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Scoping Review

THE IMPACT OF YOGA PRACTICES ON INFLAMMATORY MARKERS: A SCOPING REVIEW

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ABSTRACT :

BACKGROUND: Most of the life style disorders involving humans in their adult life is characterized by persistence underlying low-grade inflammation. The inflammation adds further insults to the pathogenic damage caused by the disorder. This inflammation is often ignored because it does not produce noticeable effect on the body to draw immediate attention. Yoga has been studied to have an effect on the well-being of the individual. A scoping review had been decided to explore the overall impact of yoga on inflammation by summarizing the existing research. The review focussed on identifying relevant studies that investigate how yoga encompassing practices like asana, pranayama, and meditation, influences inflammation. By examining various study designs and outcomes related to inflammatory markers, the review sought to provide a broad overview of the current understanding and potential benefits of yoga in managing non-communicable diseases. **METHODOLOGY:** A thorough literature search was conducted in PubMed, Scopus, and Cochrane up to April 2024 to identify studies examining the impact of yoga on inflammation. The search utilized keywords associated with yoga and inflammation, and was restricted to studies published in English. **RESULTS:** We had identified 56 studies involving 3,774 participants across multiple countries. Participants included healthy adults as well as individuals with conditions such as heart failure, cancer, autoimmune disorders, respiratory diseases, neurological disorders, and others. The collective scientific evidence from these diverse studies indicated that yoga practices showed promising effect in reducing inflammation across different populations and health conditions. **CONCLUSION:** The review indicated that yogic practices potentially reduced inflammation, although the study designs varied considerably. While many studies reported positive impacts on inflammatory markers, some did not observe significant changes. To confidently recommend yoga as a primary therapy for inflammation, additional well-designed, randomized controlled trials with sufficient statistical power and a broader scope of inflammatory parameters are necessary.

KEYWORDS: Yoga, inflammation, inflammatory markers, interleukin -6, Tumour necrosis factor –α, yogic posture, pranayama, yogic relaxation

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1. BACKGROUND

Inflammation is the body's defense mechanism, which in moderation is said to have beneficial results [1]. Chronic inflammation is a slow long-term pathophysiological state that might be due to failure in the elimination of pathogen, recurrent episodes of acute inflammation, oxidative stress, impairment in anti-inflammatory pathway, mitochondrial dysfunction and other autoimmune conditions [2]. Many chronic diseases like diabetes, cardiovascular disease, and auto-immune conditions are associated with inflammation [3]. Non-communicable diseases contribute to 74% of death globally. Cardiovascular disease, cancer, chronic respiratory diseases and diabetes contribute to 80% of the premature death due to non-communicable diseases. The sustainable development goal of 2030 aims to reduce premature mortality from NCDs through prevention and treatment by one third. Modern world and stress are inseparable; stress is the major factor for the initiation and progression of inflammation [4]. Stress acts on hypothalamic-pituitary axis and sympathetic-adrenal axis causing inflammatory dysregulation. It induces production of inflammatory cytokines leading to disruption in homeostasis of the body [5].

Biomarkers are the valuable tools to assess the inflammation. They also serve as important landmark for deciding the appropriate intervention for the patient [6]. Targeting inflammation is a promising approach to manage and treat chronic diseases. Several strategies like diet with low glycemic index with inclusion of lot of fruits and vegetables, moderate physical activity, conventional drugs and herbal supplement are recommended to keep the inflammation almost under control [7]. Yoga is the multi-component mind-body technique increasingly utilized in recent times for the effective management of various communicable and non-communicable diseases. Yoga involves the practice of various asanas, pranayama, mudra, bandha and meditation.

Several studies enumerate the beneficial effects of yoga in inflammation and also address the bidirectional mechanism of yoga in stress and inflammation [8, 9]. Previous systematic review on effects of yogic posture with or without breathing and meditation reported that yoga is a valuable tool for effective management of inflammation [10]. This review aimed to determine how comprehensive yoga practices affect inflammatory biomarkers across different health conditions and explore the potential mechanisms underlying these effects.

METHODOLOGY

1.1. Literature Search Strategy

A comprehensive literature search was conducted using electronic database search engine like PubMed, Scopus, and Cochrane for articles published from the date of inception till April 2024. The search terms yoga OR breathing OR relaxation OR meditation) AND (inflammation OR "inflammatory biomarkers" as follows:

PubMed:

(("yoga"[MeSH Terms] OR "yoga"[All Fields] OR ("breath"[All Fields] OR "breathe"[All Fields] OR

"breathed"[All Fields] OR "breathes"[All Fields] OR "breathings"[All Fields] OR "breaths"[All Fields] OR "respiration"[MeSH Terms] OR "respiration"[All Fields] OR "breathing"[All Fields]) OR ("relaxant"[All Fields] OR "relaxants"[All Fields] OR "relaxation"[MeSH Terms] OR "relaxation"[All Fields] OR "relax"[All Fields] OR "relaxations"[All Fields] OR "relaxed"[All Fields] OR "relaxational"[All Fields] OR "relaxative"[All Fields] OR "relaxes"[All Fields] OR "relaxing"[All Fields] OR "relaxivities"[All Fields] OR "relaxivity"[All Fields]) OR ("meditate"[All Fields] OR "meditated"[All Fields] OR "meditating"[All Fields] OR "meditation"[MeSH Terms] OR "meditation"[All Fields] OR "meditations"[All Fields] OR "meditation s"[All Fields] OR "meditational"[All Fields] OR "meditative"[All Fields] OR "meditator"[All Fields] OR "meditators"[All Fields])) AND ("inflammation"[MeSH Terms] OR "inflammation"[All Fields] OR "inflammations"[All Fields] OR "inflammation s"[All Fields])) OR "inflammatory biomarkers"[All Fields])

Scopus:

(TITLE-ABS-KEY(yoga) OR TITLE-ABS-KEY(breath* OR respirat*) OR TITLE-ABS-KEY(relax*) OR TITLE-ABS-KEY(meditat*)) AND (TITLE-ABS-KEY(inflammat*) OR TITLE-ABS-KEY("inflammatory biomarkers"))

Cochrane Library:

((yoga):ti,ab,kw OR (breath* OR respirat*):ti,ab,kw OR (relax*):ti,ab,kw OR (meditat*):ti,ab,kw) AND ((inflammat*):ti,ab,kw OR ("inflammatory biomarkers"):ti,ab,kw)

The search terms included “yoga “or “breathing” or “Relaxation” or “Meditation” and “inflammation” or “inflammatory biomarkers”. All the authors screened the title and the abstract to find the eligible articles as per the inclusion and exclusion criteria and then accessed the full text for final inclusion. Any discrepancies regarding the selection of studies and possible duplications were resolved by mutual discussions which involved the corresponding author as well.

