

**DEVELOPMENT AND VALIDATION OF A YOGA MODULE
IN PATIENTS WITH ANKYLOSING SPONDYLITIS**

**A THESIS SUBMITTED TO THE JADAVPUR UNIVERSITY FOR THE DEGREE
OF DOCTOR OF PHILOSOPHY IN ARTS**

By

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Dedicated to My Parents

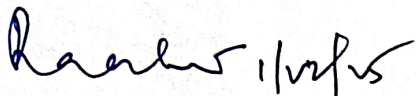
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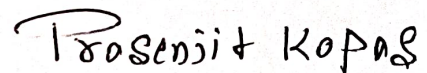
“DEVELOPMENT AND VALIDATION OF A YOGA MODULE IN PATIENTS WITH ANKYLOSING SPONDYLITIS” submitted by me for the award of the Degree of Doctor of Philosophy in Arts at Jadavpur University is based upon my work carried out under the Supervision of Dr. Asish Paul, Professor, Department of Physical Education, Jadavpur University & Dr. Pradyot Sinhamahapatra, Associate Professor, Department of Clinical Immunology and Rheumatology, Institute of Postgraduate Medical Education & Research, Kolkata (IPGME&R, SSKM) And that neither this thesis nor any part of it has been submitted before for any degree or diploma anywhere / elsewhere.



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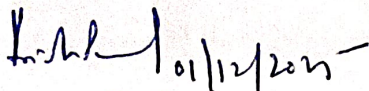
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LIST OF ABBREVIATION

SpA	Spondyloarthritis
AS	Ankylosing spondylitis
SIJ	Sacroiliac Joint
HLA B27	Human leukocyte antigen B27
BASDAI	Bath Ankylosing Spondylitis Disease Activity Index
BASFI	Bath Ankylosing Spondylitis Functional Index
BASMI	Bath Ankylosing Spondylitis Metrology Index
NSAID	Non-steroidal anti-inflammatory drugs
bDMARD	Biological disease modifying anti-rheumatic drugs
TNF-alpha	Tumour Necrosis Factor alpha
TNFi	Tumour necrosis factor inhibitor
ELISA	Enzyme-linked immunoassay
BMI	Body Mass Index
kg/m ²	Kilogram Per Square Meter
CRP	C-Reactive Protein
CBC	Complete blood count
CVR	Content validity ratio
ESR	Erythrocyte sedimentation rate
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
FABQ	Fear-Avoidance Belief Questionnaire
FABQ-PA	Fear-Avoidance Belief Questionnaire in physical activity
FABQ-WA	Fear Avoidance Belief Questionnaire in Work Activity
HAM-D or HDRS	Hamilton Depression Rating Scale
PCS	Pain Catastrophizing Scale
HRQoL	HRQoL Health Related Quality of Life
SF-36	Short Form -36

DEVELOPMENT AND VALIDATION OF A YOGA MODULE IN PATIENTS WITH ANKYLOSING SPONDYLITIS

Chapter-I INTRODUCTION

- 1.1 General Introduction
- 1.2 Pathophysiology of Ankylosing Spondylitis
- 1.3 International status of Ankylosing spondylitis
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Chapter-I

1. Introduction

1.1 General Introduction:

Low back pain is a common condition originated due to myofascial pain, facet joint pain, discogenic pain, spinal stenosis, and failed back surgery.^{1,2} Nearly 80% adults experiences lower back pain at some point in their lives.³ It can range from mild to severe and may be acute (short-term) or chronic (lasting for three months or longer).^{4,5} Globally, 619 million persons suffered from low back pain (LBP) in 2020; by 2050, cases are expected to rise to 843 million, primarily due to aging and population growth.⁶ Low back pain can have various causes, including muscle strain or sprain, poor posture, overuse or injury, degenerative conditions such as osteoarthritis or degenerative disc disease, herniated or bulging discs, spinal stenosis (narrowing of the spinal canal), sciatica (compression of the sciatic nerve), and other underlying medical conditions.^{2,7,8,9,10,11} Depending on the cause, LBP can be categorized into different groups: 80% to 90% of the cases are mechanical (such as degenerative disk or joint disease, vertebral fracture, deformity); 5% to 15% are neurogenic (such as herniated disk, spinal stenosis); 1% to 2% are nonmechanical conditions (such as neoplastic disease, infection, inflammatory); 1% to 2% are referred visceral pain cases (such as gastrointestinal, renal, or abdominal aortic aneurysm); and 2% to 4% are other (such as fibromyalgia, somatoform disorder, or malingering).¹² According to Global Burden of Disease 2010, out of 291 conditions, low back pain ranked highest in terms of disability.¹³

Ankylosing Spondylitis (AS), a spondyloarthropathy,¹⁴ is a chronic, painful and progressive inflammatory rheumatic condition characterised by stiffness and pain in rib, shoulder, neck, hip and others part of the body, worse in the morning or after rest.^{15,16,17,18,19} A gradual kyphotic deformity of the spine may develop in persons with Ankylosing Spondylitis.²⁰ In early stages of AS, erosive changes occurred in the vertebral bodies.²¹ Due to chronic inflammation the disease progresses to cause complete vertebral column calcification and fusion known as bamboo spine.^{22,23} Bamboo spine progresses through cytokine-mediated ossification together with abnormal bone remodelling and syndeamophytes formation which results in complete fusion and rigidity causing serious mobility limitations and life quality reduction.^{24,25,26}

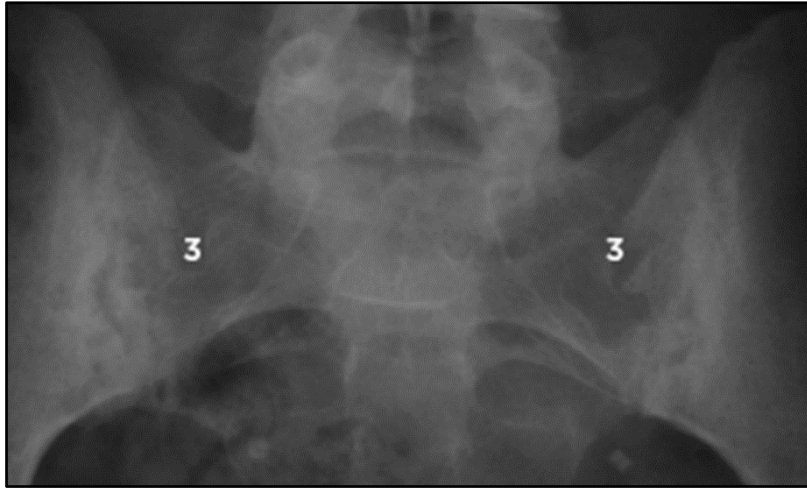


Photo. no. 1: Bilateral sacroiliitis on X-ray ¹⁶

Ankylosing spondylitis (AS) can occur at different stages of life, classified as juvenile-onset AS at or before 16 years of age, adult-onset AS between 16 and 40 years, and late-onset AS at or after 40 years.²⁷ According to Aggarwal & Malaviya (2009), disease outcomes and clinical presentations demonstrate differences when comparing various patient age groups.²⁸ The onset age of Ankylosing Spondylitis (AS) is markedly affected by both sex and HLA-B27 status.²⁷ Prevalence rate of Ankylosing Spondylitis is more in male than female, the ratio about 2:1²⁹ to 3:1. Disease characteristics, sign and symptoms are heterogeneous for the patients with Ankylosing Spondylitis.¹⁴ Approximately 80% of individuals exhibit initial symptoms of AS before the age of 30, whereas fewer than 5% present beyond the age of 45.³⁰

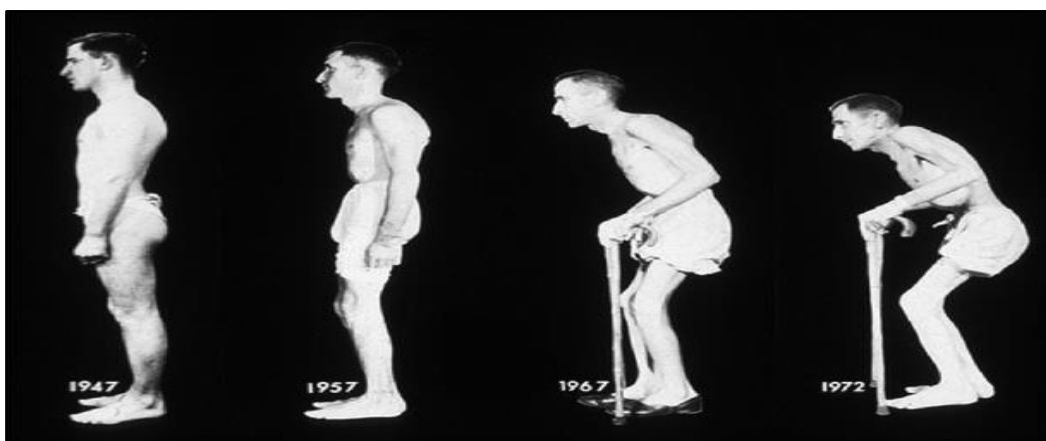


Photo. no. 2: Ankylosing Spondylitis: progression of deformities of 26 years of a patients³¹

Ankylosing Spondylitis is a prototype of spondyloarthritis (SpA).³² Spondyloarthritis (SpA) is classified into Axial spondyloarthritis (axSpA) and Peripheral spondyloarthritis (pSpA).³³ Furthermore axial spondyloarthritis (axSpA) divided into two categories one Radiographic axSpA and Non -Radiographic axSpA. Ankylosing Spondylitis comes under axial spondyloarthritis (axSpA)³⁴ with the presence of structural damage in sacroiliac joint (SIJ), visible on conventional radiography (CR), so-called radiographic axSpA (r-axSpA). Patients with chronic low back pain who have not developed such structural damage on SIJ define the non-radiographic (nr)-axSpA group.³⁵ Reactive arthritis (ReA), Inflammatory bowel disease (IBD), Uveitis, psoriatic arthritis (PsA), Undifferentiated spondyloarthritis are the types of disease in Peripheral spondyloarthritis (pSpA).³⁶ Human leukocyte antigen (HLA) B27 gene is the common genetic predisposition for SpA group of disease though this strong association varies significantly among different SpA subtypes and diverse ethnic populations.³⁷ The prevalence of HLA-B27 differs among various ethnic groups.³⁸ HLA B27 is predominantly found in northern regions and certain tribes, with prevalence rates reaching up to 50%, particularly among Eskimo populations and Haida Indians.³⁹ Early diagnosis of Ankylosing Spondylitis helps to enables treatment before permanent immobility and abnormality, allows detection of the early changes in spinal position and therefore prevention of abnormal postures.⁴⁰

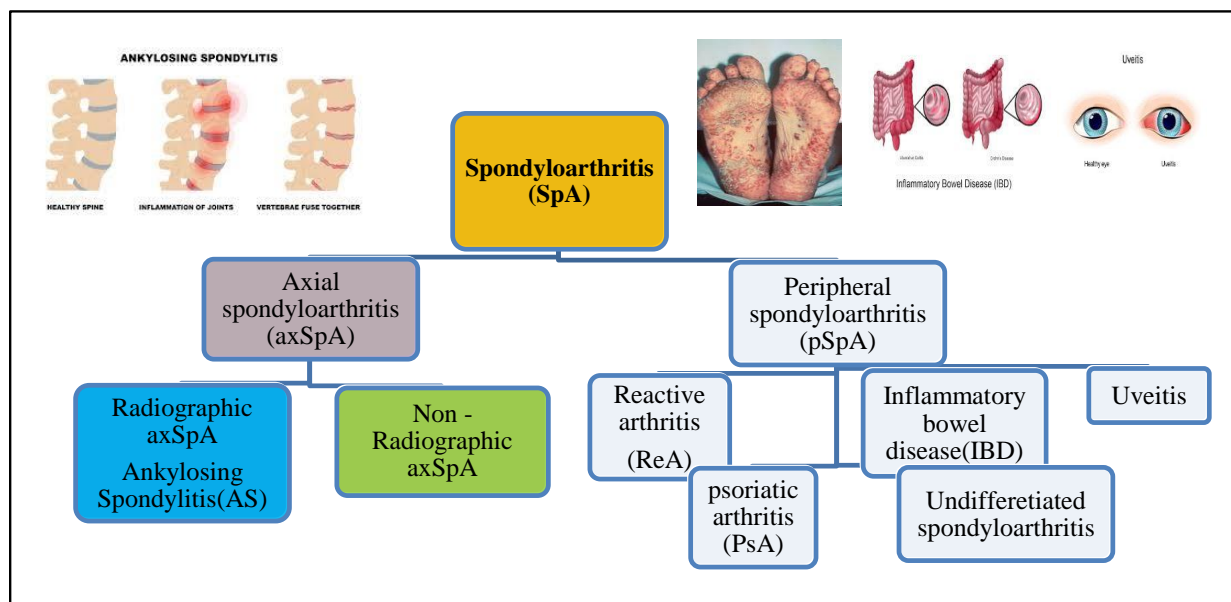


Photo. no. 3: Spondyloarthritis (SpA) family of diseases (self-illustrated)

1.2 Pathophysiology of Ankylosing Spondylitis:

The specific mechanism of Ankylosing Spondylitis remains unelucidated,³⁹ studies in immunogenetics and molecular biology have recently shed light on critical mechanisms of disease. The complex pathogenesis of Ankylosing Spondylitis relies on an interplay of multiple factors, including inherited genetic traits,⁴¹ immune dysregulation,⁴² and external environmental triggers.⁴³ AS is a chronic immune-mediated inflammatory arthritis^{44,45} with symptoms of inflammatory spinal pain and spinal immobility. Enthesis is the first stage of Ankylosing Spondylitis, where ligaments, tendons and capsules attach to bones, eventually leading to pathological new bone formation and the hallmark spinal rigidity. Enthesitis, or inflammation of the ligament and tendon, results in the erosion of bone at the site of attachment.²¹

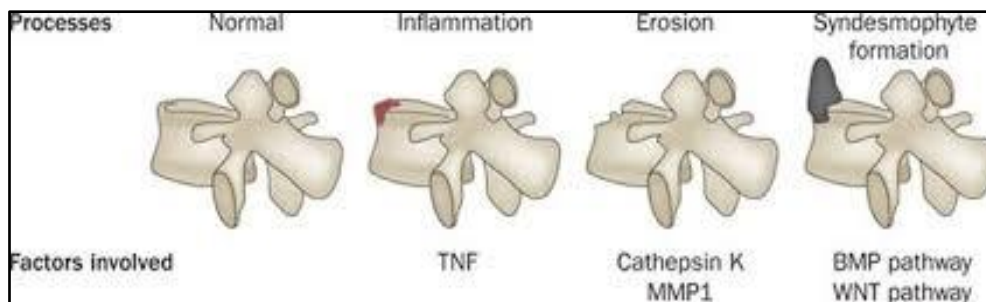


Photo. no. 4: Pathology of Entheses in Ankylosing Spondylitis²¹

The most polymorphic proteins is Human leukocyte antigens (HLA) which genetically positioned on chromosome 6, constitute the human major histocompatibility complex (MHC).⁴⁶ Approximately 90-95% patients with Ankylosing Spondylitis have carry HLA B27 gene.^{47,48} The most prominent genetic factor in AS is HLA-B27,⁴⁶ recent studies has also implicated others genes like ERAP1, IL-23R, ANTXR2, and IL-1R2 in the disease process²¹. The mechanism of association between HLA B27 and Ankylosing Spondylitis(AS) still unknown.⁴⁹ Currently more than 100 subtypes of HLA-B27 identified.⁴⁶ HLA-B*2705, B*2702, B*2704, and B*2707 are common subtypes associated with AS.⁵⁰ Several hypothesis have been proposed on the pathogenesis of HLA-B27 and AS, but particularly which HLA B27 gene contributes for the disease is under investigation.⁵¹

HLA B27 is class I MHC that interacts with CD8+Tcells, this interaction plays a central role in autoimmune response such condition observed in Ankylosing Spondylitis.^{52,53} The molecular propensity for distinctive articular site involvement remains under

investigation for the association of HLA B27 and Ankylosing Spondylitis. The damage is caused by immune cells such as CD4+, CD8+, and natural killer cells, which vary greatly across different sites. Biomechanical stressors can cause this disease by exposing the body to autoantigens that were previously immune-sequestered or allowing microorganisms to spread. Infection, for example, may be a major pathogenic step in a molecular-mimicry process, albeit this has not been definitively demonstrated.⁵⁴

The immune system regulates immune responses and inflammation by various cells, secreted-mediators and molecular markers. Th1 cells, a subset of CD4+ T cells, release cytokines such as IFN- γ , IL2, and TNF- α to activate other immune cells and contribute to immunological responses.⁵⁵ The decrease plasma 25(OH)D3 levels negatively influence the disease activity, functional status and quality of life in AS patients.⁵⁶

Cytokines, particularly tumor necrosis factor- α (TNF- α) and transforming growth factor- β (TGF- β), play a crucial role in the inflammatory process. They contribute to inflammation, fibrosis, and ossification at sites affected by enthesitis.²⁴ In a study Fang et al.,(2023) reported that beta-nerve growth factor (bNGF), Interleukin-1-beta (IL-1b), and TNF-related apoptosis inducing ligand (TRAIL) may play a crucial role in the pathogenesis of Ankylosing Spondylitis.⁵⁷ Emerging evidence suggest that intestinal dysbiosis plays significant role in the onset and development of AS.⁵⁸

In a study Hmamouchi et al., (2013) reported high incidence of vitamin D deficiency in male AS patients which indirectly lead to osteoporosis by causing an increase in the inflammatory activity.⁵⁹

1.3 International status of Ankylosing Spondylitis:

Different geographic locations along with distinct ethnic groups and population samples result in wide variation of Ankylosing Spondylitis prevalence rates.^{60,61} There are an estimated 1.30 - 1.56 million cases of AS in Europe and 4.63-4.98 million in Asia.²⁹ In an epidemiological study by Mahakkanukrauh et al., (2024) among the Tai population, reported that the prevalence rate of AS is 20.4 per 100,000 populations in 2017.⁶² On the basis of European data it is estimated that prevalence of Ankylosing Spondylitis ranges from 0.1% to 1.4%, where as it is 0.3–0.5% in Mid-Europe.³⁹

1.4 National status of Ankylosing Spondylitis:

There is limited epidemiological data on spondyloarthritis (SpA) as well as Ankylosing Spondylitis (AS) in India. According to the first Indian survey on burden of rheumatic-musculoskeletal symptoms/disorders (RMS) in rural Community under WHO-ILAR(World Health Organization - International League of Associations of Rheumatology) Community Oriented Program from Control of Rheumatic Diseases (COPCORD)⁶³ one study estimated that prevalence rate of the SpA in India about 0.17–0.34%.⁶⁴ A research study published in the Indian Journal of Rheumatology found that prevalence rate of Ankylosing Spondylitis (AS) in India ranges from 0.7 to 1.0 per 1,000 people⁶⁵ while global estimates stand at 1.5 per 1,000 people according to Gabriel & Michaud, 2009.⁶⁶ The prevalence of Ankylosing Spondylitis (AS) reaches approximately 1% among young adults in India as reported by Nokhla in 2021.⁶⁷

1.5 Mortality in Ankylosing Spondylitis:

The predominant extra-articular signs of Ankylosing Spondylitis include uveitis, gastrointestinal sickness, and involvement of the heart, lungs, skin, bones, and kidneys. Osteoporosis is very much common in patients with Ankylosing Spondylitis.⁶⁸ Primarily the cardiovascular disease affects the mortality among the patients with AS, mirroring trends in the general population. Dyslipidemia and early endothelial dysfunction is accountable for cardiovascular mortality in AS patients. Others factor like renal and gastrointestinal disease, vertebral fractures and dislocations, pulmonary disease, injuries also causes of death in AS. Research evidence reported that treatment-related options like surgery for spinal deformities, hip surgery, spinal radiotherapy, radium-224 are associated with the causes of death in AS patients.⁶⁹ Even after adjusting for age, sex, and baseline comorbidities, the mortality risk was still greater for AS patients than for the general population.⁷⁰ Significant geographical disparities found in mortality of SpA across the world.⁷¹

1.6 Auto-immunity and Ankylosing Spondylitis:

Immunity is the body's ability to protect itself from foreign invaders such as pathogens and harmful substances.⁷² The human immune system comprises two primary types of immunity: innate immunity and adaptive (or acquired) immunity. Innate immunity serves as the body's first line of defence and is characterized by its rapid, non-specific response to pathogens. This form of immunity is present from birth and provides immediate

protection against a broad range of foreign invaders. In contrast, adaptive immunity is highly specific and develops over time through exposure to pathogens or through vaccination. It involves a more targeted response, including immunological memory, which allows for a faster and more effective response upon subsequent exposures.⁷³

Ankylosing Spondylitis is an autoimmune disorder, where the body's immune system by mistake attacks and destroys the healthy body tissue.⁴² The exact cause of autoimmune disorders is unknown. One theory is that some microorganisms (such as bacteria or viruses) or drugs may trigger changes that confuse the immune system. This may happen more often in people who have genes that make them more prone to autoimmune disorders.

In the pathogenesis of Ankylosing Spondylitis dysregulation of the innate immune system plays a significant role. Emerging evidence suggest that in an innate immune cells, such as macrophages, dendritic cells and innate lymphocytes cells, contribute to the inflammatory process observed in AS.^{74,75} Genetic association - particularly with the HLA B27 allele - also point toward abnormalities in innate immune signalling pathways, which may lead to inappropriate activation of inflammatory responses and contribute to disease development and progression.⁷⁶

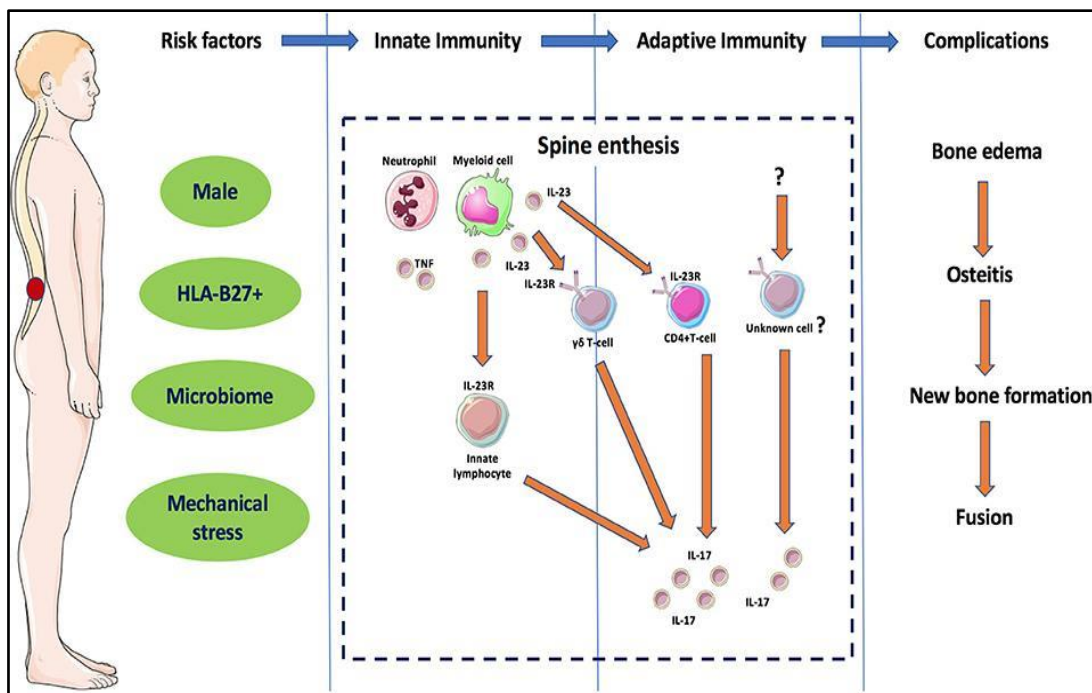


Photo. no. 5: Different phases of the immunopathogenesis of AS⁷⁷

1.7 Bio-psycho-social model of Disease (Ankylosing Spondylitis):

Bio-psycho-social model of Ankylosing Spondylitis provides a comprehensive framework to understanding the disease condition just beyond the biological symptoms. It incorporates biological, psychological and social dimensions that interact to influence the individual's experience, progression of disease and outcomes.^{78,79}

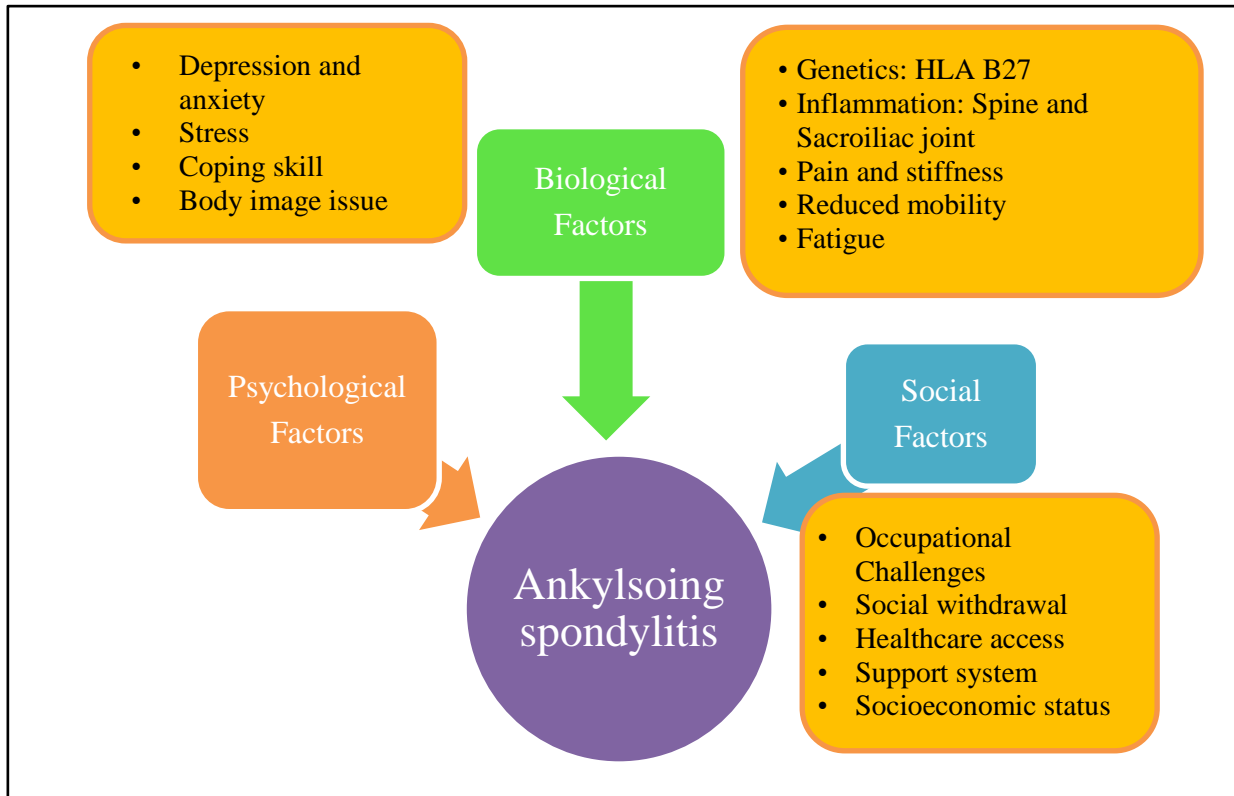


Photo. no. 6: Bio-psycho-social profile of Ankylosing Spondylitis (self-illustrated)

Ankylosing Spondylitis has strong genetic association. Most of the patients with Ankylosing Spondylitis have a chance to carry the HLA-B27 gene. Chronic inflammation of the axial skeleton, particularly the sacroiliac joint and spine, is very common for AS.⁸⁰ Stiffness and pain, especially in the lower back, worsen in the morning. In advanced stages of the disease, progressive spinal fusion leads to reduced mobility and function. Various comorbidities are like hitting inflammatory bowel disease (IBD). Cardiac muscular risk is common for patients with Ankylosing Spondylitis.⁸¹

Mental and emotional responses of the patient reflect the psychological symptoms of the patients. Chronic pain leading to depression anxiety and low mood. Cognitive disturbances like catastrophizing pain or fearing movement (kinesiophobia) is observed in AS patients. Due to pain and stiffness mood changes and sleep disturbances happened

subsequently in the AS patient. Living with a chronic condition can affect the self-esteem and body image of the patients.⁸²

Quality of life is totally hampered for the patients with Ankylosing Spondylitis. Physical restriction effects in work limitation are due to reduced ability to perform certain occupational jobs. Social support plays a significant role for quick disease recovery in AS.⁸³ Differences in healthcare availability affordability and quality may bring different results in the patients. Participation in exercise, yoga, swimming and social life can be limited but also therapeutic if encouraged.

1.8 Management of Ankylosing Spondylitis:

The management of Ankylosing Spondylitis focuses on maintaining spinal mobility and good posture, reducing inflammation, relieving symptoms and preventing long term complication. A multi-disciplinary approach is typically used combining medical treatment with lifestyle and physical therapy strategies for management of AS.^{84,85}

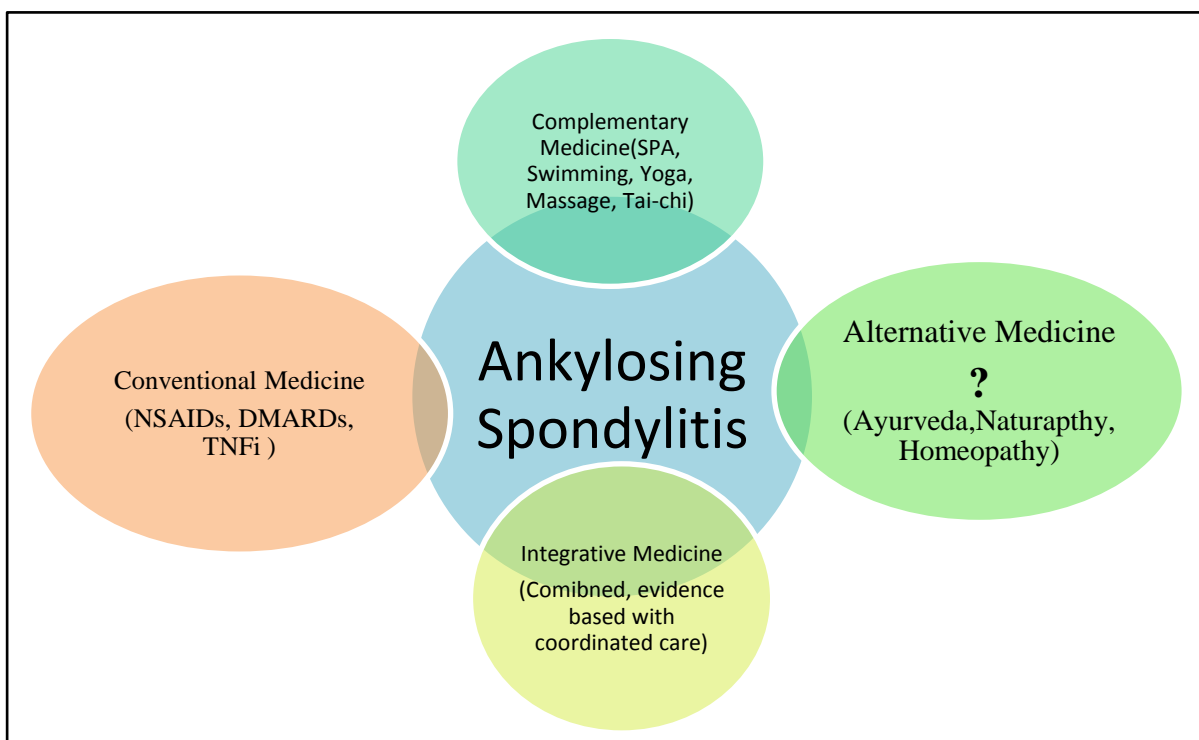


Photo. no. 7: Various kinds of treatment modalities of AS (self-illustrated)

In the modern era various concept of treatment modalities going on, objectives is similar for all i.e. quick recovery from the disease. Conventional medicine includes medication and physiotherapy, if required. Complementary medicine is used together with conventional treatments whereas alternative medicine is used instead of conventional

medicine. Integrative medicine brings conventional and complementary approaches together in a coordinated way.⁸⁶

1.8.1 Pharmacological management of Ankylosing Spondylitis:

According to American college of Rheumatology first-line medication therapy involves for symptom relief for the patients with axial Spondyloarthritis (axSpA) are non-steroidal anti-inflammatory drugs (NSAIDs). For localized joint swelling, corticosteroid injections into the joint or tendon sheath are quickly effective. If NSAIDs do not provide adequate relief, disease-modifying antirheumatic drugs (DMARDs) may be used to relieve symptoms and prevent joint damage. Medications will be advised based on the areas which are affected, such as spine, tendons or eyes. Some important medications to treat axial spondyloarthritis include methotrexate, sulfasalazine, anti-TNF alpha medications (such as adalimumab, etanercept), anti-IL17 medications (secukinumab, ixikimumab) and many others. Oral corticosteroids are not recommended. Spinal surgery is rarely needed.⁸⁷

In the year 2019 the American College of Rheumatology/ Spondylitis Association of America/ Spondyloarthritis Research and Treatment Network (ACR/SAA/SPARTAN) provided additional guidelines for the treatment of Ankylosing Spondylitis and Non-radiographic Axial Spondyloarthritis, which explored new treatment options, notably secukinumab, ixekizumab, tofacitinib, and TNFi biosimilars, for patients with axSpA. NSAIDs and TNFi remain the primary classes of medications for the treatment of AS and nr-axSpA. They recommended Secukinumab or ixekizumab is for patients with active disease who have heart failure or demyelinating disease as a contraindication to TNFi, and in primary non-responders to TNFi. For the patients with IBD or recurrent uveitis, secukinumab and ixekizumab are not recommended, as TNFi monoclonals are better options. In this update they strong suggested Tofacitinib is potential second-line option for patients with contraindications to TNFi other than infections.⁸⁸

1.8.2 Non-Pharmacological treatment for Ankylosing Spondylitis:

Due to the high cost of medication, most of the patients with Ankylosing Spondylitis struggle to afford long-term treatment, especially when biologics are prescribed.^{89,90} This economic burden often extended to their family; as a result, most of the patients may delay or discontinue treatment, which can worsen their condition over overtime. Besides the conventional therapeutic treatment for Ankylosing Spondylitis, like non-steroidal anti-

inflammatory drugs (NSAIDs), DMARDs (Disease-Modifying antirheumatic drugs), and biologic agents, non-pharmacological management is considered the essential complementary treatment for AS.⁹¹ To enhance health-related quality of life, lowering inflammation and preserving optimal functional status strategic necessitates is combination of pharmaceutical and non-pharmacological treatment modalities, including education, exercise, and physiotherapy.⁹² The multimodal approach of exercise intervention, like aerobic exercises, strength training, and flexibility exercises, and tailored exercise with relaxation techniques and mindfulness helps to improve the mobility, quality of life, alleviate pain; reduce the psychological challenges; and improve their overall well-being.⁹³ Regular home-based exercise, which is low-priced and easily applicable, helps the patients to improve pulmonary functions and quality of life.⁹⁴ Systematic exercise program, whether it is home based or supervised, have demonstrated positive effects on disease activity score, pain level and functional capacity.⁹⁵



Photo. no. 8: Complementary treatment options for Ankylosing Spondylitis (self-illustrated)

1.8.2.1 Spa therapy:

Spa therapy comprises complementary and alternative methods that include balneotherapy, hydrotherapy, exercise, and massage.⁹⁶ One study assessed the effectiveness of spa therapy on 224 patients of chronic low back pain with standard medication and confirmed the effectiveness of spa therapy for such treatment.⁹⁷

1.8.2.2 Balneotherapy:

The terms “balneotherapy” and “spa therapy” refer to bathing in mineral water for health purposes and related techniques such as mud packs. Balneotherapy may be helpful for some cases of fibromyalgia and for developing the standard of living in people with rheumatoid arthritis.^{98, 99}

1.8.2.3 Physical Therapy:

Physiotherapy, also known as physical therapy, offers treatment to individuals to facilitate the development, maintenance, and restoration of optimal movement and physical function⁹². Physical therapy includes various modalities such as - exercise, heat, cold, electrotherapy, hands on technique (massage, spinal manipulation, myofascial release), traction (for cervical and lumbar) etc.¹⁰⁰

1.8.2.4 Chiropractic Therapy:

Spinal manipulation is a practice in which chiropractors or other health professionals use their hands or a device to apply a controlled force to a joint of the spine. To decreasing the pain level and increase the joint mobility in patients with AS chiropractic manipulative therapy may be an effective treatment option.¹⁰¹

1.8.2.5 Pilates:

The Pilates therapy regimen concentrated on a sequence of targeted movements designed to improve lumbo-pelvic control.¹⁰² Pilates body conditioning method, uses a combination of approximately 500 stretching and strengthening exercises to create muscular exertion. One randomized, controlled single-blind trial study reported that pilates is as an effective and safe method to improve physical capacity in AS patients.¹⁰³

1.8.2.6 Tai Chi:

Tai chi and qigong are practices that originated in China. Qigong has both psychological and physical components and involves the regulation of the mind, breath, and the body's movements and posture. Tai chi originated as an ancient martial art. Tai chi is considered a form of qigong and involves a combination of physical postures, focused attention, and controlled breathing.¹⁰⁴

1.8.2.7 Massage:

Massage is one of the oldest forms of therapeutic tools that people used to try to relieve pain. Over the centuries it has been practiced in most cultures, both Eastern and Western. There are many massage techniques, but in general the purpose involves manipulating the soft tissues to stimulate the circulation and the nervous system's response with the goal of helping to manage a health condition or enhance wellness.¹⁰⁵

1.8.2.8 Swimming:

Aquatic exercise like swimming is very important therapeutic modalities for Ankylosing Spondylitis patients to increase the spinal mobility, quality of life etc. Dundar et al., (2014) conducted a comparison study indicating that water-based exercises resulted in superior enhancements in quality of life and decrease pain scores for individuals with Ankylosing Spondylitis compared to home-based exercises.¹⁰⁶

1.8.2.9 Lifestyle Management:

Lifestyle management play crucial role in delaying the progression of Ankylosing Spondylitis. Lifestyle management like- regular exercise, proper posture, balanced nutrition, stress reduction, smoking cessation is essential for minimizing its long term complications.¹⁰⁷

1.8.2.10 Acupuncture:

Acupuncture is a medical procedure whereby practitioners apply tiny needles to the skin to address health issues. Electroacupuncture involves using small electrical currents to stimulate the needles, which can also be manipulated manually. Acupuncture, which originated from traditional Chinese medicine, has gained global appeal since the 1970s. Warm acupuncture, a traditional Chinese therapy, is widely used to treat Ankylosing Spondylitis due to its safety, cost-effectiveness, and reduced side effects.¹⁰⁸

1.8.2.11 Relaxation Techniques:

Relaxation techniques include progressive relaxation, guided imagery, biofeedback-assisted relaxation, and deep breathing exercises. The goal of these techniques is to produce the body's natural relaxation response, with slower breathing, lower blood pressure, and a feeling of calm and well-being.¹⁰⁹

1.8.2.12 Yoga:

Yoga is an ancient and complex practice, rooted in Indian philosophy. It began as a spiritual practice and has also become popular as a way of promoting physical and mental well-being. In India yoga offered as an alternative or complementary medicine in many mainstream clinics and hospitals.¹¹⁰

1.9 What is YOGA?

The term 'Yoga' in the Rig Veda derived from the Sanskrit root word 'Yuj' meaning to Yoke, unit or join. Yoga is a vast discipline aims to purifying the mind and spiritual progress.¹¹¹ Yoga is an ancient Indian way of life purpose to integrating the body, mind and spirit to achieve state of self-realization. It is a multidisciplinary holistic practice that combines physical postures, rhythmic breathing, meditation and ethnic principles. Yoga is usually defined as a union between the Individual self and the Supreme Self. There is innumerable definition of yoga stated in various Hindu text based on the level of existence and evolution of consciousness.

1.9.1 Definition of Yoga according to Patanjali Yoga sutra:

अथ योगानुशासनम् ॥ १.१ ॥
atha yogānuśāsanam ||1.1||

atha = now yoga = process of yoking; union ānuśāsanam = teaching, exposition
“Now, the teaching of yoga.” yoga is a form of discipline.

योगश्चित्तवृत्तिनिरोधः ॥ १.२ ॥
Yogaś citta-vṛtti-nirodhaḥ ||1.2||

yogaī = process of yoking; union citta = consciousness vṛtti = patterning, turnings, movements nirodhaī = stilling, cessation, restriction

“Yoga is the cessation of the fluctuations of the mind.”

1.9.2 Definition of Yoga according to Bhagvad Gita:

Two of the important definition of yoga according to “Bhagvad Gita”, an important text book of yoga, stated below:

योगस्थः कुरु कर्माणि सङ्गं त्यक्त्वा धनञ्जय।
सिद्ध्यसिद्ध्योः समो भूत्वा समत्वं योग उच्यते ॥२.४८॥
yogasthah kuru karmani sangam tyaktwaa dhananjaya
siddhyasiddhyoh samo bhootwaa samatwam yoga uchyate || 2.48 ||

Do your duty without attachment—equanimity is yoga.

बुद्धियुक्तो जहातीह उभे सुकृतदुष्कृते।
तस्माद्योगाय युज्यस्व योगः कर्मसु कौशलम् ॥ २.५० ॥
buddhiyukto jahaateeha ubhe sukrita dushkrite
tasmaad yogaaya yujyaswa yogah karmasu kaushalam || 2.50 ||

Yoga is skill in action

1.9.3 Definition of Yoga according to Katha Upanishad:

तां योगमिति मन्यन्ते स्थिरामिन्द्रियधारणाम् ।
अप्रमत्तस्तदा भवति योगो हि प्रभवाप्ययौ ॥ २.३.११ ॥
tam yogamiti manyante sthiramindriyadharanam
apramattastada bhavati yogo hi prabhavapyayo || 2.3.11 ||

Yoga is said to be the steady holding of the senses.

1.9.4 Definition of Yoga according to Yoga Vasishtha:

मनःप्रशमन उपायःयोग इत्यभिधीयते ! (यो.व.३-९-३२)
Manah prashamanopayah yoga ityabhidhiyate || 3.9.32 ||

Yoga is said to be a remedy for calming the mind

1.10 Brief History of Yoga:

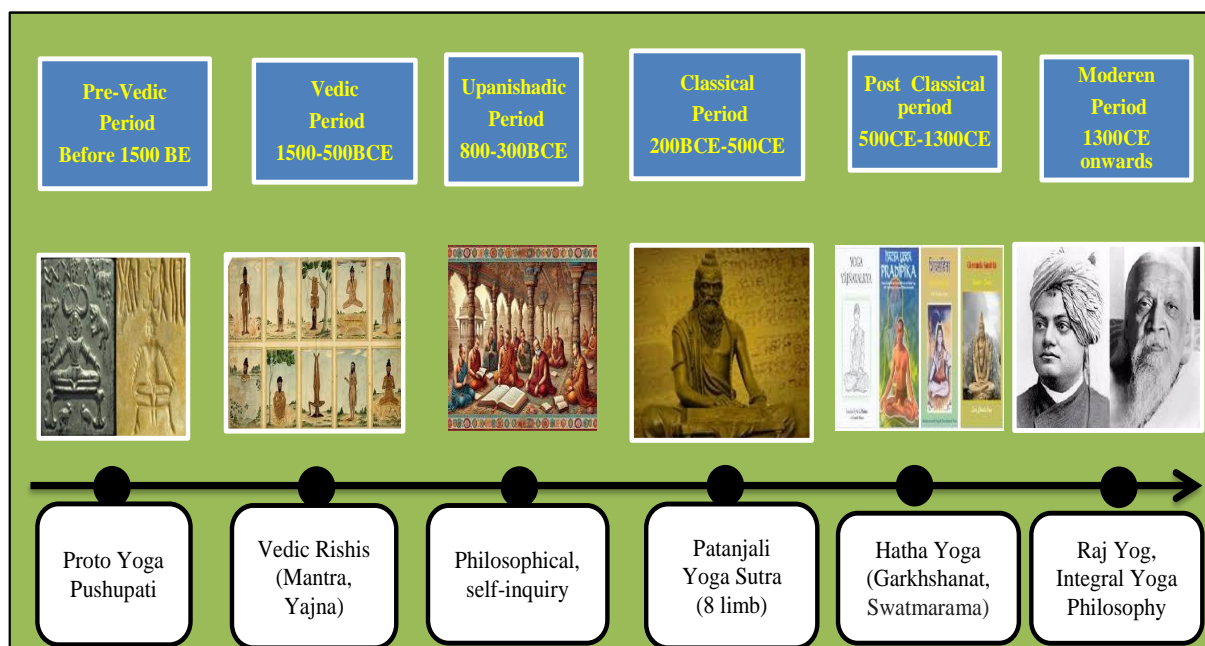


Photo. no. 9: Historical development of yoga from pre-vedic to modern period (Self illustrated)

Yoga is a pre-Vedic science - mind body practice and path of wisdom, originated in ancient India over 5000 years ago.¹¹² Traditional Yoga practices trace their origin back to the Indus Valley Civilization and have been the integral part of Vedic & Upanishad heritage, as well as Buddhist and Jain Traditions.¹¹³ Conceptual seeds of yoga found in 'Rig Veda', though the structural and formal systems as stated in 'Patanjali Yoga Sutra' not outline in Rig Veda; it emphasizes discipline, focus and meditation (dhyana). Yoga is deeply rooted in Indian philosophy i.e. Sankhya philosophy. The eight limbs of yoga which stated in Patanjali Yoga Sutra are Yama (ethical restraints), Niyama (personal observances), Asana (physical postures), Pranayama (breath control), Pratyahara (withdrawal of senses), Dhrana (concentration), Dhyana (meditation), Samadhi (state of absorption or enlightenment).

1.11 Traditional yogic practices according to classical yogic texts:

In India, several classical Hindu texts like: Hatha Yog pradipika (Asan, mudra), Ghirenda samhita (Asan, mudra), Shib samhita, Hatha ratnabali, Basistha samhita, Hatha yog samhita, Gorakhsa padhati, Yog Tarabali offered both theoretical and practical knowledge on non-invasive, holistic strategies to disease management. Various yogic practices, including Asana, Pranayama, Mudra, Bandha, Kriya and other techniques described in the traditional

Hatha yogic text, collectively contribute to promoting physical, mental, and spiritual well-being in human life.

One of the most traditional and classical yogic texts, Patanjali's Yoga Sutra, highlights several key techniques for healing. Among these, Yama (moral disciplines) and Niyama (personal observances) form the ethical and psychological foundation for balanced living by cultivating emotional stability, mental clarity, and inner discipline. Patanjali further emphasizes āsana and prāṇāyāma, which help strengthen the body and regulate the breath for balanced physiological functioning. Additionally, pratyāhāra (withdrawal of the senses), dhāraṇā (focused concentration), and dhyāna (meditation) are highlighted as powerful tools for restoring mental calmness, emotional equilibrium, and deep inner harmony. Together, these eightfold practices integrate behavior, body, breath, and mind, supporting a comprehensive healing process and promoting holistic well-being.

अहिंसासत्यास्तेयब्रह्मचर्यापरिग्रहा यमाः ॥ २. ३० ॥

Ahimsā-satya-asteya-brahmacarya-aparigrahāḥ yamāḥ ||2.30||

Non-violence, truthfulness, non-stealing, continence, and non-possessiveness are the Yamas.

शौचसन्तोषतपःस्वाध्यायेश्वरप्रणिधानानि नियमाः ॥ २. ३२ ॥

Śauca-santoṣa-tapaḥ-svādhyāya-īśvara-praṇidhānāni niyamāḥ. ||2.32||

Purity, contentment, austerity, self-study, and surrender to Īśvara are the Niyamas.

स्थिरसुखम् आसनम् ॥ २.४६ ॥

sthirasukhamāsanam ||2.46||

Asana is a posture that is steady and comfortable.

तस्मिन्सति श्वासप्रश्वासयोर्गतिविच्छेदः प्राणायामः ॥ २.४९ ॥

tasminsati ṣvāsapraṣvāsayorgativicchedaḥ prāṇāyāmaḥ ||2.49||

When asana is mastered, pranayama is the regulation of inhalation and exhalation.

स्वविषयासंप्रयोगे चित्तस्वरूपानुकारः इव इन्द्रियाणां प्रत्याहारः ॥ २.५४ ॥

svaviṣayāsamprayoge cittasvarūpānukāra iva indriyāṇāṃ pratyāhārah ||2|54||

Pratyahara, withdrawal of the senses from their objects and aligning them with the mind.

देशबन्धश्चित्तस्य धारणा ॥ ३.१ ॥
deśa-bandhaś cittasya dhāraṇā ||3|1||

Concentration is fixing the mind on a specific point or place

तत्र प्रत्ययैकतानता ध्यानम् ॥ ३.२ ॥
tatra pratyaya-ikatānatā dhyānam ||3|2||

Meditation is the uninterrupted flow of awareness toward the chosen object

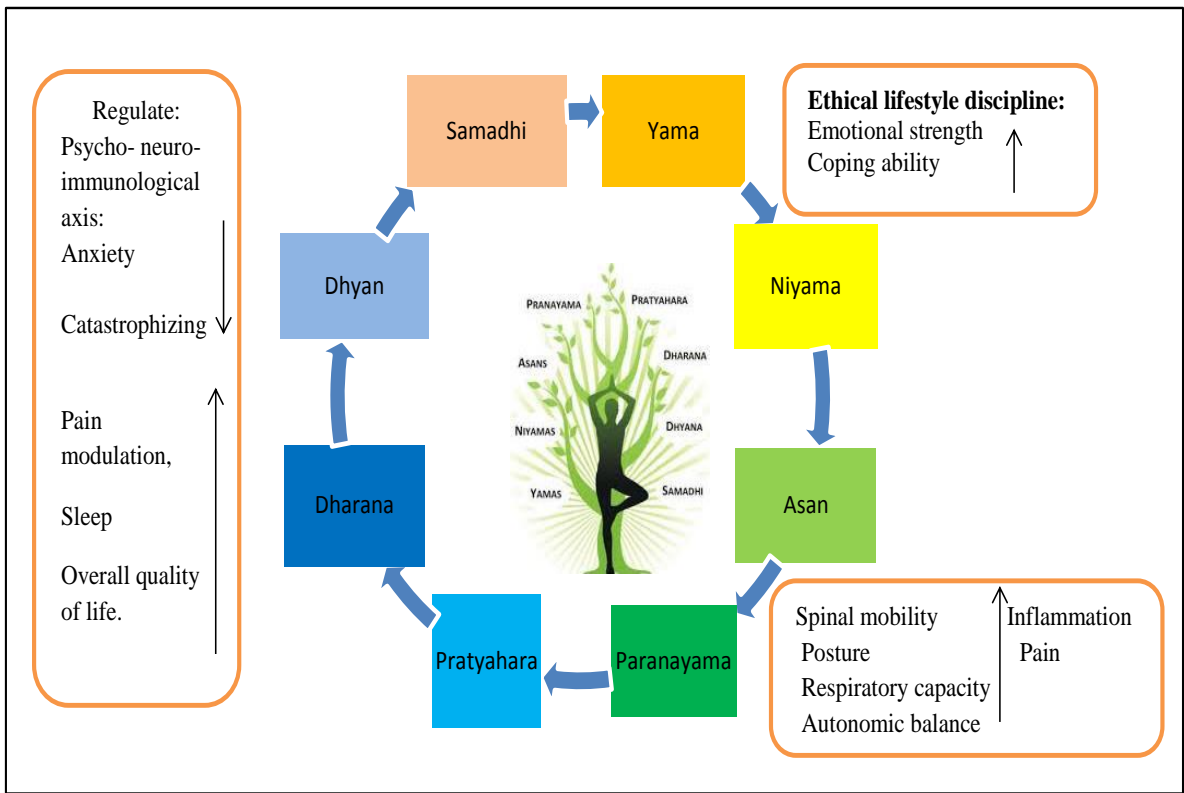


Photo. no. 10: Integration of Astanga yoga in holistic management of Ankylosing Spondylitis

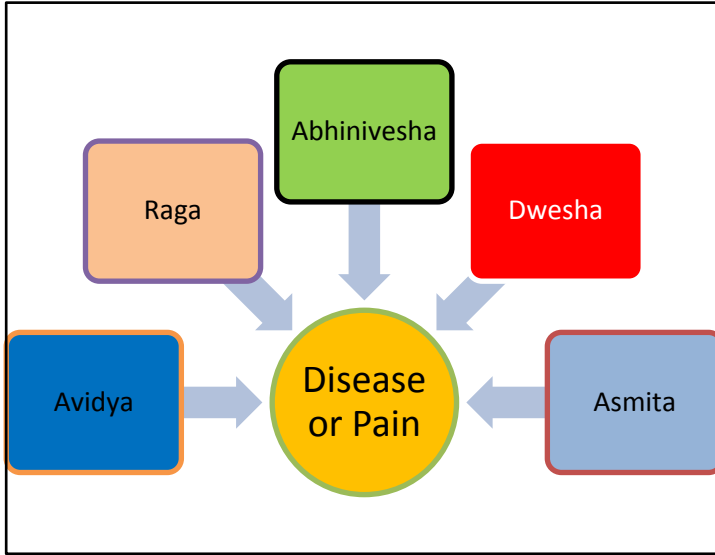
1.12 Description of Pain in classical Hindu Text:

1.12.1 Interpretation of Pain in Patanjali Yog Sutra:

Causes of disease or pain according to Yoga:

अविद्यास्मितारागद्वेषाभिनिवेशाः पंच क्लेशाः ॥ २.३ ॥
avidhyasmitārāgadveṣābhiniveśāḥ pañcakleṣāḥ ||2.3||

The word “Klish” in the ancient Sanskrit literature is the origin of the term “Klesha” which means ‘to give pain’. According to Patanjali Yoga sutra the five kleshas i.e Avdiya (Ignorance), Asmita (Ego), Raga (Attachment), Dvesha (Aversion) and Abhinivesha (Fear of death) are the causes of discomfort or pain in human being. Avidyā or ignorance is the source



of asmitā, rāga, dveṣā and abhiniveṣa. The five kleshas are part of the foundation of the Patanjali Yoga sutras and a key feature of the Yoga philosophy. Kleshas are inborn mental afflictions that hinder progress on the spiritual path. Annihilation of kleshas is an intrinsic objective of Yogic practices (kriya yoga, meditation).

Photo. no. 11: Kleśhas- the cause of disease or Pain

दुःखानुशयी द्वेषः ॥२.८॥
duḥkhānuśayī dveṣaḥ||2.8||

duḥkhānuśayī dveṣāḥ duikha = distress, pain, suffering anuśayī = following dveṣāḥ = aversion

Meaning: Something that creates pain can create aversion, if we had any painful experiences we create aversion to those experiences, situation or people.

ते प्रतिप्रसवहेयाः सूक्ष्माः ॥ २.१० ॥
te pratiprasava-heyāḥ sūkṣmāḥ ||2.10||

te = these prati = with regard to, toward, reversing prasava = flow, motion, creation, inception heyāḥ = overcome, overwhelmed sūkṣmāḥ = subtle

Meaning: In their subtle form, these causes of suffering are subdued by seeing where they come from.

परिणामतापसंस्कारदुःखैर्गुणवृत्तिविरोधाच्च दुःखमेव सर्वं विवेकिनः ॥ २.१५॥

pariñâma-tâpa-saâskâra-duïkhair guña-vëtti-virodhâc ca duïkham eva sarvam vivekinaï ||2.15||

pariñâma = transformation, tâpa = anguish, saâskâra = latent impressions, duïkhaiï = distress, pain, suffering, guña = fundamental qualities of nature, vëtti = patterning, turnings, movements virodhât = conflict, opposition ca = and duïkham = distress, pain, suffering eva = thus sarvam = all vivekinaï = a person of discrimination

Meaning: The wise see suffering in all experience, whether from the anguish of impermanence, or from latent impressions laden with suffering, or from incessant conflict as the fundamental qualities of nature vie for ascendancy.

हेयं दुःखमनागतम् ॥ २.१६॥

heyaâ duïkham anâgatam||2.16||

heyaâ = overcome, overwhelmed duïkham = distress, pain, suffering anâgatam = future

Meaning: But suffering that has not yet arisen can be prevented.

द्रष्टृदृश्ययोः संयोगो हेयहेतुः ॥ २.१७॥

draæøë-dëâyayoï saâyogo heya-hetuï ||2.17||

draæøë = seer, witness, pure awareness dëâyayoï = what is seen saâyogaï = union, coupling heya = overcome, overwhelmed hetuï = cause

Meaning: The preventable cause of all this suffering is the apparent indivisibility of pure awareness and what it regards.

1.12.2 Interpretation of Pain in Bhagvad Gita:

मात्रास्पर्शास्तु कौन्तेय शीतोष्णसुखदुःखदाः।

आगमापायिनोऽनित्यास्तांस्तितिक्षस्व भारत ॥ २.१४ ॥

mâtrâ-sparšâs tu kaunteya šitoṣṇa-sukha-duḥkha-dâḥ ।

âgamâpâyino 'nityâs tâms titikṣasva bhârata ॥ 2.14 ॥

Meaning: Sensations of pleasure and pain, heat and cold arise from the contact of the senses with external objects. Since they are temporary and constantly changing, one should learn to patiently endure them without being disturbed.

यं हि न व्यथयन्त्येते पुरुषं पुरुषर्षभ।

समदुःखसुखं धीरं सोऽमृतत्वाय कल्पते ॥२.१५ ॥

yañ hi na vyathayanty ete puruṣaṁ puruṣarṣabha ।

sama-duḥkha-sukhañ dhīrañ so 'mṛtatvāya kalpate ॥ 2.15 ॥

Meaning: a wise and steady person who remains balanced in both pleasure and pain, and is not shaken by them, attains inner peace and ultimately reaches the state of liberation.

1.13 Management of pain according to Yoga

अभ्यासवैराग्याभ्यां तन्निरोधः ॥ १.१२ ॥

abhyâsa-vairâgyâbhyââ tan-nirodhâi ॥ 1.12 ॥

abhyâsa = practice, action, method vairâgyâbhyââ = dispassion, non-reaction, non-attachment tad = these nirodhâi = stilling, cessation, restriction

Meaning: Both practice and non-reaction is required to still the patterning of consciousness.

Pancha Kosha concept of human system:

The Pancha Kosha system, described in the Taittiriya Upanishad of the vedic era, delineates five sheath that encompass human existence. These are: annamaya kosha (physical level) pranamaya kosha (energy or vital level), manomaya kosha (mental level), vijanamaya kosha (intellectual level) and anandamaya kosha (spiritual or bliss level). In Yoga philosophy, the pancha kosha represent the five layers of awareness through which all human experiences are filtered, providing a holistic framework for understanding mind-body-split integration.^{114,115}

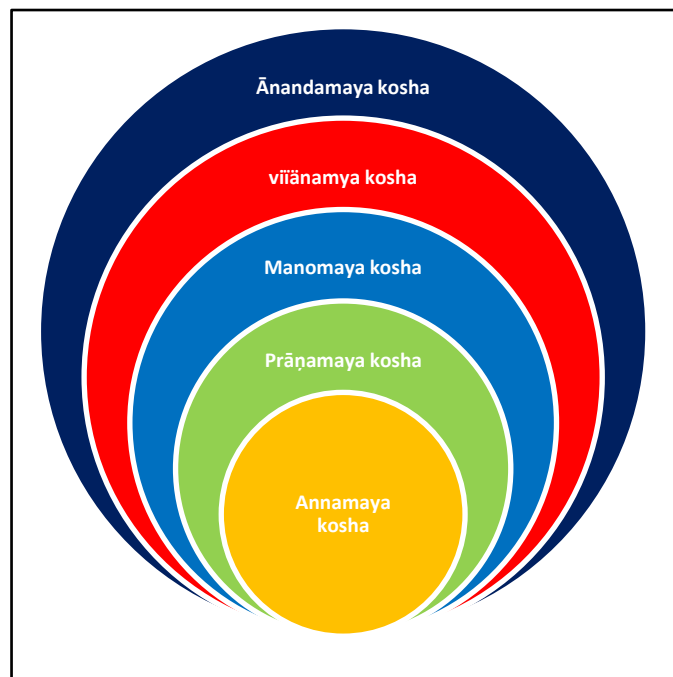


Photo. no. 12: The Pancha Kosha concept of human system (Self-illustrated)

Practices at Annamayakosha or the physical layer

Practices aimed at the Annamayakosha (physical layer) including a healthy yogic diet, kriyās, loosening exercises, and yogasanas-support pain management by improving systemic cleansing, musculoskeletal mobility, and neuromuscular efficiency. Kriyās purify internal organs and improve physiological functioning, while loosening movements (śīthilikarāṇa vyāyāma) mobilize stiff joints, reduce muscular tension, and increase circulation. Yogasanas

enhance strength, flexibility, and posture, thereby minimizing biomechanical stress and reducing pain intensity. Together, these practices promote optimal physical functioning and contribute to long-term reduction in pain sensitivity.^{116,117}

Practices at Pranamaya kosha level

Practices at the Praṇamayakosha level target the regulation of praṇa, the vital life force that governs physiological and subtle energy processes. According to Hatha Yoga texts, prāṇa and citta (mind) are deeply interconnected-when prāṇa flows unevenly or stagnates, mental fluctuations increase and the perception of pain intensifies; when prāṇa becomes steady, the mind also becomes stable. Prāṇāyāma and conscious breathing techniques restore balance in the five manifestations of prāṇa, reduce autonomic arousal, and help normalize the flow of energy in the affected regions. These practices support nervous system regulation, reduce hypersensitivity to pain, and enhance mind-body coordination. Hence, pranayama serves as a bridge between body and mind, contributing to improved pain modulation and emotional equilibrium.^{118,119}

Practices at Manomaya kosha level

Practices at the Manomayakosha level aim to regulate and refine the mind, which is often the source of emotional disturbance and pain perception. Yoga Vasistha states that the mind arises from two roots-movement of praṇa and sustained imagination; therefore, mental fluctuations can be reduced by stabilizing both breath and thought. Techniques such as dhāraṇā (focused concentration), dhyāna (meditation), samādhi (absorption), and devotional practices help redirect the mind from random, looping thoughts toward sustained inner stillness. With continued practice, concentration deepens into effortless meditation, allowing the mind to dwell on a single calm focus and gradually dissolve stress-driven reactivity. This systematic culturing of the mind enhances emotional regulation, reduces psychological distress, and promotes inner harmony, which together contribute to reduced pain and improved well-being.

Practice at Vijanamaya kosha level

Practices at the vijanamaya kosha level focus on cultivating inner wisdom (jñāna) and self-awareness to guide one's thoughts, actions, and emotional responses. When this deeper knowledge is absent, individuals tend to develop maladaptive habits, attachments, and aversions, which generate mental agitation and worsen the experience of pain and suffering.

Yogic disciplines such as self-inquiry (svādhyāya), introspection, mindfulness-based awareness, and reflective meditation help strengthen discrimination (viveka) between the Self and fluctuating mental states. As clarity increases, one becomes less reactive to sensations and situations, fostering emotional stability and healthier behavioral patterns. This shift in cognitive processing contributes to reduced pain reactivity and enhanced inner resilience, aligning individual awareness with higher wisdom.

Practices at Anandamaya kosha level

Practices at the Ānandamaya kosha level aim to awaken the innate state of bliss (ānanda) that resides in the deepest layer of human existence and to allow this inner serenity to permeate daily actions. When one functions from this layer, the natural healing potential of the body–mind system becomes active, supporting profound recovery and overall well-being. The essential principle here is to maintain inner silence and mental equipoise during all activities, regardless of likes or dislikes. Through self-awareness, positive autosuggestion, devotional attitudes, and the cultivation of a blissful inner presence, one learns to remain calm, centered, and joyful even in challenging circumstances. This state of ānanda harmonizes the mind and nervous system, reduces stress-reactivity, and promotes deep psychological and physiological healing.

1.14. Yoga as a bio-psycho-social-spiritual approach:

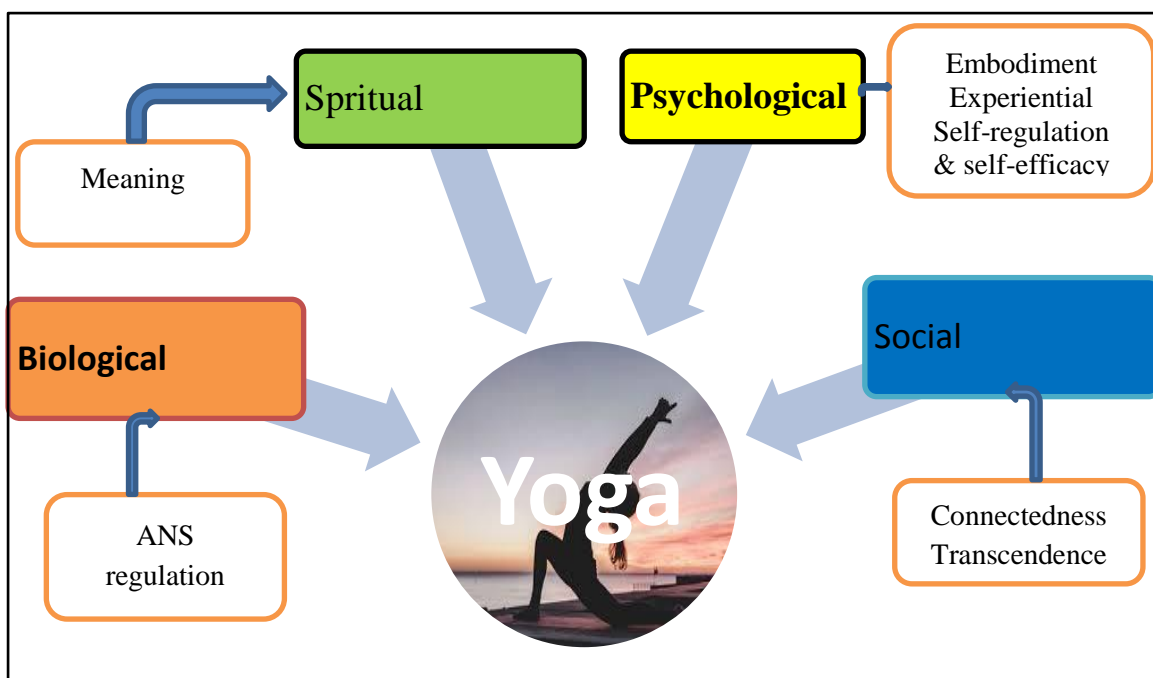


Photo. no. 13: Bio psychosocial spiritual benefits of yoga (Concept was adapted from ¹⁰⁸)

Yoga is widely recognized today as a bio-psycho-social-spiritual therapeutic approach, addressing multiple dimensions of human health rather than focusing solely on physical symptoms. Biologically, yoga improves musculoskeletal strength, autonomic regulation, and immune functioning, which contributes to reductions in pain and inflammation.¹²⁰ Psychologically, practices such as pranayama, meditation, and mindfulness enhance emotional regulation and reduce stress, anxiety, and catastrophizing associated with chronic illness.¹²¹ Socially, yoga promotes healthy relationships and supportive group dynamics through shared practice and compassionate communication. Spiritually, yoga cultivates self-awareness, meaning, and inner peace, which helps individuals transcend suffering and respond to life with greater equanimity. Together, these multidimensional benefits illustrate that yoga is not merely a physical exercise but a comprehensive system promoting holistic well-being through the integration of body, mind, behavior, and consciousness.¹²²

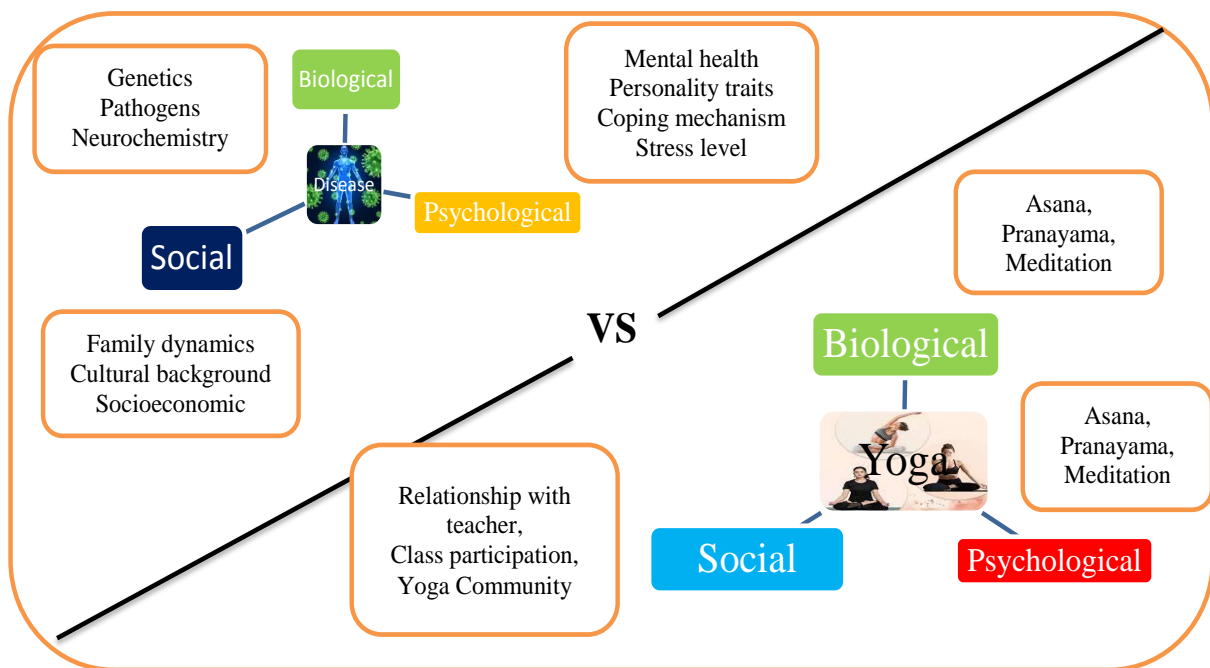


Photo. no. 14: conventional bio-psycho-social model of disease and Yoga¹²³

The conventional bio-psycho-social model of disease explains that illness results from the dynamic interaction among biological, psychological, and social factors. In Ankylosing Spondylitis, biological drivers (inflammation, genetics), psychological contributors (stress,

pain catastrophising), and social challenges (reduced participation, work limitations) interact to worsen pain and disability.^{124,125} The yoga-based bio-psycho-social-spiritual model builds upon this foundation by adding a fourth dimension—spiritual well-being, which relates to meaning, inner peace, acceptance, and self-transcendence. While the biomedical model focuses on pathology and dysfunction, yoga promotes holistic self-regulation by addressing not only the body, mind, and social environment but also the inner spiritual dimension that nurtures resilience, equanimity, and deep self-awareness. Through āsana, prāṇāyāma, meditation, and mindfulness-based living, yoga simultaneously reduces biological inflammation and autonomic imbalance, improves psychological coping and emotional stability, strengthens social connectedness through group practice, and enhances spiritual awareness that supports acceptance and purpose.^{120,102} Thus, yoga does not replace the bio-psycho-social model but expands it, offering an integrative pathway to healing and functional recovery in AS rather than merely symptom management.

1.15 Evidence based benefits of Yoga:

Yoga is widely used as a therapeutic tool for physical and mental well-being,¹²⁸ and it has become the most popular complementary health approach practiced by adults in the United States.¹²⁹ One study reported that the validated Integrated Yoga Therapy Module had no negative impact and having advantage for pain relief, recovering disability, and reducing stress in patients with CLBP.¹³⁰

Regular yogic practices has been shown significantly reduce resting levels of pro inflammatory cytokines including TNF- α and IL-6 as well as decrease the serum concentration level of cholesterol, triglyceride and VLDL, indicating its potential role in inflammatory cytokine and metabolic parameters.¹³¹ Systematic practice of asana enhanced the musculoskeletal health, improve joint mobility, improve better posture and core stability, reduce chronic pain and muscle tension.¹³² Pranayama (life force or vital energy) strengthen the respiratory muscles, increase lung capacity, improve oxygen uptake.¹³³ Meditation decreases the secretion of inflammatory biomarkers such as CRP and IL-6, increased activity of the autonomic nervous system (ANS), Brain derived neurotrophic factor (BDNF) and hypothalamic-pituitary-adrenal (HPA) axis, reduce the perception of pain and improve pain tolerance.^{134,135}

Chronic inflammation and stress is a common factor of many of the non-communicable diseases (NCDs), and an area where yoga has been found to be extremely beneficial.¹³⁶ In a comparative study between yoga and exercise on healthy and diseased populations, it is reported that yoga may be as effective as or better than exercise in case of heart rate variability, blood glucose, blood lipids, salivary cortisol, oxidative stress, and such other health related outcome.¹⁰² The pattern of increased NFκB-related transcription of pro-inflammatory cytokines in leukocytes may reversed due to the practice of meditation.¹³⁷ A theoretical study reported that yoga therapy directly affects the autonomic nervous system and whereas it also indirectly effects on the GABA (gamma amino-butyric acid) system.¹³⁸

1.16 Evidence-based therapeutic benefits of yoga for ankylosing spondylitis and other related inflammatory spinal conditions:

Yoga as a psycho-physical therapy combined with physical posture, breathing regulation, relaxation and mindfulness can be a particular therapy that helps to reduce the progression of disease in patients with Ankylosing Spondylitis. In several studies, yoga demonstrates the positive effects on rheumatoid arthritis (RA), suggesting that it could be valuable complementary therapy for managing rheumatic disorder. A randomized controlled trial study showed that post 12 weeks of yogic practice with standard medication helps to reduce disease activity score, inflammatory markers (interleukin-1a (IL-1a), IL-6, tumor necrosis factor-a (TNF-a), cortisol) and improves sympathovagal balance.¹³⁹ Another study found that yoga as a mind-body intervention (MBI) helps in significant reduction of the severity level of RA, like systematic inflammatory markers and disease activity.¹⁴⁰ A structured yoga practice of one and a half hours per day for seven weeks showed a significant reduction in joint inflammation, early morning stiffness, pain intensity, pulse rate, blood pressure, lymphocyte count, uric acid level, and C-reactive protein for RA patients.¹⁴¹ Interestingly, while yoga has been demonstrated as a promising complementary practice for arthritis¹⁴² as well as rheumatoid arthritis,¹⁴³ there is a very few research studies which evaluated the impact of yoga for the treatment of Ankylosing Spondylitis. Rheumatoid arthritis (RA) and Ankylosing Spondylitis (AS) fall under the term rheumatic disorder and share some common features like inflammation and reduced physical fitness.¹⁴⁴ Yogic intervention demonstrates that it has positive effects on inflammatory biomarkers with various chronic inflammatory disease conditions.¹⁴⁵

1.17 Role of Yoga as a Complementary Therapy in Ankylosing Spondylitis

Yoga is increasingly recognized as a complementary therapy for managing Rheumatoid Arthritis (RA) because of its multidimensional influence on the psycho-neuro-immuno-endocrine (PNIE) system, the network that connects the mind, nervous system, immunity, and hormones¹²³.

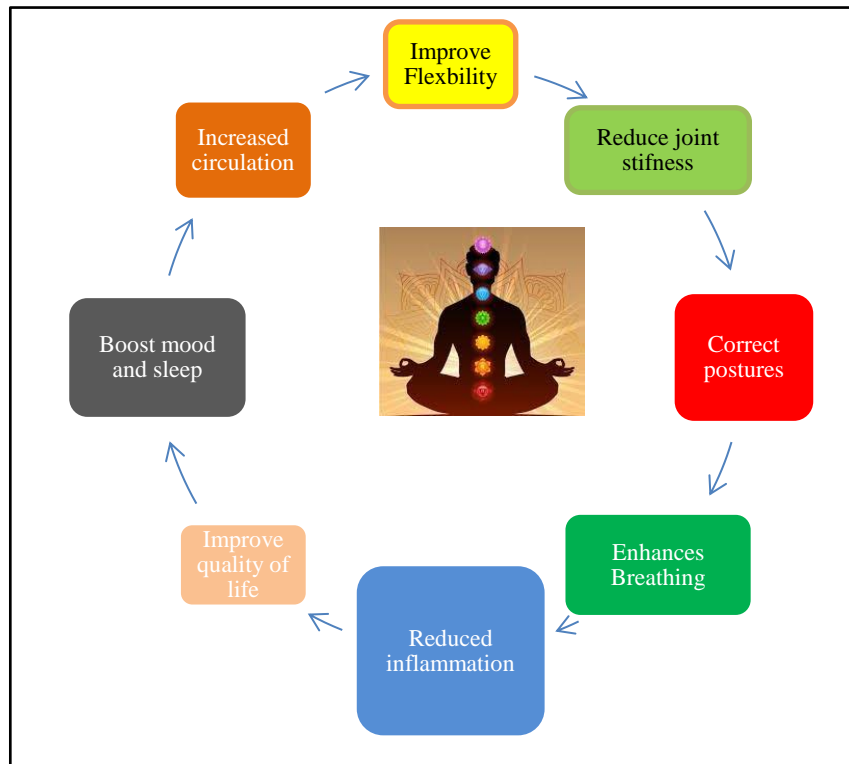


Photo. no. 15: Yoga as a complementary therapy for patients with Ankylosing Spondylitis (selfillustrated)

Regular yogic practices—āsana, prāṇāyāma, and meditation—have been shown to improve flexibility and posture, which helps reduce joint stiffness and musculoskeletal deformity associated with AS.¹⁴⁶ Yogic breathing techniques optimize autonomic balance by increasing parasympathetic activity, promoting relaxation, and improving respiratory mechanics in individuals with restricted chest expansion.¹⁴⁷ Meditation further regulates emotional responses, boosts mood and sleep, and reduces psychological distress, contributing to better pain tolerance and overall quality of life.¹⁴⁸ Through these integrated mechanisms, yoga supports both physical and mental well-being, making it a valuable adjunct to conventional treatment strategies for Ankylosing Spondylitis.¹⁴⁹

1.18 Mechanistic pathways illustrating how yoga practice confers therapeutic benefits in Ankylosing Spondylitis and related conditions

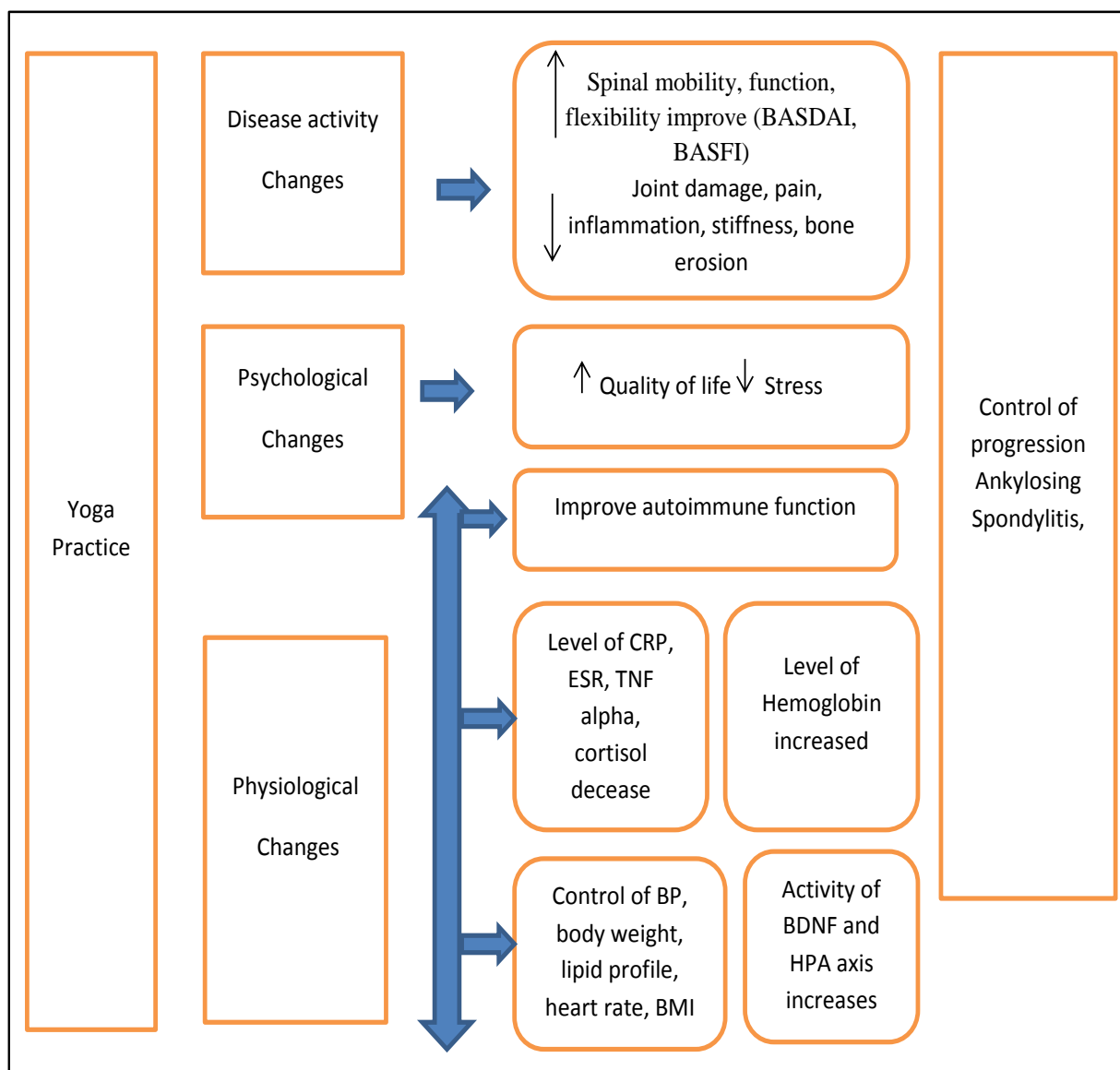


Photo. no. 16: Mechanistic Benefits of Yoga Practice in AS and related condition (self-illustrated)

Yoga produces multidimensional therapeutic effects in Ankylosing Spondylitis by influencing disease activity, psychological health, and physiological responses simultaneously. Regular yogic practices—such as āsana, prāṇāyāma, and meditation—enhance spinal mobility, flexibility, and overall physical function, contributing to reductions in joint pain, stiffness, inflammation, and bone erosion,^{150,151} which leads to lowered BASDAI and BASFI scores. Psychologically, yoga helps regulate stress by improving emotion control, mindfulness, and coping capacity, resulting in higher quality of life and reduced perceived stress levels.^{152,153} Physiologically, yoga has been shown to reduce

inflammatory markers, lower cortisol levels, regulate BP, BMI, heart rate, and optimize lipid profile, while supporting immune and endocrine homeostasis through increased BDNF and balanced HPA-axis activity.^{154,155} Collectively, these biological, psychological, and physiological improvements contribute to slowing disease progression and enhancing overall functional well-being in people with Ankylosing Spondylitis.

1.19 Comparative benefits of exercise and yoga for patients with Ankylosing Spondylitis:

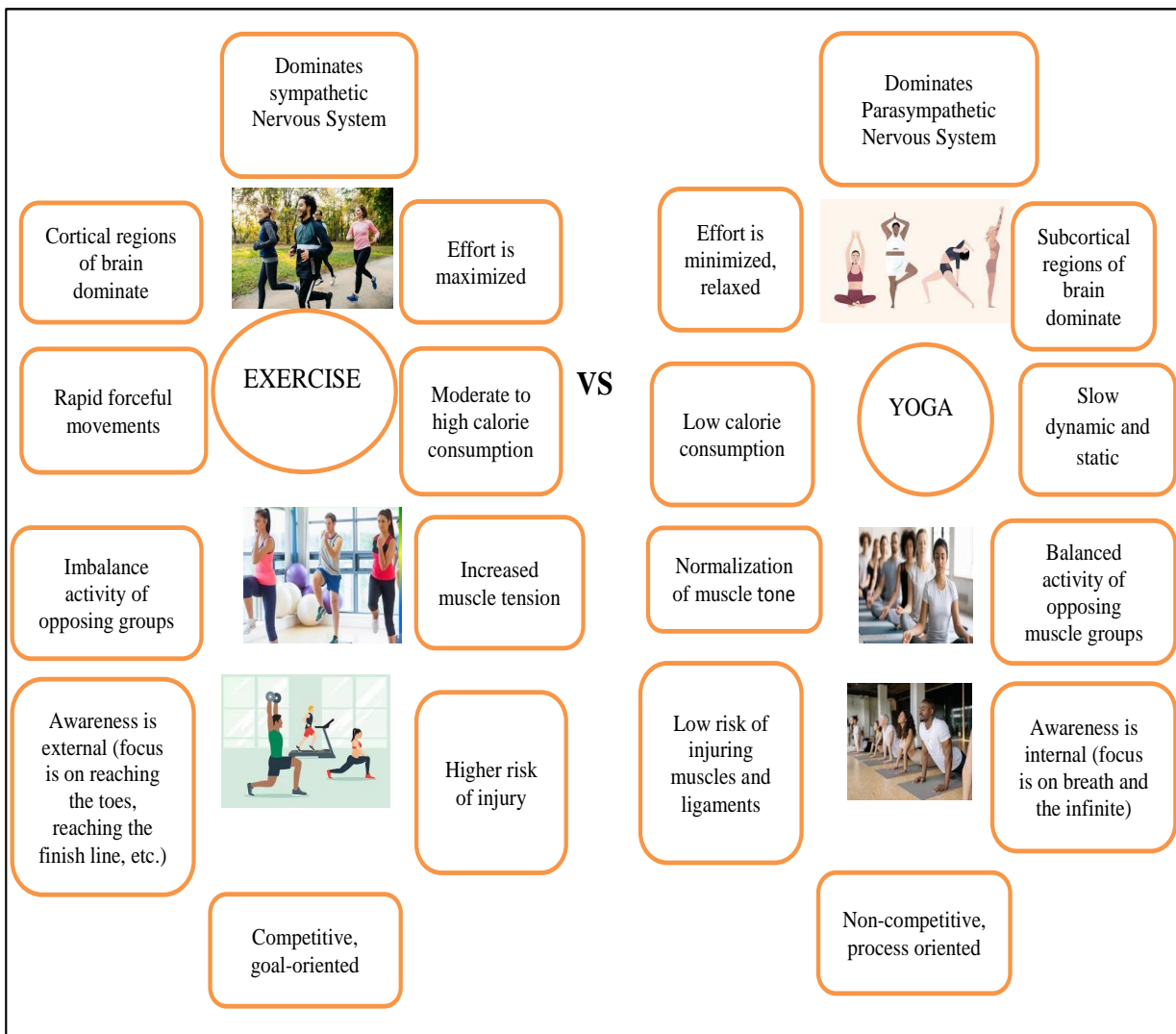


Photo. no. 17: Comparative effect of exercise and yoga on Ankylosing Spondylitis (self-illustrated)

Although structured exercise protocols are widely recommended for Ankylosing Spondylitis, yoga offers additional multidimensional benefits that extend beyond physical conditioning. Conventional exercise predominantly stimulates the sympathetic nervous

system, involves rapid and forceful movements, and maximizes physical effort.¹⁵⁶ In contrast, yoga practices activate the parasympathetic nervous system through slow, mindful, and static movements, which lead to normalized muscle tone, balanced activation of opposing muscle groups, and reduced risk of musculoskeletal strain.¹⁵⁷ Importantly, yoga cultivates internal awareness focused on breath and present-moment experience,^{158,159} rather than external performance-based goals typical of exercise, making it non-competitive and process-oriented, which supports long-term adherence. This shift toward mind–body integration reinforces autonomic balance,¹⁶⁰ reduces systemic inflammation,¹⁶¹ and improves pain modulation,¹⁶² positioning yoga as a more holistic and sustainable therapeutic strategy for Ankylosing Spondylitis than traditional exercise alone. One study conducted to examine the comparative effect of yoga and exercise in patients with AS, though this study found statistically significant improvement for yoga and exercise group of mobility, functional capacity, sleep quality and pain but between groups no significant comparison was found.¹⁶³

1.20 Statement of the problems:

In yogic field there are difference types thought among various kinds of yogic school. As a result when yoga use as a therapy for disease control or pain management purpose, practices or protocols are also different. Thus using yoga as a therapy universally a unique yoga module should have to develop. From the above prediction the problem is accordingly stated as –“Development and validation of a yoga module and examine the influence of recommended yoga module on general health status, disease activity, haematological and inflammatory biomarkers, depression, fear avoidance belief, pain Catastrophizing of Patients and quality of life (QoL) in patients with Ankylosing Spondylitis”. Thus the present study was undertaken to evaluate the effect of a validated yogic intervention on patient with Ankylosing Spondylitis and to confirm the feasibility of the module.

1.21 Significance of the Study

- By testing the feasibility of a yoga module on psychological, physiological and biochemical (inflammatory markers) variables, this study may provide empirical support for integrating yoga into standard AS care.
- Those patients who have a pre-condition of AS may follow the yogic module to prevent their worst condition.

- The finding of the study could have important implications for clinical practice, rehabilitation strategies, and public health policies, ultimately contributing to improved patients outcomes and quality of life.
- The yoga activities have no drug-related side effects; rather, they have a composite effect to elevate positive health status in all domains.
- Furthermore, comparing outcomes between a conventional treatment group and combined yoga and medication group may help establish yoga as an effective adjunct therapy for the treatment of Ankylosing Spondylitis.
- The study may unfold the possible immune-inflammatory mechanism for the development of autoimmunity related other disease condition after regular yogic practices.

1.22 Aim & Objectives of the Study

Aim: To develop and validate a yoga module and test its feasibility for treating patients with Ankylosing Spondylitis.

Objective 1:

To develop and validate a yoga module for patients with Ankylosing Spondylitis based on the opinions of experts from relevant related disciplines.

Objective 2:

To examine the feasibility and effectiveness of the validated yoga module on selected psychological variables (depression, fear avoidance belief, pain catastrophizing and health related quality of life), physiological variables (haemoglobin and platelet count), general health status (BMI, blood pressure, heart rate), clinical outcome measures (BASDAI, BASFI, BASMI, Chest expansion) and inflammatory markers (CRP, ESR, TNF alpha) by comparing patients receiving conventional treatment alone with those receiving conventional treatment combined with yoga practice.

1.23 Hypothesis

H₀: There will be no significant differences between the combined group (medicine + yoga) and the conventional group on psychological, physiological, health status, clinical outcome measures and inflammatory markers after 24 weeks.

1.24 Definition and explanation of the Terms

Yoga:

Yoga is an ancient science established in India. It is a mind-body practice comprising asana (physical postures), pranayama (breathing techniques), relaxation, meditation, and kriya (cleansing practices) to promote holistic health.^{164,165}

SpA:

Spondyloarthritis (SpA) is a family term of arthritis-associated disease that is mainly classified into two groups: axial SpA (axSpA) and peripheral SpA.¹⁶⁶

Immunity:

Immunity is the body's natural defence system which protects it from disease and infection by identifying and attacking harmful invaders like bacteria, virus.¹⁶⁷

Autoimmunity:

Autoimmunity is a malfunction of this system, where it mistakenly identifies healthy cells, tissues, or organs as threats and attacks them instead.¹⁶⁸

Inflammation:

Inflammation is the body's normal, short term immune response to injury, infection, or irritants, aiming to heal damage and fight off harmful stimuli.^{169,170}

Ankylosing Spondylitis:

Ankylosing Spondylitis is the disease of sacroiliac joint. Chronic inflammation is the main feature of this disease that primarily causes long term back pain and stiffness.¹⁷¹

Sacroiliitis:

It is the painful inflammation of the sacroiliac (SI) joint. Inflammation of the SI joint can lead to persistent lower back and buttock pain that often occurs when sitting for long periods or climbing stairs. If left untreated, the inflammatory process may cause changes in the joint structure and contribute to reduced mobility and function.¹⁷²

Enthesitis:

It is the inflammation of the entheses, which are the areas where tendons, ligaments, and joint capsules attach to bone. It often leads to tenderness, swelling, and pain at the attachment zones and, overtime may contribute to structural changes such as calcification or bone spur formation.¹⁷³

HLA B27:

It is a gene that produces a protein, or antigen, found on the surface of white blood cells, which plays a role in the immune system.^{174,175}

BASDAI:

BASDAI, the Bath Ankylosing Spondylitis Disease Activity Index, is a patient reported outcome questionnaire that measures disease activity in individual with Ankylosing Spondylitis (AS) and axial spondyloarthritis (axSpA).¹⁷⁶

BASFI:

BASFI, the Bath Ankylosing Spondylitis Functional Index, is a self-administered questionnaire that measures the functional limitations of the patients with AS.

TNF-alpha:

Tumor Necrosis Factor alpha (TNF- α) is a cytokine, a type of signalling protein, produced by cells like macrophages to regulate inflammation, host defence, and cell survival.^{177,178}

Erythrocytes Sedimentation Rate (ESR):

ESR is blood test that measures how quickly red blood cells settle at the bottom of a test tube, which indicates the presence and inflammation level present in the body.¹⁷⁹

C-reactive protein (CRP):

CRP is a protein produced by the liver that rises in the bloodstream in response to information in the body, serving as a marker for inflammation and potential underlying issues like infections, autoimmune disorders, or chronic conditions.^{180,181}

Complete Blood Count (CBC):

CBC is a common blood test that provides a detailed picture of the blood components including white blood cell, red blood cell and platelets.¹⁸²

Depression:

Depression is a mood disorder characterized by a pervasive low mood, a loss of interest in normally enjoyable activities, and an inability to experience pleasure.¹⁸³

Fear Avoidance Belief (FAB):

Fear avoidance belief is the belief that physical activity will worsen pain or lead to re-injury, resulting in the avoidance of activities that could be beneficial for recovery.¹⁸⁴

Pain Catastrophizing Scale (PCS):

Pain Catastrophizing is the tendency to focus on the negative and threatening aspects of pain, such as exaggerating its severity and feeling helpless to cope with it.¹⁸⁵

HRQoL:

Health related quality of life or HRQoL is an assessment of how a person's health status affects their perception of wellbeing and overall functioning.^{186,187}

ELISA:

ELISA (Enzyme - Linked Immunosorbent Assay) is a laboratory method used to detect and quantify specific biological substances - commonly antibodies, antigens, proteins, or hormones in sample such as blood, serum, plasma, urine, or cell culture supernatant. It is widely applied for assessing inflammatory biomarkers, including TNF- α , IL-6, and CRP to evaluate immune and disease related responses.¹⁸⁸

DEVELOPMENT AND VALIDATION OF A YOGA MODULE IN PATIENTS WITH ANKYLOSING SPONDYLITIS

Chapter-II

REVIEW OF RELATED LITERATURE

2.1 Selection of studies

2.2 Selected of Studies for review of scientific literature Review

2.2.1 Review on Yoga and Low Back Pain

2.2.2 Review on Yoga and Inflammatory markers

2.2.3 Review on Yoga for Inflammatory low back pain

2.2.4 Review on Yoga and Immune system

2.2.5 Review on Yoga and Quality of life

2.2.6 Review on Yoga and Rheumatic Disease

2.2.7 Review on Exercise and Ankylosing Spondylitis

2.2.8 Review on Yoga and Ankylosing Spondylitis

2.2.9 Review on Yoga and other related disorders

2.3 Summary of Review

Chapter-II

REVIEW OF RELATED LITERATURE

2.1 Selection of Studies:

A review was conducted by searching for keywords such as ‘yoga and low back pain’, ‘yoga and inflammatory back pain’, ‘Yoga and rheumatic disorders’, ‘Yoga and autoimmune disease’, ‘Yoga and immune system’, ‘Yoga and inflammatory markers’, ‘Exercise and Ankylosing Spondylitis’, and ‘Yoga and ankylosing spondylitis’ in databases, including Medline/PubMed, the Cochrane Library, EMBASE (via SCOPUS), Web of Science, and DOAJ.

