of drugs and yogic exercises. This, in itself, is a worthy cause that might help future patients.

**What happens if the study stops?**

The study is expected to be completed within 12 weeks of inception with each subject recruited. If it is stopped early, the reasons for it will be explained to you and arrangements made for your continued treatment.

**Are there reasons for which I might be taken out of the study later on?**

Even if you want to stay in the study, there may be reasons for which you might be withdrawn from the study. This may happen if:

- Your health worsens during the period.
- You do not take your medicines properly or repeatedly miss scheduled visit dates.
- You do not practice your yoga as prescribed by the yoga experts or maintain irregularity.

**Will my taking part in this study be kept confidential?**

Yes. All data obtained from the study will be kept confidential. The data would be archived for an appropriate period. This data will be used only by authorized persons for scientific purposes.

**What will happen to the results of the study?**

A study report will be finalized soon after the trial closes. This will be submitted to the ethics committee of the institute carrying out the study, and also to the university authority and others' if needed.

The results may be published in a scientific journal or discussed at a scientific forum. You will however, not be identified in any report / publication.

**Contact for further information:**

The Yoga expert and the doctor conducting this study can discuss it in more detail with you and reply to any query, when it arises. The contact persons are:


| **Dr. Asish Paul** | **Arumay Jana** | **Dr. Prodyot Sinhamahapatra** |
|---|---|---|
| (Associate Professor) | (Senior Research Fellow) | (Associate Professor) |
| Department of Physical Education | Department of Physical | Dept. of Rheumatology |
| Jadavpur University | Education | I.P.G.M.E.R, Kolkata-700020 |
| Kolkata-700032 | Jadavpur University | |
| Contact Number: 9831710942 | Kolkata-700032 | |
| | Contact Number: 9635149052 | |
| **Principal Investigator** | **Co-Investigator** | **Consultant Medical Expert** |


***Thank you for going through the Patient Information Sheet. Should you decide to participate in this clinical trial, we thank you for that too.***

**Informed consent form in English**

**Influence of Yogic Practices on Selected Groups of Variables Related to Lower Back Pain**

Subject's: Name: _____ Initials _____ Age _____ Sex _____

Please tick in here if you agree

1. I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions. [ ]
2. I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without having to give a reason, and without my rights and privileges being affected. [ ]
3. I understand that my data would be kept confidential but individuals authorized by the Principal Investigator, the ethics committee of the institute where the study will be conducted and government regulatory authority will have access to my records both in respect of the current study and further research that may be conducted in relation to it. Even if I withdraw, I agree to this access. However, I understand that my identity will not be revealed and confidentiality of information will be maintained. [ ]
4. I agree not to restrict the use of any data or results that arise from this study for academic purpose. [ ]
5. I agree to voluntarily take part in the above study. [ ]

**Signature / Thumb impression of the subject**: _____

Date: _____ Place: _____

Study investigator's name: _____

**Study investigator's signature**: _____ Date: _____ Place: _____

**Mandatory where subject has provided thumb impression:**

Signature of the witness: _____

Date: _____ Place: _____

Name & Address of the witness: _____

_____

Relation to the subject, if any: _____

# Consent Proforma (Bengali)

## আঙ্কিলুজিং স্পন্ডিলাইটিস-এর উপরে যোগাব্যায়াম অনুশীলানের প্রভাব

গবেষণা পরিচালনা করা হবে:

শারীরিক শিক্ষা বিভাগ, যাদবপুর বিশ্ববিদ্যালয়, রাজা এসসি মল্লিক রোড, কলকাতা-৭০০০৩২

এবং

স্নাতকোত্তর মেডিকেল শিক্ষা ও গবেষণা ইনস্টিটিউট (IPGME&R) এবং SSKM হাসপাতাল

২৪৪A এবং B, A.J.C. বোস রোড, কলকাতা – ৭০০০২০

আপনাকে একটি রোগ সংক্রান্ত গবেষণায় অংশগ্রহণ করার জন্য আবেদন জানানো হচ্ছে। এই গবেষণাটি কি কি কারণে করা হচ্ছে এবং গবেষণাটি করতে কি কি প্রয়োজন তা আপনাকে জানানোর জন্য নিম্নলিখিত তথ্যগুলো সময় নিয়ে যত্ন সহকারে তথ্যগুলি পড়ুন এবং আপনার ইচ্ছা হলে বন্ধু-বান্ধব, আত্মীয়-স্বজন এবং চিকিৎসকের সাথে এগুলো নিয়ে আলোচনা করতে পারেন। কোন কিছু বুঝতে অসুবিধা হলে অথবা অথবা যদি আপনার অতিরিক্ত কোন তথ্যাদি প্রয়োজন হয় আমাদেরকে জিজ্ঞাসা করতে দ্বিধাবোধ করবেন না। আপনি অংশগ্রহণ করবেন কিনা তার ব্যাপারে সময় নিয়ে আপনার সিদ্ধান্ত নিন। কেবলমাত্র যদি আপনি আপনাকে প্রদত্ত তথ্যাদি সম্পর্কে সম্পূর্ণরূপে সন্তুষ্ট হন এবং গবেষণায় জড়িত পদ্ধতিসমূহকে বুঝতে পারেন তবেই প্রদত্ত তথ্যাদি সম্বলিত সম্মতিপত্রে দয়া করে স্বাক্ষর করবেন।

**এই গবেষণার উদ্দেশ্য কি?**

এই গবেষণার উদ্দেশ্য হল আঙ্কিলুজিং স্পন্ডিলাইটিস এর উপরে যোগাভ্যাস এর প্রভাবের মূল্যায়ন করা। যোগাভ্যাস হলো এখন খুব জনপ্রিয় এবং এটা প্রমাণিত যে যোগাভ্যাস হলো অর্থসাশ্রয়কারী কর্মশক্তি প্রদানকারী এবং এটি জীবনের মানোন্নয়নে করে। যোগব্যায়াম গুলিকে চিকিৎসাবিদ্ দ্বারা বলে দেওয়া সাধারান প্রদাহবিরোধী ওষুধগুলির পাশাপাশি পৃথকভাবে পরিপূরক ওষুধ হিসেবে বিবেচনা করতে হবে। সাধারণতঃ চিকিৎসকেরা সমূহ নন-স্টেরয়েড, প্রদাহবিরোধী ওষুধ সমূহ অথবা জৈবিক চিকিৎসা পদ্ধতিগুলি ব্যবহার করেন আঙ্কিলুজিং স্পন্ডিলাইটিস চিকিৎসার জন্য চিকিৎসার জন্য। ওষুধ ছাড়া আঙ্কিলুজিং স্পন্ডিলাইটিস এ ভোগা রোগীদের ক্ষেত্রে কিছু নির্দিষ্ট প্রকারের যোগাভ্যাস সমূহ যেমন- আসন (দেহভঙ্গি), প্রাণায়াম(শ্বাস-প্রশ্বাসেরনিয়ন্ত্রণ)ও ধ্যান(মেডিটেশন)সাহায্য করতে পারে।

**আমাকে কেন বাছাই করা হলো?**

এই গবেষণাটি সেইসব রোগীদের ওপর করা হচ্ছে যারা আঙ্কিলুজিং স্পন্ডিলাইটিস এর কারণে নিম্ন পশ্চাৎদেশের বা কোমরের জড়তা এবং শারীরিক অক্ষমতার অভিযোগ করেছেন। অংশগ্রহণকারীদের ১৮ বছর বয়স থেকে ৪০ বছর বয়স হতে হবে। আপনাকে নির্বাচন করা হয়েছে কারণ আপনার এই সমস্যাটি আছে এবং পরীক্ষার জন্য প্রয়োজনীয় অন্যান্য নির্বাচনী শর্তাবলীগুলি আপনি পূরণ করেছেন।

**আমাকে কি বাধ্যতামূলকভাবে অংশগ্রহণ করতেই হবে?**

না, আপনি অংশগ্রহণ করবেন কি না সেই সিদ্ধান্ত নেওয়ার ভার সম্পূর্ণ আপনার ব্যক্তিগত ব্যাপার। যদি আপনি অংশগ্রহণ করবার সিদ্ধান্ত গ্রহণ করেন তাহলে আপনাকে একটি সম্মতিপত্রে স্বাক্ষর করার অনুরোধ করা হবএ। এমনকি, অংশগ্রহণ করার সিদ্ধান্ত নেওয়ার পরেও, যে কোন মুহূর্তে কোনো কারণ না দেখিয়েই নাম তুলে নেয়ার জন্য আপনি স্বাধীন। আপনার সেবা ও যত্ন পাওয়ার ক্ষেত্রে আপনার অংশগ্রহণ না করার, বা নাম তুলে নেওয়ার সিদ্ধান্ত কোন প্রভাব ফেলবে না।

**গবেষণা চলাকালীন কি হবে?**

একবার আপনি গবেষণায় অংশ গ্রহণ করতে রাজি হলে এবং আপনি এই আঙ্কিলুজিং স্পন্ডিলাইটিস –এ ভুগছেন এটা সম্পর্কে চিকিৎসক নিশ্চিত হলে শারীরিক পরীক্ষা-নিরীক্ষা এবং গবেষণাগারে বিভিন্ন পরীক্ষা দ্বারা আপনার অবস্থান মূল্যায়ন করা হবে।

আপনি চিকিৎসকের (বাতব্যাধি বিশারদ) বলে দেওয়া আপনার নিয়মিত চিকিৎসা চালু রাখবেন। ওষুধের পাশাপাশি, আপনাকে পরিপূরক ওষুধ হিসেবে ব্যবহৃত কিছু যোগব্যয়াম দেওয়া হবে। নির্ধারিত সূচী আনুসারে চিকিৎসা সম্পূর্ন করবার পরে, প্রশ্নগুচছ, শারীরিক পরীক্ষ-নিরীক্ষা এবং গবেষণাগারে নানা পরীক্ষার দ্বারা আপনার সুস্থতা কে সুনিশ্চিত করার জন্য মনোবৈজ্ঞানিক মূল্যায়নের মধ্য দিয়ে আপনার পুনারায় মূল্যায়ন করা হবে।

**আমাকে কি করতে হবে?**

আপনাকে সচেতন ভাবে, যত্নসহকারে ওষুধপ্রয়োগের এবং যোগাভ্যাস এর জন্য প্রদত্ত নির্দেশাবলী অনুসরণ করতে হবে। নাম নথিভুক্ত করার পরে, আপনাকে এক সপ্তাহ পর্যবেক্ষণ করা হবে, এবং তারপরে এটা আপনার কাছ থেকে আশা করা হবে যে আপনি সংশ্লিষ্ট চিকিৎসকের নির্দেশ অনুযায়ী ওষুধ গ্রহণ করবেন এবং খালি পেটে যোগব্যায়ামগুলিকে অভ্যাস করবেন। এই অভ্যাস ১২ সপ্তাহ ধরে দৈনিক সকালে বা সন্ধ্যায় ১ ঘণ্টা করে করতে হবে। পূর্বনির্ধারিত নিয়মানুসারে নির্দিষ্ট প্রকারের যোগাভ্যাসসমূহ যেমন আসন (নির্দিষ্ট দেহভঙ্গিমা, প্রাণায়াম(শ্বাস-প্রশ্বাসেরনিয়ন্ত্রণ)ও ধ্যান(মেডিটেশন) দেওয়া হবে।