1.2. Eligibility Criteria

1.2.1. Inclusion criteria

The following inclusion criteria was used for screening the relevant articles- (a) Yoga intervention (yogic posture, yogic breathing, Mudra, Bandha, Meditation, Yoga based relaxation), (b) Sample age– no restrictions were imposed, (c) English language article, (d) measured inflammatory biomarkers, (e) Participants – not limited to any specific population (ranged from healthy adults to chronic disease conditions like carcinoma, heart failure).

1.2.2. Exclusion criteria

We excluded the studies in which yoga was integrated with other therapies like Ayurveda, Acupuncture, physiotherapy and Naturopathy. In addition, we also excluded the studies in which the full text article was unavailable, article published in languages other than English.

1.3. Data extraction and reliability

Data was collected and recorded by three authors independently (SR, SS, MK). Following information was obtained from each included study; first author, year of publication, study period, study design (E.g., RCT, cross -

over trial), participant characteristics (E.g., age, country), yoga intervention characteristics (E.g., component of yoga- asana, pranayama, mudra, bandha, meditation duration, frequency), control intervention characteristics (E.g., control, active control, duration, and frequency if any), outcome measures (inflammatory markers) from each study. The outcome measure assessed in the review was inflammatory markers.

1.4 Bias in the study:

We did not encounter any bias in the inclusion of studies based on gender, demography, ethnicity or research outcomes.

2. RESULTS

Summary of overall results

We had identified 56 studies involving 3,774 participants across multiple countries. Participants included healthy adults as well as individuals with conditions such as heart failure, cancer, autoimmune disorders, respiratory diseases, neurological disorders, and others. The collective scientific evidence from these diverse studies indicated that yoga practices showed promising effect in reducing inflammation across different populations and health conditions. Flow chart showing recruitment of studies into this research is shown in Figure 1.

2.1. Effect of yoga on inflammation in healthy individuals

breathing, hatha yoga, advanced meditation technique, Sudarshan Kriya, high-intensity- and moderate-intensity Yoga, laughter yoga, meditation and yoga-based stretching. Totally twelve studies [11-22] were conducted involving 689 healthy adult individual interventions like yogic Minimum and maximum duration of the interventions were 20 and 90 minutes respectively. The studies found that yoga intervention reduced interleukin (IL)-1β, IL-8, IL-6, IL-12, tumour necrosis factor- alpha (TNF-α), interferon-gamma (IFN-γ), cortisol, soluble IL-2 receptor (sIL-2R), monocyte chemotactic protein-1 (MCP-1), hsCRP, circulating cluster of differentiation (CD)31+/CD42b− endothelial microparticles (EMPs), increased IL-10, reduced expression of pro-inflammatory genes and increased expression of antioxidant genes. (Table 1)

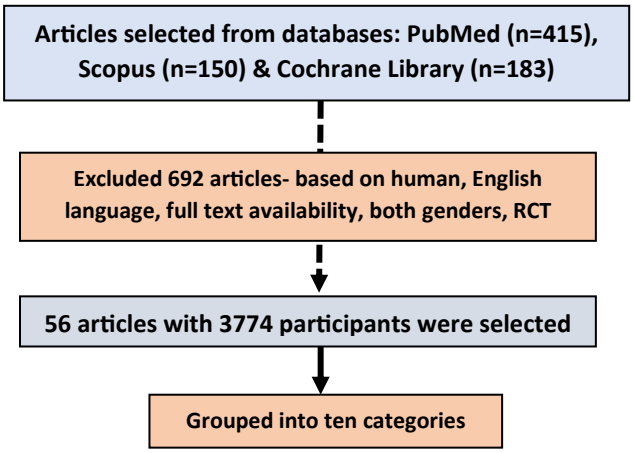
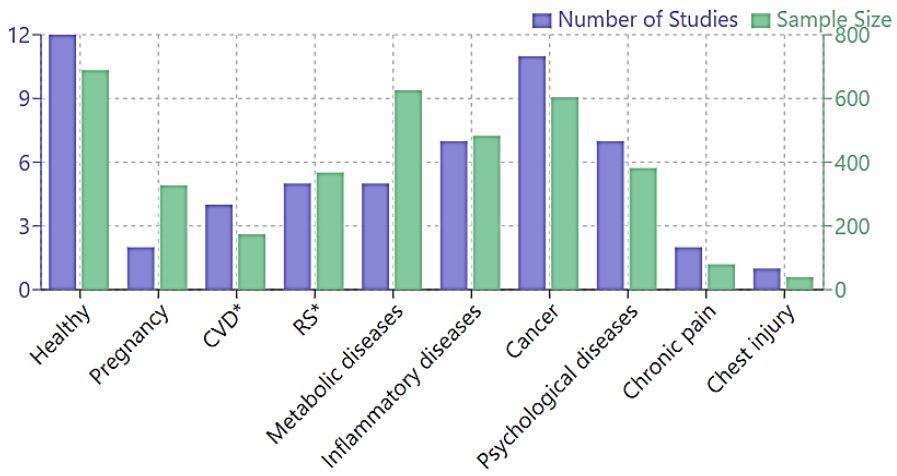


Figure 1: Flow chart showing recruitment of studies into this research

Figure 2: Distribution of Studies according to various health conditions



Effect of yoga on inflammation in pregnancy

Totally two studies [23, 24] were done in pregnancy involving 328 pregnant women; one study on gestational hypertension and another study on general pregnancy. Intervention like physical postures/stretching, deep breathing, guided imagery and deep relaxation was given. In gestational hypertension there is decrease in IL-6, and hsCRP and increase in nitric oxide (NO). In case of healthy pregnant women, there is lower salivary cortisol and higher immunoglobulin A levels immediately after yoga. (Table 1)

2.2. Effect of yoga on inflammation in cardiovascular diseases

Totally four studies [25-28] were done in 174 patients with cardiovascular diseases, out of which two studies were done in heart failure patients, one study in hypertensive individuals and another study in patients with hypertension and type 2 diabetes mellitus (T2DM). Among the patients, interventions like brain education-based meditation, asana, pranayama and kundalini yoga were given. Minimum duration of the intervention was 15 minutes and maximum duration of the intervention was 70 minutes. Out of the four studies, one study showed no change in inflammatory parameters, one study reported decreased expressions of genes such as *NFKB2*, *RELA*, and *IL1B.* In the case of heart failure, yoga therapy showed significant reductions in serum levels of IL-6 and CRP and an increase in superoxide dismutase (SOD). (Table 2)