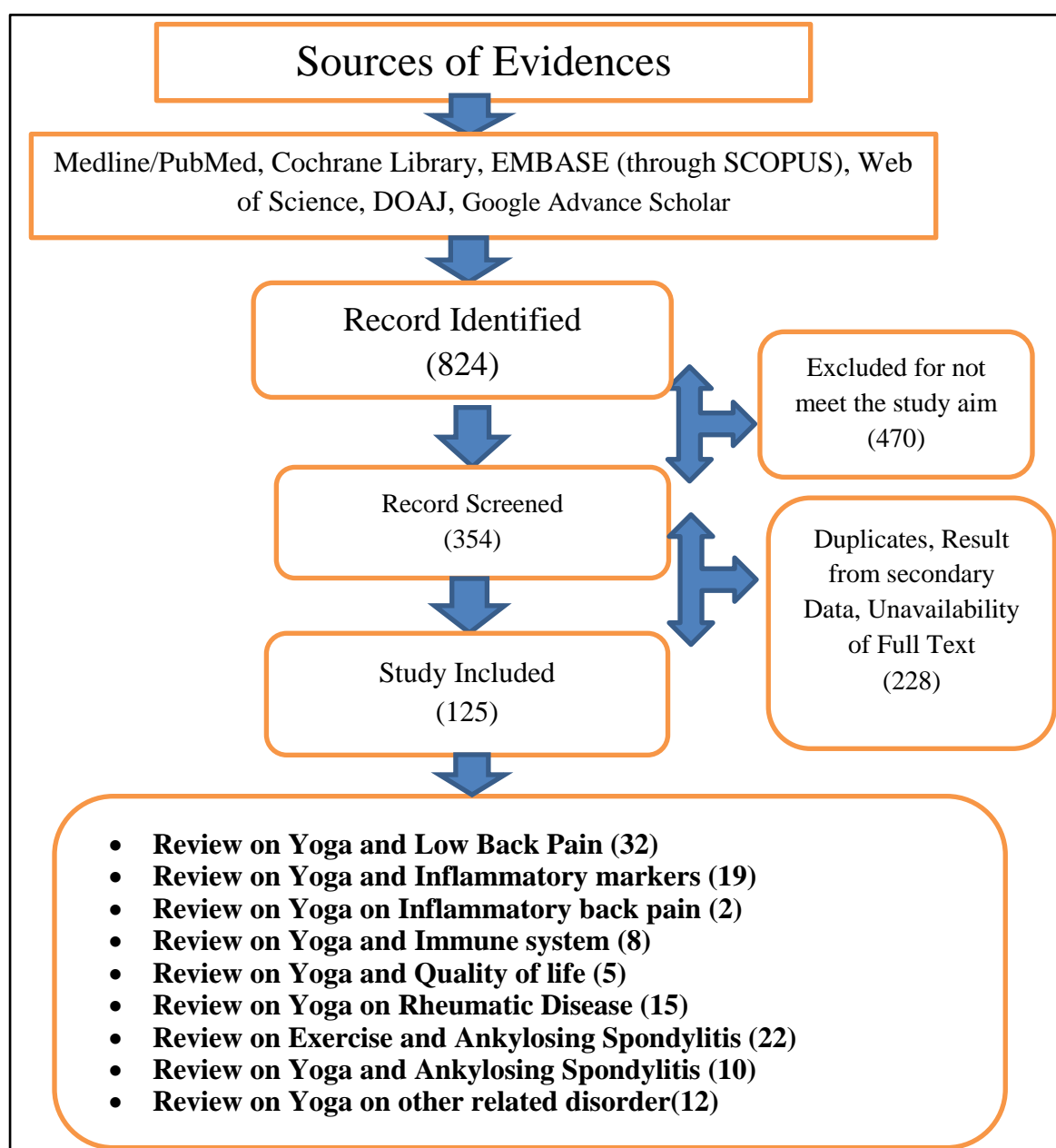


Fig. no. 1: Flow chart of the related study for literature review

2.2 Selected studies for review of scientific literature:

2.2.1 Review on Yoga and Low Back Pain:

1. **Patil et al., (2015)** conducted a feasibility study which showed significant reductions in pain, disability, and perceived stress among the participants. The study concluded that the validated module was feasible and was useful in pain reduction; reduce disability, and relief stress in patients with CLBP. The study presents a unique approach to developing a standardized yoga therapy module for CLBP by integrating practices from different schools of yoga. The rigorous validation process involving 30 yoga experts adds credibility to the module. The study also highlights the potential of yoga as a complementary therapy for CLBP.¹³⁰
2. **Saper et al., (2017)** administered a trial comparing yoga, physical therapy (PT), and education for chronic low back pain (cLBP) in a predominantly low-income, racially diverse population. 320 adults with nonspecific cLBP. Participants were randomized to receive yoga practice, physical traing, or an educational book and newsletters over a 12-week treatment phase, followed by a 40-week maintenance phase. The primary outcomes were back-related function and pain intensity. The results showed that yoga was noninferior to PT for both function and pain. It demonstrates that a structured yoga program can be as effective as PT, which is the most common evidence-based, reimbursable, and nonpharmacologic treatment for cLBP. The study also highlights the challenges of adherence in exercise interventions, particularly in lower socioeconomic status populations, and the potential for yoga to be integrated into mainstream clinical practice for cLBP management.¹⁸⁹
3. **C. Joyce et al., (2022)** directed a qualitative study to exploring the experiences of predominantly low-income and minority adults with chronic low back pain (cLBP) who participated in yoga and educational interventions. The researchers interviewed 26 participants (18 from the yoga group and 8 from the education group) to understand their perceptions, expectations, and experiences with their respective treatments. The yoga intervention consisted of 12 weekly 75-minute classes, including yoga philosophy, relaxation, breathing exercises, and yoga postures. The education intervention involved reading the Back Pain Helpbook over post 12 weeks, supplemented by newsletters and check-in calls. The study found that participants from both groups reported initial apprehension but eventually experienced physical

and psychological benefits, mainly in the form of improved pain self-management. The yoga group reported a strong sense of communal support and camaraderie, which was absent and desired by education participants. Both groups described a newfound sense of empowerment in managing their cLBP, either through body awareness (yoga) or knowledge of self-care strategies (education).¹⁹⁰

4. **Marshall et al., (2022)** conducted a secondary analysis of the Back to Health Study, a randomized controlled trial comparing the effectiveness of yoga, physical therapy (PT), and education for chronic low back pain (cLBP) in a predominantly low-income, racially diverse population. The study involved 320 adults with cLBP recruited from primary care clinics, who were randomized to post 12 weeks of yoga, PT, or education. The primary focus was on changes in cognitive appraisal of pain, measured through Pain Self-Efficacy Questionnaire (PSEQ), Coping Strategies Questionnaire (CSQ), and Fear-Avoidance Beliefs Questionnaire (FABQ). The results showed that all three interventions led to improvements in pain self-efficacy and catastrophizing at post 12 weeks, with yoga and PT groups showing clinically meaningful improvements in self-efficacy. These improvements were generally sustained at 52 weeks. However, there were no significant between-group differences in cognitive appraisal measures. The study also found that individuals with clinically meaningful improvements in cognitive appraisal demonstrated greater concurrent improvements in pain and disability during the 12-week treatment phase.¹⁹¹
5. **Groessl et al., (2020)** lead a study to examine the cost-effectiveness analysis of yoga as a treatment for chronic low back pain (cLBP) in military veterans. The study is based on data from a randomized controlled trial (RCT) involving 150 US military veterans with cLBP. Participants were assigned to either a 12-week yoga intervention or a delayed treatment (DT) group. The yoga intervention consisted of twice-weekly, 60-minute yoga sessions for post 12 weeks, including yoga postures, movement sequences, breathing techniques, focused attention, and brief periods of meditation. The cost-effectiveness analysis was conducted from both organizational and societal perspectives. From the organizational perspective, the incremental cost-effectiveness ratio (ICER) for providing yoga was \$4,488 per quality-adjusted life year (QALY) gained. This is well below the commonly accepted threshold of \$50,000 per QALY, indicating that yoga is highly cost-effective. From the societal perspective, which included lost productivity costs, yoga was found to be 'dominant,' providing both health benefits and cost savings. The study revealed several unique and interesting

insights. Firstly, the cost of delivering the yoga intervention was relatively low, at \$307 per participant, yet it produced significant health benefits. Secondly, the study found that yoga could potentially be delivered at a much lower cost than physical therapy for cLBP, while producing similar health outcomes. Finally, the study's findings align well with previous research on non-veteran populations, suggesting that yoga's cost-effectiveness for cLBP treatment may be generalizable across different populations.¹⁹²

6. **C. T. Joyce et al., (2022)** carried a research study investigating whether physical therapy (PT) and yoga improve pain and disability in adults with chronic low back pain through psychological mechanisms. The study utilized data from a randomized controlled trial comparing PT, yoga, and education interventions. The primary outcomes were changes in back-related pain and disability measured at 52 weeks after randomization. The researchers hypothesized that psychological factors such as pain self-efficacy, fear-avoidance beliefs, depression, anxiety, perceived stress, and sleep quality might mediate the effects of the interventions. The study analyzed data from 230 adults with chronic low back pain, predominantly female (69.6%) and non-White (79.6%). The researchers used causal mediation analysis to estimate the total effect, direct effect, indirect effect, and proportion mediated for each potential psychological mediator. The analysis revealed that improvements in perceived stress mediated about 34% of the effect of PT compared to education on disability outcomes. Specifically, the total effect of PT on disability was 2.6 points, with an indirect effect through perceived stress of 0.9 points. No other psychological construct was found to be a significant mediator for PT or yoga interventions compared to education.¹⁹³
7. **Poojari et al., (2024)** with a randomized controlled pilot study investigating the effectiveness of an integrated approach to yoga therapy (IAYT) compared to usual care for managing chronic low back pain (CLBP). The study enrolled 29 adult patients with non-specific CLBP, randomly divided into two groups: the yoga group receiving IAYT as an adjunct to usual care, and the control group receiving only usual care. The primary outcomes were pain intensity assessed by the verbal numerical rating scale (VNRS) and functional ability assessed by the Modified Oswestry Disability Index (MODI). Secondary outcomes included pain catastrophizing, quality of life, fear of movement related to CLBP, type of pain, and levels of certain biomarkers. All parameters were measured at baseline, 1 month, and 3 months. The results showed a significant decrease in VNRS scores at 1 and 3 months in both

groups, with the yoga group demonstrating a more significant reduction in pain over time ($p=0.036$). MODI improved significantly only in the yoga group at 1 and 3 months, with intergroup comparison revealing significantly better MODI over time in the yoga group ($p<0.001$). Secondary outcomes such as DN4, PDQ, PCS, HADS (anxiety), and Euro QOL showed statistically significant improvements at 1 and 3 months in the yoga group compared to the control group. The HADS (depression) scores were significantly reduced in the yoga group at 3 months compared to the control group ($p=0.012$). Additionally, there was a significant reduction in TNF- α values in the yoga group compared to baseline ($p=0.004$).¹⁹⁴

8. **Tankha et al., (2024)** organised a randomized clinical trial investigating the effectiveness of virtual yoga classes for chronic low back pain (CLBP) among adults in a health system employee population. 140 participants aged 18-64 were randomly assigned to either a 12-week virtual yoga intervention (yoga now group) or a wait-list control (yoga later group). The study found that participants in the yoga now group experienced significantly greater improvements in pain intensity and back-related function compared to the control group. These improvements were maintained at the 24-week follow-up. Additionally, the yoga group reported reduced pain medication use and improved sleep quality. The improvements in pain intensity and back-related function were even greater than those observed in previous in-person yoga trials for CLBP.¹⁹⁵
9. **Brämberg et al., (2017)** evaluated the impact of early interventions for non-specific low back pain (LBP) and neck pain among working populations. The study compared three interventions: kundalini yoga, strength training, and evidence-based advice (control group). The primary outcome was sickness absenteeism (SA), while secondary outcomes included sickness presenteeism (SP), back and neck pain intensity, and disability. The study involved 159 participants, predominantly with chronic low back pain, who were randomized into the three groups and followed up for 12 months. The initial results showed no statistically significant differences between the intervention groups and the control group for the primary outcome of SA. However, some significant effects were observed for the secondary outcomes. Yoga showed a significant effect on reducing neck disability, while strength training demonstrated significant effects on reducing both back pain intensity and neck disability compared to the control group. The study also found an interaction effect

between adherence to treatment recommendations and SA, indicating larger significant effects among those who adhered to the interventions.¹⁹⁶

10. **Groessler et al., (2017)** investigated the effectiveness of yoga for military veterans with chronic low back pain (cLBP). 150 veterans' participants were randomly assigned to either a yoga intervention group or a delayed treatment (DT) comparison group. The yoga intervention consisted of twice-weekly classes for post 12 weeks, focusing on physical postures, movement, and breathing techniques. Outcomes were assessed at baseline, 6 weeks, post 12 weeks, and 6 months. The primary outcome measure was the Roland-Morris Disability Questionnaire (RMDQ) score, with pain intensity as an important secondary outcome. Results showed that while there were no significant differences between groups at post 12 weeks, the yoga group demonstrated significantly greater improvements in RMDQ scores at 6 months compared to the DT group. The yoga group also showed greater reductions in pain intensity at all-time points. Notably, opioid medication use declined among all participants, although no significant differences were found between groups.¹⁹⁷
11. **Roseen et al., (2020)** presented a secondary analysis of a randomized controlled trial (RCT) examining the effects of yoga, physical therapy (PT), and education on sleep quality in adults with chronic low back pain (cLBP). The study involved 320 participants, predominantly low-income and racially diverse, who were randomized to receive post 12 weeks of yoga classes, one-on-one PT sessions, or an educational book. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) at baseline, post 12 weeks, and 52 weeks. At baseline, nearly all participants (92%) reported poor sleep quality. After post 12 weeks, modest improvements in sleep quality were observed in both the yoga and PT groups compared to the education group, although these differences were not statistically significant. By 52 weeks, the yoga group showed significantly better sleep quality improvements compared to the education group. Importantly, participants who experienced clinically meaningful improvements in pain or physical function at 6 weeks were more likely to report improved sleep quality at post 12 weeks, regardless of their assigned intervention.¹⁹⁸
12. **Oz & Ulger, (2024)** investigating the effects of yoga, physical therapy (PT), and home exercise (HE) on chronic low back pain (cLBP). The study involved 54 participants randomly assigned to three treatment groups: PT (spinal stabilization exercises with heat and electrical stimulation), HE (spinal stabilization exercises at home), and yoga. The primary outcome measures were pain intensity (Visual Analog

Scale) and disability (Oswestry Disability Index). Secondary outcomes included pain-related fear, anxiety, pain sensitivity, central sensitization, stress levels, and quality of life. The results showed that all three interventions led to improvements in pain intensity, disability, pain sensitivity, central sensitization, anxiety, transversus abdominis muscle activation, and quality of life. The PT group demonstrated more significant improvement in disability scores compared to the other groups. Cortisol levels decreased only in the PT group. The interventions did not affect DHEA-S levels and sleep quality.¹⁹⁹

13. **Ulger et al., (2023)** with a randomized crossover study comparing the effects of yoga and stabilization exercises on patients with chronic low back pain (CLBP). The study involved 28 female participants divided into two groups, with one group starting with stabilization exercises followed by yoga, and the other group starting with yoga followed by stabilization exercises. The interventions lasted for 8 weeks each, with a 2-week washout period in between. The study evaluated various outcome measures including pain intensity, functional status, transversus abdominis (TrA) muscle activation, metabolic capacity, kinesiophobia, and sleep quality. The results showed that both yoga and stabilization exercises had positive effects on pain, functional status, TrA muscle activation, metabolic capacity, and sleep quality in individuals with CLBP. However, stabilization exercises were found to be more effective in increasing TrA muscle activation compared to yoga. Neither intervention had a significant effect on kinesiophobia. The study also found that both interventions improved the 6-minute walk test (6MWT) distance, indicating an increase in metabolic capacity.²⁰⁰
14. **Yildirim & Gultekin, (2022)** in a randomized controlled trial investigated the effect of a stretch and strength-based yoga exercise program on neuropathic pain due to lumbar disc herniation (LDH). The study involved 48 female patients with neuropathic pain caused by LDH, randomly assigned to a control group and a yoga group. The yoga group participated in a 12-week program of one-hour sessions twice weekly, while both groups received patient education. The primary outcomes were neuropathic pain intensity and patient global assessment, with secondary outcomes including disability and functional tests. The results showed statistically significant improvements in the yoga group compared to the control group after the 12-week intervention. The yoga group demonstrated reduced neuropathic pain, improved patient global assessment scores, decreased low back pain, reduced disability, and

enhanced function. These improvements were maintained at the three-month and six-month follow-ups. The between-group effect sizes were moderate for most outcome measures at the six-month follow-up.²⁰¹

15. **Berlowitz et al., (2020)** conduct a secondary analysis of a randomized controlled trial investigating the effects of yoga and physical therapy (PT) on perceived stress in adults with chronic low back pain (cLBP). The study, known as the Back to Health Study, involved 320 predominantly low-income and racially diverse participants who were randomly assigned to post 12 weeks of yoga, PT, or education (control group). The primary outcome measure was the change in the 10-item Perceived Stress Scale (PSS-10) scores from baseline to 12 and 52 weeks. The results showed that both yoga and PT were more effective than education in reducing perceived stress at post 12 weeks. The effect was particularly pronounced among participants with elevated pre-intervention stress levels. While improvements in stress were maintained over the 52-week period, the difference between yoga/PT and education groups was no longer statistically significant at this time. The study also found weak correlations between improvements in pain/function and reductions in perceived stress, suggesting that other aspects of these treatments may contribute to stress reduction.²⁰²
16. **Roseen et al., (2023)** compared the effectiveness of yoga versus education for Veterans with chronic low back pain (cLBP). The study, titled 'Yoga Versus Education for Veterans with Chronic Low Back Pain: a Randomized Controlled Trial', was conducted by a team of researchers led by Eric J. Roseen. The trial involved 120 Veterans with cLBP who were randomly assigned to either 12 weekly hatha yoga classes or education using The Back Pain Helpbook. The primary outcomes measured were changes in back-related disability using the Roland Morris Disability Questionnaire (RMDQ) and pain intensity using the Defense & Veterans Pain Rating Scale (DVPRS). The results of the study showed that yoga was not significantly more effective than education in improving pain or disability outcomes among the participants. At post 12 weeks, there were no significant differences between the yoga and education groups in terms of reductions in back-related disability or pain intensity. However, more participants in the yoga group reported being 'very much improved' or 'extremely improved' (39% vs 19%) and 'very satisfied' with the treatment (60% vs 31%) compared to the education group. The study also found no differences in pain medication use or post-traumatic stress symptoms

between the two groups at post 12 weeks. No serious adverse events were reported in either group.²⁰³

17. **McCarthy et al., (2022)** examined the effect of yoga military veterans with chronic low-back pain (CLBP). The 12-week yoga intervention measured outcomes at baseline, 6 weeks, post 12 weeks, and 6 months. This suggests that yoga may work by reducing both pain and fatigue, which in turn contributes to reductions in disability.²⁰⁴
18. **Williams et al., (2005)** conducted a randomized controlled trial investigating the effect of Iyengar yoga therapy on chronic low back pain (CLBP). The study compared a 16-week Iyengar yoga intervention to an educational control group. The primary outcome was functional disability, with secondary outcomes including pain intensity, pain medication usage, pain-related attitudes and behaviors, and spinal range of motion. The study involved 60 subjects with non-specific CLBP, of which 42 completed the study. The yoga intervention consisted of 29 standardized postures, focusing on correcting imbalances in muscles affecting spinal alignment and posture. The results showed significant improvements in the yoga group compared to the control group. The yoga group reported greater reductions in functional disability (77% vs 39.6%), pain intensity (64% vs 31%), and pain medication usage (88% vs 35%). These improvements were maintained at the 3-month follow-up assessment. This study is the potential of Iyengar yoga as a complementary therapy for CLBP management. The study demonstrated that even a relatively short (16-week) yoga intervention could lead to significant and lasting improvements in pain and functional disability.²⁰⁵
19. **Singphow et al., (2022)** conducted a research study to evaluate the effects of yoga on stress, anxiety, depression, and spinal mobility in computer users with chronic low back pain (CLBP). The study was conducted as a randomized control trial involving 80 computer users from Bengaluru, India, who were divided into two groups: a yoga group and a physical exercise group. The yoga group practiced an integrated module of yoga postures and mindfulness meditation, while the physical exercise group performed exercises designed for low back pain. Both groups followed their respective programs for 16 weeks, with sessions lasting 1 hour, 3 days per week. The study utilized the Depression Anxiety Stress Scale-42 (DASS-42) to assess psychological parameters and a dial-type goniometer to measure spinal mobility. The integration of mindfulness meditation with yoga postures appears to offer a more comprehensive approach to addressing both physical and psychological aspects of

CLBP. The study suggests that yoga's effectiveness may be attributed to its ability to downregulate the hypothalamic-pituitary-adrenal axis and promote parasympathetic nervous system dominance.²⁰⁶

20. **Lee et al., (2014)** investigated the effect of yoga on chronic low back pain in premenopausal women, focusing on pain intensity, brain-derived neurotrophic factor (BDNF), and serotonin levels. The study involved 43 premenopausal women with chronic low back pain, divided into a yoga group (n=23) and a control group (n=20). The yoga group participated in a 12-week Hatha yoga program, consisting of three one-hour sessions per week. The program included warm-up, yoga poses, and relaxation/meditation. The primary outcomes measured were back pain intensity using the visual analogue scale (VAS), serum BDNF levels, and serum serotonin levels. Secondary outcomes included back flexibility and depression levels. After the 12-week intervention, the yoga group showed significant improvements in back pain intensity, flexibility, and serum BDNF levels. The control group, on the other hand, experienced increased pain and decreased serum serotonin levels.²⁰⁷
21. **Tekur et al., (2010)** carried out a randomized control study to examine the effect of yoga on the quality of life (QOL) in patients with chronic lower back pain (CLBP). The study involved 80 patients divided into two groups: a yoga group and a control group practicing physical therapy exercises. Both groups underwent a week-long residential intensive program. The study aimed to compare the effects of yoga with physical therapy exercises on QOL and to investigate the baseline correlations between QOL and stress scores. The results showed significant improvements in all domains of QOL (physical health, psychological health, social relationships, and environmental health) in the yoga group compared to the control group. The yoga group also demonstrated better improvement in spinal flexibility as measured by the SLR test. Interestingly, the study found a significant negative correlation between baseline stress levels and QOL scores, indicating that higher stress levels were associated with lower quality of life in CLBP patients.²⁰⁸
22. **Tekur et al., (2008)** conducted a randomized controlled study for evaluating the effect of a short-term intensive residential yoga program on pain, functional disability, and spinal flexibility in patients with chronic low back pain (CLBP). The study involved 80 subjects with CLBP, divided into two groups: an experimental group that underwent a yoga-based program and a control group that received a non-yogic physical exercise-based intervention. The yoga intervention consisted of various

practices including asanas (physical postures), pranayamas (breathing practices), meditation, and didactic sessions on yoga philosophy. The control group practiced physical exercises under a trained physiatrist and had sessions on lifestyle changes. The study measured outcomes using the Oswestry Disability Index (ODI) for functional disability and a goniometer for spinal flexibility. Results showed a significant reduction in ODI scores in the yoga group compared to the control group, indicating a shift from moderate to mild disability. The yoga group also demonstrated significant improvements in spinal flexibility measures, including spinal flexion, extension, and lateral flexion, with higher effect sizes compared to the control group.²⁰⁹

23. **Tilbrook et al., (2011)** administered a randomized controlled trial to assess the effectiveness of yoga for chronic or recurrent low back pain. The study, conducted from April 2007 to March 2010, involved 313 adults with chronic or recurrent low back pain. Participants were randomly assigned to either a yoga group (n=156) or a usual care group (n=157). The yoga intervention consisted of a 12-week program with weekly 75-minute classes, while the usual care group received only a back pain education booklet. The primary outcome measure was back function, assessed using the Roland-Morris Disability Questionnaire (RMDQ) at 3, 6, and 12 months. Secondary outcomes included pain, pain self-efficacy, and general health measures. The results showed that the yoga group had significantly better back function than the usual care group at all-time points. At 3 months, the adjusted mean RMDQ score was 2.17 points lower in the yoga group, with improvements maintained at 6 and 12 months. While there was no significant difference in back pain and general health scores between the groups, the yoga group demonstrated higher pain self-efficacy scores at 3 and 6 months.²¹⁰
24. **Sherman et al., (2013)** conducted a study on the effect of yoga and stretching for chronic low back pain. The study was conducted as part of a large trial comparing yoga, intensive stretching, and self-care for treating chronic low back pain. The researchers explored various potential mediators, including physical factors (hours of back exercise), cognitive factors (fear avoidance, body awareness, and self-efficacy), affective factors (psychological distress, perceived stress, positive states of mind, and sleep), and physiological factors (cortisol, DHEA). The study involved 228 participants randomized into yoga, stretching, and self-care groups. The primary outcome measure was the Roland-Morris Disability Questionnaire (RDQ) for back-

related dysfunction. The researchers used both quantitative and qualitative methods to analyze the data. The quantitative analysis focused on identifying mediators that explained the effects of yoga and stretching on back dysfunction. The qualitative analysis involved coding open-ended responses from participants about their experiences in the yoga and stretching classes.²¹¹

25. **Neyaz et al., (2019)** investigated effectiveness of Hatha yoga versus conventional therapeutic exercises (CTEs) for chronic nonspecific low-back pain (CNLBP). The study was conducted at a tertiary care hospital in India, involving 70 participants aged 18-55 years with CNLBP persisting for at least post 12 weeks. The trial consisted of a 6-week intervention period followed by a 6-week follow-up period. Participants were randomly assigned to either a yoga group or a CTE group, each receiving six standardized 35-minute weekly sessions and instructions for home practice. The primary outcome measures were back pain intensity, assessed using the Defense and Veterans Pain Rating Scale (DVPRS), and back-related dysfunction, and evaluated using the Roland Morris Disability Questionnaire (RDQ). Secondary outcomes included pain medication usage and perceived recovery. Assessments were conducted at baseline, 6 weeks, and post 12 weeks. The results showed significant improvements in back pain intensity and back-related dysfunction within both groups at 6 and post 12 weeks compared to baseline. However, no statistically significant differences were observed between the yoga and CTE groups in terms of pain intensity, back-related dysfunction, pain medication usage, or perceived recovery.²¹²
26. **Patil et al., (2018)** compared the effects of yoga and physical exercises on the quality of life (QOL) among nursing professionals suffering from chronic low back pain (CLBP). The study involved 88 female nurses from a tertiary care hospital in South India, divided into two groups: yoga (n=44) and physical exercise (n=44). The yoga group practiced an integrated yoga therapy module (IYTM) for 1 hour per day, 5 days a week, for 6 weeks, while the exercise group performed physical exercises for the same duration and frequency. The study used the World Health Organization Quality of Life-brief (WHOQOL-BREF) questionnaire to assess QOL before and after the intervention. The results showed significant improvements in physical, psychological, and social domains of QOL in both groups, with the yoga group demonstrating higher percentage improvements compared to the exercise group. The environmental domain did not show significant changes in either group. The authors suggest that the

superior effects of yoga may be due to its holistic approach, addressing not only physical aspects but also psychological and social factors.²¹³

27. **Arya et al., (2022)** conducted a research study on the effects of Medical Yoga Therapy (MYT) on chronic low back pain (CLBP). The study, conducted at the All India Institute of Medical Sciences (AIIMS), New Delhi, aimed to objectively assess the impact of MYT on pain relief and quality of life in CLBP patients. The researchers employed both subjective and objective measures to evaluate the effectiveness of MYT compared to Standard Care Therapy (SCT). Subjective assessments included Visual Analogue Scale (VAS), McGill Pain questionnaire, and WHOQOL BREF questionnaire. Objective measures involved the Nociceptive Flexion Reflex (NFR) and Diffuse Noxious Inhibitory Control (DNIC) tests. The study randomly allocated 108 CLBP patients to MYT (n=58) and SCT (n=50) groups, with assessments conducted at baseline, 4 weeks, and 8 weeks of intervention. Results showed significant improvements in the MYT group compared to the SCT group. MYT patients experienced reduced pain scores, improved quality of life, and decreased medication intake. Objectively, the NFR thresholds increased significantly in the MYT group, indicating reduced pain sensitivity. The DNIC test revealed improved descending pain modulation in MYT patients. Physiological parameters such as body weight, blood pressure, and heart rate also showed significant improvements in the MYT group.¹³⁶

28. **Michalsen et al., (2021)** conducted a three-armed randomized controlled trial to compare the effects of yoga, eurythmy therapy, and conventional physiotherapy on chronic non-specific low back pain. The study involved 274 participants who were randomly assigned to one of the three interventions, each lasting 8 weeks with group sessions of 75 minutes once per week. The primary outcome was physical disability measured by the Roland Morris Disability Questionnaire (RMDQ), while secondary outcomes included pain intensity, pain-related bothersomeness, health-related quality of life, and life satisfaction. The results showed no significant differences between the three groups for the primary and secondary outcomes. All interventions led to comparable improvements in RMDQ scores, pain intensity, and pain-related bothersomeness, as well as increases in quality of life. However, the within-group effect sizes were small to moderate and did not reach clinical meaningfulness for physical disability. Exploratory analysis suggested that eurythmy therapy might have

a potential advantage in improving mental health-related quality of life compared to physiotherapy.²¹⁴

29. **Bhatta et al., (2015)** a study on the effects of an Integrated Approach of Yoga Therapy (IAYT) on chronic low back pain (CLBP). The research was conducted at the Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA) University in Bengaluru, India. The study involved 35 patients with CLBP who underwent a 7-day intensive residential IAYT program. The program included a combination of Asanas (physical postures), Pranayama (breathing practices), meditation, and interactive sessions on yoga philosophy. The researchers used three assessment tools to measure the effectiveness of the IAYT program: the modified Roland-Morris Disability Questionnaire (RMDQ), the Beck Depression Inventory (BDI), and the Straight Leg Raising (SLR) Test. These tests were administered before and after the 7-day program. The results showed significant improvements in all measured areas. There was a 54.13% decrease in RMDQ scores, indicating reduced disability, a 71.47% decrease in BDI scores, suggesting reduced depression, and a 36.46% increase in right SLR and 36.04% increase in left SLR scores, indicating improved spinal mobility.²¹⁵
30. **Adhikari et al., (2022)** organised a feasibility study on yoga's mechanism of action for chronic low back pain (cLBP). The study aimed to examine the feasibility and acceptability of a yoga research protocol and investigate the preliminary effects of yoga on psychological and neurophysiological functions, including gene expression and DNA methylation profiles, in participants with cLBP. The research involved 11 participants who underwent a 12-week yoga intervention, with data collected on pain characteristics, quantitative sensory testing, and blood samples for genetic analysis before and after the intervention. The results of the study demonstrated that the yoga intervention was feasible and highly acceptable to participants. There was a reduction in pain severity, interference, and mechanical pain sensitivity post-yoga, along with an increase in emotion regulation and self-efficacy.²¹⁶
31. **Starkweather et al., (2024)** conducted a study focused on investigating the relationship between yoga practice, emotion regulation (ER), and chronic low back pain (CLBP). The study is designed as a 2-arm parallel group blinded randomized controlled trial involving 204 adults with CLBP. Participants will be randomly assigned to either a yoga intervention group (n=102) or a control group practicing stretching and strengthening exercises (n=102). Both interventions will be delivered through web-based synchronous biweekly 75-minute sessions over post 12 weeks,

with participants encouraged to practice for 25 minutes on other days using prerecorded videos. Assessments will be conducted at five time points: baseline, mid-intervention (6 weeks), post-intervention (post 12 weeks), and 3- and 6-month follow-ups.²¹⁷

32. Galantino et al., (2004) conducted a pilot study investigating the impact of modified Hatha yoga on chronic low back pain (CLBP). The study, conducted by Mary Lou Galantino and colleagues, aimed to evaluate a 6-week yoga protocol for individuals with CLBP. The research involved 22 participants aged 30-65 years, randomized into a yoga intervention group and a control group. The yoga protocol, designed by experts, included various postures adapted for the CLBP population and was administered twice a week for 6 weeks. The study utilized several measurement tools to assess the effectiveness of the intervention. These included the Oswestry Disability Index (ODI), Beck Depression Inventory (BDI), Sit and Reach Test (SR), and Functional Reach Test (FR). Qualitative data was also collected through participant journals and a 3-month follow-up survey. The results, while not statistically significant due to the small sample size, showed potentially important trends. The yoga group demonstrated improved balance and flexibility, and decreased disability and depression compared to the control group. The qualitative data revealed that participants found the group intervention motivating and that yoga fostered relaxation and new awareness.²¹⁸

2.2.2 Review on Yoga and Inflammatory markers:

1. **Twal et al., (2016)** administered a pilot randomized controlled trial investigated the effects of Yogic breathing (YB) on pro-inflammatory biomarkers in saliva. The study involved 20 healthy volunteers randomly assigned to either a Yogic Breathing group or an Attention Control (AC) group. The YB group performed two YB exercises for 20 minutes, while the AC group engaged in quiet reading. Saliva samples were collected at 0, 5, 10, 15, and 20 minutes and analyzed using a Cytokine Multiplex assay to measure levels of various pro-inflammatory biomarkers. The results showed significant reductions in the levels of interleukin-1 β (IL-1 β), interleukin-8 (IL-8), and monocyte chemoattractant protein-1 (MCP-1) in the YB group compared to the AC group. IL-8 levels were significantly lower at all-time points in the YB group, while IL-1 β showed reduction at 15 and 20 minutes. MCP-1 levels were marginally

different between the groups from 5 to 20 minutes. Other cytokines analyzed (IL-1RA, IL-6, IL-10, IL-17, IP-10, MIP-1b, and TNF-alpha) did not show significant differences between the groups.²¹⁹

2. **Maniaci et al., (2024)** conducted a pilot randomized controlled trial (RCT) to evaluate the neurobiological and anti-inflammatory effects of a neofunctional deep breathing (NDB) technique based on Neofunctional Psychotherapy. The study aimed to examine the feasibility of using NDB to reduce allostatic load following the Trier Social Stress Test (TSST) in healthy subjects. The study involved 44 healthy participants randomized into experimental and control groups. After undergoing the TSST procedure, participants either received a single session of NDB or an attention control intervention. Various physiological parameters were measured, including breath per minute (BPM), respiratory amplitude, heart rate variability (HRV), skin conductance, and muscle activity. Additionally, salivary cortisol and cytokine concentrations, perceived stress, and anxiety levels were assessed. These parameters were combined into an allostatic load index (ALI) to measure the intervention's effect. The results showed that the NDB group experienced a reduction in ALI, increased respiratory abdominal amplitude, decreased BPM, increased HRV indicating parasympathetic activation, and decreased cortisol and inflammatory cytokines. The study demonstrated the feasibility of the experimental design and the practicality of the NDB intervention in reducing allostatic load through neurobiological and anti-inflammatory responses after exposure to acute stress.²²⁰
3. **Shah et al., (2022)** conducted interventions which included various forms of yoga, meditation, and pranayama, either alone or in combination. The duration of interventions ranged from 20 minutes to 28 weeks. The review identified 25 biomarkers that showed favorable changes in response to these interventions. Among clinical participants, significant decreases were observed in several inflammatory markers, including IL-6, TNF- α , and cortisol. In healthy participants, increases in anti-inflammatory markers like IL-10 and IgA were noted, along with decreases in pro-inflammatory markers. Pregnant women showed increased IgA and decreased cortisol levels. The meta-analysis focused on three biomarkers: IL-6, TNF- α , and cortisol. While the overall results showed a decrease in these markers, only TNF- α demonstrated a statistically significant reduction. Subgroup analysis revealed that specific combinations of interventions and durations were more effective in reducing these biomarkers. The review suggests that yoga, meditation, and pranayama

interventions may have potential benefits for COVID-19 patients by modulating inflammatory responses. However, the authors note significant heterogeneity among studies and recommend further research, particularly RCTs involving COVID-19 patients.²²¹

4. **Mullapudi et al., (2023)** examined the effects of a six-month yoga intervention on the immune-inflammatory pathway in schizophrenia patients stabilized on antipsychotic medication. The research was conducted as a randomized controlled trial involving 60 schizophrenia patients, divided into two groups: yoga therapy (YT) and treatment-as-usual (TAU). The study aimed to explore the biological mechanisms of yoga therapy in schizophrenia, focusing on its impact on immune function. The results showed significant reductions in plasma TNF- α and IL-5 levels in the yoga therapy group, along with greater clinical improvements in various symptom scores compared to the TAU group. Notably, plasma TNF- α level exhibited a positive correlation with negative symptoms and socio-occupational functioning in the YT group.²²²
5. **Muñoz-Vergara et al., (2022)** evaluated the acute effects of high and moderate intensity yoga exercise on circulating inflammatory mediators in healthy, yoga-naïve adults. The study was designed as a three-arm, pre-post randomized controlled trial (RCT) with 30 participants divided into high-intensity yoga (HY), moderate-intensity yoga (MY), and sedentary control (CON) groups. The primary aim was to evaluate the feasibility of conducting a full-scale RCT, while the secondary aim was to preliminarily characterize the temporal responses of systemic circulatory cytokines to yoga exercise. The study protocol involved a single 60-minute yoga session for the exercise groups, with blood samples collected at baseline and six timepoints post-intervention (0-, 30-, 60-, 120-, 180-minutes, and 24-hours). A panel of 13 inflammatory cytokines was analysed, along with heart rate monitoring and assessment of body soreness. The study demonstrated feasibility in terms of recruitment, retention, and adherence to the yoga protocol. Cytokine levels showed heterogeneous responses within and between groups, with exploratory analyses revealing trends toward group-by-time effects for some cytokines (e.g., IFN- α 2, IL-6, and IL-33). Correlation analyses suggested coordinated and inter-dependent post-interventional changes across different cytokines in the yoga groups.²²³
6. **Mishra et al., (2024)** examined the effects of yoga on inflammatory markers and immune function in a systematic review and meta-analysis. The study analysed 26 randomized controlled trials (RCTs) involving 2,091 participants with various health

conditions, including cancer, rheumatoid arthritis, heart failure, and healthy individuals. The review aimed to evaluate whether yoga practice, including yogic meditation and breathing, impacts levels of inflammatory cytokines and other inflammatory markers compared to usual care or sham interventions. The most commonly reported inflammatory markers in the studies were IL-6, TNF- α , and C-reactive protein (CRP). The majority of studies (24 out of 26) reported favorable outcomes with yoga intervention, regardless of the type of yoga used, the condition studied, or the duration of the intervention. Some studies also showed significant improvements in markers of cellular immunity and mucosal defense. However, the quality of evidence was generally poor, with considerable heterogeneity among the studies. Only two studies had a low risk of bias, while 24 others had a high risk of bias.²²⁴

7. **Pullen et al., (2008)** conducted a study on the effects of yoga on inflammation and exercise capacity in patients with chronic heart failure (HF). The study involved 19 patients with New York Heart Association Class I-III HF, who were randomized into two groups: yoga treatment (YT) and standard medical therapy (MT). The study measured several parameters, including a graded exercise test to determine VO₂Peak, serum biomarkers (IL-6, hsCRP, and EC-SOD), and quality of life using the Minnesota Living with Heart Failure Questionnaire (MLHFQ). The results showed significant improvements in the yoga group compared to the control group. The yoga treatment group experienced an 18% increase in treadmill time and a 17% increase in VO₂Peak, while the control group showed decreases in both parameters. Additionally, the yoga group showed significant reductions in inflammatory markers IL-6 and hsCRP, and an increase in EC-SOD levels. The MLHFQ scores also improved by 25.7% in the yoga group compared to a 2.9% increase in the control group.²²⁵
8. **Yadav et al., (2012)** studied on the efficacy of a short-term yoga-based lifestyle intervention in reducing stress and inflammation. The study involved 86 participants with chronic diseases or who were overweight/ obese, and lasted for 10 days. The intervention program included asanas (postures), pranayama (breathing exercises), stress management, group discussions, lectures, and individualized advice. The researchers measured markers of stress (plasma cortisol and β -endorphin) and inflammation (interleukin-6 and tumor necrosis factor- α) at the beginning and end of the intervention. The results showed significant reductions in stress and inflammation

markers. Specifically, cortisol levels decreased while β -endorphin levels increased, indicating reduced stress. Additionally, both IL-6 and TNF- α levels decreased, suggesting a reduction in inflammation.²²⁶

9. **Vijayaraghava et al., (2015)** conducted a study to examine the effect of yoga practice on inflammatory markers after moderate and strenuous exercise. The study involved 218 participants, divided into two groups: 109 yoga practitioners and 109 non-yoga practitioners. The researchers measured levels of Tumour Necrosis Factor alpha (TNF- α) and Interleukin-6 (IL-6) in both groups before and after moderate and strenuous exercise challenges. The study found that yoga practitioners had significantly lower resting levels of TNF- α compared to non-yoga practitioners. After both moderate and strenuous exercise, the yoga group showed a smaller increase in both TNF- α and IL-6 levels compared to the non-yoga group. This suggests that regular yoga practice may help reduce inflammatory responses to physical stress.¹³¹
10. **Shete et al., (2017)** investigated the effects of yoga training on inflammatory cytokines and C-reactive protein in employees of small-scale industries. The study involved 48 male participants aged 30-58 years who were exposed to occupational hazards. The participants were randomly divided into an experimental group that underwent a 3-month yoga training intervention and a wait-list control group. The yoga training protocol included various asanas and pranayama practices for 1 hour, 6 days a week. Blood samples were collected before and after the intervention to measure lipid profile, interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF- α), and high-sensitivity C-reactive protein (hs-CRP). The results showed significant improvements in the experimental group for several parameters. There were highly significant changes in cholesterol, HDL, LDL, hs-CRP, IL-6, and TNF- α level in the yoga group. Comparison between the experimental and control groups revealed significant changes in cholesterol, LDL, IL-6, TNF- α , and hs-CRP. These findings suggest that yoga-based lifestyle intervention can favorably alter inflammatory markers and metabolic risk factors in individuals exposed to occupational hazards.²²⁷
11. **Gautam et al., (2021)** evaluated the effects of 8-week yoga practice with a randomized controlled trial on mitochondrial health and disease severity in patients with rheumatoid arthritis (RA). The study involved 70 participants divided into yoga and non-yoga groups. The researchers examined various markers of mitochondrial health, oxidative stress, circadian rhythm, and disease activity before and after the intervention. The results showed significant improvements in the yoga group

compared to the control group. Yoga practice led to a decrease in reactive oxygen species (ROS) levels and an increase in total antioxidant capacity (TAC). Mitochondrial activity markers, including NAD⁺ levels and COX-II activity, were significantly improved in the yoga group. The study also found an increase in mitochondrial DNA copy number (mtDNA-CN) and mitochondrial membrane potential ($\Delta\Psi_m$) in the yoga group. Additionally, there was an upregulation of genes associated with mitochondrial integrity, such as AMPK, TIMP-1, KLOTHO, and TFAM. The yoga intervention also positively impacted circadian rhythm markers, with a decrease in cortisol levels and increases in melatonin and serotonin levels.²²⁸

12. **Chen et al., (2016)** conducted a study to find out the effects of 8-week hatha yoga training program on metabolic and inflammatory markers in healthy, female Chinese subjects. The study involved 30 participants who were randomly assigned to either a control group or a yoga practice group. The yoga intervention consisted of 16 sessions over 8 weeks, with each session lasting 60 minutes and including various yoga components such as breathing exercises, loosening exercises, and different yoga poses. The researchers measured several primary and secondary outcomes, including plasma insulin levels, clinical biomarkers (glucose, lipid profiles), endothelial microparticles (EMPs), and inflammatory markers. Blood samples were collected before and after the yoga intervention for analysis. The study found significant reductions in plasma insulin, total cholesterol, and LDL-cholesterol levels in the yoga group compared to the control group. Additionally, the yoga practice led to a decrease in circulating CD31⁺/CD42b⁻ EMPs, which are markers of endothelial cell apoptosis. The study also examined the effects of yoga on inflammatory responses using whole blood culture experiments. The results showed that the yoga group had reduced secretion of pro-inflammatory cytokines (IL-6, TNF- α , and IL-1 β) both at baseline and when stimulated with a TLR2 agonist. This was associated with a reduction in TLR2 protein expression in peripheral blood mononuclear cells (PBMCs) after yoga training. One of the unique insights from this study is the potential of Hatha yoga to improve markers related to metabolic syndrome in healthy individuals, suggesting its value as a preventive intervention. The research also provides novel evidence on the effects of yoga on endothelial microparticles and TLR2-mediated inflammatory responses, which have not been extensively studied in the context of yoga practice. These findings open up new avenues for understanding the physiological mechanisms

through which yoga may exert its beneficial effects on cardiovascular and metabolic health.²²⁹

13. **Harkess et al., (2016)** investigated the effects of yoga on inflammatory markers and DNA methylation in chronically stressed women. The study involved a subsample of 28 participants from a larger randomized waitlist control trial of 116 women reporting psychological distress. The researchers measured protein levels of interleukin-6 (IL-6), tumor necrosis factor (TNF), and C-reactive protein (CRP), as well as DNA methylation of these genes and the global indicator LINE-1. The study design included both cross-sectional and longitudinal analyses. Participants engaged in an 8-week yoga intervention, attending at least one hour-long class per week. Blood samples were collected at multiple time points to assess changes in inflammatory markers and DNA methylation patterns. The researchers also explored correlations between biochemical outcomes and psychological variables such as perceived stress, psychological distress, and positive affect. The results indicated that participation in the yoga intervention was associated with some changes in immune protein and DNA methylation biomarkers. Notably, the yoga group demonstrated lower DNA methylation of the TNF region as a whole and at specific sites compared to the control group. This finding was supported by decreased methylation observed in the longitudinal analysis of the waitlist control group after they completed the yoga intervention. While the study did not find significant associations between yoga and serum measures of inflammation, it reported meaningful effect sizes in both protein and methylation analyses.²³⁰
14. **Kiecolt-Glaser et al., (2014)** studied in a randomized controlled trial (RCT) the impact of yoga on inflammation, mood, and fatigue in breast cancer survivors. The study involved 200 stage 0 to IIIa breast cancer survivors who had completed cancer treatment within the past 3 years. The participants were randomly assigned to either a 12-week hatha yoga intervention or a wait-list control condition. The yoga group participated in two 90-minute sessions per week, following a protocol of specific poses and breathing practices. The main outcome measures included the production of proinflammatory cytokines (IL-6, TNF- α , and IL-1 β), fatigue scores (MFSI-SF), vitality scores (SF-36), and depressive symptoms (CES-D). The results showed that immediately post-treatment, the yoga group had higher vitality scores compared to the control group. At 3 months post-treatment, the yoga group showed lower fatigue, higher vitality, and lower levels of IL-6, TNF- α , and IL-1 β compared to the control

group. Importantly, the frequency of yoga practice was associated with greater improvements in fatigue, vitality, and inflammation.²³¹

15. **Kiecolt-Glaser et al., (2010)** studied the effects of yoga practice on stress, inflammation, and various physiological responses in novice and expert yoga practitioners. The researchers recruited 50 healthy women, divided equally into novice and expert groups based on their yoga experience. The study involved three separate visits to a Clinical Research Center, where participants underwent a yoga session and two control conditions (movement and video watching). Before each condition, participants were exposed to stressors to assess their physiological recovery. The researchers measured several physiological markers, including serum cytokines (IL-6, TNF- α , sIL-6r), C-reactive protein (CRP), cortisol, catecholamines, and lipopolysaccharide (LPS)-stimulated cytokine production. They also assessed heart rate, skin barrier repair, and self-reported mood. The study aimed to explore the mechanisms underlying yoga's potential stress-reduction benefits and its impact on inflammatory responses. The results revealed significant differences between novice and expert yoga practitioners. Experts had lower overall serum IL-6 levels, with novices' levels being 41% higher. The odds of a novice having detectable CRP were 4.75 times higher than those of an expert. Experts also produced less LPS-stimulated IL-6 in response to stressors. The yoga session increased participants' positive affect compared to the control conditions. However, there were no significant differences in cortisol, catecholamines, or serum cytokine responses between the groups or conditions.²³²

16. **Long Parma et al., (2015)** examined the effects of a six-month yoga-based exercise program on inflammatory serum markers in breast cancer survivors. The research compared outcomes from three groups: yoga-based exercise (YE), comprehensive exercise (CE), and a comparison group (C) who chose their own exercises. The study involved 94 post-treatment breast cancer survivors, with 20 completing the yoga-based exercise program. The study assessed anthropometrics, cardiorespiratory capacity, and inflammatory markers (IL-6, IL-8, TNF α , and CRP) before and after the intervention. The yoga group showed significant improvements in body composition, with a 3% decrease in body fat. However, there were no significant changes in cardiorespiratory capacity or inflammatory serum markers for any group. The study also found no significant differences between the three groups when controlling for age, BMI, cardiorespiratory capacity, and baseline serum marker values.²³³

17. **Rajbhoj et al., (2015)** conducted a randomized controlled trial to assess the effect of a 12-week yoga module on pro-inflammatory and anti-inflammatory cytokines in industrial workers from Lonavla, India. The study involved 48 male participants aged 30-58 years, divided into experimental (n=24) and control (n=24) groups. The researchers measured levels of pro-inflammatory cytokine IL-1 β and anti-inflammatory cytokine IL-10 at baseline and after the intervention period. The yoga intervention consisted of various asanas (poses) and pranayamas (breathing exercises) practiced for 45 minutes, six days a week, for post 12 weeks. The control group continued with their daily routine without any yoga training. The results showed that the yoga group experienced a significant decrease in IL-1 β levels and a significant increase in IL-10 levels, while the control group showed no significant changes. These findings suggest that yoga practices could effectively reduce pro-inflammatory cytokines and increase anti-inflammatory cytokines in industrial workers.²³⁴
18. **Sharma et al., (2015)** conducted a study to evaluate the effect of yogic intervention on inflammatory bowel disease (IBD). The study involved 100 IBD patients in clinical remission, including 60 with ulcerative colitis (UC) and 40 with Crohn's disease (CD). The participants were randomly divided into two groups: a yoga group that underwent an 8-week yoga intervention (including physical postures, pranayama, and meditation) for one hour daily along with standard medical therapy, and a control group that continued with standard medical therapy alone. The researchers measured various outcomes, including cardiovascular autonomic functions, serum eosinophilic cationic protein, interleukin-2 soluble receptors, anxiety levels using Spielberger's State Trait Anxiety Inventory (STAI), and clinical symptoms. After the 8-week intervention, the yoga group showed some promising results. Fewer UC patients in the yoga group reported arthralgia, while more patients in the control group reported intestinal colic pain.²³⁵
19. **Kwok et al., (2025)** investigated the effects of meditation and yoga on anxiety, depression, and chronic inflammation in patients with Parkinson's disease (PD). The study involved 159 participants with mild-to-moderate PD, randomized into three groups: meditation (n=53), yoga (n=52), and waitlist control (n=54). The interventions consisted of 8-week programs with weekly 90-minute sessions. The primary outcomes were anxiety and depressive symptoms, measured using the Hospital Anxiety and Depression Scale (HADS). Secondary outcomes included motor and non-motor symptoms, health-related quality of life (HRQOL), mindfulness

attributes, and biomarkers of stress and inflammation. Assessments were conducted at baseline, 2 months (post-intervention), and 6 months. Results showed that both meditation and yoga significantly improved anxiety symptoms, motor symptoms, describing facet of mindfulness, and HRQOL compared to usual care at 2 months. The meditation group demonstrated additional benefits, including greater reduction in depressive symptoms at 2 months and sustained improvements in motor symptoms and HRQOL at 6 months. Both intervention groups showed significant reductions in the pro-inflammatory cytokine IL-6 at 6 months compared to the control group.²³⁶

2.2.3 Review on Yoga and inflammatory low back pain:

1. **Cho et al., (2015)** conducted a NON RCT based study and investigated the effects of a 12-week yoga program on back-related function, stress, and inflammatory factors in premenopausal women with chronic low back pain (CLBP). The study was conducted as a non-randomized controlled trial, with participants allocated to either a Hatha yoga group or an untreated control group. The researchers evaluated various outcomes, including back-related function using the Roland-Morris Disability Questionnaire (RMDQ), back flexibility, stress levels using the Symptoms of Stress Inventory (SOSI), and serum levels of cortisol, tumor necrosis factor-alpha (TNF- α), and C-reactive protein (CRP). The results of the study showed significant improvements in the yoga group compared to the control group. The yoga group experienced a significant reduction in RMDQ scores and an increase in back flexibility. Additionally, the yoga group showed a significant decrease in serum cortisol levels and total SOSI scores, indicating reduced stress levels. Interestingly, while TNF- α level remained stable in the yoga group, they significantly increased in the control group over the 12-week period. CRP levels did not change significantly in either group.²³⁷
2. **Colgrove et al., (2019)** in a quasi-experimental study evaluated the physical and physiological effects of yoga for an underserved population with chronic low back pain (CLBP). The research aimed to investigate the feasibility of providing yoga intervention to a predominantly low-income population and explore potential mechanisms underlying yoga's effectiveness in improving CLBP. The study employed within-subject wait-listed crossover design, where participants received twice-weekly group yoga sessions for post 12 weeks following a 6-12 week no-

intervention period. The study measured various outcomes, including pain intensity, disability, core strength, flexibility, and plasma tumor necrosis factor (TNF)- α protein levels. Additionally, brain-imaging analysis was conducted to examine changes in N-acetylaspartate (NAA) levels in the dorsolateral prefrontal cortex and thalamus. The results showed significant improvements in pain scores, disability ratings, spinal and hip flexor flexibility, and core muscle strength following the yoga intervention. The study also observed interesting changes in TNF- α levels and NAA concentrations in the brain, although these findings were limited due to the small sample size.²³⁸

2.2.4 Review on Yoga and Immunity:

1. **Gopal et al., (2011)** conducted a study on the effects of integrated yoga practices on immune responses during examination stress among first-year MBBS students. The study involved 60 female students aged 17-20 years, randomly assigned to a yoga group and a control group. The yoga group practiced integrated yoga techniques for 35 minutes daily for post 12 weeks, while the control group followed their normal routine. The researchers measured various physiological parameters, including heart rate, respiratory rate, and blood pressure. Psychological assessments were conducted using the Global Assessment of Recent Stress Scale (GARS) and Spielberger's State Anxiety Inventory (STAI). Biochemical parameters such as serum cortisol levels and immunological parameters like serum Interleukin-4 (IL-4) and Interferon-gamma (IFN- γ) were also analyzed. The results showed that the control group experienced significant increases in heart rate, systolic blood pressure, and rate pressure product during examination stress, while the yoga group showed no significant changes in these parameters. The yoga group demonstrated a decrease in GARS scores, indicating reduced stress levels, while the control group showed an increase. Both groups experienced an increase in STAI scores, but the increase was more pronounced in the control group. Serum cortisol levels increased in both groups during examination stress, but the increase was less significant in the yoga group. The study also found that examination stress led to a decrease in serum IFN- γ levels, indicating a decline in cellular immunity, which was less pronounced in the yoga group.²³⁹

2. **Agnihotri et al., (2014)** administered a randomized controlled study for assessing the impact of yoga on the biochemical profile of asthmatics. The study was conducted at King George's Medical University in Lucknow, India, involving 276 patients with mild to moderate asthma. The participants were divided into two groups: a yoga group receiving yogic intervention along with standard medical treatment, and a control group receiving only standard medical treatment. The study lasted for 6 months, with 241 subjects completing the entire duration. The researchers assessed various biochemical parameters, including hemoglobin levels, total leukocyte count (TLC), differential leukocyte count, and superoxide dismutase (SOD) levels. The yoga group practiced specific yogic techniques for 30 minutes per day, 5 days a week, under the guidance of a qualified yoga trainer. The results showed significant improvements in the yoga group compared to the control group. The yoga group experienced an increase in hemoglobin levels and SOD activity, while showing decreases in TLC and differential leukocyte counts, particularly in eosinophils and monocytes.²⁴⁰
3. **Bower et al., (2014)** administered a randomized controlled trial for investigating the effects of an Iyengar yoga intervention on inflammatory signaling in fatigued breast cancer survivors. The study involved 31 stage 0-II breast cancer survivors who had completed treatment and were experiencing persistent cancer-related fatigue. Participants were randomized to either a 12-week Iyengar yoga intervention (n=16) or a health education control condition (n=15). The researchers collected blood and saliva samples at baseline, post-intervention, and 3 months post-intervention to evaluate changes in genomic and circulating markers of inflammation, as well as diurnal cortisol production. The primary outcome of the study was fatigue, with results showing improvements in fatigue and energy among women assigned to the yoga group compared to the control group. The study also examined the effects on inflammatory processes, which may underlie symptoms of cancer-related fatigue. The results of the study indicated that the yoga intervention led to decreased pro-inflammatory NF- κ B-related gene expression and increased glucocorticoid receptor activity compared to the control group. Additionally, the yoga group showed relatively stable plasma levels of soluble TNF receptor type II (sTNF-RII), while the control group experienced increases in this marker. The researchers also observed reduced activity of CREB family transcription factors in the yoga group, which may

indicate reduced sympathetic nervous system signaling. However, no significant changes were found in cortisol production or other inflammatory markers such as IL-6 and CRP.²⁴¹

4. **Cade et al., (2010)** conducted a prospective, randomized, controlled study to evaluate the effects of a yoga lifestyle intervention on cardiovascular disease (CVD) risk factors in HIV-infected adults. The study involved 60 HIV-infected adults with mild-moderate CVD risk, who were assigned to either 20 weeks of supervised yoga practice or standard care treatment. The researchers measured various health parameters before and after the intervention, including oral glucose tolerance, body composition, lipid profiles, blood pressure, immune status, and quality of life. The primary finding of the study was that the yoga intervention significantly reduced resting systolic and diastolic blood pressures compared to the standard care group. This reduction occurred without parallel improvements in glucose tolerance, body weight, fat distribution, or proatherogenic lipid levels. The yoga intervention did not adversely affect or improve immune or virological status in the participants. While there were no significant changes in overall quality of life, there was a trend towards improved emotional well-being in the yoga group.²⁴²
5. **Krishna, (2015)** administered a prospective case-control study to explore the effects of yoga practice on leukocyte telomere biology and its relation to homocysteine and oxidative stress. The study involved yoga practitioners aged 30-40 years with a minimum of two years of yoga practice (Yoga group) and age, gender, and BMI-matched sedentary healthy individuals (Control group). The researchers measured leukocyte telomere length (LTL) using quantitative PCR, fasting plasma homocysteine using high-performance liquid chromatography, and oxidative stress markers including total antioxidant status (TAOS) and malondialdehyde (MDA) using colorimetry. The results revealed significant differences between the yoga and control groups. The yoga group demonstrated longer LTL, higher TAOS, and lower levels of MDA and homocysteine compared to the control group. Furthermore, LTL was positively correlated with TAOS and negatively correlated with MDA and homocysteine levels. These findings suggest that regular yoga practice may help preserve telomere length and reduce systemic oxidative stress.²⁴³

6. **Lim & Cheong, (2015)** conducted a randomized, double-blind, controlled pilot study for assessing the effects of regular yoga practice on antioxidant status, immune function, and stress hormone releases in young, healthy individuals. The study involved 25 university students divided into a yoga group (n=12) and a control group (n=13). The yoga group participated in 90-minute weekly sessions for post 12 weeks, with additional recommendations for daily home practice. The program included yoga poses (asanas), breathing exercises (pranayama), and meditation. The researchers measured various biomarkers in the participants' blood samples before and after the 12-week period. These included oxidative stress parameters (nitric oxide, malondialdehyde, and F2-isoprostane), antioxidant components (glutathione and related enzymes, catalase, and superoxide dismutase), immune-related cytokines (IL-12, IFN- γ , and TNF- α), and stress hormones (cortisol, serotonin, dopamine, noradrenaline, and adrenaline). The results showed that yoga practice significantly decreased oxidative stress markers and increased antioxidant levels in the body. Specifically, serum levels of nitric oxide, malondialdehyde, and F2-isoprostane were reduced, while total glutathione content and activities of glutathione peroxidase and glutathione-S-transferase were increased. The yoga group also exhibited increased levels of immune-related cytokines IL-12 and IFN- γ . Regarding stress hormones, yoga practice led to decreased plasma adrenaline levels and increased serotonin levels.²⁴⁴
7. **Naoroibam et al., (2016)** conducted a randomized controlled pilot study for evaluating the effects of Integrated Yoga (IY) on psychological states and CD4 counts in HIV-1 infected patients. The study involved 44 HIV-1 infected individuals from two rehabilitation centers in Manipur, India, who were randomly divided into a yoga group (n=22) and a control group (n=22). The yoga group received a month-long IY intervention, which included physical postures (asanas), breathing practices (pranayama), relaxation techniques, and meditation, for 60 minutes daily, six days a week. The control group followed their normal routine during this period. The study used the Hospital Anxiety and Depression Scale (HADS) to assess anxiety and depression levels, while CD4 counts were measured using flow cytometry. The results showed a significant reduction in depression scores and a significant increase in CD4 counts in the yoga group compared to the control group. Within the yoga group, there was a significant reduction in depression scores, a non-significant improvement in CD4 count, and a non-

significant reduction in anxiety scores. The control group showed non-significant increases in both anxiety scores and depression scores, along with a non-significant reduction in CD4 counts. This study provides interesting insights into the potential benefits of yoga as a complementary therapy for HIV-1 infected individuals. It suggests that regular practice of yoga may help improve psychological well-being by reducing depression and boost immunity by increasing CD4 counts in patients suffering from HIV-1 infection.²⁴⁵

8. **Vogler et al., (2011)** investigated how a short-term Iyengar yoga program influences the health and well-being of physically inactive older adults. The research, conducted by Juliane Vogler, Lily O'Hara, Jane Gregg, and Fiona Burnell from the University of the Sunshine Coast, Australia, involved 38 participants aged 55 years and over. The 8-week Iyengar yoga program consisted of twice-weekly 90-minute classes and recommended home practice. The study assessed various dimensions of holistic health and well-being, including physical, mental, spiritual, and social aspects. Physical health measures included muscle strength, active range of motion, respiratory function, blood pressure, and immune function. Self-perceived health and well-being were evaluated using the SF12v2 Health Survey and the Life's Odyssey Questionnaire. The results showed significant improvements in the yoga group for muscle strength, active range of motion, physical well-being, and aspects of mental well-being.²⁴⁶

2.2.5 Review on Yoga and Quality of life:

1. **Yonglitthipagon et al., (2017)** investigated the impact of yoga on menstrual pain, physical fitness, and quality of life in young women with primary dysmenorrhea (PD). The study was conducted as a 12-week randomized controlled trial involving 34 non-athlete women aged 18-22 years with PD. Participants were divided randomly into two groups: a yoga group or a control group, with 17 in each. The yoga group practiced a specially designed yoga program for 30 minutes per day, twice a week, for 12 weeks at home and the control group without any interventions. The program included specific yoga poses such as Shavasana, Surya Namaskar, Supta Vajrasana, Janu Sirsasana, and Pashimottanasana. Measurements of menstrual pain intensity and physical fitness (flexibility, back and leg muscle strength) were taken at baseline and after 12-week. The yoga intervention led to

significantly reduced menstrual pain intensity, increased flexibility and leg muscle strength, and improved quality of life in several domains including functional capacity, vitality, mental health, social aspects, pain, and general health in comparison to the control group. These findings suggest that the specially designed yoga program could be a potential complementary treatment for primary dysmenorrhea.²⁴⁷

2. **Woodyard, (2011)** provided a comprehensive review on the benefits of regular yoga practice and its therapeutic effects on various health conditions. The document discusses the various therapeutic effects of yoga on mental health, physical health, and overall well-being. It highlights yoga's ability to reduce stress, anxiety, and depression, improve flexibility and strength, enhance cardiovascular function, and aid in the management of chronic pain and various health conditions. The paper also explores yoga's potential benefits for cancer patients, its effects on sleep quality, and its role in addiction recovery. One of the unique insights uncovered from this document is the holistic approach of yoga in addressing health issues. Unlike modern medicine, which often focuses on treating specific symptoms or diseases, yoga aims to heal the entire human entity - physical, emotional, intellectual, and spiritual. The paper suggests that while yoga may not completely eliminate physical diseases, it offers a comprehensive path to healing that goes beyond just physical symptoms. This holistic approach to health and well-being sets yoga apart as a complementary therapy that can work alongside conventional medical treatments to improve overall quality of life.²⁴⁸
3. **Wolff et al., (2013)** conducted a study on the impact of yoga on blood pressure and quality of life in patients with hypertension in a primary care setting. The research was conducted as a prospective three-arm single-center study, involving two yoga intervention groups and one control group. The study included 83 adult patients aged 20-80 years with diagnosed hypertension and blood pressure values of 120-179/ \leq 109 mmHg at baseline. The interventions consisted of a yoga class group practicing with an instructor once a week and encouraged to practice at home daily, and a yoga at home group given instructions for two specific yoga exercises to be practiced daily. The control group received usual care. The results showed that the yoga at home group experienced a significant reduction in diastolic blood pressure compared to the control group (-4.4 ± 1.6 vs. 0.8 ± 1.6 mmHg; $p < 0.05$). This group also demonstrated significant improvements in self-

rated quality of life. However, the yoga class group did not show significant improvements in blood pressure or quality of life compared to the control group. The study suggests that a short yoga program practiced at home may have an antihypertensive effect and positively impact quality of life, potentially serving as a useful supplementary therapy to medical treatment for hypertension in primary care.²⁴⁹

4. **Bahçecioğlu Turan & Tan, (2020)** administered a research study on the effects of yoga on respiratory functions, symptom control, and quality of life in asthma patients. The study, conducted by Gülcan Bahçecioğlu Turan and Mehtap Tan, is a randomized controlled trial involving 112 asthma patients divided into experimental and control groups. The experimental group underwent 12 yoga sessions over 6 weeks, while the control group received no intervention. The study measured respiratory function tests, Asthma Control Test scores, and Asthma Quality of Life Questionnaire scores before and after the intervention. The results showed significant improvements in the experimental group compared to the control group. Respiratory function values, including FEV1, FVC, FEV1/FVC ratio, and PEF, increased in the yoga group while decreasing in the control group. Similarly, ACT scores and AQLQ total and sub-dimension scores improved significantly in the yoga group, indicating better symptom control and quality of life.²⁵⁰
5. **Keerthi et al., (2017)** studied the effect of post 12 weeks of yoga therapy on Quality of Life (QoL) and Indian Diabetes Risk Score (IDRS) in normotensive Indian young adult prediabetics and diabetics. The study involved 310 participants aged 18-45 years, divided into healthy controls, prediabetics, and diabetics. The prediabetic and diabetic groups were further subdivided into those receiving standard treatment alone and those receiving yoga therapy along with standard treatment. The study measured various parameters including QoL using the Flanagan QoL scale, IDRS, fasting plasma glucose, fasting insulin, and HOMA-IR. The results showed significant improvements in QoL and reductions in IDRS for both prediabetic and diabetic groups receiving yoga therapy along with standard treatment compared to those receiving standard treatment alone. The yoga therapy groups also showed greater reductions in fasting plasma glucose, fasting insulin, and insulin resistance.²⁵¹

2.2.6 Review on Yoga on Rheumatic Disease:

1. **Ganesan et al., (2020)** investigated the effect of a 12-week yoga therapy program on patients with rheumatoid arthritis (RA). The study was conducted as a randomized controlled trial involving 166 RA patients divided into a yoga group (YG) and a control group (CG). The primary outcomes measured were disease activity score (DAS 28), inflammatory markers (IL-1 α , IL-6, TNF- α), cortisol levels, and heart rate variability (HRV) parameters. The results showed significant improvements in the yoga group compared to the control group. Disease activity decreased more in the YG, and there were significant reductions in IL-1 α and cortisol levels. HRV parameters also improved in the YG, indicating a shift towards parasympathetic predominance. Specifically, there was a decrease in LF:HF ratio and LFnu, and an increase in HFnu, RMSSD, and SDNN.¹³⁹
2. **Evans et al., (2013)** conducted a study on the impact of Iyengar yoga on the quality of life in young women with rheumatoid arthritis (RA). The research aimed to assess the effects of a 6-week, twice-weekly Iyengar yoga program on health-related quality of life (HRQOL), pain, disability, and psychological functioning in young adults with RA compared to a usual-care waitlist control group. The study involved 26 female participants with a mean age of 28 years, who were randomly assigned to either the yoga group or the control group. The results showed significant improvements in the yoga group compared to the control group on several measures. The yoga group demonstrated greater improvement in HRQOL, pain disability, general health, mood, fatigue, acceptance of chronic pain, and self-efficacy regarding pain. Almost half of the yoga group reported clinically meaningful symptom improvement. The study also found that improvements in quality of life, pain disability, and mood persisted at the 2-month follow-up.²⁵²
3. **Badsha et al., (2009)** conducted a study on the benefits of yoga for rheumatoid arthritis (RA) patients. The research was conducted in Dubai, United Arab Emirates, involving 47 participants divided into two groups: 26 in the yoga group and 21 in the control group. The study aimed to measure the effects of a bi-weekly Raj yoga program on RA disease activity over an 8-week period. The researchers collected data on disease activity indices, health assessment questionnaire (HAQ) scores, and quality of life (QOL) measurements using SF-36 at the beginning and end of the study. The yoga program, called Vishwas-Raj yoga, was specially designed for RA

patients and included stretches, strengthening exercises, meditation, and deep breathing techniques. Participants attended 12 sessions over 6 weeks, with each session lasting one hour. The study found statistically significant improvements in disease activity scores (DAS28) and HAQ scores for the yoga group. Interestingly, while the yoga group showed improvements in all RA disease activity parameters, the quality of life scores did not change significantly, except for improvements in role limitations due to emotional health.²⁵³

4. **Greysen et al., (2019)** conducted a cross-sectional study to assess the association between yoga use, physical function, and employment status in adults with Rheumatoid Arthritis (RA). The study, part of the larger Rheumatoid Arthritis Outcomes Study (RA-OS), surveyed 398 adults with RA, of which 42 (10.6%) reported participating in yoga in the past year. The researchers investigated whether yoga participation was associated with less RA symptomatology, better physical function, and full-time work status. The study found significant associations between yoga practice and certain outcomes. Yoga practitioners were more likely to be employed full-time and less likely to be unemployed due to disability compared to non-practitioners. They also demonstrated better physical function scores, even after controlling for age and education. However, no significant differences were found in pain, fatigue, depression, or sleep quality between yoga practitioners and non-practitioners. The study also provided insights into the yoga practices of adults with RA, noting that Vinyasa, Bikram, and Hatha were the most popular styles, typically practiced in a group setting about once a week.²⁵⁴
5. **Dash & Telles, (2001)** conducted a study on the effects of yoga training on hand grip strength in different groups of subjects. The research involved three categories: normal adults (n=37), children (n=86), and patients with rheumatoid arthritis (n=20). An equal number of subjects in each category who did not practice yoga formed the control groups. The study design varied for each group based on the duration of their respective yoga camps. Adults practiced for 30 days, children for 10 days, and rheumatoid arthritis patients for 14 days. Handgrip strength was measured using a handgrip dynamometer before and after the yoga-training period. The yoga interventions included common practices such as yoga asanas, pranayama, meditation, and lectures on yoga philosophy, with additional specific practices for each group. The results showed significant increases in hand grip strength for all three categories of subjects who practiced yoga, while the control groups showed no change. Adult

female volunteers and patients demonstrated a greater percentage improvement compared to their male counterparts. This gender-based difference was not observed in children. The study also found that patients with rheumatoid arthritis showed a greater percentage increase in grip strength compared to normal adults, despite a shorter duration of yoga practice.²⁵⁵

6. **Pukšić et al., (2021)** investigated in a randomized controlled trial the impact of Yoga in Daily Life program on rheumatoid arthritis (RA) patients. The study, conducted at the University Hospital Dubrava in Zagreb, Croatia, involved 57 participants divided into a yoga intervention group (n=30) and an education control group (n=27). The yoga program consisted of post 12 weeks of twice-weekly 90-minute sessions, while the control group attended weekly 60-minute educational lectures on arthritis-related topics. The primary outcome measure, the Short Form-36 (SF-36) health-related quality of life (HQOL) assessment, showed no significant differences between the groups at post 12 weeks. However, the yoga group demonstrated significant improvements in fatigue, as measured by the Functional Assessment of Chronic Illness Therapy-fatigue scale (FACIT-fatigue), and mood, as assessed by the Hospital Anxiety and Depression Scale (HADS). These improvements were observed both at the 12-week post-intervention point and at the 24-week follow-up. Notably, the yoga program had no significant impact on RA disease activity, pain, or C-reactive protein (CRP) levels. The study also evaluated the feasibility and safety of the yoga program for RA patients. The recruitment rate was 16%, with a retention rate of 80.7%. Adherence to the yoga classes was high at 87.5%, compared to 82.7% for the control group's educational sessions. No serious adverse events were recorded, indicating that the Yoga in Daily Life program was both safe and well-tolerated by RA patients.²⁵⁶
7. **Gautam et al., (2020)** conducted a randomized controlled trial to evaluate the effects of an 8-week yoga-based lifestyle intervention (YBLI) on patients with Rheumatoid Arthritis (RA). The study aimed to evaluate the impact of YBLI on disease activity, psycho-neuro-immune markers, gene expression patterns, and quality of life in RA patients undergoing routine medical therapy. 66 patients were randomized into two groups: a yoga group and a non-yoga group. The researchers assessed various inflammatory cytokines, mind-body communicative markers, and transcript levels of several genes. Disease activity was measured using the DAS28-ESR score, while quality of life was evaluated using the WHOQOL-BREF questionnaire. The results showed significant improvements in the yoga group compared to the non-yoga group.

The yoga group experienced a reduction in disease activity, normalization of psycho-neuro-immune axis biomarkers, and improvements in quality of life. Specifically, there was a decrease in pro-inflammatory markers (IL-6, IL-17A, TNF- α) and an increase in anti-inflammatory markers (TGF- β). The yoga group also showed upregulation of mind-body communicative markers (BDNF, DHEAS, β -endorphin, and sirtuin) and downregulation of certain genes (IL-6, TNF- α , and CTLA4). The study found improvements in physical, psychological, and social domains of quality of life for the yoga group.²⁵⁷

8. **Gautam et al., (2019)** studied on the impact of yoga-based mind-body intervention (MBI) on rheumatoid arthritis (RA) patients. The research investigates how an 8-week yoga program affects systemic inflammatory markers and co-morbid depression in active RA patients who are undergoing routine disease-modifying anti-rheumatic drugs (DMARDs) therapy. The study was conducted as a randomized controlled trial with 72 RA patients divided into two groups: a yoga group (yoga with DMARDs) and a control group (DMARDs only). The researchers measured various biomarkers, including those related to systemic inflammation, neuroplasticity, and cellular health. They also assessed disease activity using the DAS28ESR score, functional status using the HAQ-DI, and depression severity using the Beck Depression Inventory II (BDI-II) scale. The results showed significant improvements in the yoga group compared to the control group. The yoga intervention led to a decrease in inflammatory markers, oxidative stress, and DNA damage, while increasing anti-inflammatory cytokines, neuroplasticity markers, and cellular health indicators. The yoga group also experienced a significant reduction in disease activity, functional disability, and depression severity.¹⁴⁰
9. **Cartwright et al., (2020)** conducted a mixed methods evaluation of an individualised yoga therapy intervention for rheumatoid arthritis (RA) in a pilot study. The study aimed to explore patients' experiences of the intervention and its impact on patient-reported outcomes. The study involved 10 patients who participated in a 16-week yoga therapy intervention at a UK hospital. The intervention consisted of 10 one-to-one consultations with a yoga therapist, followed by two group review sessions. The researchers used a mixed-methods approach, combining quantitative assessments (EQ-5D, HADS) at pre-intervention, post-intervention, and 12-month follow-up, with qualitative in-depth interviews conducted post-intervention. The study reported high attendance (98%) and strong commitment to personalized home practice among

participants. Quantitative results showed significant improvements in measures of depression, anxiety, pain, quality of life, and general health at post-intervention and 12-months follow-up. Qualitative findings revealed that participants experienced positive changes in their symptoms, with some reporting reductions in medication use. Many participants also reported broader benefits such as improved sleep, mood, and energy, enabling re-engagement with life activities.²⁵⁸

10. **Ward et al., (2018)** implemented a pilot randomized controlled trial (RCT) for investigating the feasibility and safety of a relaxation-based yoga intervention for rheumatoid arthritis (RA). The study, conducted at the University of Otago, New Zealand, involved 26 participants with mild pain, mild to moderate functional disability, and moderate disease activity. The participants were randomized into two groups: one receiving an 8-week yoga program alongside usual care, and the other receiving only usual care. The yoga intervention consisted of weekly 75-minute instructor-led classes and home practice using a guided relaxation CD. The study found that the yoga program was both feasible and safe for the RA population. Recruitment rates were satisfactory, with 25% of invited individuals participating. Retention rates were excellent, with 100% for yoga participants and 92% for usual care participants at both weeks 9 and 12. Adherence to the yoga classes was high, with participants attending a median of seven out of eight classes. However, adherence to home practice was lower, with only 38% of yoga participants meeting the target of 16 out of 24 home sessions. No serious adverse events related to the yoga intervention were reported, although some participants experienced minor, transient musculoskeletal pain.²⁵⁹
11. **V. K. Singh et al., (2011)** investigated the effects of a Yogic Package (YP) on various parameters associated with rheumatoid arthritis (RA). The study employed a randomized control group design with 80 participants (56 females and 24 males) aged 23-48 years, divided equally into experimental and control groups. The YP intervention consisted of pranayama, cleansing practices, and meditation, practiced for 1.5 hours daily over 40 days. The study measured several RA-related parameters, including pain intensity, inflammation, stiffness, and pulse rate, blood pressure, and lymphocyte count, C - reactive protein, and serum uric acid levels. The results showed statistically significant improvements in most parameters for the experimental group compared to the control group. After the YP intervention, participants experienced significant reductions in pain intensity, number of inflamed joints, morning stiffness,

pulse rate, systolic and diastolic blood pressure, lymphocyte count, C-reactive protein, and serum uric acid levels. These improvements were observed at various significance levels ($p < 0.05$, $p < 0.01$, and $p < 0.001$). The control group showed no significant improvements in most parameters, with only slight reductions in the number of inflamed joints and morning stiffness.¹⁴¹

12. **Pandya, (2020)** investigated clinically the combined effects of yoga, an anti-inflammatory diet, and self-monitoring on children with chronic rheumatic diseases. The study involved 22 children aged over 8 years with newly diagnosed rheumatic diseases. The participants were divided into two groups: an experimental group and a control group. All participants were advised to follow up monthly for four months, and baseline disease activity and damage scores were calculated for all. The experimental group, consisting of 14 children, received three types of printed materials: pictures of yoga asanas with explanations, food classification (beneficial and harmful), and a self-monitoring kit with disease information and simplified monitoring scores. The experimental group underwent a single yoga training session with an experienced teacher and were advised to practice yoga for 45 minutes daily at home. They were also put on a strict diet chart and instructed to calculate their disease scores before each follow-up visit. The study's conclusion suggests that the combination of yoga, an anti-inflammatory diet, and self-monitoring showed extremely beneficial effects in children with rheumatic diseases in multiple ways.²⁶⁰
13. **Evans et al., (2011)** conducted a qualitative study to evaluate the experiences and perceived benefits of Iyengar yoga (IY) for young adults with rheumatoid arthritis (RA). The study involved a small group of participants aged 24-31 years who completed a 6-week IY intervention. The research aimed to explore potential mechanisms of change resulting from the yoga practice and gather insights into how it impacted the participants' functioning. The study utilized face-to-face interviews conducted before and after the IY program. Pre-intervention interviews revealed that participants had initial hesitations about their ability to practice yoga due to their physical limitations. However, post-intervention interviews showed that these concerns were quickly alleviated, and participants reported numerous benefits. These included improved relaxation, increased energy levels, better sleep quality, and enhanced mood. Participants also noted physiological changes such as increased strength, improved posture, and greater body awareness. Psychospiritual benefits were reported as well, including increased confidence, self-efficacy, and mindfulness.²⁶¹

14. **Haslock et al., (1994)** explored in a pilot study the impact of yoga on patients with rheumatoid arthritis (RA). The study involved 20 volunteers with severe RA, divided into two groups of 10 each - a yoga group and a control group. The yoga group participated in a program of daily 2-hour sessions for 3 weeks, followed by weekly 2-hour sessions for 3 months, in addition to their normal medical treatment. The control group continued with only their normal medical treatment. The study assessed various rheumatological measurements and psychological factors at the beginning and after 3 months. The results showed significant improvements in the yoga group, particularly in left-hand grip strength, which increased by 63 mmHg compared to only 8 mmHg in the control group. The yoga group also showed improvements in HAQ scores and left hand ring sizes, although not to statistically significant levels. All six patients who completed the yoga course reported subjective benefits and expressed a desire to continue.²⁶²
15. **Bosch et al., (2009)** investigated in a pilot study the effects of yoga on women with rheumatoid arthritis (RA). The study involved 16 postmenopausal women with RA, divided into a yoga group and a control group. The yoga group participated in a 10-week Hatha yoga program, attending three 75-minute classes per week. The researchers measured various physiological and functional parameters before and after the intervention, including diurnal cortisol patterns, resting heart rate, balance, disability index, pain perception, and depression symptoms. The results of the study showed significant improvements in several areas for the yoga group. Participants experienced a decrease in the Health Assessment Questionnaire (HAQ) disability index, reduced perception of pain and depression symptoms, and improved balance as measured by the Berg Balance Test (BBT). The yoga intervention did not result in significant changes in awakening or diurnal cortisol patterns, although there was a trend towards a more robust awakening response in the yoga group after the intervention.²⁶³

2.2.7 Review on Exercise and AS:

1. **Ghosh & Mandal, (2019)** conducted a randomized controlled trial to assess the effectiveness of a supervised rehabilitation program (SRP) for patients with axial spondyloarthritis (Ax-spA). The study was carried out at the Department of Physical Medicine and Rehabilitation, R.G. Kar Medical College, Kolkata, from June 2014 to

July 2015. A total of 63 participants aged 18-45 years with Ax-spA were randomly allocated into two groups: an intervention group undergoing SRP and a control group following a home exercise program, both for duration of 3 months. The SRP consisted of multimodal exercises, lifestyle modification, group therapy sessions, counseling, joint protection techniques, energy conservation techniques, environmental modification, and cognitive behavioral therapy for pain management. The primary outcome measures were physical function, assessed using the Bath Ankylosing Spondylitis Functional Index (BASFI), and spinal pain, measured using the Numerical Rating Score (NRS). These were evaluated at baseline and after 3 months for both groups. The results of the study showed significant improvements in both BASFI and spinal pain for both groups after 3 months. However, the intervention group (SRP) demonstrated significantly greater improvements in both measures compared to the control group (home exercise program). The study concludes that a 3-month SRP can lead to significant improvements in physical function and reduction in spinal pain for patients with Ax-spA, potentially enhancing their quality of life and socioeconomic productivity.²⁶⁴

2. **Ince et al., (2006)** studied on the effects of a multimodal exercise program for people with ankylosing spondylitis (AS). The research involved 30 patients with AS, divided into an exercise group and a control group. The exercise program lasted post 12 weeks and included aerobic, stretching, and pulmonary exercises, conducted three times a week for 50 minutes per session. The study aimed to investigate the impact of this program on spinal mobility, vital capacity, and physical work capacity in AS patients. The methodology involved various measurements, including clinical tests (such as chest expansion, chin-to-chest distance, and Modified Schober Flexion Test), inclinometric measurements for spinal range of motion, and physiological tests (PWC170 test and vital capacity measurements). These assessments were conducted at baseline and after the 12-week program. The results showed significant improvements in the exercise group compared to the control group in several areas, including chest expansion, spinal mobility, physical work capacity, and vital capacity. The study's findings highlight the importance of multimodal exercise programs in managing AS. The exercise group showed improvements in spinal mobility, work capacity, and chest expansion, while the control group either showed no significant changes or experienced decreases in some measurements. This research supports the notion that exercise is as crucial as drug treatment in AS management, emphasizing

the need for a comprehensive approach to treatment that includes both medical intervention and structured exercise programs.²⁶⁵

3. **Roşu et al., (2014)** conducted a randomized controlled study to evaluate the effects of a multimodal exercise program with combined Pilates, McKenzie, and Heckscher techniques on patients with ankylosing spondylitis (AS). The study involved 96 patients with axial AS, divided into two groups: one following the multimodal program (group I) and the other following a classical kinetic program (group II). The exercise regimen consisted of 50-minute sessions performed three times weekly for 48 weeks. The study assessed various parameters at baseline and after 48 weeks, including pain, spine mobility, chest expansion, vital capacity, disease activity, and functional indices. The results showed significant improvements in both groups compared to baseline. However, group I, which followed the multimodal program, demonstrated significantly better outcomes in pain, lumbar spine motility, chest expansion, and various AS-related indices (BASFI, BASDAI, BASMI) compared to group II. A unique insight from this study is the potential of combining different exercise techniques to address multiple aspects of AS management. The multimodal approach incorporating Pilates, McKenzie, and Heckscher methods appears to offer comprehensive benefits, targeting not only spinal mobility and pain but also respiratory function.²⁶⁶
4. **Gurpinar et al., (2021)** investigated a randomized controlled study to find out the effects of multidimensional functional mobility exercises on pulmonary functions and disease-related scales in patients with Ankylosing Spondylitis (AS). The study involved 57 patients with definite AS, divided into three groups: aquatic (AG), land-based (LG), and home (HG) exercise groups. Participants performed exercises twice a week for 8 weeks. The study measured various parameters including pulmonary function tests, respiratory muscle strength, and disease-related scales such as BASMI, BASDAI, and BASFI. The results showed significant improvements in pulmonary functions and disease-related symptoms in both AG and LG groups, while the HG group showed no significant changes. Specifically, the AG group demonstrated improvements in peak expiratory flow (PEF), vital capacity (VC), maximum voluntary ventilation (MVV), and maximal inspiratory pressure (MIP). The LG group showed increases in PEF and MVV. Both AG and LG groups experienced improvements in BASMI, BASDAI, and pain levels. The AG group also showed improvement in BASFI scores, which was not observed in the LG group.²⁶⁷

5. **Souza et al., (2017)** carried out a study to evaluate the effectiveness of a progressive muscle strengthening program using a Swiss ball for patients with Ankylosing Spondylitis (AS). The study involved 60 AS patients divided into an intervention group (IG) and a control group (CG). The IG performed eight exercises with free weights on a Swiss ball twice a week for 16 weeks, while the CG received no intervention. The researchers evaluated various outcomes including muscle strength, functional capacity, disease activity, spinal mobility, walking performance, and quality of life. The results showed significant improvements in the IG compared to the CG in several areas. Muscle strength increased in exercises such as abdominal, rowing, squat, triceps, and reverse fly. The 6-minute walk test performance improved significantly in the IG. The Timed Up and Go test and patient satisfaction (measured by Likert scale) also showed better results for the IG. However, no significant differences were observed between groups in functional capacity (measured by BASFI and HAQ-S), spinal mobility (BASMI), quality of life (SF-36), disease activity (BASDAI, ASDAS, ESR, CRP), or medication intake.²⁶⁸
6. **Song et al., (2022)** conducted a randomized controlled trial to evaluate the effects of a theory-based mobile health (mHealth) intervention on disease knowledge, self-efficacy, and exercise adherence among Chinese patients with ankylosing spondylitis (AS). The study was conducted at a tertiary hospital in Chengdu, China, involving 118 AS patients. The intervention group received a 12-week educational program based on the Health Belief Model (HBM), delivered through WeChat, a popular social networking app in China. The control group received standard care. The primary outcomes measured were disease knowledge, self-efficacy, and exercise adherence, while secondary outcomes included disease activity and physical function. Data were collected at baseline and after post 12 weeks. The results showed that participants in the intervention group had significantly higher disease knowledge and self-efficacy scores, and a larger proportion adhered to regular exercise routines compared to the control group. However, no significant differences were found in disease activity or physical function between the two groups at the end of the intervention.²⁶⁹
7. **Passalent et al., (2010)** conducted a study on exercise habits and perceptions among patients with ankylosing spondylitis (AS). The research, conducted by Passalent et al., aimed to determine the type and extent of exercise performed by AS patients and examines their perceptions of exercise. The study involved 61 patients from the Toronto Western Hospital AS clinic, with a mean age of 38 years and average disease

duration of 14.7 years. The researchers used an exercise inventory questionnaire and the Exercise Benefits and Barriers Scale (EBBS) to collect data. The results showed that 57.4% of patients reported engaging in at least one form of exercise three times per week. Walking (35.0%) and stretching (32.8%) were the most commonly reported types of exercise performed at least three times weekly. The mean EBBS benefits score was 87.1, indicating a positive perception of exercise among AS patients. The most frequently reported benefits were increased physical fitness and improved cardiovascular functioning. However, the study also revealed that fatigue was a significant barrier to exercise, with 71.4% of participants reporting that exercise tires them.²⁷⁰

8. **Subramanian, (2017)** undertook a case study on the treatment of Ankylosing Spondylitis (AS) using innovative physiotherapy techniques. The study focuses on a 41-year-old male patient diagnosed with AS in February 2016, although he had been experiencing symptoms since 2012. The research aims to analyze the efficacy of Physioball-based exercises incorporating yoga and gravity-assisted postures. The patient's medical history included type II diabetes, vitamin D deficiency, increased parathyroid hormone levels, and decreased bone mineral density. The study details the patient's anthropometric findings, complaints, and physical examination results. The treatment plan involved a combination of active exercises, regular walking, incentive spirometry, sunlight exposure, pranayama, and a specialized home program using a Physioball. The therapy sessions lasted 20-25 minutes, conducted twice weekly from February 2016 to March 2017. The results of the study were encouraging, with the patient's Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) improving by 32% over the course of the treatment. The researchers emphasize the unique aspects of their approach, including the application of biomechanical concepts such as proprioception, co-contraction, and closed kinematic exercises. They also highlight the use of gravity for mobilizing and strengthening the spine with the Physioball as a supportive medium.²⁷¹
9. **Husakova et al., (2017)** conducted a study to assess the impact of intensive exercise therapy on patients with axial spondyloarthritis (axSpA), specifically comparing outcomes between non-radiographic axSpA (nr-axSpA) and Ankylosing Spondylitis (AS) subgroups. The researchers aimed to investigate how a structured rehabilitation program impacts the quality of life and disease activity in these patient populations. The study involved 46 axSpA patients (23 with nr-axSpA and 23 with AS) who

participated in a 24-week intensive rehabilitation program. This program consisted of twice-weekly 60-minute group physiotherapy sessions and daily home-based exercises. Various outcome measures were assessed at the beginning and end of the program, including disease activity indices (BASDAI and ASDAS-CRP) and quality of life measures (ASQoL and EurQoL). The study found improvements in disease activity across all axSpA patients, with particularly significant improvements in the nr-axSpA subgroup. Both subgroups reported positive changes in their global assessment scores. Interestingly, only the nr-axSpA group showed significant improvement in pain assessment and EurQoL scores. The researchers concluded that the intensive exercise program was beneficial for both nr-axSpA and AS patients, with nr-axSpA patients potentially benefiting even more than those with the radiographic form.²⁷²

10. **Sveaas et al., (2018)** implemented a randomized controlled pilot study to investigate the effects of high-intensity cardiorespiratory and strength exercises on emotional distress, fatigue, and ability to perform daily activities in patients with axial spondyloarthritis (axSpA). The study involved 28 physically inactive axSpA patients, who were randomly assigned to either an exercise group (EG) or a control group (CG). The EG underwent a 12-week exercise program consisting of supervised high-intensity interval training on a treadmill and strength exercises, while the CG received usual treatment. The outcomes measured included emotional distress (using the General Health Questionnaire-12), fatigue (using a numeric rating scale), and ability to do a full day's activities (using a numeric rating scale). The results showed statistically significant beneficial effects of the exercise program on all three outcomes. The exercise group demonstrated improvements in emotional distress (31% improvement), fatigue (46% improvement), and ability to do a full day's activities (52% improvement) compared to the control group.²⁷³
11. **Jennings et al., (2015)** executed a study on the effects of aerobic training in patients with ankylosing spondylitis (AS). The research, conducted by Fábio Jennings and colleagues, aimed to evaluate how aerobic exercise impacts various aspects of AS patients' health. The study involved 70 patients classified with AS, randomly assigned to two groups: an intervention group (IG) performing 50 minutes of walking followed by stretching exercises, and a control group (CG) performing only stretching exercises, both three times a week for post 12 weeks. The researchers assessed multiple outcomes, including functional capacity, spinal mobility, disease activity,

quality of life, aerobic capacity, and lipid levels. The study used various measurement tools such as the Bath indices (BASFI, BASDAI, and BASMI), Health Assessment Questionnaire for Spondyloarthropathies (HAQ-S), AS Disease Activity Score (ASDAS), 6-minute walk test (6MWT), and the Medical Outcomes Study Short Form-36 (SF-36). Assessments were conducted before randomization and at 6, 12, and post 24 weeks. The results showed significant improvements in functional capacity, mobility, and disease activity in both groups. However, the IG demonstrated additional benefits in walking distance and aerobic capacity compared to the CG. Specifically, the IG showed a significant increase in the distance walked during the 6MWT and improved cardiopulmonary capacity. Interestingly, aerobic training did not provide additional benefits in functional capacity, mobility, disease activity, quality of life, and lipid levels when compared to stretching exercises alone.²⁷⁴

12. **Rodríguez-Lozano et al., (2013)** carried out a study on the impact of a structured education and home-based exercise programme for patients with ankylosing spondylitis (AS). The research was conducted as a 6-month prospective multicentre controlled study involving 756 AS patients, with 381 randomized to an education intervention and 375 to standard care. The education intervention consisted of a 2-hour informative session about AS and the implementation of a non-supervised physical activity programme at home. The main outcome measures included the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and Functional Index (BASFI), while secondary measures included pain scales, quality of life assessments, and knowledge of the disease. The results showed statistically significant improvements in the education group compared to the control group. The adjusted mean difference for BASDAI was 0.32 ($p=0.005$) and for BASFI was 0.31 ($p=0.002$). Significant differences were also found in visual analog scale (VAS) scores for total pain and patient's global assessment, as well as in the Ankylosing Spondylitis Quality of Life questionnaire (ASQoL). Patients in the education group demonstrated increased knowledge about the disease and its treatments, and practiced more regular exercise than controls. However, the magnitudes of the clinical benefits in terms of disease activity and physical function were relatively small.²⁷⁵
13. **Sveas et al., (2014)** undertook a randomized controlled pilot study for investigating the efficacy of high-intensity exercise on disease activity and cardiovascular risk in patients with active axial spondyloarthritis (axSpA). The study involved 28 patients, with 24 completing the 12-week intervention. The exercise group (EG) performed

high-intensity endurance and strength exercises, while the control group (CG) received treatment as usual. The primary outcome measure was the Ankylosing Spondylitis Disease Activity Score (ASDAS). Secondary outcomes included patient-reported disease activity (BASDAI), physical function (BASFI), cardiovascular risk factors such as arterial stiffness (AIx and PWV), cardiorespiratory fitness (VO₂ peak), and body composition. The results showed improvements in disease activity, with a mean treatment effect of -0.7 in ASDAS score. Significant improvements were also observed in BASDAI, BASFI, arterial stiffness, VO₂ peak, and body fat composition in the exercise group compared to the control group.²⁷⁶