যোগব্যায়াম অভ্যাস শুরু করার পর থেকে প্রত্যেক দ্বিতীয় সপ্তাহের শেষে, অর্থাৎ প্রত্যেক 15 দিন অন্তর আপনাকে চিকিৎসকের কাছে যেতে হবে। যদি আপনি অন্য কোন ওষুধ গ্রহণ করেন সেক্ষেত্রে আপনাকে আপনার চিকিৎসককে তা জানাতে হবে।। যোগা ভ্যাস শুরু করার পূর্বে, গবেষক সমস্ত যোগব্যায়ামগুলি অনলাইন ভিডিও কলের মাধ্যমে করে দেখাবেন। এবং কিভাবে অভ্যাস করতে হবে সেটাও ধাপ অনুসারে দেখাবেন ও বোঝাবেন । কি কি করা উচিত আর কি কি করা অনুচিত তা অনলাইন ভিডিও কল করে দেখানর পর যোগ ব্যায়ামগুলির সম্পূর্ণ ভিডিও পেনড্রাইভে করে সবাইকে দেবেন। এছাড়াও উক্ত যোগ ব্যায়ামগুলির সচিত্র বিবরণ প্রতেককে প্রদান করবেন। ঐ সমস্ত রোগীরা তাদের যোগাযোগের নম্বর দেবেন জাতে সারাসরি ভয়েস কল ও ভিডিও কলের মাধ্যামে তাদের সাথে যোগাযোগ করে তাদের যোগাভ্যাস কেমন চলছে সেই সম্পর্কে খবর নেওয়া যায়। যদি অনুশীলনের নির্দিষ্ট সাময়সীমার মধ্যে যদি যোগব্যায়ামগুলির প্রকারের ও মাত্রার যদি কোন পরিবর্তনের প্রয়োজন হয় তাহলে আপনি সেই তথ্য টেলি যোগাযোগের মাধ্যমে পেয়ে যাবেন।

**পরীক্ষা চলাকালীন কোন্ কোন্ ওষুধ দেয়া হবে?**

আপনি আপনার চিকিত্সাকারী চিকিৎসকের দ্বারা নির্দিষ্ট করে দেওয়া ওষুধগুলিই চালিয়ে যাবেন। পরীক্ষার জন্য কোনরকম অতিরিক্ত ওষুধ দেওয়া হবে না। কেবলমাত্র পরিপূরক চিকিৎসা পদ্ধতি হিসেবে যোগ ব্যায়ামসমূহ অভ্যেস করা হবে।

**এই চিকিৎসা পদ্ধতির ঝুঁকিগুলি ও পার্শ্বপ্রতিক্রিয়া সমূহ কি কি?**

গোটা বিশ্বেই কোনরকম বিপরীত প্রতিক্রিয়া অভিযোগ ছাড়াই বিপুলভাবে ওষুধ ও যোগাভ্যাসের সমন্বয়কে ব্যবহার করা হয়।ধীরে ধীরে অস্থিসন্ধির সচলতা বৃদ্ধি পায়।

**অংশগ্রহণ করার কি আর কোন সম্ভাব্য অসুবিধা আছে?**

বরং ক্ষতির পরিবর্তে, কিছু অসুবিধা জড়িত আছে। প্রচলিত আছে। আপনাকে পূর্বনির্ধারিত তারিখগুলিতে চিকিৎসাকেন্দ্রে আসতে হবে। গবেষণাটি চালানোর জন্য আপনার রক্তপরীক্ষা করা দরকার পড়বে যার জন্য আপনার শিরাতে সূঁচ প্রবেশ করানোর দরকার হবে। গবেষণাটি শেষ হয়ে যাবার পরে, আমাদের বিনামূল্যে ওষুধপত্র দেওয়া অথবা যোগব্যায়াম অনবরতঃ চালু রাখার কোন ব্যাবস্থা থাকবে না।

**অংশগ্রহণ করার সম্ভাব্য লাভ গুলি কি কি?**

আশা করা হয় যে যোগাব্যায়ামসমূহ যোগা অভ্যাস সমূহ যন্ত্রণা থেকে মুক্তি, নমনীয়তা বৃদ্ধি, পীড়ন থেকে মুক্তি এবং এর ফলস্বরূপ উন্নততর দৈনন্দিন জীবন ইত্যাদির লাভসমুহ সমূহ প্রদান করবে।

যদি এই গবেষণা থেকে প্রাপ্ত তথ্যাদি আমাদেরকে আঙ্কিলুজিং স্পন্ডিলাইটিস এর চিকিৎসা পদ্ধতিকে আরও উন্নত করতে সাহায্য করে, তাহলে আপনি ওষুধ ও যোগব্যায়ামসমূহের একটি সমন্বয়কে মূল্যায়ন করা এবং চিকিৎসাবিজ্ঞানকে উন্নত করার মত একটি কঠিন কাজে যোগদান ও সাহয্য করার পরিতৃপ্তি লাভ করবেন। এটি স্বয়ং একটি যথেষ্ট উপযুক্ত কারণ যা ভবিষ্যতের রোগীদের সাহায্য করতে পারে।

**গবেষণাটি বন্ধ হয়ে গেলে কি হবে?**

গবেষণাটি প্রত্যেক নিযুক্ত অংশগ্রহণকারীর সাথে শুরু হবার ১২ সপ্তাহের মধ্যেই শেষ হয়ে যাবে এমনটাই প্রত্যাশা করা যায়। যদি এটি নির্ধারিত সময়ের আগেই বন্ধ হয়ে যায়, তাহলে এটি বন্ধ হয়ে যাওয়ার কারণ গুলি আপনার কাছে ব্যাখ্যা করা হবে এবং আপনার চিকিৎসা যাতে নিরবচ্ছিন্নভাবে চলতে থাকে তার ব্যবস্থা করা হবে।

**এমন কোন কারণসমূহ আছে কী যার জন্য আমাকে পরবর্তীকালে গবেষণা থেকে সরিয়ে নেওয়া হতে পারে?**

যদিও বা আপনি গবেষণায় অংশগ্রহণকারী হিসেবে থাকতে চান, এমন কিছু কারণসমূহ থাকতে পারে যেগুলির জন্য আপনাকে গবেষণাটি থেকে সরিয়ে নেওয়া হতে পারে। এমনটা ঘটতে পারে যদিঃ-

- এই নির্দিষ্ট সময়সীমার মধ্যে আপনার স্বাস্থ্য আরো বেশি খারাপ হয়ে পড়ে।
- আপনি নিয়মমতো সঠিকভাবে ওষুধগুলি গ্রহণ না করেন অথবা বারবার সাক্ষাৎ করার পুর্বনির্ধারিত তারিখ ভুলে যান।

- আপনি যোগবিশারদদের দেখিয়ে দেওয়া ও বলে দেওয়া পদ্ধতি অনুসারে যোগাভ্যাস না করেন অথবা যোগাভ্যাসে আনিয়ম বজায় রাখেন।

**এই গবেষণায় আমার অংশগ্রহণ করার খবরটি গোপন রাখা হবে?**

হ্যাঁ, গবেষণা থেকে প্রাপ্ত সমস্ত তথ্য গোপন রাখা হবে। নির্দিষ্ট সময়কালের জন্য সংরক্ষিত রাখা হবে। এই তথ্যসমূহ কেবলমাত্র অনুমতিপ্রাপ্ত লোকেরা বৈজ্ঞানিক উদ্দেশ্যসমূহ জন্য ব্যবহার করবেন।

**গবেষণার ফল গুলি নিয়ে কি কি করা হবে?**

পরীক্ষা-নিরীক্ষা শেষ হয়ে যাবার পরে দ্রুত একটি গবেষণা রিপোর্ট চূড়ান্ত ভাবে তৈরি করা হবে। এই রিপোর্টটিকে গবেষণাকারী প্রতিষ্ঠানের নীতি পরিষদে জমা দেওয়া হবে, এবং এর সাথে সাথেই এর সাথে সাথে বিশ্ববিদ্যালয় কর্তৃপক্ষকে এবং প্রয়োজন পড়লে অন্যান্যদেরকেও দেওয়া হবে। গবেষণালব্ধ ফলাফল গুলি একটি বৈজ্ঞানিক প্রক্রিয়ায় পত্রিকায় প্রকাশ করা হতে পারে অথবা একটি বৈজ্ঞানিক সম্মেলনে আলোচনা করা হতে পারে। যদিও আপনাকে কোন রকম প্রকাশনার ক্ষেত্রে আপনাকে চিহ্নিত করা হবে না।

**বিশদ তথ্যের জন্য যোগাযোগ করুন ঃ**

এই গবেষণাটি পরিচালনকারী চিকিৎসক ও যোগব্যায়ামবিদ আরো বিস্তারিতভাবে আপনার সাথে বিষয়টি আলোচনা করতে পারেন এবং আপনার কোনো প্রশ্ন থাকলে তার উত্তর দিতে পারেন। যে সমস্ত ব্যক্তিদের সাথে যোগাযোগ করবেন তাঁরা হলেন-


ডঃ আশিস পাল
সহযোগী অধ্যাপক
শারিশিক্ষা বিভাগ
যাদবপুর বিশ্ববিদ্যালয়
কলকাতা ৭০০০৩২
মোবাইল-৯৮৩১৭১০৯৪২
(মুখ্য অনুসন্ধানকারী)

অরুময় জানা
গবেষক
শারিশিক্ষা বিভাগ
যাদবপুর বিশ্ববিদ্যালয়
কলকাতা ৭০০০৩২
মোবাইল-৯৬৩৫১৪৯০৫২
(সহ অনুসন্ধানকারী)

ডাঃ প্রদ্যোত সিনহা মহাপাত্র
সহযোগী অধ্যাপক
রিউমাটলজি বিভাগ
আই.পি.জি.এম.ই.আর
কলকাতা ৭০০০২০
(পরামর্শ দানকারী চিকিৎসা বিশারদ)


রোগীকে জানানোর জন্য তথ্যাবলী সম্বলিত সম্মিলিত পত্রটি পড়বার জন্য আপনাকে ধন্যবাদ। যদি আপনার রোগ সম্পর্কিত এই গবেষণায় অংশগ্রহণ করবার সিদ্ধান্ত নেন তার জন্যেও আমরা আপনাকে ধন্যবাদ জানাই।

**অবগত সম্মতিপত্র**

**আঙ্কিলুজিং স্পন্ডিলাইটিস-এর উপরে যোগাব্যায়াম অনুশীলানের প্রভাব**

অংশগ্রহণকারীর নাম----------

স্বাক্ষর- বয়স- লিঙ্গ-

**যদি আপনার মতো থাকেন যদি আপনি সম্মত থাকেন তবে ঘরের মধ্যে টিক টিক চিহ্ন দিন**

১. এক আমি সুনিশ্চিত করছি যে আমি উপরোক্ত গবেষণার জন জন্য প্রদত্ত তথ্যাবলী সম্বলিত পত্রটি পড়েছি এবং বুঝতে পেরেছি এবং প্রশ্নসমূহ জিজ্ঞাসা করবার সুযোগ পেয়েছই। [ ]

২. আমি বুঝতে পেরেছি যে এই গবেষণাটি আমার অংশগ্রহণ হল সম্পূর্ণ ঐছিক এবং আমি কোন রকম কারণ না দেখিয়ে, এবং আমার অধিকারসমূহের প্রাপ্ত সুবিধাগুলির কোন রকম ক্ষতি না করেই যে কোন মুহূর্তে আমার নাম স্বাধীনভাবে সরিয়ে নিতে পারি। [ ]

