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## Role of *Surya Namaskar* in improving strength, flexibility and diseases of various biological system

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### Abstract

Thousands of years ago, the great "Patanjali" and his disciples created the *Surya Namaskara*, a traditional yoga practise to salute the Sun. Surya means "Sun" and Namaskara means "Salutation" or "to greet." They advised everyone to practise it early in the morning, on an empty stomach, facing the rising sun, for optimum health, endurance, mental and physical stability, and strength. *Pranamasana*, *Hasta Uttanasana*, *Hastapaadasana*, *Ashwa Sanchalana*, *Parvatasan/ Adho Mukha Svanasan*, *Bhujangasana*, *Adho Mukha Svanasana/Parvatasan*, *Ashwa Sanchalanasana*, *Hastapaadasana Swadhisthana*, *Hasta Uttanasana*, and *Pranamasana Anahata* all poses are among the sequences of 12 dynamically coordinated yoga positions known as *Suryanamaskar* that are performed in rhythm with the breath. The benefits of *Surya Namaskar* are numerous. This review is therefore carried out in order to assemble and comprehend the impact of *Suryanamaskaron* distinct bodily systems. In this review, published publications were located using search engines such as MEDLINE, EMBASE, Scopus, Science Direct Databases Directory of Open Access Journals (DOAJ), PubMed, and Google Scholar. According to research, *Surya namaskar* increases physical strength, promotes healthy skin and respiratory muscles, treats premenstrual syndrome symptoms, lowers the risk of high-risk pregnancy, reduces seminal oxidative stress and oxidative DNA damage, and improves sperm motility in men. It also lowers high glucose levels, stress, flatulence, body weight constipation, and high blood pressure and improves flexibility of the body.

**Keywords:** *Surya Namaskar*, biological system, yoga, sickness, treatment and mechanism

## Introduction

With its roots in the Indus Valley civilization in the northwest of India, yoga is thought to be 4000–8000 years old[1]. The Sanskrit word *yuj*, which means "to connect," is the root of the word yoga, which means "unity or oneness"[2]. The oldest sacred text of Brahmanism, the Rig Veda, which served as the foundation for contemporary Hinduism, first made reference to yoga around 1500 B.C.E.[2]. Prior to this, it is thought that sages kept yoga practises a secret and never recorded them[2]. Yoga was regarded as a method of living that would enable a person to become liberated from suffering in the Upanishads (800–500 B.C.E.)[2]. Yoga is also an integral part of Ayurveda, an ancient Indian system of medicine, with time-tested experiential evidence to cure various disorders[3],[4], [5]. The concept of yoga has grown to include a vast range of disciplines, philosophies, and practises via succeeding historical periods, texts, and teachers. Hatha yoga is the most well-known and recognisable type of yoga, particularly in the West[2]. The yoga practise known as Surya Namaskar is focused on improving both physical and mental wellness[2]. The Surya Namaskar is a comprehensive physical practise that was allegedly created and popularised by the late Shrimant Balasaheb Pant Pratinidhi, the King of Aundh, in the 1920s and later by Sri K V Iyer and Sri Krishnamacharya[6]. The *Surya namaskar* models put forward by Sri Krishnamacharya were discovered to be based on the Danda exercises described in Vyayama Dipika [7]. Dandaal is an old form of physical training that is still used today by wrestlers and martial artists in India. Dandaal may have been the source of the push ups utilised in western countries for bodybuilding[6]. *Surya namaskar* is considered to be the precursor to modern physical exercises because it is a traditional fusion of two different systems, such as physical culture and yoga[6]. Other yoga schools, such as the Swami Sivananda Yoga Vedanta Center, the Bihar School of Yoga (BSY), and the Swami Vivekananda Yoga Anusandhana Samsthana (SVYASA), adopted further simplified versions, which were gradually absorbed into contemporary yogic practises[7]. an old yoga posture known as *Surya Namaskara* used to practice into modern-day yogic practices[7]. Surya means "Sun" and Namaskara means "Salutation" or "to greet," making *Surya Namaskara* a traditional yoga practise to praise the Sun. As a result, it is also known as Sun Salutation or *Surya Namaskar*. This particular breathing and postural regimen was created by the great "Patanjali" and his or her disciples thousands of years ago[8]. They encouraged all people to perform it in the morning in front of the rising sun, facing towards the sun on an empty stomach, for excellent health, stamina, mental and physical stability, and strength[9]. *Suryanamaskar* is a series of dynamically coordinated yoga poses that are performed in time with the breath. *Surya namaskar* is a set of 12 physical postures that include several bends both forward and backward[2].