14. **Altan et al., (2012)** conducted a study for investigating the effects of Pilates exercises on patients with ankylosing spondylitis (AS). The research was conducted as a randomized, prospective, controlled, and single-blind trial involving 55 participants diagnosed with AS. The study aimed to evaluate the impact of Pilates on pain, functional status, and quality of life in AS patients. The participants were divided into two groups: Group I received a Pilates exercise program for post 12 weeks, while Group II served as the control group continuing their standard treatment. The primary outcome measure was functional capacity, assessed using the Bath Ankylosing Spondylitis Functional Index (BASFI). Exploratory outcome measures included the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), Bath Ankylosing Spondylitis Metrology Index (BASMI), chest expansion, and the Ankylosing Spondylitis Quality of Life (ASQoL) questionnaire. The results showed significant improvements in the Pilates group (Group I) for BASFI, BASMI, BASDAI, and chest expansion immediately after the 12-week program. At the 24-week follow-up, the Pilates group maintained improvements in BASFI and BASMI compared to the control group. However, the improvements in BASDAI and chest expansion were not sustained at the 24-week mark. The study found no significant changes in the ASQoL scores for either group.¹⁰³
15. **Dönmez et al., (2014)** conducted a randomized controlled trial to evaluate the effectiveness of physical therapy modalities, specifically microwave therapy and Global Postural Reeducation (GPR) exercises, in managing Ankylosing Spondylitis (AS). The study involved 77 AS patients divided into three groups: one receiving only GPR exercises, another receiving GPR exercises plus microwave therapy, and a control group. The researchers evaluated various parameters including disease activity, pain, quality of life, and functional status at baseline, 3 weeks, 3 months, and

6 months. The results showed significant improvements in all measured parameters for both exercise groups compared to the control group. The GPR exercise program led to statistically significant improvements in Bath Ankylosing Spondylitis Metrology Index (BASMI), Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), Bath Ankylosing Spondylitis Functional Index (BASFI), Beck Depression Inventory (BDI), and Ankylosing Spondylitis Quality of Life (ASQoL) scores. Notably, the addition of microwave therapy before exercises did not provide any additional benefits over exercise alone.²⁷⁷

16. **Fernández García et al., (2015)** executed a randomized clinical trial to evaluate the effects of an aquatic exercise and relaxation program on patients with spondyloarthritis (SpA). The study involved 30 participants with axial SpA, divided into an experimental group (n=15) and a control group (n=15). The experimental group underwent a supervised aquatic exercise program consisting of 24 sessions over 8 weeks, while the control group continued with their normal daily activities. The program included relaxation techniques, breathing exercises, active joint exercises, strength-resistance training, and aerobic exercises. The researchers used various assessment tools to measure the outcomes, including the Bath Ankylosing Spondylitis Functional Index (BASFI), Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), and SF-12 Health Survey. The results showed statistically significant improvements in the experimental group for quality of life, functional capacity, and disease severity.²⁷⁸
17. **Lim et al., (2005)** carried out a study to investigate the effects of home-based daily exercise therapy on patients with ankylosing spondylitis (AS). The research, conducted by Hyun-Ja Lim, Young-Im Moon, and Myeong Soo Lee, aimed to assess the impact of a structured exercise program on joint mobility, functional capacity, pain, and depression in AS patients. The study involved 50 subjects randomly assigned to either an exercise group or a wait-list control group. The exercise group performed a 20-minute daily exercise program for 8 consecutive weeks, while the control group maintained their usual routine. The researchers measured various parameters before and after the 8-week period, including joint mobility (using an inclinometer), finger-floor distance (FFD), functional capacity (using the Bath Ankylosing Spondylitis Functional Index - BASFI), pain levels (using a visual analogue scale - VAS), and depression (using the Beck Depression Inventory - BDI). The results showed significant improvements in the exercise group compared to the

control group. After 8 weeks, the exercise group demonstrated increased joint mobility in various areas (cervical, shoulder, hip, and knee), improved FFD, enhanced functional capacity, reduced pain, and decreased depression scores. These findings suggest that a home-based daily exercise program can be an effective intervention for AS patients, improving both physical and psychological aspects of their condition.²⁷⁹

18. **Kjeken et al., (2013)** implemented a randomized controlled trial for evaluating the long-term effects of a multidisciplinary in-patient rehabilitation programme for patients with ankylosing spondylitis (AS). The study involved 95 participants, with 46 receiving a 3-week in-patient rehabilitation programme and 49 receiving treatment as usual. The primary outcomes were disease activity measured by the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and function measured by the Bath Ankylosing Spondylitis Functional Index (BASFI). Secondary outcomes included well-being, spinal and hip mobility, and health-related quality of life. Assessments were made at baseline, 4 months, and 12 months. The results demonstrated significant overall treatment effects in favor of the rehabilitation group over the 1-year period. The BASDAI score showed a mean difference of -10.0 (95% CI: -3.7 to -16.3) between the groups. Significant improvements were also observed in well-being and several SF-36 variables, including social functioning, role physical, role mental, and bodily pain. These findings suggest that the rehabilitation programme had positive effects on disease activity, pain, function, and well-being, indicating its importance as a complement to medical disease management in AS patients.²⁸⁰
19. **Masiero et al., (2011)** conducting a randomized controlled trial for evaluating the effects of rehabilitation treatment on patients with ankylosing spondylitis (AS) who have been stabilized with tumor necrosis factor (TNF) inhibitor therapy. The study involved 62 outpatients divided into three groups: rehabilitation plus educational-behavioral program, educational-behavioral program only, and a control group. The rehabilitation program included exercises for stretching, strengthening, and improving chest and spine/hip joint flexibility, which patients were instructed to perform at home as well. The study assessed outcomes at 2 and 6 months follow-up, measuring factors such as spinal pain intensity, chest expansion, and various indices including BASMI, BASFI, and BASDAI. The results showed significant improvements in the rehabilitation group compared to the other groups, particularly in spine mobility, pain reduction, and functional ability. These positive outcomes were maintained at the 6-month follow-up.²⁸¹

20. **Xie et al., (2019)** carried out a study on the effects of Baduanjin Qigong exercise on patients with ankylosing spondylitis (AS). The research, conducted as a randomized controlled trial, involved 60 AS patients divided into two groups: an exercise group practicing Baduanjin Qigong for post 12 weeks, and a no-treatment group maintaining their current lifestyle. The study aimed to evaluate the efficacy and safety of this traditional Chinese exercise in improving AS symptoms. The results showed that while the total Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) scores did not differ significantly between the two groups, the exercise group demonstrated improvements in specific areas. Patients who practiced Baduanjin Qigong reported reduced fatigue, as well as decreased intensity and duration of morning stiffness. Additionally, the exercise group showed higher patient global assessment scores. These improvements were observed without any significant adverse effects, suggesting that Baduanjin Qigong could be a safe and potentially beneficial exercise for AS patients.²⁸²
21. **Sweeney et al., (2002)** conducted a study to assess the effect of a home-based exercise intervention package on outcomes in patients with Ankylosing Spondylitis (AS). The research, conducted by Siobhan Sweeney, Gordon Taylor, and Andrei Calin, aimed to evaluate the impact of a self-care promoting intervention on various outcome measures in AS patients. The study was designed as a 6-month randomized controlled trial involving 200 subjects randomly selected from a database of 4,569 AS patients. The intervention group received an exercise/educational video, an educational booklet, an exercise progress wall chart, and exercise reminder stickers. The outcome measures included function (BASFI), disease activity (BASDAI), global well-being (BAS-G), exercise self-efficacy (ESE), arthritis self-efficacy (SES), and quantity of AS mobility/aerobic exercise. The results showed significant improvements in the intervention group for self-reported AS mobility exercise ($p < 0.001$), aerobic exercise ($p < 0.05$), and exercise self-efficacy ($p = 0.045$). While there were no statistically significant between-group differences for BASFI, BASDAI, and BAS-G, the p-value of 0.08 for function (BASFI) approached significance.²⁸³
22. **Widberg et al., (2009)** conducted a randomized controlled study for evaluating the effects of physiotherapeutic intervention, specifically self- and manual mobilization, on patients with ankylosing spondylitis. The study involved 32 male patients aged 23-60 years, divided into treatment and control groups. The treatment group underwent an 8-week program of individualized self- and manual mobilization sessions twice a

week, along with prescribed home exercises. The control group maintained their usual physical activities. The study assessed various parameters including chest expansion, vital capacity, posture, spine mobility, and disease-related factors using Bath Ankylosing Spondylitis (BAS) scales. The results showed significant improvements in the treatment group compared to the control group in several areas. Chest expansion increased at the processus xiphoideus level, posture improved in the cervical and thoracic spine, and spinal mobility increased in flexion and range of motion. The Bath Ankylosing Spondylitis Metrology Index (BASMI) also showed significant improvement in the treatment group. However, there were no significant changes in vital capacity or the other BAS scales (Disease Activity Index, Functional Index, and Global Score).²⁸⁴

2.2.8 Yoga and Ankylosing Spondylitis:

1. **Acar et al., (2023)** conducted a randomized controlled trial, for evaluating the effects of tele-yoga on patients with Ankylosing Spondylitis (AS). The study aimed to evaluate the impact of an 8-week tele-yoga intervention on various physical and psychological parameters in AS patients. Sixty patients were randomly assigned to either a tele-yoga group (TYG) or a wait-list control group (CG). The TYG participated in online yoga classes three times per week for 8 weeks, while the CG continued their standard medical treatment. The primary outcome measure was physical function, assessed using the Bath AS Functional Index (BASFI). Secondary outcomes included disease activity, spinal mobility, flexibility, muscular endurance, exercise capacity, balance, sleep quality, stress, depression, anxiety, quality of life (QoL), and mindfulness. The study demonstrates that online yoga practice can be a safe, feasible, and effective intervention for managing both physical and psychological aspects of AS.¹⁴⁶
2. **Singh et al., (2023)** administered a randomized controlled trial for investigating the efficacy of a 3-month tele-yoga intervention for patients with Ankylosing Spondylitis (AS) during the COVID-19 pandemic. The study involved 120 AS patients divided into two groups: a yoga intervention arm (YG) and a control arm (CG). The YG received a 60-minute structured yoga module online for 3 months in addition to standard medical care, while the CG followed only standard care. The study assessed various outcomes, including disease activity (BASDAI), functional index (BASFI),

quality of life (AS-QoL), psychological measures (anxiety and depression), and inflammatory markers (ESR and CRP). Results showed significant improvements in the yoga group compared to the control group in several measures. Between-group analysis revealed significantly better improvements in the yoga arm for BASDI, BASFI, anxiety, and AS-QoL compared to the control arm.²⁸⁵

3. **Acharya et al., (2024)** compared the effects of Yoga with traditional exercise on mobility and functional capacity in individuals with ankylosing spondylitis (AS). The study was conducted as an open randomized controlled trial at the physiotherapy department of Manipal Hospital, Bangalore. Participants were divided into two groups: a Yoga group and an Exercise group. Both groups underwent an 8-week intervention program with 3 weekly sessions. Outcome measures were assessed at baseline, post-intervention (8 weeks) and follow-up (post 12 weeks). The study utilized several outcome measures including the Bath Ankylosing Spondylitis Metrology Index (BASMI) for spinal mobility, Bath Ankylosing Spondylitis Functional Index (BASFI) for functional capacity, Pittsburgh Sleep Quality Index (PSQI) for sleep quality, Numerical Pain Rating Scale (NPRS) for pain, and chest expansion (CE) for rib-cage mobility. The results showed statistically significant improvements in within-group scores for both Yoga and Exercise groups across all outcome measures. However, there were no significant differences between the two groups in the between-group comparison.¹⁶³
4. **S. K. Singh et al., (2022)** organised a case study on the role of selected yoga practices in treating Ankylosing Spondylitis (AS). The study focuses on an 18-year-old male patient who presented with severe pain in the pelvic region radiating to the thighs and calves, along with indigestion, insomnia, and weakness. The results of the study showed significant improvements in the patient's condition. The patient reported reduced pain, improved joint movements, better sleep quality, and overall well-being. Notably, the C-reactive protein (CRP) value, an indicator of inflammation, decreased from 11.39 mg/L before the yoga therapy to less than 4 mg/L after 14 weeks of practice. The BATH Indices scores also showed progressive improvements in the patient's overall condition, including reduced pain intensity and increased range of joint movements.²⁸⁶
5. **J. Singh et al., (2021)** led a retrospective study for evaluating the potential role of yoga in managing Ankylosing Spondylitis (AS), a chronic autoimmune inflammatory spondyloarthropathy. The study analyzed data from 24 male AS patients aged 30-50

years who underwent a two-week residential yoga retreat between 2015 and 2020 at a yoga center in South India. The yoga intervention included postures, breathing practices, meditation, a healthy diet, and devotional sessions. The study assessed the efficacy of the yoga intervention on spinal flexibility, blood pressure, heart rate, and symptom scores. The results showed significant improvements in several areas. The sit-and-reach test scores, which measure spinal flexibility, increased by 37% after the intervention. Systolic blood pressure and heart rate were significantly lower post-intervention. Additionally, both the symptom score and analgesic medication score showed significant improvements compared to the baseline.¹⁴⁹

6. **Sushma et al., (2022)** operated a case report which discussed the integrative approach combining Ayurveda, counselling, Yoga, and meditation with conventional management for a patient with Ankylosing Spondylitis (AS). The patient, a 59-year-old HLA-B27 positive male, had been suffering from AS for 40 years and sought Ayurvedic treatment for relapse of pain, stiffness, fatigue, intermittent constipation, and disturbed sleep. The Ayurvedic diagnosis was Amavata, a clinical condition characterized by joint inflammation. The patient underwent treatment as an outpatient for eleven days and was hospitalized for thirty-three days. The treatment included internal medicines, external therapies, diet modification, lifestyle adjustments, counselling, Yoga, and IAM Technique (Integrated Amrita Meditation Technique). At the yearly follow-up, significant improvements were observed. The C-Reactive Protein (CRP) reduced from 37.5 mg/L to 15.7 mg/L, and the Erythrocyte Sedimentation Rate (ESR) decreased from 103 mm/h to 8 mm/h, indicating a reduction in inflammation. The frequency of NSAID and DMARD (Disease Modifying Antirheumatic Drug) administration was reduced from once in twenty-four hours to once in eighty-four hours, and steroids from twice daily to once a week. The case report highlights several unique and interesting insights. Firstly, it demonstrates the potential of an integrative approach in reducing dependence on steroids and pain medications in chronic AS, a condition that typically requires lifelong medication for symptomatic relief. Secondly, it showcases the effectiveness of combining traditional Ayurvedic treatments with modern medical management, resulting in improved quality of life for the patient. Lastly, the report provides a detailed account of the Ayurvedic diagnosis and treatment process, offering valuable insights into how Ayurvedic principles can be applied to manage complex, chronic conditions like AS.²⁸⁷

7. **J. Singh et al., (2022)** presented a research study on developing and validating a yoga module for patients with ankylosing spondylitis (AS). The study was conducted in three phases: development of the yoga module, validation of the module, and feasibility testing. In the first phase, a comprehensive review of classical and contemporary yoga texts was conducted to develop a yoga module aimed at alleviating pain, reducing disability, and improving the quality of life in AS patients. Initially, 56 practices were identified, of which 41 were included in the designed yoga module. The second phase involved the validation of this module by 41 yoga experts with a minimum of five years of experience in clinical yoga. The experts rated each practice on a 3-point scale, and the Lawshe content validity ratio (CVR) method was used to determine the content validity. Practices with a CVR score of >0.3 were retained in the final module, resulting in 31 practices being included. The third phase involved a pilot study to assess the feasibility and acceptability of the validated yoga module. Nineteen AS patients with an average age of 35.5 ± 10.7 years participated in the study, practicing the yoga module thrice weekly for a month. The feasibility was evaluated based on attrition rate, retention rate, attendance, and subjective responses. The results showed that the module was feasible, acceptable, and easy to practice for AS patients. Most participants (65%) were able to practice for a minimum of 30 minutes per day, and 85% of the participants reported high efficacy in reducing pain and increasing spinal flexibility.²⁸⁸
8. **Yu et al., (2021)** framed a study on an online pain management programme for patients with ankylosing spondylitis (AS). The programme incorporates mindfulness-informed exercises and cognitive behavioral therapy (CBT) elements. Thirty AS patients participated in a five-week online programme delivered primarily through a website. The materials covered included breathing and body scanning exercises, mindful walking, positive thinking, and management of dysfunctional thinking. Participants completed various psychological measures before and after the treatment programme, and four face-to-face focus groups were conducted to gather qualitative feedback. The results indicate that the online pain management programme can improve sleep quality and reduce pain interference and catastrophic responses to pain in AS patients. However, it was not very effective in mitigating pain intensity.²⁸⁹
9. **Buijze et al., (2019)** presented a proof-of-concept clinical trial for investigating the safety and potential anti-inflammatory effects of an add-on training program in patients with axial spondyloarthritis (axSpA). The training program consisted of

breathing exercises, cold exposure, and meditation. The study involved 24 patients with moderately active axSpA, randomized into early intervention (n=13) and late intervention (n=11) groups. The primary endpoint was safety, while secondary endpoints included changes in inflammatory markers such as hs-CRP, ESR, and serum calprotectin levels. Exploratory endpoints included disease activity measures and quality of life assessments. The results showed that the add-on training program could be safely applied in axSpA patients, with no significant differences in adverse events between the intervention and control groups. The intervention group demonstrated a significant decrease in ESR levels and ASDAS-CRP scores over the 8-week period. Additionally, there were improvements in disease activity measures (BASDAI) and quality of life (SF-36) following the intervention. The study also observed a trend towards decreased serum calprotectin levels in the intervention group, although this did not reach statistical significance. This study provides intriguing insights into the potential modulation of inflammatory responses in chronic inflammatory diseases through voluntary techniques. The results suggest that the combination of breathing exercises, cold exposure, and meditation may have beneficial effects on inflammation and disease activity in axSpA patients. However, the authors acknowledge limitations such as the small sample size, unblinded design, and the inability to determine the specific mechanism of action or the individual contributions of each component of the training program. The findings warrant further investigation with larger sample sizes to formally evaluate clinical efficacy and elucidate the underlying mechanisms of this novel therapeutic approach.²⁹⁰

10. **Acar et al., (2022)** investigated the effects of tele-yoga on patients with ankylosing spondylitis (AS). The study aimed to assess the impact of tele-yoga on various aspects of patient health, including disease activity, functional limitation, and spine flexibility, quality of sleep, anxiety, stress, depression, and overall wellness. The study involved 36 AS patients (15 female and 20 male) from the Division of Rheumatology and Immunology at Dokuz Eylül University. Participants were randomly assigned to either a waiting-list control group (n=18, mean age 44.9 ± 8.01 years) or a tele-yoga group (n=18, mean age 43.22 ± 8.54 years) using block randomization. The tele-yoga group participated in one-hour sessions three times a week for eight weeks, conducted via Zoom with a maximum of five participants per group. Examinations were performed before and after the eight-week program. The control group continued their regular activities and medication regimens without additional assistance. The

researchers used various assessment tools to measure the outcomes, including the Pittsburgh Sleep Quality Index (PSQI), Short Form-36 (SF-36), Hospital Anxiety and Depression Scale (HADS), Perceived Stress Scale (PSS), Bath AS Disease Activity Index (BASDAI), Bath AS Functional Index (BASFI), and Bath AS Mobility Index (BASMI). These tools evaluated sleep quality, overall health, anxiety and depression, stress levels, disease activity, functionality, and spinal mobility, respectively. The study found that the tele-yoga group showed significant improvement in all measures ($p < 0.05$) compared to the control group.²⁹¹

11. **Jana (2024)** evaluated the therapeutic effectiveness of yoga in Ankylosing Spondylitis by comparing a yoga intervention with conventional medical management across post 24 weeks. The study assessed disease activity, inflammatory markers, blood count, general health, psychological parameters, and HRQoL. At post 12 weeks, the yoga group showed significant improvements over the control group in disease activity, inflammatory markers, psychological and HRQoL variables ($p < 0.05$), whereas most blood count and general health variables remained nonsignificant ($p > 0.05$). At post 24 weeks, significant differences were again found between groups across nearly all outcome variables, confirming sustained improvement in the yoga group ($p < 0.05$). Within-group analyses also revealed significant improvement from baseline to 12 and post 24 weeks in the yoga group ($p < 0.05$), while the control group showed limited changes. Overall, the study concluded that yoga is an effective complementary therapy for AS, producing meaningful reductions in disease activity and psychological distress and enhancing HRQoL ($p < 0.05$).²⁹²

2.2.9 Yoga in other related disorder:

1. **Manik et al., (2017)** conducted a study on the effect of selected yogic practices on pain and disability in patients with lumbar spondylitis. The research was conducted at the All India Institute of Medical Sciences, Bhubaneswar, involving 172 patients aged 21-79 years. The study design was a prospective, randomized trial without a control group, dividing participants into three subgroups: Instant Relieve Practice Group (IRPG), Short-Term Practice Group (STPG), and Long-Term Practice Group (LTPG). The yoga intervention included a module of selected practices such as pawanamuktasana series 1, backward bending asanas, pranayama, and relaxation techniques like Yoga Nidra. The effectiveness of the intervention was measured using the Roland-Morris Back Pain and Disability Questionnaire (RMDQ). The results

showed significant reduction in pain and disability across all groups, with the LTPG demonstrating the most substantial improvement. Statistical analysis, including ANOVA and regression analysis, revealed high correlations between pre- and post-intervention scores in all groups.²⁹³

2. **Deepeshwar et al., (2018)** conducted a randomized controlled trial for evaluating the effect of an integrated approach of yoga therapy (IAYT) on patients with knee osteoarthritis (OA). The study involved 66 participants aged 30-75 years, divided into two groups: Yoga (n=31) and Control (n=35). The Yoga group received a 1-week IAYT intervention at a yoga center, while the Control group maintained their normal lifestyle. The study measured several primary and secondary outcomes. Primary outcomes included the Timed Up and Go Test (TUG), Sit-to-Stand (STS) test, and goniometer measurements for knee flexibility. Secondary outcomes comprised the Falls Efficacy Scale (FES) and Handgrip Strength (HGS) tests. These assessments were conducted on day 1 and day 7 of the study. The results showed significant improvements in the Yoga group for TUG, STS, right and left knee flexion and extension, and left handgrip strength. The Control group showed no significant improvements and even experienced some worsening of symptoms.²⁹⁴
3. **Ebnezar et al., (2012)** conducted a randomized control study examining the effect of integrated yoga therapy on pain, morning stiffness, and anxiety in patients with osteoarthritis (OA) of the knee joint. The study involved 250 participants aged 35-80 years, divided into yoga and control groups. Both groups received transcutaneous electrical stimulation and ultrasound treatment, followed by either integrated yoga or physiotherapy exercises for 40 minutes daily over two weeks, with a three-month follow-up. The integrated yoga therapy consisted of yogic loosening and strengthening practices, asanas, relaxation, pranayama, and meditation. The study measured various outcomes, including resting pain, morning stiffness, state and trait anxiety, blood pressure, and pulse rate. Results showed significant improvements in the yoga group compared to the control group across all measured variables. The yoga group demonstrated better reduction in resting pain, morning stiffness, state and trait anxiety scores, blood pressure, and pulse rate.²⁹⁵
4. **Jain et al., (2021)** focussed on the effect of a selected group of asanas (yoga poses) as an adjunct treatment for cervical spondylosis (CS) of mild to moderate severity. The study was conducted as an observational study on a cohort of patients who visited the AYUSH department between May and November 2016. The researchers aimed to assess the potential benefits of specific yoga practices over a short time frame and

evaluate the functional outcomes of patients. The study included 30 patients (19 males and 11 females) with mild to moderate CS, as determined by their Neck Disability Index (NDI) scores. The patients were taught a 'Selected Group of Asana' (SGOA) module, which they practiced for 30 minutes under supervision initially and then continued as a home-based program for 8 weeks. The SGOA included six specific yoga poses designed to address CS symptoms. Patients were followed up fortnightly, and their degree of severity and disability were assessed using the NDI score. The results showed a significant improvement in the patients' NDI scores over the 8-week period. The mean NDI score decreased from 17.83 at baseline to 7.40 at the final follow-up, with statistically significant improvements noted at each follow-up interval. The researchers concluded that the SGOA, when practiced as a home-based program for eight weeks, could be useful in reducing pain and disability in people suffering from mild to moderate CS.²⁹⁶

5. **Hartfiel et al., (2017)** conducted a study on the cost-effectiveness of yoga for managing musculoskeletal conditions in the workplace, specifically within the National Health Service (NHS) in the UK. The research, conducted as a randomized controlled trial, involved 151 NHS employees who were divided into yoga and usual-care groups. The yoga intervention consisted of an 8-week program with one 60-minute session per week, along with home practice materials. The study assessed the effectiveness of yoga using the Roland-Morris Disability Questionnaire (RDQ) and the Keele STarT Back Screening Tool, while cost-effectiveness was evaluated using health-related quality of life (HRQL) measures and various cost factors. The results indicated that yoga participants experienced greater reductions in back pain-related disability compared to the usual-care group at both 8 weeks and 6 months. From a healthcare perspective, yoga was found to be more costly but more effective than usual care, with an incremental cost-effectiveness ratio well below the £20,000 per quality-adjusted life year (QALY) threshold. From a societal perspective, which included production loss costs, yoga was found to be dominant (more effective and less costly) compared to usual care. The study also noted a reduction in healthcare resource use and sickness absence days among yoga participants.²⁹⁷
6. **Joshi & Bellad, (2011)** conducted a randomized controlled trial to evaluate the impact of yogic exercises on musculoskeletal disorders (MSDs) of upper limbs among computer users. The study was conducted at Jawaharlal Nehru Medical College, Belgaum, involving symptomatic administrative and supporting staff aged less than 45 years who regularly use computers for 10-15 hours per week for at least a year. The

primary objective was to evaluate the effectiveness of yogic exercises in improving symptoms of MSDs in the upper limbs. The study involved 60 participants divided into two groups: yoga with counseling and counseling only. Both groups received counseling from physiotherapy experts for three days. The yoga group additionally received training from a yoga expert and performed daily yoga exercises for one hour, six days a week, for three months. The results showed a significant reduction in symptom severity score ($P = 0.002$) and improvement in functional status score in the yoga with counseling group compared to the counseling-only group. There was also a significant decrease in self-reported symptoms, particularly in cervico-thoracic myalgia ($P = 0.019$) and weakness. The study concluded that a yoga-based regimen is more effective than counseling alone in relieving symptoms of computer-related musculoskeletal disorders.²⁹⁸

7. **Metri et al., (2023)** conducted a randomized controlled study to assess the impact of workplace yoga on female teachers with chronic musculoskeletal pain (cMSP). The study involved 50 female teachers aged 25-55 years, split into a yoga group ($n=25$) and a control group ($n=25$). The yoga group received a 60-minute structured Integrated Yoga intervention four days a week for six consecutive weeks at school, while the control group received no intervention. The study assessed various outcome measures including pain intensity, anxiety, depression, stress, fatigue, self-compassion, sleep quality, and quality of life at baseline and after six weeks. The results showed significant improvements in the yoga group compared to the control group. There was a notable reduction in pain intensity and pain disability, as well as improvements in anxiety, depression, stress, sleep scores, and fatigue in the yoga group after six weeks. The study also found improvements in physiological measures such as systolic blood pressure, diastolic blood pressure, and heart rate in the yoga group.²⁹⁹
8. **Mirzaei et al., (2022)** conducted a clinical trial study to evaluate the effect of yoga on musculoskeletal pain in elderly females. The research was conducted on 60 females over 60 years of age with musculoskeletal pain, randomly divided into intervention and control groups. The intervention group participated in three one-hour yoga sessions weekly for eight weeks, while the control group received no special intervention. Pain was measured using the McGill Pain Questionnaire before the intervention and at weeks four and eight. The results showed a significant decrease in mean musculoskeletal pain in the intervention group compared to the control group at the end of both the 4th and 8th weeks ($\mathit{P} < 0.005$). Interestingly, while the subscales of sensory dimension and severity of pain did not show a decrease after

four weeks compared to the control group, all pain subscales decreased significantly in the intervention group by the end of the eighth week. The study also found that the knee was the most common area of pain among participants, which may be related to the traditional Iranian lifestyle and activities that put stress on the knee joint.³⁰⁰

9. **Liu et al., (2021)** investigated the biomechanical aspects of five common standing yoga poses: Chair, Tree, Warrior 1, Warrior 2, and Warrior 3. The study aims to quantify the physical demands on the lower extremities during these poses and provide insights for their application in musculoskeletal rehabilitation. The researchers analyzed joint moments of force (JMOFs) and electromyography (EMG) data from eleven experienced female yoga instructors performing these poses. The study found significant differences in hip, knee, and ankle JMOFs across the different poses. The Chair pose produced the highest knee extensor JMOF and lowest knee adductor JMOF, making it potentially suitable for knee osteoarthritis patients. Warrior 1 and Warrior 2 poses generated high hip JMOFs, with Warrior 1 producing the greatest hip extensor JMOF in the front limb and the greatest hip flexor JMOF in the back limb. Warrior 2 generated the highest knee adductor JMOF in the back limb, which could potentially impact the medial side of the knee joint. Single-leg balance poses like Tree and Warrior 3 generally produced lower hip JMOFs due to the ground reaction force passing close to the hip joint center.³⁰¹
10. **Curtis et al., (2017)** conducted a pilot randomized controlled trial for evaluating the effects of a specialized yoga program for individuals with spinal cord injury (SCI). The study aimed to assess the impact of Iyengar yoga (IY) on pain, psychological factors, and mindfulness in people with SCI. The trial involved 23 participants who were outpatients or community members affiliated with a rehabilitation hospital. They were randomly assigned to either an IY group (n=11) or a 6-week wait-list control (WLC) group (n=12). The IY group participated in a twice-weekly, 6-week seated IY program, while the WLC group received the same yoga program after the IY group's program ended. The yoga intervention incorporated various aspects of yoga, including breathing practices, physical postures, yoga philosophy, mindfulness, and meditation/relaxation techniques. The program was designed and taught by certified IY teachers with extensive experience in therapeutics and teaching yoga to limited-mobility populations. Data were collected at multiple time points using various self-report measures assessing psychological well-being, pain-related variables, and mindfulness factors. The results of the study indicated that participants in the IY group showed significant improvements in depressive symptoms and self-compassion

compared to the WLC group. When both groups were combined for analysis, there were significant improvements in depression scores, self-compassion, overall mindfulness, and specific mindfulness facets such as observing and non-reactivity. However, the study did not find significant improvements in pain intensity, pain interference, or pain catastrophizing.³⁰²

11. **Schmid et al., (2019)** implemented a feasible pilot study for evaluating the benefits of 8-week yoga intervention for individuals with chronic pain. The study, conducted at a community-based pain clinic, included 67 participants with various types and locations of pain. The yoga intervention consisted of twice-weekly 60-minute sessions over 8 weeks, incorporating physical postures, breathing exercises, positive affirmations, and meditation. The primary outcome measure was the Brief Pain Inventory (BPI), assessing pain severity and pain interference on daily activities. The results indicated that the yoga intervention was feasible and beneficial for participants with chronic pain. While pain severity scores did not significantly change, there was a significant decrease in pain interference scores for the yoga group. Additionally, the yoga group showed improvements in quality of life, self-efficacy for managing chronic pain, and body responsiveness. The study found that yoga was particularly effective in enhancing pain management skills and physical functioning, as measured by the Chronic Pain Self-Efficacy Scale (CPSS).³⁰³
12. **Lazaridou et al., (2019)** conducted a qualitative study for assessing the impact of a daily yoga program on women with fibromyalgia (FM). The study was conducted following a 6-week pilot trial that combined group yoga sessions with individual home practice. Fifteen participants were interviewed via telephone after completing the yoga intervention, and their responses were analyzed using thematic analysis. The study identified five major themes from the participants' experiences: (1) physical/body perceptual changes, (2) practices affecting pain, (3) emotional changes, (4) practice motivators and barriers, and (5) group effect. Participants reported improvements in body awareness, flexibility, and energy levels. They also noted reductions in pain, particularly in areas of maximum discomfort. The yoga program had positive effects on mood, stress levels, and self-confidence. Participants found motivation in the desire for physical fitness and the feeling of taking action towards healing. The group setting was particularly beneficial, providing a sense of connection and accountability.³⁰⁴

2.3 Summary of the Review:

Table No. 1 Summary of scientific literature on yoga-based interventions for the management of rheumatic disorders

Sl. No.	Authors and year	Title of the study	Participants (recruited, sex and age)	Intervention (type, intensity and duration)	Comparison condition & Study Design	Findings
1	Ganesan et al., 2020 ¹³⁹	Effect of Yoga Therapy on Disease Activity, Inflammatory Markers, and Heart Rate Variability in Patients with Rheumatoid Arthritis	Yoga: M/F 83 Control: M/F 83 Age: 30-60yrs (Both Gender)	post 12 weeks (30min, 3times/week)	Control group with standard medication RCT	Disease activity, IL-1 α , cortisol levels, LF:HF ratio and LFnu decreased, HFnu, RMSSD, and SDNN increased (p<0.05).
2	Evans et al., 2013 ²⁵²	Impact of Iyengar yoga on quality of life in young women with rheumatoid arthritis	Yoga:11 Control: 15 Age: 16-35yrs	6-week, 2 times/weekly	Control group with standard medication RCT	Greater improvement in HRQOL, pain disability, general health, mood, fatigue, acceptance of chronic pain, and self-efficacy regarding pain
3	Badsha et al., 2009 ²⁵³	The benefits of yoga for rheumatoid arthritis: results of a preliminary, structured 8-week program	Yoga: 26 Age: 44.0 \pm 10.0 Control: 21 Age: 46.2 \pm 10.7	8 weeks, 1 hour/12 sessions of yoga	Control group with standard medication Non-RCT	Significant improvements (DAS28) and HAQ scores quality of life scores did not change significantly, except for improvements in role limitations due to emotional health (p<0.05).
4	Pukšić et al., 2021 ²⁵⁶	Effects of Yoga in Daily Life program in rheumatoid arthritis: A randomized controlled trial	Yoga : 30 Control group: 27 Age: 55.3 \pm 11	post 24 weeks (90 min, 2 times/week)	Control cohort receiving	significant reduction in depression (HADS.D), anxiety (HADS.A) and Insignificant changes in DAS28CRP, CRP, Pain VAS and PSS,SF 36
5	Gautam et al., 2020 ²⁵⁷	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	Yoga: 33 Age: 45.1 \pm 8.7) Control: 33 Age: 43.4 \pm 9.3	8weeks 120 min, 5 times/week	Control group with standard medication RCT	Significant reduction in DAS28-ESR (p < 0.001), improvement seen in the physical health, psychological, social relationships domains (p < 0.001) of QOL, Significant in also up regulation of (TGF- β), down regulation of certain genes (IL-6, TNF- α , and CTLA4) but no significant changes (p > 0.05) in the environmental health domain

6	Ward et al., 2018 ²⁵⁹	Yoga for the management of pain and sleep in rheumatoid arthritis: a pilot randomized controlled trial	Yoga: 13 Control: 13 54 ± 11 years	8- week	Control group with standard medication RCT	Relaxation based yoga program is feasible and safe for rheumatoid arthritis- related pain and functional disability.
7	Gautam et al., 2019 ¹⁴⁰	Impact of yoga based mind-body intervention on systemic inflammatory markers and co-morbid depression in active Rheumatoid arthritis patients: A randomized controlled trial	Yoga: 36 Control: 36 Age: 18–60 years	8weeks 120 min, 5 times/week	Control group with standard medication RCT	Decrease level of inflammatory markers as well as in DAS28ESR (p-value <0.0001; effect size=0.210) and HAQDI (p-value 0.001; effect size=0.159), while increasing anti-inflammatory cytokines, neuroplasticity markers, and cellular health indicators
8	Evans et al., 2011 ²⁶¹	Now I see a brighter day": expectations and perceived benefits of an Iyengar yoga intervention for young patients with rheumatoid arthritis.	Yoga: 5 Control: NA Age: 24–31 years	6 weeks 1.5 hour 2/week	No control group Non-RCT	Improvements were seen in wellbeing, range of motion, physiological awareness, acceptance, coping mechanisms, self-efficacy, and mindfulness.
9	V. K. Singh et al., 2011 ¹⁴¹	Effect of yogic package on rheumatoid arthritis	Yoga: 80 Age: 35.08±7.3 Control: 80 Age: 34.65±7.3	40 Day (90 minutes/ Each day day)	Control group with standard medication RCT	Pain intensity, mean heart rate, blood pressure, serum uric acid, CRP, lymphocyte count and were all significantly reduced (p<0.05).
10	Bosch et al., 2009 ²⁶³	Functional and physiological effects of yoga in women with rheumatoid arthritis: A pilot study	16	10 week 75minutes/week	No control group Non-RCT	(HAQ) disability index , perception of pain and depression ↓ improved ↑ balance Not significant changes found in awakening or diurnal cortisol pattern.
11	Haslock et al., 1994 ²⁶²	Measuring the Effects of Yoga in Rheumatoid Arthritis	Yoga: 10 Control: 10	2-hour sessions for 3 weeks, followed by weekly 2 hour sessions for 3 months,	Control group with their normal medical treatment Non-RCT	Significant improvements in yoga group of left-hand grip strength, HAQ scores and left hand ring sizes, although not to statistically significant levels.

12	Pandya, 2020 ²⁶⁰	The Impact of Yoga, Anti-Inflammatory Diet & Self-Monitoring In Children With Rheumatic Diseases.	Yoga: 14 Control: 8 Above 8 years	4 weeks (45 minutes /day)	Control group with standard medication Non-RCT	Very helpful effects include yoga, anti-inflammatory diet, and self-monitoring.
13	Cartwright et al., 2020 ²⁵⁸	A mixed methods evaluation of an individualised yoga therapy intervention for rheumatoid arthritis: Pilot study	10 participants	16-week	No control group Non-RCT	Improve RA symptoms, increase self-care behaviours and manage stress and anxiety
14	Dash & Telles, 2001 ²⁵⁵	Improvement in hand grip strength in normal volunteers and rheumatoid arthritis patients following yoga training	Normal adults (n=37) Children (n=86) Rheumatoid arthritis (n=20)	Adults: 30 days, children:10 days, RA patients:14 days	Between Group Non-RCT	Greater percentage increase in grip strength for patients with rheumatoid arthritis compared to normal adults.
15	Greysen et al., 2019 ²⁵⁴	The Association between Yoga Use, Physical Function, and Employment in Adults with Rheumatoid Arthritis	398 adults mean age: 61.8 years	Yoga practitioner vs non practitioners (here author do not giving any treatment)	Yoga practitioner vs no practitioner cross-sectional study	No significant differences were found in pain, fatigue, depression, or sleep quality between yoga practitioners and non-practitioners.

Table No. 2: Summary of scientific literature on yoga-based interventions for the management of ankylosing spondylitis

Sl. No.	Authors and year	Title of the study	Participants (recruited, sex and age)	Intervention (type, intensity and duration)	Comparison condition & Study Design	Outcome measures and result
1	S. K. Singh et al., 2022 ²⁸⁶	Role of selected Yoga practices in the treatment of Ankylosing Spondylitis: a case study	Yoga: M/F 1/0 Control: NA	Yoga: 3 weeks/weekly basis	No comparison group Case study	Positive changes in BASFI, BASDAI, BAS G score, and CRP level, enhancement of spinal mobility, reduced inflammation, and pain intensity
2	Acar et al., 2023 ¹⁴⁶	The Effects of Tele-Yoga in Ankylosing Spondylitis Patients: A Randomized Controlled Trial	Yoga: M/F 28/0 Control: M/F 27/0	Yoga: 60 min/Day 3times/week for 8 weeks	continue their routine activities RCT	‘Balance, spinal mobility, flexibility, muscular endurance, disease activity, sleep quality, stress, depression, and quality of life’ improved significantly (p<0.05)
3	Acharya et al., 2024 ¹⁶³	Comparison of Yoga with exercise in Ankylosing Spondylitis on mobility and functional capacity	Yoga: M/F 13/2 Exercise: M/F 17/1	Yoga: 3 days/week for 8 weeks	Exercise group RCT	For exercise and yoga, both groups showed significant improvement in mobility, sleep quality, functional capacity, and reduced pain level, but between-group differences no significant differences occurred
4	J. Singh et al., 2022 ²⁸⁵	Tele-yoga in the management of ankylosing spondylitis amidst COVID pandemic: A prospective randomized controlled trial	Yoga: M/F 57/0 Control: M/F 52/0	Yoga: 60 min 2 session/week for 3 months	Control group with standard medication RCT	‘BASDAI, BASFI, Anxiety, AS-QoL’ statistically significant (p<0.05)

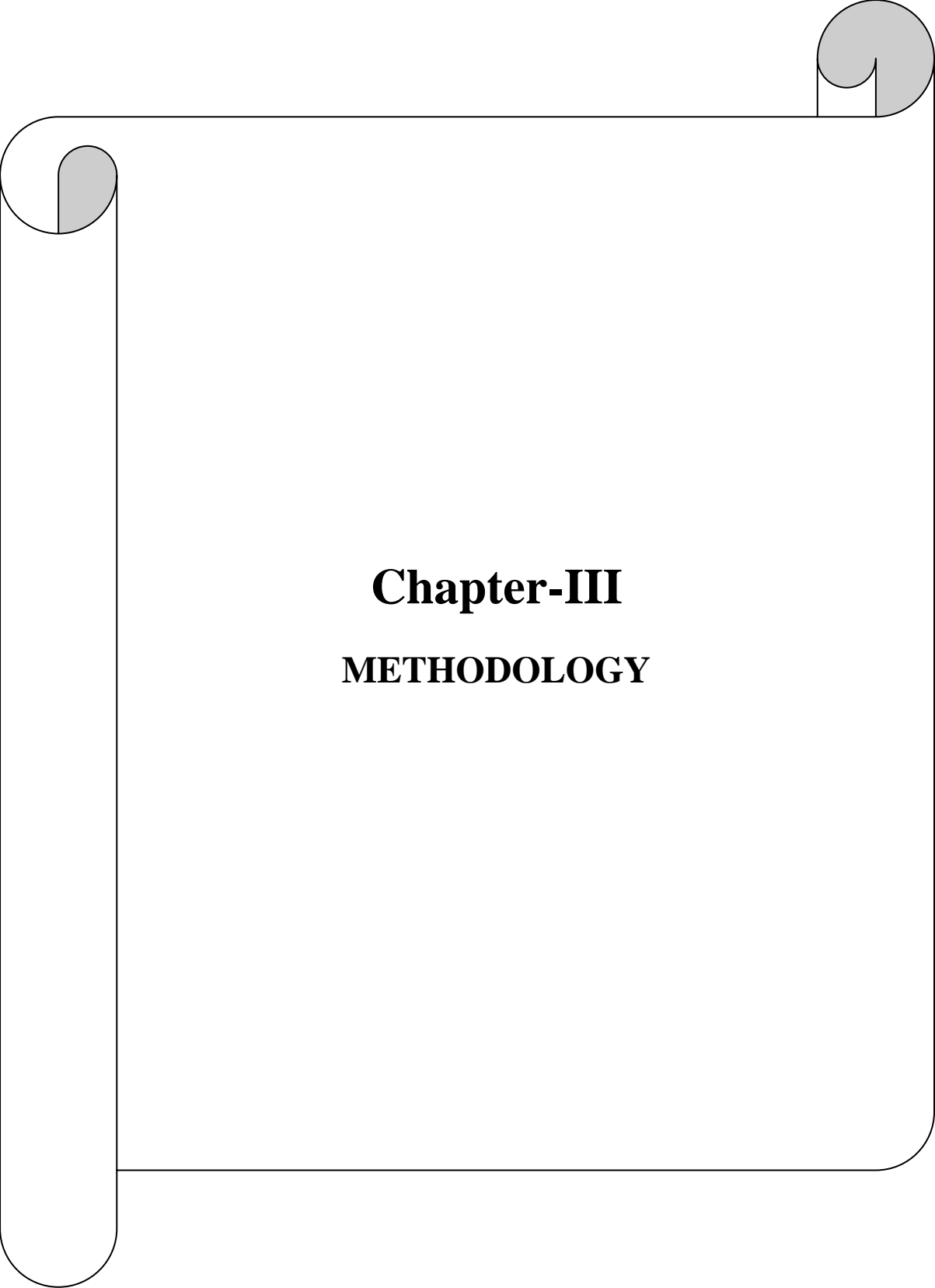
5	Buijze et al., 2019 ²⁹⁰	An add-on training program involving breathing exercises, cold exposure, and meditation attenuates inflammation and disease activity in axial spondyloarthritis – A proof of concept trial	Intervention:13 control group:11	8 weeks Breathing exercises, cold exposure, and meditation	Control group with standard medication Randomised one-way crossover design	‘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).
6	Sushma et al., 2022 ²⁸⁷	‘Integrative approach combining Ayurveda, counselling, Yoga and meditation with conventional management of Ankylosing Spondylitis - A case report’	Participants: 1 Age: 59 years (Male)	44 days	No comparison group Non RCT	CRP (37.5 mg/L- 15 mg/L) and ESR (103 mm/h to 8 mm/h) decreased reported
7	Yu et al., 2021 ²⁸⁹	A preliminary study of an online pain management programme for patients with Ankylosing Spondylitis’	33 of Females:17 Males:13 Age: 49±10.39	Breathing and body scanning exercises, mindful walking exercise, positive thinking and management of dysfunctional thinking	No comparison group Non RCT	‘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).
8	Acar et al., 2022 ²⁹¹	Ankylosing spondylitis and tele-yoga during covid-19 pandemic: preliminary results of a randomized controlled trial	Tele-yoga : 18, (Age 43.22 ±8.54 years) waiting-list control group: 18, (age 44.9 ±8.01 years)	3 days a week for 8 weeks	Control group with standard medication RCT	PSQI, SF-36, HADS, PSS BASDAI BASFI, BASMI, spinal mobility found improvement (p<0.05).

9	J. Singh et al., 2022 ²⁸⁸	Designing, validation, and feasibility of a yoga module for patients with Ankylosing Spondylitis	Participants: 25 (age 35.5 ± 10.7)	1 month	No comparison group Non RCT	Pain and flexibility improved
10	J. Singh et al., 2021 ¹⁴⁹	Potential Role of Yoga in the Management of Ankylosing Spondylitis: A Retrospective Study	Participants: 24 male average age 38.3 ± 10.5 years	2 weeks	No comparison group Non RCT	‘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).
11	Jana.,2024	Influence of Yogic practices on patients with Ankylosing Spondylitis	Intervention:23(male) control group:20(male)	post 24 weeks	Control group with standard medication Non RCT	Disease activity, functional limitation Inflammation, blood pressure, BMI, depression, fear avoidance belief, pain catastrophizing decreased (p<0.05) and HRQoL improved(p<0.05)

Conclusion of the Review:

In the present study, after comprehensive review out of 125 selected studies, only 11 studies were found which are conducted to examine the effect of yoga on ankylosing spondylitis. In the present systematic search, only a limited number of controlled trial studies (n = 4) were identified. This comprehensive literature review described on the effects of yoga and other mind-body interventions on various health conditions, with a particular focus on low back pain, inflammatory markers, and Ankylosing Spondylitis (AS). Multiple studies demonstrate that yoga interventions can significantly reduce pain intensity, improve functional disability, and enhance quality of life in individuals with chronic low back pain. Various studies also suggest that yoga may be as effective as physical therapy for managing low back pain, and it can be a cost-effective treatment option. In this review several studies indicate that yoga practice can lead to reductions in pro-inflammatory cytokines such as IL-6 and TNF- α , while increasing anti-inflammatory markers. This suggests that yoga may have potential benefits for conditions characterized by chronic inflammation. A significant portion of the review highlighted the effectiveness of exercise on Ankylosing Spondylitis. It is also revealed from few studies that yoga and other forms of exercise can improve disease activity, functional capacity, and quality of life in AS patients. Some research also suggests that yoga may have anti-inflammatory effects in AS, potentially modulating the immune response. The review highlights several studies that demonstrate yoga's ability to not only improve physical symptoms but also address psychological aspects of chronic diseases. Another interesting finding is the emerging research on tele-yoga interventions, which suggests that online yoga programs can be effective in managing conditions like AS, especially in situations where in-person sessions are not feasible. Overall, the studies demonstrated that a comprehensive yoga program is an effective intervention for managing various aspects of ankylosing spondylitis. Furthermore, robust randomized controlled trials based studies are required to establish the effectiveness of yoga in managing AS.

**DEVELOPMENT AND VALIDATION OF A YOGA MODULE
IN PATIENTS WITH ANKYLOSING SPONDYLITIS**

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Chapter-III
METHODOLOGY

Chapter-III

METHODOLOGY

The study is divided into three Stages: Part-I is the development of a Yoga Module, part-II is the validation of yoga module through expert's opinion and in part-III is the test the feasibility of that module through experimentation. For development, validation and feasibility test of the Yoga Module a systematic approach³⁰⁵ was taken, which are clearly described as follows:

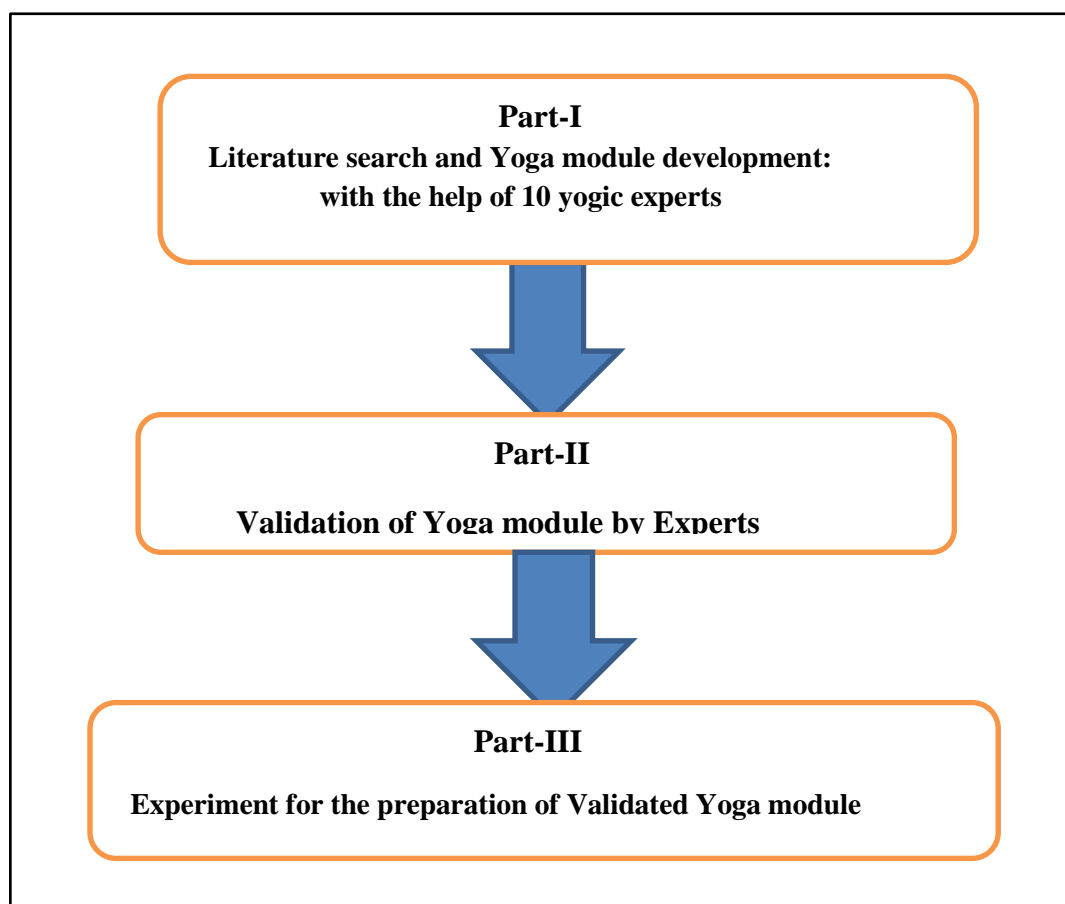


Fig. no. 2: Flow chart of the entire study

The procedure adopted for selection of experts, develop and validation of yoga module through experts, for feasibility test of the yoga module selection of subjects, selection of variables and tests, experimental design, reliability of instruments, tester's competency and reliability of the tests, reliability of data, reliability of the tests, reliability of questionnaire, subject reliability, orientation of the subjects, administration of tests, collection of data and statistical techniques were employed for analysis of the data are described in this chapter.

OBJECTIVE –I: To develop and validate a yoga module for patients with Ankylosing Spondylitis through the opinion of experts from different relevant fields of related disciplines.



PART I

3. A Literature search and Yoga module development

3. A. 1 Selection of Internal Experts

3. A. 2 Literature search

3. A.3 Demographic information of internal experts

3. A. 4 Developed yoga module

3. A.1 Selection of Internal Experts:

Twelve internal yoga experts from West Bengal were approached. All experts possessed at least master's degree in Yoga or a related discipline and had a minimum of 5 years of professional experience. Selection was based on two criteria: (i) sound foundational knowledge of yogic text and literature, and (ii) substantial research publications in the field of yoga.

3. A.2 Literature search:

Out of 12 experts 10 accepts invitation to participate in review process. Out of 10 yoga specialists, four were selected to explore the scientific literature review, focusing on classical texts such as the Shiva Samhita, Patanjali Yoga Sutra, Hath Yoga Pradipika, Gheranda Samhita, Hath Ratnavali as well as contemporary yogic literature. Six yoga experts using search engines like web of science, Scopus, PubMed, Google scholar search the articles on pain management, spinal flexibility, and quality of life in patients with musculoskeletal difficulties such as chronic lower back pain, cervical spondylitis, rheumatoid arthritis, slip disc, sacroiliac joint dysfunction and fibromyalgia using maximum possible keywords: "yoga and inflammatory back pain" "yoga and Sacroiliac pain" "yoga and Low back pain", "yoga and Chronic back pain", "yoga and cervical pain", "yoga and spinal mobility", "yoga and Ankylosing Spondylitis", "Exercise and Ankylosing Spondylitis".

3. A.3 Demographic information of internal experts:

Table No. 3 Demographic summary of internal experts involved in Part-I

Area of Participation	Total Experts	Qualification	No. of Experts	Average experience in the field (years)
Classical yoga texts	4	M.A in Yoga M.Sc in Yoga	2	17.5 ±2.5
			2	15±5
Scientific literature review	6	M.Phil Ph.D.	2	8.15± 0.35
			4	6.6+1.12

3. A.4 Result of Part-I: Developed yoga module

Table No. 4: Based on the literature review, yogic techniques suggested for developed yoga module for patients with Ankylosing Spondylitis

Item No.	Name (Description)	Reference	Physical, physiological and psychological benefits related with activity
1	Griva Shakti vikashaka (Neck movement)	286, 288, 293, 306, 307, 308,309	To maintain flexibility, reduce stiffness, and prevent fusion of the cervical spine.
2	Antarmukha-Bahirmukha hastapasara vayama (Hands in and out stretch)	288	Enhancing chest expansion and improving breathing capacity
3	Purna-Bhuja-Sakthi-Vikasaka (Swinging arm forward and backward-Hand rotation)	308	Tones and improve the physique of the upper body
4	Skandha Sanchalana (Shoulder rotation)	293	To preserve mobility, reduce stiffness, and maintain functional range of motion in ball and socket joint and associated ligaments and tendons
5	Kati Chakra (Trunk twisting)	310	To maintain spinal flexibility, prevent stiffness, and improve overall mobility of the hip joint
6	Kati sanchalana or Pelvic Rocking Pelvic tilt (supine)	311, 312, 313, 314	To improve the flexibility of lumbopelvic part
7	Baddhakonasana movement (Butterfly)	293	To improve hip flexibility, reduce stiffness, and maintain pelvic mobility.
8	Urdhva Janu Sanchalana (Vertical stretch of the knee)	288	To maintain knee flexibility, reduce stiffness, and support overall lower body mobility.
9	Janu-pada-kati Sanchalana (Alternate foot knee lumbar stretch)	288	To improve lumbar flexibility, reduce stiffness, and enhance lower back mobility.
10	Supine Hamstring stretch	308, 315	To strengthen hip muscles and maintain lower body mobility
11	Parsha pada uttana (Side leg raising)	288	Reduce the stiffness of sacroiliac joint
12	Dandyaman Bharmanasana(Kneeling superman posture/Alternate arm and hand stretch in table top position)	308	Builds strength in abdominal and lower back muscles. Restoring the hip flexibility
13	Spinal twist with shoulder opening mobilization (Upper Body Roll)	316	To enhance spinal flexibility, reduce upper back stiffness, and improve posture.

14	Lateral flexion (Side bending)	288	Improving spinal mobility, reduce stiffness and enhancing postural alignment
15	Side bending Chakrasana/Ardhakati chkrasana (Half Wheel pose)	130, 293, 309	To enhance spinal flexibility, reduce stiffness, and improve lateral mobility.
16	Trikonasan (Triangle pose)	123, 205, 286,	To improve spinal flexibility, strengthen core muscles, and enhance overall posture and balance.
17	Katichakrasana (Waist rotational pose)	286, 293, 317	To improve spinal rotation, maintain flexibility, and reduce stiffness in the back and waist.
18	Tadasana (Mountain pose)	139, 163, 253, 286, 293	To improve posture, enhance spinal alignment, and maintain flexibility.
19	Brikhasana (Tree posture)	205, 301, 318, 319	To improve balance, strengthen leg muscles, and enhance spinal stability.
20	Birbhadarsana-1 (Warrior posture)		
21	Utkatasan (Chair posture)	320	Effective in strengthening the core and legs
22	Hsata Uttanasana (Raise hand pose)	321	Improve spinal flexibility, posture, and circulation for reducing stiffness and pain
23	Meru wakrasana (Spinal twist posture)	116	To maintain spinal mobility, reduce stiffness, and improve posture
24	Bhunamanasana (Earth pose)	322, 323	For improves joint mobility
25	Ardha matsyendrasana (Half lord of fish psoe -Seated twist)	116	Seated twist that energises the spine, stimulates proper digestion, and improves postural and body awareness
26	Parvatasana (Mountain pose)	116	Parvatasana helps tone and strengthen your abdominal muscles
27	Uttanmandukasana (Extended frog pose)	116	Stretches, Strengthens, Lengthens Flexibility and Range of Motion Chest, Diaphragm and Breath
28	Gomukhasana (Cow face pose)	123,140	Achieving physical flexibility by stretching the entire body and boosting mental focus.
29	Marjarasana (Cat pose)	265, 308, 309, 311	Help maintain spinal flexibility
30	Ardhastrasana (Half camel pose)	324	Counteract spinal stiffness and maintain flexibility in the thoracic and lumbar spine.
31	Baddhakonasana (Bound angle pose)	252	Maintain mobility in the hip joints, encourages relaxation in the lumbar spine and relieves strain
32	Kurmasan (Tortoise pose)	116	stretches the spine, hips, and shoulders

33	Bhadrasana (Graciors pose)	116	Focuses on hip flexibility, spinal alignment, and relaxation, Supports Spinal Alignment
34	Dandasana (Staff pose)	252	Promotes spinal alignment, core strength, and flexibility
35	Akarna Dhonurasana (Bow and angle pose)	116	Enhances hip & hamstring flexibility, opens the chest & shoulders
36	Makarasana (Crocodile pose)	163, 293	Eases sacroiliac joint discomfort
37	Bhujangasana (cobra pose)	130,139,286, 288, 293,307, 321	Help maintain spinal flexibility
38	Niralambasana (Unsupported pose)	116	Yoga posture that requires balance and strength, often involving lifting the chest and head while lying on the stomach
39	Ardhasalbhasana/ Shalabhasana (Loctus pose)	286, 288, 307	Improve spinal mobility, core strength, and posture while reducing stiffness in the back and hips. Increases Circulation to the Spine.
40	Sarpasana (snake pose)	293	Gentle back-strengthening and spine-mobilizing
41	Dhonurasana (Bow pose)	307	Engages the lumbar, thoracic, and cervical spine, improving posture and reducing the forward bending, reduce stiffness in the hip flexors
42	Noukasana (Boat pose)	244	Increases Circulation & Reduces Inflammation – Stimulates blood flow to the spine and abdominal region.
43	Tiryak bhujungasan (Twisting cobra pose)	116	Supports the lumbar and thoracic spine, reducing strain and discomfort.
44	Ekpadauttanasana/ Uttanpadasana (Raised leg pose)	130, 163	Strengthens Core & Lower Back Muscles – Supports the spine and pelvis, improving posture and reducing stiffness.
45	Pavanmuktasana (Wind reliever pose)	130, 286,309	Promotes relaxation & stress relief – helps relieve tension in the lower back, pelvis, and abdomen, promoting relaxation
46	Setubandhanasana (Bridge posture)	232, 253	Helps to maintain spinal flexibility
47	Setu asana (Bridge posture)	116	Gently stretches the spine, shoulders, and chest, reducing stiffness in the thoracic and lumbar regions, opens the chest & enhances breathing
48	Kandhrasna (Shoulder pose)	116	Engages the lower back, glutes, and abdominal muscles, providing better spinal support, opens the chest and ribcage, promoting better breathing and oxygen intake
49	Supta udarakarshanasana (Reclined pose)	130	Helps correct imbalances in the spine, preventing hunching and misalignment.
50	Shava udarakarshanasana	130	Encourages ribcage mobility, improving lung capacity and reducing breathing restrictions

51	Matsyasana (Fish pose)	163, 307, 317, 321	Engages the upper back, shoulders, and neck, promoting better spinal support.
52	Basic abdominal breathing	94, 130, 218 220, 221, 288, 325	Enhance lung function, reduce stiffness, and improve circulation, promoting relaxation and boost energy levels.
53	Hands in and out breathing		
54	Tiger breathing		
55	Diaphragm breathing		
56	Chest Breathing		
57	Yogic Breathing		
58	Surya Anuloma-viloma Pranayama -Focuses on activating the Pingala Nadi (Sun Channel)	116	To enhance energy, circulation, and boosting metabolism, reducing joint stiffness.
59	Suryaveda Pranayama	116	Helps to activate solar energy channel
60	Chandra Anuloma Viloma Pranayama Cooling and calming breathing	116, 139	To promotes deeper sleep, which is essential for healing and managing chronic pain
61	Chandraveda pranayama	139	
62	Nadisodhana Pranayama	139, 146, 163, 293	Promoting mental calmness, improved circulation, and reduced inflammation, helps to balance the nervous
63	Anulom-Vilom Pranayama	123, 130	
64	Bhramari Pranayama - (Bee Breath)	130,139,286, 288,	To activate the parasympathetic nervous system, reducing stress, inflammation, and pain
65	Bhastrika Pranayama	116, 141	To stimulating oxygen flow, improving circulation
66	Shetali Pranayama	116	Managing flare-ups, reducing joint pain, cool the body, reduce inflammation, and calm the nervous system
67	Shitkari Pranayama		
68	Ujjayi Pranayama - (victorious breath or ocean breath)	146, 232, 263	Helps increase oxygenation
69	Murcha Pranayama - (Fainting or Swooning Breath)	116	Induces a deep state of calmness and relaxation
70	Anunasika Pranayama - (also known as nasal resonance breathing)	116	Helps improve nasal airflow, lung function, and mental calmness
71	Savitri Pranayama	116	It promotes deep relaxation, improved oxygenation, and enhanced circulation
72	Naga Pranayama (serpent breath)	116	Helps improve spinal flexibility, reduce inflammation, and promote mental calmness.

73	Nadanusandhan Pranayama (Sound Resonance Breathing)	130, 123	It promotes deep relaxation, reduces stress-induced flare-ups, and enhances spinal awareness.
74	Instant Relaxation Technique (IRT)	130, 307	Quick release of physical and mental tension
75	Quick relaxation techniques (QRT) - Conscious breathing and body relaxation.	130, 307	It ideal for managing flare-ups and improving mobility.
76	Deep relaxation technique(DRT)	130, 307	progressive relaxation, breath awareness, and mindfulness
77	OM Meditation	286	OM chanting stimulates the vagus nerve, which has anti-inflammatory effects on the body
78	Focused Meditation	116	Pain management, stress reduction, enhancing body awareness and overall well-being.
79	Mindfulness Meditation		
80	Body Awareness Meditation		

**** (Details of the module mentioned in Appendix sl.no.9)**

With the collaboration of ten yoga experts, a comprehensive list of 80 yogic practices was systematically developed as a preliminary therapeutic module for Ankylosing Spondylitis. This compilation (presented in Table 4) consisted of 14 loosening exercises; 37 customized asanas; 6 breathing techniques; 16 pranayama practices; 3 relaxation techniques; and 4 meditation practices.

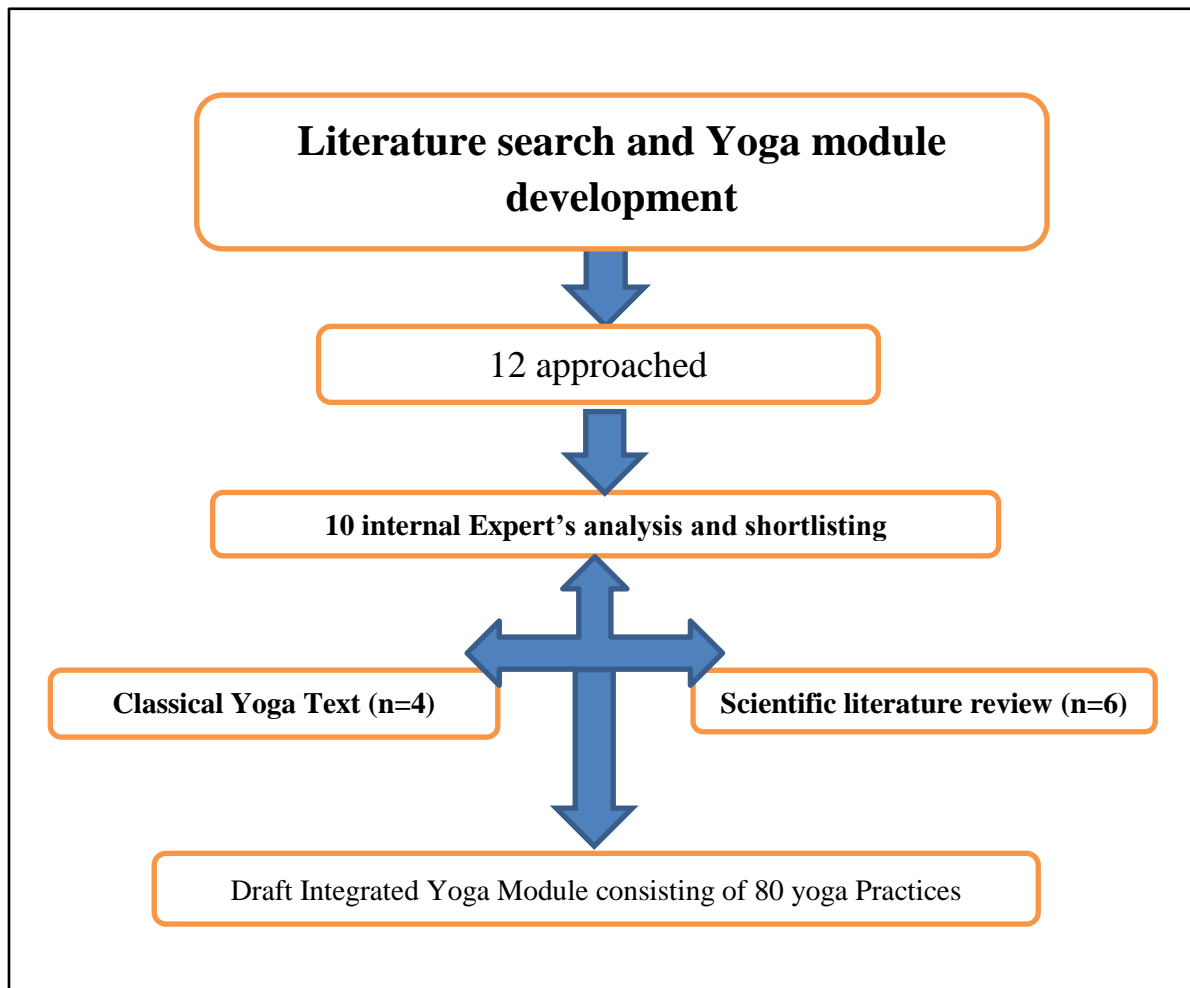


Fig. no. 3: Details flow chart of stage I

OBJECTIVE –I: To develop and validate a yoga module for patients with Ankylosing Spondylitis through the opinion of experts from different relevant fields of related disciplines.

PART II

3. B Validation of Yoga module by Experts

- 3. B. 1 Selections of experts
- 3. B. 2 Development of Google form
- 3. B. 3 Demographic Variables of the Experts
- 3. B. 4 Yogic Practices with Content Validity Ratio scores
- 3. B. 5 Validated yoga module for the patients Ankylosing Spondylitis
- 3. B. 6 Final yoga intervention module

3. B.1: Selections of experts for Part-II:

In the part II, 34 experts (22-yoga expert, 6-experienced Rheumatologist, 6-experts from Physical medicine and rehabilitation) from the various medical and academic institution of India of different relevant field were invited through Google form (<https://forms.gle/nq22uBbU3ezDH3e88>) and e-mail (Comprising with 80 yogic techniques as in part 1) for yoga module validation. Experts those have at least 5 years' experience in his/her own field, minimum qualification master degree on the relevant field was invited for the study.

3. B.2 Development of Google form:

Google form comprises with seven section – section I) would contains – Name, Degree, affiliations and experience of the experts, II) Loosening exercise/Yogic Suksma vyama, III) Asana, IV) Breathing Practices (Preparation techniques for Pranayama) V) Pranayama, VI) Relaxation Techniques, VII) Meditation. Experts were rating the each yogic practices in patients with Ankylosing Spondylitis as a) very much useful (Essential), b) moderately useful (Important, but not essential), c) Not at all useful (Not necessary). After getting the feedback from experts, Laswhe content validity ratio (CVR) method ³²⁶ was used to calculate the Content Validity of the entire yoga module. Using the formula $CVR = (n_e - N/2) / N/2$ where, n_e is the number of panel experts indicating item is essential and 'N' is the total number of experts in the panel.

Flow chart of Experts Recruitment

Approach -34



1. Yoga – 22
2. Physical Medicine and Rehabilitation -06
3. Rheumatologist -06

Fig. no. 4: Recruitments of experts in Part II



Photo no. 18: Feedback received from the rheumatologist experts

3. B.3 Demographic information of the experts

Table No. 5: Demographic summary of experts involved in Part-II

Experts Category	Total Experts	Qualification	No. of Experts	Average experience in the field (years)
Yoga experts	16	PhD	7	18.2±8.57
		Post-graduation	9	14.89±8.054
Physiatrist	05	MD(Physical Medicine and Rehabilitation)	5	25.02±15.01
Rheumatologist	05	MD/DM	5	16.80±11.92

In the second phase of the study, for validating the yoga module, we approached 36 experts, of whom 26 provided feedback. Among 16 yoga experts 7 were working and affiliated as a yoga therapist and medical practitioners in the field of yoga. In the present study few from Midnapore Homeopathic Medical College and hospital, West Bengal, Morarji Desai National Institute of Yoga (MDNIY), AYUSH Health Programme Birbhum and Rampurhat Health District. Table No. 5 shows that the module was assessed by highly experienced professionals from relevant disciplines.

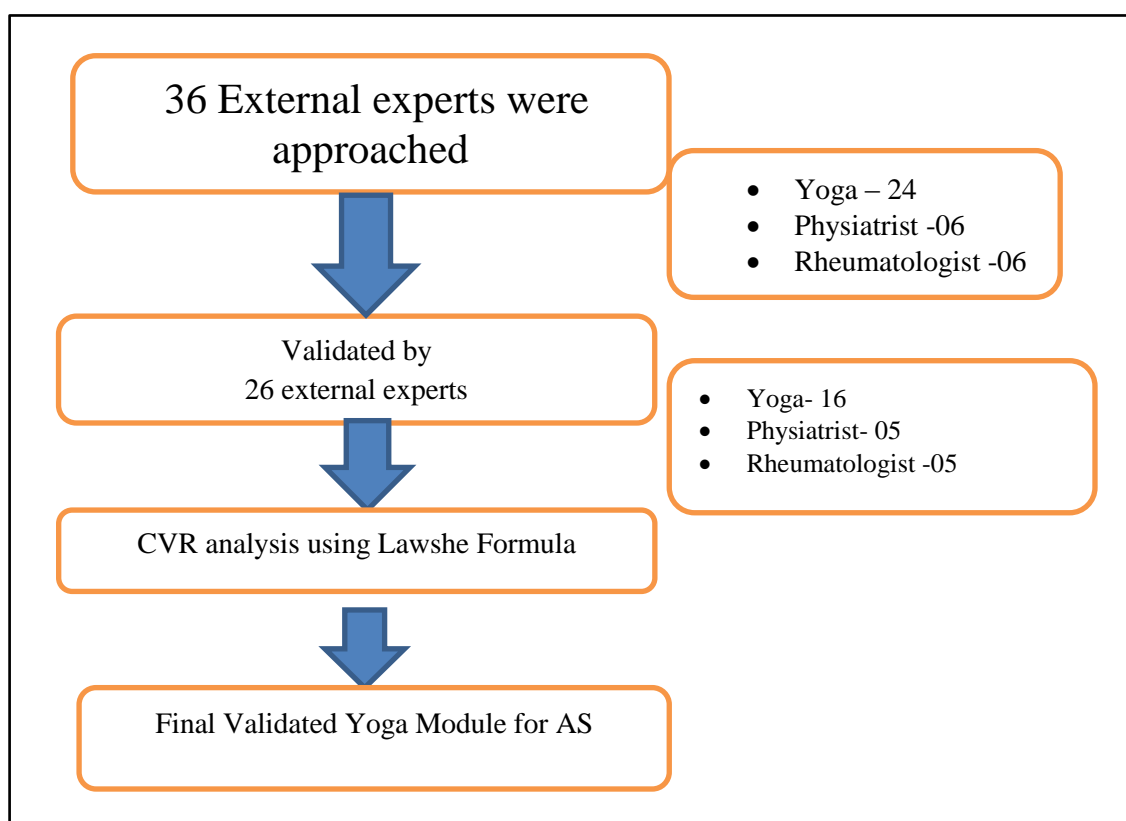


Fig. no. 5: Conceptual framework of Part-II for Validated Yoga Module

3. B.4 Yogic Practices with Content Validity Ratio scores

Table No. 6: Details of the Content Validity Ratio of each practice following validation						
Technique number	Name of the practices	Opinion given by the experts			CVR scores	Remarks
		Number of experts marked essential	Necessary but not essential	Not necessary	CVR	Accepted/rejected
Loosening Practices						
1	Neck movement	20	6	0	0.538	Accepted
2	Hands in and out stretch	23	0	3	0.769	Accepted
3	Swinging arm forward and backward	18	7	1	0.385	Accepted
4	Shoulder rotation	18	8	0	0.385	Accepted
5	Trunk Twisting	19	6	1	0.462	Accepted
6	Pelvic tilt (supine)	20	6	0	0.538	Accepted
7	Butterfly	9	10	7	-0.308	Rejected
8	Vertical stretch of the knee	12	9	5	-0.077	Rejected
9	Alternate foot knee lumbar stretch	19	4	3	0.462	Accepted
10	Supine Hamstring stretch	19	7	0	0.462	Accepted
11	Side leg raising	7	9	10	-0.462	Rejected
12	Kneeling superman posture	17	3	6	0.308	Rejected
13	Upper Body Roll	21	5	0	0.615	Accepted
14	Lateral flexion (Side bending)	20	6	0	0.538	Accepted
Asanas						
15	Side bending Chakrasana/ Ardhakati Chakrasana	18	3	5	0.385	Accepted
16	Konasana/Trikonasana	11	6	9	-0.154	Rejected
17	Katichakrasana	20	3	3	0.538	Accepted
18	Tadasana	19	7	0	0.462	Accepted
19	Brikhasana	4	10	12	-0.692	Rejected
20	Birbhadarsana-1	8	12	6	-0.385	Rejected
21	Utkatasan	6	8	12	-0.538	Rejected
22	Bandha Hsata Uttanasana	8	10	8	-0.385	Rejected
23	Meru wakrasana	11	15	0	-0.154	Rejected
24	Bhunamasana	10	12	4	-0.231	Rejected
25	Ardha matsyendrasana	11	12	3	-0.154	Rejected
26	Parvatasana	18	5	3	0.385	Accepted
27	Uttanmandukasana	19	4	3	0.462	Accepted
28	Gomukhasana	10	13	3	-0.231	Rejected
29	Marjarasana	19	7	0	0.462	Accepted
30	Ardhaustrasana	12	10	4	-0.077	Rejected
31	Baddhakonasana	7	15	4	-0.462	Rejected
32	Kurmasana	4	12	10	-0.692	Rejected
33	Bhadrasana	9	12	5	-0.308	Rejected
34	Dandasana	11	14	1	-0.154	Rejected
35	Akarna Dhonurasana	4	10	12	-0.692	Rejected
36	Makarasana	23	3	0	0.769	Accepted
37	Bhujangasana	20	3	3	0.538	Accepted
38	Niralambasana	20	3	3	0.538	Accepted
39	Ardhasalabhasana/ Shalabhasana	19	7	0	0.462	Accepted
40	Sarpasana	14	10	2	0.077	Rejected
41	Dhonurasana	4	10	12	-0.692	Rejected
42	Noukasana	9	12	5	-0.308	Rejected

43	Tiryak bhujungasan	13	10	3	0	Rejected
44	Ekpadauttanasana/ Uttanpadasana	20	3	3	0.538	Accepted
45	Pavanmuktasana lumbar stretch (Single and both legs)	18	3	5	0.385	Accepted
46	Setubandhanasana	19	7	0	0.462	Accepted
47	Setu asana	6	8	12	-0.538	Rejected
48	Kandhrasna	7	15	4	-0.462	Rejected
49	Supta udarakarshanasana	18	3	5	0.385	Accepted
50	Shava udarakarshanasana	14	10	2	0.077	Rejected
51	Matsyasana	9	12	5	-0.308	Rejected
Breathing Exercise						
52	Tiger breathing	19	7	0	0.462	Accepted
53	Fast breathing	2	10	14	-0.846	Rejected
54	Basic abdominal breathing	19	7	0	0.462	Accepted
55	Diaphragm breathing	20	3	3	0.538	Accepted
56	Chest Breathing	18	3	5	0.385	Accepted
57	Yogic Breathing	21	5	0	0.615	Accepted
Pranayama						
58	Surya Anuloma-viloma Pranayama	11	14	1	-0.154	Rejected
59	Chandra Anuloma Viloma pranayama	9	12	5	-0.308	Rejected
60	Suryaveda Pranayama	8	12	6	-0.385	Rejected
61	Chandraveda pranayama	10	13	3	-0.231	Rejected
62	Nadisodhana Pranayama	19	7	0	0.462	Accepted
63	Anulom-Vilom Pranayama	24	2	0	0.846	Accepted
64	Bhramari Pranayama	18	3	5	0.385	Accepted
65	Bhastrika Pranayama	9	12	5	-0.308	Rejected
66	Shetali Pranayama	20	3	3	0.538	Accepted
67	Shitkari Pranayama	18	3	5	0.385	Accepted
68	Ujjayi Pranayama	14	10	2	0.077	Rejected
69	Murcha Pranayama	7	15	4	-0.462	Rejected
70	Anunasika Pranayama	9	10	7	-0.308	Rejected
71	Savitri Pranayama	4	12	10	-0.692	Rejected
72	Naga Pranayama	7	5	14	-0.462	Rejected
73	Nadanusandhan Pranayama	11	14	1	-0.154	Rejected
Relaxation Technique						
74	Instant Relaxation Technique (IRT)	9	10	7	-0.308	Rejected
75	Quick relaxation techniques(QRT)	18	3	5	0.385	Accepted
76	Deep relaxation technique(DRT)	19	7	0	0.462	Accepted
Dhyana						
77	OM Meditation	24	2	0	0.846	Accepted
78	Focused Meditation	17	3	6	0.308	Rejected
79	Mindfulness Meditation	16	9	1	0.231	Rejected
80	Body Awareness Meditation	23	3	0	0.769	Accepted

CVR ≥ 0.385 were retained, CVR < 0.385 were rejected

A total of 36 experts were approached for their feedback in content validation process. Among 36 experts 26 experts have provided their feedback (Table 5). According to the Lawshe formula the content validity ratio CVR (Critical) = $(ne - N/2)/N/2$ for a panel size (N) of 26 is 0.385 where, 'ne' is the number of panel experts indicating the item is 'essential', N is the total number of experts in the panel. With the help of 26 external experts opinions from relevant fields, out of the 80 yogic techniques, 38 yogic techniques with $CVR \geq 0.385$ were retained, and the other 42 techniques with $CVR < 0.385$ were rejected (table 6).

3. B.5 Validated yoga module for the patients Ankylosing Spondylitis:

Table No. 7: Yogic practices accepted for inclusion in the yoga module according to $CVR \geq 0.385$

Sl. no.	Practices	Name of the practices	CVR Value
1	Loosening practices	Neck Movement(Front-back-side bending, twisting, and rotation)	0.538
2		Hands in and out stretch	0.769
3		Hand rotation	0.385
4		Shoulder rotation	0.385
5		Trunk Twisting	0.462
6		Pelvic tilt (supine)	0.538
7		Alternate foot knee lumbar stretch	0.462
8		Supine Hamstring stretch	0.462
9		Upper Body Roll	0.615
10		Lateral flexion (Side bending)	0.538
11	Standing Asana	Side bending Chakrasana/Ardhakati chkrasana	0.385
12		Katichakrasana,	0.538
13		Tadasana	0.462
14	Sitting Asana	Parvatasana	0.385
15		Uttanmandukasana	0.462
16		Majrasana	0.462
17	Prone postures	Makarasana	0.769
18		Niralambasana	0.538
19		Ardhasalbhasana/ Shalabhasana	0.462
20		Bhujangasana	0.538
21	Supine postures	Ekpaduttanasana/ Uttanpadasana	0.538
22		Pavanmuktasana (Single and both legs)	0.385
23		Setubandhanasana	0.462
24		Supta udarakarshanasana	0.385
25	Breathing Exercise	Tiger breathing	0.462
26		Basic abdominal breathing	0.462
27		Diaphragm breathing	0.538
28		Chest Breathing	0.385
29		Yogic Breathing	0.615
30	Pranayama	Anulom-Vilom Pranayama	0.846
31		Nadisodhana Pranayama	0.462
32		Bhramari Pranayama	0.385
33		Shetali Pranayama	0.538
34		Shitkari Pranayama	0.385
35	Relaxation techniques	Quick relaxation techniques (QRT)	0.385
36		Deep relaxation technique (DRT)	0.462
37	Meditation	Body Awareness Meditation	0.769
38		OM Meditation	0.846

The content validity ratio (CVR) analysis revealed a range of values, with the highest CVR recorded at 0.846 and the lowest at 0.385 (table no. 7). In the loosening practice section, the highest CVR (0.769) was observed for antarmukha- bahirmukha hastapasar vyama (Hands in and out stretch). Within the standing asana category, katichakrasana attained the highest CVR of 0.538. In the sitting asana section, both uttanmandukasana and marjarasana achieved the highest CVR, each scoring 0.462. In the prone posture group, makarasana recorded the highest CVR of 0.769. Among the supine posture Asanas, Setubandhnasana had the highest CVR which was 0.462. For breathing exercises, yogic breathing emerged with the highest CVR of 0.615. Within the pranayama section, anulom-vilom pranayama achieved the highest CVR, registering 0.846. In the relaxation technique category the deep relaxation technique which had a CVR of 0.462. Finally, in the meditation section, OM meditation attained the highest CVR of 0.846.

3. B.6 Final yoga intervention module:

Table No. 8: Details of the Yoga intervention with duration and sequence for treating Ankylosing Spondylitis

Sl No.	Name of Yogic practices	Execution time	Repetitions	Recovery time	Duration of practice
1	Neck Movement(Back-side bending, twisting, and backward half rotation)	20secx4 =80sec	2 times	10sec x 4= 40sec	80x2+40 =200 sec
2	Hands in and out stretch	20 sec	2 times	10 sec	40+10=50 seconds
3	Hand rotation	20 sec	2 times	10 sec	50 seconds
4	Shoulder rotation	20 sec	2 times	10 sec	50 seconds
5	Trunk Twisting	20 sec	2 times	10 sec	50 seconds
6	Pelvic tilt (supine)	20 sec	2 times	10 sec	50 seconds
7	Alternate foot knee lumbar stretch	20 sec	2 times	10 sec	50 seconds
8	Supine Hamstring stretch	20 sec	2 times	10 sec	50 seconds
9	Upper Body Roll	20 sec	2 times	10 sec	50 seconds
10	Lateral flexion (Side bending)	20 sec	2 times	10 sec	50 seconds
11	Tadasana	25 sec	2 times	10 sec	1 minute
12	Side bending- Chakrasana /Ardhakati chkrasana	25 sec	2 times	10 sec	1 minute
13	Katichakrasana	25 sec	2 times	10 sec	1 minute
14	Parvatasana	25 sec	2 times	10 sec	1 minute
15	Uttanmandukasana	25 sec	2 times	10 sec	1 minute
16	Majrasana	25 sec	2 times	10 sec	1 minute
17	Makarasana	25 sec	2 times	10 sec	1 minute
18	Niralambasana	25 sec	2 times	10 sec	1 minute

19	Ardhasalabhasana/ Shalabhasana	25 sec	2 times	10 sec	1 minute
20	Bhujangasana	25 sec	2 times	10 sec	1 minute
21	Ekpadauttanasana/ Uttanpadasana	25 sec	2 times	10 sec	1 minute
22	Pavanmuktasana lumbar stretch (Single and both legs)	25 sec	2 times	10 sec	1 minute
23	Setubandhanasana	25 sec	2 times	10 sec	1 minute
24	Supta Udarakarshanasana	25 sec	2 times	10 sec	1 minute
25	Tiger breathing	30 sec	2 times	10 sec	70 seconds
26	Basic abdominal breathing	30 sec	2 times	10 sec	70 seconds
27	Diaphragm breathing	30 sec	2 times	10 sec	70 seconds
28	Chest Breathing	30 sec	2 times	10 sec	70 seconds
29	Yogic Breathing	30 sec	2 times	10 sec	70 seconds
30	Nadisodhana Pranayama	1 minute	2 times	30 sec	2.5 minutes
31	Anulom-Vilom Pranayama	1 minute	2 times	30 sec	2.5 minutes
32	Bhramari Pranayama	1 minute	2 times	30 sec	2.5 minutes
33	Shetali Pranayama	1 minute	2 times	30 sec	2.5 minutes
34	Shitkari Pranayama	1 minute	2 times	30 sec	2.5 minutes
35	Quick relaxation techniques(QRT)	2 minutes	1 times	30 sec	2.5 minutes
36	Deep relaxation technique(DRT)	4 minutes	1 times	1 minute	5 minutes
37	Body Awareness Meditation	3 minutes	1 times	1 minute	4 minutes
38	OM Meditation	4 minutes	15 times	1 minute	5 minutes
				Total: 60 minutes(Approx.)	

Based on previous literature to ensure maximum therapeutic benefits of an integrated approach of yoga for patients with Ankylosing Spondylitis, the module was structured for a total duration of 1 hour, with time allotted to each section as follows: loosening exercises (app. 7 minutes), asanas (app. 14 minutes), breathing exercises (app. 6 minutes), pranayama (app. 12.5 minutes), relaxation techniques (app. 7.5 minutes), and meditation (app. 9 minutes). Detailed description of the procedure for each yogic practice is presented in Appendix (Sl. No. 9).

OBJECTIVE-II: To examine the feasibility and effectiveness of the validated yoga module on selected psychological variables (depression, fear avoidance belief, pain catastrophizing and health related quality of life), physiological variables (haemoglobin and platelet count), general health status (BMI, blood pressure, heart rate), clinical outcome measures (BASDAI, BASFI, BASMI, Chest expansion) and inflammatory markers (CRP, ESR, TNF alpha) by comparing patients receiving conventional treatment alone with those receiving conventional treatment combined with yoga practice.

PART: III

3. C Experiment for the preparation of Validated Yoga module

- 3. C. 1 Study Location
- 3. C. 2 Design of the study
- 3. C. 3 The Subjects
 - 3. C.3.1 Selection of the subjects
 - 3. C.3.2 Inclusions Criteria
 - 3. C.3.3 Exclusions Criteria
 - 3. C.3.4 Determination of sample size
 - 3. C.3.5 Enrolment of the patients
 - 3. C.3.6 Demonstration session of the training protocol
 - 3. C.3.7 Ethical Consideration
- 3. C. 4 Selection of Variables
- 3. C. 5 Reliability of Data
- 3. C.6 Procedure of collecting Data
- 3. C.7 Training protocol for the experimental group
- 3. C. 8 Exercise program of the control group
- 3. C. 9 Medication
- 3. C. 10 Statistical Procedure

3. C.1 Study Location:

The study carried out at the department of Physical Education, Jadavpur University, Raja Sc Mallick Road, Jadavpur Kolkata-700032 and Clinical Immunology and Rheumatology, Institute of Post Graduate Medical Education & Research (IPGME&R); Kolkata, West Bengal, India.

3. C.2 Design of the study:

A longitudinal observational experimental pre- post control group design employed to evaluate the effect of the intervention. Convenient sampling method was used for select the participant.

Experimental Design:

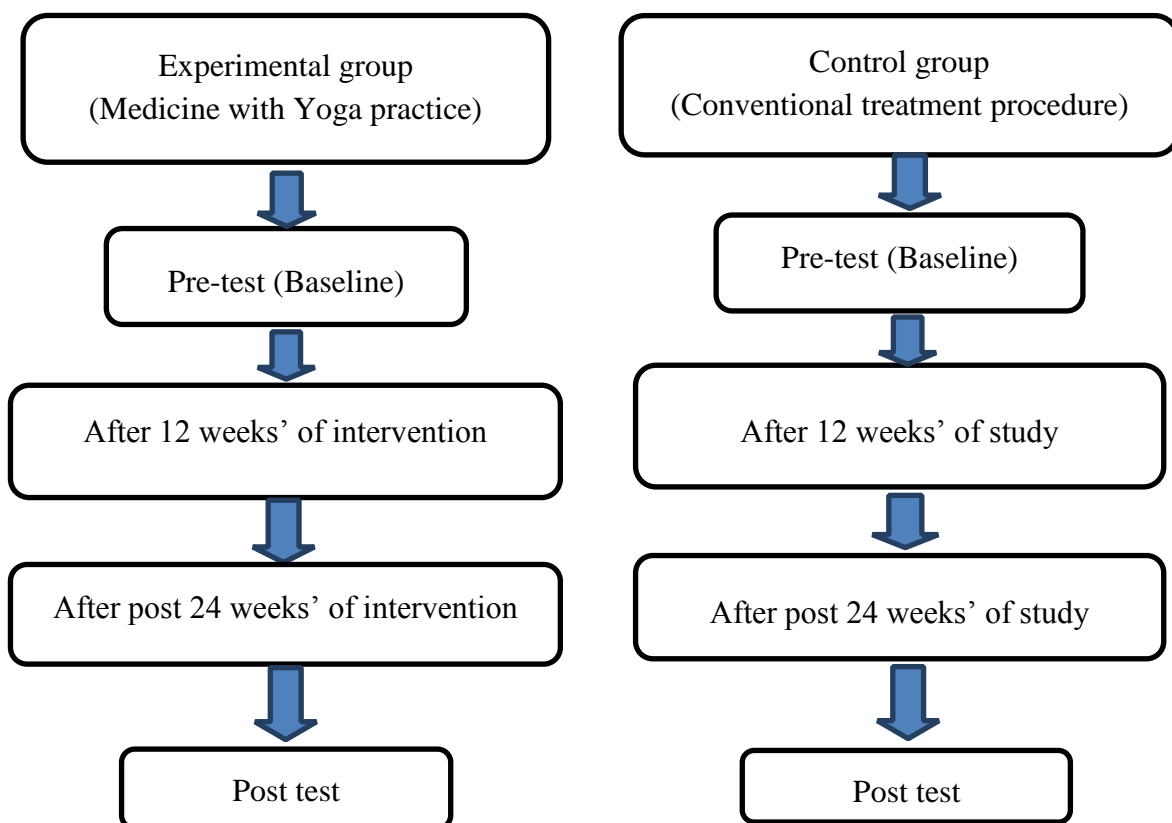


Fig. no. 6: Flow diagram of observational longitudinal-experimental trial design

3. C.3 The Subjects:

3. C.3.1 Selection of the subjects:

70 male patients were selected who came for treatment of Ankylosing Spondylitis at outdoor patient (OPD) of Clinical Immunology and Rheumatology, Institute of Post Graduate Medical Education & Research (IPGME&R); Kolkata . Subjects are selected from those who are engaged at different occupational activities. Patients were selected by Bath Ankylosing Spondylitis - Disease Activity Index (BASDAI) and Bath Ankylosing Spondylitis Functional Index (BASFI) questionnaire and confirmed with the certified rheumatologist expert.

3. C.3.2 Inclusions Criteria:

1. Patients' suffering from Ankylosing Spondylitis for >3months to <5 years were included on the basis of an expert's opinion of rheumatology.
2. Age range of the subjects were of >18 to <40 years.

3. C.3.3 Exclusions Criteria:

1. Associated other causes of back pain such as herniated disk problem, neuropathic pain, dysfunction of internal organs of the pelvis and abdomen, strain of ligaments.
2. Comorbidity like serious cardiopulmonary disease which precludes yoga and exercise.
3. Musculoskeletal conditions which contraindicates or complicates yoga and exercises
4. Psychiatric diseases or inability to comprehend commands.
5. Smokers and alcohol adductor

3. C.3.4 Determination of sample size: (G*Power 3.1.9.7)

Cohen's d (effect size): 0.74

Error probability of .05

Power of .84

Df: 64.8450761

Sample size group 1: 35 (experimental)

Sample size group 2: 35 (control)

Total sample size: 70

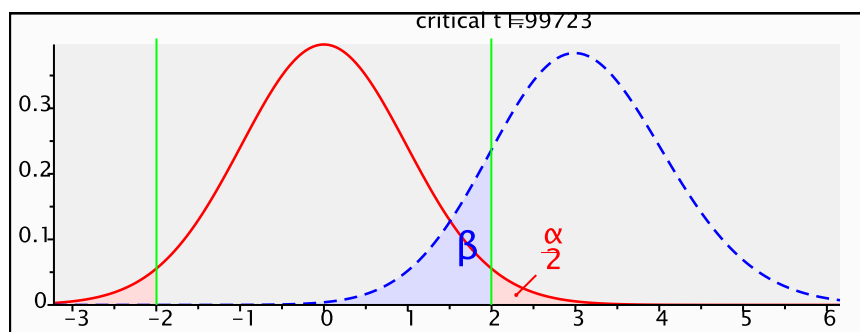


Photo. no. 19: Sample size distribution plot showing Type I error (α), Type II error (β), and critical value.