৩. আমি বুঝতে পেরেছি যে আমার সমস্ত তথ্য গোপন রাখা হবে কিন্তু মূখ্য অনুসন্ধানকারী, গবেষণা পরিচালনকারী প্রতিষ্ঠান নীতি পরিষদ এবং সরকারী নিয়ামক কর্তৃপক্ষ দ্বারা অনুমতিপ্রাপ্ত ব্যক্তিবিশেষরা আমার নথিপত্র ও তথ্যাবলী বর্তমান গবেষণার কাজে এবং ভবিষ্যতে এর সাথে সম্পর্কিত অন্য কোনো গবেষণা চালানোর জন্য ব্যবহার করতে পারবেন ব্যবহার করতে পারবেন। যদি আমি আমার নাম তুলেও নিই, আমি আমার তথ্যাদি এইরূপ ব্যবহারে সম্মত থাকবো। যদিও, আমি এটা বুঝতে পেরেছি যে আমার পরিচয় প্রকাশ করা হবে না এবং তথ্যসমূহের গোপনীয়তা বজায় রাখা হবে।[ ]

৪. কোন প্রকার তথ্য অথবা এই গবেষণা থেকে প্রাপ্ত ফলাফলসমূহের শিক্ষামূলক উদ্দেশ্য ব্যবহারে কোন প্রকার বাধা না দিতে আমি সম্মত হলাম।[ ]

৫. আমি উপরোক্ত গবেষণায় সেচ্ছায় অংশগ্রহন করতে সম্মত হয়েছি।[ ]

স্বাক্ষর/অংশগ্রহণকারী বৃদ্ধাঙ্গুষ্ঠের ছাপ-

তারিখ স্থান

গবেষণা অনুসন্ধান কারীর নাম

গবেষণা অনুসন্ধানকারীর স্বাক্ষর

তারিখ স্থান যদি কোন বৃদ্ধাঙ্গুলি অংশগ্রহণকারী বৃদ্ধাঙ্গুলে সাবধান ছাপ তাহলে এই অংশটি আবশ্যিক-

প্রত্যক্ষদর্শীর স্বাক্ষর- তারিখ- স্থান-

প্রত্যক্ষদর্শীর নাম ও ঠিকানা-

অংশগ্রহণকারীর সাথে সম্পর্ক, যদি কিছু থাকে-

# Consent Proforma (Hindi)

## <u>एंकिलोज़िंग स्पॉन्डिलाइटिस के रोगियों पर यौगिक अभ्यासों का प्रभाव</u>

**भौतिक शिक्षा विभाग, जादवपुर विश्वविद्यालय, राजा एस.सी. मल्लिक रोड़, कोलकाता – 700032 तथा स्नातकोत्तर चिकित्सा शिक्षा एवं अनुसंधान संस्थान (IPGME&R) एवं एस.एस.के.एम. (SSKM) अस्पताल – 244A एवं B, ए.जे.सी. बोस रोड़, कोलकाता –700020**

के द्वारा अध्ययन का संचालन किया जाएगा ।

आप सभी को रोग-विषयक (नैदानिक) अनुसंधान अध्ययन में भाग लेने के लिए आमंत्रित किया जाता है । निम्न सूचनाएँ आपको यह समझाने के लिए है कि यह शोध क्यों किया जा रहा है ? और इसमें क्या-क्या सम्मिलत होगा ? कृपया इसे सावधानीपूर्वक पढ़ें तथा यदि आपकी इच्छा हो तो अपने मित्रों, संबंधियों एवं पारिवारिक डॉक्टर के साथ इसकी चर्चा करें । यदि आप कोई अन्य जानकारी प्राप्त करना चाहते है या कोई सूचना जिसे समझने में आपको कोई असुविधा हो तो आप बिना हिचक के हमसे पूछ सकते है । दी गई सूचनाओं से पूरी तरह संतुष्ट होने पर तथा अध्ययन की प्रक्रिया को समझ लेने के बाद ही सूचना सहमति प्रपत्र पर अपना हस्ताक्षर करें ।

**इस अध्ययन का उद्देश्य क्या हैं ?**

इस अध्ययन का उद्देश्य एंक्यलॉसिंग स्पॉन्डिलाइटिस पर योग क्रियाओं के प्रभाव का मूल्यांकन करना है । आज के समय में योग अभ्यास बहुचर्चित है तथा यह भी स्थापित हुआ है कि योग लागत प्रभावी, ऊर्जावान क्रिया है तथा यह उच्च जीवन स्तर को भी बेहतर बनाता है । चिकित्सक विशेषज्ञों द्वारा सुझाए गये उत्तेजक विरोधी दवाओं के साथ-साथ योग क्रियाओं को अलग से पूरक / संपूरक उपचार के रुप में माना जाता है । साधारणः डॉक्टर एंक्यलॉसिंग स्पोंडिलाइटिस के उपचार के लिए गैर-स्टेरॉयड उत्तेजक विरोधी दवाओं या जैविक दवाओं का उपयोग करते हैं । दवाओं के अतिरिक्त, एंक्यलॉसिंग स्पॉन्डिलाइटिस से पीड़ित रोगियों के लिए विशेष योग क्रियाएं जैसे – आसन, प्रणायाम, ध्यान करना अच्छा होता है ।

**मैंने इसका चयन क्यों किया ?**

यह अध्ययन उन मरीजों पर किया जा रहा है जिन्हें एंक्यलॉसिंग स्पॉन्डिलाइटिस के कारण निम्न पृष्ठ दर्द, निम्न पृष्ठ अकड़न एवं शारीरिक विकलांगता की शिकायत है । यह 18 से 40 वर्ष के पुरुषों के मध्य होगा । आपका चयन इसलिए किया गया है क्योंकि आपको यह समस्या है तथा ट्रायल के लिए आप परीक्षण के अन्य मानदंडों को पूरा करते है ।

**क्या मेरा भाग लेना अनिवार्य है ?**

नहीं, यह पूरी तरह आप पर निर्भर करता है कि आप इसमें भाग लेंगे या नहीं ? अगर आप इस प्रक्रिया में भाग लेने का निर्णय लेते है, तो आपको सहमति पत्र में हस्ताक्षर करना होगा । यहाँ तक कि भाग लेने के बाद भी, आप बिना कारण बताए कभी भी अपनी इच्छा से इसे छोड़ने के लिए स्वतंत्र हैं । सहभागिता से बाहर निकलने के निर्णय या सहभागिता नहीं करने के निर्णय से आपके देखभाल के स्तर पर कोई प्रभाव नहीं पड़ेगा ।

**अध्ययन के दौरान क्या होगा ?**

यदि आप ट्रायल में सहभागिता करने का निर्णय लेते है तथा डॉक्टर भी सुनिश्चित करते है कि आपको एंक्यलॉसिंग स्पॉन्डिलाइटिस है, तो फिर आपका शारीरिक परीक्षण होगा एवं प्रयोगशाला में मूल्यांकन किया जाएगा ।

आप डॉक्टर (रिमैटोलॉजिस्ट) द्वारा निर्धारित दैनिक उपचार को जारी रखेंगे । दवाओं के साथ, आप पूरक / संपूरक दवा के रूप में योग क्रियाओं का अभ्यास करेंगे । निर्धारित उपचार पूरा होने के बाद, पुनः आपका प्रश्नावली द्वारा मनोवैज्ञानिक जांच, शारीरिक परीक्षण और प्रयोगशाला परीक्षण के माध्यम से यह सुनिश्चित किया जाएगा कि आप स्वस्थ है ।

हर दिन

**मुझे क्या करना होगा ?**

आपको दवा और योग क्रियाओं के निर्देशों का सावधानीपूर्वक पालन करना होगा । नामांकन के बाद, आपका एक सप्ताह तक निगरानी किया जाएगा और फिर उम्मीद की जाएगी कि आप संबंधित चिकित्सक के निर्देशानुसार दवा लेंगे और खाली पेट योग क्रियाएं करेंगे । यह क्रम 12 सप्ताह तक प्रतिदिन जारी रहेगा । हर दिन सुबह/शाम को 1 घंटा योग क्रिया करना होगा । निर्धारित प्रोटोकॉल के अनुसार विशिष्ट प्रकार के योग कियाएं - जैसे आसन, प्राणायाम, ध्यान करने हेतु निर्देश जाएगी ।

योग क्रिया आरंभ करने के पश्चात, आपको एक सप्ताह के बाद एक सप्ताह यानि प्रत्येक 15 दिनों के उपरांत अपने चिकित्सक से मिलना अनिवार्य होगा । यदि आप कोई अन्य दवा लेते है, तो आपको यह अपने डॉक्टर को बतलाना होगा । योग अभ्यास शुरू करने से पहले शोधकर्ता सभी योगाभ्यास ऑनलाइन वीडियो कॉल के जरिए करेंगे। और अभ्यास कैसे करना है, यह भी चरण दर चरण दिखाएं और समझाएं। ऑनलाइन वीडियो कॉल दिखाने के बाद क्या करना चाहिए और क्या नहीं करना चाहिए, सभी को पेन ड्राइव से योगाभ्यास का पूरा वीडियो दें। साथ ही सभी को इन योगाभ्यासों का सचित्र विवरण प्रदान करें। उन सभी रोगियों को उनके संपर्क नंबर दिए जाएंगे ताकि उनसे सीधे वॉयस कॉल और वीडियो कॉल के माध्यम से संपर्क किया जा सके और उनकी संचार आदतों के बारे में जानकारी प्राप्त की जा सके। यदि अभ्यास की निर्दिष्ट समय अवधि के भीतर योग के प्रकार और खुराक को बदलने की आवश्यकता है, तो आपको वह जानकारी दूरसंचार के माध्यम से दे दी जाएगी।

**ट्रायल परीक्षण के दौरान कौन-कौन सी दवाइयां दी जाएगी ?**

आपके चिकित्सक द्वारा दी गई दवाइयां ही जारी रहेगी । ट्रायल के लिए कोई भी अतिरिक्त दवाइयां नहीं दी जाएगी । ट्रायल के लिए पूरक थेरेपी के रूप में केवल योग क्रियाओँ का अभ्यास कराया जाएगा ।

**इस चिकित्सीय जांच के दुष्प्रभाव एवं जोखिम क्या है ?**

योग क्रियाओं एवं दवाइयों का मेल बिना किसी दुष्प्रभाव के पूरे विश्व में वृहद स्तर पर प्रयोग किया जाता है । धीरे-धीरे संयुक्त गतिशीलता का विकास होता है ।

**क्या इसमें भाग लेने से कोई अन्य संभावित दुष्परिणाम है ?**

हानी को छोड़कर इससे कुछ असुविधाएं जुड़ी है । आपको पूर्व निर्धारित दिनों पर क्लीनिक आना पड़ेगा । इस अध्ययन के लिए आपका रक्त-परीक्षण करना होगा जिसके लिए आपकी नसों से सुई द्वारा रक्त निकालना होगा । स अध्ययन के उपरांत, हमारे पास मुफ्त दवाइयों एवं योग क्रियाओं को जारी रखने का कोई प्रावधान नहीं है ।

