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Analytical discussion of visible physical or mental signs and other reliable indicators alleviated or cured by practicing yoga like alternative medicine

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Abstract

The modern age is advancing at a rapid pace. In this fast-paced life, the incidence of many diseases, such as premature aging, heart disease, multiple sclerosis, fibromyalgia, diabetes, obesity, eye problems, and Alzheimer's disease, has been increasing over the past 20-25 decades. In addition to modern allopathic medicine, researchers in India's rich tradition of yoga therapy have found that traditional yoga, a mind-body therapy, can be used as an alternative therapy. Yoga combines specific physical postures, pranayama (breathing techniques), relaxation, and meditation, which improve mental and physical health. The purpose of this analytical review is to compile research evidence supporting the health benefits of traditional yoga practices. The analytical discussion explores the observable physiological and psychological signs and other reliable indicators that suggest that asanas, pranayama, and meditation can alleviate or cure a wide range of lifestyle disorders. Importantly, these indicators are used to assess the severity of disorders. Several studies have shown that yoga improves the body's redox health. However, most studies have several limitations, and the authors believe that more research on yoga is needed to validate these findings.

Keywords: alternative medicine; lifestyle disorders; yoga

Introduction

Yoga is not just a spiritual path; it is a physical and mental practice that originated in India over 5,000 years ago. In the definition of yoga philosophy, the word yoga is derived from the Sanskrit word yuj, meaning "to join," and symbolizes the union of the body with consciousness in the mind and spirit. According to Ashtanga Yoga, a traditional yoga philosophy, yoga is a mind-body intervention that combines specific physical postures (asanas), breathing techniques (pranayama), relaxation, and meditation to encourage the union of mind and body. The eight limbs of yoga are: Yama (ethical behaviour), niyama (personal behaviour), asana (physical posture), pranayama (breath regulation), pratyahara (sensory inhibition), dharana (concentration), dhyana (meditation), and samadhi (integration). Yogic practice of these limbs together leads to a higher state of morality, spirit, and healing. We will connect this to therapy.

Maharishi Patanjali states that yoga should be practiced with devotion, for a long time, and consistently. Such regular yoga practice improves health and well-being. In recent years, research has been conducted on yoga as a therapeutic approach for the prevention or treatment of mental and physical medical conditions such as stress, insomnia, obesity, anxiety, diabetes, hypertension, oxidative stress, glucose tolerance, dyslipidaemia, neurodegenerative diseases, and coronary heart disease. The Department of AYUSH, an independent department of the Government of India, is leading this initiative. The practice of yoga asanas and pranayama helps regulate cognitive health, as well as total serum cholesterol (LDL, VLDL), and triglycerides. Yoga has also been found to improve overall health and reduce self-reported symptoms of various body systems, such as urinary disorders and chronic back pain. It will be important to understand the improvements achieved through yoga and their relationship to changes in biomarkers.

The nature of the compound that prevents or slows the damage caused by oxygen to organisms or food.

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Oxidative stress results from increased levels of reactive oxygen species (ROS) and reactive nitrogen species (RNS) compared to antioxidants and damages various biomolecules such as DNA, proteins, and lipids, further contributing to diseases such as cancer, heart disease, neurodegenerative disorders, and aging. For example, the production of ROS leads to overexpression of JUN, an oncogene involved in lung cancer. Maintaining the required levels of antioxidants in the body is crucial to respond to the harmful effects of oxidative stress. To this end, cells produce various antioxidant enzymes such as superoxide dismutase (SOD), catalase, peroxiredoxins (PRXs), malondialdehyde (MDA), etc. We illustrate this below. Reactive species and antioxidants.