3. C.3.5 Enrolment of the patients:

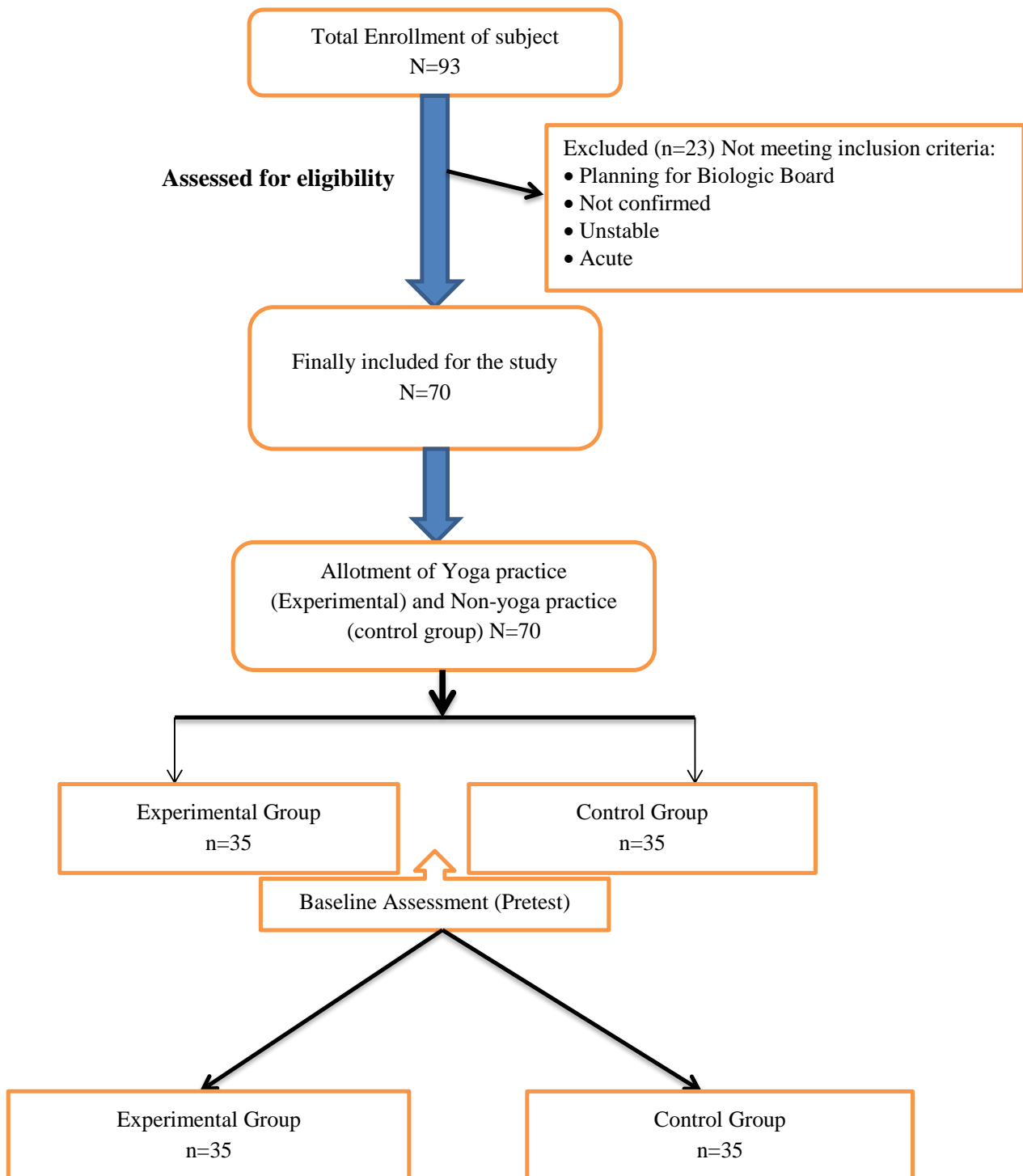


Fig. no. 7: Enrolment of the subjects

3. C.3.6 Demonstration session of the training protocol:

The subjects were called to the department of Physical Education, Jadavpur University for introduced the details of the study. In front of the subjects: purpose of the present study, procedure of testing on selected variables, details of training protocol, duration of the trail, does and don't everything clearly stated. Subjects were allowed to asking any questions related to the study. Every part of the training protocol demonstrated to the subjects of the experimental group, during the demonstration subjects were instructed to practice the yogic techniques as per their capacity. For better understanding of the obstacles, wrong practices of the yogic events a video was recorded parallay correction was did subjects to subjects.



Photo no. 20: Patients of yoga group attending demonstration session of the training protocol at Jadavpur university

3. C.7 Ethical Consideration:

3. C.7.1 Ethical Clearance:

This study received ethical approval from the Institutional Ethics Committee of Jadavpur University, Kolkata, West Bengal, India Ref No: IEC/26/C/23 on 31/05/2023 and the IPGME&R Research Oversight Committee (Registration No. ECR/35/Inst/WB/2013/RR-19 under CDSCO) under Memo No. IPGME&R/IEC/2024/0078 on 04/04/2024. The study also registered in Clinical Trial Registry of India and the CTRI No is CTRI/2025/04/084429.

3. C.7.2 Signed inform consent:

Signed inform consent taken from the subjects of experimental and control both groups.

3. C.4 Selection of variables:

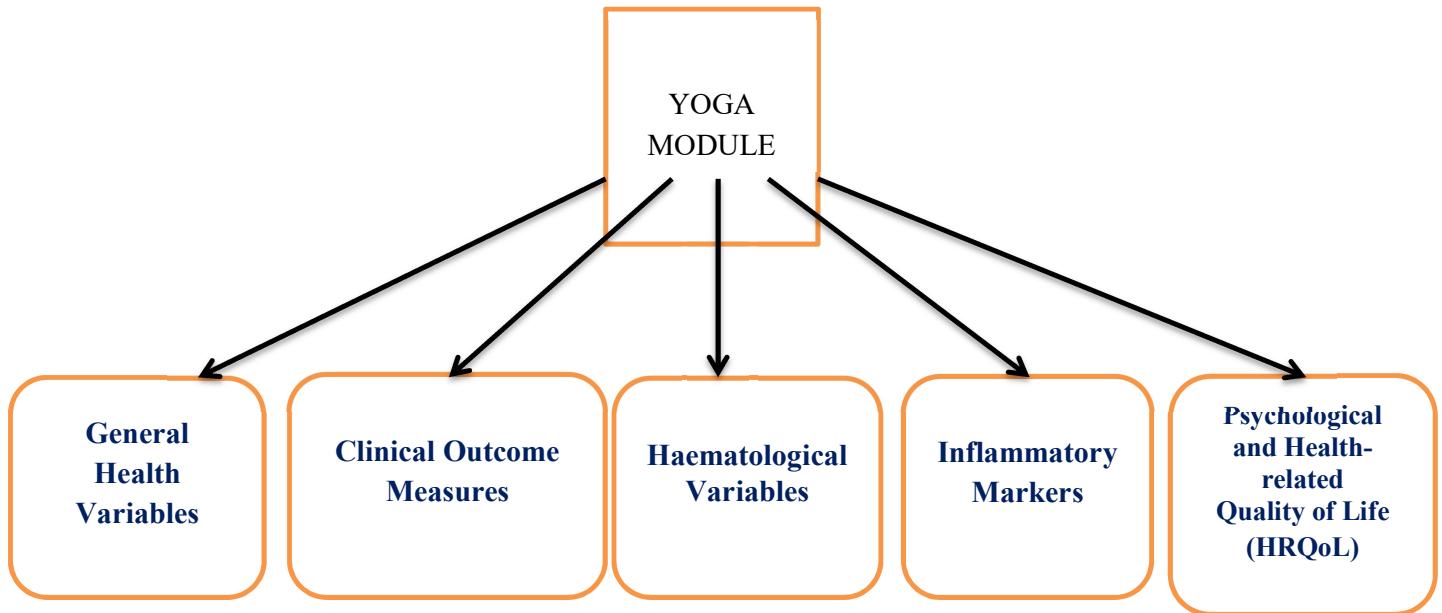


Fig. No. 8: Conceptual framework of the selected dependent variables and independent variable

Table No. 9: Selection of Variables

General Health Variables	Clinical Outcome Measures	Haematological variables	Inflammatory Markers	Psychological Variables	Health-related Quality of Life (HRQoL)
BMI	BASDAI	Haemoglobin	TNF-alpha	Fear Avoidance Beliefs (FAB)	SF-36, Health Survey
Blood pressure	BASFI	Platelet Count	C-reactive protein (CRP)	Pain Catastrophizing	
Resting Heart rate	BASMI Chest Expansion		Erythrocyte sediment rate (ESR)	Depression	

3. C.4.1 Criterion measures:

Table No. 10: Method used for measuring demographic and general health variables:

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
Blood Pressure	Blood pressure was measured by digital sphygmomanometer	mmHg
Heart Rate	Heart Rate was measured by digital sphygmomanometer	beats/Minutes

Table no.11: Method used for Clinical outcome measures

Category of Variables	Variables	Test/ Instruments	Units of Measurement	
Disease Activity, Functional Index and	BASDAI	Bath Ankylosing Spondylitis Disease Activity Index questionnaire	Self-reported Score	
	BASFI	Bath Ankylosing Spondylitis Functional Index questionnaire	Self-reported Score	
Metrology Index	BASMI	Cervical rotation	Goniometer	cm
		Tragus to wall distance	Measuring tape	cm
		Lumbar side flexion	Measuring tape and Marker pen	cm
		Modified Schober's	Measuring tape and Marker pen	cm
		Intermalleolar distance	Measuring tape and Marker pen	cm
	Chest Expansion	Measuring tape and Marker pen	cm	

Table No. 12: Method used for measuring physiological (haematological) variables and inflammatory markers

Category of Variables	Variables	Test/ Instruments	Units of Measurement
Blood Count	Haemoglobin	Electrical Impedence & VCS, Westergen	g/dl
	Platelet Count	Electrical Impedence & VCS, Westergen	thou/mm ³
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 Impedence & VCS, Westergen	mm/hr

Table No. 13: Method used for Psychological and Health-related Quality of Life (HRQoL) variables:

Category of Variables	Variables	Test/ Instruments
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. C.5 Reliability of Data:

The reliability of the test is influenced by multiple factors, including the precision of the instruments used and the reliability and competency of the testers.

3. C.5.1 Reliability of the instrument:

The instruments used in the study included a digital sphygmomanometer (Omron Model HEM-7051-C12), a weighing machine (Krupps Countess Weighing Machine, 125 kg capacity), a stadiometer (anthropometric rod), and the Human TNF-alpha ELISA Kit (RayBiotech, CAT: ELH-TNFa, LOT: 0207250193). Standardized psychological and quality-of-life assessment tools were also employed: the Hamilton Depression Rating Scale by Hamilton(1960),³²⁷ the Fear Avoidance Beliefs (FAB) Questionnaire developed by Waddell et al. (1993),³²⁸ the Pain Catastrophizing Scale developed by Michael J. L. Sullivan (1995),³²⁹ and the Short Form-36 Health-Related Quality of Life Questionnaire (RAND-SF-36, Hays et al;1993).³³⁰ All instruments and scales used have been widely applied in previous research and are well established for their reliability and validity. The questionnaire (FAB, PCS, RAND-SF-36) were translated by the supervisors Professor Asish Paul and two faculties of Dr. Atanu Ghosh and Dr. Papan Mandal Dept. of Physical Education, Jadavpur University. The researcher himself guided the patients with proper explanation of questionnaire if required.

3. C.5.2 Testers Reliability:

Data collection was carried out by qualified academicians, laboratory assistants, and the principal researcher, with support from fellow research scholars of the Institute of Postgraduate Medical Education & Research (S.S.K.M), Kolkata.

3. C.6 Procedure of Data Collection:

Disease activity, functional status, spinal mobility, and chest expansion were evaluated using standardized tools: the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), the Bath Ankylosing Spondylitis Functional Index (BASFI), the Bath Ankylosing Spondylitis Metrology Index (BASMI), and a steel tape, respectively. Anthropometric and physiological parameters—including height, weight, heart rate, and blood pressure—were also measured. Psychological variables were assessed using validated questionnaires: the Fear Avoidance Beliefs Questionnaire (FAB), the Pain Catastrophizing Scale (PCS), and the Hamilton Depression Rating Scale (HAM-D). Health-related quality of life was evaluated

through the RAND SF-36 Health Survey. Laboratory investigations included measurements of haemoglobin, platelet count, TNF-alpha, C-reactive protein (CRP), and erythrocyte sedimentation rate (ESR).

For the experimental group, the investigator developed a self-demonstrated video comprising all yogic components—loosening exercises, asanas, breathing techniques, pranayama, relaxation techniques, and meditation—with verbal instructions for each technique. The video was shared with participants via memory drive or mobile transfer. Additionally, each participant received a printed sheet with still images and the sequence of practices to support better understanding and recall. Participants were instructed to practice for one hour per day on at least five days per week. Compliance was monitored through regular online supervision supplemented by monthly physical follow-ups. The control group continued only standard medical treatment without yogic intervention.

By week 12, four participants in the control group and five in the experimental group withdrew from the study. Furthermore, data from two additional control participants and one experimental participant could not be collected due to their inability to attend scheduled assessments. A total of 58 patients completed the study (Yoga group: 29 and Control group: 29). However TNF- α level were below the assay detection limit in 3 patients from each group, therefore TNF- α analysis was performed using the available 26 samples per group. The total intervention period lasted post 24 weeks, with outcome measurements taken at the 12-week and 24-week milestones.

3. C.6.1 Measurement of blood pressure and Heart rate:

Purpose: To measure heart rate (beats per minute) and blood pressure (mmHg)

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:

- The patients were asked to seat comfortably with the arm supported, Palm facing upward, and instructed to remain Steel.
- The blood pressure cuff was positioned at heart level.
- The cuff was applied directly on the bare upper arm.
- The lower edge of the cuff was aligned approximately 1 inch above the antecubital (elbow) crease.
- Proper placement of the cuff over the brachial artery was verified
- After pressing the start button, the cup inflated automatically.
- The cuff tightened for a few second during measurement.
- As the device deflated, digital readings and heart symbol appeared on the screen
- The final display values were noted and recorded

Before beginning Data collection, blood pressure measurements of three patients were first taken using a manual sphygmomanometer. The same three patients were then assisted with digital OMRON automatic blood pressure monitor to calibrate and compare reading. As the digital device produced values consistent with the manual measurements the OMRON digital monitor was subsequently used to record blood pressure for the remaining patients.

3.C.6.2 Measurement of BASDAI:³³¹

Purpose: To define disease activity and thus disease status in the person with Ankylosing Spondylitis. Patient reported severity of fatigue, spinal pain, peripheral joint pain, localized tenderness, quantity, and duration of morning stiffness using a 0–10 numeric rating scale (NRS) or 10-cm visual analog scale (VAS) with symptoms ranging from “none” to “very severe.” In between 3 and 2 minutes, the BASDAI is a quick and easy index to complete.

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., (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.¹⁷⁶

Scoring: The final BASDAI score is calculated by summing the first four questions and the average of the last two questions and dividing the result by 5. The score ranges from 0 (no disease activity) to 10 (very active disease). A cut-off of 4 is frequently used to define active disease, and a score of 4 or more is suggestive of high disease activity.

3.C.6.3 Measurement of BASFI:³³²

The Bath Ankylosing Spondylitis Functional Index (BASFI) was employed to evaluate the functional disability of participants. BASFI consists of 10 items that measure the individual's ability to perform and manage activities of daily living. Each item is rated on a 10-cm visual analog scale (VAS) based on the patient's status over the previous month. The final BASFI score is calculated as the mean of the 10 items, where a higher score (maximum 10) indicates greater functional impairment.³³³

Purpose: To define and monitor functional ability in persons with Ankylosing Spondylitis.

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.³³⁴

Validity:

The investigators found that the BASFI's concept validity and internal consistency reliability were satisfactory.³³⁵

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.³³⁶

Scoring:

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. 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.

3.C.6.4 Measurement of BASMI:³³⁷

Purpose: To assess the axial status (Cervical rotation, Tragus to wall distance, Lumbar side flexion, Modified Schober's, Intermalleolar distance.) of individuals with Ankylosing Spondylitis and derive a metrology index to define clinically significant changes in spinal movement.

Reliability:

- The original version of BASMI³³⁸ showed good reproducibility (inter- and intra-observer) in clinical measurement of spinal mobility and hip/leg distance components.
- More recent work confirms acceptable inter- and intra-rater reliability for BASMI measurements.
- Various study^{339,340} reported on inter- & intra-rater reliability of BASMI.
- Thus BASMI is considered sufficiently reliable for clinical and research use (when measurements are done in a standardized way).

Validity:

- The index was developed to reflect axial mobility (spine, hips, pelvis) in patients with Ankylosing
- Spondylitis. The initial validation demonstrated significant correlation with the original 20-measurement metrology index.
- Subsequent studies³⁴¹ assessed validity of spinal mobility measures in AS (which relate to BASMI).
- The more modern linear version³⁴² supports construct validity of BASMI definitions.
- In summary, BASMI is considered valid for measuring spinal/hip mobility impairment in AS.

Responsiveness:

- The original BASMI development booklet reports that in a sample of 56 in-patients undergoing 3 weeks of physiotherapy, BASMI showed significant sensitivity to change ($p < 0.01$) (mean improvement -30% in 71% of patients) when compared to the original 20-measurement index.
- In van der Heijde et al.³⁴³ ("Proposal of a linear definition...", 2008) the Guyatt effect sizes for sensitivity to change were: BASMI(2) = 0.66, BASMI(10) = 0.95, BASMI (lin) = 1.04 (showing improved responsiveness of the refined definition).
- These data support that BASMI is reasonably responsive to change, especially when using refined scoring versions.

Procedure of measurement:

Tragus to wall:

- The patient was instructed to stand barefoot with the back against the wall, keeping the knees straight, scapulae, buttocks, and heels in contact with the wall.
- The feet are positioned 30 cm apart and parallel, with the head in neutral alignment.
- The chin is drawn in as far as possible for retraction.



Photo. no. 21 Measurement of Tragus to wall distance

- The examiner, with both eyes open and the side of their face against the wall, distance was measured between the tragus of the ear and the wall using a rigid ruler

Lumbar Side Flexion:

- Subject was instructed to stand bare foot with outer edges of feet 30 cm apart; mark a point midway between the Dimples of Venus, then another 10 cm above and another 5 cm below (total 15 cm).
- Patient bends forward from the waist with knees fully extended.
- Distance was measured between the upper and lower marks; any increase beyond 15 cm indicates the movement achieved



Photo. no. 22 Measurement of lumbar side flexion

Lumbar Flexion (modified Schober's test)

- Subjects was instructed to stand barefoot with outer edges of feet 30 cm apart; mark a point midway between the Dimples of Venus, then another 10 cm above and another 5 cm below (total 15 cm).
- Patient bends forward from the waist with knees fully extended.
- Distance was measured between the upper and lower marks; any increase beyond 15 cm indicates the movement achieved.



Photo. no. 23 Measurement of lumbar flexion

Cervical Rotation:

- Patient lies supine with head in neutral and forehead horizontal (supports used if needed and document setup).
- Using a goniometer/inclinometer, the patient rotates the head maximally while keeping shoulders still; measure both sides

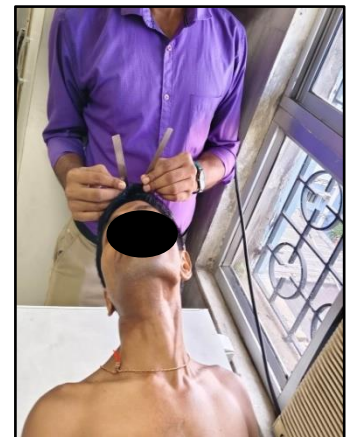


Photo. no. 24 Measurement of Cervical rotation

Intermalleolar Distance

- Patient lies supine with knees extended and legs in contact with the surface.
- The patient abducts both legs as far apart as possible without lifting them.
- Distance was measured between the medial malleoli.



Photo. no. 25 Measurement of intermalleolar distance

Table no.14: BASMI Score Calculation Table

	0	1	2	3	4	5	6	7	8	9	10
Tragus to Wall (cm)	<10	10-12.9	13-15.9	16-18.9	19-21.9	22-24.9	25-27.9	28-30.9	31-33.9	34-36.9	≥37
Lumbar Side Flexion (cm)	≥20	18-19.9	15.9-17.9	13.8-15.8	11.7-13.7	9.6-11.6	7.5-9.5	5.4-7.4	3.3-5.3	1.2-3.2	<1.2
Lumbar Flexion (modified Schober's) (cm)	>7.0	6.4-7.0	5.7-6.3	5.0-5.6	4.3-4.9	3.6-4.2	2.9-3.5	2.2-2.8	1.5-2.1	0.8-1.4	≤0.7
Cervical Rotation (degrees)	≥85	76.6-84.9	68.1-76.5	59.6-68	51.1-59.5	42.6-51	34.1-42.5	25.6-34	17.1-25.5	8.6-17	≤8.5
Intermalleolar Distance (cm)	≥120	110-119.9	100-109.9	90-99.9	80-89.9	70-79.9	60-69.9	50-59.9	40-49.9	30-39.9	<30

For cervical spine rotation, tragus to wall and lumbar spine flexion, mean of the left and right measurements were taken. After that, added the scores together for each measurement. Divide this by 5 to get the BASMI score. The higher the BASMI score the more severe the patient's limitation of movement due to their AS.

3. C.6.5 Measurement of Chest Expansion:

Purpose: To assess thoracic mobility

Procedure:

- The Patient was asked to stand in anatomical position with chest exposed.
- A steel tape placed horizontally around the chest at the nipple level.
- Patients were first asked to exhale much as possible, and the measurement was recorded.
- After that again the patients was instructed to inhale maximally, and the second measurement noted.



Photo. no. 26 Measurement of chest expansion

Scoring:

- Chest expansion was calculated as the difference of maximum inhalation to maximum exhalation.

3. C.6.6 Haematological variables:**Haemoglobin & Platelet count:****Purpose:**

- To identify whether haemoglobin levels in Ankylosing Spondylitis patient deviate from normal, indicating possible anaemia or disease related hematological changes.
- To determine whether platelet levels are elevated or reduced in Ankylosing Spondylitis patients reflecting inflammation related or coagulation abnormalities.

Procedure:

Participants were comfortably seated for blood collection. An experienced technician from IPGMER, Kolkata obtained 2.5 ml of venous blood from each patient. The collected samples were transferred into EDTA vials and maintained at room temperature. These vials were subsequently delivered to Dr. Lal Path Labs (Bhawanipur CC Branch, Kolkata – 700025), a well-recognized diagnostic laboratory in India. Haemoglobin and Platelet Count were analyzed using the Electrical Impedance and VCS technique based on the Westergren system.

3. C.6.7 Inflammatory marker:**C-reactive protein (CRP):**

Purpose: To measure acute-phase inflammation associated with active AS.

Procedure:

The patients were seated in a comfortable position, and 2.5 ml of venous blood was drawn by an expert staff member from IPGMER, Kolkata. The collected blood samples were then transferred into clot vials and kept at room temperature. Subsequently, the vials were submitted to Dr. Lal Path Labs (Bhawanipur CC Branch, Kolkata – 700025), a reputed blood testing laboratory in India, where Serum CRP levels were analyzed using the Immunoturbidimetry method.

Erythrocyte Sedimentation Rate (ESR):

Purpose: To evaluate the overall inflammatory status and progression of the AS patients.

Procedure:

Patients were seated comfortably before sample collection. A trained professional from IPGMER, Kolkata drew 2.5 ml of venous blood from each participant. The blood samples were transferred into EDTA vials and kept at room temperature. Then vials were sent to Dr. Lal Path Labs (Bhawanipur CC Branch, Kolkata – 700025), one of the reputed blood testing laboratories in India. Erythrocyte Sedimentation Rate (ESR) was assessed using the Electrical Impedance and VCS method based on the Westergren principle.



Photo. no. 27: Blood sample Collection



Photo no. 28: Centrifugation of blood samples for serum separation



Photo. no. 29: Serum separation



Photo. no. 30: Storage of serum at -40°C for TNF- α analysis.

TNF alpha:

Purpose: To assess pro-inflammatory cytokinin levels reflecting disease activity in Ankylosing Spondylitis.

Detection Method: Enzyme-linked Immunoassay (ELISA)

Kit Description: Human Tumor Necrosis Factor Alpha

ELISA Kit (RayBiotech, CAT. ELH-TNFa, LOT-0207250193)

Range: 3ng/L - 900ng/L **Sensitivity:** 1.52ng/L

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

Reagent Preparation:

- i) All reagents and serum samples were brought to room temperature (18-25 °C) prior to analysis.
- ii) Assay Diluent B was diluted 5-fold with deionized water before use.
- iii) For sample dilution, Assay Diluent A was used for serum samples, and 1X Assay Diluent B was used for cell-culture-based samples. Serum samples were diluted two-fold, and further dilution factors were determined based on individual TNF-alpha concentration variability.
- iv) The standard solution was prepared according to the RayBiotech protocol. A vial of standard protein was briefly centrifuged and reconstituted with 400 µl of Assay Diluent A to prepare a 60 ng/ml standard stock. From this, 50 µl was transferred into 450 µl of Assay Diluent A to obtain a 6,000 pg/ml working stock. Serial dilutions were subsequently prepared in Assay Diluent A to generate the standard curve, with Assay Diluent A serving as the zero standard (0 pg/ml).
- v) The Wash Buffer (20X) was inspected for crystallization and gently warmed until fully dissolved, after which 20 ml of buffer was diluted in deionized water to obtain 400 ml of 1X Wash Buffer.
- vi) The Detection Antibody vial was briefly centrifuged, reconstituted with 100 µl of 1X Assay Diluent B, and diluted 1:80 immediately prior to use. HRP-Streptavidin concentrate was gently mixed and diluted 1:600 with 1X Assay Diluent B before application; the diluted solution was not stored for subsequent use.



Photo. no. 31: TNF-alpha ELISA Kit

Assay Procedure for TNF-alpha Quantification:

- i) All reagents and serum samples were brought to room temperature (18-25 °C) before analysis, and all standards and samples were processed in duplicate. Removable 8-well strips of the ELISA plate were labelled according to the sample layout.
- ii) A volume of 100 µl of each standard and diluted serum sample was pipetted into the designated wells, covered, and incubated for 2.5 hours at room temperature with gentle shaking. Following incubation, the plate contents were discarded and washed four times with 1X Wash Buffer to ensure complete removal of residual fluid.
- iii) Subsequently, 100 µl of 1X biotinylated detection antibody was added to each well and incubated for 1 hour at room temperature with gentle shaking. The solution was discarded, and the washing process was repeated.
- iv) Then, 100 µl of 1X HRP-Streptavidin solution was added to each well and incubated for 45 minutes under similar conditions, followed by another washing cycle.
- v) Next, 100 µl of TMB One-Step Substrate Reagent was dispensed into each well and incubated for 30 minutes in the dark at room temperature with gentle shaking. The reaction was terminated by adding 50 µl of Stop Solution to each well, and the optical density was measured immediately at 450 nm using a microplate reader.



Photo no. 32: Raw serum samples prepared for TNF- α assay



Photo no.33: Preparation of TNF- α standards



Photo no.34: Incubation of samples and standards



Photo no.35: TNF- α quantification

3. C.6.8 Fear avoidance belief scale (FABQ):

The Fear-Avoidance Beliefs Questionnaire (FABQ) was developed from fear-avoidance theories to assess patients' beliefs about how physical activity and work influence their low back pain.³⁴⁴ There are two subscales in the FABQ. The FABQ consists of two subscales: the Physical Activity Subscale (FABQpa, items 1–5) and the Work Subscale (FABQw, items 6–16).

Validity and Reliability:

For the measurement of fear avoidance beliefs, the FABQ and the two subscales have been found to be valid and reliable. For the FABQpa, Cronbach's alpha was 0.75 (test-retest reliability, $r=0.64$). Cronbach's alpha for the FABQw was 0.82 (test-retest $r=0.80$).

The Tampa Scale of Kinesiophobia and the FABQ were correlated to varying degrees, ranging from 0.53 (FABQpa) and 0.76 (FABQw) to 0.39 (FABQpa) and 0.33 (FABQw).

Scoring and Interpretation:

The FABQ consists of a total of 16 items which are rated on a 7-point likert scale (0-6) where 0 = completely disagree and 6 = completely agree. The total FABQ (FABQ-T) score ranges from 0 to 96.³⁴⁵

Scoring of the FABQ subscales:

Sum items 2, 3, 4, and 5 to score the Physical Activity subscale (FABQpa)

Sum the items 6, 7, 9, 10, 11, 12, and 15 when scoring the Work subscale (FABQw)

Fear-avoidance beliefs can be interpreted based on the total FABQ score. Scores between 0–48 indicate low levels of fear-avoidance beliefs, scores within 49–64 reflect moderate levels, and scores in the range of 65–96 represent high levels of fear-avoidance beliefs. Higher scores indicate a higher degree of fear-avoidance beliefs.

3.C.6.9 Depression:

The Hamilton Depression Rating Scale (HAM-D)³⁴⁶ is a clinician - administered instrument designed to assess the severity of depressive symptoms in adults over the past week. The original version comprised 17 items (HDRS-17) and was developed by Max Hamilton in 1960. It remains among the most widely used depression scales in clinical and research settings.³⁴⁷

Reliability and validity:

Studies show that the HAM-D has good psychometric properties. For example, a meta-analysis of studies from 1960 to 2008 reported a mean cronbach's α of approximately 0.79 for internal consistency, and intraclass correlation coefficient around 0.94 for inter-rater reliability.³⁴⁸ Validity has also been supported- concurrent validity concurrent validity with structured clinical interviews is strong.

Scoring:

In the HDRS-17, each item is scored on a 5 points scale in this study. Scoring varies across HDRS versions. In the HDRS-17, a total score of 0-7 is generally interpreted as being within the normal range or clinical remission, whereas a score of 20 or above typically reflects at least moderate depressive severity and is commonly used as an inclusion threshold for clinical trials.

3. C.6.10 Pain catastrophizing Scale (PCS):

The Pain Catastrophizing Scale (PCS) is a 13-item self-report questionnaire designed to evaluate the extent of catastrophic thoughts and worries associated with pain in adults. Pain catastrophizing is widely understood as a pattern of exaggerated, negative cognitive responses to the anticipation of pain or to the actual pain experience.³⁴⁹

Scoring:

- The PCS consist of 13 items rated on a 5-point Likert scale from 0 (“not at all”) to 4 (“all the time total”).^{350,351}
- Total PCS score is calculated by summing the responses for all 13 items, giving a possible range of 0 to 52.
- The PCS also provides scores for three sub scales:
- Rumination (item 8, 9, 10, 11)
- Magnification (items 6, 7, and 13)
- Helplessness (items 1, 2, 3, 4, 5, and 12)
- Highest scores represent greater levels of catastrophizing. A commonly cited threshold is > 30 on the total PCS for clinically relevant catastrophizing

3. C.6.11 Health related quality of life (HQRoL):

The RAND 36-Item Health Survey (Version 1.0) taps eight health concepts: physical functioning, bodily pain, role limitations due to physical health problems, role limitations due to personal or emotional problems, emotional well-being, social functioning, energy/fatigue, and general health perceptions. It also includes a single item that provides an indication of perceived change in health. These 36 items, presented here, are identical to the MOS SF-36 described in.³⁵² They were adapted from longer instruments completed by patients participating in the Medical Outcomes Study (MOS), an observational study of variations in physician practice styles and patient outcomes in different systems of health care delivery.³⁵³

Scoring:

Scoring the RAND 36-item³⁵⁴ Health Survey is a two-step process:

1. Each item is recorded so that higher values represent better health status and are then transformed to a 0-100 scale (where 0= worst possible health status and 100 = best possible health state)
2. For each of the eight health domains (Physical Functioning, Role physical, Role Emotional, Energy/fatigue, Emotional wellbeing, Social Functioning, Bodily pain, General Health), the scores of the relevant items are averaged to create a domain score (0-100)
3. A higher domain score indicates a better health-related quality of life in the domain.

Table No. 15: Allocation of RAND-36 questionnaire items to their corresponding subscales

Subscale	No. of Items	Item Numbers
Physical Functioning	10	3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Role Limitations Due to Physical Health	4	13, 14, 15, 16
Role Limitations Due to Emotional Problems	3	17, 18, 19
Energy / Fatigue	4	23, 27, 29, 31
Emotional Well-Being	5	24, 25, 26, 28, 30
Social Functioning	2	20, 32
Pain	2	21, 22
General Health	5	1, 33, 34, 35, 36
Health change	1	2

3. C.6.12 Steps of Collecting Data:

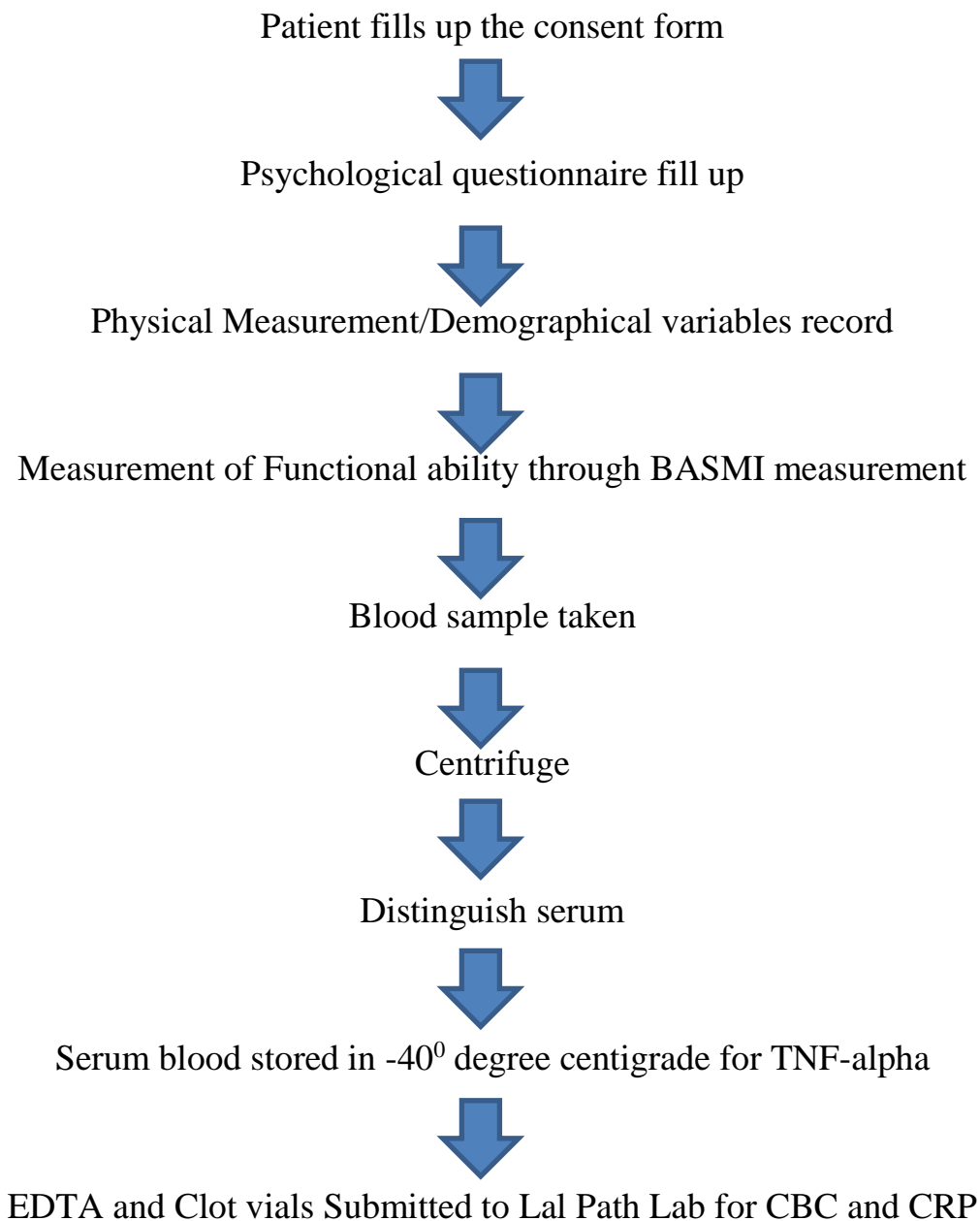


Fig. No. 9: Steps of data collection

3. C.7 Training protocol for the experimental group:

The experimental group received conventional treatment with yogic intervention (table no. 8) 1 hour/day, 5 d/week, for post 24 weeks. Instructional videos were recorded after demonstration and provided to the patients for self-practice. Patients were monitored by virtual mode and monthly physical interaction.



Photo. no. 36



Photo. no. 37



Photo. no. 38

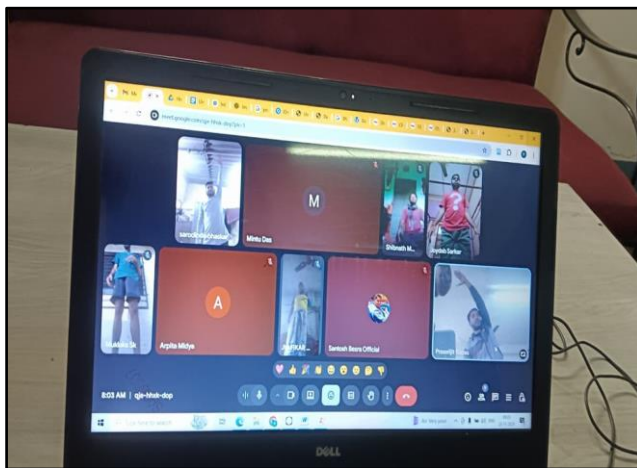


Photo. no. 39

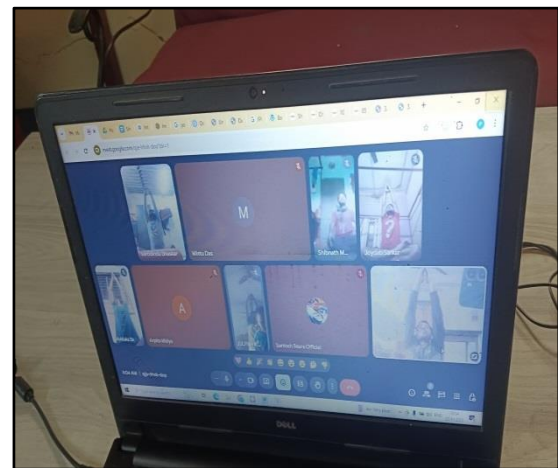


Photo. no. 40

Photo. No. 36-40: Virtual Monitoring of patients

3. C.8 Exercise program of the control group:

Patients from the control group practiced exercise with standardised medicine. Most of the patients did the exercise practice by the suggestions from the experts of Physical Medicine and rehabilitation, of Institute of Post Graduate Medical Education & Research (IPGME&R).

3. C.9 Medication:

Standardised Medicine was prescribed for the experimental and controls both groups by the rheumatologist experts from the OPD of Clinical Immunology and Rheumatology, Institute of Post Graduate Medical Education & Research (IPGME&R). Subjects were taken two kinds of drugs: Analgesics and disease modifying anti rheumatic drugs.

Analgesics:

Disease Modifying Anti Rheumatic Drugs (DMARDs).

- | | |
|----------------------------------|--|
| 1. Paracetamol: up to 1.5 mg/day | 1. Sulphasalazine: 500-2000 mg/Day |
| 2. Etoricoxib: 60-90mg/day (SOS) | 2. Methotrexate: 7.5-15mg/week |
| 3. Naproxin: 500-1000 mg/day | 3. Tofacitinive: 5-10mg/Day – one/twice time |

Due to severity of the disease, some patients in control group planning for biologics drugs, besides the standardised medicine DMARDs.

3. C.10 Statistical Procedure:

Data collected at baseline, post-12 weeks, and post-24 weeks were systematically recorded and analyzed using SPSS version 27. After assessing the normality of the dataset, non-parametric statistical methods were applied. Between-group comparisons (yoga vs. control) at each phase were conducted using the Mann–Whitney U test, with the level of significance set at $p < 0.05$. To evaluate within-group changes across the three time points, the Friedman test, the non-parametric equivalent of repeated-measures ANOVA was used for both the yoga and control groups.

H₀: There will be no significant differences between the combined group (medicine + yoga) and the conventional group on psychological, physiological, general health status, clinical outcome measures and inflammatory markers after 24 weeks.

Chapter-IV

RESULTS & DISCUSSIONS

4.1 Results

4.1.1 Baseline comparison between Yoga and Control Group

4.1.2 Post-12-Weeks comparison between Yoga and Control Group

4.1.3 Post-24-Weeks comparison between Yoga and Control Group

4.1.4 Within Group Comparisons across baseline, post 12weeks and post 24 weeks

4.1.5 Comparison of the changes between the yoga and control groups baseline to post 12 weeks and post 24 weeks

Chapter-IV

RESULTS & DISCUSSIONS

4.1 Results:

The results and analysis aimed to evaluate the process and outcomes associated with the developed yoga module, emphasizing its scientific validation and practical applicability. The data encompass experimental results that collectively demonstrate the module's feasibility and effectiveness for patients with Ankylosing Spondylitis. The results of these stages are presented in the following sections.

Results of Part-III:

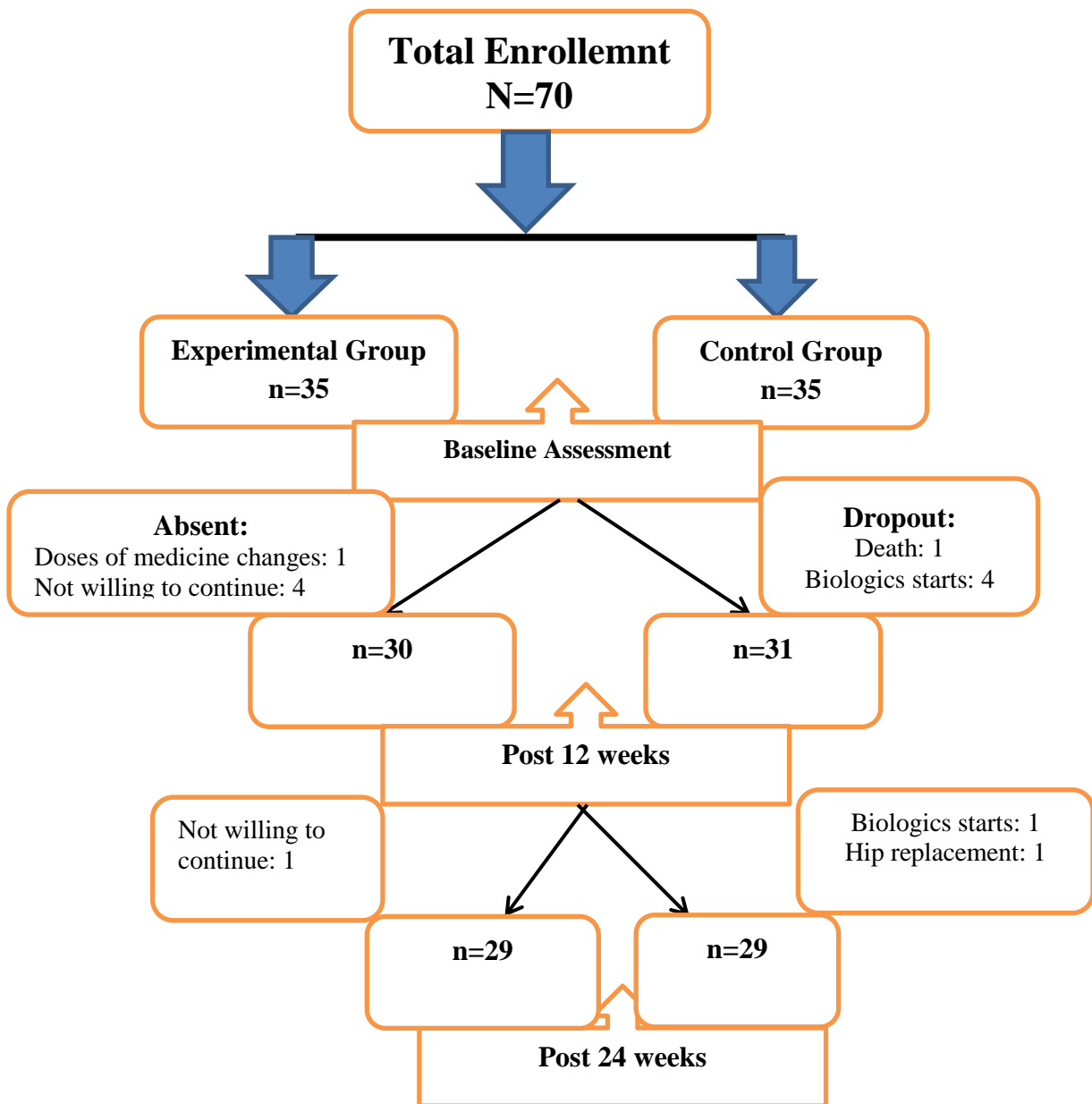


Fig. no. 10: Flow of Participants through the Study

Finally, in this study, 58 patients among which yoga group (n) =29 and control group (n) =29 completed the study from enrollment to post 24 weeks. The quantitative analysis of patient data was carried out using appropriate non-parametric statistical methods. Owing to the non-normal distribution of the data, Mann–Whitney U tests were employed for between-group comparisons (yoga vs. control groups) at baseline, after post 12 weeks, and after 24 weeks.

To examine within-group changes over time, a Friedman test (non-parametric equivalent of repeated-measures ANOVA) was applied. For variables showing significant differences, post-hoc analyses with Bonferroni correction were conducted using the Wilcoxon signed-rank test to identify specific pairwise differences between time phases within each group.

The results of the quantitative analysis are presented in tabular and graphical formats to illustrate the comparative and longitudinal effects of the yoga intervention.

Table No. 16: Demographic & Anthropometric Variables of patients

Variable	Sample Size (n)	Experimental group Mean ± SD	Sample Size (n)	Control group Mean ± SD
Height (cm)	29	165.02 ± 6.13	29	164.58 ± 5.28
Weight (kg)	29	61.62 ± 9.56	29	60.17 ± 9.42
Age (years)	29	29.86 ± 5.222	29	30.69 ± 4.70
Duration of Disease(yrs)	29	4.05 ± 2.06	29	4.19 ± 2.12

****TNF- α level were below the assay detection limit in 3 patients from each group, therefore TNF- α analysis was performed using the available 26 samples per group.

The baseline demographic and clinical characteristics of the participants demonstrated homogeneity between the experimental and control groups. There were no noticeable differences in height, weight, age, or duration of disease between the two groups at the baseline of the study.

4.1.1 Baseline comparison between Yoga and Control Group:

4.1.1.1 General Health Variables:

Table No. 17: Baseline comparison of general health variables between the Yoga group and Control Group

Variables	Groups	Mean \pm SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
BMI (kg/m ²)	Yoga Group	22.68 \pm 3.39	22.40(20.50-25.10)	374.5	0.47
	Control Group	21.87 \pm 3.10	22.70(19.15-23.75)		
Systolic BP (mmHg)	Yoga Group	115.86 \pm 14.67	113(107.50-122)	387	0.60
	Control Group	117.03 \pm 12.92	115(107-126.50)		
Diastolic BP (mmHg)	Yoga Group	78.76 \pm 10.60	78(71.50-86)	352.5	0.29
	Control Group	76.24 \pm 8.43	76(70.50-82.50)		
Heart Rate (beats/minutes)	Yoga Group	80.34 \pm 8.99	82(75.50-86.50)	295	0.051
	Control Group	77.14 \pm 7.16	77(72.00-82.50)		

P-value < 0.05 is significant

Table no. 17 shows that at baseline, no significant differences were found between the yoga and control groups in BMI, systolic blood pressure, diastolic blood pressure, or heart rate, which indicating that both groups were comparable in these general health variables.

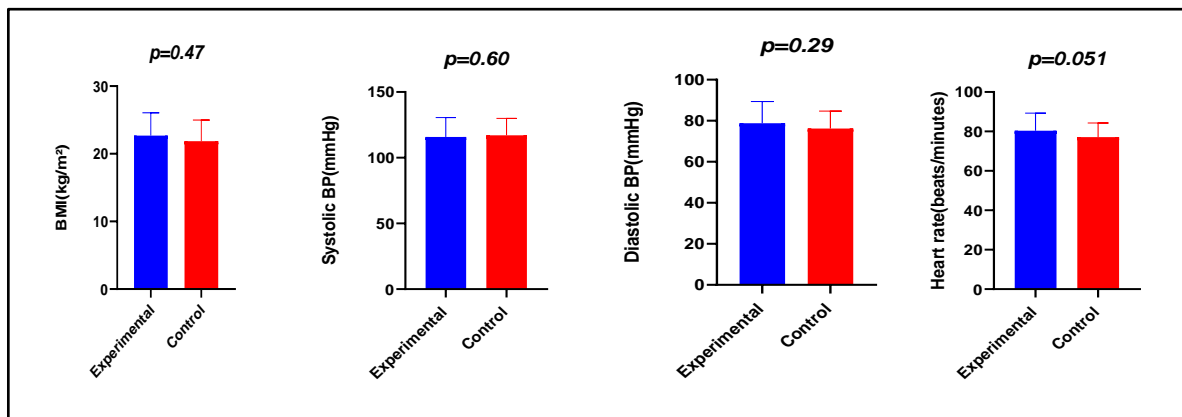


Fig. no. 11: Baseline graphical comparison of General health variables between the Yoga Group and the Control Group

4.1.1.2 Disease activity index, functional Index, metrology Index and chest expansion Variables (Clinical outcome measures):

Table No. 18: Baseline comparison of clinical outcome measures between the Yoga and Control Group

Variables	Groups	Mean \pm SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
BASDAI	Yoga Group	4.60 \pm 1.69	4.60(3.05-5.75)	379	0.52
	Control Group	4.30 \pm 1.40	4.20(3.35-4.90)		
BASFI	Yoga Group	4.47 \pm 1.65	4.30(3.05-5.55)	360	0.35
	Control Group	4.91 \pm 1.65	4.30(3.70-6.25)		
BASMI	Yoga Group	3.20 \pm 1.72	3(2-4.40)	417	0.96
	Control Group	3.21 \pm 1.74	2.60(1.70-4.60)		
Chest Expansion (cm)	Yoga Group	2.48 \pm 1.62	2.50(1-3)	392.50	0.66
	Control Group	2.70 \pm 1.77	2.50(1-4)		

p-value < 0.05 is significant

From table no. 18 it is reported that no significant differences were observed between yoga and control group at baseline for BASDAI, BASFI, BASMI, and chest expansion.

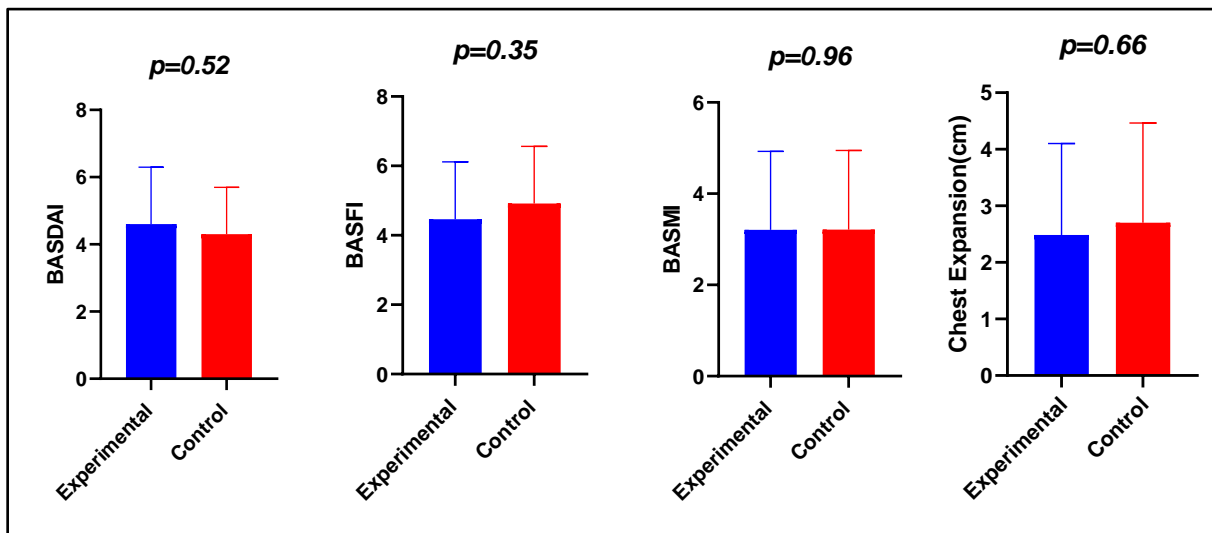


Fig. no. 12: Baseline graphical comparison of clinical outcome measures between the Yoga Group and the Control Group

4.1.1.3 Haematological and Inflammatory Markers Variables:

Table No. 19: Baseline comparison of haematological and inflammatory marker variables between yoga Group and control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Haemoglobin (g/dl)	Yoga Group	13.19±1.20	13.40(12.45-14)	385	0.59
	Control Group	13.36±1.34	13.80(12.30-14.25)		
Platelet Count (thou/mm ³)	Yoga Group	211.24±91.70	166(154-239)	409	0.86
	Control Group	200.31±53.85	181(160-243.50)		
ESR (mm/hr)	Yoga Group	24.21±22.24	20(6.50-30)	416	0.94
	Control Group	20.93±13.91	18(9-30.50)		
CRP (mg/L)	Yoga Group	9.62±11.59	5.77(2.15-13.34)	417.50	0.96
	Control Group	9.81±12.14	5.92(1.95-11.62)		
TNF-alpha (ng/L)	Yoga Group	33.12±61.38	8.20(3.59-37.48)	364	0.99
	Control Group	31.52±52.20	5.69(2.41-33.17)		

p-value < 0.05 is significant

Table no. 19 showed that there were no significant differences were observed between yoga and control group for haemoglobin, platelet count, ESR, CRP, and TNF-alpha.

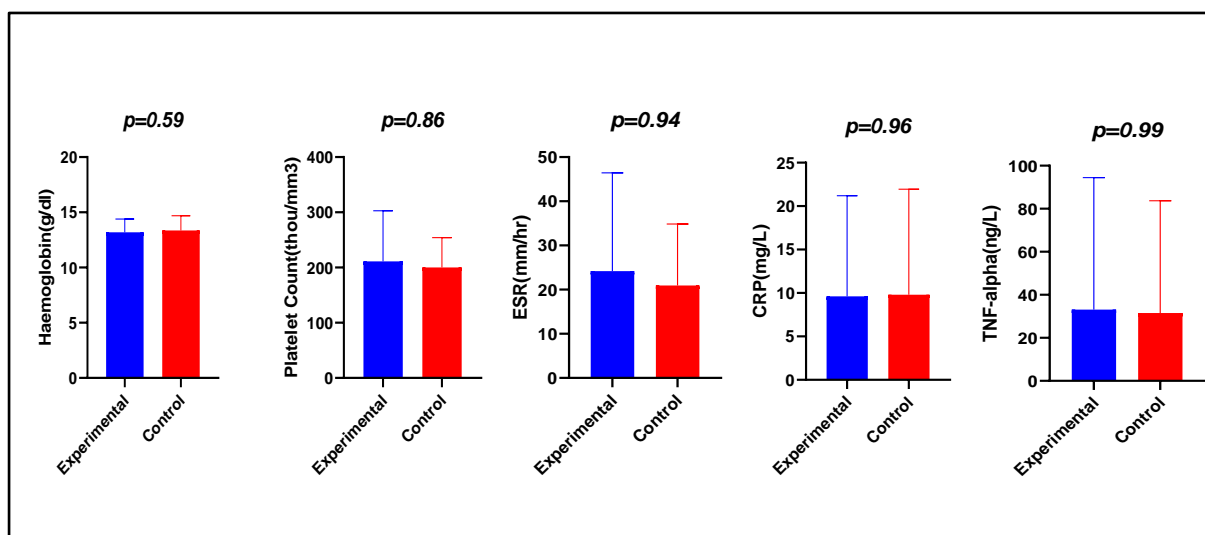


Fig. no. 13: Baseline graphical comparison of haematological variables and inflammatory markers between the Yoga Group and the Control Group

4.1.1.4 Psychological Variables:

4.1.1.4.1 Depression and Fear Avoidance Beliefs

Table No. 20: Baseline comparison of Depression and Fear Avoidance Beliefs variables between yoga Group and control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Depression	Yoga Group	13.24±4.04	13(10.50-15)	326.5	0.14
	Control Group	12.24±4.70	11(9-14)		
Fear Avoidance Belief in Physical Activity	Yoga Group	15.38±4.04	16(12-18)	307.5	0.08
	Control Group	12.83±5.82	12(9-17)		
Fear Avoidance Belief in Work Activity	Yoga Group	21.90±5.56	22(19.50-26)	377.5	0.50
	Control Group	20.45±8.54	22(15-27.50)		
FABQ Total Score	Yoga Group	52.24±14.16	52(48.50-63)	358	0.33
	Control Group	48.79±16.88	51(37.50-61)		

p-value < 0.05 is significant

From table no. 20 it is reported that at baseline, depression, fear avoidance belief in physical activity, fear avoidance belief in work activity and FABQ total Score has no significant difference exist between yoga and control group.

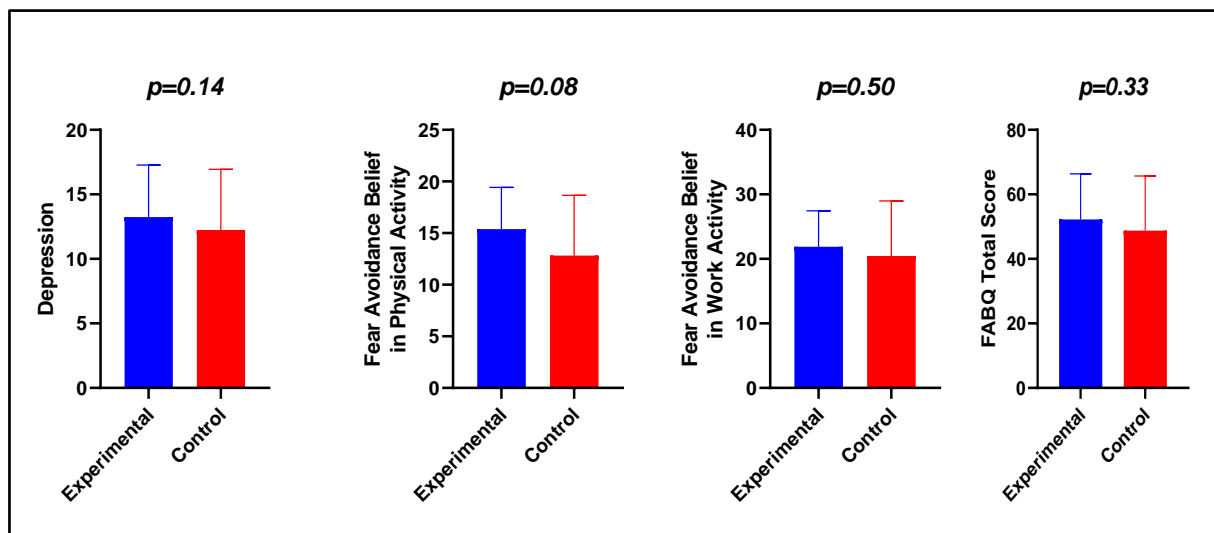


Fig. no. 14: Baseline graphical comparison of Depression and Fear Avoidance Beliefs between the Yoga Group and the Control Group

4.1.1.4.2 Pain Catastrophizing

Table No. 21: Baseline comparison of Pain Catastrophizing between yoga Group and control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Rumination subscale	Yoga Group	6.86±2.86	7(6-7.50)	344.50	0.23
	Control Group	7.24±1.98	7(6-8)		
Magnification subscale	Yoga Group	4.83±2.19	5(3-6)	396.50	0.71
	Control Group	5.07±2.03	5(3-6)		
Helplessness subscale	Yoga Group	10.79±4.93	10(7.50-13.50)	388.50	0.62
	Control Group	10.07±3.20	9(8-12)		
PCS Total Score	Yoga Group	22.55±8.99	20(16-28)	411	0.88
	Control Group	22.38±5.55	23(19-25)		

p-value < 0.05 is significant

Table no. 21 showed that at baseline among the subscale of pain catastrophizing i.e. Rumination subscale, Magnification subscale, Helplessness subscale and PCS total score had no significant difference between the yoga and control group.

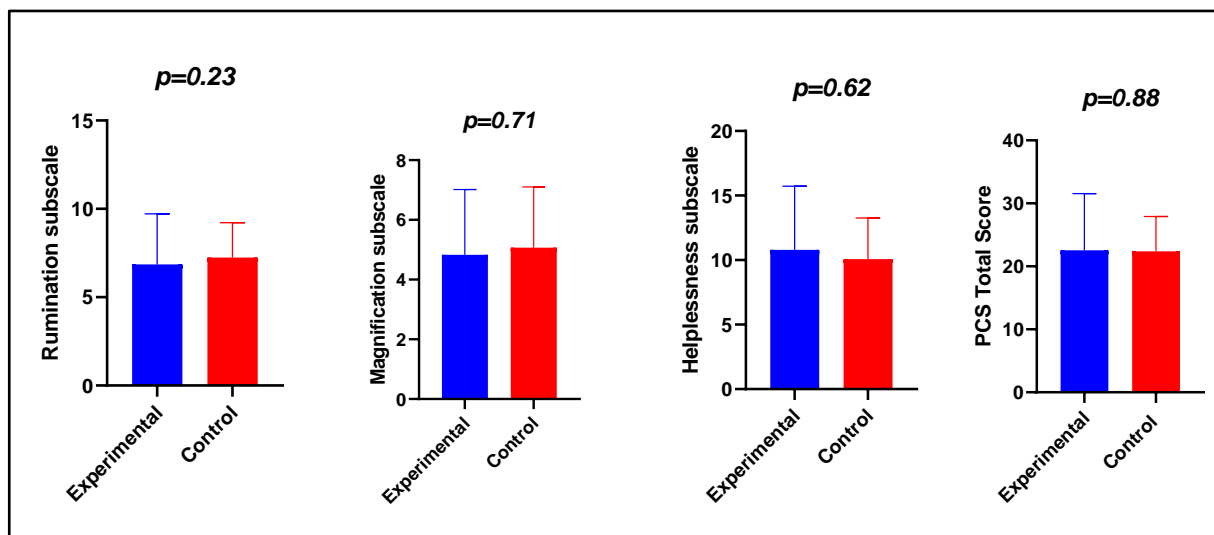


Fig. no. 15: Baseline graphical comparison of Pain Catastrophizing between the Yoga Group and the Control Group

4.1.1.5 HRQoL Variables

Table No. 22: Baseline comparison of HRQoL dimensions between the Yoga Group and Control Group

Variables	Groups	Mean \pm SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Physical Functioning	Yoga Group	54.66 \pm 20.57	50(37.50-70)	328	0.15
	Control Group	60.17 \pm 17.14	65(50-70)		
Role limitation-Physical	Yoga Group	43.10 \pm 42.73	25(0-100)	403	0.78
	Control Group	45.69 \pm 34.76	50(12.50-75)		
Role limitation-Emotional	Yoga Group	31 \pm 34.48	33(0-67)	393	0.65
	Control Group	35.62 \pm 36.72	33(0-67)		
Vitality (Energy)	Yoga Group	38.93 \pm 14.99	35(30-50)	305.5	0.07
	Control Group	45.17 \pm 10.65	45(40-52.50)		
Mental Health (Emotional wellbeing)	Yoga Group	40.69 \pm 14.62	40(30-52)	371	0.44
	Control Group	43.31 \pm 12.00	44(34-52)		
Social Functioning	Yoga Group	42.10 \pm 17.74	38(25-56.50)	418	0.97
	Control Group	42.97 \pm 19.83	38(31.50-50)		
Pain	Yoga Group	61.62 \pm 18.04	68(50-78)	381	0.53
	Control Group	66.55 \pm 11.04	68(58-78)		
General Health	Yoga Group	30.17 \pm 19.06	35(12.50-42.50)	384.5	0.57
	Control Group	33.28 \pm 21.31	30(10-47.50)		
Health Change	Yoga Group	42.24 \pm 26.81	25(25-75)	348.5	0.24
	Control Group	50.00 \pm 22.16	50(25-75)		

p-value < 0.05 is significant

From table no. 22 it is revealed that at baseline there were no significant differences observed in Physical Functioning, Role limitation-Physical, Role limitation-Emotional, Vitality (Energy), Mental Health (Emotional wellbeing), Social Functioning, Pain, General Health and Health Change between the experimental and control group.

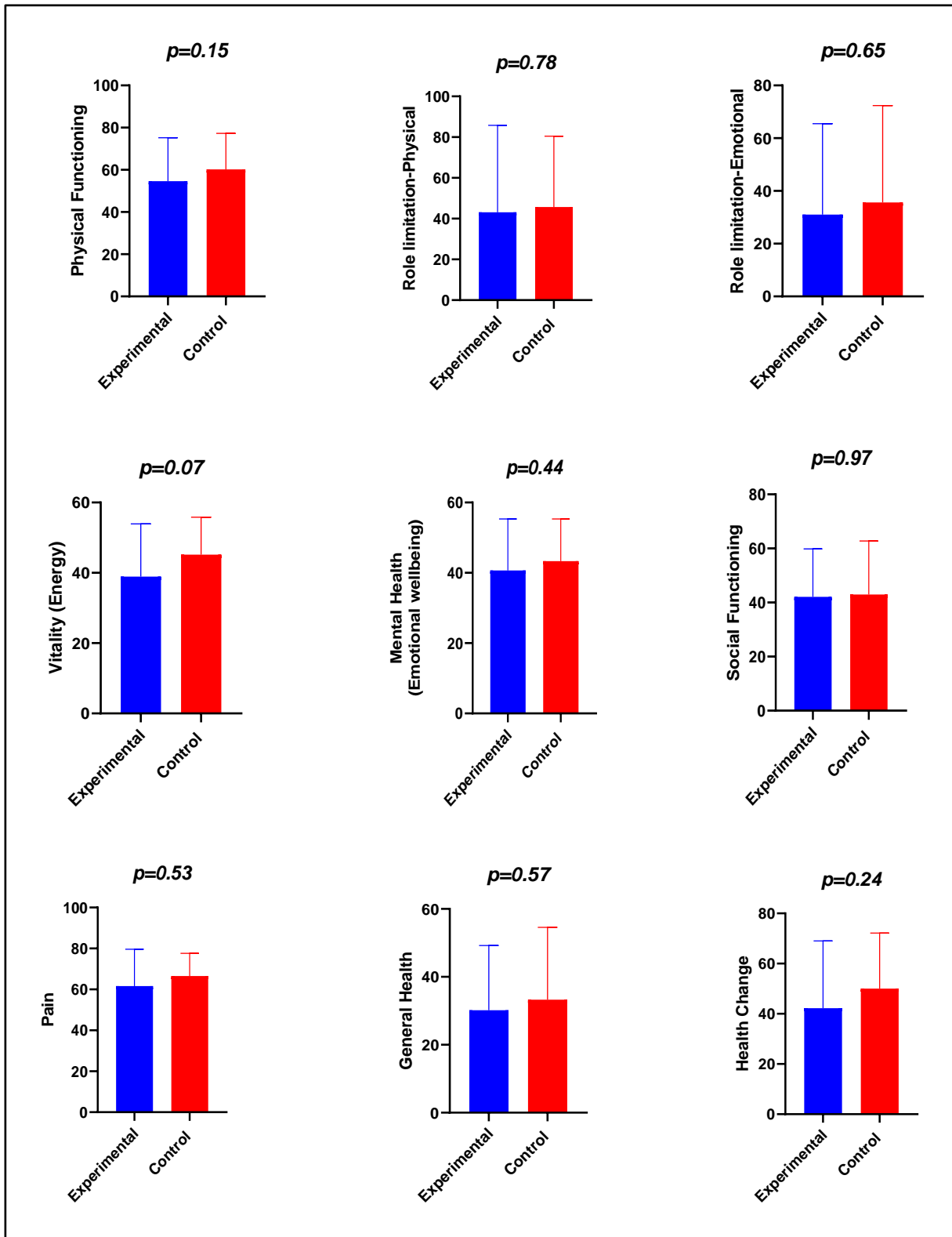


Fig. no. 16: Baseline graphical comparison of HRQoL Dimensions between the Yoga Group and the Control Group

4.1.2 Post-12-Weeks comparison between Yoga and Control Group:

4.1.2.1 General Health Variables:

Table No. 23: Post-12-week comparison of general health variables between the Yoga Group and Control Group

Variables	Groups	Mean \pm SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
BMI (kg/m ²)	Yoga Group	22.57 \pm 2.76	22.80(20.35-25)	405.5	0.82
	Control Group	22.55 \pm 3.28	22.80(20.10-24.70)		
Systolic BP (mmHg)	Yoga Group	112 \pm 9.47	110(105-117)	358.5	0.33
	Control Group	115.66 \pm 13.15	113(106.50-120)		
Diastolic BP (mmHg)	Yoga Group	76.17 \pm 6.55	75(71.50-81.50)	322.5	0.13
	Control Group	72.97 \pm 8.48	73(66.50-78.50)		
Heart Rate (beats/minutes)	Yoga Group	77.76 \pm 9.15	77(72-83)	349.5	0.27
	Control Group	81.21 \pm 8.58	78(75-89)		

p-value < 0.05 is significant

Table no. 23 showed that post 12 weeks comparison between the yoga and control groups no significant differences were observed in BMI, Systolic blood pressure, diastolic blood pressure and resting heart rate.

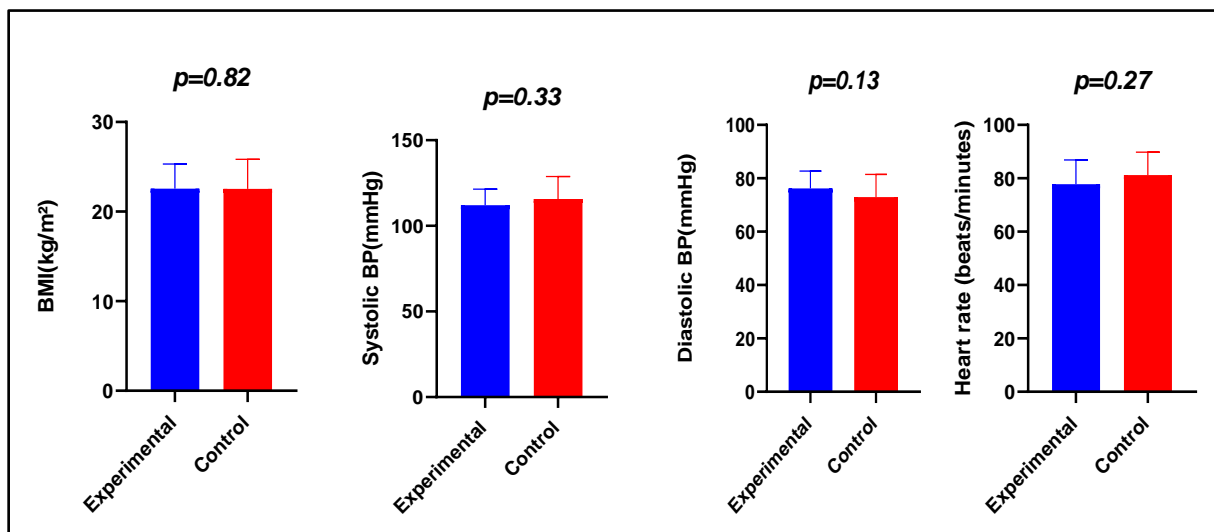


Fig. no. 17: Post-12-week graphical comparison of general health variables between the Yoga group and the Control group

4.1.2.2 Clinical outcome measures:

Table No. 24: Post-12-week comparison of clinical outcome measures between the Yoga Group and Control Group

Variables	Groups	Mean \pm SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
BASDAI	Yoga Group	3.19 \pm 1.82	3(1.90-4.60)	243	0.006
	Control Group	4.46 \pm 1.62	4.60(3.35-5.55)		
BASFI	Yoga Group	3.19 \pm 1.82	3(1.90-4.60)	183.50	0.00
	Control Group	5.21 \pm 1.67	5(4.10-6.15)		
BASMI	Yoga Group	2.32 \pm 1.45	1.80(1-3.30)	181.50	0.00
	Control Group	4.06 \pm 1.64	4(2.50-5.60)		
Chest Expansion (cm)	Yoga Group	3.32 \pm 1.74	3(2-4.50)	269.50	0.02
	Control Group	2.34 \pm 1.46	2(1.50-3)		

p-value < 0.05 is significant

From table no. 24 it is reported that post 12 weeks there were significant differences observed in BASDAI, BASFI, BASMI, and chest expansion between the yoga and control groups.

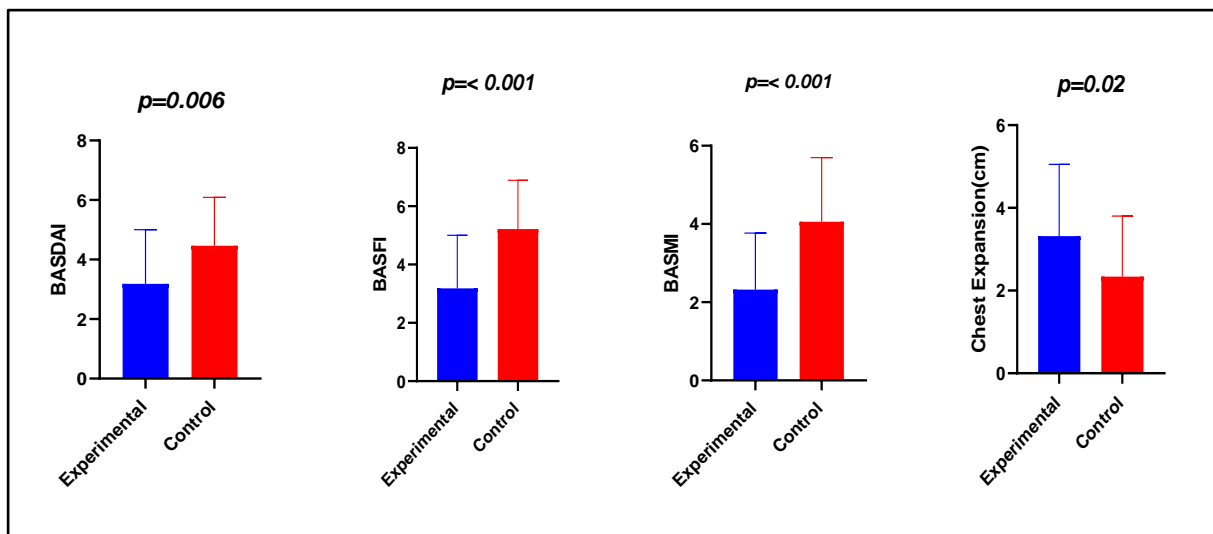


Fig. no. 18: Post-12-week graphical comparison of clinical outcome measures between the Yoga group and the Control group

4.1.2.3 Haematological variables and Inflammatory Markers:

Table No. 25: Post-12-week comparison of haematological variables and inflammatory markers of between the Yoga Group and Control Group

Variables	Groups	Mean \pm SD	Median(IQR: Q1-Q3)	p-value
Haemoglobin (g/dl)	Yoga Group	13.44 \pm 1.11	13.50(12.60-14.40)	0.04
	Control Group	12.74 \pm 1.25	12.50(11.95-13.85)	
Platelet Count (thou/mm ³)	Yoga Group	188.38 \pm 57.01	162(155-202.50)	0.07
	Control Group	222.48 \pm 77.58	188(163-275.50)	
ESR (mm/hr)	Yoga Group	22.55 \pm 19.18	15(8-40.50)	0.004
	Control Group	38.17 \pm 24.38	30(19.50-53)	
CRP (mg/L)	Yoga Group	8.24 \pm 11.49	3.61(1.18-12.91)	0.006
	Control Group	15.38 \pm 13.89	10.86(4.70-24.06)	
TNF-alpha (ng/L)	Yoga Group	12.35 \pm 17.87	6.72(2.36-13.80)	0.10
	Control Group	63.84 \pm 125.38	10.63(4.46-39.42)	

p-value < 0.05 is significant

Table no.25 reported that post 12 weeks of comparison between the yoga and control groups significant differences were observed in Haemoglobin only, whereas no significant difference found in Platelet Count. For inflammatory marker ESR and CRP are significant differences observed at post 12 weeks. But no significant differences observed in TNF-alpha.

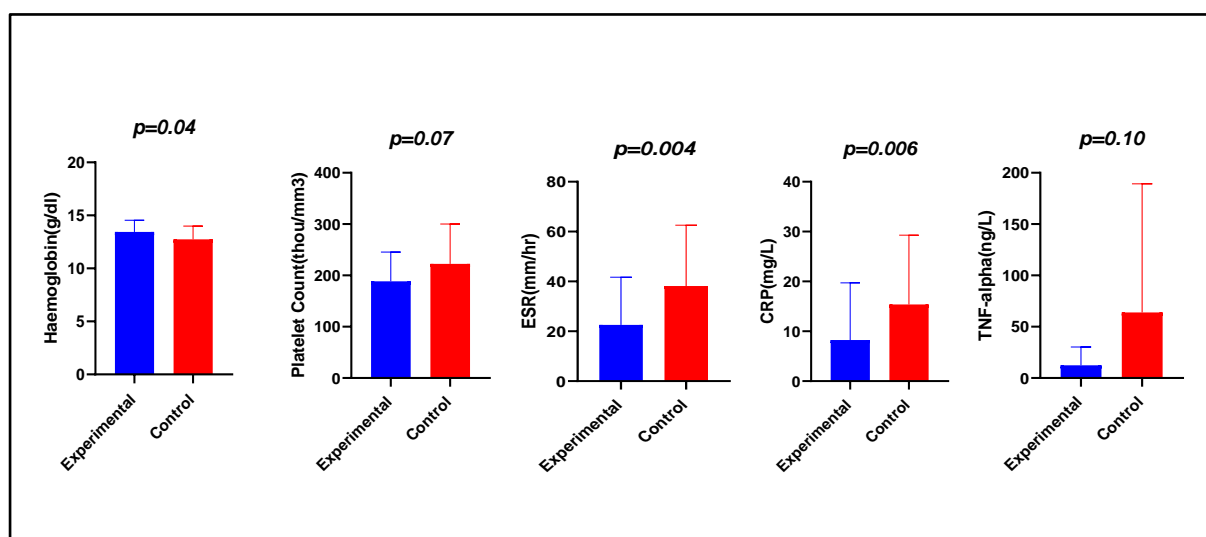


Fig. no. 19: Post-12-week graphical comparison of haematological variables and inflammatory markers between the Yoga group and the Control group

4.1.2.4 Psychological Variables:

4.1.2.4.1 Depression and Fear Avoidance Beliefs

Table No. 26: Post-12-week comparison of Depression and Fear Avoidance Beliefs Variables between the Yoga Group and Control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Depression	Yoga Group	10.52±5.21	9(6.50-13)	151.5	0.00
	Control Group	17.28±5.43	18(16-20)		
Fear Avoidance Belief in Physical Activity	Yoga Group	12.10±5.50	12(8.50-15.50)	166.5	0.00
	Control Group	17.97±4.40	18(16-21)		
Fear Avoidance Belief in Work Activity	Yoga Group	14.00±7.57	12(8.50-19.50)	120	0.00
	Control Group	25.00±6.36	27(21.50-29.50)		
FABQ Total Score	Yoga Group	37.21±17.10	31(25.50-53)	132	0.00
	Control Group	60.93±13.86	64(54.50-68.50)		

p-value < 0.05 is significant

Compared to the control group, the yoga group showed significantly lower scores in depression and in all components of the fear avoidance belief questionnaire (FABQ), indicating improved psychological well-being and reduced fear avoidance beliefs following the post 12 weeks yoga intervention.

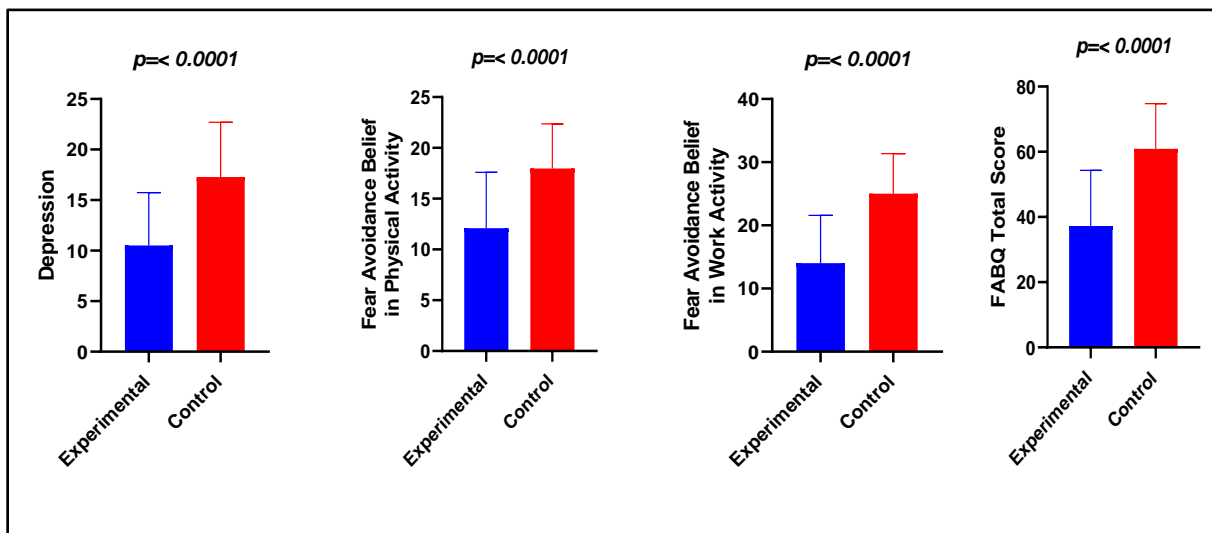


Fig. no. 20: Post-12-week graphical comparison of Depression and Fear-Avoidance Belief variables between the Yoga group and the Control group

4.1.2.4.2 Pain Catastrophizing

Table No. 27: Post-12-week comparison of Pain Catastrophizing between the Yoga and Control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Rumination subscale	Yoga Group	5.72±2.27	6(4-0.7)	261	0.01
	Control Group	7.76±3.32	8(4-10.50)		
Magnification subscale	Yoga Group	3.21±1.70	3(2-4)	208	0.001
	Control Group	5.21±2.16	5(3-7)		
Helplessness subscale	Yoga Group	6.10±3.18	5(4-8)	153	.000
	Control Group	10.76±4.59	9(8-14)		
PCS Total Score	Yoga Group	15.03±5.41	15(11-18)	170	.000
	Control Group	23.69±8.62	23(16.50-30)		

p-value < 0.05 is significant

Table no. 27 showed that significant differences were observed between the yoga and control groups across all the components of the pain catastrophizing scale, indicating a positive influence of yoga on pain catastrophizing after the post 12 weeks yoga interventions.

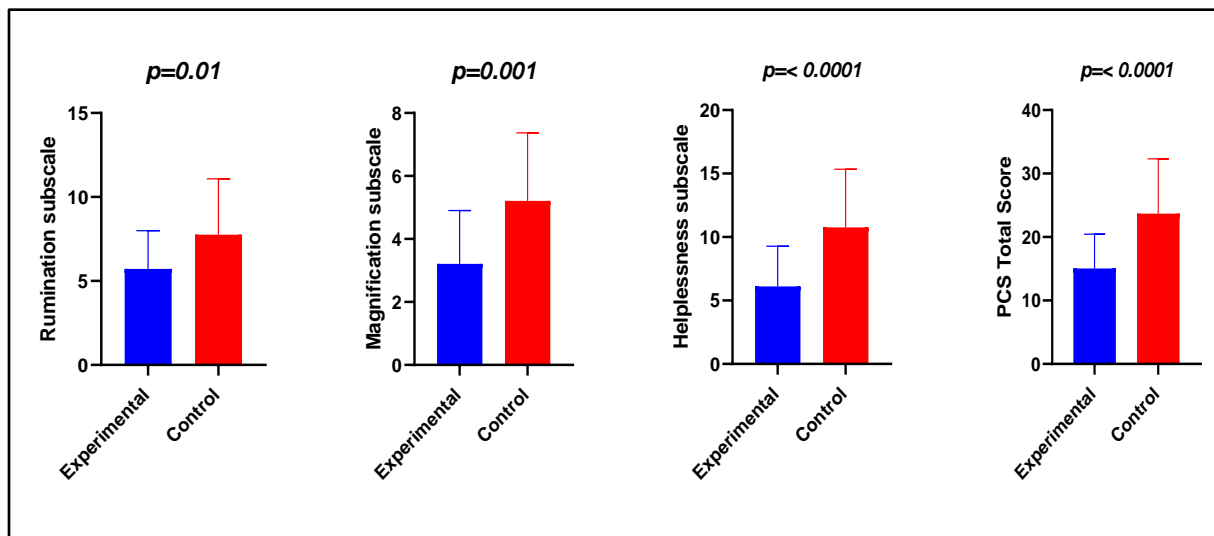


Fig. no. 21: Post-12-week graphical comparison of Pain Catastrophizing between the Yoga group and the Control group

4.1.2.5 HRQoL Variables

Table No. 28: Post-12-week comparison of HRQoL Dimensions between the Yoga and Control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Physical Functioning	Yoga Group	78.45±12.26	80(70-87.50)	75.5	0.00
	Control Group	48.97±17.75	50(35-65)		
Role limitation-Physical	Yoga Group	81.03±22.81	75(75-100)	92	0.00
	Control Group	32.76±29.20	25(0-50)		
Role limitation-Emotional	Yoga Group	74.79±30.43	67(67-100)	208	0.001
	Control Group	40.21±37.21	33(90-67)		
Vitality	Yoga Group	58.79±10.49	60(47.50-65)	168.5	0.00
	Control Group	41.03±16.87	40(27.50-55)		
Mental Health	Yoga Group	59.03±11.20	60(52-68)	91.5	0.00
	Control Group	38.00±12.79	36(30-50)		
Social Functioning	Yoga Group	61.97±11.12	63(50-63)	168	0.00
	Control Group	39.48±22.25	38(25-50)		
Pain	Yoga Group	76.10±9.75	78(68-78)	213.5	0.001
	Control Group	60.03±19.58	65(45-78)		
General Health	Yoga Group	55.86±15	55(47.50-67.50)	131.5	0.00
	Control Group	28.83±20.31	25(10-47.50)		
Health Change	Yoga Group	79.31±15.04	75(75-100)	94	0.00
	Control Group	39.48±24.69	25(25-50)		

p-value < 0.05 is significant

According to the above table it is evident that post 12 weeks, all dimensions of health related quality of life (HQRoL) scale showed a statistical significant improvement in the yoga group compared to the control group at the 0.05 level.

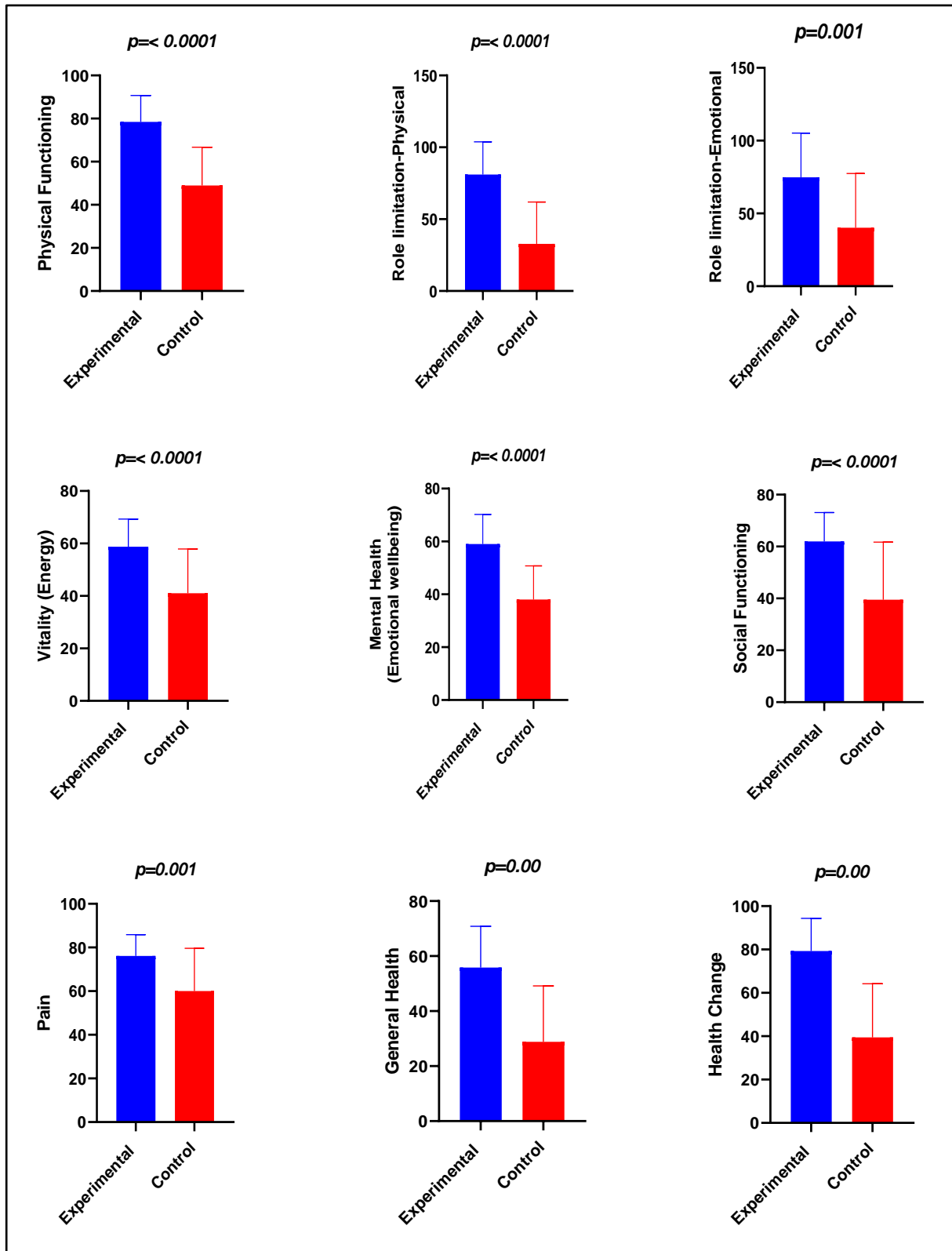


Fig. no. 22: Post-12-week graphical comparison of Health-Related Quality of Life (HRQoL) dimensions between the Yoga group and the Control group

4.1.3 Post-24-Weeks comparison between Yoga and Control Group:

4.1.3.1 General Health Variables:

Table No. 29: Post-24-week comparison of general health variables between the Yoga Group and Control Group

Variables	Groups	Mean \pm SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
BMI (kg/m²)	Yoga Group	22.09 \pm 2.25	22.30(20.30-23.65)	328	0.15
	Control Group	23.02 \pm 3.47	23.70(19.80-25.25)		
Systolic BP (mmHg)	Yoga Group	113.79 \pm 12.34	113(106-119.50)	347	0.25
	Control Group	117.38 \pm 12.21	117(107.50-127)		
Diastolic BP (mmHg)	Yoga Group	76.48 \pm 8.43	77(70.50-82)	389.5	0.63
	Control Group	75.28 \pm 10.49	77(65-82.50)		
Heart Rate (beats/minutes)	Yoga Group	75.10 \pm 7.18	76(70-79.50)	187	0.00
	Control Group	84.03 \pm 10.39	84(77-90)		

P-value < 0.05 is significant

The above table indicates that there were no significant differences between the yoga and control groups in BMI, systolic blood pressure and diastolic blood pressure after 24 weeks; however, a statistically significant difference were observed in case of heart rate only.

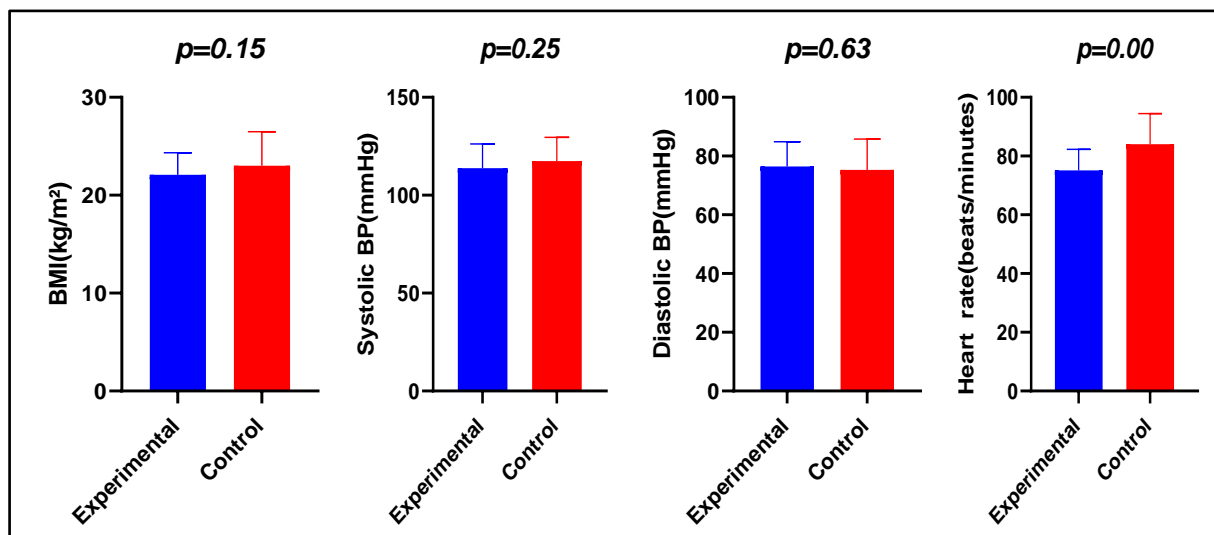


Fig. no. 23: Post-24-weeks comparison of general health variables between the Yoga group and the Control group

4.1.3.2 Clinical outcome measures Variables:

Table No. 30: Post-24-week comparison of clinical outcomes measures variables between the Yoga Group and Control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
BASDAI	Yoga Group	2.08±1.09	1.90(1.25-2.80)	49.50	0.000
	Control Group	5.24±1.64	5.40(4.30-6.35)		
BASFI	Yoga Group	2.08±1.09	1.90(1.25-2.80)	30	0.000
	Control Group	5.77±1.75	5.90(4.35-6.95)		
BASMI	Yoga Group	2.16±1.43	2(90.80-3.20)	73	0.000
	Control Group	5.23±1.68	5(4-6.40)		
Chest Expansion (cm)	Yoga Group	4.08±2.14	4(2-5.75)	237.50	0.004
	Control Group	2.43±1.62	2.50(1-3.75)		

p-value < 0.05 is significant

Table no. 30 clearly indicates that after 24 weeks, the comparison between the yoga and control groups showed a statistically significant difference in disease activity, functional index metrology index, and chest expansion parameters among patients with Ankylosing Spondylitis.