**इसमें भाग लेने के संभावित लाभ क्या है ?**

योग क्रियाओं से कई लाभ अपेक्षित है, जैसे - दर्द से मुक्ति, लचीलेपन में वृद्धि, तनाव से मुक्ति आदि, अंततः एक बेहतर एवं सुखद जीवन ।

यदि इस अध्ययन से प्राप्त जानकारी हमें एंक्यलॉसिंग स्पॉन्डिलाइटिस की चिकित्सा में सुधार लाने में सहायक सिद्ध हुई, तो आपको चिकित्सा विज्ञान को आगे बढ़ाने तथा दवाइयों एवं व्यायाम के मूल्यांकन करने की इस कठिन कार्य में सहभागिता करने का संतोष प्राप्त होगा । यह अपने आप में एक मूल्यवान कारण है जो भविष्य में मरीजों की सहायता कर सकता है ।

**यदि यह अध्ययन रुक जाए, तो क्या होगा ?**

प्रत्येक व्यक्ति के जुड़ने की तिथि से 12 हफ्तों के भीतर यह अध्ययन संपन्न हो जाने की संभावना है । यदि इसे पहले रोक दी जाती है, तो आपको इसके कारणों से अवगत कराया जाएगा तथा आपके निरंतर चिकित्सा के लिए उपयुक्त व्यवस्थाएं की जाएगी ।

**क्या ऐसा कोई कारण है जिसकी वजह से मुझे बाद में इस अध्ययन से निकाला जा सकता है ?**

यदि आप इस अध्ययन में रहना भी चाहे, तो भी आपको इस अध्ययन से निम्न कारणों से निकाला जा सकता है । यह हो सकता है यदि-

- इस अवधि के दौरान आपका स्वास्थ्य बिगड़ जाए ।
- यदि आप अपनी दवाइयों का सही तरीके से सेवन नहीं करते है या मिलने की निर्धारित समय को बार-बार भूल जाए ।
- यदि आप विशेषज्ञों द्वारा बताए गए योग क्रियाओं का अभ्यास नहीं करते है अथवा इसे करने में अनियमितता बरते है ।

**क्या मेरी सहभागिता को गोपनीय रखा जाएगा ?**

हां, इस अध्ययन में अर्जित सभी तथ्यों एवं डेटा को गोपनीय रखा जाएगा । डेटा को उपयुक्त अवधि के लिए संग्रहित किया जाएगा । इस डेटा का उपयोग वैज्ञानिक उद्देश्यों की पूर्ति हेतु केवल अधिकृत व्यक्ति द्वारा किया जाएगा ।

**इस अध्ययन के परिणामों का क्या होगा ?**

ट्रायल समाप्त होते ही इस अध्ययन का एक फाइनल रिपोर्ट तैयार किया जाएगा । इसे संस्थान के आचार समिति के पास अध्ययन करने के लिए प्रस्तुत की जाएगी तथा विश्वविद्यालय प्राधिकारी को भी सौंपी जाएगी और आवश्यकता पड़ने पर दूसरों के साथ भी साझा की जाएगी ।

इन परिणामों को किसी वैज्ञानिक पत्रिका में प्रकाशित भी किया जा सकता है अथवा किसी वैज्ञानिक मंच पर इसकी चर्चा की जा सकती है । तथापि, आपको किसी भी रिपोर्ट / प्रकाशन में चिन्हित नहीं किया जाएगा ।

**अतिरिक्त जानकारी के लिए संपर्क करेः**

इस अध्ययन का आयोजन करने वाले योग विशेषज्ञ एवं चिकित्सक आपसे इस विषय में विस्तार पूर्वक चर्चा कर सकेंगे तथा जिज्ञासा उत्पन्न बोने पर आपके प्रश्नों का उत्तर दे सकेंगे । आप इन लोगों से संपर्क कर सकते हैं-

डॉ आशीष पाल
(एसोसियट प्रोफेसर)
भौतिक शिक्षा विभाग
कलकत्ता विश्वविद्यालय
कोलकता – 700032
संपर्क सं- 983170942
**प्रधान निरीक्षक**

अरुमय जाना
(वरीष्ठ अनुसंधानकर्ता)
भौतिक शिक्षा विभाग
जादवपुर विश्वविद्यालय
कोलकाता – 700032
संपर्क सं- 9635149052
**सह-निरीक्षक**

डॉ. प्रद्योत सिन्हामहापत्र
(एसोसियट प्रोफेसर)
रिमैटोलॉजी विभाग
आई.पी.जी.एम.ई.आर.
कोलकाता – 700020

**चिकित्सीय विशेषज्ञ सलाहकार**

## सूचित सहमति पत्र

**पीठ के निचले हिस्से में दर्द से संबंधित चरों के चयनित समूहों पर योग क्रियाओं का प्रभाव**

विषय का नाम- .....  संक्षिप्त हस्ताक्षर .....

उम्र- .....  लिंग- .....

(यदि आप सहमत है, तो कृपया यहां निशान लगाएं)

1. मैं पुष्टि करता हूं कि मैंने उपर्युक्त अध्ययन के लिए सूचना पत्र पढ़ा एवं समझा है तथा मुझे प्रश्न पूछने का अवसर मिला है । [ ]

2. मैं समझता हूँ कि इस अध्ययन में मेरी भागीदारी स्वैच्छिक है और बिना कारण बताए तथा अपने अधिकारों एवं विशेषाधिकारों को प्रभावित किए बिना मैं किसी भी समय निकलने के लिए स्वतंत्र हूँ । [ ]

3. मैं समझता हूँ कि मेरा डेटा गोपनीय रखा जाएगा लेकिन प्रिंसिपल इन्वेस्टिगेटर द्वारा प्राधिकृत व्यक्तियों, संस्थान के आचार समिति जहां अध्ययन किया जाएगा तथा सरकारी नियामक प्राधिकरण, वर्तमान अध्ययन और इस संबंध में भविष्य में होने वाले शोध दोनो के लिए मेरे रिकॉर्ड तक पहुंच रख सकेगा । हालांकि, मैं समझता हूँ कि मेरी पहचान उजागर नहीं की जाएगी और सूचना की गोपनीयता बरकरार रखी जाएगी । [ ]

4. मैं सहमत हूँ कि इससे उत्पन्न होने वाली किसी भी डेटा या परिणामों को शैक्षणिक उद्देश्य के लिए उपयोग को प्रतिबंधित ना करें । [ ]

5. मैं उपर्युक्त अध्ययन में स्वेच्छा से भाग लेने के लिए सहमत हूँ । [ ]

विषयी का हस्ताक्षर अंगुठे का निशान- .....

दिनांक- ..... स्थान- .....

अध्ययन के निरक्षक का नाम- .....

अध्ययन के निरक्षक का नाम- ..... दिनांक-..... स्थान-.....

**जहाँ विषयी के अंगूठे के निशान दिए गए है, अनिवार्य है ।**

साक्षी का हस्ताक्षर- .....

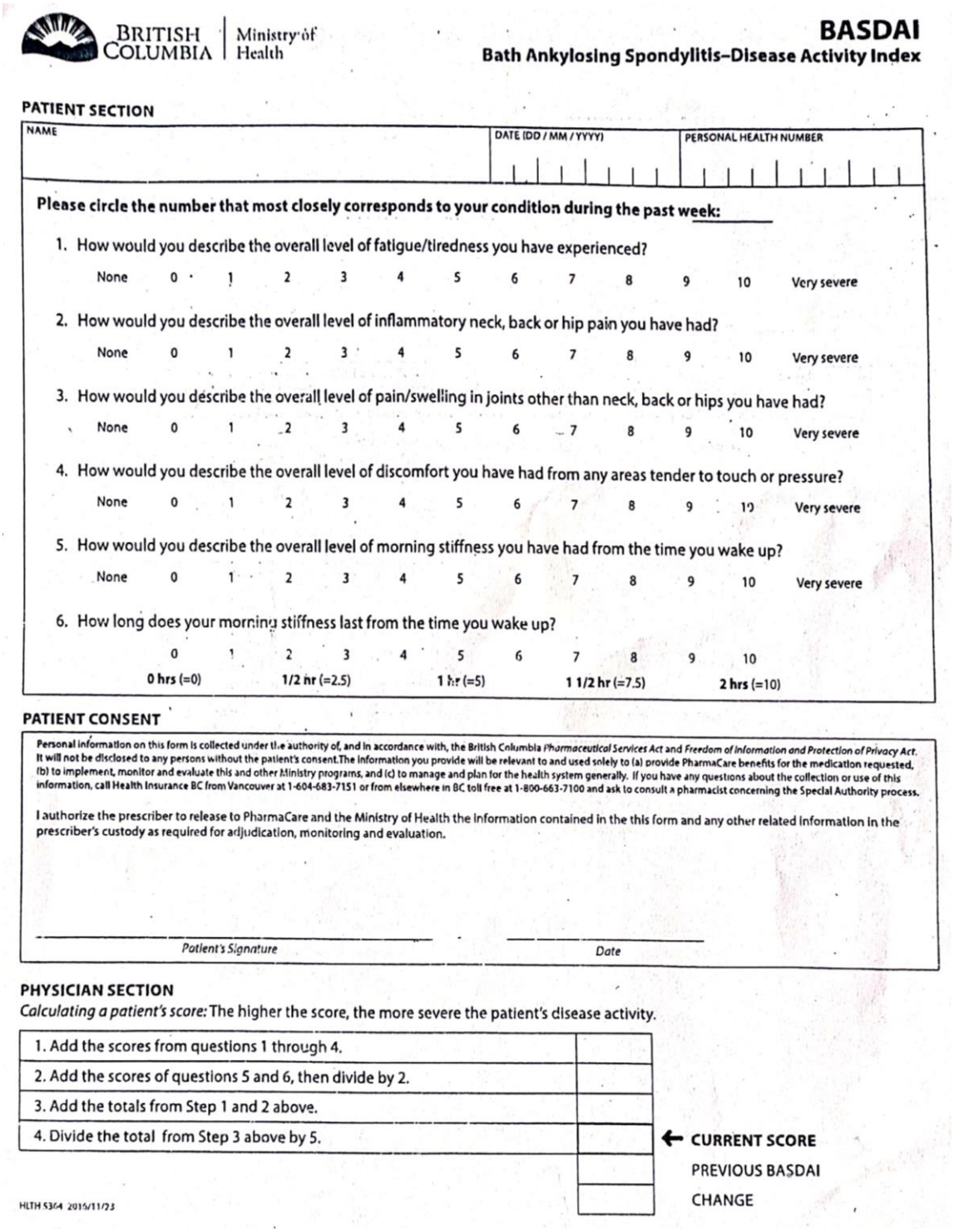
दिनांक-..... स्थान-.....

साक्षी का नाम वं पता- .....

.....

विषयी से संबंध, यदि हो, तो- .....