Major reactive species : ROS (Reactive oxygen species)

Major Free radicals : Superoxide anion radical (O2−•), hydroxyl radical (•OH), alkoxyl radical (RO•), peroxyl radical (ROO•)

Major Non-radicals : Hydrogen peroxide (H2O2), organic hydroperoxide (ROOH), singlet molecular oxygen (O21Δg), electronically excited

Major reactive species : RNS (Reactive nitrogen species)

Major Free radicals : Nitric oxide (NO•),nitrogen dioxide (NO2•)

Major Non-radicals : Nitrite (NO2−), nitroxyl anion(NO−), peroxynitrite (ONOO−), peroxynitrate(O2NOO−), nitrosuperoxycarbonate

Level of glutathione (GSH) is a major non-enzymatic intracellular marker of antioxidant status. The level of Glutathione increased significantly from 235.3 + 16.9 nmol/L to 331.7 + 37.6 nmol/L among male volunteers of Indian navy who practiced yoga. A Pilot study among pre-diabetics showed no significant difference between the baseline value 7.8 ± 2.5 and the final value 8.2 ± 2.4 after 3-months of yoga practice. Whereas yoga practices (Yogasana, pranayama and meditation) for three months resulted in 2.1 fold increase in GSH among healthy university students.

GSH can be oxidized to glutathione disulfide (GSSG) with the action of glutathione peroxidase (GPX) in response to oxidative stress and Glutathione reductase (GR) recycle GSSG to its reduced state using reduced nicotinamide adenine dinucleotide phosphate (NADPH) as hydrogen donor. The ratio of GSH/GSSG, also known as the glutathione redox ratio (GRR) is a sensitive indicator of oxidative stress and has been shown to increase significantly ($p<0.001$) after 3 months of yoga practice (Yog asana, pranayama, and meditation).

Glutathione peroxidase (GPx) glutathione reductase (GR) and glutathione S-transferase (GST), SOD and catalase are the enzymatic antioxidant components that protect against oxidative stress. Studies on healthy individuals showed that activities of GPx, and GST were significantly increased after 3 months yoga practice ($p<0.05$). Whereas no significant change was observed in glutathione reductase activity ($p<0.05$).

In another study conducted on physically active males from Indian Air Force, activity of glutathione S-transferase increased significantly ($p<0.001$), while GPx activity decreased significantly ($p<0.001$). GR activity also increased significantly ($p<0.05$) following 3 months yogic practice.

Superoxide radical (O2−•) is highly active oxidant however, SOD detoxifies superoxide radical (O2−•) by converting it to hydrogen peroxide and O2; further, catalase and GSH detoxifies hydrogen peroxide into water and alcohol. The activity of SOD increases significantly after following 3 months yoga practice among healthy individuals whereas, Hegde et al documented significant decrease in SOD activity (unit/gm Hb) after 3 months of yogic practices (Yog asana, shavasana and pranayama) 4721.0 ± 1263.0 (3992.0-5450) vs. 4340.0 ± 978.0

(3776.0-4905.0) among pre-diabetes patients. There was significant 4.65% increase in SOD activity and 0.09% in catalase among patients with end-stage renal disease on haemodialysis who practiced hatha yoga for 4-months.

Vitamin C and vitamin E both are potent components of an antioxidant defence system. The levels of vitamin C and vitamin E were increased significantly ($p<0.001$) following yogic practices.

MDA is the end product of lipid peroxidation, which is stimulated by increased level of ROS. Moreover, increased level of MDA induces various cellular reactions which results in destruction of DNA and protein. A study done among the healthy yoga practitioners has shown significant reduction in the level of MDA as compared with the control group ($p<0.01$). In another study done among prediabetic patients, 3-month practice of yogasanas and pranayama and shavasana resulted in significant reduction in malondialdehyde level ($p<0.001$).

A study conducted among hypertensive individuals, has shown that the level of MDA was significantly reduced ($p<0.05$) among patients who performed yoga (Yogasana and Pranayama), the decrease was by 4.0% after four months of intervention ($p=0.096$). Pal et al also observed non-significant decrease in both the control group (8.56 ± 0.63 to 8.38 ± 0.60) and yoga group (7.78 ± 0.50 to 6.01 ± 0.46) among healthy males. This decrease in the MDA level may be due to decrease of lipid peroxidation via increased antioxidant level.

Total antioxidant status (TAS) is also an important antioxidant marker. The level of TAS increased significantly ($p<0.001$) following 3 months of yogic practice which indicates a marked improvement in the overall cellular antioxidant level.

The above-mentioned studies involved different types of participants; healthy as well as individual suffering from various health conditions. The yoga interventions and the duration of the program were also varied. Majority of studies reported that practicing yoga was helpful in increasing the level of GSH, GSH/GSSH, total antioxidants status (TAS), vitamin C, vitamin E, glutathione reductase (GR) activity, catalase and GST activity and reducing the level of GSSG and MDA We illustrate this below.