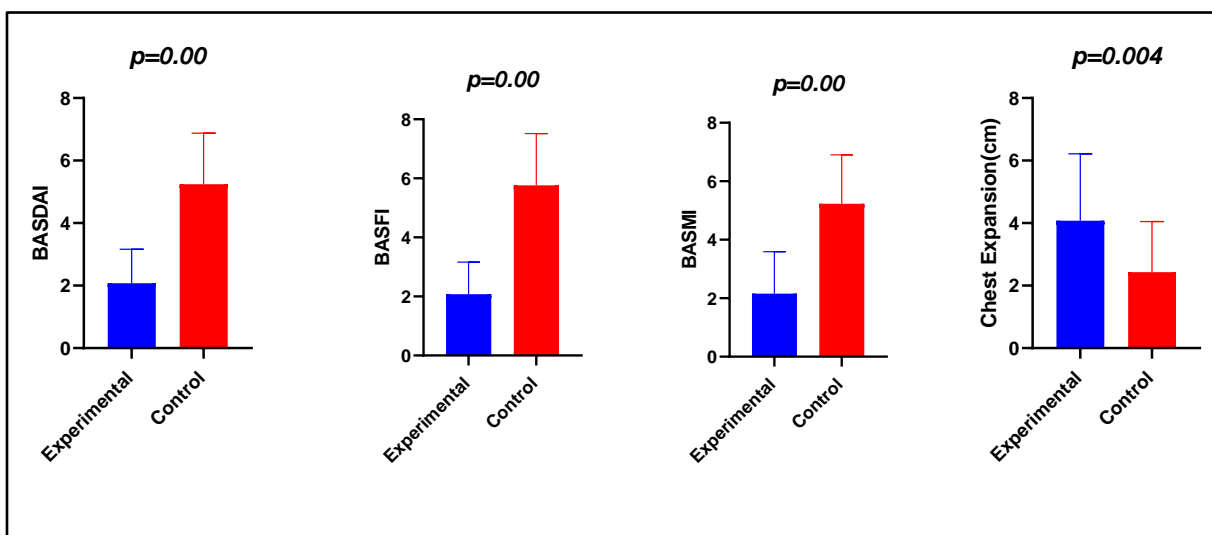


Fig. no. 24: Post-24-weeks comparison of clinical outcome measures variables between the Yoga group and the Control group

4.1.3.3 Haematological variables and Inflammatory Markers:

Table No. 31: Post-24-week comparison of haematological and inflammatory marker Variables between the Yoga Group and Control Group

Variables	Groups	Mean \pm SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Haemoglobin (g/dl)	Yoga Group	13.73 \pm 1.07	13.70(12.95-14.80)	193	0.00
	Control Group	11.95 \pm 2.42	12(11.05-13.60)		
Platelet Count (thou/mm ³)	Yoga Group	207.72 \pm 69.02	181(154.50-239)	281	0.03
	Control Group	249.76 \pm 106.26	210(173.50-303)		
ESR (mm/hr)	Yoga Group	15.45 \pm 12.92	15(3.50-23)	177.500	.000
	Control Group	44.72 \pm 32.10	36(18.50-69.50)		
CRP (mg/L)	Yoga Group	5.65 \pm 5.97	3.83(1.71-8.42)	132.500	.000
	Control Group	29.37 \pm 27.48	24.96(7.59-37.90)		
TNF-alpha (ng/L)	Yoga Group	9.46 \pm 9.81	4.57(2.41-14.72)	190.000	0.03
	Control Group	81.37 \pm 128.02	20.08(5.84-102.65)		

p-value < 0.05 is significant

Table no.31 revealed that after 24 weeks there were statistically significant differences between the yoga and control groups in haemoglobin level, platelet count, erythrocyte sedimentation rate (ESR), C-reactive protein, and TNF-alpha.

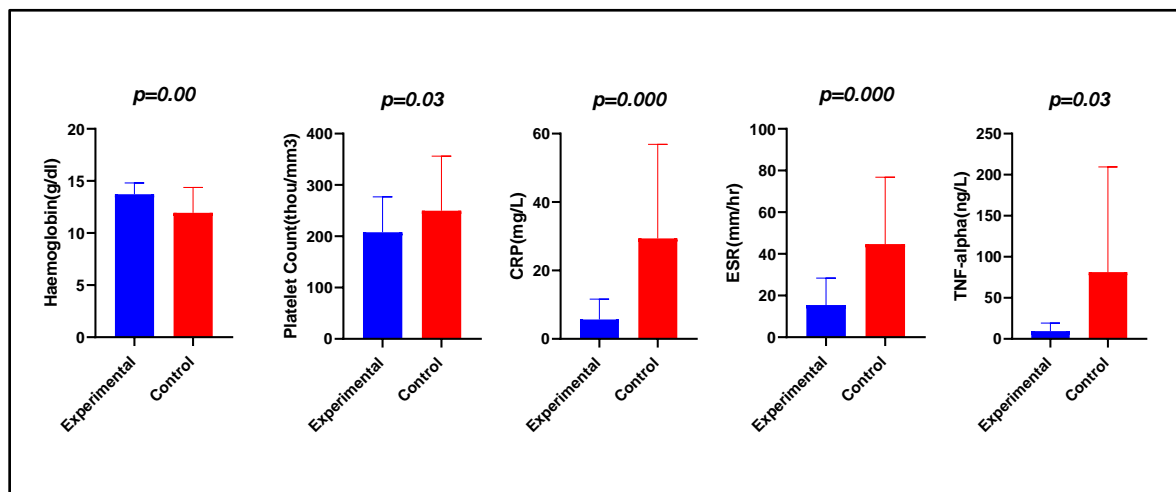


Fig. no. 25: Post-24-weeks comparison of haematological variables and inflammatory markers between the Yoga group and the Control group

4.1.3.4 Psychological Variables:

4.1.3.4.1 Depression and Fear Avoidance Beliefs

Table No. 32: Post-24-week comparison of Depression and Fear Avoidance Beliefs Variables between the Yoga Group and Control Group

Variables	Groups	Mean \pm SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Depression	Yoga Group	7.28 \pm 3.60	7(4.50-9)	7.5	0.00
	Control Group	23.03 \pm 5.70	23(19-28)		
Fear Avoidance Belief in Physical Activity	Yoga Group	10.55 \pm 5.36	11(7.50-13)	102.5	0.00
	Control Group	18.93 \pm 6.50	19(16-21)		
Fear Avoidance Belief in Work Activity	Yoga Group	12.66 \pm 7.14	12(8-14)	67	0.00
	Control Group	29.48 \pm 9.64	30(26.50-34.50)		
FABQ Total Score	Yoga Group	32.72 \pm 15.02	30(25-39)	63.5	0.00
	Control Group	66.10 \pm 15.40	70(54.50-78)		

p-value < 0.05 is significant

The above table demonstrate that after 24 weeks, a comparison of depression and fear avoidance belief variables between the yoga and control groups revealed a statistically significant differences at the 0.05 level.

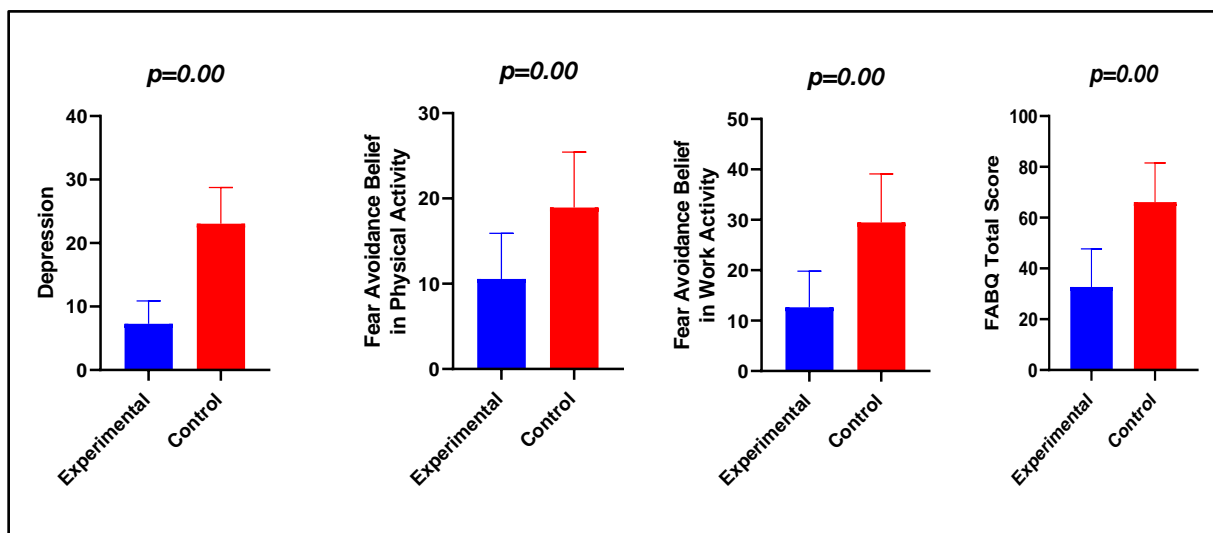


Fig. no. 26: Post-24-weeks comparison of Depression and Fear Avoidance Beliefs Variables between the Yoga group and the Control group

4.1.3.4.2 Pain Catastrophizing

Table No. 33: Post-24-week comparison of Pain Catastrophizing between the Yoga Group and Control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Rumination subscale	Yoga Group	4.07±1.53	4(3-5)	59	0.00
	Control Group	9.97±3.71	10(8-12)		
Magnification subscale	Yoga Group	2.55±1.50	3(1.50-3.50)	48	0.00
	Control Group	7.52±2.67	8(6-9)		
Helplessness subscale	Yoga Group	4.48±2.53	4(2.50-6)	63.50	0.00
	Control Group	12.93±5	14(8.50-16.50)		
PCS Total Score	Yoga Group	10.90±4.37	10(8-13.50)	43	0.00
	Control Group	29.52±9.05	30(25.50-36)		

p-value < 0.05 is significant

Table no. 33 showed that significant difference was observed in rumination subscale, magnification subscale, helplessness subscale, and PCS total score between the yoga and control group after 24 weeks.

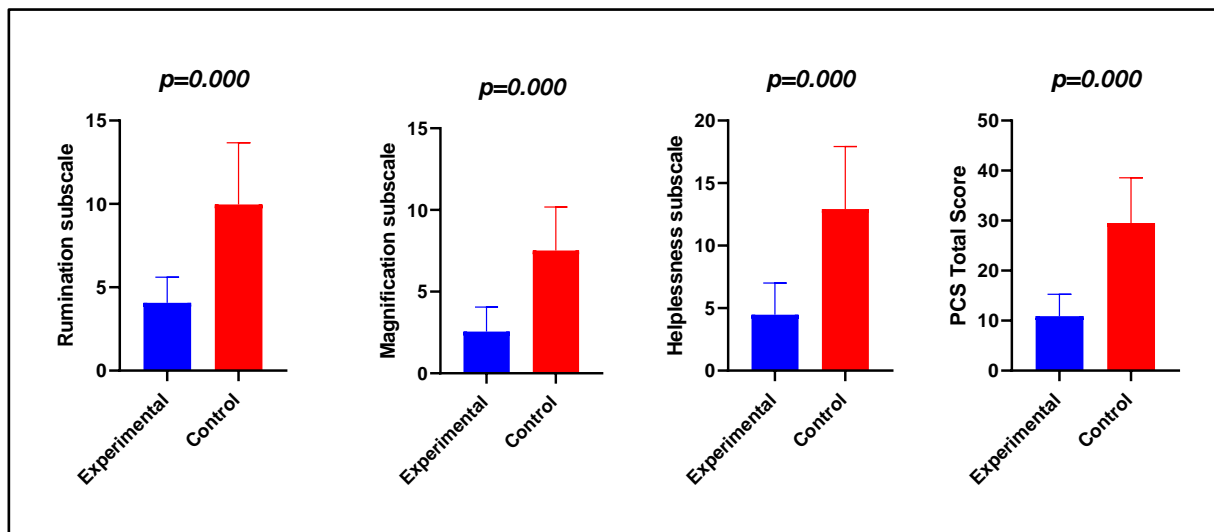


Fig. no. 27: Post-24-weeks comparison of Catastrophizing between the Yoga group and the Control group

4.1.3.5 HRQoL Variables

Table No. 34: Post-24-week comparison of HRQoL Dimensions between the Yoga Group and Control Group

Variables	Groups	Mean ± SD	Median (IQR: Q1-Q3)	Mann-Whitney U	p-value
Physical Functioning	Yoga Group	85.69±12.23	90(75-95)	58.5	0.00
	Control Group	39.66±24.53	35(20-55)		
Role limitation-Physical	Yoga Group	81.90±29.05	100(75-100)	91	0.00
	Control Group	17.86±33.31	0(0-25)		
Role limitation-Emotional	Yoga Group	84.79±24.35	100(67-100)	77	0.00
	Control Group	22.03±31.01	0(0-33)		
Vitality	Yoga Group	64.14±14.83	65(55-77.50)	95.5	0.00
	Control Group	39.83±13.85	40(30-50)		
Mental Health (Emotional wellbeing)	Yoga Group	64.14±15.91	64(50-76)	78	0.00
	Control Group	35.34±14.75	36(24.50-44)		
Social Functioning	Yoga Group	69.62±18.84	63(50-88)	139	0.00
	Control Group	41.24±21.12	38(25-56.50)		
Pain	Yoga Group	80.97±13.48	78(78-90)	94.5	0.00
	Control Group	51.03±19.45	45(35-66.50)		
General Health	Yoga Group	55.69±22.11	60(37.50-70)	87	0.00
	Control Group	19.59±15.69	15(10-27.50)		
Health Change	Yoga Group	71.21±2.21	75(62.50-75)	147	0.00
	Control Group	33.45±1.69	25(0-75)		

p-value < 0.05 is significant

It is evident from table no. 34 that all components of health related quality of life (HQRoL) showed statistically significant differences between the yoga and control groups after 24 weeks.

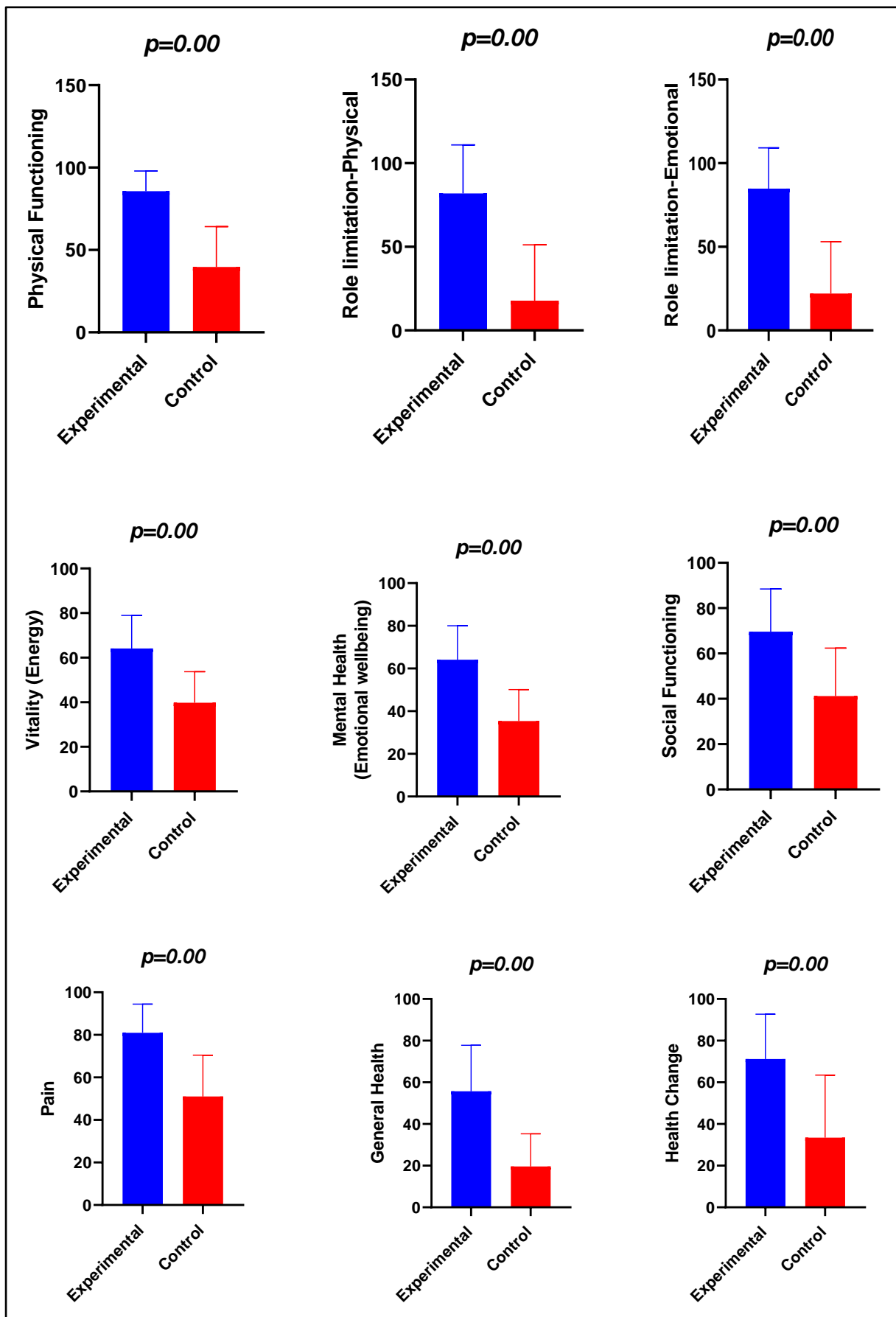


Fig. no. 28: Post-24-weeks comparison of HRQoL Dimensions between the Yoga group and the Control group

4.1.4 Within Group Comparisons across baseline, post 12weeks and post 24 weeks:

4.1.4.1 General health variables

Table No. 35: Within-group comparison of baseline, post-12-week and post-24-week general health variables in the Yoga Group and Control Group

Variables	Group	Time point	Mean \pm SD	Mean Rank	Friedman χ^2 (df=2)	Friedman p
BMI (kg/m ²)	Yoga	Baseline	22.68 \pm 3.39	1.9	0.57	0.75
		post 12 weeks	22.57 \pm 2.76	2.02		
		post 24 weeks	22.09 \pm 2.25	2.09		
	Control	Baseline	21.87 \pm 3.10	1.79	1.96	0.38
		post 12 weeks	22.55 \pm 3.28	2.1		
		post 24 weeks	23.02 \pm 3.47	2.1		
Systolic BP (mmHg)	Yoga	Baseline	115.86 \pm 14.67	2.10	0.76	0.68
		post 12 weeks	112 \pm 9.47	1.88		
		post 24 weeks	113.79 \pm 12.34	2.02		
	Control	Baseline	117.03 \pm 12.92	2.12	1.63	0.44
		post 12 weeks	115.66 \pm 13.15	1.81		
		post 24 weeks	117.38 \pm 12.21	2.07		
Diastolic BP (mmHg)	Yoga	Baseline	78.76 \pm 10.60	2.26	3.11	0.21
		post 12 weeks	76.17 \pm 6.55	1.84		
		post 24 weeks	76.48 \pm 8.43	1.90		
	Control	Baseline	76.24 \pm 8.43	2.21	3.02	0.22
		post 12 weeks	72.97 \pm 8.48	1.76		
		post 24 weeks	75.28 \pm 10.49	2.03		
Heart Rate (beats/minutes)	Yoga	Baseline	80.34 \pm 8.99	2.43	20.73	0.00
		post 12 weeks	77.76 \pm 9.15	2.24		
		post 24 weeks	75.10 \pm 7.18	1.33		
	Control	Baseline	77.14 \pm 7.16	1.60	11.84	0.003
		post 12 weeks	81.21 \pm 8.58	1.91		
		post 24 weeks	84.03 \pm 10.39	2.48		

p-value < 0.05 is significant

Table no.35 shows that, across the three phases -baseline, post 12 weeks, and post 24 weeks, there were no significant changes in BMI, systolic blood pressure, or diastolic blood pressure within either the yoga or control groups. Specifically, the Friedman test for BMI indicated non-significant results for both the yoga group ($\chi^2 = 0.57$, $p = 0.75$) and the control group ($\chi^2 = 1.96$, $p = 0.38$). Similarly, systolic blood pressure showed no significant change

in the yoga group ($\chi^2 = 0.76$, $p = 0.68$) or control group ($\chi^2 = 1.63$, $p = 0.44$), and diastolic blood pressure remained stable in both groups (yoga: $\chi^2 = 3.11$, $p = 0.21$; control: $\chi^2 = 3.02$, $p = 0.22$). However, a significant change was observed in heart rate across time in both groups, with the effect being more pronounced in the yoga group ($\chi^2 = 20.73$, $p < 0.001$) than in the control group ($\chi^2 = 11.84$, $p = 0.003$).

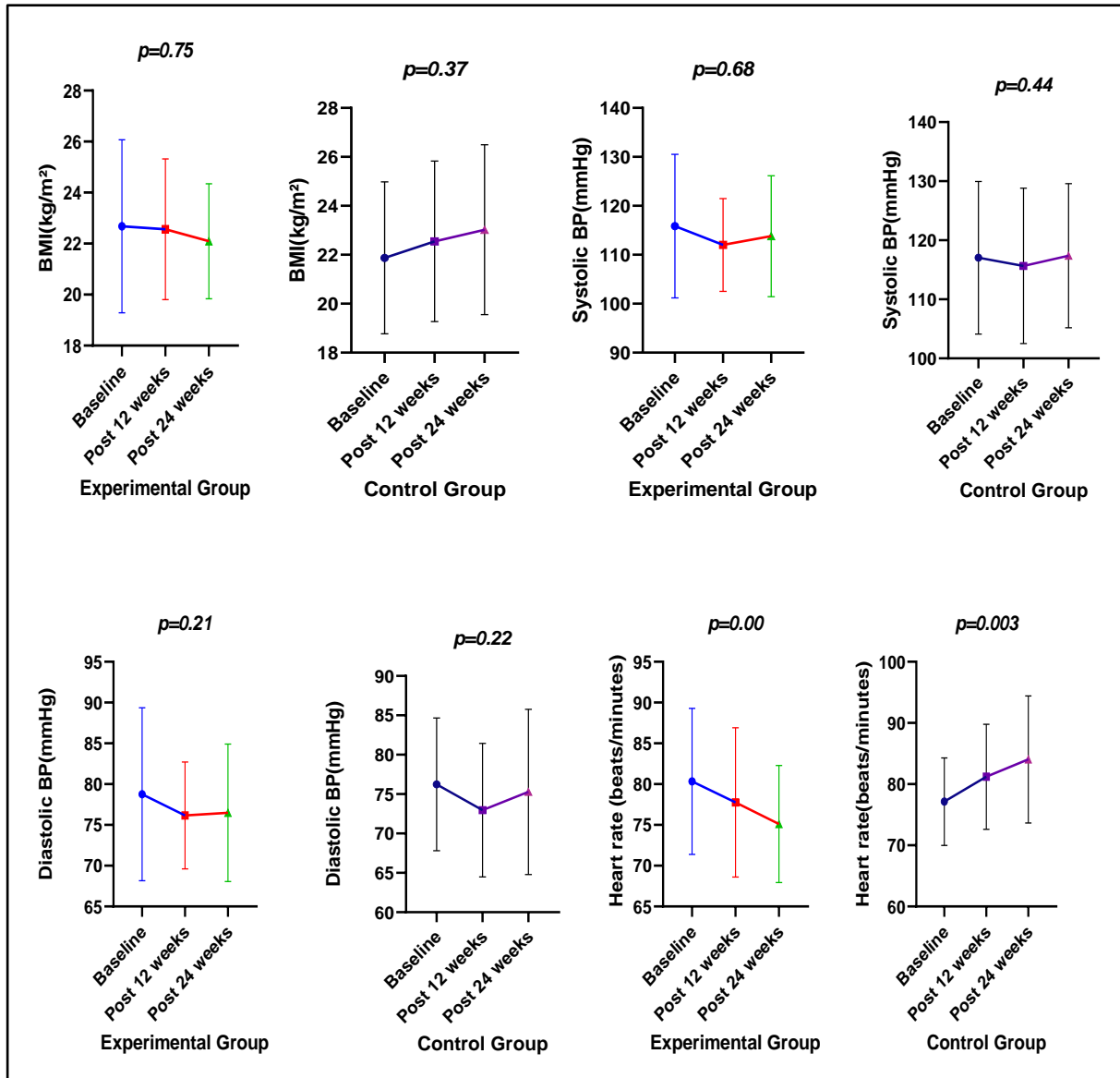


Fig. no. 29: Graphical representation of general health variables of the Yoga and Control groups at baseline, post-12 weeks, and post-24 weeks

Table No. 36: Results of Post hoc comparisons of heart rate across three phases in the yoga group and control group

Post-hoc analysis							
Variables	Time Series	Group	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Heart Rate	Baseline vs. post 12 wks	Yoga	.190	.263	.722	.470	1.000
	Baseline vs. post 24 wks		1.103	.263	4.202	.000	.000
	. post 12 wks vs. post 24 wks		.914	.263	3.480	.001	.002
	Baseline vs. post 12 wks	Control	-.310	.263	-1.182	.237	.712
	Baseline vs. post 24 wks		-.879	.263	-3.348	.001	.002
	. post 12 wks vs. post 24 wks		-.569	.263	-2.167	.030	.091

Above table reported that heart rate showed a significant reduction in the yoga group from baseline to post-24 weeks and post-12 to post-24 weeks, indicating progressive improvement. The control group also showed a significant change from baseline to post-24 weeks, but the change was less favourable than yoga. Overall, yoga produced a stronger and more sustained reduction in heart rate.

4.1.4.2 Clinical outcome measure variables

Table No. 37: Within-group comparison of baseline, post-12-week and post-24-week Clinical outcome measures in the Yoga Group and Control Group

Variables	Group	Time point	Mean \pm SD	Mean Rank	Friedman χ^2 (df=2)	Friedman p
BASDAI	Yoga	Baseline	4.60 \pm 1.69	2.79	34.97	0.00
		post 12 weeks	3.19 \pm 1.82	1.97		
		post 24 weeks	2.08 \pm 1.09	1.24		
	Control	Baseline	4.30 \pm 1.40	1.60	9.20	0.01
		post 12 weeks	4.46 \pm 1.62	2.00		
		post 24 weeks	5.24 \pm 1.64	2.40		
BASFI	Yoga	Baseline	4.47 \pm 1.65	2.79	34.97	0.00
		post 12 weeks	3.19 \pm 1.82	1.97		
		post 24 weeks	2.08 \pm 1.09	1.24		
	Control	Baseline	4.91 \pm 1.65	1.72	4.75	0.09
		post 12 weeks	5.21 \pm 1.67	1.98		
		post 24 weeks	5.77 \pm 1.75	2.29		
BASMI	Yoga	Baseline	3.20 \pm 1.72	2.60	17.16	0.00
		post 12 weeks	2.32 \pm 1.45	1.81		
		post 24 weeks	2.16 \pm 1.43	1.59		
	Control	Baseline	3.21 \pm 1.74	1.67	14.57	0.001
		post 12 weeks	4.06 \pm 1.64	1.76		
		post 24 weeks	5.23 \pm 1.68	2.57		
Chest Expansion (cm)	Yoga	Baseline	2.48 \pm 1.62	1.33	29.69	0.00
		post 12 weeks	3.32 \pm 1.74	1.97		
		post 24 weeks	4.08 \pm 2.14	2.71		
	Control	Baseline	2.70 \pm 1.77	2.12	0.67	0.71
		post 12 weeks	2.34 \pm 1.46	1.95		
		post 24 weeks	2.43 \pm 1.62	1.93		

p-value < 0.05 is significant

As presented in table no. 37, a significant change was observed across the three phases for the experimental group. The Friedman test results indicated significant improvements in disease activity (BASDAI: $\chi^2 = 34.97$, $p < 0.001$), functional ability (BASFI: $\chi^2 = 34.97$, $p < 0.001$), metrology index (BASMI: $\chi^2 = 17.16$, $p < 0.001$), and chest expansion ($\chi^2 = 29.69$, $p < 0.001$). Notably, BASDAI, BASFI, and BASMI scores showed a progressive decrease from baseline to post 24 weeks, reflecting reduced disease severity and

functional limitation. Conversely, chest expansion increased significantly, indicating an improvement in thoracic mobility among patients with Ankylosing Spondylitis.

In contrast, the control group showed comparatively minimal or adverse changes over the same period. The Friedman test results revealed that BASDAI ($\chi^2 = 9.20$, $p = 0.01$) and BASMI ($\chi^2 = 14.57$, $p = 0.001$) exhibited slight but significant changes, whereas BASFI ($\chi^2 = 4.75$, $p = 0.09$) did not reach statistical significance. Chest expansion ($\chi^2 = 0.67$, $p = 0.71$) also remained non-significant. From baseline to post 24 weeks, BASDAI, BASFI, and BASMI scores tended to increase, while chest expansion decreased, suggesting worsening disease status compared to the experimental (yoga) group.

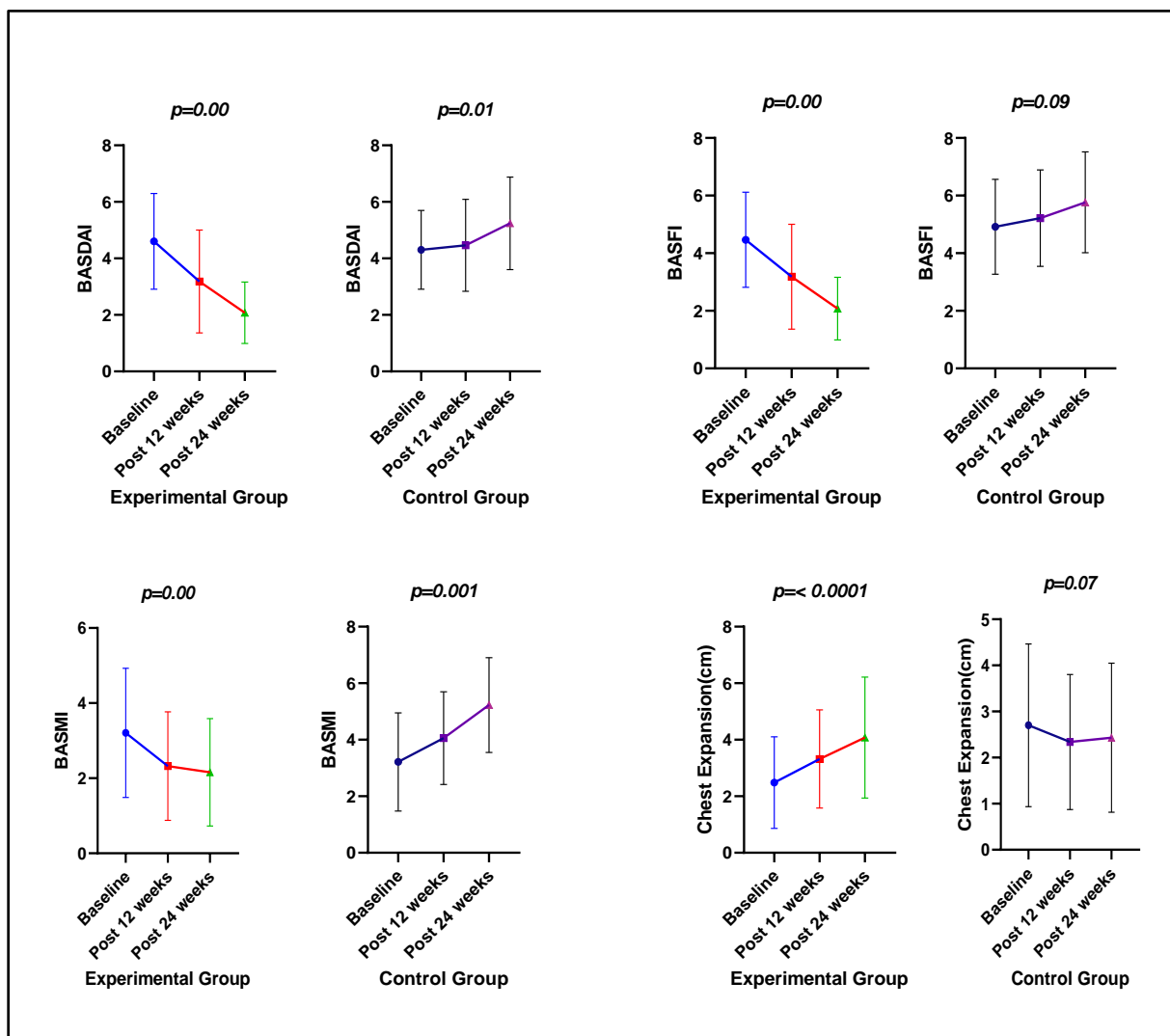


Fig. no. 30: Graphical representation of clinical outcome measures of the Yoga and Control groups at baseline, post-12 weeks, and post-24 weeks

Table No. 38: Results of Post hoc comparisons for clinical outcome measures across three phases in yoga and control group

Post-hoc analysis							
Variables	Time Series	Group	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
BASDAI	Baseline vs. post 12 weeks	Yoga	.828	.263	3.151	.002	.005
	Baseline vs. post 24 weeks		1.552	.263	5.909	.000	.000
	post 12 weeks vs. post 24 weeks		.724	.263	2.757	.006	.017
	Baseline vs. post 12 weeks	Control	-.397	.263	-1.510	.131	.393
	Baseline vs. post 24 weeks		-.793	.263	-3.020	.003	.008
	post 12 weeks vs. post 24 weeks		-.397	.263	-1.510	.131	.393
BASFI	Baseline vs. post 12 weeks	Yoga	.828	.263	3.151	.002	.005
	Baseline vs. post 24 weeks		1.552	.263	5.909	.000	.000
	post 12 weeks vs. post 24 weeks		.724	.263	2.757	.006	.017
BASMI	Baseline vs. post 12 weeks	Yoga	.793	.263	3.020	.003	.008
	Baseline vs. post 24 weeks		1.017	.263	3.874	.000	.000
	post 12 weeks vs. post 24 weeks		.224	.263	.853	.393	1.000
	Baseline vs. post 12 weeks	Control	-.086	.263	-.328	.743	1.000
	Baseline vs. post 24 weeks		-.897	.263	-3.414	.001	.002
	post 12 weeks vs. post 24 weeks		-.810	.263	-3.086	.002	.006
Chest expansion	Baseline vs. post 12 weeks	Yoga	-.638	.263	-2.429	.015	.045
	Baseline vs. post 24 weeks		-1.379	.263	-5.252	.000	.000
	post 12 weeks vs. post 24 weeks		-.741	.263	-2.823	.005	.014
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .050.							
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.							

Above Post hoc comparisons table reported that in the yoga group, BASDAI, BASFI, and BASMI significantly improved at both post-12 and post-24 weeks, with further gains between 12 and 24 weeks. Chest expansion also improved significantly across all comparisons. The control group showed deterioration in BASDAI and BASMI over time and no improvement in BASFI or chest expansion, indicating disease worsening without yoga.

4.1.4.3 Haematological variables and Inflammatory Markers

Table No. 39: Within-group comparison of baseline, post-12-week and post-24-week haematological variables and inflammatory markers in the Yoga Group and Control Group

Variables	Group	Time point	Mean \pm SD	Mean Rank	Friedman χ^2 (df=2)	Friedman p
Haemoglobin (g/dl)	Yoga	Baseline	13.19 \pm 1.20	1.79	7.15	0.03
		post 12 weeks	13.44 \pm 1.11	1.81		
		post 24 weeks	13.73 \pm 1.07	2.40		
	Control	Baseline	13.36 \pm 1.34	2.36	6.07	0.05
		post 12 weeks	12.74 \pm 1.25	1.88		
		post 24 weeks	11.95 \pm 2.42	1.76		
Platelet Count (thou/mm ³)	Yoga	Baseline	211.24 \pm 91.70	1.86	1.50	0.5
		post 12 weeks	188.38 \pm 57.01	1.97		
		post 24 weeks	207.72 \pm 69.02	2.17		
	Control	Baseline	200.31 \pm 53.85	1.67	4.82	.09
		post 12 weeks	222.48 \pm 77.58	2.12		
		post 24 weeks	249.76 \pm 106.26	2.21		
ESR (mm/hr)	Yoga	Baseline	24.21 \pm 22.24	2.21	6.28	0.04
		post 12 weeks	22.55 \pm 19.18	2.17		
		post 24 weeks	15.45 \pm 12.92	1.62		
	Control	Baseline	20.93 \pm 13.91	1.41	15.15	0.001
		post 12 weeks	38.17 \pm 24.38	2.33		
		post 24 weeks	44.72 \pm 32.10	2.26		
CRP (mg/L)	Yoga	Baseline	9.62 \pm 11.59	2.48	11.24	0.004
		post 12 weeks	8.24 \pm 11.49	1.90		
		post 24 weeks	5.65 \pm 5.97	1.62		
	Control	Baseline	9.81 \pm 12.14	1.69	7.10	0.03
		post 12 weeks	15.38 \pm 13.89	1.93		
		post 24 weeks	29.37 \pm 27.48	2.38		
TNF-alpha (ng/L)	Yoga	Baseline	33.12 \pm 61.38	2.33	6.74	0.03
		post 12 weeks	12.35 \pm 17.87	2.04		
		post 24 weeks	9.46 \pm 9.81	1.63		
	Control	Baseline	31.52 \pm 52.20	1.81	2.30	0.32
		post 12 weeks	63.84 \pm 125.38	1.96		
		post 24 weeks	81.37 \pm 128.02	2.22		

p-value < 0.05 is significant

Table no. 39 clearly indicates that, across the three phases (baseline, post 12 weeks, and post 24 weeks), haemoglobin levels showed a significant increase in the yoga group ($\chi^2 = 7.15$, $p = 0.03$), whereas a slight reduction was observed in the control group ($\chi^2 = 6.07$, $p =$

0.05). Platelet count did not show significant changes in either group, with $\chi^2 = 1.50$ ($p = 0.50$) for the yoga group and $\chi^2 = 4.82$ ($p = 0.09$) for the control group.

Regarding inflammatory markers, the yoga group demonstrated significant reductions over time in erythrocyte sedimentation rate (ESR: $\chi^2 = 6.28$, $p = 0.04$), C-reactive protein (CRP: $\chi^2 = 11.24$, $p = 0.004$), and TNF- α ($\chi^2 = 6.74$, $p = 0.03$), indicating an overall improvement in inflammatory status. In contrast, the control group exhibited increases in these inflammatory parameters—ESR ($\chi^2 = 15.15$, $p = 0.001$), CRP ($\chi^2 = 7.10$, $p = 0.03$), and TNF- α ($\chi^2 = 2.30$, $p = 0.32$)—though the change in TNF- α was not statistically significant.

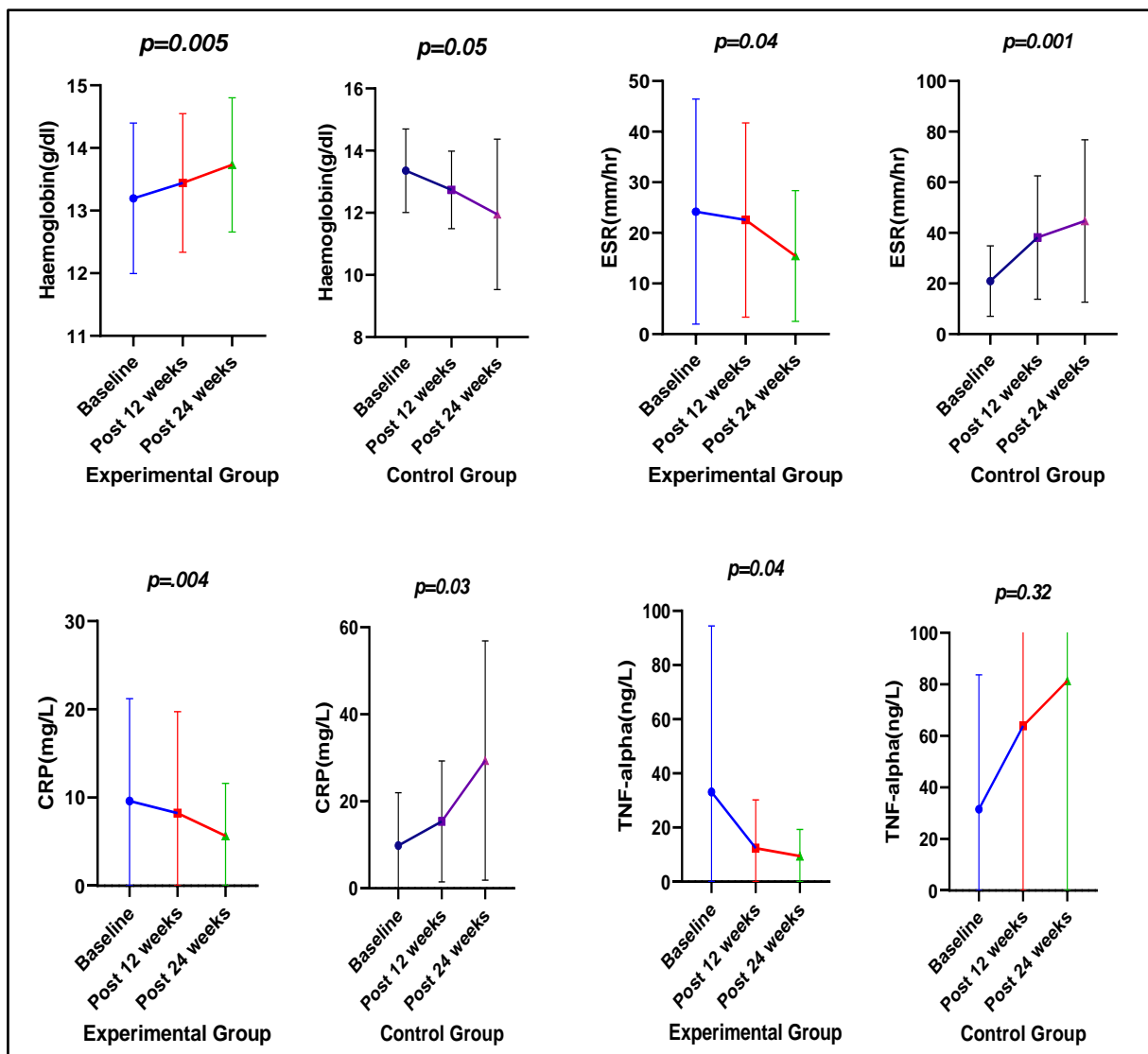


Fig. no. 31: Graphical representation of haematological variables and inflammatory markers of the Yoga and Control groups at baseline, post-12 weeks, and post-24 weeks

Table No. 40: Results of Post hoc comparisons for haematological variables and inflammatory markers in across three phases in the yoga group and control group

Post-hoc analysis							
Variables	Time Series	Group	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Haemoglobin	Baseline vs. post 12 wks	Yoga	-.259	.263	-.985	.325	.974
	Baseline vs. post 24 wks		-.828	.263	-3.151	.002	.005
	post 12 wks vs. post 24 wks		-.569	.263	-2.167	.030	.091
	Baseline vs. post 12 wks	Control	.483	.263	1.838	.066	.198
	Baseline vs. post 24 wks		.603	.263	2.298	.022	.065
	post 12 wks vs. post 24 wks		.121	.263	.460	.646	1.0
ESR	Baseline vs. post 12 wks	Yoga	.034	.263	.131	.896	1.000
	Baseline vs. post 24 wks		.586	.263	2.232	.026	.077
	post 12 wks vs. post 24 wks		.552	.263	2.101	.036	.107
	Baseline vs. post 12 wks	Control	-.914	.263	-3.480	.001	.002
	Baseline vs. post 24 wks		-.845	.263	-3.217	.001	.004
	post 12 wks vs. post 24 wks		.069	.263	.263	.793	1.000
CRP	Baseline vs. post 12 weeks	Yoga	.586	.263	2.232	.026	.077
	Baseline vs. post 24 weeks		.862	.263	3.283	.001	.003
	post 12 wks vs. post 24 wks		.276	.263	1.050	.294	.881
	Baseline vs. post 12 wks	Control	-.241	.263	-.919	.358	1.000
	Baseline vs. post 24 wks		-.690	.263	-2.626	.009	.026
	post 12 wks vs. post 24 wks		-.448	.263	-1.707	.088	.263
TNF alpha	Baseline vs. post 12 wks	Yoga	.296	.272	1.089	.276	.829
	Baseline vs. post 24 wks		.704	.272	2.586	.010	.029
	post 12 wks vs. post 24 wks		.407	.272	1.497	.134	.403
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.							
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.							
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.							

Above table indicate that Yoga group produced a significant increase in haemoglobin by post-24 weeks and progressive reductions in ESR, CRP, and TNF- α between baseline and post-24 weeks, demonstrating anti-inflammatory benefits. Though in multiple comparison analysis ESR showed not statistical significant changes in any phases of the study. The control group showed worsening ESR, CRP, and TNF- α over time and no meaningful improvement in haemoglobin. Overall, yoga markedly improved inflammatory and haematological status.

4.1.4.3 Psychological variables

4.1.4.3.1 Depression and fear avoidance belief scale

Table No. 41: Within-group comparison of baseline, post-12-week and post-24-week depression and fear avoidance belief scale in the Yoga Group and Control Group

Variables	Group	Time point	Mean \pm SD	Mean Rank	Friedman χ^2 (df=2)	Friedman p
Depression	Yoga	Baseline	13.24 \pm 4.04	2.66	28.79	0.00
		post 12 weeks	10.52 \pm 5.21	2.07		
		post 24 weeks	7.28 \pm 3.60	1.28		
	Control	Baseline	12.24 \pm 4.70	1.19	37.62	0.00
		post 12 weeks	17.28 \pm 5.43	2.02		
		post 24 weeks	23.03 \pm 5.70	2.79		
Fear Avoidance Belief in Physical Activity	Yoga	Baseline	15.38 \pm 4.04	2.4	8.63	.013
		post 12 weeks	12.10 \pm 5.50	1.93		
		post 24 weeks	10.55 \pm 5.36	1.67		
	Control	Baseline	12.83 \pm 5.82	1.47	13.23	.001
		post 12 weeks	17.97 \pm 4.40	2.19		
		post 24 weeks	18.93 \pm 6.50	2.34		
Fear Avoidance Belief in Work Activity	Yoga	Baseline	21.90 \pm 5.56	2.6	18.86	0.00
		post 12 weeks	14.00 \pm 7.57	1.86		
		post 24 weeks	12.66 \pm 7.14	1.53		
	Control	Baseline	20.45 \pm 8.54	1.33	28.63	0.00
		post 12 weeks	25.00 \pm 6.36	1.97		
		post 24 weeks	29.48 \pm 9.64	2.71		
FABQ Total Score	Yoga	Baseline	52.24 \pm 14.16	2.67	21.47	0.00
		post 12 weeks	37.21 \pm 17.10	1.81		
		post 24 weeks	32.72 \pm 15.02	1.52		
	Control	Baseline	48.79 \pm 16.88	1.43	18.544	0.00
		post 12 weeks	60.93 \pm 13.86	2.02		
		post 24 weeks	66.10 \pm 15.40	2.55		

p-value < 0.05 is significant

The above table indicates that depression and all components of the Fear-Avoidance Beliefs Scale showed significant changes over time in both the experimental and control groups. In the experimental group, these scores decreased progressively, reflecting improved psychological well-being. In contrast, the control group exhibited an increase in these scores, suggesting deterioration in psychological status and maladaptive fear-related beliefs among patients.

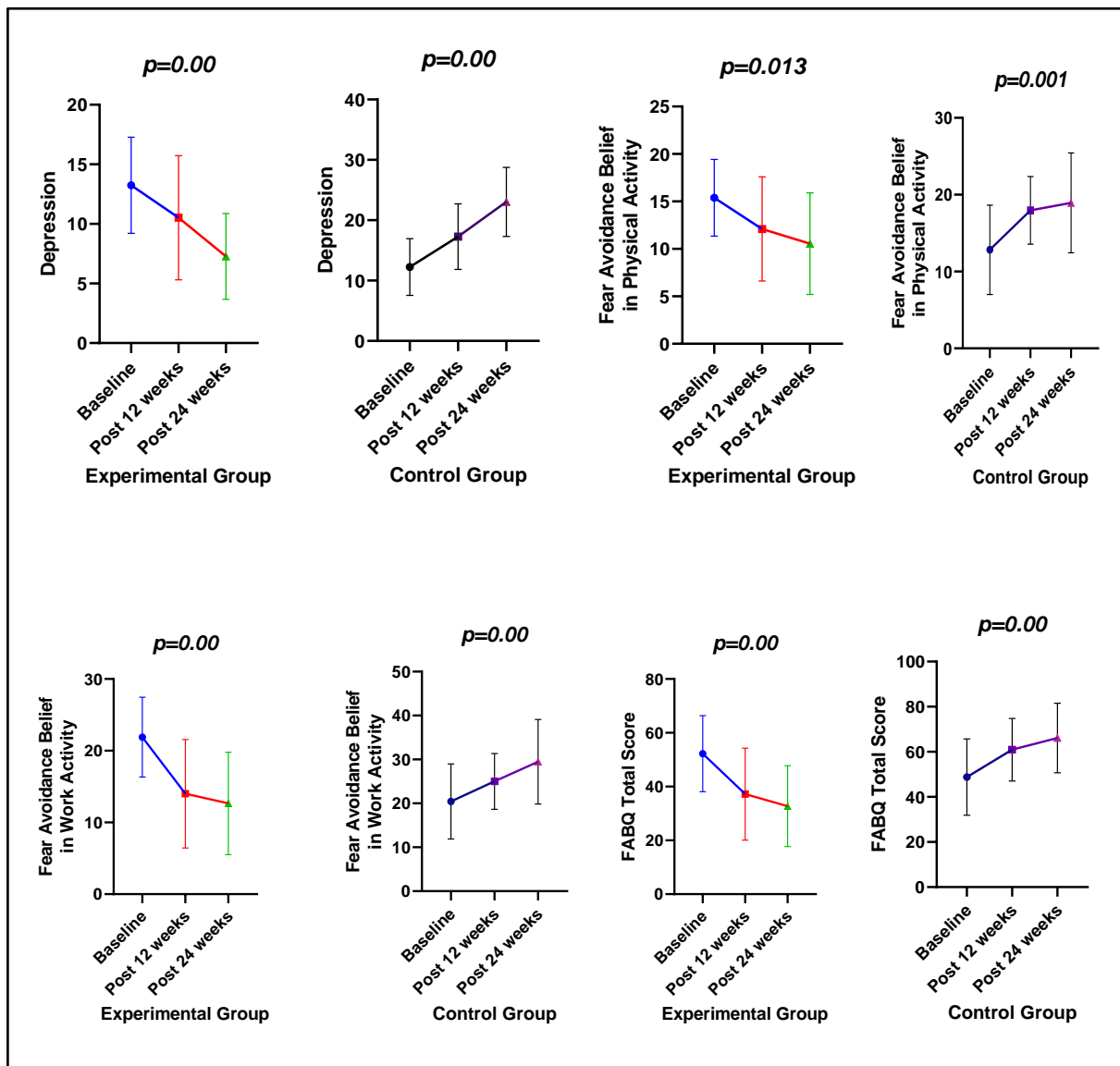


Fig. no. 32: Graphical representation of baseline, after 12 and post 24 weeks of yoga group and control group with respect to depression and fear avoidance belief variables

Table No. 42: Results of Post Hoc comparisons for depression and fear avoidance belief scale across three phases in yoga and control group

Post-hoc analysis							
Variables	Time Series	Group	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Depression	Baseline vs. post 12 wks	Yoga	.586	.263	2.232	.026	.077
	Baseline vs. post 24 wks		1.379	.263	5.252	.000	.000
	post 12 wks vs. post 24 wks		.793	.263	3.020	.003	.008
	Baseline vs. post 12 wks	Control	-.828	.263	-3.151	.002	.005
	Baseline vs. post 24 wks		-1.603	.263	-6.106	.000	.000
	post 12 wks vs. post 24 wks		-.776	.263	-2.954	.003	.009
Fear Avoidance Belief in Physical Activity	Baseline vs. post 12 wks	Yoga	.466	.263	1.773	.076	.229
	Baseline vs. post 24 wks		.724	.263	2.757	.006	.017
	post 12 wks vs. post 24 wks		.259	.263	.985	.325	.974
	Baseline vs. post 12 wks	Control	-.724	.263	-2.757	.006	.017
	Baseline vs. post 24 wks		-.879	.263	-3.348	.001	.002
	post 12 wks vs. post 24 wks		-.155	.263	-.591	.555	1.000
Fear Avoidance Belief in Work Activity	Baseline vs. post 12 weeks	Yoga	.741	.263	2.823	.005	.014
	Baseline vs. post 24 weeks		1.069	.263	4.070	.000	.000
	post 12 wks vs. post 24 wks		.328	.263	1.247	.212	.637
	Baseline vs. post 12 wks	Control	-.638	.263	-2.429	.015	.045
	Baseline vs. post 24 wks		-1.379	.263	-5.252	.000	.000
	post 12 wks vs. post 24 wks		-.741	.263	-2.823	.005	.014
FABQ Total Score	Baseline vs. post 12 wks	Yoga	.862	.263	3.283	.001	.003
	Baseline vs. post 24 wks		1.155	.263	4.399	.000	.000
	post 12 wks vs. post 24 wks		.293	.263	1.116	.264	.793
	Baseline vs. post 12 wks	Control	-.586	.263	-2.232	.026	.077
	Baseline vs. post 12 wks		-1.121	.263	-4.267	.000	.000
	Baseline vs. post 24 wks		-.534	.263	-2.035	.042	.125
	post 12 wks vs. post 24 wks		.586	.263	2.232	.026	.077
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.							
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.							
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.							

From the above table it is observed that the yoga group experienced significant reductions in depression and FABQ scores from baseline to post-24 weeks, with most improvements already evident by 12 weeks. In contrast, the control group showed significant worsening of depression and fear-avoidance beliefs across time. These results indicate a strong psychological benefit of yoga intervention.

4.1.4.3.2 Pain Catastrophizing scale

Table No. 43: Within-group comparison of baseline, post-12-week and post-24-week Pain Catastrophizing scale in the Yoga Group and Control Group

Variables	Group	Time point	Mean ± SD	Mean Rank	Friedman χ^2 (df=2)	Friedman p
Rumination	Yoga	Baseline	6.86±2.863	2.50	20.21	0.00
		post 12 weeks	5.72±2.266	2.10		
		post 24 weeks	4.07±1.534	1.40		
	Control	Baseline	7.24±1.976	1.76	12.02	0.00
		post 12 weeks	7.76±3.324	1.74		
		post 24 weeks	9.97±3.708	2.50		
Magnification	Yoga	Baseline	4.83±2.19	2.69	26.88	.000
		post 12 weeks	3.21±1.70	1.86		
		post 24 weeks	2.55±1.50	1.45		
	Control	Baseline	5.07±2.03	1.67	17.776	.000
		post 12 weeks	5.21±2.16	1.74		
		post 24 weeks	7.52±2.67	2.59		
Helplessness	Yoga	Baseline	10.79±4.93	2.78	34.785	.000
		post 12 weeks	6.10±3.18	1.93		
		post 24 weeks	4.48±2.53	1.29		
	Control	Baseline	10.07±3.20	1.69	6.559	.038
		post 12 weeks	10.76±4.59	1.97		
		post 24 weeks	12.93±5	2.34		
PCS total score	Yoga	Baseline	22.55±8.99	2.83	39.252	.000
		post 12 weeks	15.03±5.41	1.98		
		post 24 weeks	10.90±4.37	1.19		
	Control	Baseline	22.38±5.55	1.55	18.500	.000
		post 12 weeks	23.69±8.62	1.83		
		post 24 weeks	29.52±9.05	2.62		

p-value < 0.05 is significant

A similar pattern was observed in table no.43 for the components of the Pain Catastrophizing Scale (PCS)—namely rumination, magnification, helplessness, and the total PCS score—across the three phases. Significant time-related changes were noted in both groups; however, the experimental group showed a consistent reduction in all subscale scores, indicating decreased pain-related catastrophizing tendencies. In contrast, the control group exhibited an upward trend in these scores, suggesting a worsening of pain-related cognitive and emotional responses over time.

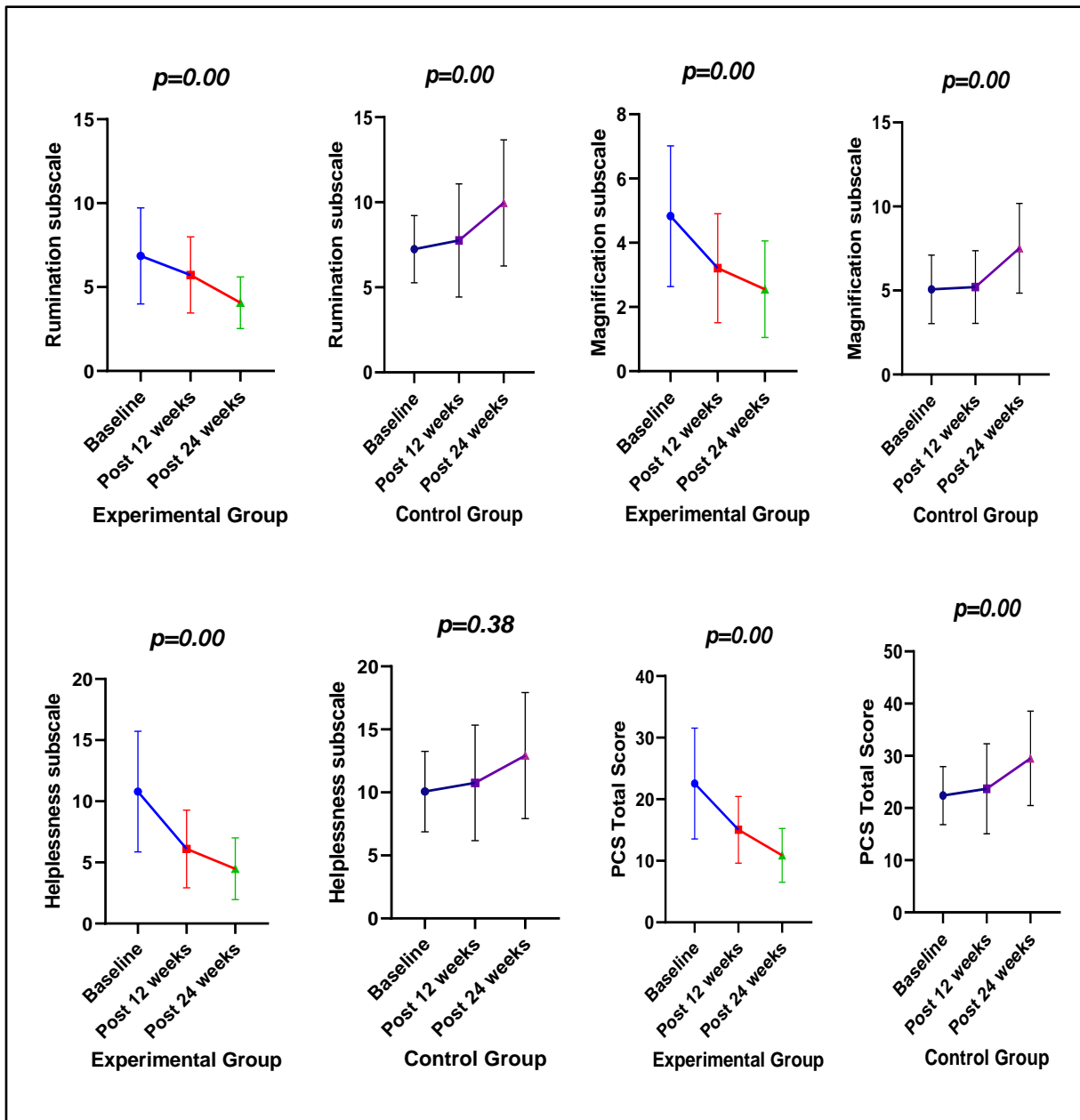


Fig. no. 33: Graphical representation of pain catastrophizing variables of the Yoga and Control groups at baseline, post-12 weeks, and post-24 weeks

Table No. 44: Results of Post Hoc Comparisons for Pain catastrophizing across three phases in yoga and control group

Post-hoc analysis							
Variables	Time Series	Group	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Rumination	Baseline vs. post 12 wks	Yoga	.397	.263	1.510	.131	.393
	Baseline vs. post 24 wks		1.103	.263	4.202	.000	.000
	post 12 wks vs. post 24 wks		.707	.263	2.692	.007	.021
	Baseline vs. post 12 wks	Control	.017	.263	.066	.948	1.000
	Baseline vs. post 24 wks		-.741	.263	-2.823	.005	.014
	post 12 wks vs. post 24 wks		-.759	.263	-2.889	.004	.012
Magnification	Baseline vs. post 12 wks	Yoga	.828	.263	3.151	.002	.005
	Baseline vs. post 24 wks		1.241	.263	4.727	.000	.000
	post 12 wks vs. post 24 wks		.414	.263	1.576	.115	.345
	Baseline vs. post 12 wks	Control	-.069	.263	-.263	.793	1.000
	Baseline vs. post 24 wks		-.914	.263	-3.480	.001	.002
	post 12 wks vs. post 24 wks		-.845	.263	-3.217	.001	.004
Helplessness	Baseline vs. post 12 weeks	Yoga	.845	.263	3.217	.001	.004
	Baseline vs. post 24 weeks		1.483	.263	5.646	.000	.000
	post 12 wks vs. post 24 wks		.638	.263	2.429	.015	.045
	Baseline vs. post 12 wks	Control	-.276	.263	-1.050	.294	.881
	Baseline vs. post 24 wks		-.655	.263	-2.495	.013	.038
	post 12 wks vs. post 24 wks		-.379	.263	-1.444	.149	.446
PCS total score	Baseline vs. post 12 wks	Yoga	.845	.263	3.217	.001	.004
	Baseline vs. post 24 wks		1.638	.263	6.237	.000	.000
	post 12 wks vs. post 24 wks		.793	.263	3.020	.003	.008
	Baseline vs. post 12 wks	Control	-.276	.263	-1.050	.294	.881
	Baseline vs. post 12 wks		-1.069	.263	-4.070	.000	.000
	Baseline vs. post 24 wks		-.793	.263	-3.020	.003	.008
	post 12 wks vs. post 24 wks		.397	.263	1.510	.131	.393
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.							
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.							
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.							

Table no. 44 revealed that all the subscale of pain-catastrophizing significantly decreased in the yoga group, particularly from baseline to post-24 weeks, reflecting improved pain-related coping. The control group demonstrated significant increases in most PCS subscales over time, suggesting worsening pain perception. Yoga therefore reduced maladaptive pain cognition effectively.

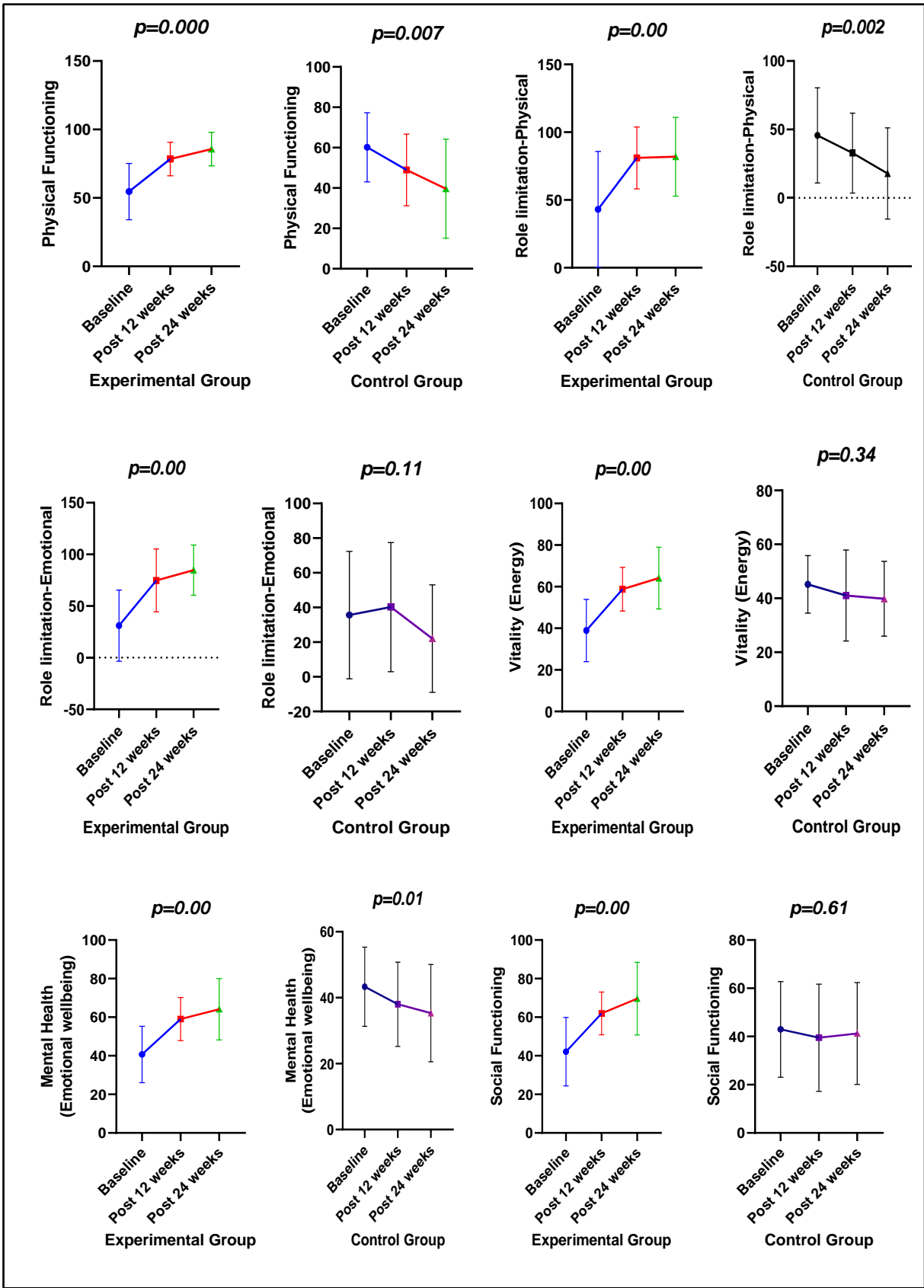
4.1.4.5 HQRoL variables

Table No. 45: Within-group comparison of baseline, post-12-week and post-24-week HRQoL variables in the Yoga Group and Control Group

Variables	Group	Time point	Mean ± SD	Mean Rank	Friedman χ^2 (df=2)	Friedman p
Physical Functioning	Yoga	Baseline	54.66±20.57	1.22	30.38	0.000
		post 12 weeks	78.45±12.26	2.16		
		post 24 weeks	85.69±12.23	2.62		
	Control	Baseline	60.17±17.14	2.38	9.98	0.007
		post 12 weeks	48.97±17.75	2.05		
		post 24 weeks	39.66±24.53	1.57		
Role limitation-Physical	Yoga	Baseline	43.10±42.73	1.43	18.92	0.00
		post 12 weeks	81.03±22.81	2.24		
		post 24 weeks	81.90±29.05	2.33		
	Control	Baseline	45.69±34.76	2.41	12.94	0.002
		post 12 weeks	32.76±29.20	2		
		post 24 weeks	17.86±33.31	1.59		
Role limitation-Emotional	Yoga	Baseline	31.00±34.48	1.31	27.48	0.00
		post 12 weeks	74.79±30.43	2.21		
		post 24 weeks	84.79±24.35	2.48		
	Control	Baseline	35.62±36.72	2.09	4.38	0.11
		post 12 weeks	40.21±37.21	2.17		
		post 24 weeks	22.03±31.01	1.74		
Vitality (Energy)	Yoga	Baseline	38.93±14.99	1.31	24.46	.000
		post 12 weeks	58.79±10.49	2.16		
		post 24 weeks	64.14±14.83	2.53		
	Control	Baseline	45.17±10.65	2.21	2.15	0.34
		post 12 weeks	41.03±16.87	1.93		
		post 24 weeks	39.83±13.85	1.86		
Mental Health (Emotional wellbeing)	Yoga	Baseline	40.69±14.62	1.29	23.29	0.00
		post 12 weeks	59.03±11.20	2.28		
		post 24 weeks	64.14±15.91	2.43		
	Control	Baseline	43.31±12.00	2.4	8.69	0.01
		post 12 weeks	38.00±12.79	1.95		
		post 24 weeks	35.34±14.75	1.66		

Social Functioning	Yoga	Baseline	42.10±17.74	1.29	27.98	0.00
		post 12 weeks	61.97±11.12	2.17		
		post 24 weeks	69.62±18.84	2.53		
	Control	Baseline	42.97±19.83	2.09	0.98	0.61
		post 12 weeks	39.48±22.25	1.86		
		post 24 weeks	41.24±21.12	2.05		
Pain	Yoga	Baseline	61.62±18.04	1.34	22.94	0.00
		post 12 weeks	76.10±9.75	2.19		
		post 24 weeks	80.97±13.48	2.47		
	Control	Baseline	66.55±11.04	2.29	6.97	0.03
		post 12 weeks	60.03±19.58	2.07		
		post 24 weeks	51.03±19.45	1.64		
General Health	Yoga	Baseline	30.17±19.06	1.31	22.88	0.00
		post 12 weeks	55.86±15	2.33		
		post 24 weeks	55.69±22.11	2.36		
	Control	Baseline	33.28±21.31	2.24	6.29	0.04
		post 12 weeks	28.83±20.31	2.12		
		post 24 weeks	19.59±15.69	1.64		
Health Change	Yoga	Baseline	42.24±26.81	1.34	26.33	0.00
		post 12 weeks	79.31±15.04	2.45		
		post 24 weeks	71.21±21.49	2.21		
	Control	Baseline	50.00±22.16	2.34	8.09	0.02
		post 12 weeks	39.48±24.69	1.97		
		post 24 weeks	33.45±30.033	1.69		

Above table indicate that across the three phases all components of Health-Related Quality of Life (HRQoL) showed significant improvements over time in the experimental group receiving yogic intervention. The scores consistently increased at each assessment, indicating enhanced overall well-being. In contrast, although the control group also showed statistically significant changes over time, their HRQoL scores progressively declined, reflecting a reduction in perceived quality of life.



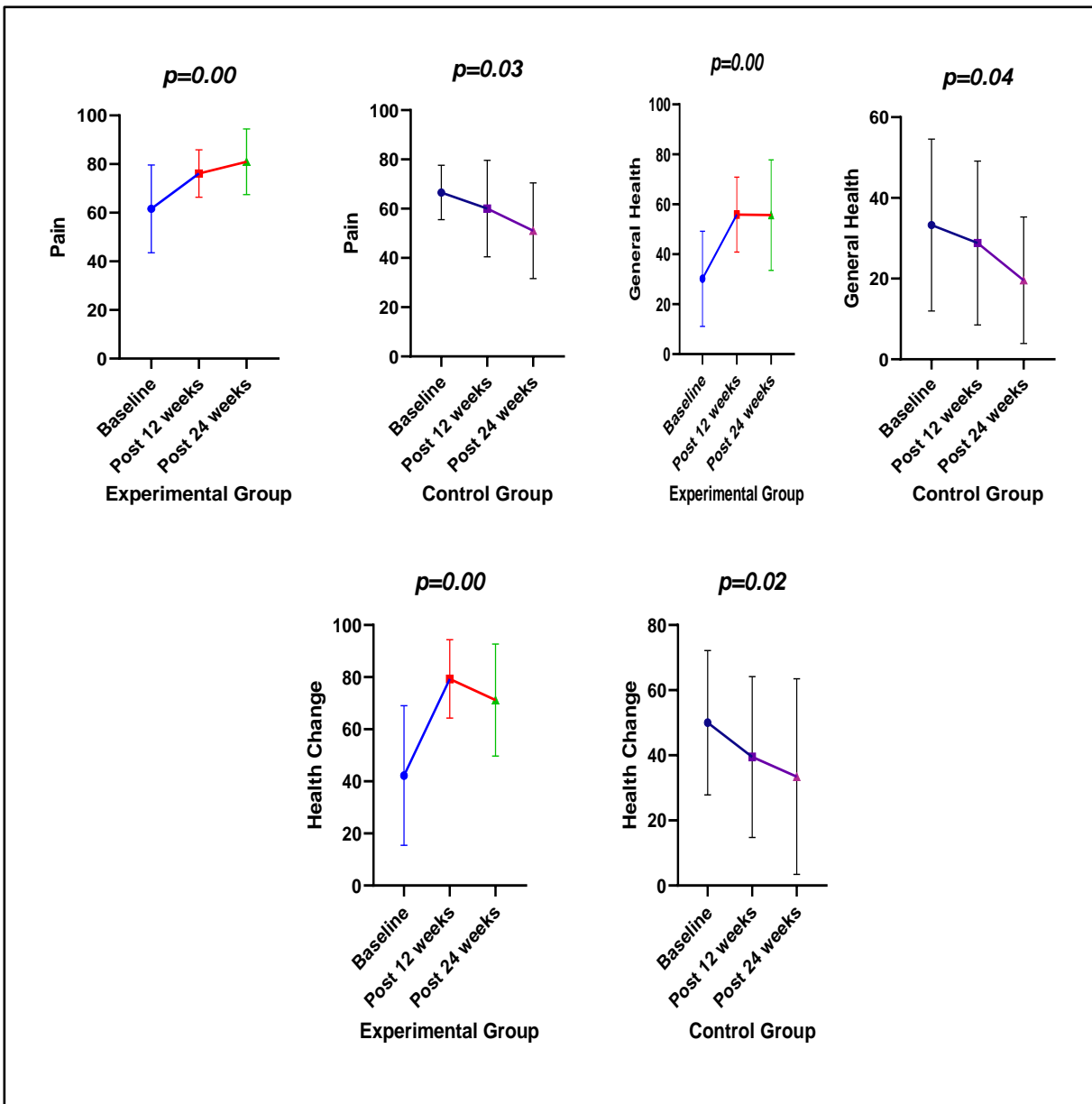


Fig. no. 34: Graphical representation of HRQoL variables of the Yoga and Control groups at baseline, post-12 weeks, and post-24 weeks

Table No. 46: Results of Post Hoc Comparisons for HRQoL variables across three phases in yoga and control group

post-hoc analysis							
Variables	Time Series	Group	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Physical Functioning	Baseline vs. post 12 weeks	Experimental	-.931	.263	-3.545	.000	.001
	Baseline vs. post 24 weeks		-1.397	.263	-5.318	.000	.000
	. post 12 weeks vs. post 24 weeks		-.466	.263	-1.773	.076	.229
	Baseline vs. post 12 weeks	Control	.328	.263	1.247	.212	.637
	Baseline vs. post 24 weeks		.810	.263	3.086	.002	.006
	. post 12 weeks vs. post 24 weeks		.483	.263	1.838	.066	.198
Role limitation-Physical	Baseline vs. post 12 weeks	Experimental	-.810	.263	-3.086	.002	.006
	Baseline vs. post 24 weeks		-.897	.263	-3.414	.001	.002
	. post 12 weeks vs. post 24 weeks		-.086	.263	-.328	.743	1.000
	Baseline vs. post 12 weeks	Control	.414	.263	1.576	.115	.345
	Baseline vs. post 24 weeks		.828	.263	3.151	.002	.005
	. post 12 weeks vs. post 24 weeks		.414	.263	1.576	.115	.345
Role limitation-Emotional	Baseline vs. post 12 weeks	Experimental	-.897	.263	-3.414	.001	.002
	Baseline vs. post 24 weeks		-1.172	.263	-4.464	.000	.000
	. post 12 weeks vs. post 24 weeks		-.276	.263	-1.050	.294	.881
Vitality (Energy)	Baseline vs. post 12 wks	Experimental	-.845	.263	-3.217	.001	.004
	Baseline vs. post 24 wks		-1.224	.263	-4.661	.000	.000
	post 12 wks vs. post 24 wks		-.379	.263	-1.444	.149	.446
Mental Health (Emotional wellbeing)	Baseline vs. post 12 wks	Experimental	-.983	.263	-3.742	.000	.001
	Baseline vs. post 24 wks		-1.138	.263	-4.333	.000	.000
	post 12 wks vs. post 24 wks		-.155	.263	-.591	.555	1.000
	Baseline vs. post 12 wks	Control	.448	.263	1.707	.088	.263
	Baseline vs. post 24 wks		.741	.263	2.823	.005	.014
	post 12 wks vs. post 24 wks		.293	.263	1.116	.264	.793

Social Functioning	Baseline vs. post 12 weeks	Experimental	-0.879	.263	-3.348	.001	.002
	Baseline vs. post 24 weeks		-1.241	.263	-4.727	.000	.000
	post 12 wks vs. post 24 wks		-.362	.263	-1.379	.168	.504
Pain	Baseline vs. post 12 weeks	Experimental	-.845	.263	-3.217	.001	.004
	Baseline vs. post 24 weeks		-1.121	.263	-4.267	.000	.000
	post 12 weeks vs. post 24 weeks		-.276	.263	-1.050	.294	.881
	Baseline vs. post 12 weeks	Control	.224	.263	.853	.393	1.000
	Baseline vs. post 24 weeks		.655	.263	2.495	.013	.038
	post 12 weeks vs. post 24 weeks		.431	.263	1.641	.101	.302
General Health	Baseline vs. post 12 weeks	Experimental	-1.017	.263	-3.874	.000	.000
	Baseline vs. post 24 weeks		-1.052	.263	-4.005	.000	.000
	post 12 weeks vs. post 24 weeks		-.034	.263	-.131	.896	1.000
	Baseline vs. post 12 weeks	Control	.121	.263	.460	.646	1.000
	Baseline vs. post 24 weeks		.603	.263	2.298	.022	.065
	post 12 weeks vs. post 24 weeks		.483	.263	1.838	.066	.198
Health Change	Baseline vs. post 12 weeks	Experimental	-1.103	.263	-4.202	.000	.000
	Baseline vs. post 24 weeks		-.862	.263	-3.283	.001	.003
	post 12 weeks vs. post 24 weeks		.241	.263	.919	.358	1.000
	Baseline vs. post 12 weeks	Control	.379	.263	1.444	.149	.446
	Baseline vs. post 24 weeks		.655	.263	2.495	.013	.038
	post 12 weeks vs. post 24 weeks		.276	.263	1.050	.294	.881

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

From table no. 46 it is clear that all dimensions of HRQoL variables significantly improved in the yoga group from baseline to both post-12 and post-24 weeks, with the strongest gains by week 24. The control group showed reduced or stagnant HRQoL over time, including worsening physical, emotional, and pain-related domains. Overall, yoga enhanced overall quality of life substantially compared to control.

4.1.5 Comparison of the changes between the yoga and control groups from baseline to post 12 weeks and post 24 weeks:

4.1.5.1 General Health Variables

Table No. 47: Comparison of the Changes in general health variables from baseline to post 12 and post 24 weeks in the Yoga and Control Groups

Variables	Groups	Baseline to post 12 weeks			Baseline to post 24 weeks		
		Changes scores mean	Percentage of changes (%)	p-value	Changes scores mean	Percentage of changes (%)	p-value
BMI (kg/m ²)	Yoga Group	-1.11±2	0.49 ↓	0.56	-1.58±2.69	2.60 ↓	0.20
	Control Group	0.68±2.45	3.11 ↑		1.15±3.23	5.26 ↑	
Systolic BP (mmHg)	Yoga Group	-3.86±11.83	3.33 ↓	0.91	-2.07±9.28	1.79 ↓	0.49
	Control Group	-1.38 ±17.26	1.17 ↓		0.34±17.28	0.30 ↓	
Diastolic BP (mmHg)	Yoga Group	-2.59±7.80	3.29 ↓	0.48	-2.28±9.05	2.90 ↓	0.59
	Control Group	-3.28±11.47	4.29 ↓		-1.97±13.47	1.26 ↓	
Heart Rate (beats/minutes)	Yoga Group	-2.59±8.74	3.21 ↓	0.00	-5.24±7.81	6.52 ↓	0.00
	Control Group	4.07±9.50	5.28 ↑		6.90±10.85	8.93 ↑	

p-value < 0.05 is significant

From baseline to post 12 weeks, the yoga group showed slight reductions in BMI, systolic blood pressure, diastolic blood pressure, and heart rate, though these changes were not statistically significant except for heart rate (p = 0.00). Between baseline and post 24 weeks, similar trends were observed, with further decreases in all parameters, among which the reduction in heart rate remained statistically significant (p = 0.00).

In contrast, the control group exhibited gradual increases in BMI, systolic blood pressure, diastolic blood pressure, and heart rate over both time intervals, indicating an overall deterioration in general health parameters without any significant improvements.

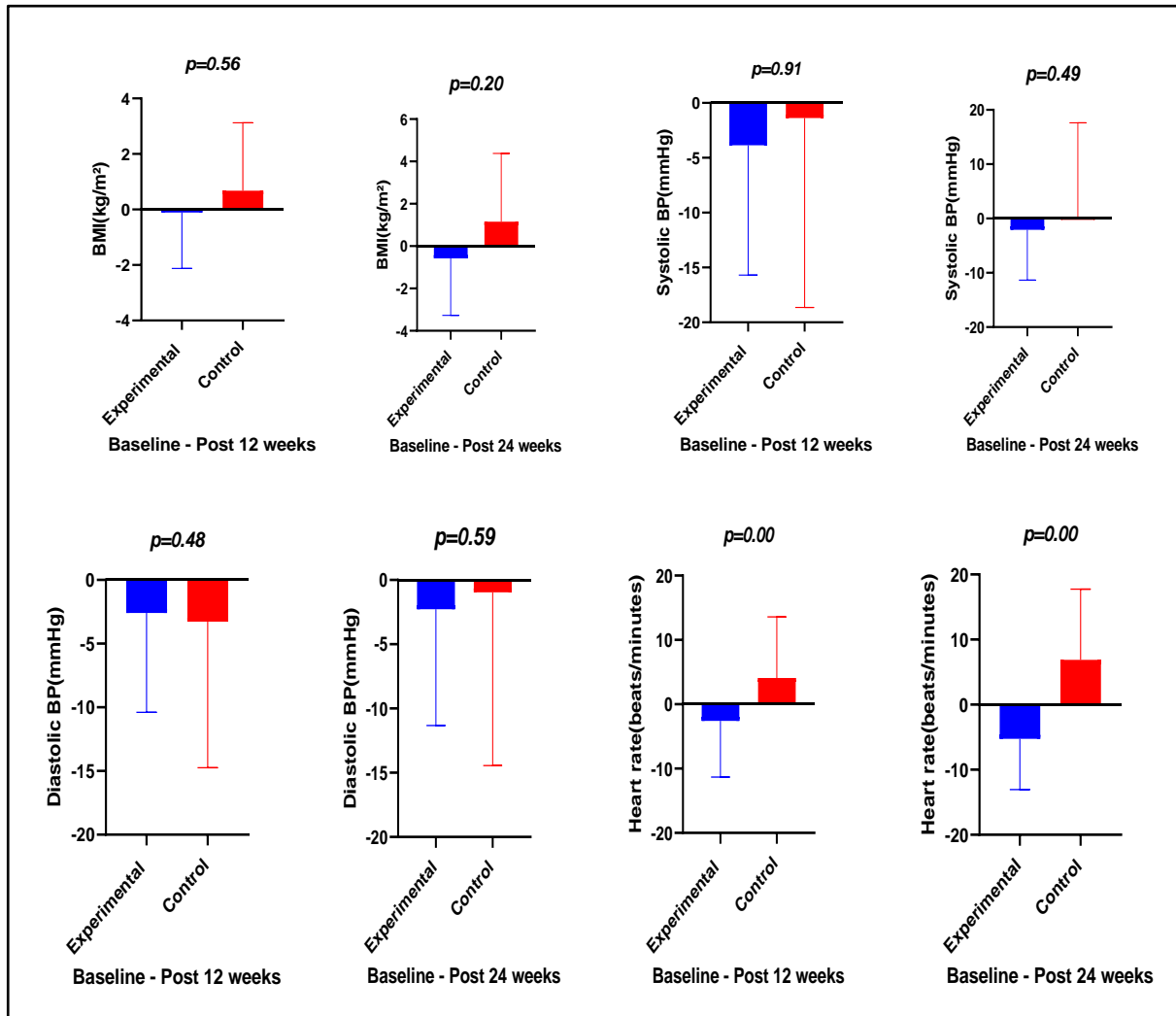


Fig. no. 35: Graphical representation of the changes for General Health Variables in yoga group and control group at baseline to post 12 weeks and post 24 weeks

4.1.5.2 Clinical outcome measures

Table No. 48: Comparison of changes in clinical outcome measures from baseline to post 12 and post 24 weeks in the Yoga and Control Groups

Variables	Groups	Baseline to post 12 weeks			Baseline to post 24 weeks		
		Changes scores mean	Percentage of changes (%)	p-value	Changes scores mean	Percentage of changes (%)	p-value
BASDAI	Yoga Group	-1.42±2	30.65 ↓	0.000	-2.53±1.66	54.78 ↓	0.00
	Control Group	0.16±1.31	3.72 ↑		0.94±1.80	21.86 ↑	
BASFI	Yoga Group	-1.28±1.96	28.63↓	0.002	-2.39±1.73	53.47 ↓	0.00
	Control Group	0.30±1.84	6.11↑		0.85±2.22	17.51 ↑	
BASMI	Yoga Group	-.88±1.17	27.5↓	0.001	-1.05±1.34	32.50 ↓	0.00
	Control Group	0.84±2.03	26.48 ↑		2.01±2.46	62.93 ↑	
Chest Expansion (cm)	Yoga Group	0.83±1.48	33.87 ↑	0.03	1.59±1.54	64.52 ↑	0.00
	Control Group	-.36±2.28	13.33↓		-0.27±2.11	10 ↓	

From table no. 48, it was observed that from baseline to post 12 weeks, the yoga group showed a significant reduction in BASDAI, BASFI, and BASMI scores, along with a significant improvement in chest expansion. Similar trends were noted between baseline and post 24 weeks, with further decreases in all disease activity and functional limitation parameters, and a continued significant increase in chest expansion. In contrast, the control group demonstrated gradual increases in BASDAI, BASFI, and BASMI scores, accompanied by a decline in chest expansion over the same period.

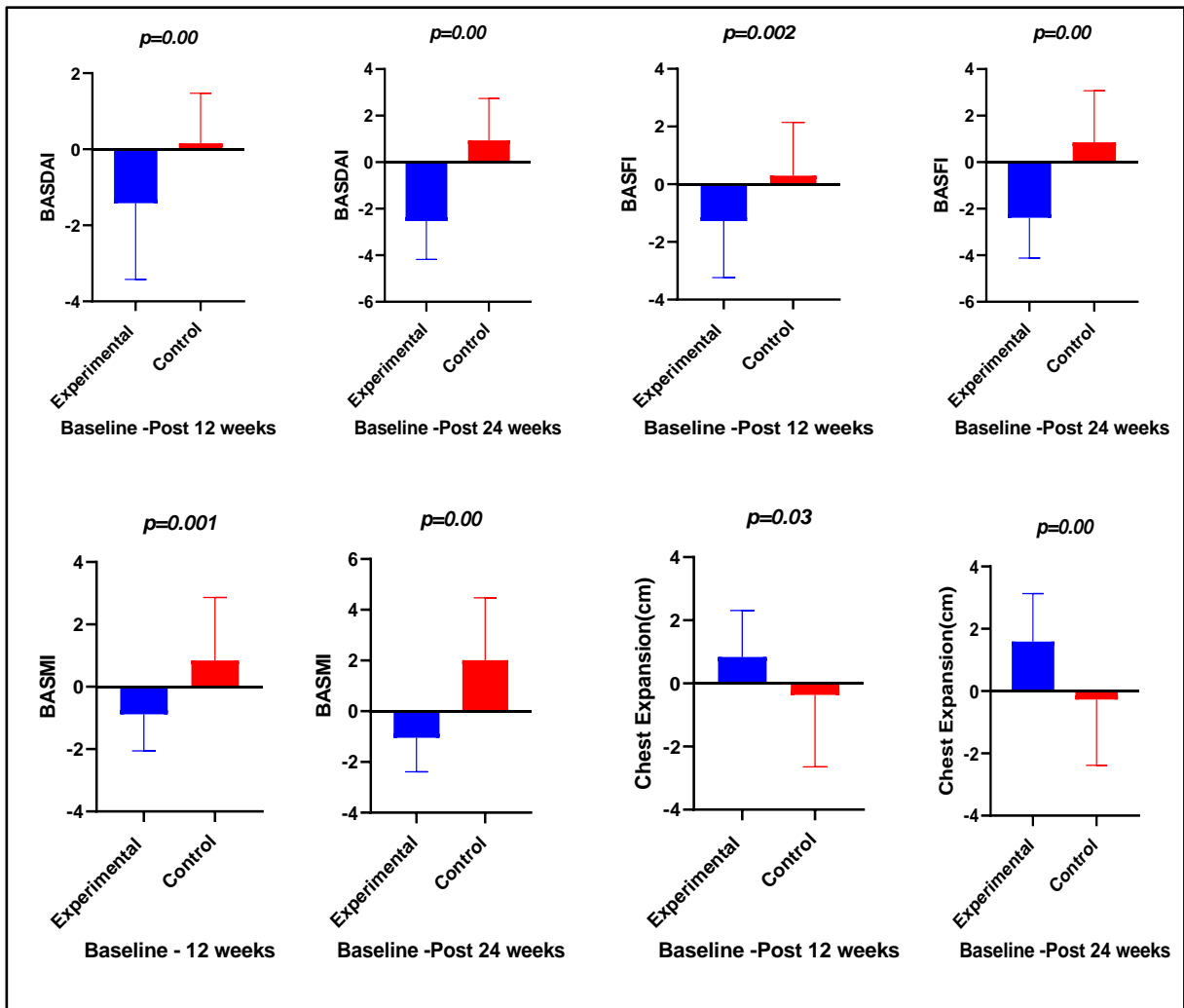


Fig. no. 36: Graphical representation of changes for clinical outcome measures variables in Yoga group and control group at baseline to 12 week and baseline to post 24 weeks

4.1.5.3 Haematological variables and Inflammatory Markers

Table No. 49: Comparison of changes in haematological variables and inflammatory markers from baseline to post 12 and post 24 weeks in the Yoga and Control Groups

Variables	Groups	Baseline to post 12 weeks			Baseline to post 24 weeks		
		Changes scores mean	Percentage of changes (%)	p-value	Changes scores mean	Percentage of changes (%)	p-value
Haemoglobin (g/dl)	Yoga Group	0.24±0.88	1.89 ↑	0.003	0.53±0.86	4.10↑	0.00
	Control Group	-0.62±1.19	4.64 ↓		-1.40±2.40	10.56↓	
Platelet Count (thou/mm ³)	Yoga Group	-22.86±69.84	10.83↓	0.031	-3.52±74.75	1.67↓	0.11
	Control Group	22.17±59.16	11.07 ↑		49.45±114.98	24.67↑	
ESR (mm/hr)	Yoga Group	-1.66±19.76	6.86↓	0.001	-8.76±20.08	36.20↓	0.00
	Control Group	17.24±22.09	82.36↑		23.79±30.81	113.65↑	
CRP (mg/L)	Yoga Group	-1.38±12.26	14.34↓	0.03	-3.97±9.11	41.26↓	0.00
	Control Group	5.57±14.49	56.80↑		19.56±29.57	199.49↑	
TNF-alpha (ng/L)	Yoga Group	-20.77±52.47	62.73↓	0.05	-23.66±62.32	71.45↓	0.00
	Control Group	32.33±96.17	102.54↑		49.86±125.29	158.1↑	

p-value < 0.05 is significant

The Yoga group showed significant improvement in haematological and inflammatory markers from baseline to both post 12 and post 24 weeks compared to the control group. A significant increase in haemoglobin ($p = 0.003$ at post 12 weeks; $p = 0.00$ after 24 weeks) was observed, accompanied by marked reductions in ESR, CRP, and TNF- α levels (all $p < 0.05$), indicating improved anti-inflammatory response and recovery. Conversely, the control group demonstrated a rise in ESR, CRP, and TNF- α over time. Platelet count changes were non-significant after 24 weeks. Overall, the findings suggest that yoga practice effectively modulates haematological balance and inflammatory status, promoting physiological recovery.

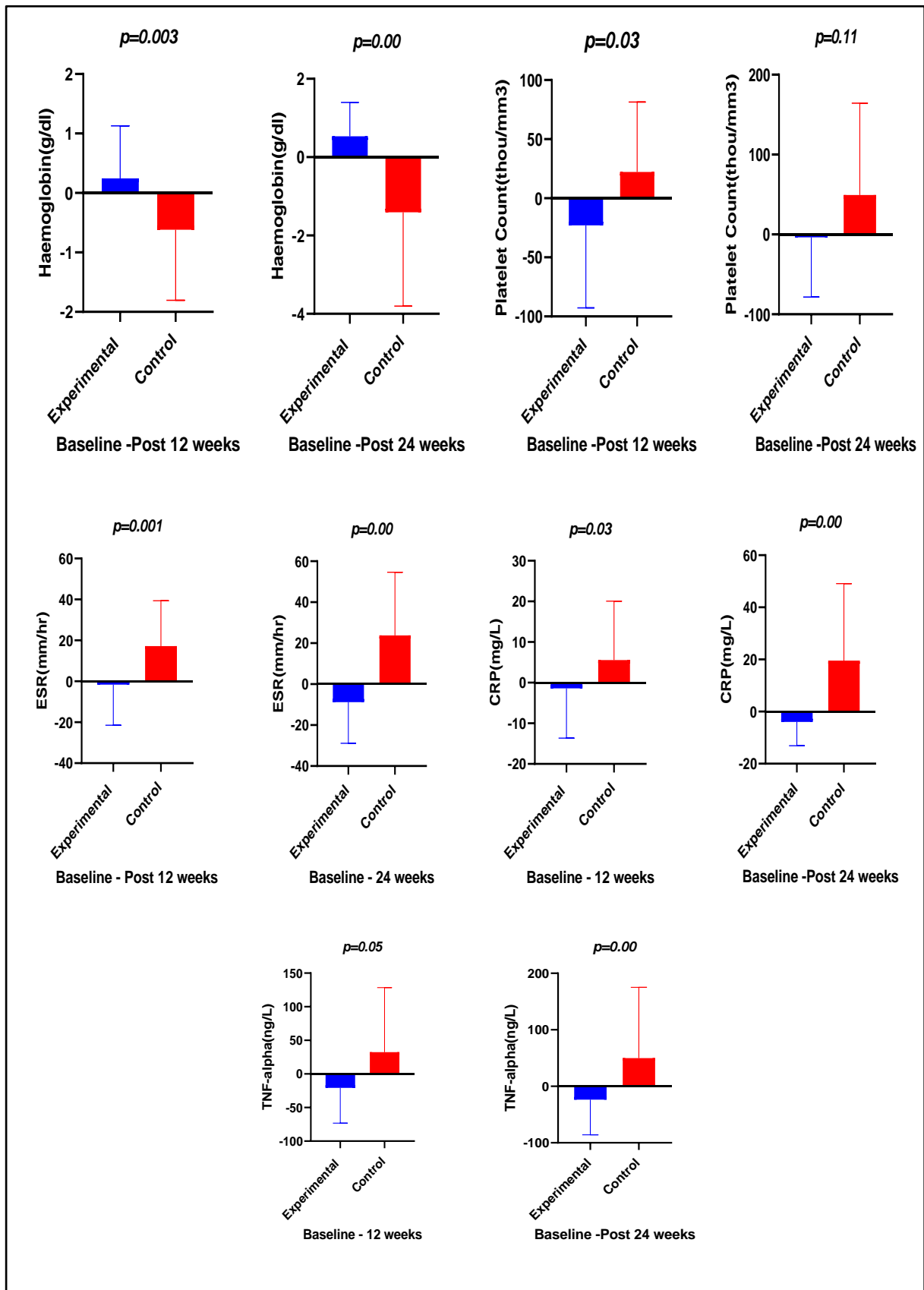


Fig. no. 37: Graphical representation of changes for haematological and inflammatory markers in the Yoga Group and Control Group at baseline to post 12 week and post 24 weeks

4.1.5.3 Psychological Variables

4.1.5.3.1 Depression and Fear Avoidance Beliefs Variables

Table No. 50: Comparison of changes in Depression and Fear Avoidance Beliefs Variables from baseline to post 12 and post 24 weeks in the Yoga and Control Groups

Variables	Groups	Baseline to post 12 weeks			Baseline to post 24 weeks		
		Changes scores mean	Percentage of changes (%)	p-value	Changes scores mean	Percentage of changes (%)	p-value
Depression	Yoga Group	-2.72±5.37	20.53↓	0.00	-5.97±4.20	45.02↓	0.00
	Control Group	5.03±5.72	41.18↑		10.79±6.45	88.19↑	
Fear Avoidance Belief in Physical Activity	Yoga Group	-3.28±6.45	21.33↓	0.00	-4.83±6.22	31.39↓	0.00
	Control Group	5.14±6.54	40.03↑		6.10±8.58	47.55↑	
Fear Avoidance Belief in Work Activity	Yoga Group	-7.90 ±8.69	36.07↓	0.00	-9.24±7.09	42.19↓	0.00
	Control Group	4.55±9.50	22.25↑		9.03±12.03	44.18↑	
FABQ Total Score	Yoga Group	-15.03±17.59	28.77↓	0.00	-19.52±17.90	37.38↓	0.00
	Control Group	12.14 ±20.03	24.88↑		17.31±20.70	35.49↑	

p-value < 0.05 is significant

The Yoga group demonstrated a significant reduction in psychological distress and maladaptive beliefs compared to the control group. Depression scores significantly decreased at both post 12 weeks ($p = 0.00$) and post 24 weeks ($p = 0.00$), showing a 45% overall improvement from baseline. Similarly, Fear Avoidance Belief scores for both physical and work activities, as well as the total FABQ score, showed marked reductions ($p < 0.001$), indicating improved psychological resilience and adaptive recovery behavior.