2.3. Effect of yoga on inflammation in respiratory system

Totally five studies [29-33] were done in 368 patients. Out of five studies, two studies were done in Covid -19, two studies were done in chronic obstructive pulmonary disease (COPD) and one study was done in allergic

rhinitis. Minimum duration of intervention was 25 minutes and maximum duration was 60 minutes. Yoga intervention included ashtanga yoga, hatha yoga and yogic pranayama. Out of five studies, one study reported increase in IL-2 levels while other studies reported decrease in CRP, IL-6, TNF-α and D-dimer. (Table 2)

2.4. Effect of yoga on inflammation in metabolic diseases

Totally five studies [34-38] were done involving 626 patients. One study was done on obesity with 30 patients, which showed significant reduction in plasma IL-6 and significant increase in plasma adiponectin. One study was done in metabolic syndrome which showed significant reduction in the levels of leptin, leptin/adiponectin ratio, IL-6, 8-hydroxy-2'-deoxyguanosine (8-OHdG), and thiobarbituric acid reactive substances (TBARS) with significant increase in adiponectin and SOD levels. Two studies exclusively done on diabetes showed decrease in IL-6, hsCRP, TNF-α, malondialdehyde (MDA), and lipid peroxidation markers with increase in anti-oxidant markers. One study which was done with chronic inflammatory diseases, showed that with reduction in weight from overweight and obesity, there was reduction in plasma cortisol, IL-6, and TNF-α, and increase in β-endorphin levels. (Table 2)

Table 1: Effect of yoga on inflammation in healthy individuals and in pregnancy

Author, Year, Ref	Place	Study design	Condition	Sample Size	Type of intervention	Duration	Outcome	Findings
Twal et al. 2016 [11]	USA	RCT	Healthy individuals	Case:10 Control:10	Case: Yogic breathing Control: text reading	Single session 20 min	IL-1β, IL-1RA, IL-6, IL-8, IL-10, IL-17, IP-10, MCP-1, MIP-1b, TNF-α	↓ IL-1β, IL-8, MCP-1
Chen et al. 2016 [12]	China	RCT	Healthy females	Case: 15 Control: 15	Case: Hatha yoga Control: No intervention.	8 weeks Case: 60 min twice/ wk	Glucose, TG, HDL, LDL, TC, IL-6, IL-8, IL-1β, MCP-1, TNF-α, insulin. EMPs.	↓ plasma insulin, TC, LDL, CD31+/ CD42b− EMPs, IL-6, TNF-α, IL-1β, TLR2
Rajbhoj et al. 2023 [13]	India	RCT	Healthy individuals	Case: 22 Control: 15	Case: yoga training Control: waitlist	16 weeks Case: six times/ wk	FVC, FEV1, PEFR, sIL-2R	Improved FVC, FEV1, PEFR ↓ sIL-2R

						for an hour)		
Vijayaraghava et al. 2015 [14]	India	RCT	Healthy individuals	Case: 109 Control: 109	Case: yoga practitioner 5 years (1hr /day) Control: non yoga practitioner	10 m Shuttle Walk test	TNF-α, IL-6	↓ TNF-α, IL-6
Cahn et al. 2017 [15]	US	RCT	Healthy individuals	Case: 38	Case: Isha retreat (yoga, vegetarian diet, Samyama, Shoonya Kriya)	12 weeks Case: yoga retreat (before & after)	Psychometric measures, BDNF, salivary cortisol, cytokines	↓BMI ↑ BDNF, anti- and pro-inflammatory cytokines
Bhaskar et al. 2023 [16]	India	RCT Convenience sampling, stratified random sampling	Healthy volunteer	Case:50 Control: 47	Case: advanced meditation, Sudarshan Kriya, basic workshop - 6 days; Control- Sudarshan Kriya yoga practice (30min/day), basic 6 days	6 days Case: 4 days residential Control: basic workshop for 6 days - (30 min/ day)	mRNA expression of IL1β, IL6, TNF-α; antioxidants- SOD, catalase, GPx	↓ Reduced expression of IL1β, IL6, TNF-α genes ↑ expression of SOD, catalase, GPx genes
Fujisawa et al. 2018 [17]	Japan	RCT	Student volunteers	Case: 40 Control: 80	Case: Laughter yoga, breathing, meditation Control: comedy movie, reading book group	Case: 30 min, one session	Cortisol, DHEA, cortisol/ DHEA ratio	Laughter yoga ↓cortisol cortisol/DHEA ratio; No effect on DHEA
Lim et al. 2015 [18]	Korea	RCT	Student volunteers	Case:12 Control: 13	Case: pranayama, awareness exercise, asana,	E- 90 mins (once a wk for 12	Serum NO, F_2-isoprostane, lipid	↓ NO, F_2-isoprostane, lipid peroxide adrenaline

					meditation Control: usual care	wks)	peroxide, total GSH, GPx, GSH-*s*-T, IL-12, IFN-γ	↑ GSH, GPx, GSH-*s*-T, IL-12, IFN-γ, serotonin
Muñoz-Vergara et al. 2022 [19]	US	3-arm, pre-post pilot-RCT	Healthy individuals	Case 1- 10 Case 2: 10 Control: 10	Case 1- High-intensity yoga Case 2- moderate-intensity yoga Control- sedentary	60 min	IFN-α2, IFN-γ, TNF-α, MCP-1, IL-6, IL-8, IL-10, IL-12p70, IL-17A, IL-18, IL-23, IL-33	↓IFN-γ, TNF-α, IL-8, IL-10, IL-12p70, IL-17A, IL-33
Rajbhoj et al. 2015 [20]	India	RCT	Healthy industrial workers	Case: 19 Control:18	Case: yoga therapy Control: no intervention	12 weeks Case: 45 min yoga, 6 days/wk	IL-1β, IL-10	↓ IL-1β ↑ IL-10
Kim et al. 2017 [21]	Korea	Experimental study	Elderly women	Case: 7 Control: 7	Case: hatha yoga Control: no intervention	10 weeks Case: one hr (3 times/ wk)	ESR, hsCRP	↓ ESR, hsCRP
Eda et al. 2017 [22]	Japan	Crossover design	Young adults	Case: 23	Yoga based stretching	2 weeks Case: 90 mins session	Salivary SIgA, cortisol, testosterone	↓ cortisol ↑ SIgA, testosterone
Karthiga et al. 2022 [23]	India	RCT	GHT	Case: 121 Control: 113	Case: yoga intervention Control: usual care	20 weeks Case: 16^{th}-36^{th} wk gestation Control: usual care	BRS, HRV, IR, lipid-risk factors, IL-6, hsCRP, MDA, VED, NO	↓ IL-6, hsCRP ↑NO
Chen et al.	Taiwan	Longitud	Pregnant	Case: 48	Case: physical	20 weeks	Salivary	↓ salivary