Yoga improves overall antioxidant capacity of the body.

1. Population (after completion of the study) : n=70 healthy males, yoga group n=34, control group n=30

Yoga type & duration : Yogasana, pranayama, and meditation, 3 months, 6 days/week

2. Population (after completion of the study) : n=25, control group n=13, yoga intervention group n=12

Yoga type & duration : Yogasana, pranayama and meditation (also some exercises involving awareness), 12 weeks, 90 min/week (with recommendations to practice daily at home for 40 min)

3. Population (after completion of the study) : n=60 patients with hypertension, control group n=30, yoga group=30

Yoga type & duration : Yogasana and Pranayama (including conventional

therapy for hypertension), 42 days, 50–60 min/day

4. Population (after completion of the study) : n=68 patients with end-stage renal disease on hemodialysis, control group n=35, yoga group n=33

Yoga type & duration : 30 min Hatha yoga and 30 min unsupervised training for 4 months

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5. Population (after completion of the study) : n=29 patients with pre diabetes, control group n=15, yoga group n=14

Yoga type & duration : Yogasana, shavasana and pranayama, 3 months, 5 days/week, 75–90 min/day

1. GSH, glutathione; GSSG, oxidized glutathione; GSH/GSSG ratio of reduced and oxidized glutathione; SOD, superoxide dismutase; MDA, malondialdehyde; GPx, glutathione peroxidase; GR, glutathione reductase; GST, glutathione-S-transferase

2. ap>0.05; bp>0.01; cp>0.001

Improvement of cardiovascular health due to yogic practices

People suffering from mood disorders have higher risk of cardiovascular disease due to less cardiorespiratory coupling and autonomic dysfunction. Anxiety which is common in mood disorders is known to change the breathing patterns which evokes increase in tidal volume, respiratory rate and decrease in respiratory time amongst healthy people. Yoga has been shown to help in improved breathing function and coronary artery calcium (CAC), increased adaptation to hypoxia and improved mood. Sudarshan Kriya yoga (SKY) which is known to be helpful in depression, anxiety and stress has now also been reported to increase the spontaneous respiratory coupling and cardiac autonomous control in patients with anxiety and stress disorders which decreases the risk of cardiovascular disease in such patients We illustrate this below.

Improvement of cardiovascular health due to yogic practices.

Population (after completion of the study) : n=92 heart patients, control group n=48, yoga group n=44

Yoga type & duration : Meditation and pranayama (including standard medical therapy, modifications were made on an individual basis, according to each participant’s specific medical or orthopedic limitations), 12 weeks, 3 days/week, 60 min/day

Technique : ECG (Electrocardiography

Tools/methods : ECG & HRV Version 2.0 software for HRV (Bio-signal analysis

Population (after completion of the study) :

Yoga type & duration

Technique :

Tools/methods : ECG & HRV Version 2.0 software for HRV (Bio-signal analysis

Population (after completion of the study) : n=34 heart patients, control group n=16, yoga group n=18

Yoga type & duration : Yogasanas and pranayama (including relaxation phase, modifications were made on an individual basis according to individual medical and orthopedic limitations), 8–10 weeks, 2 days/week, 1 h/session

Technique : Enzyme immunoassay (Cayman Chemical, Ann Arbor, MI) by taking blood

Tools/methods : Treadmill time test

Population (after completion of the study) n=34 heart patients, control group n=16, yoga group n=18

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Yoga type & duration : Yogasanas and pranayama (including relaxation phase, modifications were made on an individual basis according to individual medical and orthopedic limitations), 8 weeks, 2 sessions/week, 70 min/session

Technique Enzyme immunoassay (CaymanChemical, Ann Arbor, MI) by takingTreadmill time test

Tools/methods : Minnesota Living with Heart Failure Questionnaire [MLHFQ]

1. a p Value versus base line value ranges from 0.3 to 0.8 which is considered non-significant. We illustrate this below.

Anti-aging effect of yoga.