In contrast, the control group exhibited a notable increase in depression and fear avoidance beliefs across both time points, suggesting worsening psychological outcomes without yoga intervention. These results highlight that Yoga practice effectively reduces depressive symptoms and fear avoidance behaviors, thereby enhancing psychological well-being and recovery confidence.

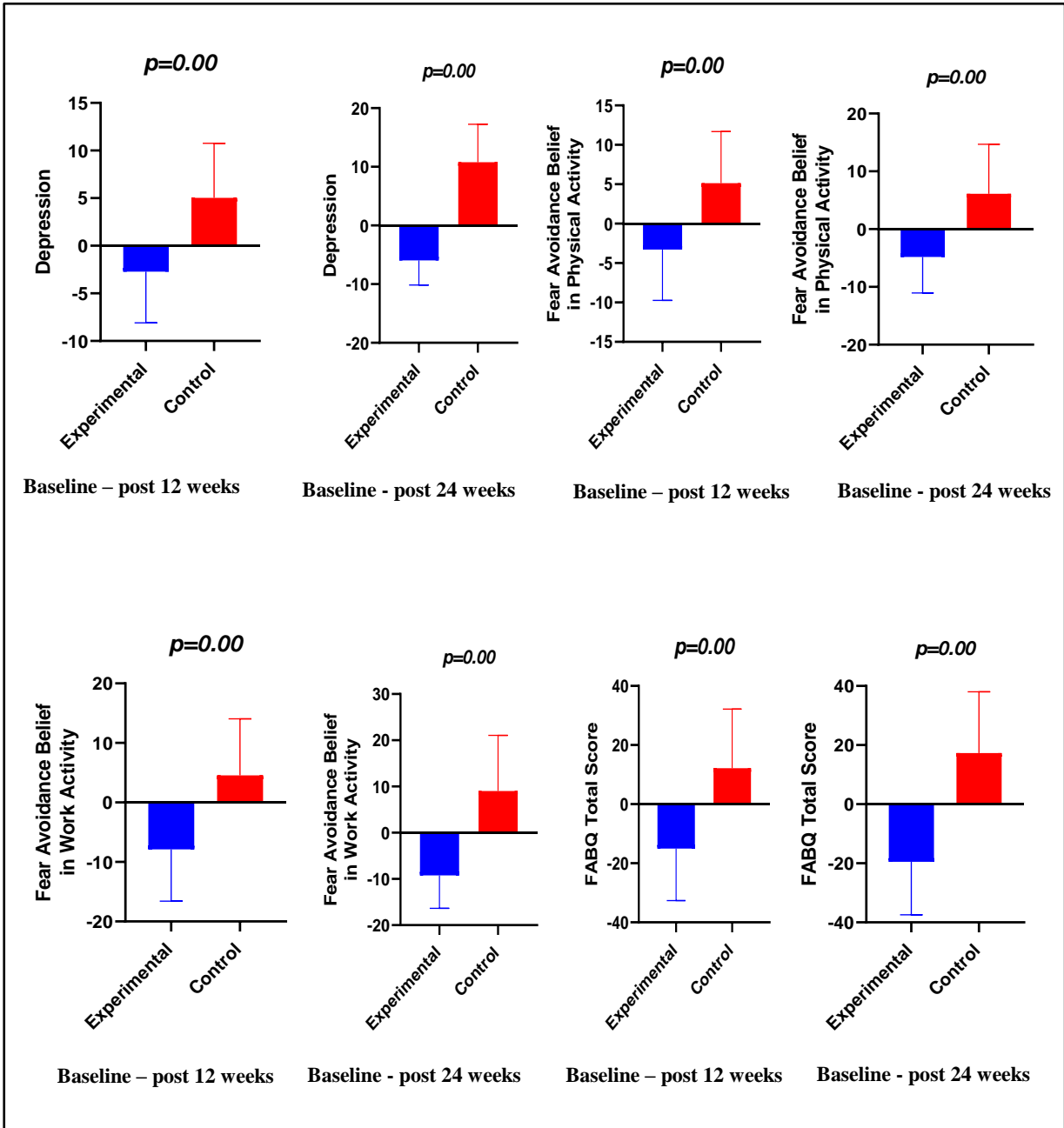


Fig. no. 38: Graphical representation of changes of Depression and Fear Avoidance Beliefs Variables of Yoga group and control group at baseline to post 12 week and post 24 weeks

4.1.5.3.2 Pain Catastrophizing

Table No. 51: Comparison of changes in Pain Catastrophizing from baseline to post 12 and post 24 weeks in the Yoga and Control Groups

Variables	Groups	Baseline to post 12 weeks			Baseline to post 24 weeks		
		Changes scores mean	Percentage of changes (%)	p-value	Changes scores mean	Percentage of changes (%)	p-value
Rumination subscale	Yoga Group	-1.14±2.82	16.61↓	0.20	-2.79±2.94	40.67↓	.000
	Control Group	0.52±3.64	7.18↑		2.72±3.66	37.69↑	
Magnification subscale	Yoga Group	-1.62±2.11	33.54↓	0.02	-2.28±2.31	47.20↓	.000
	Control Group	0.14±3.18	2.76↑		2.45±3.26	48.33↑	
Helplessness subscale	Yoga Group	-4.69±5	43.46↓	0.00	-6.31±4.39	58.47↓	.000
	Control Group	0.69±4.31	6.85↑		2.86±5.42	28.46↑	
PCS Total Score	Yoga Group	-7.52±7.87	33.35↓	0.001	-11.66±8.15	51.65↓	.000
	Control Group	1.31±8.48	5.85↑		7.14±9.42	31.90↑	

p-value < 0.05 is significant

The results of table no.51 shows that the Yoga group exhibited a clear reduction in pain catastrophizing across all subscales—rumination, magnification, and helplessness—compared to the control group. Significant improvements were observed particularly in magnification and helplessness, while the overall PCS total score also declined notably, indicating reduced pain-related negative thinking. In contrast, the control group showed an increase in all subscale and total scores, suggesting a worsening of pain catastrophizing over time. Overall, yoga practice was associated with better cognitive control and reduced maladaptive responses to pain.

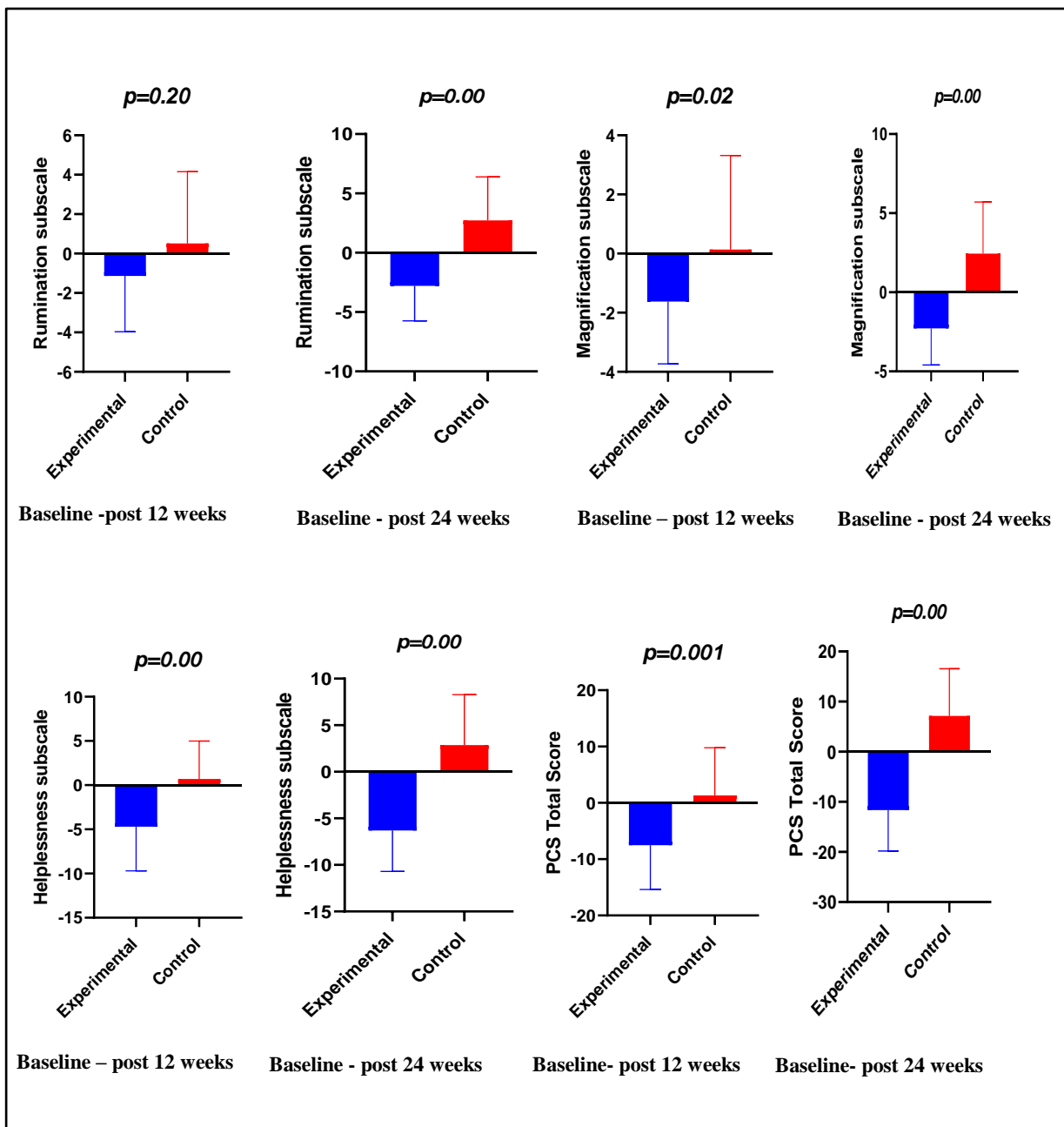


Fig. no. 39: Graphical representation of changes of Pain Catastrophizing of Yoga group and control group at baseline to post 12 week and post 24 weeks

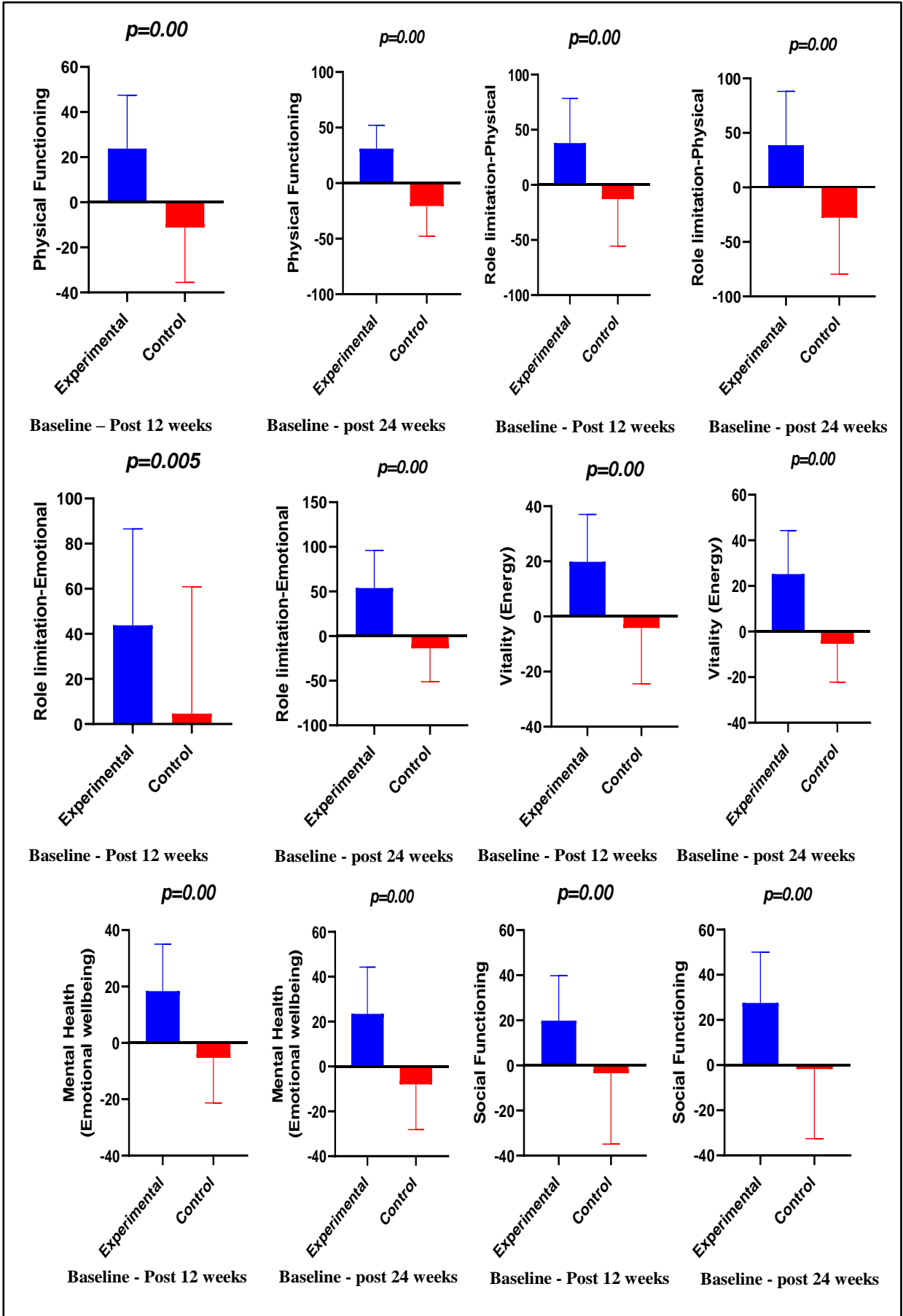
4.1.5.5 HRQoL

Table No. 52: Comparison of changes in HRQoL Dimensions from baseline to post 12 and post 24 weeks in the Yoga and Control Groups

Variables	Groups	Baseline to post 12 weeks			Baseline to post 24 weeks		
		Changes scores mean	Percentage of changes (%)	p-value	Changes scores mean	Percentage of changes (%)	p-value
Physical Functioning	Yoga Group	23.79±23.67	43.53%↑	0.00	31.03±21.10	56.80↑	0.00
	Control Group	-11.21±24.30	18.61%↓		-20.52±27.23	34.09↓	
Role limitation-Physical	Yoga Group	37.93±40.43	88.02%↑	0.00	38.79±49.36	90.02↑	0.00
	Control Group	-12.93±42.58	28.30%↓		-27.83±51.79	60.93↓	
Role limitation-Emotional	Yoga Group	43.79±42.78	141.26%↑	0.005	53.79±42.09	173.52↑	0.00
	Control Group	4.59±56.26	12.89%↓		-13.59±37.60	38.15↓	
Vitality	Yoga Group	19.86±17.18	51%↑	0.00	25.21±19.10	64.75↑	0.00
	Control Group	-4.14±20.31	9.16%↓		-5.34±16.90	11.82↓	
Mental Health	Yoga Group	18.34±16.72	45.08%↑	0.00	23.45±20.83	57.64↑	0.00
	Control Group	-5.31±16.01	12.26%↓		-7.97±20.20	18.40↓	
Social Functioning	Yoga Group	19.86±19.94	47.22%↑	0.001	27.52±22.55	65.39↑	0.001
	Control Group	-3.48±31.36	8.12%↓		-1.72±30.83	4.03↓	
Pain	Yoga Group	14.48±19.58	23.51%	0.00	19.34±21.21	31.41	0.00
	Control Group	-6.52±20.44	9.80%↓		-15.51±22.85	23.31↓	
General Health	Yoga Group	25.69±20.73	85.13%↑	0.00	25.52±24.40	84.59↑	0.00
	Control Group	-4.45±26.58	13.37%↓		-13.69±26.92	41.14↓	
Health Change	Yoga Group	37.07±30.34	87.76%↑	0.00	28.97±32.33	68.61↑	0.00
	Control Group	-10.52±33.18	21.04%↓		-16.55±31.48	33.10↓	

p-value < 0.05 is significant

The results from table no.52 show a significant improvement in all dimensions of health-related quality of life (HRQoL) among participants in the Yoga group compared to the Control group. The Yoga group demonstrated marked gains in physical functioning, role limitations (physical and emotional), vitality, mental health, social functioning, pain, general health, and perceived health change, all with statistically significant differences ($p < 0.05$). In contrast, the Control group showed declines or minimal improvement across these domains. Overall, the findings indicate that yoga practice substantially enhanced both physical and psychological aspects of quality of life over post 24 weeks.



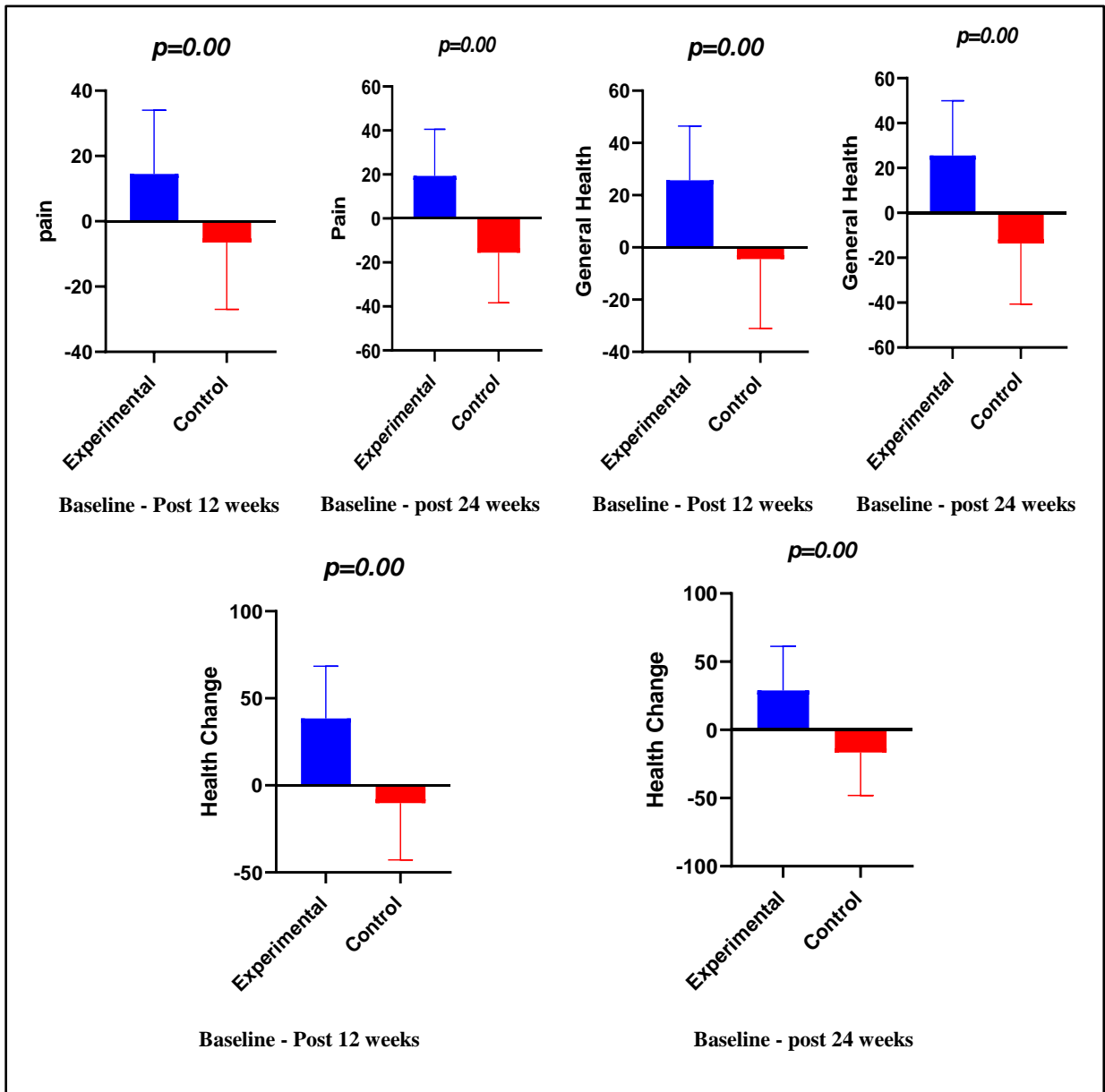


Fig. no. 40: Graphical representation of changes HRQoL Dimensions of Yoga and control group at baseline to post 12 week and post 24 weeks

DEVELOPMENT AND VALIDATION OF A YOGA MODULE IN PATIENTS WITH ANKYLOSING SPONDYLITIS

4.2 DISCUSSION

4.2.1 Discussion on Part-I of the study: Literature search and Yoga module development

4.2.2 Discussion on Part-II of the study: Validation of Yoga module by Experts

4.2.3 Discussion on Part-III of the study: Experimental evaluation of the validated module

4.2.3.1 Discussion on General health variables

4.2.3.2 Discussion on Clinical outcome measures

4.2.3.3 Discussion on haematological variables and
Inflammatory Markers

4.2.3.4 Discussion on Depression and Fear
avoidance beliefs scale

4.2.3.5 Discussion on Pain Catastrophizing

4.2.3.6 Discussion on Health Related Quality of Life (HQRoL)

4.2 DISCUSSION

The primary objective of the present research was to develop and validate a specialized yoga module tailored for individuals with Ankylosing Spondylitis (AS). The study was systematically conducted in three sequential phases, involving the design, validation, and evaluation of a structured yoga-based therapeutic intervention. This integrative approach sought to bridge traditional yogic principles with modern rehabilitation science to address the multidimensional challenges associated with AS, including pain, stiffness, inflammation, and functional limitation.

4.2.1 Discussion on Part-I of the study: Literature search and Yoga module development

The initial phase of the study laid a strong conceptual foundation by integrating insights from both classical yogic literature and contemporary scientific research on yoga therapy, musculoskeletal and rheumatologic disorders, and rehabilitation science. Through this synthesis, key yogic concepts relevant to pain modulation, spinal mobility, inflammation control, and psychosomatic equilibrium were identified. These insights guided the preliminary development of a yoga module aimed at enhancing spinal flexibility and functional well-being. The module adopted a holistic approach, incorporating loosening exercises, asanas, breathing practices, pranayama, relaxation techniques, and meditation. In total, 80 techniques were shortlisted for inclusion in the subsequent phase of the research, ensuring that the module was comprehensive, evidence-informed, and aligned with both traditional principles and modern therapeutic goals. Most of the yogic techniques selected during the validation process have been shown in past research papers to be effective in various diseases condition, particularly musculoskeletal diseases and auto-immune diseases^{257, 355, 300, 356, 357} indicating that yoga may serve as effective complementary therapy for the management of AS.

Practicing meditation has been shown to be highly beneficial in reducing chronic pain and musculoskeletal discomfort through its influence on pain perception and neural pain-processing pathways.³⁵⁸ Earlier yoga module developed for patients with AS²⁸⁸ did not include meditation practices; however the present module incorporated meditation to enhance mind-body integration and pain self-regulation. Meditation has been reported to down-regulate nociceptive signalling, reduce central sensitization and activate the parasympathetic

system, thereby lowering perceived pain intensity. It also decreases stress-induced inflammatory responses by modulating the hypothalamic-pituitary-adrenal (HPA) axis and improving emotional coping in chronic pain conditions.³⁵⁹ Therefore, the inclusion of meditation in the current yoga module may have contributed to pain reduction and overall improvement in well-being among participants with Ankylosing Spondylitis.

4.2.2 Discussion on Part-II of the study: Validation of Yoga module by Experts

During the feedback process, experts provided valuable suggestions regarding the yoga module, particularly concerning the safety and appropriate duration of each practice. Their recommendations also clarified the reasons for rejecting certain items from the list. The inclusion and exclusion of specific yogic techniques are detailed in table no.6.

Notably, practices such as butterfly and side leg raising were rejected due to concerns about their relevance and suitability. Some experts including medical experts like rheumatologists and physiatrists submitted justification for their decisions to exclude these techniques or practices. Interestingly, the findings from the CVR analysis also closely aligned with these expert opinions, further validating the exclusion of these items from the final module.

The loosening exercise which is incorporated in the module, performed from head to toe with breath synchronization and mindfulness is the foundational component of any training protocol. Few loosening exercises are excluded in the validation process, as the postures may be challenging for people with AS, who may experience difficulties with balance and an exacerbation of discomfort during practice. In this section some postures also excluded which may have other health benefits but not directly beneficial for patients with Ankylosing Spondylitis. In the asana section some postures were not selected, because they may create challenges to the patients, require excessive physical strength or efforts. The practices additionally can increase the spinal pressure which may be adversely affecting the weak spinal bone, joint, ligament. Others concern include difficulties in balancing, risk of the overstretching and severe backward bending. One breathing exercise was omitted from the list due to the undue spinal strain may feel by AS patients during its performance. In pranayama section few practices excluded due to forward flexed postures (chin lock-Jalandhar bandha in ujjayi pranayama), prolonged upright sitting, and spinal strain during

the practice, which could be detrimental for the patients in Ankylosing Spondylitis with spinal vulnerabilities.

4.2.3 Discussion on Part-III of the study: Experimental evaluation of the validated module

Previous research has attempted to develop yoga modules for Ankylosing Spondylitis;²⁸⁸ however, feasibility assessment in earlier studies was generally limited to attrition rate, retention rate, session attendance, and subjective feedback using a structured checklist. A later study²⁸⁵ by the same research group examined the efficacy of the previously developed yoga module in a 3-month tele-yoga format focusing only on disease activity, inflammatory markers (CRP and ESR), and mental health outcomes in patients with AS. In contrast, the present study developed a comprehensive 6-month validated yoga module and examined its feasibility using a broader and more clinically relevant set of measures. Along with disease activity and functional indices (BASDAI, BASFI, BASMI, and chest expansion), general health variables, inflammatory biomarkers including TNF-alpha, and several psychological outcomes (fear-avoidance beliefs, pain catastrophizing, and multiple domains of quality of life) were evaluated, thereby providing a more holistic understanding of therapeutic impact.

The third phase comprised an experimental study conducted on two groups—experimental (yoga) and control (standard care)—assessed at three phases: baseline, post 12 weeks, and post 24 weeks. The validated yoga module was administered to the experimental group under supervision, while the control group continued conventional treatment. The effect of the structured yoga module as an adjunct therapeutic approach in patients with Ankylosing Spondylitis across three assessment points at baseline At post 12 weeks and post 24 weeks, the intervention focused on improving physical function, reducing disease activity and inflammation, and enhancing overall quality of life through integrated yoga practices, including sukshma vyayama (loosening practices), asana, pranayama, relaxation techniques and meditation.

4.2.3.1 Discussion on General health variables:

In the present study, no significant differences were observed between the experimental and control groups in general health variables across the three phases, except for heart rate, which showed a significant difference after 24 weeks. Within-group

comparisons further revealed that, apart from heart rate, BMI, systolic blood pressure, and diastolic blood pressure did not change significantly from baseline to post 12 weeks, baseline to post 24 weeks, or 12 to post 24 weeks. Despite the absence of statistically significant changes in most variables, the overall trend in the experimental group indicated gradual improvements in BMI, blood pressure, and heart rate over 12 and post 24 weeks, with the reduction in heart rate representing a meaningful physiological benefit of yoga practice. In contrast, the control group recorded progressive increases in all parameters during the same period, suggesting a decline in general health outcomes without yoga intervention.

Our findings supports Singh et al.,2021 who reported significant reduction in heart rate, SBP and DBP post yogic intervention for patients with AS patients observed in short guided residential program and in control interventions.¹⁴⁹ Similar result found in a one week Integrated approach of Yoga therapy (IAYT) intervention, showed an improvement heart rate (non significantly decrease), SBP and DBP decrease significantly, whereas in control group SBP and DBP increases.³⁶⁰ Another study showed significant reduction in BMI, heart rate and BP in the total cohort with yoga^{361,362,139}. One randomized controlled trial design reported that 17-week standardized yoga program at the school helps to decrease BMI level as 18.7 ± 4.5 to 18.4 ± 4.2 ³⁶³ Changes in BMI are mixed - some yoga programs report no significant BMI changes over post 12 weeks while other reviews of Yoga in inflammatory condition note improvements in BMI over longer more intensive programs. In AS specific studies BMI is less consistently report it has changing significantly.

4.2.3.2 Discussion on clinical outcome measures:

The Bath ankylosing Spondylitis disease activity index(BASDAI), Bath ankylosing Spondylitis functional index (BASFI), Bath ankylosing Spondylitis metrology index (BASMI) and chest expansion demonstrated significant improvement in the yoga group compared to the controls over 12 and post 24 weeks improvement in this indices suggest a reduction in inflammation associated stiffness and enhance spinal flexibility.

The present study shows significant improvements in disease activity and functional capacity in the yoga group align with prior research suggesting that mind-body practice can meaningfully modulate symptomatology. For instance, a randomized controlled trial of tele-yoga showed a mark reduction in BASDAI and improved physical function as measured by BASFI, after just 8 weeks of regular yoga practice.¹⁴⁶ Singh et al; investigate the efficacy of

tele-yogic intervention on the disease activity and after three months of intervention, they reported significant reduction for BASDAI as 6.04 ± 1.53 to 4.91 ± 1.28 (p value < 0.001), though in same study BASFI score was reduced from baseline but it is not statistically significant. Systematic reviews and meta-analysis also support this finding; mind body exercise interventions including yoga have been associated with moderate decrease in BASDAI and BASFI in patient with axial Spondyloarthritis.³⁶⁴ In a comparative study Acharya et al., reported that BASMI and BASFI score significantly change across three time measures. BASMI change from baseline to post 12 weeks as 3.3 ± 1.4 to 2.8 ± 1.49 (p value .001) and BASFI reduces as 2.1 ± 2.02 to 1.6 ± 2.2 (p value .005).¹⁶³ Physioball exercises using yoga and gravity helps to reduce BASDAI index by 32%.²⁷¹

Improvements in the metrology index (BASMI) in Yoga group are particularly noteworthy because spinal mobility is a core feature of long term impairment in AS. This mirrors the effect seen in other exercise intervention; for example meta-analysis of exercise programs (including flexibility and strength training) reported moderate but significant effect of BASMI³⁶⁵. Yoga as holistic combination of stretching, spinal extension and control breathing may help maintain or even restore spinal flexibility there by showing structural progression of functional decline.^{366,367}

In the present study after 12 and post 24 weeks of yogic intervention enhancement of chest expansion observed in yoga group cohort also reflects clinical relevance. Restricted chest expansion is common in AS due to costovertebral joint involvement leading to impaired respiratory function.^{368,369} The improvement suggests that yoga postures and pranayama (breathing practices) might improve rib cage mobility and diaphragmatic breathing, which are not only beneficial for functional capacity but might also contribute to better overall respiratory health.³⁷⁰

4.2.3.3 Discussion on haematological and inflammatory Markers

In the present study, we observed significant differences for haematological and inflammatory markers between the yoga and control groups at both after 12 and post 24 weeks. Over the three time phases, within-group comparisons revealed statistically significant changes in haemoglobin, CRP and TNF- α . However, in pairwise comparisons, haemoglobin did not change significantly from baseline to post 12 weeks; instead, meaningful improvements emerged between baseline and post 24 weeks, and between week 12 and week

24. After adjusting for multiple comparisons, only the baseline-to-24-week change in haemoglobin remained significant. Platelet count did not show significant change in any of the paired intervals. CRP decreased significantly from baseline to post 12 weeks and baseline to post 24 weeks, but with adjustment only the reduction from baseline to post 24 weeks remained statistically significant. For ESR, a significant difference was seen only between baseline and post 24 weeks, but this did not survive after adjustment. Finally, TNF- α showed a significant reduction from baseline to post 24 weeks even after adjusting for multiple comparisons.

Rahaman & Pramanik; conducted a study to examine the effect of twelve-week structured yogic intervention on haematological parameters among college students and observed that haemoglobin increase from baseline to post intervention as 15.10 to 15.60 gm/dl, for control group it is decreased as 15.14 to 14.88 gm/dl. In the same study they reported that a structured yogic intervention positively influenced haematological parameters, enhancing immune function and reducing inflammation.³⁷¹ One study reported that eight week intervention of pranayama yoga exercise as an add on therapy with laser acupuncture helps to reduce the CRP and ESR label as 16.88 ± 2.09 to 13.73 ± 2.13 mg/L and 21.86 ± 2.47 to $15.43 + 1.94$ mm/hour.³⁷²

In a study Vijayaraghava et al., reported that regular yogic practices lowers basal TNF- α level.¹³¹ Gautam et al., conducted a study to examine the effect of Yoga based mind body intervention (MBI) in active Rheumatoid arthritis patients and reported after 8 weeks of yoga based that MBI reduces CRP(ng/ml) as 5652.44 ± 1467.17 to 4984.12 ± 1389.60 (<0.0001), ESR(mm/1sthour) as 42.41 ± 9.16 to 38.00 ± 8.37 (<0.0001), TNF- (pg/ml) 17.04 ± 3.4 to 14.06 ± 3.7 (<0.0001).¹⁴⁰ Ganesan et al; in a randomized controlled trail of RA patients reported that after post 12 weeks of yogic intervention TNF-a(pg/mL) reduced from baseline as 91.7 ± 71.8 to 61.05 ± 46.84 .¹³⁹ One study evaluate the impact of 8 weeks of a yoga-based lifestyle intervention (YBLI) in RA patients on routine medical therapy, reported TNF-(pg/ml) reduced as 17 ± 3.5 to 13.7 ± 3.8 .²⁵⁷ A recent study (2023) found that yoga helps to restore the various inflammatory markers levels to normal range, aids in immunomodulation and reduces RA severity.³⁷³

4.2.3.4 Discussion on depression and fear avoidance beliefs scale

The results of the depression and Fear Avoidance Beliefs Scale demonstrated a significant difference between the yoga and control groups at both post 12 weeks and post 24

weeks. In the within-group analysis, depression and the subscales of fear-avoidance beliefs showed significant changes across all three time-points. After adjusting the p-values, depression remained significant for the baseline-to-24-week and 12-to-24-week comparisons. For the Fear Avoidance Belief in Physical Activity (FAB-PA) subscale, a significant change was observed only between baseline and post 24 weeks, and this significance persisted after adjustment. No significant change was noted for the Fear Avoidance Belief in Work Activity (FAB-Work) subscale and the FABQ Total Score between baseline and post 12 weeks; however, both became significant from baseline to post 24 weeks and from post 12 weeks to post 24 weeks, and these findings also remained significant after the adjusted p-value.

Psychological comorbidity, especially depression is quite common in AS. A meta-analysis estimated the pooled prevalence of depression in AS patient to be around 35%, which is significantly higher than in the general population.³⁷⁴ Depression in AS is not just by-product of pain but is also strongly associated with disease activity, functional impairment and quality of life.³⁷⁵ For instance, a cross sectional study using the hospital anxiety and depression scale (HADS) found that higher HADS- depression(HADS-D) score related with worse disease activity, more pain poorer functional status and lower quality of life.³⁷⁶

Yoga practice is thought to downregulate the hypothalamic–pituitary–adrenal (HPA) axis, elevate gamma-aminobutyric acid (GABA) activity in the brain, and enhance autonomic regulation by increasing parasympathetic activation and reducing sympathetic drive.^{377,378} (Michalsen et al., 2005) Regular yoga practice has also been associated with reduced cortisol, increased serotonin and GABA activity and improved pain tolerance - factors that may collectively reduce depressive symptoms.³⁷⁹ Importantly improvement in pain and sleep quality resulting from yoga may indirectly reduce depression since these symptoms are major contributors to poor mental health in AS. The findings of the current study are consistent with earlier reports demonstrating that anti-depressant effects of Yoga in chronic pain and rheumatic condition.³⁸⁰ A clinical trial by Tekur et al; (2012) observed significant reduction in depression scores following an integral yoga program among individuals with chronic muscular skeletal disorder.³⁸¹ Similarly a bibliometric analysis study by Cramer et al; reported that yoga significantly improve depressive symptoms in patients with inflammatory arthritis³⁸². Studies in autoimmune disease further support that yoga enhances self-efficacy, emotional resilience, and coping skills, which contribute to lower depression level.³⁸³

4.2.3.5 Discussion on Pain Catastrophizing

The results of the Pain Catastrophizing subscales indicated a significant difference between the yoga and control groups at both 12 and post 24 weeks. In the within-group comparison, the Rumination subscale showed significant improvement from baseline to post 24 weeks and from 12 to post 24 weeks. For the Magnification subscale, significant changes were found from baseline to post 12 weeks and from baseline to post 24 weeks, and these remain significant even after adjustment. The Helplessness subscale demonstrated statistically significant improvement across all three phases, and the significance persisted after adjusted p-values. Similarly, the total Pain Catastrophizing Score (PCS total) improved significantly across the three phases, and this improvement also remained significant following adjustment.

One study framed with the aim of online pain management programme incorporating mindfulness-informed exercises (i.e. breathing and body scanning exercises) and CBT elements for Ankylosing Spondylitis patients reported that Pain Catastrophizing Scales (PCS) showed a significant difference across the three phases.²⁸⁹ One pilot study on Fibromyalgia (FM) patients observed in post yoga intervention pain catastrophizing score decreased, they also reported that yoga may reduce pain and catastrophizing.³⁸⁴

4.2.3.6 Discussion on Health related quality of life variables:

Result of the various subscale of health related quality of life variables revealed that Physical Functioning, Role limitation – Physical, Role limitation – Emotional, Vitality (Energy), Mental Health (Emotional wellbeing), Social Functioning, Pain, General Health, and Health Change has significant difference between yoga and control group at 12 and post 24 weeks. Significant changes found of every subscale health related quality of life variables for within group comparison at baseline to post 12 weeks as well as baseline to post 24 weeks. All the dimension of HQRoL till significant even after multiple comparison in three phases.

Similar result like our study found by Acar et al; who reported that 8 weeks of tele yoga practice improves quality of life of AS patients.¹⁴⁶ Another study notifies that yoga and naturopathy showed improve quality of life for patients with Ankylosing Spondylitis. Singh et al., 2023 found that 60-min structured yoga module online for 3 months in addition to standard medical care helps to improve Quality of life for AS patients. Yoga has been shown

to produce significant improvements across all eight domains of the SF 36, reflecting broad enhancement of physical, emotional and social functioning. This demonstrates that yoga supports both physical and psychological components of quality of life leading to an overall better health status.³⁸⁶ The present findings are further supported by two doctoral theses that examined the impact of yogic intervention on individuals with ankylosing spondylitis, both of which demonstrated similar improvements in quality of life.^{292,387}

The majority of OPD patients participated in this study were residents of rural areas of West Bengal, typically travelling 30–40 km to access healthcare services. To overcome this physical barrier, the yoga intervention was administered through a hybrid delivery approach, consisting of on-site sessions conducted once every 15 days complemented by virtual sessions held five days per week. The experimental group showed better outcomes than the control group because participants received continuous follow-up and support throughout the study. Virtual monitoring and physical session helped maintain motivation, correct mistakes, and ensure regular practice. Since the sessions were conducted online, participants could join immediately after their morning routine at home, which reduced barriers to attendance and strengthened adherence. Consistent participation enabled them to experience the full therapeutic effect of the structured yoga module. Yoga works holistically on the physical, psychological, and emotional dimensions of health. The postures improved muscular strength, flexibility, posture, and circulation, while breathing practices enhanced internal energy and supported relaxation. Together, these practices improved sleep, reduced stress, increased body awareness, and nurtured a balanced mind. The integration of movement, breath, and mindfulness may also have regulated neuroendocrine pathways involved in inflammation and stress, which contributed to better overall well-being. As a result, participants in the yoga group were able to cope more effectively with their symptoms and demonstrate meaningful improvements in quality of life, and selected physiological markers. Although some variations in variables indicate the need for further investigation with a larger sample, the overall trend suggests that regular and guided yoga practice produces superior clinical outcomes compared to routine daily activities without structured intervention. However the present module reflects a more realistic clinical application in various aspects of the patients with AS. The broader methodological approach suggests that the present yoga module may offer superior feasibility and translational value compared with earlier intervention particularly due to its longer duration, multimodal outcome assessment, and evaluation of deeper psychophysiological dimensions relevant to AS management.

DEVELOPMENT AND VALIDATION OF A YOGA MODULE IN PATIENTS WITH ANKYLOSING SPONDYLITIS

Chapter-V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

- 5.1 Summary of the study
- 5.2 Conclusions of the study
- 5.3 Recommendations of the study
- 5.4 Suggestions of the study
- 5.5 Limitations of the study



Chapter-V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the study:

Ankylosing Spondylitis is a chronic inflammatory disorder that primarily affects the spine and sacroiliac joints. Persistent inflammation over time can lead to stiffness and eventual fusion of vertebral segments, reducing spinal flexibility. The condition typically begins in early adulthood and progresses gradually with recurrent episodes of pain and mobility limitation. Beyond the musculoskeletal structures, it may also involve the eyes, heart, and other organs, making it a systemic disease. Early diagnosis along with appropriate medical care and therapeutic exercise is essential to maintain function and quality of life.

Yoga has been demonstrated as a promising complementary practice for arthritis.¹⁴² While there are few studies of yoga in rheumatoid arthritis^{141,143} are available, studies examining the impact of yoga on Ankylosing Spondylitis are limited. An extensive search of scientific literature yielded only a single study on yoga module in AS²⁸⁸ which is however, limited by the methodology used, especially the choice of specialists or stakeholders involved.

Therefore, a study to develop a validated integrated yoga module was undertaken which could greatly enhance the management of AS, complementing conventional treatments and potentially improving patients' quality of life.

The primary aim of the present study is to develop, validate and test the feasibility of the said yoga module in a scientific way. To fulfil this aim, total study conducted in three phases i.e. literature search and yoga module development, validation of that yoga module by experts, feasibility test of that validated yoga module through intervention.

The initial phase of the study developed a strong conceptual base by combining classical yogic knowledge with modern scientific insights on musculoskeletal rehabilitation. From this integration, key yoga principles related to pain reduction, spinal mobility, inflammation control, and mind–body balance were identified. With the help of ten yoga experts, a holistic yoga module was formulated that included loosening exercises, asanas,

breathing practices, pranayama, relaxation, and meditation. In total, 80 techniques were shortlisted to ensure therapeutic relevance and comprehensive coverage.

In the second phase, 36 experts were invited and 26 (72.2%) provided feedback on the yoga module. Each expert evaluated the practices for therapeutic safety, clarity, sequencing, and suitability for Ankylosing Spondylitis, leading to refinements in the number, duration, and order of techniques. Statistical validation using the Content Validity Ratio (CVR) and Content Validity Index (CVI) confirmed strong expert agreement, resulting in an evidence-based and clinically relevant module. Out of 80 yogic techniques, 38 items were shown to be significant ($CVR \geq 0.385$), including loosening exercise or yogic suksmavyama, asana, basic breathing practices, pranayama, relaxation techniques, and meditation for ankylosing spondylitis patients. Several practices—such as butterfly, side leg raising, few asanas, breathing techniques, and pranayama—were excluded due to concerns regarding spinal strain, excessive physical effort, balance challenges, or lack of direct therapeutic benefit for AS patients. The final validated module prioritized safety and effectiveness, ensuring feasibility for individuals with spinal vulnerability and preparing the protocol for empirical testing in the next phase of the study.

Third phase is the feasibility test of the developed yoga module. Through convenient sampling method after G*Power analysis of effect size a total of 70 male patients with Ankylosing Spondylitis were selected from the OPD of the Clinical Immunology and Rheumatology department, IPGMER; Kolkata. Patients were selected by Bath Ankylosing Spondylitis - Disease Activity Index (BASDAI) and Bath Ankylosing Spondylitis Functional Index (BASFI) questionnaire and confirmed with the certified rheumatologist. Subjects were allotted into two groups: Yoga group (YG) (n=35) and Control group (CG) (n=35). Yoga module was administered to participants in the YG for post 24 weeks, along with standard medical treatment. The CG received only standard medical treatment. Demographic data-age, height, weight, disease duration, general health variables – BMI, blood pressure, heart rate, disease activity and functional indices-BASDAI, BASFI, BASMI, chest expansion, haematological and inflammatory markers- Haemoglobin, plate late count, CRP, ESR, TNF alpha, fear avoidance belief scale, pain catastrophizing and health related quality of life were documented at enrolment, after post 12 weeks and after completion of post 24 weeks. For non-normal distribution of the data, ‘Mann Whitney U’ tests were employed for between-group comparisons (yoga and control groups) at baseline, post 12 weeks, and post 24 weeks.

To examine within-group changes over time, a Friedman test (non-parametric equivalent of repeated-measures ANOVA) was applied with Bonferroni adjustment using SPSS 27 version.

A total 58 patients of Yoga group (YG) (N=29) and control group (CG) (N=29) were completed the study. The baseline demographic and clinical characteristics of the participants demonstrated homogeneity between the experimental and control groups. For general health variables category no significant difference were found between yoga and control group at baseline, post 12 weeks and post 24 weeks, though a significant difference found for heart rate ($p < 0.001$) only in post 24 weeks of comparison. Significant differences were observed in BASDAI, BASFI, BASMI and chest expansion at post 12 weeks and post 24 weeks between two groups. In haematological and inflammatory variables –haemoglobin, platelet count, ESR, CRP and TNF-alpha shows significant difference at post 12 weeks and post 24 weeks. All the subscale of fear avoidance belief and pain catastrophizing found significant difference at post 12 weeks and post 24 weeks. Similar result also observed for the all domains of health related quality of life scale, significant at 12 and post 24 weeks between both group comparisons.

BMI and blood pressure did not exhibit significant changes over time in either the yoga or control group, indicating that these parameters may require longer intervention duration, higher training intensity, or dietary modification to show measurable improvement. In contrast, heart rate demonstrated a significant time-dependent reduction in yoga groups, with a markedly stronger effect in the yoga group ($\chi^2 = 20.73$, $p < 0.001$) compared with the escalation of heart rate in control group ($\chi^2 = 11.84$, $p = 0.003$). Post-hoc Bonferroni results confirmed that the most substantial reduction occurred between baseline and post 24 weeks ($p < 0.001$), suggesting progressive cardiovascular adaptation among yoga participants. These findings highlight yoga's early influence on autonomic regulation and cardiorespiratory efficiency, even in the absence of concurrent changes in BMI or blood pressure.

BASDAI showed a significant reduction over time in yoga group ($\chi^2 = 34.97$, $p < 0.001$) and upward trend in control groups ($\chi^2 = 9.20$, $p = 0.01$), indicating gradual improvement in disease activity across the intervention period; however, reflecting superior symptom modulation through yogic practices. BASFI demonstrated significant improvement in the yoga group (BASFI: $\chi^2 = 34.97$, $p < 0.001$), suggesting that functional capacity and ease of daily living are more responsive to structured therapeutic movement than to usual care alone. BASMI also showed significant change over time in both groups, greater

improvement in the yoga group ($\chi^2 = 17.16$, $p < 0.001$) and worsening in control group indicates that spinal mobility responds more effectively when an active, flexibility-focused intervention is incorporated. Chest expansion displayed a significant increase exclusively in the yoga group ($\chi^2 = 29.69$, $p < 0.001$), emphasizing the specific impact of yoga-based breathing and thoracic mobility practices in enhancing respiratory mechanics-an area often compromised in Ankylosing Spondylitis.

Bonferroni- adjusted pairwise comparison further revealed that disease activity score ($p < 0.001$), functional index ($p=0.005$) significantly reduced across three phases but most substantial significant reduction occurred between baseline and post 24 weeks. For Bath Ankylosing Spondylitis Metrology Index (BASMI) significant changes mostly occurred at baseline to post 12 weeks ($p=0.008$) and baseline to post 24 weeks ($p < 0.001$). For chest expansion, significant changes also occurred at baseline to post 24 weeks' time phases ($p < 0.001$).

Haemoglobin demonstrated a contrasting pattern between the two groups, showing a significant increase over time in the yoga group ($p=0.03$) and a significant decrease in the control group ($p=0.05$). Pairwise Bonferroni-adjusted comparisons indicated that the improvement in haemoglobin for the yoga group was driven primarily by the change between baseline and post 24 weeks ($p=0.005$), while no time-phase comparison reached significance in the control group. Platelet count did not show significant variation across any time points in either group, suggesting that platelet physiology was not substantially altered by the intervention within the study duration. CRP displayed a significant time effect (YG: $p=0.004\downarrow$ and CG: $p=0.03\uparrow$), and post-hoc analysis confirmed that the reduction was significant only between baseline and post 24 weeks, highlighting a delayed but meaningful anti-inflammatory response. Although ESR did not achieve statistical significance across post-hoc comparisons, the greatest reduction occurred between baseline and post 24 weeks, indicating a downward clinical trend despite the absence of statistical confirmation. TNF- α showed a significant change over time only in the yoga group, with the Bonferroni comparison identifying baseline to post 24 weeks ($p=0.03$) as the key improvement window, while no significant change was observed in the control group. Together, these biochemical findings suggest that yoga exerts a deeper and more progressive influence on haematological and inflammatory markers than routine care.

Within group comparison across three phases a significant difference was observed for depression and more significant reduction found in baseline to post 24 weeks for experimental group ($p < 0.001$). For control group depression score significantly increases for every phases. Three subscale of fear avoidance belief scale i.e. fear avoidance belief in physical activity, fear avoidance belief in work activity and FABQ total Score, for each subscale a contrasting pattern between the two groups were observed, showing a significant decrease over time in the yoga group and a significant increase in the control group. For the experimental group most significant reduction observed in baseline to post 24 weeks' time pair. Similar results also found for each subscale of pain catastrophizing between both groups and most significant reduction at baseline to post 24 weeks comparison- Rumination, Magnification, Helplessness, PCS total score ($p < 0.001$).

For health related quality of life in every domain significant changes has occurred at every phases-baseline to post 12 weeks, baseline to post 24 weeks and post 12 weeks to post 24 weeks comparison in both groups. Here also a contrasting pattern between the two groups found, showing a significant increase over time in the yoga group and a significant decrease in the control group in physical Functioning, role limitation physical, role limitation emotional, vitality (energy), mental health (emotional wellbeing), social functioning, pain, general health and health change.

5.2 Conclusions:

The study achieved its primary objectives of developing, validating, and determining the feasibility and effectiveness of a yoga module specifically designed for the treatment of the individuals with ankylosing Spondylitis. The first objective was achieved through a systematic and evidence-based yoga module development process followed by expert validation, which confirmed the clinical relevance, safety, and appropriateness of the selected practices. A total of 38 yogic practices were found to be significant ($CVR \geq 0.385$), including loosening exercises (Sūkṣma Vyāyāma), asana, basic breathing practices, pranayama, relaxation techniques, and meditation.

With respect to second objective, the findings from the 24 week experimental trial demonstrated that patients receiving a combination of conventional medical treatment and the validated yoga module showed significantly greater improvements compared to those receiving conventional treatment only. Significant ($p < 0.05$) positive changes were observed across psychological variables (depression, fear avoidance belief, pain catastrophizing and

health related quality of life), physiological variables (haemoglobin), general health status (heart rate), clinical outcome measures (BASDAI, BASFI, BASMI, Chest expansion) and inflammatory markers (CRP, TNF alpha) thereby supporting the alternate hypothesis and rejecting the null hypothesis. These improvements reflect reduced disease activity, enhanced functional capacity and spinal mobility, better autonomic regulation, decreased inflammatory response and improved emotional well-being and quality of life.

Overall, the result highlights the feasibility, safety, and therapeutic value of the validated yoga module as a complementary intervention for Ankylosing Spondylitis. By offering a structured, cost-efficient, and patient-empowering practice that can be followed both under supervision and at home, the module has the potential to support long-term disease management and reduce the burden of disability associated with this chronic condition. The findings contribute meaningful evidence to support the integration of yoga into multidisciplinary rehabilitation programs for Ankylosing Spondylitis and lay the groundwork for future multicentre trials and clinical guideline adoption.

5.3 Recommendations:

Based on the findings of the study, the following recommendation is proposed:

- 1) Healthcare professionals, including physiotherapists and rehabilitation specialists, may be encouraged to receive training in the delivery of disease-specific yoga protocols to ensure safe and standardized implementation in clinical settings.
- 2) Patient education programs should be developed to promote awareness and motivation for practicing yoga regularly, which enables individuals with ankylosing spondylitis to adopt self-management strategies beyond supervised sessions.
- 3) The validated yoga module may be incorporated into routine rehabilitation and clinical management programs for Ankylosing Spondylitis as a complementary intervention and along with medical care to enhance functional outcomes and quality of life.
- 4) Community-based centres, outpatient departments and support groups for spondyloarthritis may integrate yoga sessions into their on-going services, expanding accessibility for patients outside of rehabilitation.
- 5) The validated yoga module has strong commercial and start-up potential.

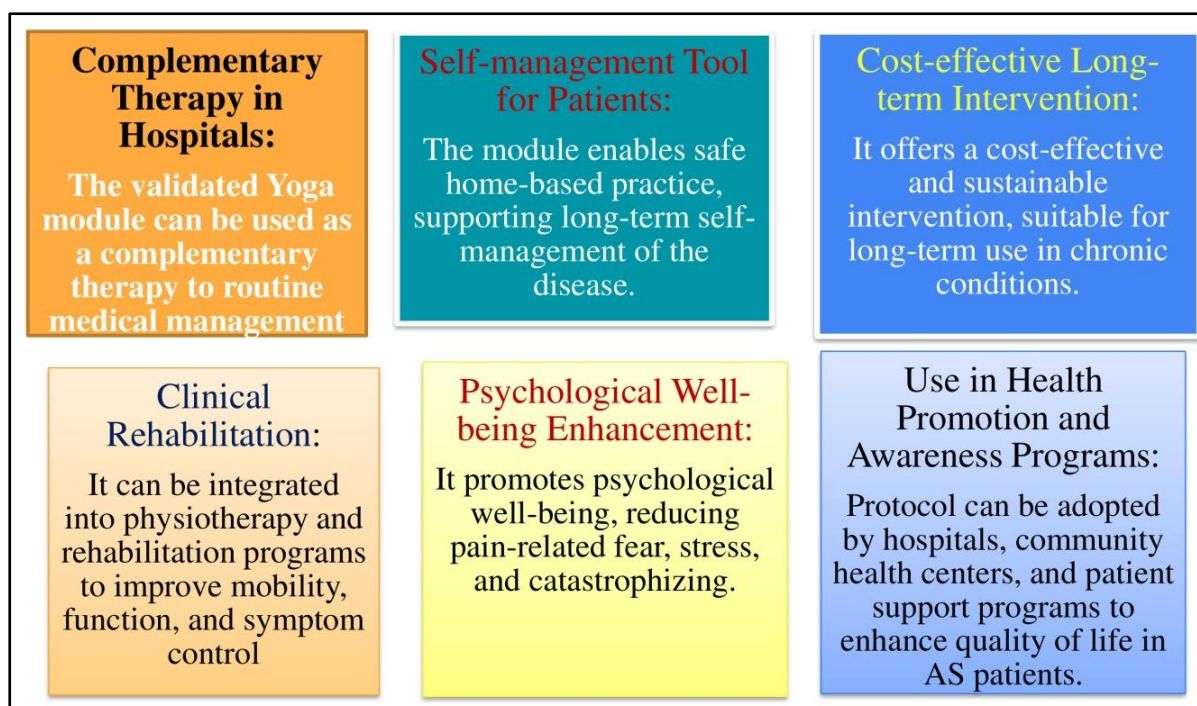


Photo. no.41: Application of the study

5.4 Suggestions:

- 1) Feasibility test of the developed yoga module can be applied on female Ankylosing Spondylitis patients.
- 2) Similar studies may be extended with large numbers of patients and multicentre randomized control trails.
- 3) Future studies may plan in rehabilitation centre set up where patients can get face to face yoga treatment.
- 4) Subsequent investigation can focus to establish the validity and reliability (test-retest) of the developed yoga module.
- 5) Researcher in future may take this study to follow up to check the remission of the yoga module.
- 6) It suggested that similar studies may conduct with other relevant variables related with Ankylosing Spondylitis.
- 7) Further studies may focus on specific yogic techniques only sukhma vayam, asana, pranayama, mediation.

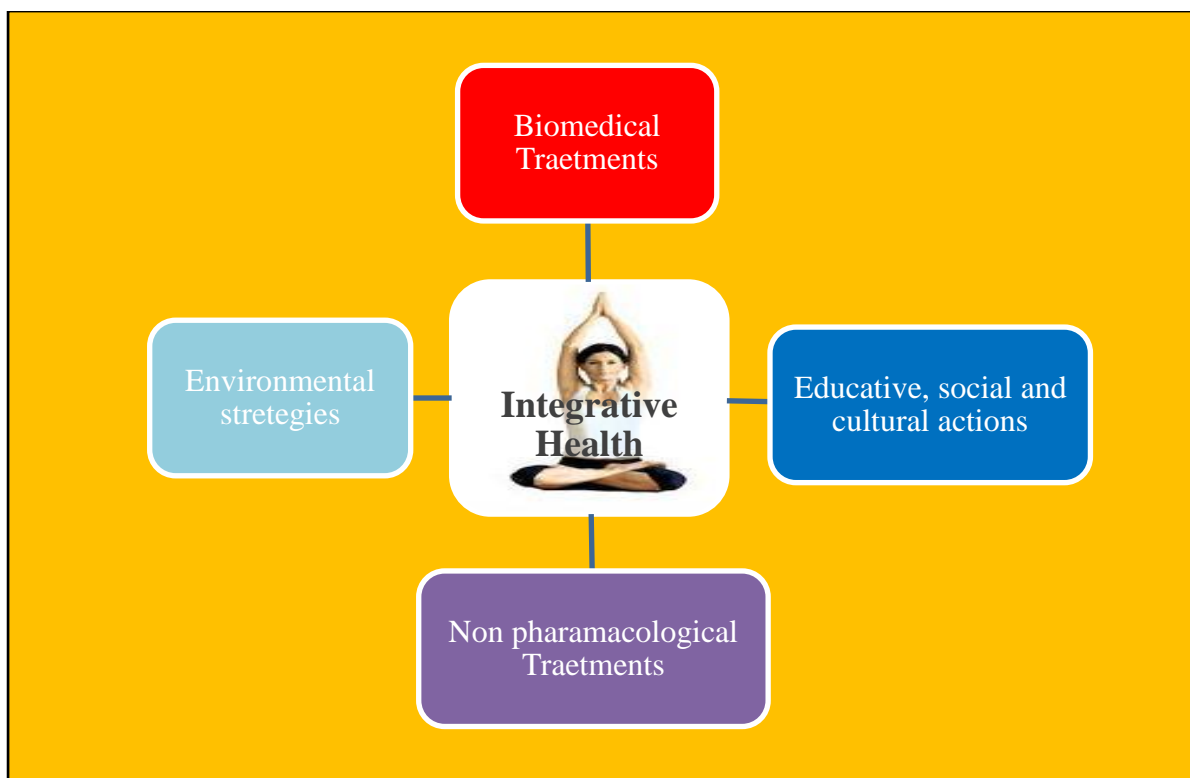


Photo. no. 42: Integrative health planning for Ankylosing Spondylitis patients

5.5 Limitations:

The present study has some limitations. For construct of the draft of the yoga module (80 yogic practices) the investigators took help from classical yoga text or research paper where the benefits of the techniques were not described adequately for reducing pain, immobility or inflammation. A total of 36 experts were approached, of whom, only 26 experts provided their feedback (72.2%). Medical experts like physiatrists and rheumatologists often prescribe exercises similar to yogic postures, although they may not have extensive technical knowledge of Yoga. This was a reason to include them, which was not done in the earlier study.²⁸⁸ Feasibility of the yoga module tested considering the male AS patients only.

“Does a validated Yoga module influence clinical symptoms, inflammatory markers, psychological distress, and quality of life in individuals with Ankylosing Spondylitis?”

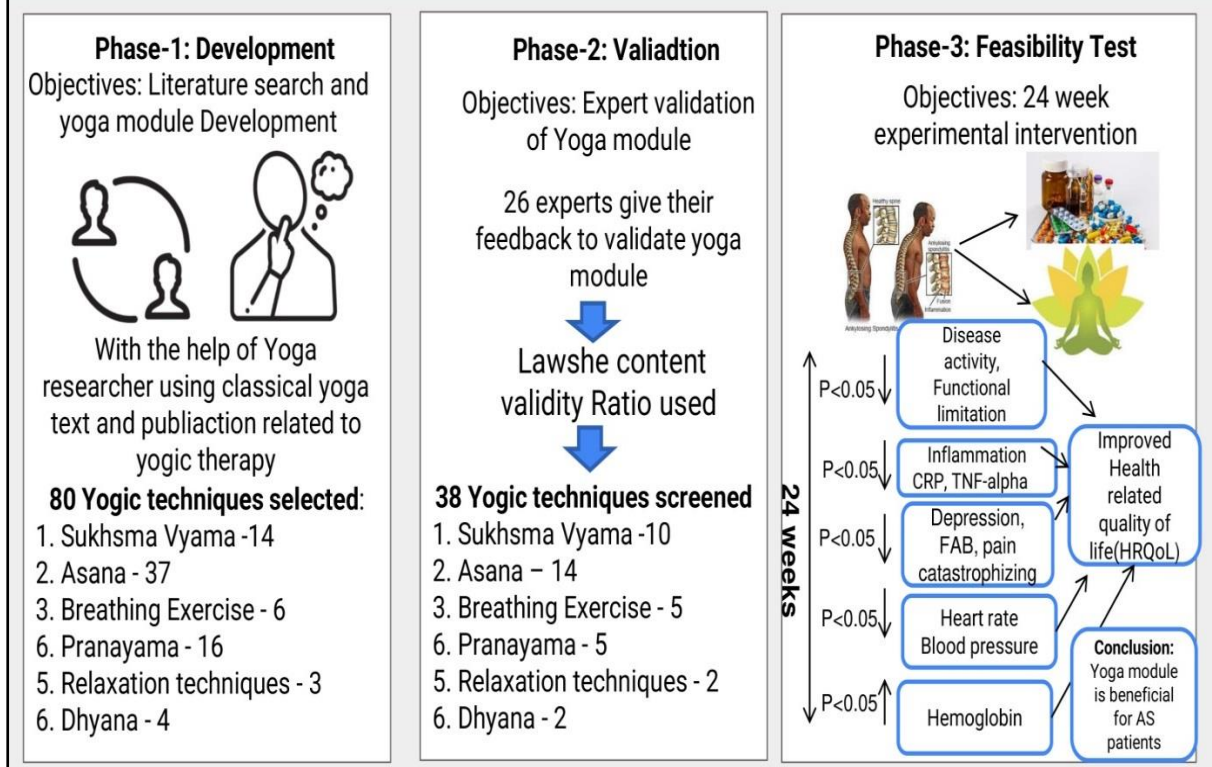
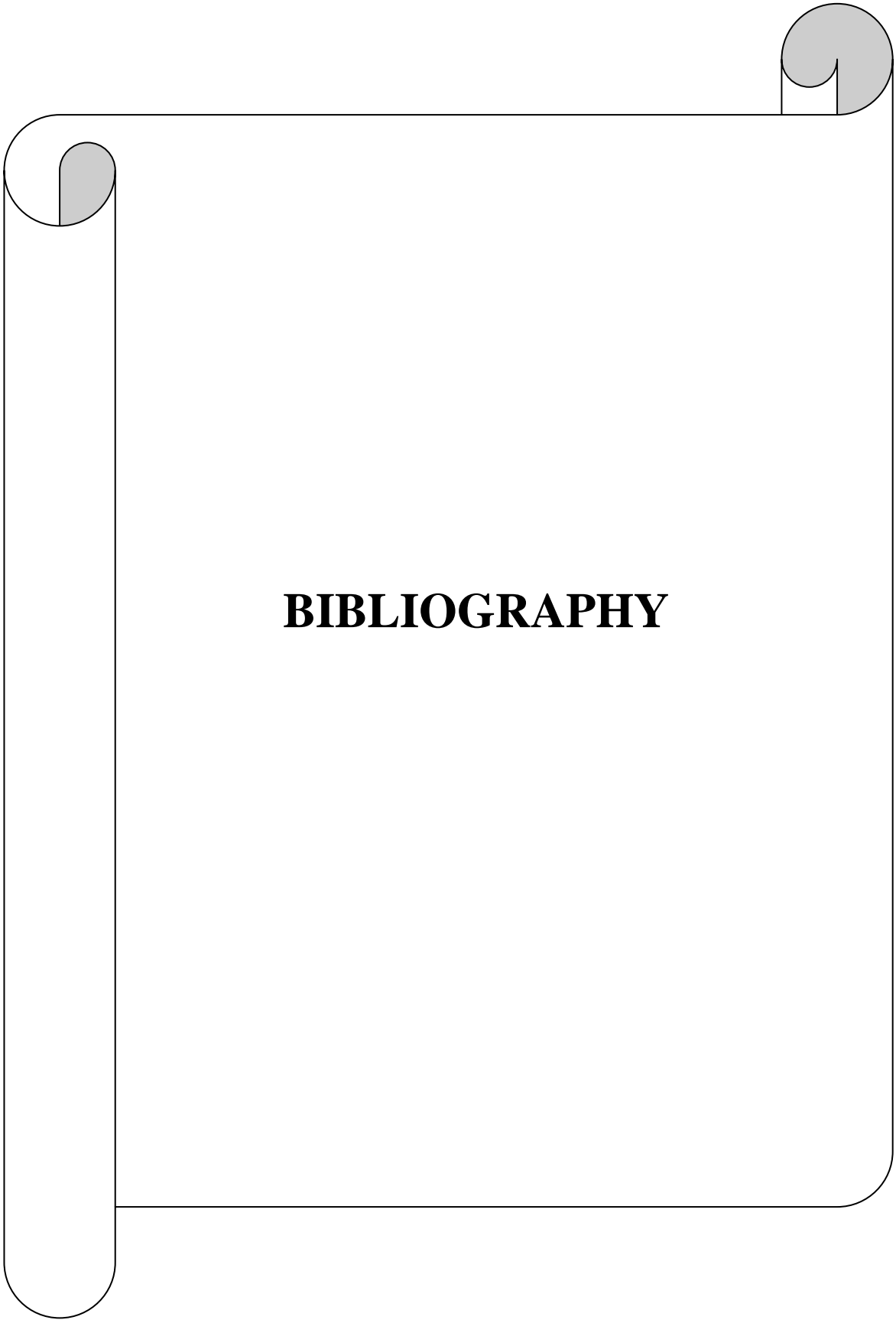


Photo. no. 43: Visual Abstract of the entire study



BIBLIOGRAPHY

Reference:

1. Urits I, Burshtein A, Sharma M, et al. Low Back Pain, a Comprehensive Review: Pathophysiology, Diagnosis, and Treatment. *Curr Pain Headache Rep.* 2019;23(3):23. doi:10.1007/s11916-019-0757-1
2. Allegri M, Montella S, Salici F, et al. Mechanisms of low back pain: a guide for diagnosis and therapy. *F1000Research.* 2016;5:F1000 Faculty Rev-1530. doi:10.12688/f1000research.8105.2
3. Almeida DC, Kraychete DC. Low back pain – a diagnostic approach. *Rev Dor.* 2017;18(2). doi:10.5935/1806-0013.20170034
4. Patrick N, Emanski E, Knaub MA. Acute and chronic low back pain. *Med Clin North Am.* 2014;98(4):777-789, xii. doi:10.1016/j.mcna.2014.03.005
5. Borenstein DG. CHRONIC LOW BACK PAIN. *Rheum Dis Clin N Am.* 1996;22(3):439-456. doi:10.1016/S0889-857X(05)70281-7
6. GBD 2021 Low Back Pain Collaborators. Global, regional, and national burden of low back pain, 1990-2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. *Lancet Rheumatol.* 2023;5(6):e316-e329. doi:10.1016/S2665-9913(23)00098-X
7. Malik K, Nelson A. Overview of Low Back Pain Disorders. In: *Essentials of Pain Medicine.* Elsevier; 2018:193-206.e2. doi:10.1016/B978-0-323-40196-8.00024-3
8. Padayachee N, Lundie M, Shellack N. An overview of the management of back pain. *South Afr Fam Pract.* 2018;60(4):14-21. doi:10.4102/safp.v60i4.4897
9. Borenstein D, Calin A. *Fast Facts: Low Back Pain.* Accessed April 10, 2025. <https://karger.com/books/book/3599/Fast-Facts-Low-Back-Pain>
10. Falconer MA, McGEORGE M, Begg AC. Observations on the cause and mechanism of symptom-production in sciatica and low-back pain. *J Neurol Neurosurg Psychiatry.* 1948;11(1):13-26. doi:10.1136/jnnp.11.1.13
11. Hooten WM, Cohen SP. Evaluation and treatment of low back pain: a clinically focused review for primary care specialists. In: *Mayo Clinic Proceedings.* Vol 90. Elsevier; 2015:1699-1718. Accessed May 29, 2024. <https://www.sciencedirect.com/science/article/pii/S0025619615008046>
12. Deyo Richard A., Weinstein James N. Low Back Pain. *N Engl J Med.* 2001;344(5):363-370. doi:10.1056/NEJM200102013440508
13. Hoy D, March L, Brooks P, et al. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. *Ann Rheum Dis.* 2014;73(6):968-974. doi:10.1136/annrheumdis-2013-204428
14. Van Der Linden S, Van Der Heijde D. ANKYLOSING SPONDYLITIS. *Rheum Dis Clin N Am.* 1998;24(4):663-676. doi:10.1016/S0889-857X(05)70036-3
15. Kim TH, Uhm WS, Inman RD. Pathogenesis of ankylosing spondylitis and reactive arthritis: *Curr Opin Rheumatol.* 2005;17(4):400-405. doi:10.1097/01.bor.0000163447.44037.c4

16. Mahmood F, Helliwell P. Ankylosing Spondylitis: A Review. Published online November 30, 2017. Accessed March 20, 2025. <https://www.emjreviews.com/rheumatology/article/ankylosing-spondylitis-a-review/>
17. Frey Law LA, Haftel HM. Shoulder, Knee, and Hip Pain as Initial Symptoms of Juvenile Ankylosing Spondylitis: A Case Report. *J Orthop Sports Phys Ther.* 1998;27(2):167-172. doi:10.2519/jospt.1998.27.2.167
18. Watkins J. Ankylosing spondylitis. *Indep Nurse.* 2011;2011(11). doi:10.12968/indn.2011.21.11.87837
19. Gran JT. An epidemiological survey of the signs and symptoms of ankylosing spondylitis. *Clin Rheumatol.* 1985;4(2):161-169. doi:10.1007/BF02032287
20. Bot SD, Caspers M, Van Royen BJ, Toussaint HM, Kingma I. Biomechanical analysis of posture in patients with spinal kyphosis due to ankylosing spondylitis: a pilot study. *Rheumatology.* 1999;38(5):441-443. doi:10.1093/rheumatology/38.5.441
21. Tam LS, Gu J, Yu D. Pathogenesis of ankylosing spondylitis. *Nat Rev Rheumatol.* 2010;6(7):399-405. doi:10.1038/nrrheum.2010.79
22. Yu T, Zhang J, Zhu W, et al. Chondrogenesis mediates progression of ankylosing spondylitis through heterotopic ossification. *Bone Res.* 2021;9(1):19. doi:10.1038/s41413-021-00140-6
23. Carter S, Lories RJ. Osteoporosis: A Paradox in Ankylosing Spondylitis. *Curr Osteoporos Rep.* 2011;9(3):112-115. doi:10.1007/s11914-011-0058-z
24. Wenker KJ, Quint JM. Ankylosing Spondylitis. In: *StatPearls.* StatPearls Publishing; 2025. Accessed April 12, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK470173/>
25. Jacobs WB, Fehlings MG. Ankylosing spondylitis and spinal cord injury: origin, incidence, management, and avoidance. *Neurosurg Focus.* 2008;24(1):E12. doi:10.3171/FOC/2008/24/1/E12
26. Sambrook PN, Geusens P. The epidemiology of osteoporosis and fractures in ankylosing spondylitis. *Ther Adv Musculoskelet Dis.* 2012;4(4):287-292. doi:10.1177/1759720X12441276
27. Chen HA, Chen CH, Liao HT, et al. Clinical, functional, and radiographic differences among juvenile-onset, adult-onset, and late-onset ankylosing spondylitis. *J Rheumatol.* 2012;39(5):1013-1018. doi:10.3899/jrheum.111031
28. Aggarwal R, Malaviya AN. Clinical characteristics of patients with ankylosing spondylitis in India. *Clin Rheumatol.* 2009;28(10):1199-1205. doi:10.1007/s10067-009-1227-7
29. Dean LE, Jones GT, MacDonald AG, Downham C, Sturrock RD, Macfarlane GJ. Global prevalence of ankylosing spondylitis. *Rheumatology.* 2014;53(4):650-657. doi:10.1093/rheumatology/ket387
30. Feldtkeller E, Khan MA, van der Heijde D, van der Linden S, Braun J. Age at disease onset and diagnosis delay in HLA-B27 negative vs. positive patients with ankylosing spondylitis. *Rheumatol Int.* 2003;23(2):61-66. doi:10.1007/s00296-002-0237-4
31. Little H, Swinson DR, Cruickshank B. Upward subluxation of the axis in ankylosing spondylitis. A clinical pathologic report. *Am J Med.* 1976;60(2):279-285. doi:10.1016/0002-9343(76)90438-1

32. Sieper J, Rudwaleit M, Baraliakos X, et al. The Assessment of SpondyloArthritis international Society (ASAS) handbook: a guide to assess spondyloarthritis. *Ann Rheum Dis.* 2009;68 Suppl 2:ii1-44. doi:10.1136/ard.2008.104018
33. Raychaudhuri SP, Deodhar A. The classification and diagnostic criteria of ankylosing spondylitis. *J Autoimmun.* 2014;48-49:128-133. doi:10.1016/j.jaut.2014.01.015
34. Reveille JD. 57 - Spondyloarthritis. In: Rich RR, Fleisher TA, Shearer WT, Schroeder HW, Frew AJ, Weyand CM, eds. *Clinical Immunology (Fifth Edition)*. Elsevier; 2019:769-787. doi:10.1016/B978-0-7020-6896-6.00057-0
35. Drosos AA, Venetsanopoulou AI, Voulgari PV. Axial Spondyloarthritis: Evolving concepts regarding the disease's diagnosis and treatment. *Eur J Intern Med.* 2023;117:21-27. doi:10.1016/j.ejim.2023.06.026
36. Mease PJ, Bhutani MK, Hass S, Yi E, Hur P, Kim N. Comparison of Clinical Manifestations in Rheumatoid Arthritis vs. Spondyloarthritis: A Systematic Literature Review. *Rheumatol Ther.* 2022;9(2):331-378. doi:10.1007/s40744-021-00407-8
37. Shani U, Watad A, Ehrenfeld M. Spondyloarthritis. In: Shoenfeld Y, Cervera R, Espinosa G, Gershwin ME, eds. *Autoimmune Disease Diagnosis: Systemic and Organ-Specific Diseases*. Springer Nature Switzerland; 2024:287-294. doi:10.1007/978-3-031-69895-8_39
38. Reveille JD, Hirsch R, Dillon CF, Carroll MD, Weisman MH. The prevalence of HLA-B27 in the US: data from the US National Health and Nutrition Examination Survey, 2009. *Arthritis Rheum.* 2012;64(5):1407-1411. doi:10.1002/art.33503
39. Braun J, Sieper J. Ankylosing spondylitis. *Lancet Lond Engl.* 2007;369(9570):1379-1390. doi:10.1016/S0140-6736(07)60635-7
40. Dougados M, Revel M, Khan MA. Spondylarthropathy treatment: progress in medical treatment, physical therapy and rehabilitation. *Baillieres Clin Rheumatol.* 1998;12(4):717-736. doi:10.1016/s0950-3579(98)80046-0
41. Wordsworth BP, Cohen CJ, Davidson C, Vecellio M. Perspectives on the Genetic Associations of Ankylosing Spondylitis. *Front Immunol.* 2021;12. doi:10.3389/fimmu.2021.603726
42. Mauro D, Thomas R, Guggino G, Lories R, Brown MA, Ciccia F. Ankylosing spondylitis: an autoimmune or autoinflammatory disease? *Nat Rev Rheumatol.* 2021;17(7):387-404. doi:10.1038/s41584-021-00625-y
43. Bilski R, Kamiński P, Kupczyk D, et al. Environmental and Genetic Determinants of Ankylosing Spondylitis. *Int J Mol Sci.* 2024;25(14):7814. doi:10.3390/ijms25147814
44. Liu F. *Investigating the Genetics and Immunopathogenesis of Ankylosing Spondylitis*. <http://purl.org/dc/dcmitype/Text>. University of Oxford; 2024. Accessed April 19, 2025. <https://ora.ox.ac.uk/objects/uuid:2056bd08-4873-4572-9d1d-4537aa133306>
45. Brown MA, Kenna T, Wordsworth BP. Genetics of ankylosing spondylitis—insights into pathogenesis. *Nat Rev Rheumatol.* 2016;12(2):81-91. doi:10.1038/nrrheum.2015.133
46. Bowness P. HLA-B27. *Annu Rev Immunol.* 2015;33(1):29-48. doi:10.1146/annurev-immunol-032414-112110

47. Brewerton DA, Hart FD, Nicholls A, Caffrey M, James DC, Sturrock RD. Ankylosing spondylitis and HL-A 27. *Lancet Lond Engl.* 1973;1(7809):904-907. doi:10.1016/s0140-6736(73)91360-3
48. Taurog JD. The Role of HLA-B27 in Spondyloarthritis. *J Rheumatol.* 2010;37(12):2606-2616. doi:10.3899/jrheum.100889
49. Reeves E, Colebatch-Bourn A, Elliott T, Edwards CJ, James E. Functionally distinct *ERAP1* allotype combinations distinguish individuals with Ankylosing Spondylitis. *Proc Natl Acad Sci.* 2014;111(49):17594-17599. doi:10.1073/pnas.1408882111
50. Dakwar E, Reddy J, Vale FL, Uribe JS. A review of the pathogenesis of ankylosing spondylitis. *Neurosurg Focus.* 2008;24(1):E2. doi:10.3171/FOC/2008/24/1/E2
51. Parameswaran P, Lucke M. HLA-B27 Syndromes. In: *StatPearls.* StatPearls Publishing; 2025. Accessed April 20, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK551523/>
52. Chen B, Li J, He C, et al. Role of HLA-B27 in the pathogenesis of ankylosing spondylitis (Review). *Mol Med Rep.* 2017;15(4):1943-1951. doi:10.3892/mmr.2017.6248
53. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. T Cells and MHC Proteins. In: *Molecular Biology of the Cell. 4th Edition.* Garland Science; 2002. Accessed April 20, 2025. <https://www.ncbi.nlm.nih.gov/books/NBK26926/>
54. Shamji MF, Bafaquh M, Tsai E. The pathogenesis of ankylosing spondylitis. *Neurosurg Focus.* 2008;24(1):E3. doi:10.3171/FOC/2008/24/1/E3
55. Rezaieanesh A, Abdolmaleki M, Abdolmohammadi K, et al. Immune cells involved in the pathogenesis of ankylosing spondylitis. *Biomed Pharmacother.* 2018;100:198-204. doi:10.1016/j.biopha.2018.01.108
56. Durmus B, Altay Z, Baysal O, Ersoy Y. Does vitamin D affect disease severity in patients with ankylosing spondylitis? *Chin Med J (Engl).* 2012;125(14):2511-2515.
57. Fang P, Liu X, Qiu Y, et al. Exploring causal correlations between inflammatory cytokines and ankylosing spondylitis: a bidirectional mendelian-randomization study. *Front Immunol.* 2023;14. doi:10.3389/fimmu.2023.1285106
58. Shen J, Yang L, You K, et al. Indole-3-Acetic Acid Alters Intestinal Microbiota and Alleviates Ankylosing Spondylitis in Mice. *Front Immunol.* 2022;13:762580. doi:10.3389/fimmu.2022.762580
59. Hmamouchi I, Allali F, Handaoui BE, et al. The relation between disease activity, vitamin D levels and bone mineral density in men patients with ankylosing spondylitis. *Rheumatol Rep.* 2013;5(1):e3-e3. doi:10.4081/rr.2013.e3
60. Exarchou S, Lindström U, Askling J, et al. The prevalence of clinically diagnosed ankylosing spondylitis and its clinical manifestations: a nationwide register study. *Arthritis Res Ther.* 2015;17(1):118. doi:10.1186/s13075-015-0627-0
61. Deodhar A, Kruzikas D, Zhou L, Biljan A, Saffore CD. Geographic Variations in Diagnosis and Treatment of Ankylosing Spondylitis in the United States: A Real-World Study. *Rheumatol Ther.* 2022;9(2):447-463. doi:10.1007/s40744-021-00406-9

62. Mahakkanukrauh A, Suwannaroj S, Pongkulkiat P, Onchan T, Foocharoen C. The incidence and prevalence of ankylosing spondylitis in Thailand using ministry of public health database. *Sci Rep.* 2024;14(1):16981. doi:10.1038/s41598-024-67666-7
63. Chopra A, Patil J, Billempelly V, Relwani J, Tandle HS, WHO-ILAR COPCORD Study. WHO International League of Associations from Rheumatology Community Oriented Program from Control of Rheumatic Diseases. Prevalence of rheumatic diseases in a rural population in western India: a WHO-ILAR COPCORD Study. *J Assoc Physicians India.* 2001;49:240-246.
64. Malaviya A, Shankar S, Arya V, et al. Indian Rheumatology Association consensus statement on the diagnosis and treatment of axial spondyloarthropathies. *Indian J Rheumatol.* 2010;5(1):16-34. doi:10.1016/S0973-3698(10)60531-6
65. Misra DP, Sharma A, Dharmanand BG, Chandrashekara S. The Epidemiology of Rheumatic Diseases in India. *Indian J Rheumatol.* 2024;19(1):54-61. doi:10.1177/09733698241229779
66. Gabriel SE, Michaud K. Epidemiological studies in incidence, prevalence, mortality, and comorbidity of the rheumatic diseases. *Arthritis Res Ther.* 2009;11(3):229. doi:10.1186/ar2669
67. Nokhla DN. Ankylosing Spondylitis: Early intervention, prevents bone fusion. *The Times of India.* <https://timesofindia.indiatimes.com/blogs/voices/ankylosing-spondylitis-early-intervention-prevents-bone-fusion/>. Accessed November 23, 2025.
68. El Maghraoui A. Extra-articular manifestations of ankylosing spondylitis: Prevalence, characteristics and therapeutic implications. *Eur J Intern Med.* 2011;22(6):554-560. doi:10.1016/j.ejim.2011.06.006
69. Prati C, Claudepierre P, Pham T, Wendling D. Mortality in spondylarthritis. *Joint Bone Spine.* 2011;78(5):466-470. doi:10.1016/j.jbspin.2011.02.012
70. Ben- Shabat N, Shabat A, Watad A, et al. Mortality in Ankylosing Spondylitis According to Treatment: A Nationwide Retrospective Cohort Study of 5,900 Patients From Israel. *Arthritis Care Res.* 2022;74(10):1614-1622. doi:10.1002/acr.24616
71. Fakhri O, Wendling D, Verhoeven F, Prati C. World mortality of ankylosing spondylitis, psoriatic arthritis and inflammatory bowel disease in 2015 and its evolution from 2001 to 2015. *Joint Bone Spine.* 2022;89(6):105452. doi:10.1016/j.jbspin.2022.105452
72. Keselowsky BG, Acharya A, Lewis JS. 2.2.3 - Innate and Adaptive Immunity: The Immune Response to Foreign Materials. In: Wagner WR, Sakiyama-Elbert SE, Zhang G, Yaszemski MJ, eds. *Biomaterials Science (Fourth Edition)*. Academic Press; 2020:747-775. doi:10.1016/B978-0-12-816137-1.00049-0
73. Delves PJ. Chapter 4 - Innate and Adaptive Systems of Immunity. In: Rose NR, Mackay IR, eds. *The Autoimmune Diseases (Sixth Edition)*. Academic Press; 2020:45-61. doi:10.1016/B978-0-12-812102-3.00004-X
74. Vanaki N, Aslani S, Jamshidi A, Mahmoudi M. Role of innate immune system in the pathogenesis of ankylosing spondylitis. *Biomed Pharmacother Biomedecine Pharmacother.* 2018;105:130-143. doi:10.1016/j.biopha.2018.05.097
75. Rezaeiemanesh A, Abdolmaleki M, Abdolmohammadi K, et al. Immune cells involved in the pathogenesis of ankylosing spondylitis. *Biomed Pharmacother Biomedecine Pharmacother.* 2018;100:198-204. doi:10.1016/j.biopha.2018.01.108

76. Vanaki N, Aslani S, Jamshidi A, Mahmoudi M. Role of innate immune system in the pathogenesis of ankylosing spondylitis. *Biomed Pharmacother Biomedecine Pharmacother*. 2018;105:130-143. doi:10.1016/j.biopha.2018.05.097
77. Watad A, Bridgewood C, Russell T, Marzo-Ortega H, Cuthbert R, McGonagle D. The Early Phases of Ankylosing Spondylitis: Emerging Insights From Clinical and Basic Science. *Front Immunol*. 2018;9. doi:10.3389/fimmu.2018.02668
78. Sariyildiz A, Coskun Benlidayi I, Turk I, Zengin Acemoglu SS, Unal I. Biopsychosocial factors should be considered when evaluating central sensitization in axial spondyloarthritis. *Rheumatol Int*. 2023;43(5):923-932. doi:10.1007/s00296-023-05317-2
79. Verep U, Unal E, Oksüz S, Soy M, Önen F, Kiraz S. A new biopsychosocial questionnaire (BETY-BQ) for patients with ankylosing spondylitis. *Eur J Integr Med*. 2023;61:102267. doi:10.1016/j.eujim.2023.102267
80. Zhang S, Wang Y, Peng L, et al. Comparison of Clinical Features in HLA-B27 Positive and Negative Patients With Axial Spondyloarthritis: Results From a Cohort of 4,131 Patients. *Front Med*. 2020;7:609562. doi:10.3389/fmed.2020.609562
81. Rosenbaum J, Chandran V. Management of comorbidities in ankylosing spondylitis. *Am J Med Sci*. 2012;343(5):364-366. doi:10.1097/MAJ.0b013e3182514059
82. Yang K, Gong Y, Geng Z, et al. Correlates of depression, anxiety, and stress among patients with ankylosing spondylitis. *Adv Rheumatol*. 2025;65(1):14. doi:10.1186/s42358-025-00439-6
83. Özgül A, Peker F, Taskaynatan MA, Tan AK, Dinçer K, Kalyon TA. Effect of ankylosing spondylitis on health-related quality of life and different aspects of social life in young patients. *Clin Rheumatol*. 2006;25(2):168-174. doi:10.1007/s10067-005-1150-5
84. Subramanian R, Prasad S. Management of Ankylosing Spondylitis; Present Concepts and Guidelines. *APIK J Intern Med*. 2020;8(3):107. doi:10.4103/AJIM.AJIM_69_19
85. Gravaldi LP, Bonetti F, Lezzerini S, De Maio F. Effectiveness of Physiotherapy in Patients with Ankylosing Spondylitis: A Systematic Review and Meta-Analysis. *Healthcare*. 2022;10(1):132. doi:10.3390/healthcare10010132
86. Pm B, B B, RI N. Complementary and alternative medicine use among adults and children: United States, 2007. *Natl Health Stat Rep*. 2008;(12). Accessed May 7, 2025. <https://pubmed.ncbi.nlm.nih.gov/19361005/>
87. Axial Spondyloarthritis | American College of Rheumatology. Accessed November 23, 2025. <https://rheumatology.org/patients/axial-spondyloarthritis>
88. Ward MM, Deodhar A, Gensler LS, et al. 2019 Update of the American College of Rheumatology/Spondylitis Association of America/Spondyloarthritis Research and Treatment Network Recommendations for the Treatment of Ankylosing Spondylitis and Non-radiographic Axial Spondyloarthritis. *Arthritis Care Res*. 2019;71(10):1285-1299. doi:10.1002/acr.24025
89. Xuan Y, Huang H, Huang Y, Liu D, Hu X, Geng L. The Efficacy and Safety of Simple-Needling Therapy for Treating Ankylosing Spondylitis: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Evid-Based Complement Altern Med ECAM*. 2020;2020:4276380. doi:10.1155/2020/4276380

90. Westhovens R, Annemans L. Costs of drugs for treatment of rheumatic diseases. *RMD Open*. 2016;2(2). doi:10.1136/rmdopen-2016-000259
91. Srivastava RN, Pant S, Srivastava SR, et al. Treatment Modalities of Ankylosing Spondylitis. In: *Ankylosing Spondylitis - Recent Concepts*. IntechOpen; 2023. doi:10.5772/intechopen.108698
92. Ozgocmen S, Akgul O, Altay Z, et al. Expert opinion and key recommendations for the physical therapy and rehabilitation of patients with ankylosing spondylitis. *Int J Rheum Dis*. 2012;15(3):229-238. doi:10.1111/j.1756-185X.2011.01700.x
93. Alaffari N, Alqahtani F, Alhudiry S, et al. Exercise-based interventions for ankylosing spondylitis. *Int J Community Med Public Health*. 2024;12:482-486. doi:10.18203/2394-6040.ijcmph20244058
94. Aytekin E, Caglar NS, Ozgonenel L, Tutun S, Demiryontar DY, Demir SE. Home-based exercise therapy in patients with ankylosing spondylitis: effects on pain, mobility, disease activity, quality of life, and respiratory functions. *Clin Rheumatol*. 2012;31(1):91-97. doi:10.1007/s10067-011-1791-5
95. Zão A, Cantista P. The role of land and aquatic exercise in ankylosing spondylitis: a systematic review. *Rheumatol Int*. 2017;37(12):1979-1990. doi:10.1007/s00296-017-3829-8
96. Baysal E, Leblebicioğlu H, Khorshid L, Sari D. Why individuals choose balneotherapy and benefit from this kind of treatment. *Complement Ther Clin Pract*. 2018;32:157-162. doi:10.1016/j.ctcp.2018.06.010
97. Constant F, Guillemin F, Collin JF, Boulangé M. Use of Spa Therapy To Improve the Quality of Life of Chronic Low Back Pain Patients. *Med Care*. 1998;36(9):1309. Accessed May 6, 2025. https://journals.lww.com/lww-medicalcare/abstract/1998/09000/use_of_spa_therapy_to_improve_the_quality_of_life.3.aspx
98. Naumann J, Sadaghiani C. Therapeutic benefit of balneotherapy and hydrotherapy in the management of fibromyalgia syndrome: a qualitative systematic review and meta-analysis of randomized controlled trials. *Arthritis Res Ther*. 2014;16(4):R141. doi:10.1186/ar4603
99. Fernandez-Gonzalez M, Fernandez-Lao C, Martin-Martin L, et al. Therapeutic Benefits of Balneotherapy on Quality of Life of Patients with Rheumatoid Arthritis: A Systematic Review. *Int J Environ Res Public Health*. 2021;18(24):13216. doi:10.3390/ijerph182413216
100. van Middelkoop M, Rubinstein SM, Kuijpers T, et al. A systematic review on the effectiveness of physical and rehabilitation interventions for chronic non-specific low back pain. *Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc*. 2011;20(1):19-39. doi:10.1007/s00586-010-1518-3
101. Rutherford SM, Nicolson CF, Crowther ER. Symptomatic improvement in function and disease activity in a patient with ankylosing spondylitis utilizing a course of chiropractic therapy: a prospective case study. *J Can Chiropr Assoc*. 2005;49(2):81-91. Accessed May 6, 2025. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1840019/>
102. Vera-Saura P, Agudo-Pavón J, Velázquez-Torres DM, et al. The Importance of Mind–Body in Pilates Method in Patients with Chronic Non-Specific Low Back Pain—A Randomized Controlled Trial. *J Clin Med*. 2024;13(16):4731. doi:10.3390/jcm13164731

103. Altan L, Korkmaz N, Dizdar M, Yurtkuran M. Effect of Pilates training on people with ankylosing spondylitis. *Rheumatol Int.* 2012;32(7):2093-2099. doi:10.1007/s00296-011-1932-9
104. Mak S, Allen J, Vries GD, et al. BACKGROUND. In: *Evidence Map of Tai Chi and Qigong: Update from 2014–2024*. Department of Veterans Affairs (US); 2025. Accessed November 23, 2025. <https://www.ncbi.nlm.nih.gov/books/NBK617891/>
105. Gasibat Q, Suwehli W. Determining the Benefits of Massage Mechanisms: A Review of Literature. *J Rehabil Sci.* 2017;2:58-67. doi:10.11648/j.rs.20170203.12
106. Dundar U, Solak O, Toktas H, et al. Effect of aquatic exercise on ankylosing spondylitis: a randomized controlled trial. *Rheumatol Int.* 2014;34(11):1505-1511. doi:10.1007/s00296-014-2980-8
107. Ramiro S, Landewé R, Tubergen A van, et al. Lifestyle factors may modify the effect of disease activity on radiographic progression in patients with ankylosing spondylitis: a longitudinal analysis. *RMD Open.* 2015;1(1):e000153. doi:10.1136/rmdopen-2015-000153
108. Dang S, Ren Y, Zhao B, et al. Efficacy and safety of warm acupuncture in the treatment of ankylosing spondylitis. *Medicine (Baltimore).* 2021;100(1):e24116. doi:10.1097/MD.00000000000024116
109. Benson H, Beary JF, Carol MP. The relaxation response. *Psychiatry.* 1974;37(1):37-46. doi:10.1080/00332747.1974.11023785
110. Yoga: Effectiveness and Safety. NCCIH. Accessed November 23, 2025. <https://www.nccih.nih.gov/health/yoga-effectiveness-and-safety>
111. Ferrara M. Rest after War: yóga in the R̥gveda and Its Scholarly Understanding in the Nineteenth and Twentieth centuries. *Myth Riv Storia Delle Relig.* 2020;(14). doi:10.4000/mythos.2643
112. Mooventhan A, Nivethitha L. Evidence based effects of yoga practice on various health related problems of elderly people: A review. *J Bodyw Mov Ther.* 2017;21(4):1028-1032. doi:10.1016/j.jbmt.2017.01.004
113. Bharat K, Pandey A, Chowdhury K, Sonika. Historical and Current Perspective of Yoga: An Overview. *Int Res J Ayurveda Yoga.* 2023;06. doi:10.47223/IRJAY.2023.6413
114. Shukla M, Nathani N, Mishra PK, Kumar A. Neuroscience and the Pancha Kosha: A Scientific Exploration. *Afr J Biomed Res.* 2025;28(1S):734-736. doi:10.53555/AJBR.v28i1S.6212
115. Rayabagi P, Patil B. Contemplating the relevance of theory of Pancha Kosha in the present era. *J Ayurveda Holist Med JAHM.* 2023;11(2). doi:10.70066/jahm.v11i2.663
116. Satyānanda. *Asana Pranayama Mudra Bandha*. 4. ed., repr. Yoga Publications Trust; 2009.
117. Nourollahimoghadam E, Gorji S, Gorji A, Khaleghi Ghadiri M. Therapeutic role of yoga in neuropsychological disorders. *World J Psychiatry.* 2021;11(10):754-773. doi:10.5498/wjp.v11.i10.754
118. Burley M. Haṭha-Yoga : its context, theory, and practice. In: 2000. Accessed November 19, 2025. <https://www.semanticscholar.org/paper/Ha%E1%B9%ADha-Yoga-%3A-its-context%2C-theory%2C-and-practice-Burley/76b39cd8275e263554c3cad3da2c9643cd15a061>