2017 [24]		inal prospec tive RCT	women	Control: 46	postures/ stretching, deep breathing, guided imagery, deep relaxation.	Case: 70 min session 2/wk Control: usual care	Cortisol, IgA	cortisol ↑IgA

IL: interleukin; IL-1RA: IL – 1 receptor antagonist; IP-10: Interferon-gamma inducible protein 10; MCP: monocyte chemoattractant protein; MIP: macrophage inflammatory protein; TNF-α: tumour necrosis factor-alpha: TG: triglyceride: HDL: high-density lipoprotein; LDL: low-density lipoprotein; TC: total cholesterol; SOD: superoxide dismutase; ESR: erythrocyte sedimentation rate; FVC: forced vital capacity; FEV1: forced expiratory volume in first second; PEFR: peak expiratory flow rate; sIL-2R: soluble IL-2 receptor; BDNF: brain derived neurotrophic factor; DHEA: dehydroepiandrosterone; NO: nitric oxide; GSH: glutathione; GPx: GSH-peroxidase; GSH-s-T: GSH-s-transferase; SIgA: secretory immunoglobulin A; GHT: gestational hypertension; BRS: barorefex sensitivity; HRV: heart rate variability; IR: insulin resistance; MDA: malondialdehyde; VED: vascular endothelial dysfunction. US: United States

Table 2: Effect of yoga on inflammation in patients with cardiac, respiratory and metabolic disorders

Author, Year, Ref	**Place**	**Study design**	**Condition**	**Sample Size**	**Type of intervention**	**Duration**	**Outcome**	**Findings**
Wolff et al. 2015 [25]	Sweden	Prospective 3-arm single-centre study	HT	Case 1: 28 Case 2: 26 (home) Control : 26	Case: Kundalini Yoga Control: Usual Care	12 weeks Case 1:30min day Case 2-15min/da y Control: no change	hsCRP, IL-6, plasma glucose, HbA1c, TC, TG, LDL, HDL. Questionnaire on self-rated quality of life (WHOQOL-BREF).	No change
Lee et al. 2019 [26]	Korea	Randomized nonblinded trial	HT & T2DM	Case: 21 Control : 14	Case: BEM Control: Health education	8 weeks Case: twice/wk Control:	SGOT, SGPT, GGT, HDL, TC, LDL, inflammatory	↓ expressions of *NFKB2*, *RELA*, *IL1B*

						usual care	markers gene expression	
Pullen et al. 2008 [27]	Georgia	RCT	NYHA Class I-III LVEF ≤ 50%	Case: 9 Control : 10	Case: yoga, medical therapy, health education Control: health education, medical therapy	8 weeks Case: 2 sessions/ wk 70 min each	Exercise/fitness testing, IL-6, hsCRP, SOD, MLHFQ	↓ IL-6, hsCRP ↑ SOD; Improvement in QoL-MLHFQ
Pullen et al. 2010 [28]	US	RCT	HF	Case: 21 Control : 19	Case: yoga group Control: standard care	8 weeks Case - one hr yoga twice /wk	IL-6, CRP, SOD	↓IL-6, CRP ↑ SOD
Chanta et al. 2022 [29]	Thailand	RCT	Allergic Rhinitis	Case: 13 Control : 14	Case: hatha yoga Control: no activity	8 weeks Case:60 min session, thrice/wk	Rhinitis symptoms, PNIF, NBF, levels of IL-2 & IL-6	↑ IL-2
Kaminsky et al. 2017 [30]	Burlington	RCT	COPD	Case: 21 Control : 22	Case: pranayama and education Control: education alone	12 weeks Case: 2/wk- 30 min pranayama & 30 min education session Control: 60 min education	6-min walk distance, lung function, oxidative stress markers, inflammatory markers, measures of dyspnoea & QOL	No change
Suganthy et al. 2023 [31]	India	Prospective observational study	COVID-19	Case: 32	Ashtanga yoga (asanas, pranayama)	3 months (10 days - in person session, online	CRP, LDH, IL-6, Hb, TLC, NLR, RBG	↓ CRP, IL-6, D- dimer, ferritin

						zoom session)		
Thockam et al. 2018[32]	India	RCT parallel, open-label	COPD	Case: 20 Control: 21	Case: conventional, yoga intervention Control:conventional treatment	12 weeks Case: 50 min/day Control: usual	PR, BP, RR, BMI, Hb, CBC, KFT, LFT, PFT, 6MWD, 8-isoPF2α, TNF-α, FeNO, SGRQ	↑FEV1, FVC, 6MWD, SGRQ ↓ FeNO, TNF-α, 8-isoPF2α
Majumdar et al. 2023 [33]	India	Non-RCT	COVID-19	Case: 113 Control: 112	Case: Yoga intervention Control: Conventional care.	2 weeks Case: 15 min - morning &10 min-evening yoga/day	CRP, D-dimer, IL-6, ferritin, LDH	↓ CRP, LDH.
Sarvottam et al. 2013[34]	India	Non- RCT	Overweight, obese men	Case: 30	Case: YBLI	10 days Case: 2 hrs /day	IL-6, adiponectin, ET-1	↓ IL-6 ↑adiponectin ET-1: no change
Yadav et al. 2019 [35]	India	RCT	Metabolic syndrome	Case: 89 Control: 79	Case: YBLI Control: DI	12 weeks Case: 2hr/ day	Leptin, adiponectin, leptin: adiponectin ratio, IL-6, TNF-α, TBARS, 8-OHdG, SOD	↓ leptin:, IL-6, 8-OHdG, TBARS; ↑adiponectin, SOD
Promsrisuk et al. 2023 [36]	Thailand	RCT	T2DM	Case: 21 Control: 21	Case: EBRE with Thai Yoga Control: routine	12 weeks Case: 40 min, 5 days/wk	FBS, PFT, MDA, SOD, CAT, FeNO	↓ MDA, FeNO ↑ SOD, CAT
Yadav et al. 2012 [37]	India	Non-RCT	Overweight, obese	Case: 86	Case: YBLI	2 weeks Case: 2	Cortisol, β-endorphin, IL-	↓ cortisol, IL-6, TNF-α; ↑

						hrs/day	6, TNF-α	β-endorphin
Viswanathan et al. 2021 [38]	India	RCT	T2DM	Case: 150 Control: 150	Case: asanas, relaxation, pranayama; Control: physical exercise	12 weeks Case: 30 min (5 times/wk)	IL-6, TNF-α, hsCRP	↓ IL-6, TNF-α, hsCRP