Population (after completion of the study) : n=94 male/female for Yoga- and Meditation-based Lifestyle Intervention, age=30–65 years

Yoga type & duration: Pranayama, asanas and meditation, derived from a mix of Hatha yoga and

Raja yoga, 12 weeks (1st two weeks were taught by registered, specialized

yoga instructors and remaining 10 weeks were home based)

Techniqe : Chemiluminescence assay (Berthold detection luminometer

Quantitative Telomerase Cayman's EIA

Tools/methods : ELISA kits (Cayman

Population (after completion of the study) : n=1, a 31-year-old-man with class I obesity

Yoga type & duration: Asnas, pranayama and shavasana, 100 days (10-day active intervention under direct supervision of a qualified yoga instructor at IHC, 90 days at home), 2 h/day

Techniqe : TelomeraseEnzyme-linked immunosorbent assay (Cayman Chemical)

Tools/methods : Estimating the luminol-dependent chemiluminescence with luminometer

Population (after completion of the study) : n=39 family demented caregivers, mean age=60.3 years

Yoga type & duration: Kirtan Kriya or listening to relaxation music, 8 weeks, 12 min/day

Techniqe :

Tools/methods : TRAPeze (telomeric repeat amplification protocol) telomerase detection kit (Chemicon, Temecula, CA, USA)

Population (after completion of the study) : n=33, age=30–40 years, control group (healthy people) n=18, yoga group (people with minimum 2 years of yoga practice) n=15

Yoga type & duration: Asanas, pranayama, meditation (dhyana), minimum 2 years of yoga practice

Techniqe :

Tools/methods : Quantitative

A study done among the heart failure (HF) patients has shown that 12 weeks of yoga therapy (Meditation and pranayama) along with standard medical therapy resulted in a significant decrease in Heart Rate (HR)

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($p<0.001$), Rate pressure product (RPP) ($p<0.001$), systolic blood pressure ($p<0.01$), diastolic blood pressure ($p<0.001$), normalized Low Frequency power (LFnu) ($p<0.001$), low freq., high freq. ratio (LF/HF ratio) ($p<0.001$) and a significant increase in normalized High Frequency power (HFnu) ($p<0.001$).

Another study among heart failure patients has shown significant improvement in left ventricle ejection fraction (LVEF) and Tei index after 12 weeks of yoga therapy (Meditation and pranayama). LVEF was increased from 38.93 ± 5.1 to 52.96 ± 6.01 (36.88% in the yoga group (YG) and 16.9% in the control group (CG) ($p<0.01$) and Tei index was reduced from 0.54 ± 0.85 to 0.38 ± 0.03 (27.87% in the YG) and 2.79% in the CG ($p<0.01$). A significant decrease 63.75% in the YG and 10.77% in the CG ($p<0.01$) in N-terminal pro b-type natriuretic peptide (NT-proBNP) level, which was also reported in Yoga Group (pre: 3965.48 ± 1365.08, post: 1395 ± 997.08). These results indicate that 12-week yoga therapy offered additional benefits to standard medical therapy for Heart Failure patients by improving cardiac function, parasympathetic activity while reducing the sympathetic activity and myocardial stress.

Pro-inflammatory markers such as interleukin-6 (IL-6), high sensitivity C-reactive protein (hs-CRP) and extra cellular superoxide dismutase (EcSOD) have been associated with unfavorable cardiovascular outcomes in heart failure. Increased levels of IL-6 and CRP have been adversely associated with HF and ECSOD activity has been correlated with endothelium-mediated, flow-dependent vasodilatation. Pullen et al showed that after yogic intervention (Yogasanas and pranayama) there was a significant reduction in serum level of IL-6 (19.6 ± 2.5 to 16.0 ± 2.1 mg. dL−1: $p<0.001$) and hs-CRP (2.4 ± 0.58 to 1.9 ± 0.4 mg. dL−1: $p<0.001$). Levels of EC-SOD increased from 509 ± 71.9 to 610 ± 86.2 U. mL−1: $p<0.001$) and the results showed consistency with the earlier studies of Pullen et al which showed statistically significant reductions in serum levels of inflammatory markers: IL-6 and hs-CRP and an increase in EC-SOD in the Yoga (Yogasanas and pranayama) treatment group (all $p<0.005$).