119. Brown RP, Gerbarg PL. Sudarshan Kriya yogic breathing in the treatment of stress, anxiety, and depression: part I-neurophysiologic model. *J Altern Complement Med N Y N*. 2005;11(1):189-201. doi:10.1089/acm.2005.11.189
120. Telles S, Naveen KV. Yoga for rehabilitation: an overview. *Indian J Med Sci*. 1997;51(4):123-127.
121. Gard T, Hölzel BK, Lazar SW. The potential effects of meditation on age-related cognitive decline: a systematic review. *Ann N Y Acad Sci*. 2014;1307:89-103. doi:10.1111/nyas.12348
122. Gard T, Noggle JJ, Park CL, Vago DR, Wilson A. Potential self-regulatory mechanisms of yoga for psychological health. *Front Hum Neurosci*. 2014;8:770. doi:10.3389/fnhum.2014.00770
123. Gautam S, Kumar M, Kumar U, Dada R. 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. *Front Psychol*. 2020;11. doi:10.3389/fpsyg.2020.02259
124. Kieskamp SC, van der Kraan Y, Arends S, et al. Interrelationships of disease activity, central sensitization, psychosocial and lifestyle factors in axial spondyloarthritis. *Rheumatol Oxf Engl*. 2025;64(6):3547-3555. doi:10.1093/rheumatology/keaf102
125. Webers C, Vanhoof L, Leue C, Boonen A, Köhler S. Depression in ankylosing spondylitis and the role of disease-related and contextual factors: a cross-sectional study. *Arthritis Res Ther*. 2019;21(1):215. doi:10.1186/s13075-019-1995-7
126. Ross A, Thomas S. The health benefits of yoga and exercise: a review of comparison studies. *J Altern Complement Med N Y N*. 2010;16(1):3-12. doi:10.1089/acm.2009.0044
127. Ross A, Thomas S. The health benefits of yoga and exercise: a review of comparison studies. *J Altern Complement Med N Y N*. 2010;16(1):3-12. doi:10.1089/acm.2009.0044
128. Streeter CC, Gerbarg PL, Saper RB, Ciraulo DA, Brown RP. Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. *Med Hypotheses*. 2012;78(5):571-579. doi:10.1016/j.mehy.2012.01.021
129. Gothe NP, Khan I, Hayes J, Erlenbach E, Damoiseaux JS. Yoga Effects on Brain Health: A Systematic Review of the Current Literature. *Brain Plast*. 5(1):105-122. doi:10.3233/BPL-190084
130. Patil NJ, Nagarathna R, Tekur P, Patil DN, Nagendra HR, Subramanya P. Designing, validation, and feasibility of integrated yoga therapy module for chronic low back pain. *Int J Yoga*. 2015;8(2):103-108. doi:10.4103/0973-6131.158470
131. Vijayaraghava A, Doreswamy V, Narasipur OS, Kunnavil R, Srinivasamurthy N. Effect of Yoga Practice on Levels of Inflammatory Markers After Moderate and Strenuous Exercise. *J Clin Diagn Res JCDR*. 2015;9(6):CC08-CC12. doi:10.7860/JCDR/2015/12851.6021
132. Gandolfi MG, Zamparini F, Spinelli A, Prati C. Āsana for Back, Hips and Legs to Prevent Musculoskeletal Disorders among Dental Professionals: In-Office Yóga Protocol. *J Funct Morphol Kinesiol*. 2024;9(1):6. doi:10.3390/jfkm9010006
133. Singh RB, Wilczyńska-Kwiatek A, Fedacko J, Pella D, De Meester F. Pranayama: The power of breath. *Int J Disabil Hum Dev*. 2009;8(2). doi:10.1515/IJDHD.2009.8.2.141

134. Moreno JJ. Modulation of inflammatory response and pain by mind-body therapies as meditation. *Brain Behav Immun Integr*. 2024;5:100036. doi:10.1016/j.bbii.2023.100036
135. Bower JE, Irwin MR. Mind-body therapies and control of inflammatory biology: A descriptive review. *Brain Behav Immun*. 2016;51:1-11. doi:10.1016/j.bbi.2015.06.012
136. Arya S, Yadav RK, Venkataraman S, Deepak KK, Bhatia R. Objective evidence for chronic back pain relief by Medical Yoga therapy. *Front Pain Res*. 2022;3:1060685. doi:10.3389/fpain.2022.1060685
137. Bhargav H, Metri K, Raghuram N, Ramarao NH, Koka PS. Enhancement of cancer stem cell susceptibility to conventional treatments through complementary yoga therapy: possible cellular and molecular mechanisms. *J Stem Cells*. 2012;7(4):261-267.
138. Streeter CC, Gerbarg PL, Saper RB, Ciraulo DA, Brown RP. Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. *Med Hypotheses*. 2012;78(5):571-579. doi:10.1016/j.mehy.2012.01.021
139. Ganesan S, Gaur GS, Negi VS, Sharma VK, Pal GK. Effect of Yoga Therapy on Disease Activity, Inflammatory Markers, and Heart Rate Variability in Patients with Rheumatoid Arthritis. *J Altern Complement Med*. 2020;26(6):501-507. doi:10.1089/acm.2019.0228
140. Gautam S, Tolahunase M, Kumar U, Dada R. Impact of yoga based mind-body intervention on systemic inflammatory markers and co-morbid depression in active Rheumatoid arthritis patients: A randomized controlled trial. *Restor Neurol Neurosci*. 2019;37(1):41-59. doi:10.3233/RNN-180875
141. Singh VK, Bhandari RB, Rana BB. Effect of yogic package on rheumatoid arthritis. *Indian J Physiol Pharmacol*. 2011;55(4):329-335.
142. Sharma M. Yoga as an Alternative and Complementary Approach for Arthritis: A Systematic Review. *J Evid-Based Complement Altern Med*. 2014;19(1):51-58. doi:10.1177/2156587213499918
143. Sagtaganov Z, Yessirkepov M, Bekaryssova D. Yoga as a complementary therapy for rheumatoid arthritis: a case-based review. *Rheumatol Int*. 2024;44(8):1575-1579. doi:10.1007/s00296-024-05641-1
144. Baraliakos X, Weisman MH. *Spondyloarthritis: The Changing Landscape Today, An Issue of Rheumatic Disease Clinics of North America*. Elsevier Health Sciences; 2020.
145. Djalilova DM, Schulz PS, Berger AM, Case AJ, Kupzyk KA, Ross AC. Impact of Yoga on Inflammatory Biomarkers: A Systematic Review. *Biol Res Nurs*. 2019;21(2):198-209. doi:10.1177/1099800418820162
146. Acar Y, İlçin N, Sarı İ. The Effects of Tele-Yoga in Ankylosing Spondylitis Patients: A Randomized Controlled Trial. *J Integr Complement Med*. 2023;29(11):727-737. doi:10.1089/jicm.2023.0022
147. Singh VP, Khandelwal B, Sherpa NT. Psycho-neuro-endocrine-immune mechanisms of action of yoga in type II diabetes. *Anc Sci Life*. 2015;35(1):12-17. doi:10.4103/0257-7941.165623
148. Zeidan F, Vago DR. Mindfulness meditation–based pain relief: a mechanistic account. *Ann N Y Acad Sci*. 2016;1373(1):114-127. doi:10.1111/nyas.13153

149. Singh J, Tekur P, Metri KG, Mohanty S, Singh A, Nagaratna R. Potential Role of Yoga in the Management of Ankylosing Spondylitis: A Retrospective Study. *Ann Neurosci*. 2021;28(1-2):74-78. doi:10.1177/09727531211035335
150. Moonaz SH, Bingham CO, Wissow L, Bartlett SJ. Yoga in Sedentary Adults with Arthritis: Effects of a Randomized Controlled Pragmatic Trial. *J Rheumatol*. 2015;42(7):1194-1202. doi:10.3899/jrheum.141129
151. Haaz S, Bartlett SJ. Yoga for Arthritis: A Scoping Review. *Rheum Dis Clin North Am*. 2011;37(1):33-46. doi:10.1016/j.rdc.2010.11.001
152. Bower JE, Irwin MR. Mind-body therapies and control of inflammatory biology: A descriptive review. *Brain Behav Immun*. 2016;51:1-11. doi:10.1016/j.bbi.2015.06.012
153. Cramer H, Lauche R, Langhorst J, Dobos G. Yoga for rheumatic diseases: a systematic review. *Rheumatol Oxf Engl*. 2013;52(11):2025-2030. doi:10.1093/rheumatology/ket264
154. Schmalzl L, Powers C, Henje E. Neurophysiological and neurocognitive mechanisms underlying the effects of yoga-based practices: towards a comprehensive theoretical framework. *Front Hum Neurosci*. 2015;9. doi:10.3389/fnhum.2015.00235
155. Innes KE, Selfe TK. Meditation as a Therapeutic Intervention for Adults at Risk for Alzheimer's Disease – Potential Benefits and Underlying Mechanisms. *Front Psychiatry*. 2014;5:40. doi:10.3389/fpsy.2014.00040
156. Katayama K, Saito M. Muscle sympathetic nerve activity during exercise. *J Physiol Sci JPS*. 2019;69(4):589-598. doi:10.1007/s12576-019-00669-6
157. Khattab K, Khattab AA, Ortak J, Richardt G, Bonnemeier H. Iyengar yoga increases cardiac parasympathetic nervous modulation among healthy yoga practitioners. *Evid-Based Complement Altern Med ECAM*. 2007;4(4):511-517. doi:10.1093/ecam/nem087
158. Tellhed U, Daukantaitė D, Maddux RE, Svensson T, Melander O. Yogic Breathing and Mindfulness as Stress Coping Mediate Positive Health Outcomes of Yoga. *Mindfulness*. 2019;10(12):2703-2715. doi:10.1007/s12671-019-01225-4
159. Tripathi V, Bharadwaj P. Neuroscience of the yogic theory of consciousness. *Neurosci Conscious*. 2021;2021(2):niab030. doi:10.1093/nc/niab030
160. Eda N, Ito H, Akama T. Beneficial Effects of Yoga Stretching on Salivary Stress Hormones and Parasympathetic Nerve Activity. *J Sports Sci Med*. 2020;19(4):695-702. Accessed November 23, 2025. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7675619/>
161. Djalilova DM, Schulz PS, Berger AM, Case AJ, Kupzyk KA, Ross AC. Impact of Yoga on Inflammatory Biomarkers: A Systematic Review. *Biol Res Nurs*. 2019;21(2):198-209. doi:10.1177/1099800418820162
162. Chopra D, Stern E, Bushell WC, Castle RD. Yoga and pain: A mind-body complex system. *Front Pain Res*. 2023;4:1075866. doi:10.3389/fpain.2023.1075866
163. Acharya NN, Venkatesan P, Karvannan H, Balebail Gopalakrishna D. Comparison of Yoga with exercise in ankylosing spondylitis on mobility and functional capacity. *Int J Rheum Dis*. 2024;27(6):e15223. doi:10.1111/1756-185X.15223

164. Swathi PS, Raghavendra BR, Saoji AA. Health and therapeutic benefits of Shatkarma: A narrative review of scientific studies. *J Ayurveda Integr Med.* 2021;12(1):206-212. doi:10.1016/j.jaim.2020.11.008
165. Sengupta P. Health Impacts of Yoga and Pranayama: A State-of-the-Art Review. *Int J Prev Med.* 2012;3(7):444-458. Accessed November 23, 2025. <https://pmc.ncbi.nlm.nih.gov/articles/PMC3415184/>
166. Sepriano A, Rubio R, Ramiro S, Landewé R, van der Heijde D. Performance of the ASAS classification criteria for axial and peripheral spondyloarthritis: a systematic literature review and meta-analysis. *Ann Rheum Dis.* 2017;76(5):886-890. doi:10.1136/annrheumdis-2016-210747
167. Marshall JS, Warrington R, Watson W, Kim HL. An introduction to immunology and immunopathology. *Allergy Asthma Clin Immunol.* 2018;14(2):49. doi:10.1186/s13223-018-0278-1
168. Kurup S, Pozun A. Biochemistry, Autoimmunity. In: *StatPearls*. StatPearls Publishing; 2025. Accessed November 23, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK576418/>
169. Chen L, Deng H, Cui H, et al. Inflammatory responses and inflammation-associated diseases in organs. *Oncotarget.* 2017;9(6):7204-7218. doi:10.18632/oncotarget.23208
170. Oronsky B, Caroén S, Reid T. What Exactly Is Inflammation (and What Is It Not?). *Int J Mol Sci.* 2022;23(23):14905. doi:10.3390/ijms232314905
171. Wenker KJ, Quint JM. Ankylosing Spondylitis. In: *StatPearls*. StatPearls Publishing; 2025. Accessed November 23, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK470173/>
172. Lee A, Gupta M, Boyinepally K, Stokey PJ, Ebraheim NA. Sacroiliitis: A Review on Anatomy, Diagnosis, and Treatment. *Adv Orthop.* 2022;2022:3283296. doi:10.1155/2022/3283296
173. Benjamin M, McGONAGLE D. Basic Concepts of Enthesis Biology and Immunology. *J Rheumatol Suppl.* 2009;83:12-13. doi:10.3899/jrheum.090211
174. Crux NB, Elahi S. Human Leukocyte Antigen (HLA) and Immune Regulation: How Do Classical and Non-Classical HLA Alleles Modulate Immune Response to Human Immunodeficiency Virus and Hepatitis C Virus Infections? *Front Immunol.* 2017;8:832. doi:10.3389/fimmu.2017.00832
175. Gao J, Zhu C, Zhu Z, et al. The human leukocyte antigen and genetic susceptibility in human diseases. *J Bio-X Res.* 2019;02(03):112-120. doi:10.1097/JBR.0000000000000044
176. Garrett S, Jenkinson T, Kennedy LG, Whitelock H, Gaisford P, Calin A. A new approach to defining disease status in ankylosing spondylitis: the Bath Ankylosing Spondylitis Disease Activity Index. *J Rheumatol.* 1994;21(12):2286-2291.
177. Balkwill F. Tumour necrosis factor and cancer. *Nat Rev Cancer.* 2009;9(5):361-371. doi:10.1038/nrc2628
178. Parameswaran N, Patial S. Tumor necrosis factor- α signaling in macrophages. *Crit Rev Eukaryot Gene Expr.* 2010;20(2):87-103. doi:10.1615/critreveukargeneexpr.v20.i2.10
179. Tishkowsky K, Zubair M. Erythrocyte Sedimentation Rate. In: *StatPearls*. StatPearls Publishing; 2025. Accessed November 23, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK557485/>

180. Sproston NR, Ashworth JJ. Role of C-Reactive Protein at Sites of Inflammation and Infection. *Front Immunol.* 2018;9:754. doi:10.3389/fimmu.2018.00754
181. Mouliou DS. C-Reactive Protein: Pathophysiology, Diagnosis, False Test Results and a Novel Diagnostic Algorithm for Clinicians. *Diseases.* 2023;11(4):132. doi:10.3390/diseases11040132
182. El Brihi J, Pathak S. Normal and Abnormal Complete Blood Count With Differential. In: *StatPearls.* StatPearls Publishing; 2025. Accessed November 23, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK604207/>
183. Li Z, Ruan M, Chen J, Fang Y. Major Depressive Disorder: Advances in Neuroscience Research and Translational Applications. *Neurosci Bull.* 2021;37(6):863-880. doi:10.1007/s12264-021-00638-3
184. Yihunie M, Abich Y, Demissie SF, Kassa T, Ranganathan P, Janakiraman B. Fear-Avoidance Beliefs for Physical Activity Among Chronic Low Back Pain: A Multicenter Cross-Sectional Study. *J Pain Res.* 2023;16:233-243. doi:10.2147/JPR.S388002
185. THOMPSON OJ, POWELL-ROACH K, TAYLOR JL, TERRY EL, BOOKER SQ. Pain catastrophizing: A patient-centered approach to assessment. *Nursing (Lond).* 2022;52(4):26-30. doi:10.1097/01.NURSE.0000823252.50782.45
186. Yin S, Njai R, Barker L, Siegel PZ, Liao Y. Summarizing health-related quality of life (HRQOL): development and testing of a one-factor model. *Popul Health Metr.* 2016;14:22. doi:10.1186/s12963-016-0091-3
187. de Wit M, Hajos T. Health-Related Quality of Life. In: *Encyclopedia of Behavioral Medicine.* Springer, New York, NY; 2013:929-931. doi:10.1007/978-1-4419-1005-9_753
188. Alhaji M, Zubair M, Farhana A. Enzyme Linked Immunosorbent Assay. In: *StatPearls.* StatPearls Publishing; 2025. Accessed November 23, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK555922/>
189. Saper RB, Lemaster C, Delitto A, et al. Yoga, Physical Therapy, or Education for Chronic Low Back Pain: A Randomized Noninferiority Trial. *Ann Intern Med.* 2017;167(2):85-94. doi:10.7326/M16-2579
190. Joyce C, Kelly KC, Gurnani S, Sherman KJ, Roseen EJ, Saper RB. "In Class We Were All One." A Qualitative Exploration of Yoga and Educational Interventions for Predominantly Low-Income and Minority Adults with Chronic Low Back Pain. *J Integr Complement Med.* 2022;28(11):870-877. doi:10.1089/jicm.2022.0557
191. Marshall A, Joyce CT, Tseng B, et al. Changes in Pain Self-Efficacy, Coping Skills, and Fear-Avoidance Beliefs in a Randomized Controlled Trial of Yoga, Physical Therapy, and Education for Chronic Low Back Pain. *Pain Med Malden Mass.* 2022;23(4):834-843. doi:10.1093/pm/pnab318
192. Groessl EJ, Liu L, Richard EL, Tally SR. Cost-effectiveness of Yoga for Chronic Low Back Pain in Veterans. *Med Care.* 2020;58:S142. doi:10.1097/MLR.0000000000001356
193. Joyce CT, Chernofsky A, Lodi S, Sherman KJ, Saper RB, Roseen EJ. Do Physical Therapy and Yoga Improve Pain and Disability through Psychological Mechanisms? A Causal Mediation Analysis of Adults with Chronic Low Back Pain. *J Orthop Sports Phys Ther.* 2022;52(7):470-483. doi:10.2519/jospt.2022.10813

194. Poojari S, Dhiman D, Ghai B, et al. Effectiveness of integrated approach of yoga therapy versus usual care in management on chronic low back pain patients: A randomized controlled pilot study. *Pain Pract Off J World Inst Pain*. 2024;24(2):248-260. doi:10.1111/papr.13296
195. Tankha H, Gaskins D, Shallcross A, et al. Effectiveness of Virtual Yoga for Chronic Low Back Pain: A Randomized Clinical Trial. *JAMA Netw Open*. 2024;7(11):e2442339. doi:10.1001/jamanetworkopen.2024.42339
196. Brämberg EB, Bergström G, Jensen I, Hagberg J, Kwak L. Effects of yoga, strength training and advice on back pain: a randomized controlled trial. *BMC Musculoskelet Disord*. 2017;18(1):132. doi:10.1186/s12891-017-1497-1
197. Groessl EJ, Liu L, Chang DG, et al. Yoga for Military Veterans with Chronic Low Back Pain: A Randomized Clinical Trial. *Am J Prev Med*. 2017;53(5):599-608. doi:10.1016/j.amepre.2017.05.019
198. Roseen EJ, Gerlovin H, Femia A, et al. Yoga, Physical Therapy, and Back Pain Education for Sleep Quality in Low-Income Racially Diverse Adults with Chronic Low Back Pain: a Secondary Analysis of a Randomized Controlled Trial. *J Gen Intern Med*. 2020;35(1):167-176. doi:10.1007/s11606-019-05329-4
199. Oz M, Ulger O. Yoga, Physical Therapy and Home Exercise Effects on Chronic Low Back Pain: Pain Perception, Function, Stress, and Quality of Life in a Randomized Trial. *Percept Mot Skills*. 2024;131(6):2216-2243. doi:10.1177/00315125241292235
200. Ulger O, Oz M, Ozel Asliyuce Y. The Effects of Yoga and Stabilization Exercises in Patients With Chronic Low Back Pain: A Randomized Crossover Study. *Holist Nurs Pract*. 2023;37(4):E59-E68. doi:10.1097/HNP.0000000000000593
201. Yildirim P, Gultekin A. The Effect of a Stretch and Strength-Based Yoga Exercise Program on Patients with Neuropathic Pain due to Lumbar Disc Herniation. *Spine*. 2022;47(10):711-719. doi:10.1097/BRS.00000000000004316
202. Berlowitz J, Hall DL, Joyce C, et al. Changes in Perceived Stress After Yoga, Physical Therapy, and Education Interventions for Chronic Low Back Pain: A Secondary Analysis of a Randomized Controlled Trial. *Pain Med Malden Mass*. 2020;21(10):2529-2537. doi:10.1093/pm/pnaa150
203. Roseen EJ, Pinheiro A, Lemaster CM, et al. Yoga Versus Education for Veterans with Chronic Low Back Pain: a Randomized Controlled Trial. *J Gen Intern Med*. 2023;38(9):2113-2122. doi:10.1007/s11606-023-08037-2
204. McCarthy A, Liu L, Groessl E. Mediation Analysis of Yoga's Effect on Chronic Low-Back Pain in Veterans: What Factors Really Matter? *Int J Yoga Ther*. 2022;32(2022):Article 9. doi:10.17761/2022-D-21-00020
205. Williams KA, Petronis J, Smith D, et al. Effect of Iyengar yoga therapy for chronic low back pain. *Pain*. 2005;115(1-2):107-117. doi:10.1016/j.pain.2005.02.016
206. Singphow C, Purohit S, Tekur P, et al. Effect of Yoga on Stress, Anxiety, Depression, and Spinal Mobility in Computer Users with Chronic Low Back Pain. *Int J Yoga*. 2022;15(2):114-121. doi:10.4103/ijoy.ijoy_9_22

207. Lee M, Moon W, Kim J. Effect of yoga on pain, brain-derived neurotrophic factor, and serotonin in premenopausal women with chronic low back pain. *Evid-Based Complement Altern Med ECAM*. 2014;2014:203173. doi:10.1155/2014/203173
208. Tekur P, Chametcha S, Hongasandra RN, Raghuram N. Effect of yoga on quality of life of CLBP patients: A randomized control study. *Int J Yoga*. 2010;3(1):10-17. doi:10.4103/0973-6131.66773
209. Tekur P, Singphow C, Nagendra HR, Raghuram N. Effect of short-term intensive yoga program on pain, functional disability and spinal flexibility in chronic low back pain: a randomized control study. *J Altern Complement Med N Y N*. 2008;14(6):637-644. doi:10.1089/acm.2007.0815
210. Tilbrook HE, Cox H, Hewitt CE, et al. Yoga for chronic low back pain: a randomized trial. *Ann Intern Med*. 2011;155(9):569-578. doi:10.7326/0003-4819-155-9-201111010-00003
211. Sherman KJ, Wellman RD, Cook AJ, Cherkin DC, Ceballos RM. Mediators of Yoga and Stretching for Chronic Low Back Pain. *Evid-Based Complement Altern Med ECAM*. 2013;2013:130818. doi:10.1155/2013/130818
212. Neyaz O, Sumila L, Nanda S, Wadhwa S. Effectiveness of Hatha Yoga Versus Conventional Therapeutic Exercises for Chronic Nonspecific Low-Back Pain. *J Altern Complement Med N Y N*. 2019;25(9):938-945. doi:10.1089/acm.2019.0140
213. Patil NJ, Nagaratna R, Tekur P, Manohar PV, Bhargav H, Patil D. A Randomized Trial Comparing Effect of Yoga and Exercises on Quality of Life in among nursing population with Chronic Low Back Pain. *Int J Yoga*. 2018;11(3):208-214. doi:10.4103/ijoy.IJOY_2_18
214. Michalsen A, Jeitler M, Kessler CS, et al. Yoga, Eurythmy Therapy and Standard Physiotherapy (YES-Trial) for Patients With Chronic Non-specific Low Back Pain: A Three-Armed Randomized Controlled Trial. *J Pain*. 2021;22(10):1233-1245. doi:10.1016/j.jpain.2021.03.154
215. Bhatta J, Tekur P, Tikhe SG, Nagendra HR. Yoga reduces chronic low back pain: An innovative approach. *Yoga Mimamsa*. 2015;47(1-2):6. doi:10.4103/0044-0507.195460
216. Adhikari B, Starkweather A, Xu W, et al. A feasibility study on yoga's mechanism of action for chronic low back pain: psychological and neurophysiological changes, including global gene expression and DNA methylation, following a yoga intervention for chronic low back pain. *Pilot Feasibility Stud*. 2022;8(1):142. doi:10.1186/s40814-022-01103-2
217. Starkweather AR, Xu W, Gnall KE, et al. Testing Biological and Psychological Pathways of Emotion Regulation as a Primary Mechanism of Action in Yoga Interventions for Chronic Low Back Pain: Protocol for a Randomized Controlled Trial. *JMIR Res Protoc*. 2024;13:e56016. doi:10.2196/56016
218. Galantino ML, Bzdewka TM, Eissler-Russo JL, et al. The impact of modified Hatha yoga on chronic low back pain: a pilot study. *Altern Ther Health Med*. 2004;10(2):56-59.
219. Twal WO, Wahlquist AE, Balasubramanian S. Yogic breathing when compared to attention control reduces the levels of pro-inflammatory biomarkers in saliva: a pilot randomized controlled trial. *BMC Complement Altern Med*. 2016;16(1):294. doi:10.1186/s12906-016-1286-7

220. Maniaci G, Daino M, Iapichino M, et al. Neurobiological and Anti- Inflammatory Effects of a Deep Diaphragmatic Breathing Technique Based on Neofunctional Psychotherapy: A Pilot RCT. *Stress Health*. 2024;40(6):e3503. doi:10.1002/smi.3503
221. Shah K, Adhikari C, Sharma S, Saha S, Saxena D. Yoga, Meditation, Breathing Exercises, and Inflammatory Biomarkers with Possible Implications in COVID-19: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Garrido G, ed. *Evid Based Complement Alternat Med*. 2022;2022:1-28. doi:10.1155/2022/3523432
222. Mullapudi T, Debnath M, Govindaraj R, Raj P, Banerjee M, Varambally S. Effects of a six-month yoga intervention on the immune-inflammatory pathway in antipsychotic-stabilized schizophrenia patients: A randomized controlled trial. *Asian J Psychiatry*. 2023;86:103636. doi:10.1016/j.ajp.2023.103636
223. Muñoz-Vergara D, Schreiber KL, Langevin H, et al. The Effects of a Single Bout of High- or Moderate-Intensity Yoga Exercise on Circulating Inflammatory Mediators: A Pilot Feasibility Study. *Glob Adv Health Med*. 2022;11:2164957X221145876. doi:10.1177/2164957X221145876
224. Mishra B, Agarwal A, George JA, et al. Effectiveness of Yoga in Modulating Markers of Immunity and Inflammation: A Systematic Review and Meta-Analysis. *Cureus*. Published online April 3, 2024. doi:10.7759/cureus.57541
225. Pullen PR, Nagamia SH, Mehta PK, et al. Effects of yoga on inflammation and exercise capacity in patients with chronic heart failure. *J Card Fail*. 2008;14(5):407-413. doi:10.1016/j.cardfail.2007.12.007
226. Yadav RK, Magan D, Mehta N, Sharma R, Mahapatra SC. Efficacy of a short-term yoga-based lifestyle intervention in reducing stress and inflammation: preliminary results. *J Altern Complement Med N Y N*. 2012;18(7):662-667. doi:10.1089/acm.2011.0265
227. Shete SU, Verma A, Kulkarni DD, Bhogal RS. Effect of yoga training on inflammatory cytokines and C-reactive protein in employees of small-scale industries. *J Educ Health Promot*. 2017;6:76. doi:10.4103/jehp.jehp_65_17
228. Gautam S, Kumar U, Kumar M, Rana D, Dada R. Yoga improves mitochondrial health and reduces severity of autoimmune inflammatory arthritis: A randomized controlled trial. *Mitochondrion*. 2021;58:147-159. doi:10.1016/j.mito.2021.03.004
229. Chen N, Xia X, Qin L, et al. Effects of 8-Week Hatha Yoga Training on Metabolic and Inflammatory Markers in Healthy, Female Chinese Subjects: A Randomized Clinical Trial. *BioMed Res Int*. 2016;2016:1-12. doi:10.1155/2016/5387258
230. Harkess KN, Ryan J, Delfabbro PH, Cohen-Woods S. Preliminary indications of the effect of a brief yoga intervention on markers of inflammation and DNA methylation in chronically stressed women. *Transl Psychiatry*. 2016;6(11):e965-e965. doi:10.1038/tp.2016.234
231. Kiecolt-Glaser JK, Bennett JM, Andridge R, et al. Yoga's impact on inflammation, mood, and fatigue in breast cancer survivors: a randomized controlled trial. *J Clin Oncol Off J Am Soc Clin Oncol*. 2014;32(10):1040-1049. doi:10.1200/JCO.2013.51.8860
232. Kiecolt-Glaser JK, Christian L, Preston H, et al. Stress, Inflammation, and Yoga Practice. *Psychosom Med*. 2010;72(2):113-121. doi:10.1097/PSY.0b013e3181cb9377

233. Long Parma D, Hughes DC, Ghosh S, et al. Effects of six months of Yoga on inflammatory serum markers prognostic of recurrence risk in breast cancer survivors. *SpringerPlus*. 2015;4(1):143. doi:10.1186/s40064-015-0912-z
234. Rajbhoj PH, Shete SU, Verma A, Bhogal RS. Effect of yoga module on pro-inflammatory and anti-inflammatory cytokines in industrial workers of lonavla: a randomized controlled trial. *J Clin Diagn Res JCDR*. 2015;9(2):CC01-05. doi:10.7860/JCDR/2015/11426.5551
235. Sharma P, Poojary G, Dwivedi SN, Deepak KK. Effect of Yoga-Based Intervention in Patients with Inflammatory Bowel Disease. *Int J Yoga Ther*. 2015;25(1):101-112. doi:10.17761/1531-2054-25.1.101
236. Kwok JYY, Chan LML, Lai CA, et al. Effects of Meditation and Yoga on Anxiety, Depression and Chronic Inflammation in Patients with Parkinson's Disease: A Randomized Clinical Trial. *Psychother Psychosom*. Published online February 28, 2025:101-118. doi:10.1159/000543457
237. Cho HK, Moon W, Kim J. Effects of yoga on stress and inflammatory factors in patients with chronic low back pain: A non-randomized controlled study. *Eur J Integr Med*. 2015;7(2):118-123. doi:10.1016/j.eujim.2014.10.008
238. Colgrove YM, Gravino-Dunn NS, Dinyer SC, Sis EA, Heier AC, Sharma NK. Physical and Physiological Effects of Yoga for an Underserved Population with Chronic Low Back Pain. *Int J Yoga*. 2019;12(3):252-264. doi:10.4103/ijoy.IJOY_78_18
239. Gopal A, Mondal S, Gandhi A, Arora S, Bhattacharjee J. Effect of integrated yoga practices on immune responses in examination stress – A preliminary study. *Int J Yoga*. 2011;4(1):26-32. doi:10.4103/0973-6131.78178
240. Agnihotri S, Kant S, Kumar S, Mishra RK, Mishra SK. Impact of yoga on biochemical profile of asthmatics: A randomized controlled study. *Int J Yoga*. 2014;7(1):17. doi:10.4103/0973-6131.123473
241. Bower JE, Greendale G, Crosswell AD, et al. Yoga reduces inflammatory signaling in fatigued breast cancer survivors: A randomized controlled trial. *Psychoneuroendocrinology*. 2014;43:20-29. doi:10.1016/j.psyneuen.2014.01.019
242. Cade W, Reeds D, Mondy K, et al. Yoga lifestyle intervention reduces blood pressure in HIV-infected adults with cardiovascular disease risk factors*. *HIV Med*. 2010;11(6):379-388. doi:10.1111/j.1468-1293.2009.00801.x
243. Krishna BH. Association of Leukocyte Telomere Length with Oxidative Stress in Yoga Practitioners. *J Clin Diagn Res*. Published online 2015. doi:10.7860/JCDR/2015/13076.5729
244. Lim SA, Cheong KJ. Regular Yoga Practice Improves Antioxidant Status, Immune Function, and Stress Hormone Releases in Young Healthy People: A Randomized, Double-Blind, Controlled Pilot Study. *J Altern Complement Med*. 2015;21(9):530-538. doi:10.1089/acm.2014.0044
245. Naoroibam R, Metri KG, Bhargav H, Nagaratna R, Nagendra HR. Effect of Integrated Yoga (IY) on psychological states and CD4 counts of HIV-1 infected patients: A randomized controlled pilot study. *Int J Yoga*. 2016;9(1):57-61. doi:10.4103/0973-6131.171723
246. Vogler J, O'Hara L, Gregg J, Burnell F. The impact of a short-term iyengar yoga program on the health and well-being of physically inactive older adults. *Int J Yoga Ther*. 2011;(21):61-72.

247. Yonglitthipagon P, Muansiangsai S, Wongkhumngern W, et al. Effect of yoga on the menstrual pain, physical fitness, and quality of life of young women with primary dysmenorrhea. *J Bodyw Mov Ther.* 2017;21(4):840-846. doi:10.1016/j.jbmt.2017.01.014
248. Woodyard C. Exploring the therapeutic effects of yoga and its ability to increase quality of life. *Int J Yoga.* 2011;4(2):49-54. doi:10.4103/0973-6131.85485
249. Wolff M, Sundquist K, Larsson Lönn S, Midlöv P. Impact of yoga on blood pressure and quality of life in patients with hypertension - a controlled trial in primary care, matched for systolic blood pressure. *BMC Cardiovasc Disord.* 2013;13:111. doi:10.1186/1471-2261-13-111
250. Bahçecioglu Turan G, Tan M. The effect of yoga on respiratory functions, symptom control and life quality of asthma patients: A randomized controlled study. *Complement Ther Clin Pract.* 2020;38:101070. doi:10.1016/j.ctcp.2019.101070
251. Keerthi GS, Pal P, Pal GK, Sahoo JP, Sridhar MG, Balachander J. Effect of 12 Weeks of Yoga Therapy on Quality of Life and Indian Diabetes Risk Score in Normotensive Indian Young Adult Prediabetics and Diabetics: Randomized Control Trial. *J Clin Diagn Res JCDR.* 2017;11(9):CC10-CC14. doi:10.7860/JCDR/2017/29307.10633
252. Evans S, Moieni M, Lung K, et al. Impact of Iyengar yoga on quality of life in young women with rheumatoid arthritis. *Clin J Pain.* 2013;29(11):988-997. doi:10.1097/AJP.0b013e31827da381
253. Badsha H, Chhabra V, Leibman C, Mofti A, Kong KO. The benefits of yoga for rheumatoid arthritis: results of a preliminary, structured 8-week program. *Rheumatol Int.* 2009;29(12):1417-1421. doi:10.1007/s00296-009-0871-1
254. Greysen HM, Hong OS, Katz P. The Association Between Yoga Use, Physical Function, and Employment in Adults With Rheumatoid Arthritis. *Holist Nurs Pract.* 2019;33(2):71-79. doi:10.1097/HNP.0000000000000296
255. Dash M, Telles S. Improvement in hand grip strength in normal volunteers and rheumatoid arthritis patients following yoga training. *Indian J Physiol Pharmacol.* 2001;45(3):355-360.
256. Pukšić S, Mitrović J, Čulo MI, et al. Effects of Yoga in Daily Life program in rheumatoid arthritis: A randomized controlled trial. *Complement Ther Med.* 2021;57:102639. doi:10.1016/j.ctim.2020.102639
257. Gautam S, Kumar M, Kumar U, Dada R. 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. *Front Psychol.* 2020;11:2259. doi:10.3389/fpsyg.2020.02259
258. Cartwright T, Cahill M, Sadana V. A mixed methods evaluation of an individualised yoga therapy intervention for rheumatoid arthritis: Pilot study. *Complement Ther Med.* 2020;50:102339. doi:10.1016/j.ctim.2020.102339
259. Ward L, Stebbings S, Athens J, Cherkin D, David Baxter G. Yoga for the management of pain and sleep in rheumatoid arthritis: a pilot randomized controlled trial. *Musculoskeletal Care.* 2018;16(1):39-47. doi:10.1002/msc.1201
260. Pandya DB. AB0973 THE IMPACT OF YOGA, ANTI-INFLAMMATORY DIET & SELF MONITORING IN CHILDREN WITH RHEUMATIC DISEASES. *Ann Rheum Dis.* 2020;79(Suppl 1):1781-1782. doi:10.1136/annrheumdis-2020-eular.2650

261. Evans S, Moieni M, Subramanian S, Tsao JCI, Sternlieb B, Zeltzer LK. "Now I see a brighter day": expectations and perceived benefits of an Iyengar yoga intervention for young patients with rheumatoid arthritis. *J Yoga Phys Ther.* 2011;1(101):101. doi:10.4172/2157-7595.1000101
262. Haslock I, Monro R, Nagarathna R, Nagendra HR, Raghuram NV. Measuring the effects of yoga in rheumatoid arthritis. *Br J Rheumatol.* 1994;33(8):787-788. doi:10.1093/rheumatology/33.8.787-a
263. Bosch PR, Traustadóttir T, Howard P, Matt KS. Functional and physiological effects of yoga in women with rheumatoid arthritis: a pilot study. *Altern Ther Health Med.* 2009;15(4):24-31.
264. Ghosh A, Mandal P. A study to assess the improvement in physical function and spinal pain after a 3-month supervised rehabilitation program in patients with axial spondyloarthritis. *Indian J Pain.* 2019;33:67. doi:10.4103/ijpn.ijpn_64_18
265. Ince G, Sarpel T, Durgun B, Erdogan S. Effects of a multimodal exercise program for people with ankylosing spondylitis. *Phys Ther.* 2006;86(7):924-935.
266. Roşu MO, Ţopa I, Chiriac R, Ancuta C. Effects of Pilates, McKenzie and Heckscher training on disease activity, spinal motility and pulmonary function in patients with ankylosing spondylitis: a randomized controlled trial. *Rheumatol Int.* 2014;34(3):367-372. doi:10.1007/s00296-013-2869-y
267. Gurpınar B, Ilcin N, Savci S, Akkoc N. Do mobility exercises in different environments have different effects in ankylosing spondylitis? *Acta Reumatol Port.* 2021;46(4):297-316.
268. Souza MC de, Jennings F, Morimoto H, Natour J. Swiss ball exercises improve muscle strength and walking performance in ankylosing spondylitis: a randomized controlled trial. *Rev Bras Reumatol.* 2017;57(1):45-55. doi:10.1016/j.rbre.2016.09.009
269. Song Y, Reifsnider E, Chen Y, Wang Y, Chen H. The Impact of a Theory-Based mHealth Intervention on Disease Knowledge, Self-efficacy, and Exercise Adherence Among Ankylosing Spondylitis Patients: Randomized Controlled Trial. *J Med Internet Res.* 2022;24(10):e38501. doi:10.2196/38501
270. Passalent LA, Soever LJ, O'Shea FD, Inman RD. Exercise in ankylosing spondylitis: discrepancies between recommendations and reality. *J Rheumatol.* 2010;37(4):835-841. doi:10.3899/jrheum.090655
271. Subramanian S. Ankylosing Spondylitis treated with Physioball Exercises Using Yoga and Gravity – An Innovative Means of physiotherapy. *J Med Sci Clin Res.* 2017;05:20426-20432. doi:10.18535/jmscr/v5i4.112
272. Husakova M, Pavelka K, Spiritovic M, Levitova A. AB1180 The intensive exercise programme for non-radiographic axial spondyloarthritis and for ankylosing spondylitis may improved quality of life and disease activity. *Ann Rheum Dis.* 2017;76:1468-1469. doi:10.1136/annrheumdis-2017-eular.2589
273. Sveaas S, Berg JJ, Fongen C, Provan SA, and Dagfinrud H. High-intensity cardiorespiratory and strength exercises reduced emotional distress and fatigue in patients with axial spondyloarthritis: a randomized controlled pilot study. *Scand J Rheumatol.* 2018;47(2):117-121. doi:10.1080/03009742.2017.1347276

274. Jennings F, Oliveira HA, Souza MC de, Cruz V da G, Natour J. Effects of Aerobic Training in Patients with Ankylosing Spondylitis. *J Rheumatol.* 2015;42(12):2347-2353. doi:10.3899/jrheum.150518
275. Rodríguez-Lozano C, Juanola X, Cruz-Martínez J, et al. Outcome of an education and home-based exercise programme for patients with ankylosing spondylitis: A nationwide randomised study. *Clin Exp Rheumatol.* 2013;31(5):739-748.
276. Sveaas SH, Berg IJ, Provan SA, et al. Efficacy of high intensity exercise on disease activity and cardiovascular risk in active axial spondyloarthritis: a randomized controlled pilot study. *PLoS One.* 2014;9(9):e108688. doi:10.1371/journal.pone.0108688
277. Dönmez U, Ozturk C, Kocanaogullari H, Gucenmez S, Hepguler S. SAT0369 Do Physical Therapy Modalities Have Additional Benefit over Exercise Therapy in the Management of Ankylosing Spondylitis? A Randomized Controlled Trial. *Ann Rheum Dis.* 2014;73:727. doi:10.1136/annrheumdis-2014-eular.4279
278. Fernández García R, Sánchez Sánchez L de C, López Rodríguez M del M, Sánchez Granados G. Effects of an exercise and relaxation aquatic program in patients with spondyloarthritis: A randomized trial. *Med Clínica Engl Ed.* 2015;145(9):380-384. doi:10.1016/j.medcle.2016.03.001
279. Lim HJ, Moon YI, Lee MS. Effects of home-based daily exercise therapy on joint mobility, daily activity, pain, and depression in patients with ankylosing spondylitis. *Rheumatol Int.* 2005;25(3):225-229. doi:10.1007/s00296-004-0536-z
280. Kjekken I, Bå, I, RÅnningen A, et al. A three-week multidisciplinary in-patient rehabilitation programme had positive long-term effects in patients with ankylosing spondylitis: Randomized controlled trial. *J Rehabil Med.* 2013;45(3):260-267. doi:10.2340/16501977-1078
281. Masiero S, Bonaldo L, Pigatto M, Lo Nigro A, Ramonda R, Punzi L. Rehabilitation Treatment in Patients with Ankylosing Spondylitis Stabilized with Tumor Necrosis Factor Inhibitor Therapy. A Randomized Controlled Trial. *J Rheumatol.* 2011;38(7):1335-1342. doi:10.3899/jrheum.100987
282. Xie Y, Guo F, Lu Y, et al. A 12-week Baduanjin Qigong exercise improves symptoms of ankylosing spondylitis: A randomized controlled trial. *Complement Ther Clin Pract.* 2019;36:113-119. doi:10.1016/j.ctcp.2018.12.007
283. Sweeney S, Taylor G, Calin A. The effect of a home based exercise intervention package on outcome in ankylosing spondylitis: a randomized controlled trial. *J Rheumatol.* 2002;29(4):763-766.
284. Widberg K, Karimi H, Hafström I. Self- and manual mobilization improves spine mobility in men with ankylosing spondylitis — a randomized study. *Clin Rehabil.* 2009;23(7):599-608. doi:10.1177/0269215508101748
285. Singh J, Metri K, Tekur P, Mohanty S, Singh A, Raghuram N. Tele-yoga in the management of ankylosing spondylitis amidst COVID pandemic: A prospective randomized controlled trial. *Complement Ther Clin Pract.* 2023;50:101672. doi:10.1016/j.ctcp.2022.101672
286. Singh SK, Sharma DK, Acharya IN, Deo G. ROLE OF SELECTED YOGA PRACTICES IN THE TREATMENT OF ANKYLOSING SPONDYLITIS: A CASE STUDY. *Int J AYUSH.* 2022;11(1):44-55. Accessed April 28, 2024. <https://internationaljournal.org.in/journal/index.php/ijayush/article/view/577>

287. Sushma NS, Shyamasundaran K, Prajeesh Nath EN, Puthiyedath R. Integrative approach combining Ayurveda, counselling, Yoga and meditation with conventional management of Ankylosing Spondylitis - A case report. *J Ayurveda Integr Med.* 2022;13(1):100497. doi:10.1016/j.jaim.2021.07.013
288. Singh J, Metri K, Tekur P, et al. Designing, validation, and feasibility of a yoga module for patients with ankylosing spondylitis. *J Ayurveda Integr Med.* 2022;13(1):100479. doi:10.1016/j.jaim.2021.06.019
289. Yu KC, Lo LY, Lin M, Cheung Y, Wong SS. A preliminary study of an online pain management programme for patients with ankylosing spondylitis. *Couns Psychother Res.* 2021;21(1):227-236. doi:10.1002/capr.12314
290. Buijze GA, De Jong HMY, Kox M, et al. 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. *PLoS ONE.* 2019;14(12):e0225749. doi:10.1371/journal.pone.0225749
291. Acar Y, İlçin N, Sari I. ANKYLOSING SPONDYLITIS AND TELE-YOGA DURING COVID-19 PANDEMIC: PRELIMINARY RESULTS OF A RANDOMIZED CONTROLLED TRIAL. Vol 81.; 2022. doi:10.1136/annrheumdis-2022-eular.1930
292. Jana A. Influence of yogic practices on patients with Ankylosing spondylitis. *University.* Published online 2024. Accessed November 26, 2025. <https://shodhganga.inflibnet.ac.in/handle/10603/609576>
293. Manik RK, Mahapatra AK, Gartia R, Bansal S, Patnaik A. Effect of Selected Yogic Practices on Pain and Disability in Patients with Lumbar Spondylitis. *Int J Yoga.* 2017;10(2):81-87. doi:10.4103/0973-6131.205516
294. Deepeshwar S, Tanwar M, Kavuri V, Budhi RB. Effect of Yoga Based Lifestyle Intervention on Patients With Knee Osteoarthritis: A Randomized Controlled Trial. *Front Psychiatry.* 2018;9:180. doi:10.3389/fpsy.2018.00180
295. Ebnezar J, Nagarathna R, Yogitha B, Nagendra HR. Effect of integrated yoga therapy on pain, morning stiffness and anxiety in osteoarthritis of the knee joint: A randomized control study. *Int J Yoga.* 2012;5(1):28-36. doi:10.4103/0973-6131.91708
296. Jain M, Sahoo DP, Sahoo J, Kumar DS, Manik R. Effect of selected group of asana when used as an adjunct in management of cervical spondylosis of mild to moderate severity: An observational study. *J Ayurveda Integr Med.* 2021;12(2):351-355. doi:10.1016/j.jaim.2021.01.011
297. Hartfiel N, Clarke G, Havenhand J, Phillips C, Edwards RT. Cost-effectiveness of yoga for managing musculoskeletal conditions in the workplace. *Occup Med.* 2017;67(9):687-695. doi:10.1093/occmed/kqx161
298. Joshi V, Bellad A. Effect of yogic exercises on symptoms of musculoskeletal disorders of upper limbs among computer users: A randomised controlled trial. *Indian J Med Sci.* 2011;65(10):424. doi:10.4103/0019-5359.109256
299. Metri KG, Raghuram N, Narayan M, et al. Impact of workplace yoga on pain measures, mental health, sleep quality, and quality of life in female teachers with chronic musculoskeletal pain: A randomized controlled study. *Work Read Mass.* 2023;76(2):521-531. doi:10.3233/WOR-210269

300. Mirzaei T, Tavakoli O, Ravari A. The Effect of Yoga on Musculoskeletal Pain in Elderly Females: A Clinical Trial. *Iran Rehabil J.* 2022;20(0):55-64. doi:10.32598/irj.20.SpecialIssue.1512.1
301. Liu AM, Chu IH, Lin HT, Liang JM, Hsu HT, Wu WL. Training Benefits and Injury Risks of Standing Yoga Applied in Musculoskeletal Problems: Lower Limb Biomechanical Analysis. *Int J Environ Res Public Health.* 2021;18(16):8402. doi:10.3390/ijerph18168402
302. Curtis K, Hitzig SL, Bechsgaard G, et al. Evaluation of a specialized yoga program for persons with a spinal cord injury: a pilot randomized controlled trial. *J Pain Res.* 2017;10:999-1017. doi:10.2147/JPR.S130530
303. Schmid AA, Fruhauf CA, Sharp JL, Van Puymbroeck M, Bair MJ, Portz JD. Yoga for People With Chronic Pain in a Community-Based Setting: A Feasibility and Pilot RCT. *J Evid-Based Integr Med.* 2019;24:2515690X19863763. doi:10.1177/2515690X19863763
304. Lazaridou A, Koulouris A, Dorado K, Chai P, Edwards RR, Schreiber KL. The Impact of a Daily Yoga Program for Women with Fibromyalgia. *Int J Yoga.* 2019;12(3):206-217. doi:10.4103/ijoy.IJOY_72_18
305. Katla N, Ramsahaye A, Thulasi A, et al. Yoga Module Development and Validation: A Systematic Review with Methodological Guidelines. *Int J Yoga.* 2022;15(3):175-186. doi:10.4103/ijoy.ijoy_59_22
306. O'Driscoll SL, Jayson MI, Baddeley H. Neck movements in ankylosing spondylitis and their responses to physiotherapy. *Ann Rheum Dis.* 1978;37(1):64-66. Accessed February 25, 2025. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1000191/>
307. Pravalika B, Yamuna U, Saoji AA. Effect of Yoga on musculoskeletal pain and discomfort, perceived stress, and quality of sleep in industrial workers: Study protocol for a randomized controlled trial. *Adv Integr Med.* 2022;9(4):224-229. doi:10.1016/j.aimed.2022.11.003
308. Brahmachari D. YOGIC SUKSMA VYAYAMA.
309. Spondyloarthritis and Exercise | SPONDYLITIS.ORG. Spondylitis Association of America - Ankylosing Spondylitis. Accessed November 23, 2025. <https://spondylitis.org/about-spondylitis/treatment-information/exercise/>
310. Sutanto D, Ho RST, Poon ETC, Yang Y, Wong SHS. Effects of Different Trunk Training Methods for Chronic Low Back Pain: A Meta-Analysis. *Int J Environ Res Public Health.* 2022;19(5):2863. doi:10.3390/ijerph19052863
311. Resources -> Exercise. ASIF. Accessed November 23, 2025. <https://asif.info/resources-exercise/>
312. TAKAKI S, KANEOKA K, OKUBO Y, et al. Analysis of muscle activity during active pelvic tilting in sagittal plane. *Phys Ther Res.* 2016;19(1):50-57. Accessed April 25, 2025. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5342962/>
313. Ludwig O, Dindorf C, Kelm S, Kelm J, Fröhlich M. Muscular Strategies for Correcting the Pelvic Position to Improve Posture—An Exploratory Study. *J Funct Morphol Kinesiol.* 2024;9(1):25. doi:10.3390/jfmk9010025
314. Laird RA, Gilbert J, Kent P, Keating JL. Comparing lumbo-pelvic kinematics in people with and without back pain: a systematic review and meta-analysis. *BMC Musculoskelet Disord.* 2014;15:229. doi:10.1186/1471-2474-15-229

315. Nolte K, Janse van Rensburg DC. The role of exercise in the rehabilitation of ankylosing spondylitis. *Int J Sports Med*. Published online November 1, 2001.
316. Sohrabi S, Rahimi M, Babaei-Mobarakeh M, Piri H. The Effect of Eight Weeks of Iyengar Yoga With an Emphasis on Spine and Shoulder Exercises on the Upper Cross Syndrome in Middle-aged Women | *Journal of Modern Rehabilitation*. Accessed November 27, 2025. <https://jmr.tums.ac.ir/index.php/jmr/article/view/319>
317. Madanmohan null, Thombre DP, Balakumar B, et al. Effect of yoga training on reaction time, respiratory endurance and muscle strength. *Indian J Physiol Pharmacol*. 1992;36(4):229-233.
318. Scholar P, Schola P, Scholar P. Importance of Virabhadrasana-I in day to day life. Published online 2021.
319. Gautam S, Kumar U, Dada R. Yoga and its impact on chronic inflammatory autoimmune arthritis. *Front Biosci Elite Ed*. 2021;13(1):77-116. doi:10.2741/873
320. Chaudhari A, Dalvi O, Ramade O, Ambawade D. Yog-Guru: Real-Time Yoga Pose Correction System Using Deep Learning Methods. In: *2021 International Conference on Communication Information and Computing Technology (ICCICT)*. 2021:1-6. doi:10.1109/ICCICT50803.2021.9509937
321. Jain S, Rustagi A, Saurav S, Saini R, Singh S. Three-dimensional CNN-inspired deep learning architecture for Yoga pose recognition in the real-world environment. *Neural Comput Appl*. 2021;33(12):6427-6441. doi:10.1007/s00521-020-05405-5
322. Telles S, Bhardwaj AK, Gupta RK, Sharma SK, Monro R, Balkrishna A. A Randomized Controlled Trial to Assess Pain and Magnetic Resonance Imaging-Based (MRI-Based) Structural Spine Changes in Low Back Pain Patients After Yoga Practice. *Med Sci Monit Int Med J Exp Clin Res*. 2016;22:3238-3247. doi:10.12659/MSM.896599
323. Bhunamasana. Accessed November 27, 2025. https://www.yogaindailylife.org/system/en/level-2/bhunamasana?utm_source=chatgpt.com
324. Archana Y, Rakesh S, Ravindra P, Manish A. AN OBSERVATIONAL CLINICAL STUDY ON EFFECT OF USHTRASANA (YOGA) IN MANAGEMENT OF KATISHULA (LOW BACK PAIN) AND MANYASHULA (NECK PAIN). *J Res Educ Indian Med*. 2015;20(2):95-95. Accessed February 25, 2025. <https://www.jreim-ayushjournal.com/?mno=191192>
325. Yong MS, Lee YS, Lee HY. Effects of breathing exercises on resting metabolic rate and maximal oxygen uptake. *J Phys Ther Sci*. 2018;30(9):1173-1175. doi:10.1589/jpts.30.1173
326. Lawshe CH. A QUANTITATIVE APPROACH TO CONTENT VALIDITY¹. *Pers Psychol*. 1975;28(4):563-575. doi:10.1111/j.1744-6570.1975.tb01393.x
327. Hamilton M. A RATING SCALE FOR DEPRESSION. *J Neurol Neurosurg Psychiatry*. 1960;23(1):56-62. doi:10.1136/jnnp.23.1.56
328. Waddell G, Newton M, Henderson I, Somerville D, Main CJ. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain*. 1993;52(2):157-168. doi:10.1016/0304-3959(93)90127-B
329. Sullivan MJL, Bishop SR, Pivik J. The Pain Catastrophizing Scale: Development and validation. *Psychol Assess*. 1995;7(4):524-532. doi:10.1037/1040-3590.7.4.524

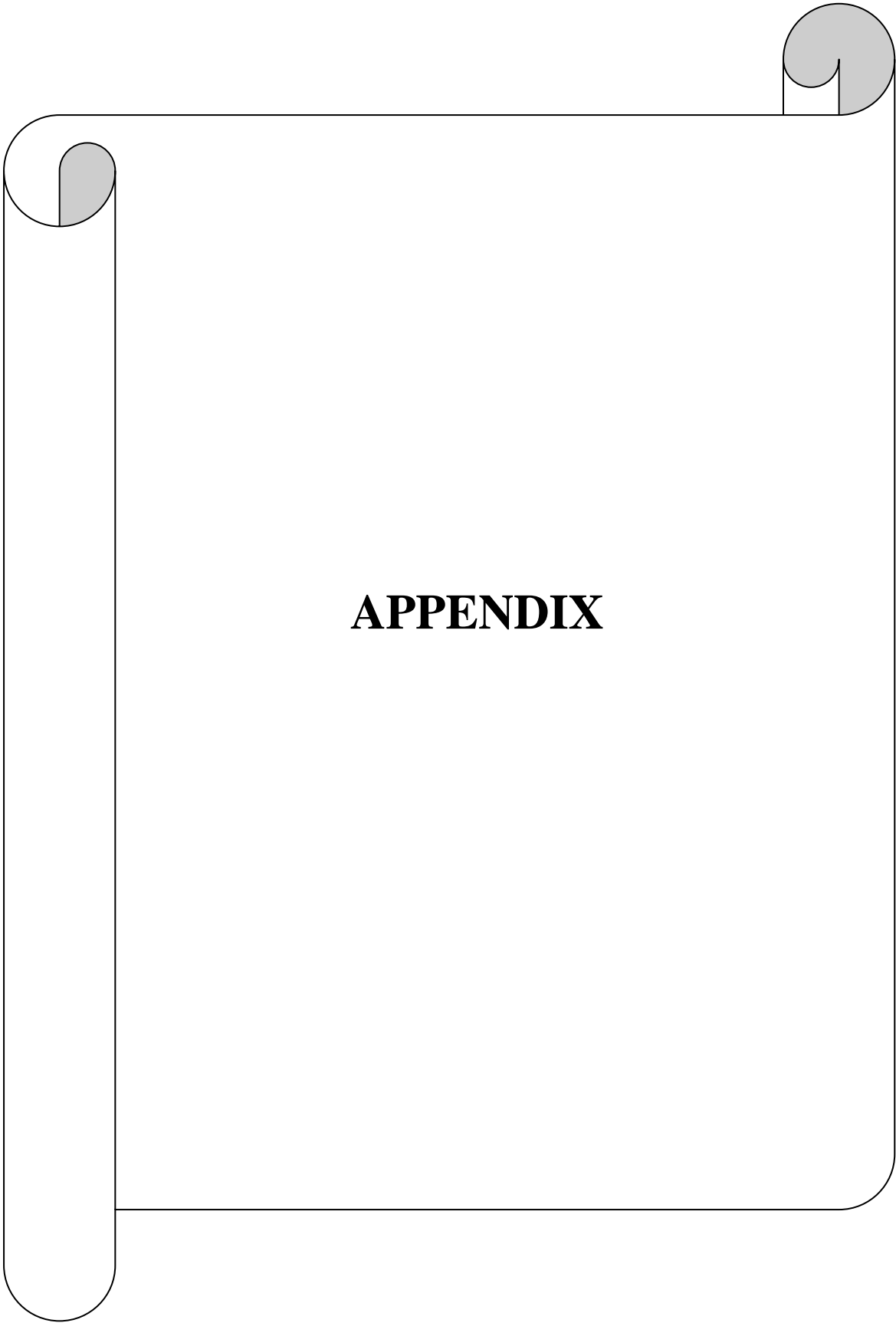
330. Hays RD, Sherbourne CD, Mazel RM. The rand 36- item health survey 1.0. *Health Econ.* 1993;2(3):217-227. doi:10.1002/hec.4730020305
331. Garrett S, Jenkinson T, Kennedy LG, Whitelock H, Gaisford P, Calin A. A new approach to defining disease status in ankylosing spondylitis: the Bath Ankylosing Spondylitis Disease Activity Index. *J Rheumatol.* 1994;21(12):2286-2291.
332. Calin A, Garrett S, Whitelock H, et al. A new approach to defining functional ability in ankylosing spondylitis: the development of the Bath Ankylosing Spondylitis Functional Index. *J Rheumatol.* 1994;21(12):2281-2285.
333. van Weely SFE, van Denderen CJ, van der Horst-Bruinsma IE, et al. Reproducibility of performance measures of physical function based on the BASFI, in ankylosing spondylitis. *Rheumatol Oxf Engl.* 2009;48(10):1254-1260. doi:10.1093/rheumatology/kep190
334. Sf van W, Cj van D, Ie van der HB, et al. Reproducibility of performance measures of physical function based on the BASFI, in ankylosing spondylitis. *Rheumatol Oxf Engl.* 2009;48(10). doi:10.1093/rheumatology/kep190
335. Madsen OR, Rytter A, Hansen LB, Suetta C, Egsmose C. Reproducibility of the Bath Ankylosing Spondylitis Indices of disease activity (BASDAI), functional status (BASFI) and overall well-being (BAS-G) in anti-tumour necrosis factor-treated spondyloarthritis patients. *Clin Rheumatol.* 2010;29(8):849-854. doi:10.1007/s10067-010-1407-5
336. Calin A, Garrett S, Whitelock H, et al. A new approach to defining functional ability in ankylosing spondylitis: the development of the Bath Ankylosing Spondylitis Functional Index. *J Rheumatol.* 1994;21(12):2281-2285.
337. Viitanen JV, Kokko ML, Heikkilä S, Kautiainen H. Assessment of Thoracolumbar Rotation in Ankylosing Spondylitis: A Simple Tape Method. *Clin Rheumatol.* 1999;18(2):152-157. doi:10.1007/s100670050074
338. Jenkinson TR, Mallorie PA, Whitelock HC, Kennedy LG, Garrett SL, Calin A. Defining spinal mobility in ankylosing spondylitis (AS). The Bath AS Metrology Index. *J Rheumatol.* 1994;21(9):1694-1698.
339. Calvo-Gutiérrez J, Garrido-Castro JL, González-Navas C, et al. Inter-rater reliability of clinical mobility measures in ankylosing spondylitis. *BMC Musculoskelet Disord.* 2016;17(1):382. doi:10.1186/s12891-016-1242-1
340. Martindale JH, Sutton CJ, Goodacre L. An exploration of the inter- and intra-rater reliability of the Bath Ankylosing Spondylitis Metrology Index. *Clin Rheumatol.* 2012;31(11):1627-1631. doi:10.1007/s10067-012-2057-6
341. Haywood KL, Garratt AM, Jordan K, Dziedzic K, Dawes PT. Spinal mobility in ankylosing spondylitis: reliability, validity and responsiveness. *Rheumatology.* 2004;43(6):750-757. doi:10.1093/rheumatology/keh169
342. van der Heijde D, Landewé R, Feldtkeller E. Proposal of a linear definition of the Bath Ankylosing Spondylitis Metrology Index (BASMI) and comparison with the 2-step and 10-step definitions. *Ann Rheum Dis.* 2008;67(4):489-493. doi:10.1136/ard.2007.074724
343. van der Heijde D, Landewé R, Feldtkeller E. Proposal of a linear definition of the Bath Ankylosing Spondylitis Metrology Index (BASMI) and comparison with the 2-step and 10-step definitions. *Ann Rheum Dis.* 2008;67(4):489-493. doi:10.1136/ard.2007.074724

344. Waddell G, Newton M, Henderson I, Somerville D, Main CJ. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *PAIN*. 1993;52(2):157. doi:10.1016/0304-3959(93)90127-B
345. Landers MR, Creger RV, Baker CV, Stutelberg KS. The use of fear-avoidance beliefs and nonorganic signs in predicting prolonged disability in patients with neck pain. *Man Ther*. 2008;13(3):239-248. doi:10.1016/j.math.2007.01.010
346. Hamilton M. A rating scale for depression. *J Neurol Neurosurg Psychiatry*. 1960;23(1):56-62. doi:10.1136/jnnp.23.1.56
347. Bagby RM, Ryder AG, Schuller DR, Marshall MB. The Hamilton Depression Rating Scale: Has the Gold Standard Become a Lead Weight? *Am J Psychiatry*. Published online December 1, 2004. doi:10.1176/appi.ajp.161.12.2163
348. Trajković G, Starčević V, Latas M, et al. Reliability of the Hamilton Rating Scale for Depression: a meta-analysis over a period of 49 years. *Psychiatry Res*. 2011;189(1):1-9. doi:10.1016/j.psychres.2010.12.007
349. Pocovi NC, Correa LA. Clinimetrics: The Pain Catastrophizing Scale. *J Physiother*. 2025;71(4):281. doi:10.1016/j.jphys.2025.08.006
350. Sullivan M, Bishop S, Pivik J. The Pain Catastrophizing Scale: Development and Validation. *Psychol Assess*. 1995;7:524-532. doi:10.1037/1040-3590.7.4.524
351. Pain Catastrophizing Scale | RehabMeasures Database. March 1, 2009. Accessed November 24, 2025. <https://www.sralab.org/rehabilitation-measures/pain-catastrophizing-scale>
352. Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30(6):473-483.
353. Hays RD, Sherbourne CD, Mazel RM. The RAND 36-Item Health Survey 1.0. *Health Econ*. 1993;2(3):217-227. doi:10.1002/hec.4730020305
354. Hays RD, Sherbourne CD, Mazel RM. The RAND 36-Item Health Survey 1.0. *Health Econ*. 1993;2(3):217-227. doi:10.1002/hec.4730020305
355. Koneru S, Tanikonda R. Role of yoga and physical activity in work-related musculoskeletal disorders among dentists. *J Int Soc Prev Community Dent*. 2015;5(3):199-204. doi:10.4103/2231-0762.159957
356. M O, S B, Bayram K, et al. The Effect of Breathing and Posture Exercise on the Clinical, Functional Status and Disease Related Quality of Life in Patients with Ankylosing Spondylitis. *Med Sci*. 2012;1:103. doi:10.5455/medscience.2012.01.103-117
357. Silva EM, Andrade SC, Vilar MJ. Evaluation of the effects of Global Postural Reeducation in patients with ankylosing spondylitis. *Rheumatol Int*. 2012;32(7):2155-2163. doi:10.1007/s00296-011-1938-3
358. Creswell JD. Mindfulness Interventions. *Annu Rev Psychol*. 2017;68(Volume 68, 2017):491-516. doi:10.1146/annurev-psych-042716-051139
359. Hilton L, Hempel S, Ewing BA, et al. Mindfulness Meditation for Chronic Pain: Systematic Review and Meta-analysis. *Ann Behav Med Publ Soc Behav Med*. 2017;51(2):199-213. doi:10.1007/s12160-016-9844-2

360. Metri KG, Pradhan B, Singh A, Nagendra HR. Effect of 1-Week Yoga-Based Residential Program on Cardiovascular Variables of Hypertensive Patients: A Comparative Study. *Int J Yoga*. 2018;11(2):170-174. doi:10.4103/ijoy.IJOY_77_16
361. Banerjee AB, Banerjee AA, Sharma LK, Kumar S. Effect of yoga on physical and various hematological parameters. *Int J Community Med Public Health*. 2019;6(12):5186-5190. doi:10.18203/2394-6040.ijcmph20195467
362. K S, Sonu H. Effect of practicing yoga for 6 months on heart rate and blood pressure and its clinical significance. *Eur J Cardiovasc Med*. 2025;15:27-31. doi:10.5083/ejcm/25-07-06
363. Ranjani H, Jagannathan N, Rawal T, et al. The impact of yoga on stress, metabolic parameters, and cognition of Indian adolescents: A cluster randomized controlled trial. *Integr Med Res*. 2023;12(3):100979. doi:10.1016/j.imr.2023.100979
364. Wang J, Li X, Yang F, et al. Efficacy and safety of mind-body exercise for patients with axial spondyloarthritis: a systematic review and meta-analysis. *J Orthop Surg*. 2024;19(1):586. doi:10.1186/s13018-024-05072-5
365. Boudjani R, Challal S, Semerano L, Sigaux J. Impact of different types of exercise programs on ankylosing spondylitis: a systematic review and meta-analysis. *Disabil Rehabil*. 2023;45(24):3989-4000. doi:10.1080/09638288.2022.2140842
366. Tekur P, Singphow C, Nagendra HR, Raghuram N. Effect of Short-Term Intensive Yoga Program on Pain, Functional Disability and Spinal Flexibility in Chronic Low Back Pain: A Randomized Control Study. *J Altern Complement Med*. 2008;14(6):637-644. doi:10.1089/acm.2007.0815
367. Szewczyk D, Sadura-Sieklucka T, Tarnacka B, Sokołowska B. Is there a connection between spine alignment, chest mobility, shoulder joint and respiratory parameters of patients with ankylosing spondylitis? *Rheumatol Int*. 2024;44(8):1481-1486. doi:10.1007/s00296-024-05642-0
368. Szewczyk D, Sadura-Sieklucka T, Tarnacka B, Sokołowska B. Is there a connection between spine alignment, chest mobility, shoulder joint and respiratory parameters of patients with ankylosing spondylitis? *Rheumatol Int*. 2024;44(8):1481-1486. doi:10.1007/s00296-024-05642-0
369. Fisher LR, Cawley MI, Holgate ST. Relation between chest expansion, pulmonary function, and exercise tolerance in patients with ankylosing spondylitis. *Ann Rheum Dis*. 1990;49(11):921-925. doi:10.1136/ard.49.11.921
370. Dasari V, Dhaniwala M, Dhaniwala N. Pranayama and Breathing Exercises -Types and Its Role in Disease Prevention & Rehabilitation. *J Evol Med Dent Sci*. 2020;9. doi:10.14260/jemds/2020/730
371. Rahaman A, Pramanik TN. Yogic Practices for Modulating Hematological Indices and Inflammatory Markers: A Non-Pharmacological Approach. *Int J Kinesiol Sports Sci*. 2025;13(2):101-114. doi:10.7575/aiac.ijkss.v.13n.2p.101
372. Ismail AMA, Alahmari M, Elsis HF, Ghaleb HAM. Effect of adding pranayama yoga exercises to laser acupuncture on inflammatory markers in elderly with allergic rhinitis: A randomized controlled study. *Electron J Gen Med*. 2025;22(3):em644. doi:10.29333/ejgm/16224

373. Gautam S, Kumar R, Kumar U, Kumar S, Luthra K, Dada R. Yoga maintains Th17/Treg cell homeostasis and reduces the rate of T cell aging in rheumatoid arthritis: a randomized controlled trial. *Sci Rep.* 2023;13(1):14924. doi:10.1038/s41598-023-42231-w
374. Zhang L, Wu Y, Liu S, Zhu W. Prevalence of Depression in Ankylosing Spondylitis: A Systematic Review and Meta-Analysis. *Psychiatry Investig.* 2019;16(8):565-574. doi:10.30773/pi.2019.06.05
375. Zhao S, Thong D, Miller N, et al. The prevalence of depression in axial spondyloarthritis and its association with disease activity: a systematic review and meta-analysis. *Arthritis Res Ther.* 2018;20(1):140. doi:10.1186/s13075-018-1644-6
376. Baysal O, Durmuş B, Ersoy Y, et al. Relationship between psychological status and disease activity and quality of life in ankylosing spondylitis. *Rheumatol Int.* 2011;31(6):795-800. doi:10.1007/s00296-010-1381-x
377. Riley KE, Park CL. How does yoga reduce stress? A systematic review of mechanisms of change and guide to future inquiry. *Health Psychol Rev.* 2015;9(3):379-396. doi:10.1080/17437199.2014.981778
378. Cramer H, Lauche R, Anheyer D, et al. Yoga for anxiety: A systematic review and meta-analysis of randomized controlled trials. *Depress Anxiety.* 2018;35(9):830-843. doi:10.1002/da.22762
379. Streeter CC, Gerbarg PL, Saper RB, Ciraulo DA, Brown RP. Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. *Med Hypotheses.* 2012;78(5):571-579. doi:10.1016/j.mehy.2012.01.021
380. Baishya A, Sharma S, Hazarika D, Saini S, Sharma H, Metri K. Yoga in autoimmune disorders: a systematic review of randomized controlled trials. *Ann Behav Med Publ Soc Behav Med.* 2025;59(1):kaaf049. doi:10.1093/abm/kaaf049
381. Tekur P, Nagarathna R, Chametcha S, Hankey A, Nagendra HR. A comprehensive yoga programs improves pain, anxiety and depression in chronic low back pain patients more than exercise: An RCT. *Complement Ther Med.* 2012;20(3):107-118. doi:10.1016/j.ctim.2011.12.009
382. Cramer H, Lauche R, Dobos G. Characteristics of randomized controlled trials of yoga: a bibliometric analysis. *BMC Complement Altern Med.* 2014;14(1):328. doi:10.1186/1472-6882-14-328
383. Pandey AOP, Mishra N, Vishvakarma SK. Effects of a yoga-based intervention program on psychological immunity and life satisfaction among armed forces personnel of India: a randomised controlled trial. *BMC Psychol.* 2025;13:1183. doi:10.1186/s40359-025-03257-z
384. Lazaridou A, Koulouris A, Devine JK, et al. Impact of daily yoga-based exercise on pain, catastrophizing, and sleep amongst individuals with fibromyalgia. *J Pain Res.* 2019;12:2915-2923. doi:10.2147/JPR.S210653
385. Rosenbaum JT, Pisenti L, Park Y, Howard RA. Insight into the Quality of Life of Patients with Ankylosing Spondylitis: Real-World Data from a US-Based Life Impact Survey. *Rheumatol Ther.* 2019;6(3):353-367. doi:10.1007/s40744-019-0160-8

386. Benavidez G, Hart PD. Effects of Yoga on Measures of Health-related Quality of Life from SF-36 and SF-12 Assessments: A Systematic Review and Meta-analysis. *Exerc Med.* 2017;1. doi:10.26644/em.2017.005
387. Singh J. Yoga as an add on intervention to the conventional management of ankylosing spondylitis A RCT study. *University.* Published online 2023. Accessed November 27, 2025. <https://shodhganga.inflibnet.ac.in/handle/10603/544464>



APPENDIX

APPENDIX

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Case Record Form

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								
Ongoing Medicine									
Bath Ankylosing Spondylitis Metrology Index (BASMI)	Cervical rotation		Lateral spinal flexion		Tragus to wall distance		Schobar Test	Intermellicular Distance	Chest Expeption
	Left	Right	Left	Right	Left	Right			

**Case Record Proforma
Follow-up Data Sheet**

Scales												
Visits	Date	BASDAI	BASFI	BASMI	Chest Expansion	ESR	CRP	TNF	FAB	Pain Catastrophizing	HAM-D Depression	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												

যাদবপুর বিশ্ববিদ্যালয়
কলকাতা-৭০০০৩২, ভারত



*JADAVPUR UNIVERSITY
KOLKATA-700 032, INDIA

To
Prof. Asish Paul
Department of Physical Education
Jadavpur University

Dear Sir/ Madam

Ref No: IEC/26/C/23

Date: 31.05.2023

Institutional Ethics Committee (IEC) Approval

Title of the Study: Effect of yogic intervention on Ankylosing Spondylitis: validation of a yoga module

The above application of **Prasenjit Kapas** under the supervision of **Prof. Asish Paul** 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 University Institutional Ethics Committee, the proposed research has been judged as per meeting appropriate ethical standards, and accordingly approval has been granted in the meeting dated **25.05.2023**.

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,

CHAIRPERSON

Prof. Pritha Mukhopadhyay

25.5.2023

Professor

Established on and from 24th December, 1955 vide Notification No.10986-Edn/1U-42/55 dated 6th December, 1955 under Jadavpur University Act, 1955 (West Bengal Act XXIV of 1955) followed by Jadavpur University Act, 1981 (West Bengal Act XXIV of 1981)

92, A.P.C. Road, Kolkata-700002

ফোন: ২৪১৪-৬৬৬৬/৬১২৪/৬৬৪০/৬৪৯০/৬৪৪০

ফ্যাক্স: (৯১)-০৩৩-২৪১৪-৬৪১৪/২৪১০-৭১২১

Website: www.jadavpur.edu

E-mail: registrar@admin.jdvu.ac.in

Phone : 2414-6666/6194/6643/6495/6443

Fax : (91)-033-2414-6414/2413-7121



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/2024/0078

Date: 04.04.2024

Dr. Pradyot Sinhamahapatra
Associate Professor
Department of Rheumatology
IPGME&R, Kolkata

Dear Dr. Sinhamahapatra,

A meeting of the Institutional Ethics Committee of IPGME&R, Kolkata, was held on 23.03.2024 at 12:00 Noon in the Office of the Dean, IPGME&R, Kolkata. In this meeting the members considered the documents related to your project:

Development and validation of a yoga module in 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.

After deliberations and review the committee took the following decision regarding your project:

Approved

Please note that the Committee understands / declares the following:

- The project has no commercial sponsor.
- Your Co-Investigators for the project will be Dr. Asish Paul, Associate Professor, and Mr. Prasenjit Kapas, PhD Scholar, Dept. of Physical Education, Jadavpur University, Kolkata.
- The approval for the study, in its present form, will remain valid for a period of 3 years from 23.03.2024.

It is placed on record that the decision regarding your proposal was unanimous and therefore did not require any voting procedure. The 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 mentioned on Page 2, if any are applicable, are also to be noted.

Continued on Page 2



Institute of Post Graduate Medical Education & Research
244, A.J.C. Bose Road, Kolkata – 700020.
IPGME&R Research Oversight Committee
(Institutional Ethics Committee)



Continued from Page 1

Additional points to be noted

- Clinical trials must be registered prospectively with Clinical Trials Registry India (CTRI).
- The Committee expects that any amendments to the Study Protocol, Informed Consent documents or other relevant documents will be brought to its notice.
- The Committee reserves the right to inspect informed consent documents and other study related documents, visit study sites, and, if necessary, interact with study participants to ensure that rights, safety, and well-being of study participants are not being compromised.
- 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 23.03.2024

SN	Name & role in the committee	Gender	Designation
1	Dr. Hemanta Kumar Majumder [Scientist & Chairperson]	Male	Senior Scientist, Indian Institute of Chemical Biology, Kolkata
2	Prof. Amal Kanti Das [Basic Medical Scientist]	Male	Professor, Dept. Pharmacology, IPGME&R
3	Prof. Bijay Kumar Majumdar [Clinician]	Male	Consultant Plastic Surgeon; Former Head, Department of Plastic Surgery, IPGME&R
4	D. Amal Kumar Santra [Basic Medical Scientist]	Male	Scientist, Formerly of Department of Gastroenterology, IPGME&R
5	Prof. Bobby Paul [Public Health Expert]	Female	Professor, Department of Preventive & Social Medicine, All India Institute of Hygiene & Public Health, Kolkata
6	Prof. Biman Kanti Ray [Clinician]	Male	Professor, Dept. Neurology, Bangur Institute of Neuroscience, IPGME&R
7	Dr. Sananda Pati [Clinician – Pediatrician]	Female	Assistant Professor, Department of Pediatrics, IPGME&R
8	Mr. Debdut Mukherjee [Legal expert]	Male	Advocate, Calcutta High Court
9	Mr. Arunangshu Shekhar Jana [Social worker]	Male	Social worker, Mahendraganj, Dist. South 24 Parganas
10	Dr. Nila Majumdar [Lay person]	Female	Bengali teacher, Kolkata
11	Prof. Avijit Hazra [Pharmacologist & Member secretary]	Male	Professor, Department of Pharmacology, IPGME&R

Avijit Hazra 04/04/2024

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

FULL DETAILS (Read-only) -> [Click Here to Create PDF for Current Dataset of Trial](#)

CTRI Number	CTRI/2025/04/084429 [Registered on: 08/04/2025] Trial Registered Prospectively		
Last Modified On:	22/07/2025		
Post Graduate Thesis	Yes		
Type of Trial	Interventional		
Type of Study	Yoga & Naturopathy		
Study Design	Non-randomized, Multiple Arm Trial		
Public Title of Study	Preparation of yoga module for Ankylosing Spondylitis patients		
Scientific Title of Study	Development and validation of a yoga module in patients with Ankylosing Spondylitis		
Trial Acronym	NIL		
Secondary IDs if Any	Secondary ID	Identifier	
	NIL	NIL	
Details of Principal Investigator or overall Trial Coordinator (multi-center study)	Name	Prasenjit Kapas	
	Designation	UGC Senior Research Fellow	
	Affiliation	Jadavpur University	
	Address	Department of Physical Education, 188, Raja Subodh Chandra Mallick Rd, Jadavpur University, Kolkata, West Bengal 700032	
		Kolkata WEST BENGAL 700032 India	
	Phone	7407522627	
	Fax		
Email	prasenjtkapas4@gmail.com		
Details of Contact Person Scientific Query	Name	Dr Pradyot Sinha mahapatra	
	Designation	Associate Professor	
	Affiliation	Institute of Post Graduate Medical Education and Research (IPGME&R) - SSKM Hospital	
	Address	Dept of Clinical Immunology and Rheumatology, IPGME&R/SSKM Hospital, 244, A.J.C. Bose Road, Kolkata-700020	
		Kolkata WEST BENGAL 700020 India	
	Phone	9433416336	
	Fax		
Email	sinhamahapatra@yahoo.com		
Details of Contact Person Public Query	Name	Dr Asish Paul	
	Designation	Professor	

	<table border="1"> <tr> <td>Affiliation</td> <td>Jadavpur University</td> </tr> <tr> <td>Address</td> <td>Department of Physical Education, 188, Raja Subodh Chandra Mallick Rd, Jadavpur University, Kolkata, West Bengal 700032 Kolkata WEST BENGAL 700032 India</td> </tr> <tr> <td>Phone</td> <td>9831710942</td> </tr> <tr> <td>Fax</td> <td></td> </tr> <tr> <td>Email</td> <td>asishpaul705@gmail.com</td> </tr> </table>	Affiliation	Jadavpur University	Address	Department of Physical Education, 188, Raja Subodh Chandra Mallick Rd, Jadavpur University, Kolkata, West Bengal 700032 Kolkata WEST BENGAL 700032 India	Phone	9831710942	Fax		Email	asishpaul705@gmail.com						
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Phone	9831710942																
Fax																	
Email	asishpaul705@gmail.com																
Source of Monetary or Material Support	Institute Innovation Council, Jadavpur University, 188, Raja Subodh Chandra Mallick Rd, Jadavpur, Kolkata, West Bengal 700032																
Primary Sponsor	<table border="1"> <tr> <td>Name</td> <td>University Grant Commission</td> </tr> <tr> <td>Address</td> <td>University Grants Commission Bahadur Shah Zafar Marg, New Delhi - 110002</td> </tr> <tr> <td>Type of Sponsor</td> <td>Government funding agency</td> </tr> </table>	Name	University Grant Commission	Address	University Grants Commission Bahadur Shah Zafar Marg, New Delhi - 110002	Type of Sponsor	Government funding agency										
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Type of Sponsor	Government funding agency																
Details of Secondary Sponsor	<table border="1"> <tr> <td>Name</td> <td>Address</td> </tr> <tr> <td>NIL</td> <td>NIL</td> </tr> </table>	Name	Address	NIL	NIL												
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NIL	NIL																
Countries of Recruitment	India																
Sites of Study	<table border="1"> <tr> <td colspan="4" style="text-align: center;">No of Sites = 2</td> </tr> <tr> <th>Name of Principal Investigator</th> <th>Name of Site</th> <th>Site Address</th> <th>Phone/Fax/Email</th> </tr> <tr> <td>Dr Pradyot Sinhamahapatra</td> <td>Institute of Post Graduate Medical Education and Research (IPGME&R) - SSKM Hospital</td> <td>4th Floor, Dept of Clinical Immunology and Rheumatology, IPGME&R/SSKM Hospital Kolkata WEST BENGAL</td> <td>9433416336 sinhamahapatra@yahoo.com</td> </tr> <tr> <td>Prasenjit Kapas</td> <td>Jadavpur University</td> <td>Department of Physical Education, 188, Raja Subodh Chandra Mallick Rd, Jadavpur University, Kolkata, West Bengal 700032 Kolkata WEST BENGAL</td> <td>7407522627 prasenjtkapas4@gmail.com</td> </tr> </table>	No of Sites = 2				Name of Principal Investigator	Name of Site	Site Address	Phone/Fax/Email	Dr Pradyot Sinhamahapatra	Institute of Post Graduate Medical Education and Research (IPGME&R) - SSKM Hospital	4th Floor, Dept of Clinical Immunology and Rheumatology, IPGME&R/SSKM Hospital Kolkata WEST BENGAL	9433416336 sinhamahapatra@yahoo.com	Prasenjit Kapas	Jadavpur University	Department of Physical Education, 188, Raja Subodh Chandra Mallick Rd, Jadavpur University, Kolkata, West Bengal 700032 Kolkata WEST BENGAL	7407522627 prasenjtkapas4@gmail.com
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	IEC - Jadavpur University		Approved
	IPGME and R Resaerch Oversight Committee		Approved
Regulatory Clearance Status from DCGI	Status Not Applicable		
Health Condition / Problems Studied	Health Type Patients	Condition (1) ICD-10 Condition: M049 Autoinflammatory syndrome, unspecified,	
Intervention / Comparator Agent	Type	Name	Details
	Comparator Agent	Active Control	Medication(advised by the expert's of rheumatology), Exercise advised by the Physical Medicine and Rehabilitation(PMR) experts for 6 months
	Intervention	Yogic techniques with group comparison	Medicine advised by the expert's of rheumatology and Yogic techniques advised by the experts from relevent field- Loosening exercise or yogic suksma vyama, asana, basic breathing Practices, pranayama, relaxation.45 minutes/Day(6 Days in a week) for 6 months
Inclusion Criteria	Age From	18.00 Year(s)	
	Age To	40.00 Year(s)	
	Gender	Male	
	Details	1) Patients suffering from ankylosing spondylitis for 3 months to 5 years will be included on the basis of experts opinion of rheumatology. 2) The age range of the subjects will be 18 to 40 years. 3) Providing written informed consent	
ExclusionCriteria	Details	1. Associated other causes of back pain, such as herniated disk 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 complicates yoga and exercises 4. Psychiatric diseases or inability to comprehend commands. 5. Smokers and alcohol addiction.	
Method of Generating Random Sequence	Not Applicable		
Method of Concealment	Other		
Blinding/Masking	Participant, Investigator, Outcome Assessor and Date-entry Operator Blinded		

Primary Outcome	Outcome	TimePoints
	Inflammatory Markers: TNF-alpha, C-reactive protein (CRP), Erythrocyte sediment rate (ESR), Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), Bath Ankylosing Spondylitis Functional Index (BASFI), Bath Ankylosing Spondylitis Metrology Index(BASMI)	Baseline, three months & six months
Secondary Outcome	Outcome	TimePoints
	Fear Avoidance Beliefs (FAB), Pain Catastrophizing, Inflexibility in Pain thoughts, Depression, Health Survey (RAND SF-36), Resting Heart rate, Resting Blood pressure	Baseline, three months & six months
Target Sample Size	Total Sample Size="50" Sample Size from India="50" Final Enrollment numbers achieved (Total)= "70" Final Enrollment numbers achieved (India)="70"	
Phase of Trial	Phase 3	
Date of First Enrollment (India)	15/04/2025	
Date of Study Completion (India)	Date Missing	
Date of First Enrollment (Global)	Date Missing	
Date of Study Completion (Global)	Date Missing	
Estimated Duration of Trial	Years="0" Months="8" Days="0"	
Recruitment Status of Trial (Global) Modification(s)	Not Applicable	
Recruitment Status of Trial (India)	Completed	
Publication Details	N/A	
Individual Participant Data (IPD) Sharing Statement	Will individual participant data (IPD) be shared publicly (including data dictionaries)? Response - NO	
Brief Summary Modification(s)	The proposed study tries to test the feasibility of a developed and validated yoga module for the patients of Ankylosing Spondylitis on selected psychological variables, physiological variables, health status, and inflammatory markers and compare them between the conventional group (medicine and exercise	

10/20/25, 7:07 PM

CTRI

suggested by PMR) and the combined group (medicine with yoga practice). All the processes regarding the 3-month experiments and data collection have been completed. Now we are continuing the 6-month follow-up study.

[Close](#)

Development and validation of a yoga module in patients with Ankylosing Spondylitis

Study to be conducted by:

**Department 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 it with friends, relatives and your family or 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 immediate purpose of this study is to evaluate the influence of yogic practices on ankylosing spondylitis. Yogic exercises are 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 a complementary/supplementary medicine along with regular conventional system of medical treatment suggested by the medical experts. Generally, doctors use non-steroidal anti-inflammatory drugs or biologic medications to treat ankylosing spondylitis. Apart from that, specific form of yogic practices like-asana (posture), pranayama (control breathing), Dhyana (meditation) is to be helpful for patients suffer from ankylosing spondylitis. The ultimate goal of this study is to frame consolidated yogic modalities comprising with the said components of yogic practices, that a person having this type of problem can practice an uniform pattern of yogic exercises under the direct supervision of related experts for their long term recovery. Even this yogic modality can prevent the occurrence of the problem of ankylosing spondylitis and thus it can be considered as a preventive measure against this type of problem.

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 well-being.

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 an empty stomach. This practice should be done for 1 hour daily in the morning or evening for 12 weeks. Specific forms of yogic practices like asana (posture), pranayama (control of breathing), and Dhyana (meditation) are to be given as per the 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 jug exercises through an 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 a 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 benefits such as being free from pain, increased flexibility, relief from stress, and thus a 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 will be 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 regularity.

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 thesis will be submitted to the Ph.D. section of Jadavpur University for examination. After that the thesis paper may be published in a scientific journal or discussed at a scientific forum/conference. 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

(Professor)

Department of Physical Education

Jadavpur University

Kolkata-700032

Contact Number: 9831710942

Co- Investigator

Prasenjit kapas

(Senior Research Fellow)

Department of Physical Education

Jadavpur University

Kolkata- 700032

Contact Number: 7407522627

Principal Investigator

Dr. Prodyot Sinha mahapatra

(Associate Professor)

Dept. of Rheumatology

I.P.G.M.E.R,

Kolkata-700020

Contact Number: 9635149052

Co- Investigator

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

Development and validation of a yoga module in patients with Ankylosing Spondylitis

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: _____

Answer the following questions yourself:

1. Do you have any heart disease? Yes / No
If yes, please specify -----
2. Do you have any mental health problems? Yes / No
If yes, please specify -----
3. Are you suffering from any respiratory disease? Yes / No
If yes, please specify -----
4. Are you suffering from any digestive problems? Yes / No
If yes, please specify -----
5. Have you ever undergone any operation or surgery in the past? Yes / No
If yes, please specify -----
6. Do you have any kidney problems? Yes / No
If yes, please specify -----
7. Do you have any kind of skin problem? Yes / No
If yes, please specify -----
8. Do you suffer from physical weakness or fatigue? Yes / No
If yes, please specify -----
9. Do you have any kind of eye problem? Yes / No
If yes, please specify -----
10. Do you have any old injury or wound? Yes / No
If yes, please specify -----
11. Do you smoke or consume alcohol? Yes / No
If yes, please mention the quantity -----

আঙ্কিলুজিং স্পন্ডাইলাইটিস-এর উপর প্রভাব বিস্তারকারী যোগাভ্যাস সম্বলিত একটি মডিউল গঠন ও বৈধতাকরন

গবেষণা পরিচালনা করা হবে:

শারীরশিক্ষা বিভাগ, যাদবপুর বিশ্ববিদ্যালয়, রাজা এস. সি. 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 পারেনতবেই প্রদত্ত তথ্যাদি সম্বলিত সম্মতিপত্রে দয়া করে স্বাক্ষর করবেন।

এই গবেষণার উদ্দেশ্য কি?

এই গবেষণার উদ্দেশ্য হল আঙ্কিলুজিং স্পন্ডাইলাইটিস এর উপরে যোগাভ্যাস এর প্রভাবের মূল্যায়ন করা। যোগাভ্যাস হলো এখন খুব জনপ্রিয় এবং এটা প্রমাণিত যে যোগাভ্যাস হলো অর্থসাম্প্রদায়কারী কর্মশক্তিপ্রদানকারী এবং এটিজীবনের মানোন্নয়নে করে। যোগব্যায়াম গুলিকে চিকিৎসাবিদ দ্বারা বলে দেওয়া সাধারণ প্রদাহবিরোধীওষুধগুলির পাশাপাশি পৃথকভাবে পরিপূরক ওষুধহিসেবে বিবেচনা করতে হবে। সাধারণতঃ চিকিৎসকেরা সমূহনন-স্টেরয়েড, প্রদাহবিরোধী ওষুধ সমূহ অথবা জৈবিক চিকিৎসা পদ্ধতিগুলি ব্যবহার করেন আঙ্কিলুজিং স্পন্ডাইলাইটিসচিকিৎসার জন্য চিকিৎসার জন্য। ওষুধ ছাড়া আঙ্কিলুজিং স্পন্ডাইলাইটিস এ ভোগা রোগীদের ক্ষেত্রে কিছু নির্দিষ্টপ্রকারের 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 স্পন্ডাইলাইটিস এর কারণে নিম্ন পশ্চাৎদেশের বা কোমরের জড়তা এবং শারীরিক অক্ষমতার অভিযোগ করেছেন। অংশগ্রহণকারীদের ১৮বছর বয়স থেকে ৪০বছর 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 হবে। এমনকি, অংশগ্রহণ করার সিদ্ধান্ত নেওয়ার পরেও, যে কোন মুহূর্তে কোনো কারণ না দেখিয়েই নাম তুলে নেয়ার জন্য আপনি স্বাধীন। আপনার সেবা

ও যন্ত্র 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 স্পন্ডাইলাইটিস-এ ভুগছেন এটা সম্পর্কে চিকিৎসক নিশ্চিত হলে শারীরিক পরীক্ষা-নিরীক্ষা এবং গবেষণাগারে বিভিন্ন পরীক্ষা দ্বারা আপনার অবস্থান মূল্যায়ন করা হবে।

আপনি চিকিৎসকের (বাতব্যাদি বিশারদ) বলে দেওয়া আপনার নিয়মিত চিকিৎসা চালু রাখবেন। ওষুধের পাশাপাশি, আপনাকে পরিপূরক ওষুধ হিসেবে ব্যবহৃত কিছু যোগব্যায়াম দেওয়া হবে। নির্ধারিত সূচী আনুসারে চিকিৎসা সম্পূর্ণ করার পরে, প্রশ্নগুচ্ছ, শারীরিক পরীক্ষা-নিরীক্ষা এবং গবেষণাগারে নানা পরীক্ষার দ্বারা আপনার সুস্থতা কে সুনিশ্চিত করার জন্য মনোবৈজ্ঞানিক মূল্যায়নের মধ্য দিয়ে আপনার পুনরায় মূল্যায়ন করা হবে।

আমাকে কি করতে হবে?

আপনাকে সচেতন ভাবে, যন্ত্রসহকারে 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-প্রশ্বাসের নিয়ন্ত্রণ) 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 সে ক্ষেত্রে আপনাকে আপনার চিকিৎসককে তা জানাতে হবে। যোগা ভ্যাস শুরু করার পূর্বে, গবেষক সমস্ত জগ ব্যায়ামগুলি 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 দেখানোর পর যোগ ব্যায়ামগুলির সম্পূর্ণ ভিডিও পেনড্রাইভে করে সবাইকে দেবেন। এছাড়াও উক্ত যোগ ব্যায়ামগুলির সচিত্র বিবরণ প্রত্যেককে প্রদান করবেন। ঐ সমস্ত রোগীরা তাদের যোগাযোগের নম্বর দেবেন যাতে সারাসরি ভয়েস কল ও ভিডিও কলের মাধ্যমে তাদের সাথে যোগাযোগ করে তাদের যোগাভ্যাস কেমন চলছে সেই সম্পর্কে খবর নেওয়া যায়। যদি অনুশীলনের নির্দিষ্ট সময়সীমার মধ্যে যদি যোগব্যায়ামগুলির প্রকারের ও মাত্রার যদি কোন পরিবর্তনের প্রয়োজন হয় তাহলে আপনি সেই তথ্য টেলি যোগাযোগের মাধ্যমে পেয়ে যাবেন।

পরীক্ষা চলাকালীন কোন কোন 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 রক্তপরিষ্কার 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 ব্যবস্থা থাকবে না।

অংশগ্রহণ করার সম্ভাব্য লাভ গুলি কি কি?