Hr: hour; min: minute; wk: week; HT: hypertension; RCT: randomised controlled trial; COVID-19: coronavirus infectious disease-19; T2DM: type 2 diabetes mellitus; NYHA: New York Heart Association; LVEF: left ventricular ejection fraction; HF: heart failure; MLHFQ: The Minnesota Living with Heart Failure Questionnaire; WHOQOL-BREF: The World Health Organization Quality of Life Brief Version; BEM: Brain education-based meditation; HbA1c: glycated haemoglobin; hsCRP: high-sensitivity C-reactive protein; SGOT: serum glutamate oxaloacetate transaminase; SGPT: serum glutamate pyruvate transaminase; GGT: gamma glutamyl transpeptidase; PNIF: Peak Nasal Inspiratory Flow; NBF: Nasal Blood Flow; QoL: quality of life; LDH: lactate dehydrogenase; Hb: haemoglobin; TLC: total leukocyte count; NLR: neutrophil-lymphocyte ratio; RBG: random blood glucose; PR: pulse rate; BP: blood pressure; RR: respiratory rate; BMI: body mass index; CBC: complete blood count; KFT: kidney function test; LFT: liver function test; PFT: pulmonary function test; 8-isoPF2α: 8-isoprostane F2 alpha; FeNO: fractional exhaled nitric oxide; SGRQ: the St. George's Respiratory Questionnaire; 6MWD: 6-minute walking distance; ET-1: endothelin-1; COPD: chronic obstructive pulmonary disease; YBLI: yoga-based lifestyle intervention; DI: dietary intervention; TBARS; thiobarbituric acid reactive substances; 8-OHdG: 8-hydroxy-2'-deoxyguanosine; EBRE: elastic band resistance exercise; FBG: fasting blood glucose; CAT: catalase

2.5. Effect of yoga on inflammation in inflammatory diseases

Totally seven studies [39-45] were done involving 483 patients. Out of the seven studies, two studies were done in inflammatory bowel disease, four studies were done in rheumatoid arthritis and one study in multiple sclerosis. In patients with inflammatory bowel disease one study reported no change, whereas another study lacked power to detect change in paediatric ulcerative colitis activity index (PUCAI), and faecal calprotectin. One study with 14 multiple sclerosis patients showed increase in adrenocorticotrophic hormone (ACTH) and decrease in cortisol with the practice of yoga. Patients with rheumatoid arthritis showed decrease in IL-1α, IL-17, IL-17A, cortisol, IL-6, TNF-α, Cytotoxic T-lymphocyte-associated protein 4 (CTLA-4), also known as CD152, lymphocyte count, Th17 cells, aged T cell, erythrocyte sedimentation rate (ESR) and CRP. Anti-inflammatory cytokine and immunomodulatory marker TGF-β and soluble human leukocyte antigen G (HLA-G) showed significant increase in the yoga group.

2.6. Effect of yoga on inflammation in Cancer

Totally 11 studies [46-56] were done involving 604 patients with carcinoma. Out of the 11 studies, seven studies were done on breast cancer, and rest of the studies were done on prostate cancer, myeloproliferative neoplasm, colorectal cancer and gastro-intestinal carcinoma. Among the studies on breast cancer, one study reported no change, while other studies reported decrease in morning waking cortisol, improvement in NK cells, decrease in IL-6, IFN-γ, TNF-α, IL-1β, IL-1RA, IL-4, and increase in IL-10, sIL-6R, sTNFRI, sTNFRII, and CRP production. Reduced activity of the pro-inflammatory transcription factor- nuclear factor kappa B (NF-κB) and increased activity of the anti-inflammatory glucocorticoid receptor. Other studies done on prostate cancer, myeloproliferative neoplasm, colorectal cancer and gastro-intestinal carcinoma showed increase in numbers of CD4+, CD8+, T-cells and IFN-γ, and decrease in number of regulatory T-cells, TNF-α, IL-6, sTNFR1, and myeloid-derived suppressor cells.(Table 3)

2.7. Effect of yoga on inflammation in psychological diseases

Totally seven studies [57-63] were done involving 382 patients with various psychological conditions like dementia among caregivers, depression, stress, occupational hazards and Alzheimer's disease. Studies reported reduction in IL-6, hsCRP, TNF-α, CRP, cortisol, down-regulated expression of pro-inflammatory cytokines and activation-related immediate-early genes. Patients with Alzheimer's disease showed down regulation of genes of IFN-γ and levels of CCL (C–C motif chemokine)-11 or eotaxin-1.(Table 4)

2.8. Effect of yoga on inflammation in conditions with chronic pain

Two studies [64, 65] were done in conditions with chronic pain involving 80 patients. Studies reported that serum CRP and cortisol reduced with yoga intervention. (Table 4)

2.9. Effect of yoga on inflammation in miscellaneous conditions

In 40 patients with isolated chest injury [66], practice of yoga did not show any change in cytokine levels. (Table 4)

Table 3: Effect of yoga on inflammation in patients with inflammatory disorders and cancer

Author, Year, Ref	Place	Study design	Condition	Sample Size	Type of intervention	Duration	Outcome	Findings
Ganesan et al. 2020 [39]	India	RCT	RA	Case: 68 Control: 75	Case: yoga therapy Control: standard care	12 weeks Case: 30min session thrice/ wk	Disease activity, short-term HRV, IL-1α, IL-6, TNF-α, cortisol	↑TP, HFnu, RR, RMSSD, SDNN, NN50, pNN50 ↓LFnu, LF: HF, IL-1α, IL-6, TNF-α, cortisol

Singh et al. 2011 [40]	India	RCT	RA	Case: 40 Control: 40	Case: posture, cleansing technique, yoga, diet, breathing, meditation Control: waiting list	7 weeks Case: 6 days/ wk (90 min session)	Lymphocyte count, CRP, uric acid	↓ Lymphocyte count, CRP, uric acid
Gautam et al. 2019 [41]	India	RCT	RA	Case: 30 Control: 32	Case: yoga based MBI Control: routine care	8 weeks Case: yoga body MBI 120 min/ day (5 sessions/wk)	ESR, CRP, (IL-6, IL-17A, TNF-α, TGF-β	↓ ESR, CRP, IL-6, IL-17A, TNF-α. ROS ↑ TGF-β, HLA-G
Najafi et al. 2017 [42]	Iran	Quasi experimental	MS	Case: 14 Control: 10	Case: Iyengar yoga Control: usual care	8 weeks Case: 3 days/ wk	ACTH, cortisol	↑ ACTH ↓ cortisol
Arruda et al. 2018 [43]	US	Non-RCT, pilot study	IBD	Case: 9	Case: Yoga	8 weeks Case: 60min in-person thrice/wk 30 min online thrice/ wk	PUCAI, faecal calprotectin, PROMIS-37	No change
Gautam et al. 2023 [44]	India	Single blinded RCT	RA	Case:32 Control: 32	Case: yoga Control: usual care	8 weeks	DAS28-ESR, Th17 (CD3+CD4+ IL17+ RORγt+CD28-), Treg (CD3+CD4+CD25+CD127-Foxp3+CD28-) cells, markers of Th1 & Treg cell aging, IL-6, IL-17, TGF-β, IL-10, 5-mC, 5-hmC, HDAC1; gene expression - RORγt,	↓ DAS28-ESR, Th17 cells & aged T cell subsets ↑ Treg cell ↑expression-FoxP3, TGF-β ↓ RORγt, IL-17, IL-6, CXCL2, CXCR2