Anti-ageing impacts of yoga

Aging is sequential change in an organism, or a decline of physiological goodness that leads to an increased threat of disease, debility, organism's inability to habituate to metabolic stress and ultimately death . Ageing at genomic level is largely the result of DNA damage caused by ROS, chemicals like benzo[a]pyrene, UV/IR radiations, spontaneous hydrolytic reactions, DNA replication errors which leads to various genetic lesions which includes point mutations, gene disruption, telomere shortening, translocations etc. Damage caused by these lesions is repaired by DNA repair mechanisms for example base excision repair (BER), nucleotide excision repair (NER), non-homologous end joining (NHEJ). Excessive DNA damage and insufficient DNA repair mechanism favors the aging process.

Recently published studies demonstrated that aging is associated with telomerase activity and telomere length and maintaining telomere length is important to prevent cellular senescence. Telomere is repetitive nucleotide sequence at each end of the chromosome which protects chromosome from damage and prevents the fusion with adjoining chromosomes and these ends of chromosomes are vulnerable to age-related decay. The length of telomere gets shorten with ageing and age-related diseases. Telomeres are found to be prone to inflammation and oxidative stress which can further promote telomere shortening, hence ageing. Loss of telomere-protective sequences due to deprivation of human telomerase reverse transcriptase (hTERT) activity lead to aging in humans and mice, whereas aging can be delayed in mice by reactivation of telomerase. Telomeric DNA is protected by a six-subunit protein called Shelterin which bounds telomere prevents the ingression of DNA repair proteins to the telomeres. Lack of shelterin induces telomere uncapping, non-homologous end joining, senescence and/or apoptosis.

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Several studies have provided significant evidence of the impact of yoga-intervention on telomerase activity and telomere length.

Tolahunase et al studied the effect of a 12-week Yoga (Yogasana, pranayama, and meditation) Based Lifestyle Intervention on both cardinal and metabotropic biomarkers associated with cellular aging. The findings showed a significant reduction in the mean levels of 8-hydroxy 2′ deoxyguanosine (8-OH2dG) and ROS while enhancement in the mean levels of total antioxidant capacity (TAC) and telomerase activity (all values $p<0.05$). The mean level of telomere length was increased, but this result was not significant ($p=0.069$). The metabotrophic blood biomarkers associated with cellular aging are cortisol, β-endorphin, IL-6, Brain-derived neurotrophic factor (BDNF), and sirtuin-1. The mean levels of cortisol and IL-6 were significantly reduced and mean levels of β-endorphin, BDNF, and sirtuin-1were significantly increased (all values $p<0.05$).

A study by Kumar et al showed there was an enhancement in telomerase activity and decrease in oxidative stress (ROS) and DNA damage marker (8-OH2dG) by yoga (Asnas, pranayama, shavasana) lifestyle intervention. The yoga program included asanas (postures), pranayama (breathing exercises), stress management, group discussions, lectures, and individualized advice.

Lavretsky et al measured the effect of 12 min kirtan kriya and listening to relaxation music on telomerase activity using telomeric repeat amplification protocol (TRAPeze) telomerase detection kit, and observed a significant 43% increase in telomerase activity which leads to increase in length of telomeres and ultimately delay aging.

A similar study by Krishna et al reported that leukocyte telomere length (LTL) was significantly increased ($p<0.001$) in the yoga group by yogic actions like Asanas (bodily/tangible positions), Pranayama, Dhyana (meditation) and was measured by quantitative PCR.

Limitations

In many case studies the control group was missing, so it is very difficult to suggest whether the results are due to the yogic intervention or not. In some studies, yogic intervention along with medication, physical exercise, or relaxing music were employed to analyze the changes in biological indicators and so it is difficult to assess the impact of yoga alone. While in some studies the focus was to establish cause and effect relationship without going into the details of mechanism.

Conclusions

Taken together, evidences are gaining which suggest that yogic interventions improve overall health of body which can be analysed by assessing the levels of biological indicators. These indicators can also help to determine which practice could be employed to have greater impact in curing a specific ailment or getting a specific benefit. These studies would be important for people who are predisposed to diseases due to genetic or environmental factors. Further studies, with proper control groups, can be taken to analyse the impact of diet or change in lifestyle could further add value to the yogic interventions. Another interesting area of study could be to determine the relation between ethnic/genetic diversity, economic variability, and environmental factors and their impact on the final outcome of yogic practices.

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