আশা করা হয় যে যোগব্যায়ামসমূহ যোগা অভ্যাস সমূহ যন্ত্রণা থেকে মুক্তি, নমনীয়তা বৃদ্ধি, পীড়ন থেকে মুক্তি এবং এর ফলস্বরূপ উন্নততর দৈনন্দিন জীবন ইত্যাদির লাভসমূহ সমূহ প্রদান করবে।

যদি এই গবেষণা থেকে প্রাপ্ত তথ্যাদি আমাদেরকে আঙ্কিলুজিং স্পন্ডাইলাইটিস 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 সাহায্য 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 যদি:-

- এই নির্দিষ্ট সময়সীমার মধ্যে আপনার স্বাস্থ্য আরো বেশি খারাপ হয়ে পড়ে।
- আপনি নিয়মমতো সঠিকভাবে ওষুধগুলি গ্রহণ না করেন অথবা বারবার সাক্ষাৎ করার পূর্বনির্ধারিত 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 প্রক্রিয়াকৃত 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
অধ্যাপক
শারীরশিক্ষা বিভাগ
যাদবপুর বিশ্ববিদ্যালয়
কলকাতা ৭০০০৩২
মোবাইল-৯৮৩১৭১০৯৪২
(সহ অনুসন্ধানকারী)

প্রসেনজিৎ কাপাস
গবেষক
শারীরশিক্ষা বিভাগ
যাদবপুর বিশ্ববিদ্যালয়
কলকাতা ৭০০০৩২
মোবাইল-৯৬৩৫১৪৯০৫২
(মুখ্য অনুসন্ধানকারী)

ডাঃ প্রদ্যোত সিনহা মহাপাত্র
সহযোগী অধ্যাপক
রিউমাটলজি বিভাগ
আই.পি.জি.এম.ই.আর
কলকাতা ৭০০০২০
(সহ অনুসন্ধানকারী)

রোগীর তথ্যপত্রটি পড়ার জন্য আপনাকে ধন্যবাদ। আপনি যদি এই ক্লিনিক্যাল ট্রায়ালে অংশগ্রহণ করার সিদ্ধান্ত নেন, তবে তার জন্যও আমরা আপনার প্রতি কৃতজ্ঞ।

অবগত সন্মতিপত্র

আঞ্চলিক স্পন্ডিলাইটিস-এর উপর প্রভাব বিস্তারকারী যোগাভ্যাস সম্বলিত একটি মডিউল গঠন ও বৈধতাকরন

অংশগ্রহণকারীর নাম-----

স্বাক্ষর-বয়স-লিঙ্গ-

যদি আপনি সম্মত থাকেন, তবে ঘরের মধ্যে 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 পেয়েছি। []

২. আমি বুঝতে পেরেছি যে এই গবেষণাটি আমার অংশগ্রহণ হল সম্পূর্ণ ঐচ্ছিক এবং আমি কোন রকম কারণ না দেখিয়ে, এবং আমার অধিকারসমূহের প্রাপ্ত সুবিধাগুলির কোন রকম ক্ষতি না করেই যে কোন মুহুর্তে 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 স্বেচ্ছায় অংশগ্রহণ করতে সম্মত হয়েছি। []

স্বাক্ষর/অংশগ্রহণকারী বৃদ্ধাঙ্গুরের ছাপ-

তারিখস্থান

গবেষণা অনুসন্ধান কারীর নাম

গবেষণা অনুসন্ধানকারীর স্বাক্ষর

তারিখ স্থান যদি কোন বৃদ্ধাঙ্গুরি অংশগ্রহণকারী বৃদ্ধাঙ্গুরে সাবধান ছাপ তাহলে এই অংশটি
আবশ্যিক-

প্রত্যক্ষদর্শীর স্বাক্ষর-তারিখ-স্থান-

প্রত্যক্ষদর্শীর নাম ও ঠিকানা-

অংশগ্রহণকারীর সাথে সম্পর্ক, যদি কিছু থাকে-

নিজে নিজে উত্তরগুলি দিন

১. আপনার কি কোনো হৃদযন্ত্রের রোগসমূহ আছে? হ্যাঁ/না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

২. আপনার কি কোনো মনোরোগ সংক্রান্ত সমস্যা আছে? হ্যাঁ/না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

৩. আপনি কি কোনো শ্বাসজনিত রোগে ভুগছেন? হ্যাঁ/না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

৪. আপনার কি কোনো হজমের সমস্যায় ভুগছেন? হ্যাঁ/না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

৫. আপনার শরীরে কি অতীতে কখনো অপারেশন বা সার্জারি হয়েছে? হ্যাঁ/না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

৬. আপনার কি কিডনির সমস্যায় ভুগছেন? হ্যাঁ/না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

৭. আপনার কি কোন প্রকার স্বকের সমস্যা আছে? হ্যাঁ /না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

৮. আপনি কি শারীরিক দুর্বলতায় বা অবসাদে ভোগেন? হ্যাঁ /না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

৯. আপনার কি কোন প্রকার চোখের সমস্যা আছে? হ্যাঁ /না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

১০. আপনার কি পুরনো কোন চোট-আঘাত আছে। হ্যাঁ /না

যদি হ্যাঁ হয় নির্দিষ্ট করে বলুন-----

১১. আপনি কি ধূমপান বা মদ্যপান করেন? হ্যাঁ /না

যদি হ্যাঁ হয় পারিমাণ নির্দিষ্ট করে বলুন-----

एंकिर्लॉज़िंग स्पॉन्डिलाइटिस पर योग अभ्यास वाले मॉड्यूल का गठन और मान्यकरण

शारीरशिक्षा विभाग, जादवपुरविश्वविद्यालय, राजा एस.सी. मल्लिकरोड़, कोलकाता – 700032

तथा स्नातकोत्तर चिकित्सा शिक्षा एवं अनुसंधान संस्थान (IPGME&R) एवंएस.एस.के.एम. (SSKM)

अस्पताल – 244A एवं B, ए.जे.सी.बोसरोड़, कोलकाता –700020

आपको एक नैदानिक अनुसंधान अध्ययन में भाग लेने के लिए आमंत्रित किया जा रहा है। निम्नलिखित जानकारी आपके लिए यह समझने के लिए है कि शोध क्यों किया जा रहा है और इसमें क्या शामिल होगा। कृपया इसे ध्यान से पढ़ने के लिए समय निकालें और यदि आप चाहें तो दोस्तों, रिश्तेदारों और अपने परिवार, डॉक्टर से चर्चा करें। यदि कोई ऐसी बात है जो स्पष्ट नहीं है या यदि आप अधिक जानकारी चाहते हैं तो कृपया बेझिझक हमसे पूछें। यह तय करने के लिए समय लें कि आप भाग लेना चाहते हैं या नहीं। कृपया सूचित सहमति फॉर्म पर तभी हस्ताक्षर करें जब आप दी गई जानकारी से पूरी तरह संतुष्ट हों और अध्ययन में शामिल प्रक्रियाओं को समझते हों।

इस अध्ययन का उद्देश्य क्या है ?

इस अध्ययन का तात्कालिक उद्देश्य एंकिर्लॉज़िंग स्पॉन्डिलाइटिस पर योगाभ्यास के प्रभाव का मूल्यांकन करना है। यौगिक अभ्यास अब लोकप्रिय हैं और यह स्थापित हो गया है कि योग अभ्यास लागत प्रभावी, ऊर्जावान हैं और जीवन की गुणवत्ता बढ़ाता है। चिकित्सा विशेषज्ञों द्वारा सुझाए गए चिकित्सा उपचार की नियमित पारंपरिक प्रणाली के साथ-साथ योग अभ्यास को एक पूरक/पूरक दवा के रूप में अलग से माना जाना चाहिए। आम तौर पर, डॉक्टर एंकिर्लॉज़िंग स्पॉन्डिलाइटिस के इलाज के लिए गैर-स्टेरायडल विरोधी भड़काऊ दवाओं या जैविक दवाओं का उपयोग करते हैं। इसके अलावा, विशिष्ट प्रकार की योगाभ्यास जैसे-आसन (आसन), प्राणायाम (सांस पर नियंत्रण), ध्यान (ध्यान) एंकिर्लॉज़िंग स्पॉन्डिलाइटिस से पीड़ित रोगियों के लिए सहायक है। इस अध्ययन का अंतिम लक्ष्य योग प्रथाओं के उक्त घटकों को शामिल करते हुए समेकित योग पद्धतियों को तैयार करना है, ताकि इस प्रकार की समस्या वाला व्यक्ति अपने दीर्घकालिक स्वास्थ्य लाभ के लिए संबंधित विशेषज्ञों की प्रत्यक्ष देखरेख में योग अभ्यासों के एक समान पैटर्न का अभ्यास कर सके। यहां तक कि यह योग पद्धति एंकिर्लॉज़िंग स्पॉन्डिलाइटिस की समस्या को होने से रोक सकती है और इस प्रकार इसे इस प्रकार की समस्या के खिलाफ एक निवारक उपाय माना जा सकता है।

मैंने इसका चयन क्यों किया ?

यह अध्ययन उन मरीजों पर किया जा रहा है जिन्हें एंकिर्लॉज़िंग 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 हैं।

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 हैं, 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 हैं तथा डॉक्टर भी सुनिश्चित करते हैं कि आपको एंक्विलॉसिंग स्पोन्डिलाइटिस है, तो फिर आपका शारीरिक परीक्षण होगा एवं प्रयोगशाला में मूल्यांकन किया जाएगा ।

आप डॉक्टर (रिमेंटोलॉजिस्ट) 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 हैं ।

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 । प्रति सप्ताह 3 दिन सुबह/शाम को 1 घंटा योग क्रिया करना होगा । निर्धारित प्रोटोकॉल के अनुसार विशिष्ट प्रकार के योग क्रियाएं - 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 हैं, तो आपको यह अपने डॉक्टर को बतलाना होगा । योग क्रिया आरंभ करने से पूर्व, परीक्षक संपूर्ण अभ्यास का प्रदर्शन करेंगे कि कैसे अभ्यास करना है, क्या करना चाहिए और क्या नहीं ? योग के वीडियो के साथ यह सब विषय की चर्चा करेंगे, योग कार्यक्रम भी दिखाए जाएंगे तथा इन योग क्रियाओं की चित्र प्रस्तुति भी सभी मरीजों को उपलब्ध कराई जाएगी । इसके उपरांत, इन मरीजों को फोन नम्बर सहित घर का पता देना होगा ताकि उनसे संपर्क किया जा सके एवं टेलीफोन के जरिए या उपस्थित होकर यह जांच किया जा सके कि वह घर पर अभ्यास को जारी रख रहे हैं । यदि प्रयोगात्मक अवधि के दौरान योग क्रिया में कोई बदलाव की आवश्यकता होगी, तो तदनुसार आपको इसकी सूचना 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 क्रियाओं का अभ्यास कराया जाएगा ।

इस चिकित्सीय जांच के दुष्प्रभाव एवं जोखिम क्या हैं ?

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 हैं । आपको पूर्व निर्धारित दिनों पर क्लिनिक 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 हैं ?

योग क्रियाओं से कई लाभ अपेक्षित हैं, जैसे - दर्द से मुक्ति, लचीलेपन में वृद्धि, तनाव से मुक्ति आदि, अंततः एक बेहतर एवं सुखद जीवन।

यदि इस अध्ययन से प्राप्त जानकारी हमें एंक्विलॉसिंग 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 हैं या मिलने की निर्धारित समय को बार-बार भूल जाए।
- यदि आप विशेषज्ञों द्वारा बताए गए योग क्रियाओं का अभ्यास नहीं करते हैं अथवा इसे करने में अनियमितता बरते हैं।

क्या मेरी सहभागिता को गोपनीय रखा जाएगा ?

हाँ, अध्ययन से प्राप्त सभी डेटा को गोपनीय रखा जाएगा। डेटा को उचित अवधि के लिए संग्रहीत किया जाएगा। इस डेटा का उपयोग केवल अधिकृत व्यक्तियों द्वारा वैज्ञानिक उद्देश्यों के लिए किया जाएगा।

इस अध्ययनके परिणामों का क्या होगा ?

परीक्षण बंद होने के तुरंत बाद एक अध्ययन रिपोर्ट को अंतिम रूप दिया जाएगा। यह थीसिस जांच के लिए जादवपुर विश्वविद्यालय के पीएचडी अनुभाग में जमा की जाएगी। उसके बाद थीसिस पेपर को किसी वैज्ञानिक पत्रिका में प्रकाशित किया जा सकता है या किसी वैज्ञानिक मंच/सम्मेलन में चर्चा की जा सकती है। हालाँकि, किसी भी रिपोर्ट/प्रकाशन में आपकी पहचान नहीं की जाएगी।

अतिरिक्त जानकारीके लिए संपर्क करे:

योग विशेषज्ञ और इस अध्ययन को करने वाले डॉक्टर आपके साथ इस पर अधिक विस्तार से चर्चा कर सकते हैं और कोई भी प्रश्न उठने पर उसका उत्तर दे सकते हैं। संपर्क व्यक्ति हैं:

डॉ. आशीष पाल
(एसोसियट प्रोफेसर)
शारीर शिक्षा विभाग
जादवपुर विश्वविद्यालय
आई.पी.जी.एम.ई.आर.
कोलकाता – 700032
संपर्कसं- 983170942
सह-निरीक्षक

प्रसेनजित कापास
(वरीष्ठ अनुसंधानकर्ता)
शारीर शिक्षा विभाग
जादवपुर विश्वविद्यालय
कोलकाता – 700032
संपर्कसं- 9635149052
प्रधाननिरीक्षक

डॉ. प्रद्योत सिन्हा महापत्र
(एसोसियट प्रोफेसर)
रिमैटोलॉजी विभाग
कोलकाता – 700020
संपर्कसं-9635149052
सह-निरीक्षक

रोगी सूचना पत्रक पढ़ने के लिए आपका धन्यवाद। यदि आप इस नैदानिक परीक्षण में भाग लेने का निर्णय लेते हैं, तो उसके लिए भी हम आपका धन्यवाद करते हैं।

सूचित सहमति पत्र

एंकिलॉजिंग स्पॉन्डिलाइटिस पर योग अभ्यास वाले मॉड्यूल का गठन और मान्यकरण

विषयकानाम-

संक्षिप्तहस्ताक्षर

उम्र-

लिंग-

यदि आप सहमत हैं, तो कृपया यहाँ निशान लगाएँ:

1. मैं पुष्टि करता हूँ कि मैंने सूचना पत्रक को पढ़ और समझ लिया है उपरोक्त अध्ययन और प्रश्न पूछने का अवसर मिला है।
[]

2. मैं समझता हूँ कि अध्ययन में मेरी भागीदारी स्वैच्छिक है और मैं हूँ बिना कोई कारण बताए, किसी भी समय वापस लेने के लिए स्वतंत्र, और मेरे अधिकारों और विशेषाधिकारों को प्रभावित किये बिना []

3. मैं समझता हूँ कि मेरा डेटा गोपनीय रखा जाएगा लेकिन व्यक्तिगत रूप से संस्थान की आचार समिति, प्रधान अन्वेषक द्वारा अधिकृत जहां अध्ययन आयोजित किया जाएगा और सरकारी नियामक प्राधिकरण वर्तमान अध्ययन के संबंध में मेरे रिकॉर्ड तक पहुंच होगी और आगे के शोध जो इसके संबंध में किए जा सकते हैं। भले ही मैं पीछे हट जाऊं, मैं इस पहुंच से सहमत हूँ. हालाँकि, मैं समझता हूँ कि मेरी पहचान नहीं होगी खुलासा किया जाएगा और सूचना की गोपनीयता बनाए रखी जाएगी। []

4. मैं इससे उत्पन्न होने वाले किसी भी डेटा या परिणाम के उपयोग को प्रतिबंधित नहीं करने पर सहमत हूँ
शैक्षणिक उद्देश्य के लिए अध्ययन करें. []

5. मैं उपरोक्त अध्ययन में स्वेच्छा से भाग लेने के लिए सहमत हूँ। []

विषयीकाहस्ताक्षरअंगुठेकानिशान-

दिनांक- स्थान-

अध्ययनकेनिरक्षककानाम-

अध्ययनकेनिरक्षककानाम- दिनांक-..... स्थान-.....

जहाँविषयीके अंगुठेके निशान दिएगएहै, अनिवार्यहै।

साक्षीका हस्ताक्षर-

दिनांक-..... स्थान-.....

साक्षीका नाम वंपता-

.....

विषयीसेसंबंध, यदिहो, तो-

अपने आप उत्तर दें

नीचे दिए गए प्रश्नों के उत्तर स्वयं दें:

1. क्या आपको किसी प्रकार की हृदय सम्बन्धी बीमारी है? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
2. क्या आपको किसी प्रकार की मानसिक समस्या है? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
3. क्या आप किसी श्वसन सम्बन्धी बीमारी से पीड़ित हैं? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
4. क्या आप पाचन सम्बन्धी किसी समस्या से ग्रसित हैं? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
5. क्या आपके शरीर पर पहले कभी कोई ऑपरेशन या सर्जरी हुई है? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
6. क्या आपको किडनी की कोई समस्या है? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
7. क्या आपको किसी प्रकार की त्वचा सम्बन्धी समस्या है? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
8. क्या आप शारीरिक कमजोरी या थकान महसूस करते हैं? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
9. क्या आपको किसी प्रकार की आँखों की समस्या है? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
10. क्या आपको कोई पुरानी चोट या घाव है? हाँ / नहीं
यदि हाँ, तो कृपया स्पष्ट करें -----
11. क्या आप धूम्रपान या मद्यपान करते हैं? हाँ / नहीं
यदि हाँ, तो कृपया मात्रा स्पष्ट करें -----

Details of the Google Form

Title of the study:

Development and validation of a yoga module in patients with Ankylosing Spondylitis

Statement of the problem:

Yoga is an ancient discipline mainly with three aspects: Asanas (posture), Pranayama (breathing regulation), and Dhyana (meditation). Yoga has been tried as complementary modalities to modern medicine in different disease conditions.

There are reports of the usefulness of yoga in rheumatic diseases like rheumatoid arthritis, Ankylosing Spondylitis etc. (Singh et al., 2022) (Pukšić et al., 2021)

The investigators have already evaluated the effect of yoga in one health condition (in rheumatology) and have found its effectiveness as a complementary modality.

There are many modules of yogic practices including sets of Asana, Pranayama etc. We need to develop a set of such practices which may be offered to people with specific health conditions or diseases. The said module should be specific to the condition because some practices may not be effective or sometimes improper/incorrect for a particular disease condition.

The current study aims to develop a yogic module for patient with AS for this the investigator would, i) consider a set of such yogic practices as per objective recommendation by a group of experts (specialist doctors – rheumatologists,

Physiatrist, Yoga experts), and subsequently, ii) validate a module in patients with AS.

For phase I after study, investigators would use Laswhe content validity ratio method. In this complete set of yogic practices would be sent to the experts, who will then mark them as a) very much useful (Essential), b) moderately useful (Important, but not essential), c) Not at all useful (Not necessary)

In case a particular question or point is considered by the experts difficult or unable to validate he/she may mark it as d) cannot be answered.

The module would be sent in the form of a physical questionnaire or Google form. The form would content seven section – section I) would contains – Name, Degree, affiliations and experience of the experts, section II-VII (II. Loosening exercise/Yogic Suksma vyama, III. Asana, IV. Breathing Practices (Preparation techniques for Pranayama) V. Pranayama, VI. Relaxation Techniques, VII. Meditation) contains different yogic practices as detailed below:

Complete List of Yogic Techniques

Section II to VII of the Google Form

Section - II

Loosening exercise/Yogic Suksma Vyama

Loosening exercises or Suksma Vyayama in Sanskrit is a set of practices intended to increase mobility of joints and to prepare for

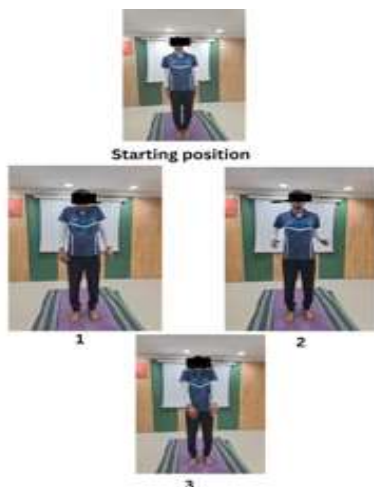
the practice of yoga postures. It has also been named the locomotive exercise because the movement resembles that of a locomotive. The techniques involve repetitive movements of all the joints from the toes up to the neck.

1. Neck movement/ Griva-Sakthi-Vikasaka (Front-back-side bending, twisting, and rotation)

- **Cervical flexion:** bending the head forward towards the chest.
- **Cervical extension:** bending the head backward with the face towards the sky.
- **Cervical rotation:** turning the head to the left or the right.
- **Cervical side-bending:** tipping the head to the side or touching an ear to the ipsilateral shoulder.



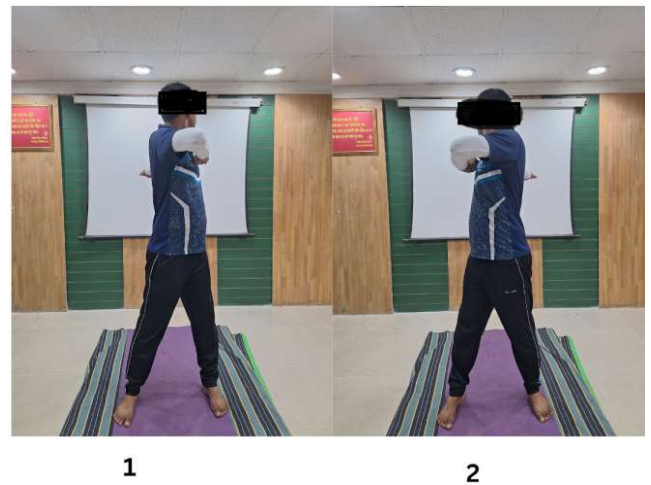
2. Shoulder rotation



- Rotation away from the midline along a vertical axis

3. Trunk Twisting

- The exercise stretches the back, spine and upper torso muscles



4. Side bending



- Complex movement that involves range of motion of the spine, control of the chest and

the lower back, movement of the hips and reaching of the arms and shoulder girdle

5. Butterfly

- Sit on the floor with both legs straight out in front of you.
- Bring the soles of your feet together
- Bring your heels as close to your body as you can, hold the pose for 30 seconds



6. Alternate straight leg raising



- i. Inhale. Exhale. While keeping your legs extended, slowly lower your right leg until it

almost touches the floor, ensuring your spine remains in a neutral position.

- ii. Inhale. Raise your right leg to return to the starting position.

- iii. Exhale. While keeping your legs extended, slowly lower your left leg until it almost touches the floor, ensuring your spine remains in a neutral position.

- iv. Inhale. Raise your left leg to return to the starting position. Continue alternating between right and left for the specified number of repetitions.

7. Vertical stretch of the knee



- i. Stand with both legs.
- ii. Fold the right knee in upward direction and catch with the hand.
- iii. Try to press the knee towards the chest.
- iv. Same action will be required in opposite leg.

8. Vertical stretch of the knee of both legs



Isolating the abdominal muscles, building strength in the hip flexors and developing the core.

9. Pawanmuktasana/lumbar stretch (Single and both legs)



- i. Lie down in Shavasana with both legs together, hands on the side of thighs, palm facing downward
- ii. Slowly pull both the legs toward chest while folding from the knees and holding the knees with fingers interlocked. Simultaneously, lift the head and touch the chin to the knees

10. Dorsal stretch



- i. Stand with feet together.
- ii. Toes back toward your shins
- iii. Hold for 20 to 30 seconds.
- iv. Repeat with the other foot.

11. Alternate foot knee lumbar stretch



- i. Turn the head to the left, looking along the left arm, and gaze at the middle finger of the left hand. The right hand should be on the left knee

and the left arm and shoulder should remain in contact with the floor.

ii. In the final position, the head should be turned in the opposite direction to the folded knee and the other leg should remain straight. Hold the position for as long as is comfortable.

12. Side leg raising



- Resistance move where the lift one leg out to the side

13. Side lumbar stretch



14. Instant relaxation techniques



Section III to VII of the Google Form

Section – III: ASANAS OR PHYSICAL POSTURES

Asana (posture) is usually defined as a body posture held with stability and ease by Patanjali. Hathayoga Pradipika emphasises that asana helps bring about stability in health and suppleness of body. As intra-thoracic, intra-abdominal pressure-volume changes affect internal organs and systems, it is plausible that asanas produce changes through mechanisms both local as well as general. (Bhavanani & Ramanathan, 2018)

- A. Standing Postures , B. Spinal Twist Postures
- C. Sitting Postures D. Prone Postures E. Supine Postures

III.A Standing Pose

15. Side bending Chakrasana/Ardhakati chkrasana

(Lateral bend yoga posture)

- Stand straight with your toes joined together, heels should be slightly apart.
- Relax both shoulders and place palms near the respective thighs.
- Next, take a deep breath and raise your right hand sidewise till the shoulder level and continue raising your right arm until it touches the right ear.
- Exhale and with a deep inhalation, stretch the right side of your body as you bend towards the left.

- v. Hold this position for about 30-60 seconds.
- vi. Now, again take a deep breath and slowly come back to the initial position, bring the right arm back near the thigh and relax. Repeat the same with the other side (left)



16.Konasana/Trikonasan (Triangle Pose)

- i. Stand erect with the feet more than shoulder width apart. Turn the right foot to the right side.
- ii. Stretch the arms sideways and raise them to shoulder level so that they are in one straight line.
- iii. Bend to the right, taking care not to bring the body forward. Simultaneously bend the right



Starting position



Left Side



Right Side

- knee slightly.
- iv. Place the right hand on the right foot, keeping the two arms in line with each other.
- v. Turn the left palm forward. Look up at the left hand in the final position.
- vi. Return to the upright position with the arms in a straight line.
- vii. Repeat on the other side, bending the left knee slightly. This completes one round. Practice 5 to 10 rounds.

17.Katichakrasana (standing spinal twist pose)

- i. Stand with the feet about shoulder width apart and the arms by the sides.
- ii. Raise the arms to shoulder level, then twist the body to the right.
- iii. Bring the left hand to the right shoulder and wrap the right arm around the back, bringing the right hand around the left side of the waist. Look over the right shoulder as far as is comfortable.
- iv. Keep the back of the neck straight and imagine the top of the spine is the fixed point around which the head turns. Hold for two seconds; accentuate the twist, gently stretching the abdomen.



Starting position



Left Side



Right Side

v. Return to the starting position. Repeat on the other side to complete one round. Keep the feet firmly on the ground while twisting.

vi. Relax the arms and back as much as possible throughout the practice. Do not strain. The movement should be relaxed and spontaneous.

vii. Perform the rotation smoothly, without jerking or stiffness. Practice 5 to 10 rounds

18. Tadasana (Mountain Pose)

i. Stand with the feet together or about 10 cm apart, and the arms by the sides.

ii. Steady the body and distribute the weight equally on both feet. Raise the arms over the head.

iii. Interlock the fingers and turn the palms upward. Place the hands on top of the head. Fix the eyes at a point on the wall slightly above the level of the head.

iv. The eyes should remain fixed on this point throughout the practice. Inhale and stretch the arms, shoulders and chest upward.

v. Raise the heels, coming up onto the toes. Stretch the whole body from top to bottom, without losing balance or moving the feet.

vi. Hold the breath and the position for a few seconds. At first it may be difficult to maintain balance, but with practice it becomes easier.



vii. Lower the heels while breathing out and bring the hands to the top of the head. This is one round.

viii. Relax for a few seconds before performing the next round. Practice 10 rounds.

19. Brikhasana (Tree Pose)

1. Stand erect, legs together, hands by the side of the thighs, and gaze in front

2. Fold right leg from the knee, placing the sole near left thigh joint. Bring hands in Namaskara mudra. Hold and repeat with other leg.



20. Birbhadarsana-1 (Warrior Pose-1)

i. Begin by standing straight with your feet 3-4 feet apart.

ii. Turn your right foot out so that it is at an angle of 90-degrees. Turn your left foot in by around 15-degrees.

iii. Now slowly lift both arms sideways to your shoulder height. Your palms must be facing upwards. Exhale deeply and bend your right knee.

iv. Turn your head and look towards your right. Stretch your arms more.

- v. Hold your head high and don the determination of a warrior. Keep breathing deeply.
- vi. To release the pose, breathe in and lower your arms. Repeat the yoga Warrior 1 pose on the other side.



21. Utkatasana (Chair Pose)

- i. Starting in [Mountain pose / Tadasana](#) Exhale as you bend your knees and move your hips back as if you were sitting down on a chair.



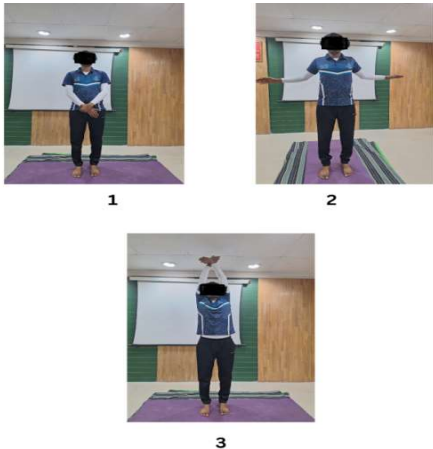
- ii. Draw your lower abdomen in and up to support your lower back.
- iii. Send your hips back rather than your knees forward, so that you can still see your toes.
- iv. Inhale as you raise your arms up around your ears and soften your shoulders Keep reaching higher, while sitting lower for 5 to 10 breaths
- v. To come back into in Tadasana, exhale, as you press your feet down to straighten your legs and then bring your arms down to your sides.

22. Bandha Hsata Uttanasana

(Locked hand raising pose)

- i. Begin from [Uttanasana](#) (Standing Forward Fold). Inhale, bring the arms interlocked at the elbows and take the face and chest close towards the thighs flexing at the hips, to the maximum.
- ii. Exhale, and bring the torso deeper down trying to touch the floor with the elbows.
- iii. Allow the head, shoulders, arms, and neck to hang loose and remain here in this pose for about 8 breaths. If holding this posture is a challenge, then bend the legs at the knees and look up to avoid any pressure to the head and neck.
- iv. To release, inhale and look up, then release the arms and slowly come up to stand in [Tadasana](#) (Mountain Pose).
- v. Relax here and if required repeat the practice of Baddha Hasta Uttanasana, taking the practice for a longer duration.
- vi. Feel the stretch at the hamstrings, quadriceps, shoulders, arms, and lower back while in this forward bend variation.

vii. The pressure at the neck and head would be more when compared to the practice of Uttanasana, as there is no support. Exhale,



going deeper down and if the knees are bent, hold the posture without going any further down towards the ground.

III. B. Spinal Twist Postures

23. Meru wakrasana

- i. Firstly align to [Staff Pose](#) (Dandasana). Stay for a couple of breaths and prepare for the pose. The torso and the spine of the body are upright and engaged.
- ii. Inhale and extend the torso. Exhale, place the left foot on the outside of the right knee. Ground the left foot. Keep the right leg extended and the right foot engaged. Inhale.
- iii. Exhaling, take a twist from the lower back towards the right side. Place the palms behind the body, a little away from the buttocks. Stay in the pose as per capacity.
- iv. Breathe with awareness. Now release the palms and then re centre to Dandasana. Moving to the other side, practice towards the left.

v. This time the right foot is placed on the floor, outside the left knee. The student takes the twist towards the left side with palms placed behind.

vi. Stay as per capacity and repeat according to your comfort. Release and finally relax in [Staff Pose Hands Back Knees Bent](#) (Dandasana Hands Back Knees Bent).



24. Bhunamasana

- i. Sit comfortably on the ground or yoga mat. Stretch your legs towards the sides with sitting bones touched to the ground.
- ii. Keep your spine or back straight. Inhale and raise your arms. Hold both toes with fingers.
- iii. Now starting bending forward towards the ground. Do as much your body allows you to do. Don't force the body or else you may suffer pain.
- iv. Try to touch the floor with your forehead or chin. If you cannot, don't worry. Nobody can perfect this pose in one go. Your flexibility will improve gradually.
- v. Come back in the neutral position. Rest for a minute.
- vi. Repeat this for a couple of times daily.



25. Ardha matsyendrasana

- i. Sit down on the floor. Stretch your legs out in front of you. Bend your right leg at the knee.
- ii. Bring your right foot close to your anus, against the inside of your left thigh.
- iii. Bend your left leg by raising your knee. Place your left foot flat on the floor to the right of your right knee.
- iv. Stretch your right hand backward and place your palm flat on the floor behind your back.
- v. Raise your left arm over your head. Stretch it around your right knee and grasp your right ankle.
- vi. Maintain the posture for 30 seconds while breathing evenly. Repeat the posture on the other side.



1



2



3

III.C Sitting Pose

26. Parvatasana

- i. Start by sitting in the Padmasana pose (legs crossed with left foot on right thigh and right foot on left thigh). Keep your hands on respective sides, chest forward, neck straight and eyes fixed on a single point with a straight head.

- ii. Inhale and raise both arms together and make an upward stretch. Join the palms with each other in this upward stretch position. You can either interlace the fingers or keep the palms joined.

iii.



Bring the hands close to the ears and keep your back straight. Avoid bending the arms at the elbow and wrists, keeping them straight and stretched and gaze fixed at a single point.

- iv. Hold this fully stretched position with joined palms for at least 6 seconds and retain the breath. Now, to return to the starting position, exhale, open the palms, and bring the arms down to complete one round. You may practice it for up to four rounds without pause and beginners may start with one round.

v. To try variations while in seated mountain pose asana, bend to your right/left side, keeping the head between the arms. Let the spine arch sideways with no movement below the waist.

- vi. Likewise, you may also try bending backwards and forward. You might complete one cycle of each variation and practice two rounds of the above variation

27. Uttanmandukasana

- i. First, sit in Vajrasana (sit in a kneeling position with your hips on the heels and your toes pointing behind you; ensure your big toes should touch each other).
- ii. Next, spread the knees wide apart. Raise the left arm, fold it from the elbow, swing it back above the right shoulder, and place the palm on the right shoulder blade.
- iii. Similarly, fold the right arm and place it on the left shoulder blade. Hold this position for a while and then come back slowly in a reverse manner.
- iv. Relax the whole body.



28. Gomukhasana

- i. Start in [Dandasana](#) (Staff pose). Bend the right knee. Bring your left foot to the outside of your right hip, weaving it underneath your right knee.
- ii. Bring your right foot to the outside of your left hip, so that your right knee is stacked on top of your left knee.
- iii. Ground through your sitting bones. As you inhale, lengthen your spine and stretch your arms out to the sides, palms facing forward.

- iv. Internally rotate your right shoulder so that your palm faces to the wall behind you and your thumb points down. Sweep the arm behind your back, walking your hand up between your shoulder blades, palm facing outwards.



1



2

- v. Stretch the left arm up, fingertips pointing towards the ceiling, the palm of your hand still facing forward.
- vi. Bend the elbow and reach down for the right fingertips, hooking the fingers together if they reach.
- vii. So you now have your right knee on top and your left elbow pointing upwards
- viii. Firm your shoulder blades against your back ribs and open your chest.
- viii. Stay for a few breaths. To come out of the pose, release the arms, uncross the legs and repeat on the other side.
- ix. Remember to switch legs as well as the arms. Whichever knee is stacked on top, the opposite side elbow is pointing upwards.

29. Marjarasana

- i. Sit in vajrasana. Raise the buttocks and stand on the knees. Lean forward and place the hands flat on the floor beneath the shoulders with the fingers facing forward.

ii. The hands should be in line with the knees; the arms and thighs should be perpendicular to the floor. The knees may be slightly separated so that they are well aligned under the hips.

iii. This is the starting position. Inhale while raising the head and depressing the spine so that the back becomes concave.

iv. Expand the abdomen fully and fill the lungs with the maximum amount of air. Hold the breath for 3 seconds. Exhale while lowering the head and stretching the spine upward.

v. At the end of exhalation, contract the abdomen and pull in the buttocks. The head will now be between the arms, facing the thighs.



vi. Hold the breath for 3 seconds, accentuating the arch of the spine and the abdominal contraction. This is one round

30. Ardhastrasana

i. Sit in vajrasana. Ushtrasana Stand on the knees with the arms at the sides.

ii. The knees and feet should be together, but may be separated if this is more comfortable. Lean backward,

iii. slowly reaching for the right side of the hip with the right hand and then the left side of the hip with the left hand. Do not strain.

iv. Push the hips forward, keeping the thighs vertical, and bend the head and spine backward as far as is comfortable.

v. Relax the whole body, especially the back muscles, into the stretch. The weight of the body should be evenly supported by the legs and arms.



vi. The arms should anchor the shoulders to maintain the arch of the back. Remain in the final position for as long as is comfortable.

vii. Return to the starting position by slowly releasing the hands from the hip one at a time.

31. Baddhakonasana (Cobbler's Pose)

- i. Begin seated in [Staff Pose \(Dandasana\)](#) with your legs outstretched straight in front of you.
- ii. Bend your knees and bring the soles of your feet together as you let your knees fall out to either side.
- iii. Draw your feet in as close to your body as is comfortable. Back off if you feel any pain in your knees.
- iv. Press the outer edges of your feet together strongly. The feet may begin to open like a book.



- v. You can encourage this with your hands or hold onto your big toes in a [yogi toe lock](#). Sit up tall with a long spine while keeping your shoulder blades on your back and your shoulders moving away from your ears.

32. Kurmasana (Tortoise Pose)

- i. Sit on the floor. Stretch your legs forward and then place them as wide apart as you can.

- ii. Inhale. Stretch your arms upward, over your head. Raise your knees slightly, bending them.
- iii. Lower your stretched arms to either side and ensure that your palms face downward.
- iv. Turn your wrist to have your fingers pointing backward.
- v. Now, slide your arms under your raised knees. Your torso must be parallel to the ground at this point.
- vi. Allow your head to touch the floor. Gently stretch your legs to straighten your knees.



33. Bhadrasana (Butterfly Pose or Gracious Pose)

- i. Sit with legs extended in front.
- ii. Bring the soles of the feet together, allowing the knees to fall outward.
- iii. Hold the feet with hands.
- iv. Sit up straight, lengthening the spine.
- v. Gently press the knees towards the floor.
- vi. Inhale deeply, expanding the chest.

Hold for 30 seconds to 1 minute

- vii. Exhale as you fold forward, maintaining a relaxed posture.



34. Dandasana (Staff Pose)

- i. Sit with your legs extended in front of you. Make sure to sit on your sit bones.
- ii. Next, engage your thigh muscles while flexing both your feet. If your heels start coming up off the floor, try to keep them rooted.
- iii. Release your shoulders away from your ears, and stack them directly on your hips.
- iv. Hold your arms straight and keep your palms flat on the floor.



- V. Keep inhaling and exhaling while holding the position for as long as possible.

35. Akarna Dhonurasana

- i. Sit on the floor. Stretch your legs out in front of you.



- ii. Ensure that your feet are close together. Bend forward and stretch your arms to hold your toes.

- iii. Keep your torso as erect as you can. Inhale.
- iv. Lift your left leg. Bring your left foot up to your left ear. Keep your hold on the other leg.
- v. Maintain the posture. Breathe evenly. Repeat the movement on the other side.

III.D Prone Postures

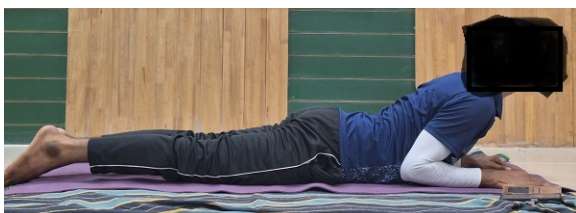
36. Makarasana

- i. Lie flat on the stomach. Raise the head and shoulders and rest the chin in the palms of the hands with the elbows on the floor.
- ii. Keep the elbows together for a more pronounced arch to the spine. Separate the elbows slightly to relieve excess pressure on the neck.
- iii. In makarasana the effect is felt at two points: the neck and the lower back. If the elbows are too far in front, tension will be felt in the neck; if they are drawn too close to the chest, tension will be felt more in the lower back.
- iv. Adjust the position of the elbows so that these two points are equally balanced.
- v. The ideal position is when the whole spine is equally relaxed. Relax the whole body and close the eyes. After some time, again become aware of the body and surroundings, and gently and smoothly release the posture



37. Bhujangasana

- i. Lie flat on the stomach with the legs straight, feet together and the soles of the feet uppermost.
- ii. Place the palms of the hands flat on the floor, below and slightly to the side of the shoulders, with the fingers together and pointing forward.
- iii. Position the arms so that the elbows point backward and are close to the sides of the body.
- iv. Rest the forehead on the floor and close the eyes. Relax the whole body, especially the lower back. Slowly raise the head.
- v. Gently tilt the head backward, so that the chin points forward and the back of the neck is compressed, then raise the neck and then the shoulders.
- vi. Straighten the elbows, using the back muscles first, then the arm muscles to raise the trunk further and arch the back.
- vii. In the final position, the pubic bone remains in contact with the floor and the navel is raised a maximum of 3 cm. If the navel is raised too high, the bend tends to be in the knees and not in the back.
- viii. The arms may or may not be straight; this will depend on the flexibility of the back. Hold the final position.
- ix. To return to the starting position, slowly release the upper back by bending the arms, lower the navel, chest, shoulders and finally the forehead to the floor. Relax the lower back muscles. This is one round.



39. Ardhasalabhasana/ Shalabhasana (locust pose)

- i. Lie on your abdomen in prone position with feet together pointing outward and hands on the side of thighs, forehead resting on the ground
- ii. Close fists and place them under the thighs. Chin should be placed on the ground Raise both the legs slowly without bending from the knees.
- iii. Pelvic area should be on the floor. Hold this position and slowly come back in original position



40. Sarpasana (Snake Pose)

- i. Lie flat on the stomach with the legs straight and the feet together
- ii. Interlock the fingers and place the hands on top of the buttocks
- iii. Place the chin on the floor
- iv. This is the starting position
- v. Raise the chest as far as possible from the floor
- vi. Push the hands further back and raise the arms as high as comfortable
- vii. Imagine the arms are being pulled from behind

viii. Raise the body as high as possible without straining

ix. Squeeze the shoulder blades together and look forward



41. Dhonurasana(Bow Pose)

i. Lie down flat on your abdomen. Ensure that your forehead is placed against the floor and that your legs are close together.

ii. Bend your legs at the knees and bring your feet up behind you. Stretch your arms backward and grasp your ankles.

iii. Inhale. Lift your head off the ground and simultaneously lift your thighs upwards. Your body should be arching upwards now.

iv. Maintain the posture for 10 seconds at the outset.

v. As you practise, you can increase the timing to about one minute.



42. Noukasana (Boat posture)

i. Lie in the starting position. Keep the eyes open throughout. Breathe in deeply. Hold the breath and then raise the legs, arms, shoulders, head and trunk off the ground.

ii. The shoulders and feet should be no more than 15cm off the floor. Balance the body on the buttocks and keep the spine straight.

iii. The arms should be held at the same level and in line with the toes. The hands should be open with the palms down.

iv. Look towards the toes. Remain in the final position and hold the breath. Count to 5 mentally (or for longer if possible).

v. Breathe out and return to the supine position. Be careful not to injure the back of the head while returning to the floor. Relax the whole body.

vi. This is one round. Practice 3 to 5 rounds. Relax in shavasana after each round, gently pushing out the abdomen with inhalation to relax the stomach muscles.



43. Tiryak bhujungasan

i. Lie flat on the stomach with the legs separated about half a metre. The toes should be tucked under and the heels raised so that the foot rests on the ball of the foot.

ii. Place the palms of the hands flat on the floor, below and slightly to the side of the shoulders.

The fingers should be together and pointing forward.

iii. The arms should be positioned so that the elbows point backward and are close to the sides of the body. Rest the forehead on the floor and close the eyes.

iv. Relax the whole body, especially the lower back. Slowly raise the head, neck and shoulders. Straightening the elbows, raise the trunk as high as comfortable. Use the back muscles more than the arm muscles.

v. The head should be facing forward, instead of bending backward as in bhujangasana. Twist the head and upper portion of the trunk, and look over the left shoulder. Gaze at the heel of the right foot. In the final position, the arms remain straight or slightly bent as the shoulders and trunk are twisted.

vi. Relax the back and keep the navel close to the floor. Stay in the final position for a few seconds. Face forward again and repeat the twist on the other side without lowering the trunk. Return to the centre and lower the body to the floor. This is one round. Practice 3 to 5 rounds.



III.E Supine Postures

44. Ekpadauttanasana/ Uttanpadasana (both leg) (leg raised pose)

i. Lie down in Shavasana with both legs together, hands on the side of thighs, palm facing downward

ii. Raise both the legs together slowly up to 30°, 45°, 60° angle slowly Stay in this position as long as comfortable and return to the original position while breathing out



45. Setubandhanasana (bridge pose)

i. Lie down in Shavasana with both legs together, hands on the side of thighs, palm facing downward

ii. Fold your legs from the knees, feet touching the ground Slowly exhale and raise the body up, keeping head, neck, and feet on the floor, and rest of the body is lifted up in the air.

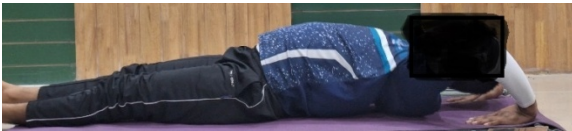
iii. Hold and return back slowly to the original position



47. Setu asana

- i. Sit with the legs stretched forward. Place the palms on the floor on either side of the body, about 30 cm behind the buttocks.
- ii. The elbows should be straight, the fingers pointing back and the trunk slightly reclined.
- iii. This is the starting position. Raise the buttocks and lift the body upward. Let the head hang back and down.
- iv. Try to place the soles of the feet flat on the ground. Keep the arms and legs straight. Hold the final position for as long as is comfortable. Lower the buttocks to the floor. This is one round. Practice up to 5 times.

48. Kandhrasna



- i. Lay your back on the floor. Keep the legs stretched out and arms by your side. Take a bend at the knees and place the feet on the ground. Extend the arms to grab the ankles with your palms.
- ii. Make sure the grasp is firm and tight. Now, try to pull your feet in the backward direction until your heels come in close contact with the hips.
- iii. Stay within your limits. Inhale, retain the breath, uplift the hips higher, and arch the back

upwards. Feet and shoulders will rest on a yoga mat.

iv. Support the body weight on your shoulders, neck, head, arms, and feet. This is the final position.

v. Hold it for 20-seconds. To release, lower the hips and back to the ground, extend the legs, unlock the ankles and rest the arms by your side and relax in the supine position.



49. Supta udarakarshanasana

- i. Lie in the starting position and relax. Bend the knees and place the soles of both feet flat on the floor, directly in front of the buttocks. Keep the knees and feet together throughout the practice.
- ii. Interlock the fingers of both hands, place the palms under the back of the head and let the elbows touch the floor.
- iii. Breathe in, and while breathing out, slowly lower the legs to the right, trying to bring the knees down to the floor. The feet should remain in contact with each other, although the left foot will move slightly off the floor.
- iv. At the same time, gently turn the head and neck in the opposite direction to the legs. This will give a uniform twisting stretch to the entire spine. Hold the breath in the final position while mentally counting three seconds. While

breathing in, raise both legs to the upright position. Keep the shoulders and elbows on the floor throughout. Repeat on the left side to complete one round. Practise 5 complete rounds



50. Shava udarakarshanasana

- i. Lie in the starting position with the legs and feet together. Stretch the arms out to the sides at shoulder level with the palms of the hands facing down.
- ii. Bend the right leg and place the sole of the foot beside the left kneecap. Place the left hand on top of the right knee. This is the starting position. Gently bring the right knee down towards the floor on the left side of the body, keeping the leg bent and the foot in contact with the left knee.
- iii. Turn the head to the right, looking along the straight arm, and gaze at the middle finger of the right hand. The left hand should be on the right knee and the right arm and shoulder should remain in contact with the floor.

- iv. In the final position, the head should be turned in the opposite direction to the folded knee and the other leg should remain straight. Hold the position for as long as is comfortable.
- v. Return to the starting position, bringing the head and knee to the centre. Stretch the right arm out to the side and straighten the right leg. Repeat on the opposite side. Practise once to each side, gradually extending the holding time.



51. Matsyasana

- i. Sit with the legs stretched forward. Fold one leg, placing the foot on the opposite thigh as in ardha padmasana, the half lotus pose.
- ii. Keep the other leg straight in front of the body. Slowly bend backward, using the elbows for support, and lower the crown of the head to the floor. Hold the foot of the bent leg with both hands.
- iii. Accentuate the arch of the back as much as possible without straining. Relax the whole body and close the eyes.
- iv. Remain in the final position for a comfortable length of time and then return to the starting position. Repeat the same pose with the other leg

folded. As an alternative, rest the back of the head on the floor instead of the top of the head.



Section IV to VII of the Google Form

Section – IV: Breathing Practices (Preparation techniques for Pranayama):

52. Basic abdominal breathing

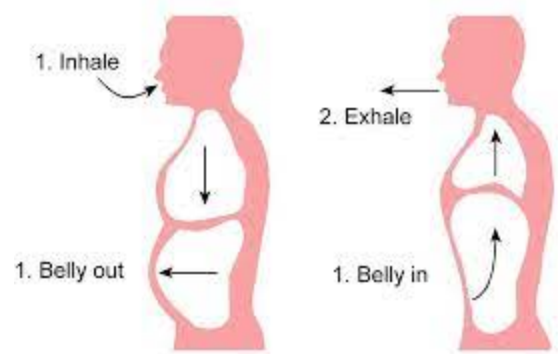
i. Lie in shavasana and relax the whole body. Place the right hand on the abdomen just above the navel and the left hand over the centre of the chest. Observe the spontaneous breath without controlling it in any way.

ii. Let it be absolutely natural. To practise abdominal breathing, feel as though you are drawing the energy and breath in and out directly through the navel. The right hand will move up with inhalation and down with exhalation. The left hand remains almost still. Let the abdomen relax. Do not try to force the movement In any way.

iii. Do not expand the chest or move the shoulders. Feel the abdomen expanding and contracting. Continue breathing slowly and deeply. Inhale while expanding the abdomen as much as is comfortable, without expanding the ribcage. At the end of the inhalation, the diaphragm will be compressing the abdomen and the navel will be at its highest point.

iv. On exhalation, the diaphragm moves upward and the abdomen moves downward. At the end of the exhalation, the abdomen will be contracted and the navel compressed towards the spine. Continue for a few minutes.

v. Relax any effort and once again watch the spontaneous breathing pattern. Bring the awareness back to observing the physical body as a whole. Be aware of the surroundings and gently open the eyes.



53. Fast breathing

Some patients may feel dizziness, light headed due to fast breathing, if one feels uncomfortable then he / she can stop the fast breathing and may hold the breath for about 10 seconds, or try to inhale and exhale in same plastic bag, and then continue normal breathing. (This dizziness is caused due to reduced carbon dioxide levels, which cause constriction of blood vessels in the brain, reducing blood flow to that part temporarily.)

i. Initially one should start slowly by 30 Inhalation and exhalations in 1 minute, and slowly build the speed to 60 rounds in 1 minute.

ii. May practice it for about 3 minutes. After practicing for 15 to 20 days, one can increase the speed to about 80 rounds per minute and then you may even do 120 rounds in 1 minute.

54. Hands in and out breathing

- i. To start these practices first stand in Tadasana.
- ii. Bring your both palms together.
- iii. Now inhaling, slowly spread your arms sideways horizontally.
- iv. While exhaling slowly bring your arms in front of your chest with palms touching each other.
- v. This completes one round of the practice. Practice this for ten rounds.
- vi. Remember your arms movements should synchronize continuously with your breath rhythmically.
- vii. Stop practicing after completing ten rounds and come to Shithila Tadasana.



Breathing practice is a simple and easy practice that can help mobilize your joints and strengthen the muscles.

55. Tiger breathing

- i. To start this practice first come to Dandasana. (Sthiti)
- ii. Imitate breathing like a Tiger.

iii. Slowly sit in Vajrasana and lean forward.

Now place your hands flat on the floor in line with the shoulders with fingers pointing outwards.

iv. Keep your arms, thighs and heels about one shoulder width apart.

v. The arms and thighs should be perpendicular to the floor.

vi. Before starting the practice ensure that you are comfortable while standing on "all-fours" (i.e., two hands and two knees).

vii. Now while inhaling slowly raise your head and look up.

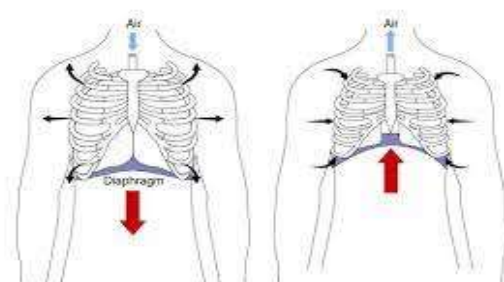
viii. Simultaneously lower the spine making it concave.

ix. While exhaling, arch the spine upwards and bend the head downward bringing the chin towards the chest.

x. This completes one round of tiger breathing. Practice it for five rounds.



56. Diaphragm breathing



- i. Sit or lie in a comfortable place. Close your eyes. Place one hand on your chest and one hand on your abdomen.
- ii. The bottom hand should do the moving. The top hand should remain still or only move as the bottom hand moves. Inhale through your nose for about 4 seconds, feeling your abdomen expand. (You may feel slight tension the first few times you inhale.)
- iii. Hold your breath for 2 seconds. Exhale very slowly and steadily through your mouth for about 6 seconds.
- iv. The mouth should be relaxed. Repeat for 5-15 minutes.

57. Chest Breathing

- i. Sit in a steady asana.
- ii. Breath in Chest up, count 1-10
- iii. Breath out Chest down, count 10-1



Section V to VII of the Google Form

Section – V: Pranayama

58. Surya Anuloma-viloma Pranayama

- i. Sit in a steady asana. Padmasana is most suited for the practice. Siddhasana and Vajrasana may also be used.
- ii. Close the left nostril with your thumb and draw in air from the right nostril. Do this as slowly as you can, till your lungs are full.

- iii. Now release the thumb and close the right nostril with your ring finger. Then breathe out slowly through the left nostril.
- iv. Next take the air in from the left nostril and then release it through the right nostril (after closing the left nostril with the thumb).
- v. This is one round of Surya Anulom Vilom Pranayama. Start with 5 rounds and increase it up to 20 rounds in one sitting.



59. Chandra Anuloma Viloma Pranayama

- i. Sit in a steady asana. Padmasana is most suited for the practice. Siddhasana and Vajrasana may also be used.
- ii. Close the right nostril with your thumb and draw in air from the left nostril. Do this as slowly as you can, till your lungs are full.
- iii. Now release the thumb and close the left nostril with your ring finger. Then breathe out slowly through the right nostril.
- iv. Next take the air in from the right nostril and then release it through the left nostril (after closing the right nostril with the thumb).
- v. This is one round of Chandra Anulom Vilom Pranayama. Start with 5 rounds and increase it up to 20 rounds in one sitting.



60. Suryaveda Pranayama Technique

- i. Assume a comfortable meditation asana. Place the hands on the knees in either chin or jnana mudra. Close the eyes and relax the whole body. When the body is comfortable and still, watch the breath until it spontaneously becomes slow and deep.
- ii. Adopt nasagra mudra. Close the left nostril with the ring finger and inhale slowly and deeply through the right nostril.
- iii. This is one round

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61. Chandraveda pranayama

- i. Assume a comfortable meditation asana. Place the hands on the knees in either chin or jnana mudra. Close the eyes and relax the whole body. When the body is comfortable and still, watch

the breath until it spontaneously becomes slow and deep.

- ii. Adopt nasagra mudra. Close the right nostril with the ring finger and inhale slowly and deeply through the left nostril.
- iii. This is one round

62. Nadisodhana Pranayama Technique

- i. Sit in any comfortable meditation posture, preferably siddha/siddha yoni asana or padmasana. Keep the head and spine upright. Relax the whole body and close the eyes. Practise yogic breathing for some time. Adopt nasagra mudra with the right hand and place the left hand on the knee in chin or jnana mudra. Close the right nostril with the thumb. Inhale and exhale through the left nostril 5 times. The rate of inhalation/exhalation should be normal. Be aware of each breath. After completing 5 breaths, release the pressure of the thumb on the right nostril and press the left nostril with the ring finger, blocking the flow of air. Inhale and exhale through the right nostril 5 times, keeping the respiration rate normal. Lower the hand and breathe 5 times through both nostrils together. This is one round. Practise 5 rounds or for 3 to 5 minutes, making sure that there is no sound as the air passes through the nostrils. Practise until this stage is mastered before commencing the next stage.

- ii. Begin to control the duration of each breath. Count the length of the inhalation and exhalation through the left, right and both nostrils. Breathe deeply without strain. While inhaling, count mentally, "1, Om; 2, Om; 3, Om", until the

inhalation ends comfortably. While exhaling, simultaneously count, "1, Om; 2, Om; 3, Om". Inhalation and exhalation should be equal. Practise 5 rounds or for 3 to 5 minutes, making sure that there is no sound as the air passes through the nostrils. Extension: Notice that the length of the breath will spontaneously increase after some days of practice. Contraindications: Nadi shodhana is not to be practised while suffering from colds, flu or fever.



63. Anulom-Vilom Pranayama

- i. Sit in Padmasana
- ii. Fold your index and middle finger of the right hand toward the inner side of palm rounds Ring finger and little finger should be straight Press right nostril using thumb while inhaling from left nostril
- iii. Now close the left nostril with ring finger and little finger while exhaling slowly through right nostril after removing the thumb
- iv. Now inhale through the right nostril and exhale through the left nostril. This completely one round of Anuloma-Viloma Exhalation time should be double than inhalation time



64. Bhramari Pranayama

- i. Sit in a comfortable meditation asana, preferably padmasana or siddha/siddha yoni asana with the hands resting on the knees in joana or chin mudra. Close the eyes and relax the whole body. The lips should remain gently closed with the teeth slightly separated throughout the practice. This allows the sound vibration to be heard and felt more distinctly. Raise the arms sideways and bend the elbows, bringing the hands to the ears.
- ii. Use the index or middle finger to plug the ears or the flaps of the ears may be pressed without inserting the fingers. Bring the awareness to the centre of the head, where ajna chakra is located, and keep the body absolutely still. Inhale through the nose.
- iii. Exhale slowly and in a controlled manner while making a deep, steady humming sound like that of the black bee. The humming should be smooth, even and continuous for the duration of the exhalation. The sound should be soft and mellow, making the front of the skull reverberate.
- iv. At the end of exhalation, the hands can be kept steady or returned to the knee and then raised again for the next round. The inhalation and exhalation should be smooth and controlled. This is one round.



65. Bhastrika Pranayama

- i. Preparatory practice Sit in a comfortable meditation posture with the hands resting on the knees in either chin or jnana mudra.
- ii. Keep the head and spine straight, close the eyes and relax the whole body. Take a deep breath in and breathe out forcefully through the nose. Immediately afterwards breathe in with the same force. Forceful inhalation results from fully expanding the abdominal muscles and forceful exhalation from firm contraction of the abdominal muscles. Do not strain.
- iii. During inhalation, the diaphragm descends and the abdomen moves outward. During exhalation, the diaphragm moves upward and the abdomen moves inward. The movements should be slightly exaggerated. Continue in this manner, counting 10 breaths. Take a deep breath in and breathe out slowly. This is one round. Practise up to 5 rounds.



66. Shetali Pranayama

- i. Sit in any comfortable meditation posture. Close the eyes and relax the whole body. Extend the tongue outside the mouth as far as possible without strain. Roll the sides of the tongue up so that it forms a tube. Practise a long, smooth and controlled inhalation through the rolled tongue.
- ii. At the end of inhalation, draw the tongue in, close the mouth and exhale through the nose. Practise yogic breathing throughout. The breath should produce a sucking sound. A feeling of icy coldness will be experienced on the tongue and the roof of the mouth. This is one round.

Duration: With practice, the duration of the inhalation should gradually become longer to increase the cooling effect. Gradually increase the number of rounds from 9 to 15. For general purposes 15 rounds is sufficient; however, up to 60 rounds may be performed in very hot weather.

Awareness: On the tongue, the sound and the cooling sensation of the inhaled breath.

Sequence: Practise after asanas and other yogic practices which heat the body in order to restore temperature balance



67. Shitkari Pranayama

i. Sit in any comfortable meditation posture. Close the eyes and relax the whole body. Hold the teeth lightly together. Separate the lips, exposing the teeth. ii. The tongue may be kept flat or folded against the soft palate in khechari mudra. Inhale slowly and deeply through the teeth.

iii. At the end of the inhalation, close the mouth. Exhale slowly through the nose in a controlled manner. This is one round.

Awareness: On the hissing sound and the cooling sensation of the inhaled breath.



Contra-indications: As for sheetali pranayama. Practitioners with sensitive teeth, missing teeth or dentures should practise sheetali pranayama instead. Other details: As for sheetali pranayama

68. Ujjayi Pranayama

i. Sit in any comfortable meditation asana. Close the eyes and relax the whole body. Take the awareness to the breath in the nostrils and allow the breathing to become calm and rhythmic.

ii. After some time, transfer the awareness to the throat. Feel or imagine that the breath is being drawn in and out through the throat and not

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through
the
nostrils,
as if it

is taking place through a small hole in the throat.

iii. As the breathing becomes slower and deeper, gently contract the glottis so that a soft snoring sound, like the breathing of a sleeping baby, is produced in the throat. If practised correctly, there will be a spontaneous contraction of the abdomen, without any effort being made. Both inhalation and exhalation should be long, deep and controlled. Practice yogic breathing while concentrating on the sound produced by the breath in the throat. The sound of the breath should be audible to the practitioner alone.

69. Murcha Pranayama

i. Sit in any comfortable meditation asana, preferably padmasana or siddha/siddha yoni asana. Keep the head and spine straight. Relax the whole body.

ii. Observe the breath until it becomes slow and deep. Adopt khechari mudra, then slowly inhale through both nostrils with ujjayi pranayama, while gently and smoothly bending the head slightly back. Perform shambhavi mudra. Straighten the arms by locking the elbows and pressing the knees with the hands.

iii. Retain the breath inside for as long as is comfortable, maintaining shambhavi mudra. Exhale and relax the arms. Close the eyes and slowly bring the head back to the upright position.

iv. Relax the whole body for a few seconds, keeping the eyes closed. Experience the lightness and tranquillity in the mind and body. This is one round.

70. Anunasika Pranayama

Take a deep breath, then blow it out through the nostrils in a series of exhales until the lungs are empty. Do this six times through both nostrils, then six times through the right nostril only (holding the left nostril closed with the fingers), then six times through the left nostril only (closing the right nostril with the fingers), and finally six times through both nostrils.

71. Savitri Pranayama

Savitri rhythm breathing brings about a beautiful oneness and harmony between the entire system of your body, mind, emotions and spirit. This 'pranayama' (prana = energy + yama = control) or conscious breathing can be practised in various timings and counts. The

breath has 4 parts:
i) inhaling breath in (puraka)

ii) hold in (kumbhaka)

iii) exhaling breath out (rechaka)

iv) hold out (shunyaka)

Best practised in any of the classical sitting postures such as cross-legged (sukhasana), kneeling sitting on feet (vajrasana / thunderbolt), or resting in savasana (corpse pose)

72. Naga Pranayama

'Naga' means 'serpent' in sanskrit. This breathing stimulates the special skin breath of the serpent. The human skin has an elimination function like the kidneys or the lungs. It contains a great number of pores which allows toxins to be properly released. It is thus advisable to practice this purification technique before any cycle of pranayamas for regeneration. It also improves the breathing capacity.

i. Sit in vajarasana. Inhale deeply through the nose. Hold the breath for a period of ten seconds. Then take another inhalation and hold the breath again for ten seconds. Exhale slowly through the mouth like snake.

ii. With this practice, the skin becomes warm and perspiration may even begin to form on the arms. Repeat this process three times and then, lie on the back and relax totally.

iii. This is a very powerful kumbhaka and it should not be practiced by persons with weak lungs, bronchial problems or a weak heart.

This naga pranayama channelizes the pranic energy and activates the energy centres of our chakras.

73. Nadanusandhan Pranayama

In this practice, we will do 4 rounds of chanting using different sounds: A, U, M, and lastly AUM/Om. The sounds should be produced loudly so you can become aware of the resonance in different parts of the body. This will happen when the frequency of the generated sound matches the natural frequency of the body. You can try using different pitches until the resonance is felt. Eventually you can begin to focus on the post-resonance silence, which will help to deepen the awareness and help to relieve subtle tensions.

i. Sit in any meditative position and adopt Cin Mudra (Pic-A)

ii. Take a couple of breaths to centre yourself and draw the attention inwards.

iii. A-kara chanting

iii.i Slowly inhale to fill the lungs completely, and begin to chant A-kara in a low voice (just the ‘AAA’ sound).

iii.ii Notice how the sound reverberates in the abdomen.

iii.iii Repeat 9 times.

iv. U-kara chanting

iv.i With Chinmaya Mudra (pic-B), Slowly inhale to fill the lungs and completely, and begin to chant ‘UUU’ in a low pitch.

iv.ii Notice how the sound reverberates in the chest and middle part of the body.

iv.iii Repeat 9 times.

v. M-kara chanting

v.i With Aadi Mudra (Pic-C), Slowly inhale to fill the lungs and completely, and begin to chant ‘MMM’ in a low pitch.

v.ii Notice how the sound resonates in the throat and head region.

v.iii Repeat 9 times.

vi. AUM chanting

vi.i Inhale slowly and completely fill the lungs.

vi.ii Adopt Brahma mudra (Pic-D) (thumb inside the fist) and exhale to chant AUM in a low voice.

vi.iii Feel the sound resonate throughout the body.

vi.iv Repeat nine times.

vii. To close the practice, take another few deep breaths becoming aware of any sensations in the body and observe your emotional state.

Section VI to VII of the Google Form

Section – VI: Relaxation Techniques

Relaxation techniques are a great way to help with stress management. Relaxation isn't only about peace of mind or enjoying a hobby. It's a process that decreases the stress effects on mind and body. Relaxation techniques can help to cope with everyday stress. And these techniques can help with long-term stress or stress related to various health problems, such as heart disease and pain.

Whether stress is spiraling out of control or already got it tamed, can benefit from learning relaxation techniques. Learning basic relaxation techniques is easy. Relaxation techniques are often free or low cost, pose little risk, and can be done nearly anywhere.

74. Instant Relaxation Technique (IRT)

Instant Relaxation Technique (IRT) is an immediate way to bring the body and mind to relax with this practice. Instant Relaxation Technique (IRT) is usually done at the beginning of Yogic practices.

Sthithi : Savasana

Practice :

- i. Bring your legs together; join the heels and toes together and place the palms by the side of the thighs. Keep the face relaxed with a smile all through the practice.
- ii. Start tightening from the toes. Tighten the ankle joints, and calf muscles. Pull up the knee caps. Tighten the thigh muscles. Compress and squeeze the buttocks. Breathe out and suck the abdomen in.
- iii. Make fists and tighten the arms. Inhale and expand the chest. Tighten the shoulders, neck muscles and compress the face. Tighten the whole body from toes to the head. Tighten; tighten; tighten.
- iv. Release and let go the whole body instantaneously. Legs and arms go apart with the open palms facing the roof. Collapse the whole body. Enjoy the instant relaxation.

75. Quick relaxation techniques (QRT)

- i. Lie down or sit on the chair. Start observing the movements of abdominal muscles going up and down as you breath in and out normally. Observe this about 5-7 cycles.
- ii. Now synchronize the same movement with slow deep breathing. As you inhale your

abdomen is bulging up, while exhaling abdomen is sinking down close to your spine, feel how your breath and belly are well synchronized. Observe this about 5-7 cycles again.

- iii. As you inhale deeply and slowly, energize the whole body and feel the lightness. As you exhale release the tension and collapse all the muscles, enjoy the beautiful moment and relax completely. Observe this about 5-7 cycles again. Chant A sound (A-kara) during exhalation. Open your eyes with a few blinks when you are ready.

76. Deep relaxation technique (DRT)

- I. Relax each specific part of the body from the tip of the toes to the waist, followed by chanting 'A'.
- II. Relax each body part from the waist to the neck, followed by chanting 'U'.
- III. Relax head and neck, followed by chanting 'M', the last part of 'A-U-M'.
- IV. Let the body collapse on the ground with a feeling of 'letting go', chanting the whole word, 'AUM'.
- V. Let oneself feel apart from the physical body, aware of expansion, and merging with a limitless space like the sky.



Section VII to VII of the Google Form

Section – VII: Meditation

People have been meditating for thousands of years, often as part of a spiritual practice. But in more recent years, meditation has become a popular way to help people manage their stress and improve their overall well-being- and a wealth of research shows it's effective. Psychologists have found that meditation changes our brain and biology in positive ways, improving mental and physical health. Meditation is as an alternative mind-body therapy. It is a popular intervention to improve mental and physical health.

77. OM Meditation

In this phase, investigators instructed all participants to sit in a comfortable meditative posture with the eyes close. Participants were asked to perform loud chanting of OM for 10 min. OM chanting was performed by inhaling through both nostrils, and while exhaling a-ā-u-ū-m-(ng) was chanted at a rate of 2 breaths/min. During meditation, subjects were asked to inhale for a longer time and exhale with chanting OM.

78. Focused Meditation

Focused meditation involves focusing on something (focus attention on an object, sound, or sensation rather than trying to achieve a clear mind without a specific focal point) intently as a

way of staying in the moment and quieting your inner dialogue.

79. Mindfulness Meditation

Mindfulness meditation originally stems from Buddhist meditation traditions. Since the 1990s, mindfulness meditation has been applied to multiple mental and physical health conditions, and has received much attention in psychological research. In current clinical and research contexts, mindfulness meditation is typically described as non-judgemental attention to experiences in the present moment. This definition encompasses the Buddhist concepts of mindfulness and equanimity and describes practices that require both the regulation of attention (in order to maintain the focus on immediate experiences, such as thoughts, emotions, body posture and sensations) and the ability to approach one's experiences with openness and acceptance. Mindfulness meditation can be subdivided into methods involving focused attention and those involving open monitoring of present-moment experience

80. Transcendental Meditation

- i. Eyes close for a few seconds to a minute,
- ii. Take a few deep breaths, relax the body. Eyes should remain closed during the 15- to 20-minute session.
- iii. Silently repeat any mantra in mind and concentrate on breath pattern.

Yogic Practices Delivered in Hybrid Mode:

Physical Sessions Once every in 15 Days and Virtual Sessions Five Days per Week

Sukshma vayama/loosening practices



Neck movement



Shoulder Rotation



Trunk Rotation



Hands in and out stretch

Asana/ Physical posture



Tadasana



Katichakrasana



Parvatasana



Uttanmandukasana



Bhujangasana



salvasana

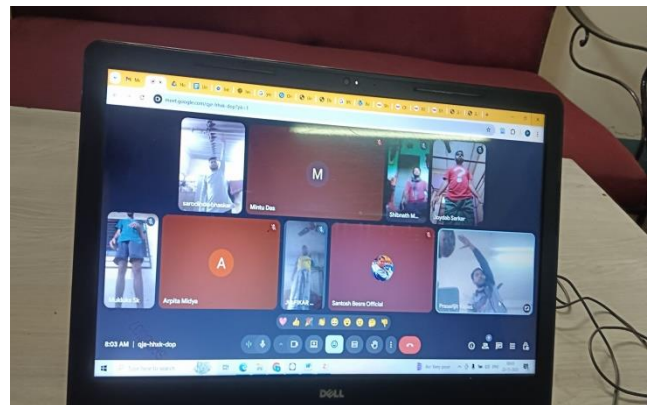


Uttanpadasana



Marjarasana

Virtual monitoring of yogic practices



Yogic Practices Delivered in Hybrid Mode:

Physical Sessions Once every in 15 Days and Virtual Sessions Five Days per Week

Breathing exercises



Tiger breathing



Abdominal breathing



Chest breathing



Yogic breathing

Pranayama/relaxation techniques/meditation practices at physical mode and virtual monitoring



Anulome-vilome



Shitkari Pranayama



Bhramari Pranayama



Nadisodhana Pranayama



Deep relaxation



OM Dhyana



Virtual monitoring



Sample Practices from the Validated 38-Practice Yoga Module

(Loosening practices: 10; Asana: 14; Breathing: 5; Pranayama: 5; Relaxation: 2; Dhyana: 2)

Name: _____

Date: _____

Please draw a mark on each line below to indicate your situation in the past 7 days:



① How would you describe the overall level of fatigue / tiredness you have experienced in the past week?



Evaluation by the doctor

② How would you describe the overall level of AS neck, back or hip pain you have had in the past week?



③ How would you describe the overall level of pain / swelling in joints other than neck, back or hips you have had in the past week?



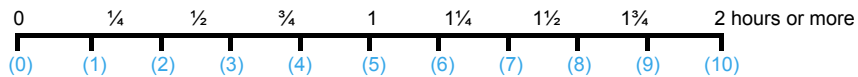
④ How would you describe the overall level of discomfort you have had in the past week from any areas tender to touch or pressure?



⑤ How would you describe the overall level of morning stiffness you have had in the past week from the time you wake up?



⑥ How long did your morning stiffness last from the time you wake up?



BASDAI =

(sum of questions 1 to 4 plus mean of questions 5 and 6) divided by 5

BASFI

Bath Ankylosing Spondylitis
Functional Index



Name: _____

Date: _____

Please draw a mark on each line below to indicate your level of ability with each of the following activities in the past 7 days:



1 Putting on your socks or tights without help or aids (e.g. sock aid)



Evaluation by
the doctor

2 Bending forward from the waist to pick up a pen from the floor without an aid



3 Reaching up to a high shelf without help or aids (e.g. helping hand)



4 Getting up out of an armless dining room chair without using your hands or any other help



5 Getting up off the floor without help from lying on your back



6 Standing unsupported for 10 minutes without discomfort



7 Climbing 12–15 steps without using a handrail or walking aid, one foot on each step



8 Looking over your shoulder without turning your body



9 Doing physically demanding activities (e.g. physiotherapy exercises, gardening or sports)



10 Doing a full day's activities whether it be at home or at work



BASFI =
(sum of answers 1 to 10
divided by 10)

Ankylosing Spondylitis International Federation

World-wide network of societies of patients suffering from ankylosing spondylitis or related diseases
www.spondylitis-international.org



Name: _____

Date: _____

- 1 Lateral lumbar flexion:** Patient stands with heels and buttocks touching the wall, knees straight, shoulders back, hands by the side. The patient is then asked to bend to the right side as far as possible without lifting the left foot/heel or flexing the right knee, and maintaining a straight posture with heels, buttocks, and shoulders against the wall. The distance from the third fingertip to the floor when patient bends to the side, is subtracted from the distance when patient stands upright. The manoeuvre is repeated on the left side.

Assessment:	> 20	18–20	15,9–18,9	13,8–15,8	11,7–13,79	9,6–11,6	7,5–9,5	5,4–7,4	3,3–5,3	1,2–3,2	< 1,2
Score:	0	1	2	3	4	5	6	7	8	9	10

mean of right/left

- 2 Tragus-to-wall distance:** Maintain same starting position as above. Ensure head in as neutral position (anatomical alignment) as possible, chin drawn in as far as possible. Measure distance between tragus of the ear and wall on both sides, using a rigid ruler. Ensure no cervical extension, rotation, flexion or side flexion occurs.

Assessment:	< 10	10–12	13–15	16–18	19–21	22–24	25–27	28–30	31–33	34–36	> 36
Score:	0	1	2	3	4	5	6	7	8	9	10

mean of right/left

- 3 Lumbar flexion (modified Schober):** With the patient standing upright, place a mark at the lumbosacral junction (at the level of the dimples of Venus on both sides). Further marks are placed 5 cm below and 10 cm above¹. Measure the distraction of these two marks when the patient bends forward as far as possible, keeping the knees straight.

¹) Among the "modified Schober"s published in the literature, the modification recommended by Macrae and Wright is used.

Assessment:	> 7,0	6,4–7,0	5,7–6,3	5,0–5,6	4,3–4,9	3,6–4,2	2,9–3,5	2,2–2,8	1,5–2,1	0,8–1,4	< 0,8
Score:	0	1	2	3	4	5	6	7	8	9	10

- 4 Maximal intermalleolar distance:** Patient supine on the floor or a wide plinth, with the knees straight and the feet pointing straight up. Patient is asked to separate legs along the resting surface as far as possible. Distance between medial malleoli is measured.

Assessment:	> 119	110–119	100–109	90–99	80–89	70–79	60–69	50–59	40–49	30–39	< 30
Score:	0	1	2	3	4	5	6	7	8	9	10

- 5 Cervical rotation:** Patient supine on plinth, head in neutral position, forehead horizontal (if necessary head on pillow or foam block to allow this, must be documented for future reassessments). Gravity goniometer placed centrally on the forehead. Patient rotates head as far as possible, keeping shoulders still, ensure no neck flexion or side flexion occurs.

> 85,0	76,6–85	68,1–76,5	59,6–68,0	51,1–59,5	42,6–51,0	34,1–42,5	25,6–34,0	17,1–25,5	8,6–17,0	< 8,6
0	1	2	3	4	5	6	7	8	9	10

mean of right/left

BASMI:
(mean of 5 scores)

***) Remark:**

In the literature (Jenkinson et al: J Rheumatol 1994;21:1694–1698 and Jones et al: J Rheumatol 1995;22:1609) two different BASMI definitions have been published where the same measurement results lead to different BASMI values. The above is based on the newer definition of 1995 with scores 0 to 10 for each component.

Hamilton Depression Rating Scale

হামিল্টন ডীপ্রেসন রেটিং স্কেল

নাম-

বয়স-

লিঙ্গ-

প্রত্যেক প্রশ্ন থেকে নিজের মত বেছে নিন-

১। বিষণ্ণ মেজাজে অর্থাৎ আপনি মনমরা বা ভবিষ্যৎ-এর জন্য হতাশা বোধ করেন বা কেঁদে ফেলেন-

ক) কখনো না খ) বিষণ্ণতা হয় গ) মাঝে মাঝে কান্না পায় ঘ) প্রায়ই কেঁদে ফেলি ঙ) উপরোক্ত সবগুলি

২। নিজেকে অপরাধী 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। আত্মহত্যা

ক) কখনই না খ) মনে করেন জীবনের কোন মূল্য নেই গ) মনে করি জেন মরে গেছি ঘ) আত্মহত্যা চিন্তা আসে ঙ) আত্মহত্যার 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) উৎপাদনশীলতা হ্রাস পায় ঙ) কাজ করতে অসামর্থ্য তার কারণে 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) সম্পূর্ণ 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, হৃৎসংবহনে, মাথাধারা, শ্বাসকষ্ট বা মুত্রাশয়ে কিছু সমস্যা হয়

- ক) কখনো না খ) হালকা হয় গ) মাঝারি হয় ঘ) নিদারুণ মাত্রায় হয় ঙ) সহসীমার 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 প্রত্যঙ্গ 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 অগ্নিছা

- 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) আশ্চর্যজনক হ্রাস হয়েছে।

১৭। অন্তর্দৃষ্টি (নিজের বোধগম্যতা)

ক) ঠিক আছে খ) কিছুটা হারিয়েছি গ) পুরো বোধগম্যতা হারিয়েছি।

Fear Avoidance Beliefs (FAB)

ভয়েতে কিছু এড়িয়ে চলার বিশ্বাস

নাম-

বয়স-

লিঙ্গ-

প্রত্যেক প্রশ্ন থেকে নিজের মত বেছে নিন-

১। শারীরিক কার্জকলাপের জন্য আমার ব্যাথা হত।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

২। শারীরিক ক্রিয়াকলাপ আমার বাথ্যাকে আর খারাপের দিকে নিয়ে যায়।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

৩। শারীরিক ক্রিয়াকলাপের জন্য আমার পিঠের ক্ষতি হতে পারে।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

৪। আমি কোন শারীরিক ক্রিয়াকলাপ করব না যেটা আমার ব্যাথার পক্ষে ক্ষতিকর।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

৫। আমি এমন কোন শারীরিক ক্রিয়াকলাপ করি না যেটা আমার ব্যাথার পক্ষে ক্ষতিকর।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

৬। আমার কাজে বা দুর্ঘটনাবশত কারণে আমার ব্যাথা হয়েছিলো।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

৭। আমার কাজের জন্য আমার ব্যাথা বৃদ্ধি পায়।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

৮। আমার ব্যাথার ক্ষতিপূরণের জন্য অভিযোগ করি।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

৯। আমার কাজ আমার পক্ষে একটু বেশীই কষ্টকর।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

১০। আমার কাজ আমার ব্যাথার মারাত্মক ক্ষতি করে অথবা করতে পারে।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

১১। আমার কাজ আমার পিঠের ক্ষতি করতে পারে।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

১২। আমার বর্তমান ব্যাথার জন্য নিজের স্বাভাবিক কাজ করতে পারব না।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

১৩। ব্যাথার জন্য নিজের স্বাভাবিক কাজ করতে পারি না।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

১৪। আমি স্বাভাবিক কোন কাজ করতে পারি না যতক্ষণ না ব্যাথার চিকিৎসা হয়।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

১৫। ৩ মাসের মধ্যে আবার স্বাভাবিক কাজে ফিরে আসব একথা আমি ভাবতেই পারি না।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

১৬। ভাবতেই পারি না যে আমি আবার আমার স্বাভাবিক কাজের অবস্থায় ফিরতে পারব।

ক) সম্পূর্ণ 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) সম্পূর্ণ একমত

Pain catastrophizing Scale (PCS)

ব্যথাৰ সৰ্বনাশা অনুভূতি সূচক

যখন আমাৰ ব্যাথা হয়-

১। আমি সাবসময় ভায়ে থাকি যদি কিনা ব্যাথা সবকিছু শেষ কৰে দেয়।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

২। আমি অনুভব কৰি আমি কিছু কৰতে পাৰব না।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

৩। এটা খুব ভয়ানক এবং আমি ভাবি এটাৰ জন্য ভাল কিছু হবো না।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

৪। এটা খুব আতঙ্কজনক, এবং এটা আমাকে আছন্ন কৰে রেখেছে।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

৫। আমি অনুভব কৰি এটাৰ জন্য আৰ দাঁড়াতে পাৰব না।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

৬। আমি ভীত হই যে ব্যাথা আমাকে আৰও খাৰাপেৰ দিকে নিয়ে যাচ্ছে।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

৭। আমি অন্যসমস্ত ব্যাথা যন্ত্ৰনাৰ ঘটনাগুলো মনে কৰি।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

৮। আমি উদ্বিগ্নভাবে চাই যেন ব্যাথা চলে যায়।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

৯। আমি ব্যাথাকে মনের বাইরে কৰতে পাৰি না বা ভুলতে পাৰি না।

ক) কখনই না খ) সামান্য হয় গ) মাঝাৰি ধৰনেৰ 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 আশ্চর্য হই মারাত্মক কিছু একটা ঘটবে।

ক) কখনই না খ) সামান্য হয় গ) মাঝারি ধরনের ঘ) তীব্রভাবে হয় ঙ) সবসময় হয়

Health related quality of life (HQRoL)

সংক্ষিপ্ত রূপ ৩৬ স্বাস্থ্য জরিপ স্কেল (HRQoL)

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 স্বাস্থ্য 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 অসুবিধা হয়?

i) হ্যাঁ ii) কিছুটা iii) না

৪. মাঝারী ধরনের কাজকর্ম, যেমন টেবিল সরানো, 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 দৈনিক ও আবেগগত সমস্যা গুলো বিভিন্নভাবে 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

শেষ ৪ সপ্তাহ আপনি কেমন অনুভব করেছেন। প্রশ্নানুযায়ী দাগ দিন-

২৩. আপনি কি পূর্ণ উদ্যমে অনুভব করেছেন? 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 ব্যক্তি 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 প করেন?

i) একদম সত্য ii) আধিকাংশ ক্ষেত্রে সত্য iii) জানি না iv) আধিকাংশ ক্ষেত্রে মিথ্যা v) একদম মিথ্যা

৩৪. আমি আমার পরিচিত যে কারো মত সুস্থ। i) একদম সত্য ii) আধিকাংশ ক্ষেত্রে সত্য iii) জানি না iv) আধিকাংশ ক্ষেত্রে মিথ্যা v) একদম মিথ্যা

৩৫. আমি মনে করি আমার স্বাস্থ্য খারাপ হবে। i) একদম সত্য ii) আধিকাংশ ক্ষেত্রে সত্য iii) জানি না iv) আধিকাংশ ক্ষেত্রে মিথ্যা v) একদম মিথ্যা

৩৬. আমার স্বাস্থ্য চমৎকার। i) একদম সত্য ii) আধিকাংশ ক্ষেত্রে সত্য iii) জানি না iv) আধিকাংশ ক্ষেত্রে মিথ্যা v) একদম মিথ্যা




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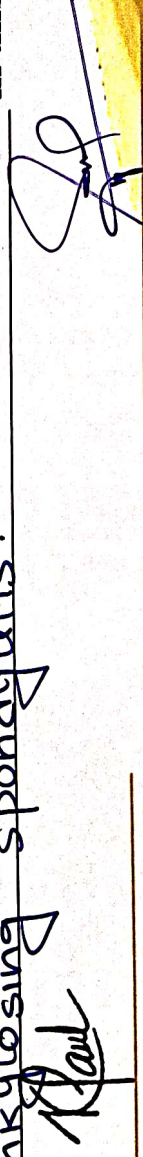
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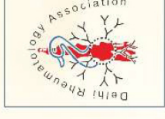
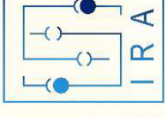
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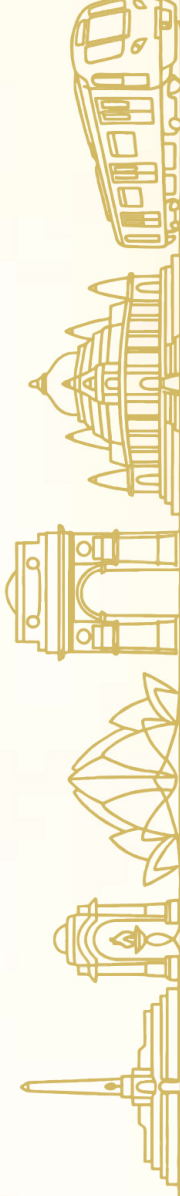
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RESEARCH ARTICLE

**CONSEQUENCES OF NON-INVASIVE THERAPIES ON
LOW BACK PAIN: A NARRATIVE REVIEW**

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Low back pain, epidemiology, cost effectiveness, non- invasive therapy, non-pharmacological management

Abstract

Background: Low back pain is a global public health concern, causing major morbidity, disability, and costs. It is the third largest health expenditure after diabetes and ischemic heart disease, with world wide impact. Previous studies reported that most cases unnecessary invasive treatments carry extra expenses of money and are hazardous for patients who suffer from lower back pain. The study aimed to find out the consequences of various non-invasive therapeutic approaches for nonspecific low back pain.

Methods: A comprehensive review of relevant article and existing literature was conducted using prominent scientific databases and research search engine, including PubMed, Cochrane Library, Google scholar, Google advanced search covering the period from 2000 to 2024. All appropriate publications were systematically reviewed and presented.

Results: Based on past information, it has been found that the status of low back pain varies due to factors like socio-economic conditions, nature of activity, habits, etc. Different non-invasive therapies i.e. exercise therapy, massage therapy, cognitive behavioral therapy, educational interventions, tai-chi, pilates, yoga, and different other complementary and alternative treatments, helped to reduce the volume and intensity of pain and develop the quality of life without any side effect.

Conclusion: Findings of the present study suggested that more multidimensional and larger studies are required to investigate the accurate epidemiological structure of low back pain and acquainted with new non-invasive therapies to reduce low back pain.

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- 8 Deepanwita. "Association Between Interleukin-6 and C-Reactive Protein in Gingival Crevicular Fluid, Periodontal Inflamed Surface Area and the Systemic Inflammatory Burden in Patients with Chronic Periodontitis", Rajiv Gandhi University of Health Sciences (India), 2023
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- 13 worldwidescience.org
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- 18 Lau, Hoi Lam. "Effects of Hatha Yoga on Physical and Mental Health: Mixed Methods Approach.", Proquest, 2014. 51 words — < 1%
- 19 Jyoti Singh, Kashinath Metri, Padmini Tekur, Sriloy Mohanty, Amit Singh, Nagaratna Raghuram. "Tele-yoga in the management of ankylosing spondylitis amidst COVID pandemic: A prospective randomized controlled trial", Complementary Therapies in Clinical Practice, 2022. 50 words — < 1%
- 20 Paul, Hanna. "A Feasibility Study of Using Headspace for Mindfulness Among Individuals Undergoing Surgical Repair of the Rotator Cuff", The University of Wisconsin - Milwaukee, 2023. 48 words — < 1%
- 21 S Giridharan, Rajanee Bhana. "The Impact of Yoga on the Immune System of Cancer Patients: A Scoping Review of Current Evidence", International Research Journal of Ayurveda & Yoga, 2024. 46 words — < 1%
- 22 Gomes, José Luís Sanchez. "The Effects of Water and Land-Based Exercise in Ankylosing Spondylitis", Universidade do Porto (Portugal), 2024. 43 words — < 1%
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25 "2015 ACR/ARHP Annual Meeting Abstract Supplement", *Arthritis & Rheumatology*, 2015. 40 words — < 1%
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26 Shaikh-Kader, Asma. "Effect of Photobiomodulation on Apoptosis and Inflammation in an in Vitro Diabetic Wounded Fibroblast Model", University of Johannesburg (South Africa), 2022 39 words — < 1%
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27 people.bu.edu 39 words — < 1%
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28 Awasthi, Arti. "Effect of Comprehensive Yogic Practices on Academic Stress, Examination Anxiety, Concentration and Memory of College Students.", *Devi Ahilya Vishwavidyalaya*, 2019 37 words — < 1%
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29 Selvaraj Giridharan, Rajanee Bhana. "The Role of Yoga in Patients Undergoing Radiotherapy: A Review of Current Literature", *International Research Journal of Ayurveda & Yoga*, 2023 37 words — < 1%
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30 Yaser Mohammed Al-Worafi. "Handbook of Complementary, Alternative, and Integrative Medicine - Education, Practice and Research: Volume 5: Disease Focused Efficacy and Safety Profiles: Psychiatric, Infectious, Skin, Hematologic, Oncologic, Urologic and Special Population Diseases/Disorders", CRC Press, 2025 36 words — < 1%
Publications

31 "Neuroscience of Yoga", Springer Science and Business Media LLC, 2024 32 words — < 1%
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32 Aruna Bakhru. " Nutrition and Integrative Medicine - A Primer for Clinicians", CRC Press, 31 words — < 1%

-
- 33 Greysen, Heather M.. "The Benefits of Yoga for Adults with Rheumatoid Arthritis.", Proquest, 2015.
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-
- 34 Waddell, Gordon. "A Biopsychosocial Analysis of Low Back Pain and Disability.", University of Glasgow (United Kingdom), 2020
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- 35 "The Principles and Practice of Yoga in Cardiovascular Medicine", Springer Science and Business Media LLC, 2022
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-
- 36 Awajneh, Raghad. "Designing a Virtual Reality Experience With Gradual Calming Elements for Pain Management From Cold Exposure: A Human-Computer Interaction Study", Princess Sumaya University for Technology (Jordan)
ProQuest 30 words — < 1%
-
- 37 Jerald Hage. "Organizational Innovation", Routledge, 2018
Publications 30 words — < 1%
-
- 38 "Abstracts", Psychology & Health, 2005
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-
- 39 Erik J., Marisa Sklar, Douglas Chang. "Chapter 6 Yoga as a Treatment for Low Back Pain: A Review of the Literature""", IntechOpen, 2012
Crossref 29 words — < 1%
-
- 40 Kwan, Yu Heng. "Quality of Life of Patients with Spondyloarthritis", National University of Singapore (Singapore), 2021 29 words — < 1%

41 "The International Congress on Integrative Medicine and Health (ICIMH), Las Vegas, Nevada, USA May 17–20, 2016", *The Journal of Alternative and Complementary Medicine*, 2016. 28 words — < 1%

Crossref

42 Chukwuebuka Egbuna, Shashank Kumar, Jonathan Chinenye Ifemeje, Jaya Vikas Kurhekar. "Phytochemistry - Pharmacognosy, Nanomedicine, and Contemporary Issues", CRC Press, 2018. 28 words — < 1%

Publications

43 Harvey W. Wallmann, Robert Donatelli. "Foundations of Orthopedic Physical Therapy", Routledge, 2024. 28 words — < 1%

Publications

44 K., Vikas. "To Evaluate the Efficacy of Sulfasalazine in Ankylosing Spondylosis", Postgraduate Institute of Medical Education and Research, Chandigarh (India), 2024. 27 words — < 1%

ProQuest

45 Meyer, Skyler Scott. "Cognitive Behavioral Therapy for Improving Chronic Pain", Grand Canyon University, 2023. 26 words — < 1%

ProQuest

46 Carvalho, Pedro David Costa Silva. "Relationship Between Health Outcomes in Spondyloarthritis and Rheumatoid Arthritis.", Universidade de Lisboa (Portugal), 2024. 22 words — < 1%

ProQuest

47 "Poster Presentation Abstracts", *International Journal of Rheumatic Diseases*, 2016. 21 words — < 1%

Crossref

-
- 48 Field, Tiffany. "Yoga research review", *Complementary Therapies in Clinical Practice*, 2016. 21 words — < 1%
Crossref
-
- 49 Hilary McClafferty. "Mind-Body Medicine in Clinical Practice", Routledge, 2018. 21 words — < 1%
Publications
-
- 50 "Abstract", *Quality of Life Research*, 2003. 20 words — < 1%
Crossref
-
- 51 Шимпрага, Љиљана Ж.. "Карактеристике Социјалне Партиципације и Квалитета Живота код Особа са Реуматоидним Артритисом.", University of Belgrade (Serbia). 20 words — < 1%
ProQuest
-
- 52 Choubey, Abhipsa. "Impact of the Intervention Strategies With Special Reference to Yoga Nidra & Counseling on Psycho Physiological Changes in People Living With HIV/AIDS.", Devi Ahilya Vishwavidyalaya, 2019. 19 words — < 1%
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-
- 53 Zougar, Mohammad J.. "Can Exergames be Used to Improve the Physical Abilities of Older Male Care Home Residents in Saudi Arabia?", The University of Manchester (United Kingdom), 2024. 19 words — < 1%
ProQuest
-
- 54 Christensen L.. "Hazardous and Industrial Waste Proceedings, 30th Mid-Atlantic Conference", CRC Press, 2019. 18 words — < 1%
Publications
-
- 55 Martin, Kimberly M. "The role of yoga as a therapeutic tool and practice for improving cognitive, emotional, and spiritual well being: A pilot study", Proquest, 20111003. 18 words — < 1%

-
- 56 "8th Annual International Congress of Complementary Medicine Research, ICCMR 2013. London, 11-13 April, 2013", *Forschende Komplementärmedizin / Research in Complementary Medicine*, 2013
16 words — < 1%
Crossref
-
- 57 Spoorthi Poojari, Deepanshu Dhiman, Babita Ghai, Deepali Mathur, Kashinath Metri, Ketan Kataria, Akshay Anand. "Effectiveness of Integrated Approach of Yoga Therapy (IAYT) Versus Usual Care in Management on Chronic Low Back Pain Patients: a Randomized Controlled Pilot Study", *Research Square Platform LLC*, 2021
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-
- 58 Adhikari, Bandita. "Understanding Fungal Infection and Chronic Pain from a Systems Biology Perspective", *University of Connecticut*, 2024
15 words — < 1%
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-
- 59 Augustine, Anju Mary. "A Study to Evaluate the Effectiveness of Structured Teaching Programme on Knowledge Regarding Complementary Therapies Among Arthritis Patients in Selected Hospitals at Tumkur", *Rajiv Gandhi University of Health Sciences (India)*, 2023
15 words — < 1%
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-
- 60 Donagh Seaver O'Leary, David Marshall, Justin Smyth, Mary Clarke, Keith Gaynor. "A Systematic Review of Tai Chi-based Interventions for Positive and Negative Symptoms, Cognitive Functioning, and Quality of Life in Psychosis", *Springer Science and Business Media LLC*, 2024
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Complementary Therapies in Clinical Practice, 2023

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62 Raj Bawa, János Szebeni, Thomas J. Webster, Gerald F. Audette. "Immune Aspects of Biopharmaceuticals and Nanomedicines", Routledge, 2019 14 words — < 1%
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