# Data Collection Tool (BASDAI Questionnaire)



BRITISH COLUMBIA | Ministry of Health

**BASDAI**

**Bath Ankylosing Spondylitis–Disease Activity Index**

**PATIENT SECTION**

| NAME | DATE (DD / MM / YYYY) | PERSONAL HEALTH NUMBER |
|---|---|---|
| | | |

**Please circle the number that most closely corresponds to your condition during the past week:**

1. How would you describe the overall level of fatigue/tiredness you have experienced?

None 0 1 2 3 4 5 6 7 8 9 10 Very severe

2. How would you describe the overall level of inflammatory neck, back or hip pain you have had?

None 0 1 2 3 4 5 6 7 8 9 10 Very severe

3. How would you describe the overall level of pain/swelling in joints other than neck, back or hips you have had?

None 0 1 2 3 4 5 6 7 8 9 10 Very severe

4. How would you describe the overall level of discomfort you have had from any areas tender to touch or pressure?

None 0 1 2 3 4 5 6 7 8 9 10 Very severe

5. How would you describe the overall level of morning stiffness you have had from the time you wake up?

None 0 1 2 3 4 5 6 7 8 9 10 Very severe

6. How long does your morning stiffness last from the time you wake up?

0 1 2 3 4 5 6 7 8 9 10

**0 hrs** (=0) **1/2 hr** (=2.5) **1 hr** (=5) **1 1/2 hr** (=7.5) **2 hrs** (=10)

**PATIENT CONSENT**

Personal information on this form is collected under the authority of, and in accordance with, the British Columbia *Pharmaceutical Services Act* and *Freedom of Information and Protection of Privacy Act*. It will not be disclosed to any persons without the patient's consent. The information you provide will be relevant to and used solely to (a) provide PharmaCare benefits for the medication requested, (b) to implement, monitor and evaluate this and other Ministry programs, and (c) to manage and plan for the health system generally. If you have any questions about the collection or use of this information, call Health Insurance BC from Vancouver at 1-604-683-7151 or from elsewhere in BC toll free at 1-800-663-7100 and ask to consult a pharmacist concerning the Special Authority process.

I authorize the prescriber to release to PharmaCare and the Ministry of Health the information contained in the this form and any other related information in the prescriber's custody as required for adjudication, monitoring and evaluation.

*Patient's Signature* *Date*

**PHYSICIAN SECTION**

*Calculating a patient's score:* The higher the score, the more severe the patient's disease activity.

| | | |
|---|---|---|
| 1. Add the scores from questions 1 through 4. | | |
| 2. Add the scores of questions 5 and 6, then divide by 2. | | |
| 3. Add the totals from Step 1 and 2 above. | | |
| 4. Divide the total from Step 3 above by 5. | | ← **CURRENT SCORE** |
| | | PREVIOUS BASDAI |
| | | CHANGE |

HLTH 5364 2015/11/23

# Data Collection Tool (BASFI Questionnaire)

## The BASFI Score

Please read each question and circle the box you feel is the most appropriate to describe how severe your condition has been in the last week. Please only circle one box for each question. There is no wrong answer.

1. Putting on your socks or tights without help or aids (eg, sock aid). Score out of 10

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

2. Bending forward from the waist to pick up a pen from the floor without an aid.

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

3. Reaching up to a high shelf without help or aids (eg, helping hand).

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

4. Getting up out of an armless dining room chair without using your hands or any other help.

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

5. Getting up off the floor without help from lying on your back.

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

6. Standing unsupported for 10 min without discomfort.

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

7. Climbing 12 to 15 steps without using a handrail or walking aid. One foot at each step.

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

8. Looking over your shoulder without turning your body.

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

9. Doing physically demanding activities (eg, physiotherapy, exercises, gardening or sports).

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

10. Doing a full day's activities, whether it be at home or at work.

*None* 0 1 2 3 4 5 6 7 8 9 10 *Impossible*

*For clinician use only* *BASFI Score*

**BASFI Score Calculation**
Add all scores from questions 1–10 and divide by 10.
The higher the BASFI score, the more severe the patient's limitation of function due to their AS.

Adapted from Calin et al. J Rheumatol. 1994 Dec;21(12):2281-5.

# Data Collection Tool (Depression)

## হামিল্টন ডীপ্রেসন রেটিং স্কেল

নাম-  বয়স-  লিঙ্গ-

**প্রত্যেক প্রশ্ন থেকে নিজের মত বেছে নিন-**

**১। বিষণ্ন মেজাজে অর্থাৎ আপনি মনমরা বা ভবিশ্যতের জন্য হতাশা বোধ করেন বা কেঁদে ফেলেন-**

ক) কখনো না খ) বিষণ্নতা হয় গ) মাঝে মাঝে কান্না পায় ঘ) প্রায়ই কেঁদে ফেলি ঙ) উপরোক্ত সবগুলি

**২। নিজেকে অপারাধী বলে মনে হয়-**

ক) কখনো না খ) ভর্তসনা করেন গ) কেউ বাধা দিচ্ছে বা নামিয়ে দিচ্ছে মনে হয় ঘ) এটা কোন শাস্তি বলে মনে হয় ঙ) অবাস্তব কিছুকে দোষী বলে মনে করছেন।

**৩। আত্মাহত্যা-**

ক) কখনই না খ) মনে করেন জীবনের কোন মূল্য নেই গ) মনে করি জেন মরে গেছি ঘ) আত্মাহত্যা চিন্তা আসে ঙ) আত্মাহত্যার চেষ্টা করেছি।

**৪। অনিদ্রা (প্রাথমিক পর্বে সমস্যা )**

ক) ঘুম আসতে সমস্যা হয় খ) কখনই না গ) মাঝে মাঝে হয় ঘ) প্রায়শ হয়।

৫। **অনিদ্রা (রাত্রের মাঝামাঝি বা ঘুমের মাঝামাঝি সময় )**

নিজেকে ঘুমের সময় বিরামহীন বা অস্থির লাগে যার জন্য ঘুমের সময় হাটাচলা করেন-

ক) কখনো না খ) মাঝেমাঝে গ) সবসময়

৬। **অনিদ্রা (বিলম্বিত )**

**সকালে** হাটাচলা করেন তারপরেও ঘুম পায় না।

ক) কখনো না খ) মাঝেমাঝে গ) প্রায়শই

**৭। কাজের প্রতি আগ্রহ** –

ক) কোন সমস্যা হয় না খ) অসামর্থ্য, ঔদাসিন্য, দ্বিধাগ্রস্ত অনুভব করি গ) শখের কাজে আগ্রহ হারাই ও সামাজিক কাজকর্ম হ্রাস পায়। ঘ) উৎপাদানশীলতা হ্রাস পায় ঙ)কাজ করতে অসামর্থ্য তার কারনে এই অসুস্থতা।

**৮। মানসিক মন্দন** –

কাজকর্ম, চিন্তা করা, কথাবলা, ধীর হয়ে যাওয়া বা আড়সতা আসা-

ক) কখনই না খ) সাক্ষাতকারের সময় কিছুটা মন্দন হয়। গ) সাক্ষাতকারে অসুবিধা হয় ঘ) সম্পুর্ন আড়সতা আসে।

**৯। উত্তেজনা-**

উদ্বেগ বা বিরামহীনতা –

ক) কখনই না খ) মাঝেমাঝে গ) প্রায়শই

**১০। মনোগত উদ্‌বিগ্নতা-**

ক) কোন সমস্যা হয় না খ) চাপা উত্তেজনা ও বিরক্তি হয় গ) ছোটখাটো জিনিসে ভয় ঘ) শঙ্কিত মনোভাব ঙ) ভয় হয়

**১১। উদ্বেগ (শারীরিক)**

হজমে, বাহ্যে, হৃতসংবহনে, মাথাধারা, শ্বাসকষ্ট বা মুত্রাশয়ে কিছু সমস্যা হয়

ক) কখনো না খ) হালকা হয় গ) মাঝারি হয় ঘ) নিদারুণ মাত্রায় হয় ঙ) সহ্যসীমার বাইরে।

১২। **শারীরিক সমস্যা** (হজমে)

খিদে না পাওয়া, পেট ভারী হয়ে থাকা, বাহ্য না হওয়া-

ক) হয় না খ) মাঝারি মাত্রায় হয় গ) নিদারুণ সমস্যা হয়।

**১৩। শারীরিক লক্ষণ**

**যে মন অঙ্গ প্রতঙ্গ ভারি হয়ে যাওয়া, কোমর বা মাথা ধরা, অবসাদ আসা ইত্যাদি-**

ক) কখনো না খ) মাঝারি মাত্রায় হয় গ) নিদারুণ মাত্রায় হয়

**১৪। যৌন লক্ষণ**

**যৌন সঙ্গমে অনিছা**

ক) হয় না খ) হালকা হয় গ) নিদারুণ মাত্রায় হয়

**১৫। স্নায়বিক উন্মাদনা (উদ্বেগ ও ভয়)**

ক) হয় না খ) শরীর মানিয়ে নেয় গ) রাগান্বিত মনোভাব ঘ) স্নায়বিক বিভ্রম হয়।

**১৬। ওজন হ্রাস-**

ক) হয়নি খ) কিছুটা হয়েছে গ) আস্বাভাবিক হ্রাস হয়েছে।

**১৭। অন্তর্দৃষ্টি ( নিজের বোধগম্যতা)**

ক) ঠিক আছে খ) কিছুটা হারিয়েছি গ) পুরো বোধগম্যতা হারিয়েছি।

**১৮। দৈনিক পরিবর্তন ( দিনের সময় অনুযায়ী উপরোক্ত সমস্যা গুলো দেখা যায়)**

ক) কোন পরিবর্তন নেই খ) সামান্য পরিবর্তন আছে (am.....pm.) গ) অস্বাভাবিক পরিবর্তন আছে।

**১৯। অবাস্তব ও শূন্যবোধ ধারনা-**

ক) অনুপস্থিত খ) হালকা গ) মাঝারি ঘ) খুব ঙ) অসহ্য

**২০। প্যারানয়েডের লক্ষণ (উদ্বিগ্ন বা আতঙ্কিত চিন্তা)-**

ক) হয় না খ) সন্দেহজনক গ) চিন্তার উল্লেখ হয় ঘ) বিভ্রম ও নিপীড়ন হয় ঙ) অলীক কিছু অস্বস্তি হয়।

**২১। অত্যাধিক চিন্তা ও বাধ্যবাধকতা কোন সামস্যার বিষয়ে-**

ক) হয় না খ) হালকা হয় গ) নিদারুণ মাত্রায় হয়

# Data Collection Tool (Fear Avoidance Belief)

## ভয়েতে কিছু এড়িয়ে চলার বিশ্বাস

নাম-  বয়স-  লিঙ্গ-

**<u>প্রত্যেক প্রশ্ন থেকে নিজের মত বেছে নিন-</u>**

**ক)** সম্পুর্ন একমত নই **খ)** মোটামুটি একমত নই **গ)** কিছু কিছু সময় একমত নই **ঘ)** বলতে পারছি না **ঙ)** কিছু কিছু সময় একমত **চ)** মোটামুটি একমত **ছ)** সম্পুর্ন একমত

১। শারীরিক কার্জকলাপের জন্য আমার ব্যাথা হত। **ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

২। শারীরিক ক্রিয়াকলাপ আমার বাথ্যাকে আর খারাপের দিকে নিয়ে যায়।

**ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

৩। শারীরিক ক্রিয়াকলাপের জন্য আমার পিঠের ক্ষতি হতে পারে। **ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

৪। আমি কোন শারীরিক ক্রিয়াকলাপ করব না যেটা আমার ব্যাথার পক্ষে ক্ষতিকর।

**ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

৫। আমি এমন কোন শারীরিক ক্রিয়াকলাপ করি না যেটা আমার ব্যাথার পক্ষে ক্ষতিকর।

**ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

৬। আমার কাজে বা দুর্ঘটনাবশত কারনে আমার ব্যাথা হয়েছিলো। **ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