							FoxP3, IL-17, IL-6, TGF-β, CXCL2, CXCR2, JUN	
Peerani et al. 2022 [45]	Canada	RCT	IBD	Case: 49 Control: 52	Case: yoga therapy Control: usual	12 weeks Case: thrice/wk (20-30 min)	hsCRP, IL-6, IL-10, TNF-α, BDNF, IDO, TREM-2	No change
Kaushik et al. 2022 [46]	US	RCT	Prostate cancer	Case: 12 Control: 14	Case: hatha yoga Control: standard care	12 weeks Case: preoperatively-60 min yoga exercise twice wkly for 6 wks post-operatively-6 wks starting 3–6 wks	QoL, FACIT-F, FACT, EGF, FGF2, Flt-3L, fractalkine, G-CSF, GM-CSF, IFN-α2/γ, IL-1α/1β, IL-1RA, IL-2,IL-3, IL-4, IL-5, IL-6, IL-7, IL-8, IL-9, IL-10, IL-12p40/p70, IL-13,IL-15,IL-17A, IP-10,MCP-1/3, MDC-CCL22, MIP-1α/1β, TGF-α, TNF-α/β, VEGF, eotaxin, sCD40L	↑ CD4+, CD8+ T-cells, IFN-γ ↑ expression of Fc receptor III in NK cells ↓ inflammatory cytokine levels ↓ Reg T-cells, myeloid-derived suppressor cells→ antitumor activity
Huberty et al. 2019 [47]	US	RCT	Myeloproliferative neoplasm	Case: 27 Control: 21	Case: yoga Control: routine care	12 weeks session; assessed-16 wks Case: 12-wk online yoga (60min/wk- 12 wks)	IL-6, TNF-α	↓TNF-α
Rao et al. 2017 [48]	India	RCT	Metastatic breast cancer	Case: 35 Control: 31	Case: posture, breathing, meditation	12 weeks Case: twice/wk (60 min)	Salivary cortisol, NK cells	↓ morning waking cortisol Improved NK

					yoga Control: education			cell%
Kiecolt-Glaser et al. 2014[49]	US	RCT	Breast Cancer	Case: 96 Control: 90	Case: hatha yoga Control: standard care	12 weeks Case: 90-min sessions twice/wk.	MFSI-SF, SF-36, CES-D, PSQI, IL-6, TNF-α, IL-1β	↓IL-6, IL-1β
Sohl et al. 2016 [50]	US	RCT	Colorectal cancer	Case: 6 Control: 5	Case: meditation, breathing, relaxation Control: AC	8 weeks Case: three 15 min session every 2 wks	IL-6, IL-1, sTNFR1, TNF-α, CRP	No change
Jain et al. 2023 [51]	India	RCT	Breast cancer	Case: 42 Control: 40	Case: yoga Control: usual care	48 weeks Case: 5 days /wk	TNF-α, IFN-γ, GM-CSF, SOD, CAT, MDA, NO; QoL	↓ TNF-α, IFN-γ, MDA, NO
Bower et al. 2014 [52]	US	RCT	Breast cancer survivors	Case: 13 Control: 15	Case: Iyengar yoga Control: education	12 weeks Case: 90min-two/wkControl: 120 min (1/wk)	Gene expression profiling- inflammatory markers, cortisol	↓ expression of NF-κB ↑ glucocorticoid receptor, CREB
Long Parma et al. 2015 [53]	US	RCT	Breast cancer survivors	Case 1: 26; Case 2: 20 Control: 26	Case1- aerobic flexibility Case 2: hatha yoga Control: own exercise	Six months One hr session, thrice/wk	IL-6, IL-8, TNF-α. CRP	↓ percentage of body fat No change in biomarkers
Sohl et al. 2022 [54]	US	RCT	GI Cancer stage II-IV	Case: 23 Control: 21	Case: YST Control: AC	4 weeks Case: 30 min session (2/wk)	Cytokine	↓ IL-6, sTNFR1
Patel et al.	US	Single arm	Cancer	Case: 17	Case: yoga	16 weeks	TNF-α, IL-1RA, IL-1β, IL-	↓IL-1β, IL-1RA

2023 [55]		self-control			therapy	Case: 3/wk (75 min/ session)	4, IL-6, IL-8, IL-10, IFN-γ, CRP sTNFRII, sIL-6R	
Micheletti et al. 2022 [56]	Italy	RCT	Breast cancer (Stage 0-III)	Case: 12 Control: 12	Case: yoga therapy. Control: usual care	6 months Case: twice/wk (75 min/session)	QOL, fatigue, sleep quality, cortisol, IL6, IL10, IL1RA, TNFα, LMR	↓IL-1RA

RA: rheumatoid arthritis; MS: multiple sclerosis; IBD: inflammatory bowel disease; CVD; cardiovascular disease; LFnu: low-frequency component expressed as normalized unit; HFnu: high-frequency component expressed as normalized unit; LF-HF; low-frequency/high-frequency; TP: total power; RMSSD: square root of mean squared differences of successive normal to normal intervals; SDNN: standard deviation of normal to normal interval; NN50: number of interval differences of successive NN intervals greater than 50 ms; pNN50: proportion derived by dividing NN50 by total number of NN intervals; MBI: mind body intervention; ROS: reactive oxygen species; HLA-G: human leukocyte antigen-G; PROMIS: Patient Reported Outcomes Measurement Information System; PUCAI: pediatric ulcerative colitis activity index; DAS: disease activity score; CD: cluster of differentiation; 5-mC: 5-methylcytosine; 5-hmC: 5-hydroxymethylcytosine; HDAC1: histone deacetylase 1; IDO: indoleamine 2,3-dioxygenase; TREM-2: triggering receptor expressed on myeloid cells 2; FACIT-F: Functional Assessment of Chronic Illness Therapy – Fatigue, EGF: epidermal growth factor; FGF2: fibroblast growth factor-2; Flt: FMS-like tyrosine kinase; G-CSF: granulocyte colony-stimulating factor; GM-CSF: granulocyte-macrophage colony-stimulating factor; MDC: macrophage-derived chemokine, IFN-γ: interferon-gamma; TGF: transforming growth factor, VEGF: vascular endothelial growth factor; sCD40L: soluble CD40 ligand; NK: natural killer; MFSI-SF: multidimensional fatigue symptom inventory-short form; SF36: Short-form health survey 36; CES-D: Centre for Epidemiological Studies Depression Scale; PSQI: Pittsburgh Sleep Quality Index; NF-κB: nuclear factor kappa B; cAMP: cyclic adenosine monophosphate; CREB: cAMP response element-binding protein; YST: yoga skills training; AC: attention control; sIL-6R: soluble IL-6 receptor; sTNFRII: soluble receptor for tumor necrosis factor type II; XRT: radiotherapy; LMR: lymphocyte-to-monocyte ratio.