৭। আমার কাজের জন্য আমার ব্যাথা বৃদ্ধি পায়। **ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

৮। আমার ব্যাথার ক্ষতিপুরণের জন্য অভিযোগ করি । **ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

৯।আমার কাজ আমার পক্ষে একটু বেশীই কষ্টকর। **ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

১০। আমার কাজ আমার ব্যাথার মারাত্মক ক্ষতি করে অথবা করতে পারে।

**ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

১১। আমার কাজ আমার পিঠের ক্ষতি করতে পারে। **ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

১২। আমার বর্তমান ব্যাথার জন্য নিজের স্বাভাবিক কাজ করতে পারব না।

**ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

১৩। ব্যাথার জন্য নিজের স্বাভাবিক কাজ করতে পারি না। **ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

১৪। আমি স্বাভাবিক কোন কাজ করতে পারি না যতক্ষণ না ব্যাথার চিকিৎসা হয়।

**ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

১৫। ৩ মাসের মধ্যে আবার স্বাভাবিক কাজে ফিরে আসব একথা আমি ভাবতেই পারি না।

**ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

১৬। ভাবতেই পারি না যে আমি আবার আমার স্বাভাবিক কাজের অবস্থায় ফিরতে পারব।

**ক/ খ/ গ/ ঘ/ ঙ/ চ/ ছ**

## Data Collection Tool (Pain Catastrophizing)

**ব্যাথার সর্বনাশা অনুভুতি সূচক**

নাম- বয়স- লিঙ্গ-

**যখন আমার ব্যাথা হয়, তখন আমার নিম্নোক্ত অনুভুতিগুলি হয়-**

**১। আমি সবসময় ভয়ে থাকি যদি কিনা ব্যাথা সবকিছু শেষ করে দেয়।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**২। আমি অনুভব করি আমি কিছু করতে পারব না।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**৩। এটা খুব ভয়ানক এবং আমি ভাবি এটার জন্য ভাল কিছু হবে না।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**৪। এটা খুব আতঙ্কজনক, এবং এটা আমাকে আছন্ন করে রেখেছে।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**৫। আমি অনুভব করি এটার জন্য আর দাঁড়াতে পারব না।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**৬। আমি ভীত হই যে ব্যাথা আমাকে আরও খারাপের দিকে নিয়ে যাছে।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**৭। আমি অন্যসমস্ত ব্যাথা যন্ত্রনার ঘটনাগুলো মনে করি।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**৮। আমি উদ্‌বিগ্নভাবে চাই যেন ব্যাথা চলে যায়।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**৯। আমি ব্যাথাকে মনের বাইরে করতে পারি না বা ভুলতে পারি না।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**১০। আমি চিন্তা করতে থাকি এটা কতটা আমাকে আঘাত দিতে পারে।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**১১। আমি চিন্তা করতে থাকি এটা কতটা খারাপভাবে ব্যথাকে দূর করতে চাই।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**১২। এমন কিছু নেই যার দ্বারা ব্যাথার তীব্রতা কমাতে পারি।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

**১৩। আমি এটা ভেবে আর্শ্চয হই মারাত্মক কিছু একটা ঘটবে।**

**ক)** কখনই না **খ)** সামান্য হয় **গ)** মাঝারি ধরনের **ঘ)** তীব্রভাবে হয় **ঙ)** সবসময় হয়

# Data Collection Tool (SF-36 HRQoL)

## সংক্ষিপ্ত রূপ ৩৬ স্বাস্থ্য জরিপ স্কেল

নামঃ বয়সঃ

১. **সাধারণভাবে আপনার স্বাস্থ্য কেমন বলবেন।**

i) চমৎকার ii) খুব ভালো iii) ভালো iv) চলনসই v) ভাল না

২. **এক বছর আগের তুলনায় এখন আপনার স্বাস্থ্যা কেমন-**

i) এক বছর আগের থেকে ভালো ii)এক বছর আগের থেকে কিছুটা ভালো iii)একইরকম

iv)এক বছর আগের থেকে কিছুটা খারাপ v)খুবই খারাপ

**নিচের প্রশ্নগুলি আপনার দিনদিন জীবন যাপনে যে কাজকর্ম করেন –এখন কি আপনার স্বাস্থ্য কাজকর্মের প্রতি প্রতিবন্ধকতার সৃষ্টি করে। যদি করে কতটা?**

৩. **ভারী কাজ যেমন দরতে, ভারি জিনিস তুলতে , পরিশ্রম যুক্ত খেলাধুলায় অংশগ্রহণ করতে আসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

৪. **মাঝারী ধরনের কাজকর্ম, যেমন টেবিল সরানও, ঝাঁট দেওয়া, খেলাধুলা করতে অসুবিধা হয়?**

i)হ্যাঁ ii)কিছুটা iii) না

৫. **মুদিখানার মালপত্র ব্যাগে করে নিয়ে যেতে অসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

৬. **সিঁড়িতে লাফিয়ে লাফিয়ে উঠতে অসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

৭. **একটা একটাসিঁড়িতে উঠতে অসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

৮. **ঝুঁকে, হাঁটু গেড়ে বা নুয়ে পড়তে অসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

৯. **এক মাইলের বেশি হাঁটতে অসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

১০. **৫০০-৬০০ মিটার হাঁটতে অসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

১১. **১০০ মিটার হাঁটতে অসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

১২. **নিজে স্নান করতে বা নিজের ড্রেস পরতে অসুবিধা হয়?** i)হ্যাঁ ii)কিছুটা iii) না

**গত ৪ সপ্তাহে, দিনদিন কাজকর্মের উপর নিম্নোক্ত শারীরিক সমস্যা গুলি কি হয়েছে?**

**১৩. আপনার কাজ করার সময় কি কমে গেছে?** হ্যাঁ / না

**১৪. যতটা আপনি কাজ করতে চাইছেন ততটা করতে পারছেন না।** হ্যাঁ / না

**১৫. যে কোন কাজ খুবই কম করতে পেরেছিলেন?** হ্যাঁ / না

**১৬. যে কোন কাজ করতে প্রচুর কষ্ট হতো।** হ্যাঁ / না

**গত ৪ সপ্তাহে, দিনদিন কাজকর্মের উপর নিম্নোক্ত আবেগগত সমস্যা গুলি কি হয়েছে?**

**১৭. মানসিকভাবে আপনার কাজ করার সময় কমে গেছে?** হ্যাঁ / না

১৮. **যতটা আপনি মানসিক কাজ করতে চাইছেন ততটা করতে পারছেন না।** হ্যাঁ / না

১৯. **কোন কাজই মনঃসংযোগ দিয়ে করতে পারেননি।** হ্যাঁ / না

২০. **শেষ ৪ সপ্তাহে দৈহিক ও আবেগগত সমস্যা গুলো বিভন্নভাবে সামাজিক, পরিবার, বন্ধুদের বা প্রতিবেশীদের মেলামেশাতে সমস্যা করেছে।**

i) মোটেও না ii) সামান্য iii)মাঝারি iv)বেশ v)খানিকটা ভালোই

২১. **শেষ ৪ সপ্তাহে শরীরে কতটা ব্যাথা অনুভূতি হয়েছে?** I)একদম না ii)খুবই কম, iii)কম তীব্র iv)বেশ তীব্র

**২২. শেষ ৪ সপ্তাহে আপনার বাড়ীর ও বাইরের কতটা বাধার সৃষ্টি করেছে? i)**একদম না ii)কিছুটা iii) মাঝারী iv) বেশ একটু v) প্রচুর

**<u>শেষ ৪ সপ্তাহ আপনি কেমন অনুভব করেছেন। প্রশ্ননানুযায়ী দাগ দিন-</u>**

২৩.**আপনি কি পূর্ণ উদ্যমে অনুভব করছেন?** i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

**২৪. আপনি কি খুব নার্ভাস ছিলেন?** i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

**২৫. আপনি কি এতটাই ভেঙ্গে পরেছিলেন যে কোন কিছুই আপনাকে উৎসাহিত করতে পারেনি।**

i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

**২৬. আপনি কি শান্তি বোধ উপলব্ধি করেছিলেন।** i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

**২৭. আপনি কি অনুভব করেছেন যে আপনার অনেক এনার্জি আছে।** i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

**২৮. আপনি কি নিজেকে হতাশাগ্রস্ত বলে অনুভব করেছেন?** i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

**২৯. আপনি কি ক্লান্তি বা জীর্ণ বোধ অনুভব করেছেন?** i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

**৩০. আপনি কি নিজেকে সুখী ব্যাক্তি বলে মনে করেন?** i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

**৩১. আপনি কি ক্লান্ত বোধ করেন।** i) সর্বক্ষণ ii)বেশিরভাগ সময় iii)কিছুটা সময় iv)সামান্য কিছু সময় v)কোন সময় না

৩২. **গত সপ্তাহে আপনার দৈহিক স্বাস্থ্য ও আবেগগত স্বাস্থ্য সমস্যা আপনার স্বাভাবিক কাজকর্মে প্রভাব ফেলেছে কি? যেমন বন্ধু, পরিবার, আত্মীয় ইত্যাদি। i)** সর্বদা বেশিরভাগ সময়, ii)কিছু সময় iii)সামান্য কিছু সময় iv)কোন সময় না

**৩৩. আপনি কি অন্যদের তুলনায় খুব সহজে অসুস্থ হয়ে পরেন?**

i)একদম সত্য ii)আধিকাংশ ক্ষেত্রে সত্য iii)জানি না iv)আধিকাংশ ক্ষেত্রে মিথ্যা v)একদমমিথ্যা

৩৪. **আমি আমার পরিচিত যে কারো মত সুস্থ।** i)একদম সত্য ii)আধিকাংশ ক্ষেত্রে সত্য iii)জানি না iv)আধিকাংশ ক্ষেত্রে মিথ্যা v)একদমমিথ্যা

৩৫. **আমি মনে করি আমার স্বাস্থ্যা খারাপ হবে।** i)একদম সত্য ii)আধিকাংশ ক্ষেত্রে সত্য iii)জানি না iv)আধিকাংশ ক্ষেত্রে মিথ্যা v)একদমমিথ্যা

৩৬. **আমার স্বাস্থ্য চমৎকার।** i)একদম সত্য ii)আধিকাংশ ক্ষেত্রে সত্য iii)জানি না iv)আধিকাংশ ক্ষেত্রে মিথ্যা v)একদমমিথ্যা

## Seminar Presentation Certificate-1



OLYMPICS DOWN THE AGES: GOA - 2020

Dempo Charities Trust's
S. S. Dempo College of Commerce & Economics
Reaccredited by NAAC at 'A' Grade (CGPA of 3.30/4)
Cujira, Bambolim - Goa

&

Government College of
Arts, Science & Commerce
Reaccredited by NAAC at 'A' Grade (CGPA of 3.17/4)
Sanquelim - Goa

# CERTIFICATE

This is to certify that Mr./~~Ms./Prof./Dr.~~ Ayumay Jana

of Jadavpur University

Participated in the **Scientific International Conference on Physical Education and Allied Sciences,**

on the theme ***"Holistic Development for Excellence in Sport Performance, Health & Well Being"***

from **27th to 29th February, 2020**. He/~~She~~ also Presented a Paper/ ~~Chaired Technical Session/ Delivered an Invited Talk~~

~~Served as a NAPESS Member/ Organised/~~ Volunteered, titled

"INFLUENCE OF YOGIC PRACTICES ON PSYCHOLOGICAL VARIABLES IN YOUTH WITH REFERENCE TO LOW BACK PAIN: A PILOT STUDY".

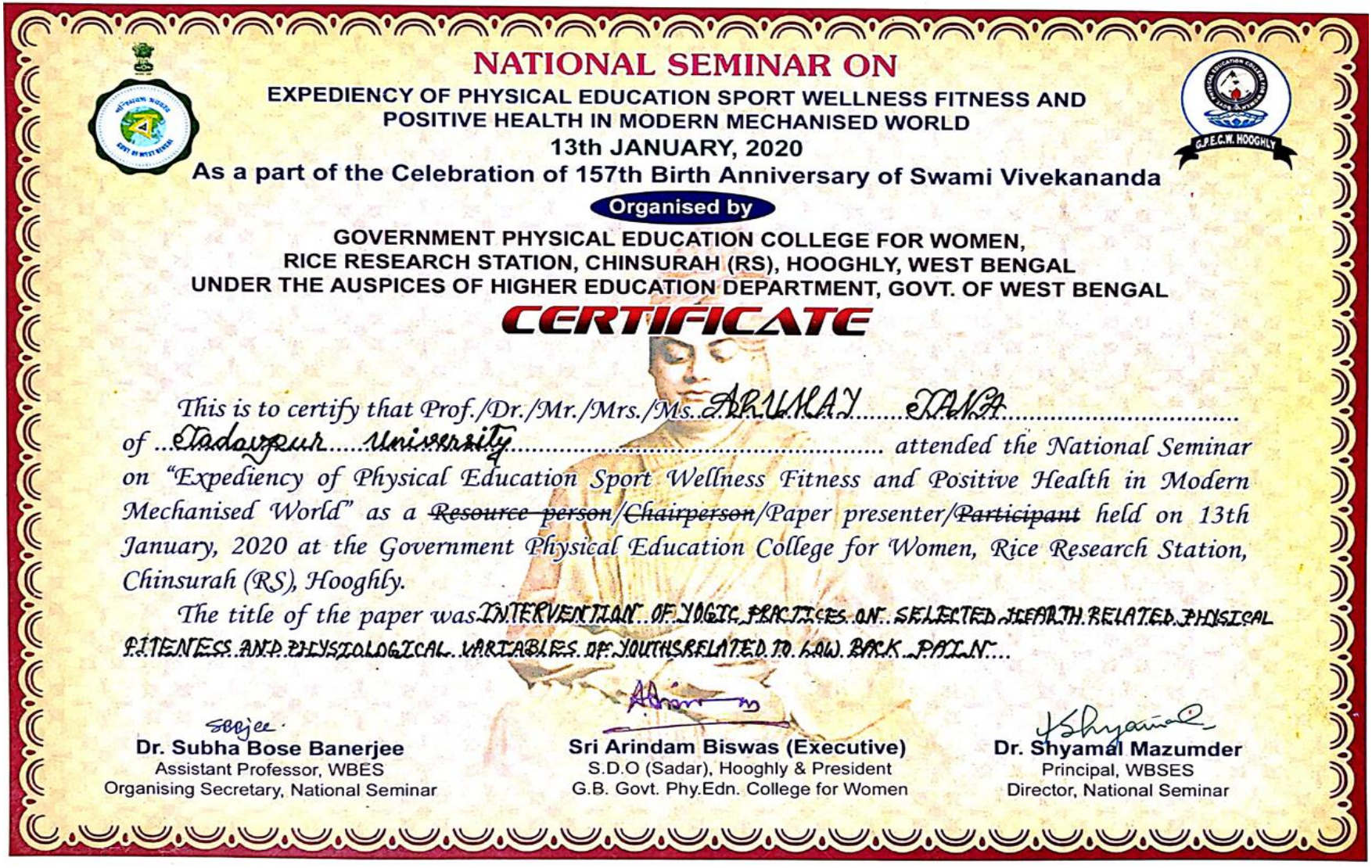
**Dr. Radhika S. Nayak**
Principal,
DCT's S. S. Dempo College of
Commerce & Economics, Cujira, Goa

**Shri. Prasad Lolayekar**
Director,
Directorate of Higher Education,
Govt. of Goa

**Dr. Pradeep Deshmukh**
President, NAPESS

**Dr. Gervasio S. F. L. Mendes**
Principal,
Govt. College of Arts, Science &
Commerce, Sanquelim, Goa

## Seminar Presentation Certificate-2



NATIONAL SEMINAR ON

EXPEDIENCY OF PHYSICAL EDUCATION SPORT WELLNESS FITNESS AND POSITIVE HEALTH IN MODERN MECHANISED WORLD

13th JANUARY, 2020

As a part of the Celebration of 157th Birth Anniversary of Swami Vivekananda

Organised by

GOVERNMENT PHYSICAL EDUCATION COLLEGE FOR WOMEN,
RICE RESEARCH STATION, CHINSURAH (RS), HOOGHLY, WEST BENGAL
UNDER THE AUSPICES OF HIGHER EDUCATION DEPARTMENT, GOVT. OF WEST BENGAL

CERTIFICATE

This is to certify that Prof./Dr./Mr./Mrs./Ms. ARUNAY ..... of Jadavpur University ..... attended the National Seminar on "Expediency of Physical Education Sport Wellness Fitness and Positive Health in Modern Mechanised World" as a ~~Resource person~~/~~Chairperson~~/Paper presenter/~~Participant~~ held on 13th January, 2020 at the Government Physical Education College for Women, Rice Research Station, Chinsurah (RS), Hooghly.

The title of the paper was INTERVENTION OF YOGIC PRACTICES ON SELECTED HEALTH RELATED PHYSICAL FITENESS AND PHYSIOLOGICAL VARIABLES OF YOUTHS RELATED TO LOW BACK PAIN.

Dr. Subha Bose Banerjee
Assistant Professor, WBES
Organising Secretary, National Seminar

Sri Arindam Biswas (Executive)
S.D.O (Sadar), Hooghly & President
G.B. Govt. Phy.Edn. College for Women

Dr. Shyamal Mazumder
Principal, WBSES
Director, National Seminar

## Seminar Presentation Certificate-3

38th Annual Conference of Indian Rheumatology Association

IRACON'23

# CERTIFICATE OF PARTICIPATION

*For*

## E POSTER PRESENTATION ABSTRACT

Confirmation Number : 376

This is to certify that

**Arumay Jana**

participated as a delegate and presented a e poster tittled "Effect of Yogic Practices on Disease Activity and Quality of Life in Patients with Ankylosing Spondylitis" at the Indian Rheumatology Association Conference IRACON 2023, on the 24th to 25th November at Hyderabad, Telangana, India

| Dr G Narasimulu | Dr I Rajendra Vara Prasad | Dr Rajkiran Dudam |
|---|---|---|
| Organising Chair | Scientific Chair | Organising Secretary |

# Paper Publication-1

*Studies in Indian Place Names*
**(UGC Care Journal)**

**ISSN: 2394-3114**

**VOL-40-ISSUE-62-MARCH-2020**

## Influence of Yogic Practices on Psychological Variables in Youths With reference To Low Back Pain: A Pilot Study

**Arumay Jana**
Senior Research Fellow,
Department of Physical Education, Jadavpur University,
West Bengal, India
E-mail: arumayjana.phed.rs@jadavpuruniversity.in

**Dr. Asish Paul**
Associate Professor, Department of Physical Education, Jadavpur University,
West Bengal, India
E-mail:asp_f2000@yahoo.com

**Abstract**

Low back pain is a specific or nonspecific multidimensional disorder suffers from adolescent to old age either long term or certain times in daily life activities. Studies showed that before treating low back pain not only considered biomedical factors but stick to contemplation patient own thought, emotional and behavioural factors. The aim of the present study was to evaluate the influence of yoga intervention on beliefs in fear avoidance, catastrophizing thoughts and depression of youth college students suffering from low back pain. Total nine moderately disable subjects were selected by oswestry low back pain disability questionnaire after those patients were medically checked by an expert orthopaedic surgeon. Five subjects received yogic treatment for 12 weeks as 4 days in a week and rest of them without any kind of treatment. This design of the study was a pre - test – post - test experimental group design. Fear Avoidance Beliefs Questionnaire (FABQ), Pain Catastrophizing Scale (PCS), Hamilton Depression Rating Scale (HAM- D), Psychological inflexibility in pain scale was used as measuring tools. Data were analysed using mean and percentage only. Mean differences of pre and post intervention data indicates that intensity of low back pain in experimental group was reduced moderate (24.44%) to minimum disability (7.5%) but little change in control group (27.77% to 24.40%) and decrease pain related thought, belief, distraction in compare to control group those were not received any treatment. The present study concluded that yoga is an effective alternative medicine to lessen pain and pain related negative thought, belief and elevated mood and interest in work of college students.

**Keywords:** ***Low Back Pain, Yogic Practices, Fear Avoidance Beliefs, Pain Catastrophizing, Depression***

# Paper Publication-2

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**Arumay Jana**
Regular Research Scholar, Department of Physical Education, Jadavpur University, West Bengal, India

**Dr. Asish Paul**
Assistant Professor, Department of Physical Education, Jadavpur University, West Bengal, India

**Correspondence**
Regular Research Scholar, Department of Physical Education, Jadavpur University, West Bengal, India

# Epidemiology of low back pain: A literature review

**Arumay Jana and Dr. Asish Paul**

**Abstract**
Today's Science have done lot things easy, they produce human robot but can't cure low back pain by a click. That is why in dynamic life, threatening of lower back pain increasing day by day. It crosses the limit to different age, sex, occupation and habits. Now it is time think about it. We aim to draw attention on epidemiology of low back pain in globally and India. Systematic review was adopted as design of the study. We adopted scientific electronic databases; PubMed, Embase, Medline, Google Scholar, Google Advance Search, Psyc INFO, ROAJ, DOAJR, Cochrane Database, ISI Web of Knowledge, Web of Science and critically analysed the entire relevant article according to the nature of this study. On basis of the information, we found that wideness of low back pain is unequal percentage throughout the globe due to factors like socio-economic conditions, nature of activity, habits etc. In India near about 8% peoples years lived with disability (YLD) due to low back problem and 4.6% peoples Disability-Adjusted Life Years (DALYs) in musculoskeletal disorder in India. Rate of change DALYs in respect of low back pain has been 1.2% to 2.3% between years 1990 to 2016.More multidimensional and number studies will require further investigate for accurate epidemiological structure of low back pain in world and India.

**Keywords:** Low back pain, epidemiology, India

## 1. Introduction
Low back pain causes more disability around the globe than any other condition, and accounts for a third of all work related disability, according to new research. Researchers found that almost one in 10 people (9.4 per cent) worldwide suffers from low back pain. The prevalence of low back pain was highest in Western Europe, followed by North Africa and the Middle East, and lowest in the Caribbean and Latin America published in journal Annals of the Rheumatic Diseases [1].

## 2. Methods
### 2.1 Acquisition of evidence
Researchers collected scientific evidences through electronic databases; PubMed, Embase, Medline, Google Scholar, Google Advance Search, Psyc INFO, ROAJ, DOAJR, PED ro, CINAHL, Cochrane Database, ISI Web of Knowledge, Web of Science and critically analysed the entire relevant article according to the nature of this study.