Table 4: Effect of yoga on inflammation in psychological, chronic pain and miscellaneous conditions

Author, Year, Ref	**Place**	**Study design**	**Condition**	**Sample Size**	**Type of intervention**	**Duration**	**Outcome**	**Findings**
Black et al. 2013 [57]	US	RCT	Dementia caregivers	Case: 23 Control: 16	Case: KKM Control: RM	Case: 12-min, 7 days -8 wks Control: 12-min, 7 days -8	Genome-wide transcriptional profiles	↑ expression - immunoglobulin-related ↓ expression of

						wks		pro-inflammatory cytokines and activation-related immediate-early genes.
Nugent et al. 2021 [58]	US	RCT	Depression	Case: 48 Control: 39	Case: hatha yoga Control: HLW health education	10 weeks Case: 80 min (twice/ wk), Control: two 60-min classes /wk	IL-6, hsCRP, TNF-α	↓IL-6
Harkess et al. 2016 [59]	Australia	RCT	Chronic stressed women	Case: 11 Control: 15	Case: Yoga intervention Control: wait list	8 weeks Case: hr-long yoga classes (twice/wk)	IL6, TNF-α, CRP DNA methylation	↑ IL-6 ↓ methylation of TNF gene
Naveen et al. 2016 [60]	India	Experimental group	MDD	Case 1: yoga- 19; Case 2: medication-16; Case 3: yoga + medication -19	Yoga module – not available	Three months (1hr /session)	BDNF, cortisol	↑ BDNF ↓ cortisol
Grzenda et al. 2024 [61]	US	RCT	AD	Case: 40 Control: 39	Case: Kundalini yoga; Control: memory enhancement training	12 weeks Case/control: 60 min/wk, 12 min home work/ day	IFN-γ, eotaxin-1	↓ IFN-γ, eotaxin-1
Gopal et al. 2011 [62]	India	RCT	Medical students examination stress	Case: 30 Control: 30	Case: integrated yoga practice Control: Usual	35 mins daily for 12 weeks	Serum cortisol, IL-4, IFN -γ	No changes

					care			
Shete et al. 2017 [63]	India	RCT	Industrial workers with prolonged stress	Case: 18 Control: 19	Case: classical yoga asanas, pranayama Control: wait list	12 weeks One hr yoga session 6 days/wk	IL-6, TNF-α, hsCRP	↓IL-6, hsCRP, TNF-α
Cho et al. 2015 [64]	Korea	Non-RCT	CLBP	Case: 23 Control: 20	Case: hatha yoga Control: usual care	12 weeks Thrice/wk, 60min/ session	RMDQ, back flexibility, SOSI, serum cortisol, TNF-α, CRP	↓ cortisol, SOSI score
Seguin Flower et al. 2020[65]	US	2-arm, parallel-group, RCT	Chronic pain in older women	Case: 19 Control: 18	Case: Yoga Control: education & supportive therapy	12 weeks Twice/wk (60 min/ session	CRP, IL-2, IL-1β, TNF-α, IFN-γ, IL-6, IL-4, IL-10	↓ CRP
Gunjiganvi et al. 2021[66]	India	RCT	Isolated chest injury	Case: 38 Control: 42	Case: yoga, chest physiotherapy Control: chest physiotherapy	Duration, frequency not clear; Case: yoga therapy 1hr/day	PFT, QoL, IL-2, IL-4, IL-8, IL-10, IL-12, TNF-*α*, IFN-*γ*	No change

KKM: Kirtan Kriya Meditation; RM: relaxing Music; HLW: Healthy living and working; MDD: major depression disorder; DNA: deoxyribonucleic acid; AD: Alzheimer's disease; CLBP: chronic low back pain; RMDQ: Roland–Morris Disability Questionnaire; SOSI: Symptoms of Stress Inventory

3. DISCUSSION

This scoping review aimed to evaluate the overall effect of yogic practices on inflammation. We identified 56 potential studies involving 3,774 participants, covering diverse medical conditions as well as healthy adult volunteers. The studies investigated the effects of yoga on inflammatory markers in conditions such as heart failure, hypertension, pregnancy, cancer, COPD, allergic rhinitis, COVID-19, inflammatory bowel disease, rheumatoid arthritis, multiple sclerosis, obesity, T2DM, depression, stress, Alzheimer's disease, chronic pain, and occupational hazards.

The interventions varied widely, with durations ranging from 15 to 90 minutes. Various yogic practices were employed, including asanas (physical postures), pranayama (breathing exercises), relaxation techniques, and meditation. The most commonly used approach was Hatha yoga, which combines asanas and

pranayama. The inflammatory markers assessed predominantly included IL-6, TNF-α and hsCRP/CRP.

Considerable heterogeneity was observed in the type of yoga practices, intervention durations, control groups, and outcome measures across the studies. Most studies reported favourable changes in the levels of inflammatory markers following yoga interventions, aligning with previous meta-analyses and systematic reviews. However, a few studies did not find significant effects [23, 33, 36, 41, 59, 62, 66].

The potential mechanisms underlying the anti-inflammatory effects of yoga may involve reducing autonomic imbalance and stress, which are known to initiate inflammatory cascades [67]. Chronic stresses can dysregulate the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis, leading to the release of pro-inflammatory cytokines like IL-6, IL-1β, and TNF-α [68]. Non-communicable diseases contribute to 74% of death globally. Cardiovascular disease, cancer, chronic respiratory diseases and diabetes contribute to 80% of the premature death due to non-communicable diseases. The sustainable development goal of 2030 aims to reduce premature mortality from NCDs through prevention and treatment by one third. Yoga can be the most potential tool that may help in the effective prevention as well as management of non-communicable diseases.