### 2.2 Inclusion and exclusion criteria
Studies related to the objective of this paper were included in this project whereas studies which were not directly matched with the concept of analysis were excluded from the process.

### 2.3 Selection procedure of review articles
In the first attempt, a total 113 articles were assessed on the basis of eligibility criteria. Out of which only 41 papers fulfilled the objective of this study. Details selection procedure adopted for this study is presented in the Figure-1.

## Yoga Practice Images (Training Protocol)

1 Prayer 1

2 Neck Bending

3 Hand Stretch-I

4 Hand Stretch-II

5 Shoulder Rotations

6 Trunk Rotations

7 Ankles Up

8 Ankles Down

# Surya Namaskar

9 Pranamasana

10 ArdhaChakrasana

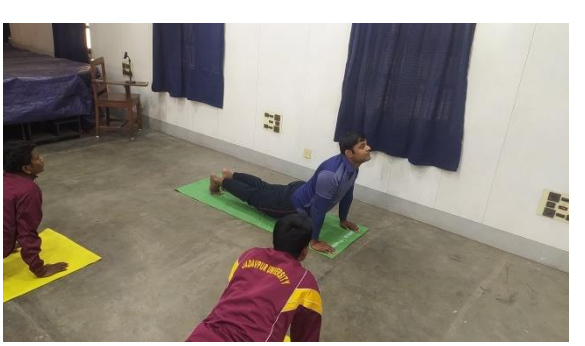
11 Tadasana

12 Aswasanchalasana

13 Dandasana

14 AshtangaPranam

15 Bhujangasana



16 Dandasana

17 Aswasanchalasana

18 ArdhaChakrasana

19 Tadasana

20 Pranamasana

## Standing Asanas

21 Side Bending Chakrasana

22, 23 Trikonasana


24, 25 Katichakrasana

## Supine Lying Asanas


26 Shavasana

27 Uttanpadasana (left leg)


28 Uttanpdasana (right leg)

29 Uttanpdasana (both leg)

30 JatharaParbartita asana (left side)

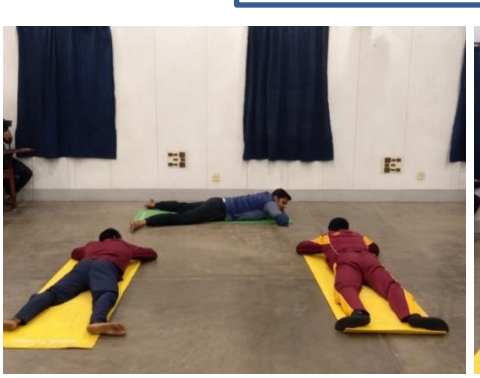
31 JatharaParbartita asana (right side)

32 Setubandhasana

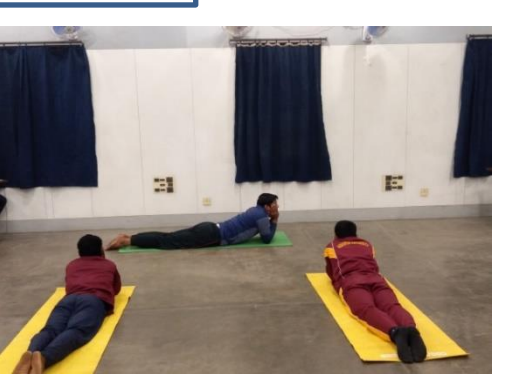
33 Pawanmuktasana

## Prone Lying Asanas

35 Side roll



36 Makarasana



37 Nirlambasana

38 Bhujangasana

39 ArdhaShalvasana (left leg)

40 ArdhaShalvasana (right leg)

41 ArdhaShalvasana (both leg)

## Sitting Asanas

42 Parvatasana

43 Resting Pose

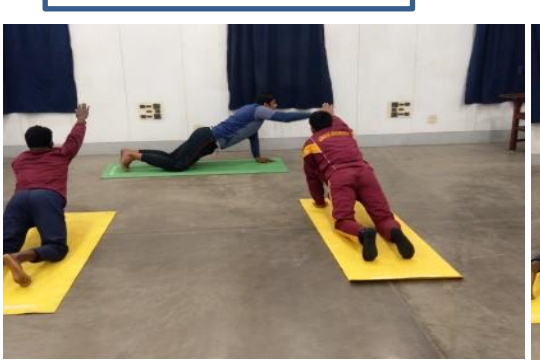
44 Vakrasana (right twist)

45 Vakrasana (left twist)

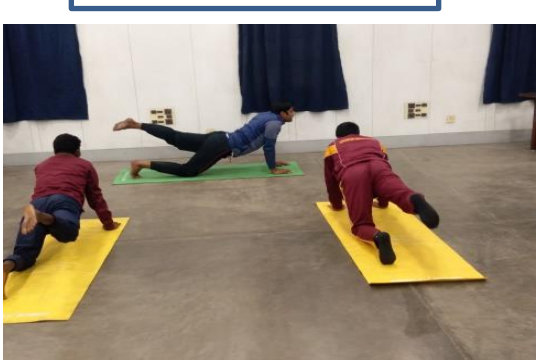
46 UttanMandukasana

47 ArdhaUstrasana

48 Majrasana



**49 Majrasana (with hand raise)**



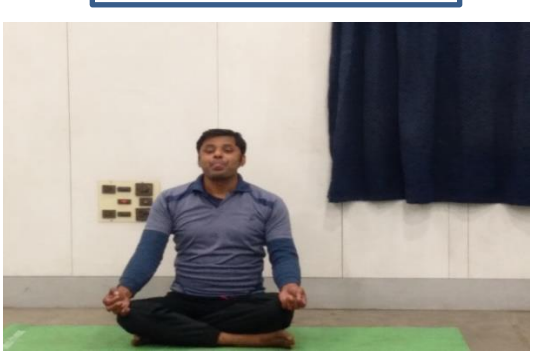
**50 Majrasana( with leg raise)**

51 Shasankasana

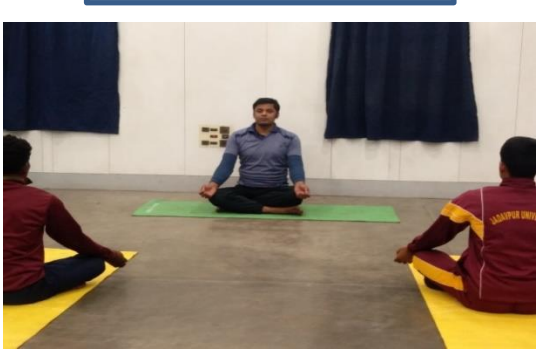
52 Kapalbhati Kriya

53 Anulom-Vilom Pranayama

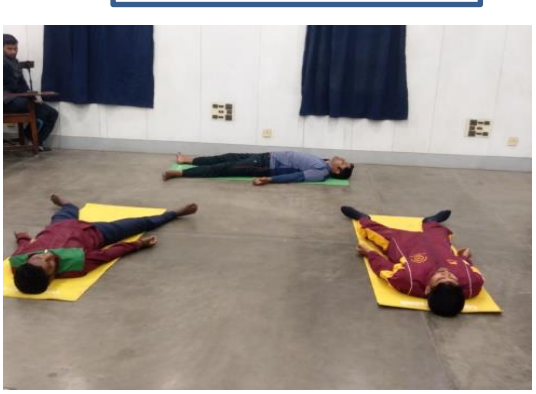
54 Bhramari Pranayama



55 Sheetali Pranayama



56 Bhrastika Pranayama



57 Meditation (body awareness)

58 OM chanting

59 Closing Prayer

# Certificate of Plagiarism (iThenticate)

## INFLUENCE OF YOGIC PRACTICES ON PATIENTS WITH ANKYLOSING SPONDYLITIS

ORIGINALITY REPORT

1%
SIMILARITY INDEX

PRIMARY SOURCES

| | | |
|---|---|---|
| 1 | worldnaturopathicfederation.org<br>Internet | 178 words — < 1% |
| 2 | Joanna Leaviss, Sarah Davis, Shijie Ren, Jean Hamilton et al. "Behavioural modification interventions for medically unexplained symptoms in primary care: systematic reviews and economic evaluation", Health Technology Assessment, 2020<br>Crossref | 92 words — < 1% |
| 3 | Heather Wilson-Robles, Jason Terrell, Theresa Kathleen Kelly, Tasha Miller, Bygott Thomas, Bougoussa Mhammed, Jill Jarvis. "Characterizing Circulating Nucleosomes in the Plasma of Dogs with Hemangiosarcoma", Research Square, 2021<br>Crossref Posted Content | 44 words — < 1% |
| 4 | zenodo.org<br>Internet | 44 words — < 1% |
| 5 | event.ners.unair.ac.id<br>Internet | 42 words — < 1% |
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| 7 | www.physio-pedia.com<br>Internet | 35 words — < 1% |

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| 8 | worldwidescience.org<br>Internet | 34 words — < 1% |
| 9 | www.researchgate.net<br>Internet | 21 words — < 1% |
| 10 | David Kusmawan. "Salivary Alpha-Amylase (sAA) Concentration Related to Fatigue Biomarkers in Palm Oil Offiffice Workers in Jambi Province: Preliminary Study", Research Square Platform LLC, 2022<br>Crossref Posted Content | 17 words — < 1% |
| 11 | S., Shah Lajja. "A Comparative Study Between Yogic Exercises and Hydrotherapeutic Exercises as a Home Therapyprogramme for Patients with Chronic Low Back Pain", Rajiv Gandhi University of Health Sciences (India), 2023<br>ProQuest | 16 words — < 1% |
| 12 | "2013 Annual Meeting Abstract Supplement", Arthritis & Rheumatism, 2013.<br>Crossref | 15 words — < 1% |
| 13 | Yasemin Acar, Nursen Ilçin, İsmail Sarı. "The Effects of Tele-Yoga in Ankylosing Spondylitis Patients: A Randomized Controlled Trial", Journal of Integrative and Complementary Medicine, 2023<br>Crossref | 15 words — < 1% |
| 14 | www.ijhpecss.org<br>Internet | 15 words — < 1% |
| 15 | "Abstract Supplement 2018 ACR/ARHP Annual Meeting", Arthritis & Rheumatology, 2018<br>Crossref | 14 words — < 1% |

16 Awasthi, Arti. "Effect of Comprehensive Yogic Practices on Academic Stress, Examination Anxiety, Concentration and Memory of College Students.", Devi Ahilya Vishwavidyalaya, 2019
ProQuest
14 words — < 1%

17 B. Pravalika, U. Yamuna, Apar Avinash Saoji. "Effect of Yoga on musculoskeletal pain and discomfort, perceived stress, and quality of sleep in industrial workers: Study protocol for a randomized controlled trial", Advances in Integrative Medicine, 2022
Crossref
14 words — < 1%

18 Perpetuo, Ines Pedro. "Differences in Osteoclast Activity Between Rheumatoid Arthritis and Ankylosing Spondylitis", Universidade de Lisboa (Portugal), 2021
ProQuest
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19 Tripathi, Shyam Kumar. "A Comparative Study on Short Wave Diathermy with Conventional Exercises Versus Short Wave Diathermy with Yoga Exercises in Chronic Low Back Pain", Rajiv Gandhi University of Health Sciences (India), 2023
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14 words — < 1%

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