Yogic posture or asana, pranayama, mudra, bandha are considered to be the integral part of yoga. Asana is known to increase baroreceptor sensitivity, improves oxygenation, favourably affects nervous system and autonomic function by exerting positive effects on inflammation. Pranayama and yogic relaxation techniques are known to alleviate stress and autonomic imbalance in the body. It is the first ever study to show the effect of various yogic techniques in inflammation. Based on the comprehensive review of literature, yoga demonstrates significant anti-inflammatory effects across diverse populations. In healthy individuals and various pathological conditions, yoga interventions consistently reduced pro-inflammatory markers including IL-1β, IL-6, IL-8, TNF-α, and cortisol while increasing anti-inflammatory markers like IL-10, TGF-β, and antioxidant activity. These benefits were observed in cardiovascular, respiratory, metabolic, inflammatory, and psychological conditions, as well as in cancer patients. The findings collectively support yoga interventions as a complementary therapeutic approach for modulating inflammatory responses and improving overall health outcomes.

4. CONCLUSION

This scoping review provides evidence for the favourable effects of yogic practices on reducing inflammation. While heterogeneity existed across the studies, most reported beneficial changes in inflammatory markers following the yoga interventions. With non-communicable diseases contributing significantly to global mortality, yoga emerges as a promising complementary approach for prevention and management of these diseases. Further research should optimize the use of yoga for different inflammatory conditions.

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Abbreviations:

5-hmC: 5-hydroxymethylcytosine

5-mC: 5-methylcytosine

6MWD: 6-minute walking distance

8-isoPF2α: 8-isoprostane F2 alpha

8-OHdG: 8-hydroxy-2'-deoxyguanosine

AC: attention control

AD: Alzheimer's disease

BDNF: brain derived neurotrophic factor

BEM: Brain education-based meditation

BMI: body mass index

BP: blood pressure

BRS: barorefex sensitivity

cAMP: cyclic adenosine monophosphate

CAT: catalase

CBC: complete blood count

CD: cluster of differentiation

CES-D: Centre for Epidemiological Studies Depression Scale

CLBP: chronic low back pain

COPD: chronic obstructive pulmonary disease

COVID-19: coronavirus infectious disease-19

CREB: cAMP response element-binding protein

CVD; cardiovascular disease

DAS: disease activity score

DHEA: dehydroepiandrosterone

DI: dietary intervention;

DNA: deoxyribonucleic acid

EBRE: elastic band resistance exercise

EGF: epidermal growth factor

ESR: erythrocyte sedimentation rate

ET-1: endothelin-1

FACIT-F: Functional Assessment of Chronic Illness Therapy – Fatigue

FBG: fasting blood glucose;

FeNO: fractional exhaled nitric oxide

FEV1: forced expiratory volume in first second

FGF2: fibroblast growth factor-2

Flt: FMS-like tyrosine kinase

FVC: forced vital capacity

G-CSF: granulocyte colony-stimulating factor

GGT: gamma glutamyl transpeptidase

GHT: gestational hypertension

GM-CSF: granulocyte-macrophage colony-stimulating factor

GPx: GSH-peroxidase

GSH: glutathione

GSH-s-T: GSH-*s*-transferase

Hb: haemoglobin

HbA1c: glycated haemoglobin

HDAC1: histone deacetylase 1

HDL: high-density lipoprotein

HF: heart failure

HFnu: high-frequency component expressed as normalized unit
HLA-G: human leukocyte antigen-G
HLW: Healthy living and working
hr: hour
HRV: heart rate variability
hsCRP: high-sensitivity C-reactive protein
HT: hypertension
IBD: inflammatory bowel disease
IDO: indoleamine 2,3-dioxygenase
IFN-γ: interferon-gamma
IL: interleukin
IL-1RA: IL-1 receptor antagonist
IP-10: Interferon-gamma inducible protein 10
IR: insulin resistance
KFT: kidney function test
KKM: Kirtan Kriya Meditation
LDH: lactate dehydrogenase
LDL: low-density lipoprotein
LF-HF; low-frequency/high-frequency
LFnu: low-frequency component expressed as normalized unit
LFT: liver function test
LMR: lymphocyte-to-monocyte ratio
LVEF: left ventricular ejection fraction
MBI: mind body intervention
MCP-1: monocyte chemoattractant protein-1
MDA: malondialdehyde
MDC: macrophage-derived chemokine
MDD: major depression disorder
MFSI-SF: multidimensional fatigue symptom inventory-short form
min: minute
MIP-1β: macrophage inflammatory protein-1 beta
MLHFQ: The Minnesota Living with Heart Failure Questionnaire
MS: multiple sclerosis
NBF: Nasal Blood Flow
NF-κB: nuclear factor kappa B
NK: natural killer
NLR: neutrophil-lymphocyte ratio
NN50: number of interval differences of successive NN intervals greater than 50 ms
NO: nitric oxide
NYHA: New York Heart Association
PEFR: peak expiratory flow rate
PFT: pulmonary function test
PNIF: Peak Nasal Inspiratory Flow
pNN50: proportion derived by dividing NN50 by total number of NN intervals
PR: pulse rate
PROMIS: Patient Reported Outcomes Measurement Information System
PSQI: Pittsburgh Sleep Quality Index
PUCAI: pediatric ulcerative colitis activity index
QoL: quality of life
RA: rheumatoid arthritis
RBG: random blood glucose
RCT: randomised controlled trial
RM: relaxing Music
RMDQ: Roland–Morris Disability Questionnaire
RMSSD: square root of mean squared differences of successive normal to normal intervals
ROS: reactive oxygen species
RR: respiratory rate
sCD40L: soluble CD40 ligand
SDNN: standard deviation of normal-to-normal interval
SF36: Short-form health survey 36
SGOT: serum glutamate oxaloacetate transaminase
SGPT: serum glutamate pyruvate transaminase
SGRQ: the St. George's Respiratory Questionnaire
SIgA: secretory immunoglobulin A
sIL-2R: soluble IL-2 receptor
sIL-6R: soluble IL-6 receptor
SOD: superoxide dismutase
SOSI: Symptoms of Stress Inventory
sTNFRII: soluble receptor for tumor necrosis factor type II
T2DM: type 2 diabetes mellitus
TBARS; thiobarbituric acid reactive substances

TC: total cholesterol

TG: triglyceride

TGF: transforming growth factor

TLC: total leukocyte count

TNF-α: tumour necrosis factor-alpha

TP: total power

TREM-2: triggering receptor expressed on myeloid cells 2

US: United States

VED: vascular endothelial dysfunction

VEGF: vascular endothelial growth factor

WHOQOL-BREF: The World Health Organization Quality of Life Brief Version

wk: week

XRT: radiotherapy

YBLI: yoga-based lifestyle intervention

YST: yoga skills training

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