*Surya Namaskar* consists of 12 various asanas (poses) in sequences, including *Pranamasana*, *Hasta Uttanasana*, *Hastapaadasana*, *Ashwa Sanchalana* *Adho Mukha Svanasana* / *Parvatasan* *Ashtanga Namaskara*, *Bhujangasana*, *Adho Mukha Svanasana* / *Parvatasan*, *Ashwa Sanchalanasana*, *Hastapaadasana* *Swadhisthana*, *Hasta Uttanasana*, *Pranamasana* *Anahata*. *Surya Namaskar* has numerous additional advantages because it is best performed while facing the rising sun. This allows our bodies to absorb the vitamin D that the sun's rays contain, which strengthens our bones and improves our vision[10]. Yoga's therapeutic benefits are also being investigated as a result of growing scientific studies on various

health disorders and treatment regimens based on human constitution [11]. The advantages span a variety of physical health systems and include psychological safety via aerobic conditioning under the sun [10].

Studies on the effects of *Surya Namaskara* on physiological and psychological parameters suggest that by performing these asanas, the abdominal muscles get stretched and compressed, stimulates peristaltic movements of the intestines helping to remove excess gas and constipation, stimulates blood circulation to the spinal canal, brain, and stretched and contracted whole musculoskeletal system, gives the body additional strength and flexibility, revitalises every cell and tissue, increases upper body strength through the naturally occurring weight bearing poses, especially in the arms and shoulders, tones and stimulates essential organs, promotes physical strength, flexibility, and mental calmness [9]. Increase skin glow because perspiration cleans the skin's pores, improve contractility of the respiratory system and vital capacity, balance the entire endocrine system by directly massaging the glands with increased blood flow, increase myocardial contractility and strength, increase cardiac output, ventilate the lungs and oxygenate the blood thoroughly, gives one's body strength, flexibility of their muscles, especially their legs, backs, chests, and buttocks, mental peace, helps them reduce extra body fat, loosens up their joints, and tones their muscles, helps all our internal organs function better and combat insomnia, regulate menstrual cycles and makes childbirth easier [9]. Additionally, *Surya Namaskara* has a tendency to activate the *Pingala nadi* (*Surya nadi*), which raises the body's energy level [8]. Improvements in pulmonary function, including peak expiratory flow rate, forced vital capacity, forced expiratory volume in 1 second (FEV1), and maximal inspiratory and expiratory pressures, have been shown. Following frequent *Surya namaskar* practise, decreased levels of biomarkers for oxidative stress have been seen coupled with improved glucose tolerance [12][13]. Among the advantages of *Surya namaskar* intervention are increased muscular mass and decreased fat mass [14]. When comparing baseline to the ninth posture, Sinha et al. (2004) found a 2.711 kcal/min increase in energy expenditure, drawing the conclusion that *Surya namaskar* is the best aerobic workout with an optimal stress on the cardiorespiratory system [15].

Previous studies have revealed kinetics, kinematics, and muscle activation during standing yoga asanas in senior people with regard to the biomechanical demands of these poses [16]. The joint moment of force in the sagittal plane was reduced by 30% to 268% during supported asanas due to the graduated biomechanical stress caused by starting with supported asanas and working up to typical unsupported tree pose, warrior stance, dog posture, and chair pose [16]. Supported asanas, on the other hand, resulted in reduced muscle activity, whereas traditionally performed asanas, on the other hand, resulted in higher muscle activity and, as a result, higher joint moments, which were, however, low to moderate [16]. Most standing poses worked the quadriceps femoris, gluteus medius, and erector spinae, and produced 70% more rectus abdominis activity than walking did [16]. Regarding *Surya namaskar's* biomechanics, the fluid rhythmic kinematic transition from one position to the next as well mathematical model to predict loads on the wrist, elbow, shoulder, hip, knee, and ankle joints are also reported [17]. The description of low loading forces applied in particular distribution patterns leads to the conclusion that none of the joints are

overloaded during *Surya namaskar*. Clinical measurements are also used to describe improvements in fatigue, balance, gait speed, and stride length[18].

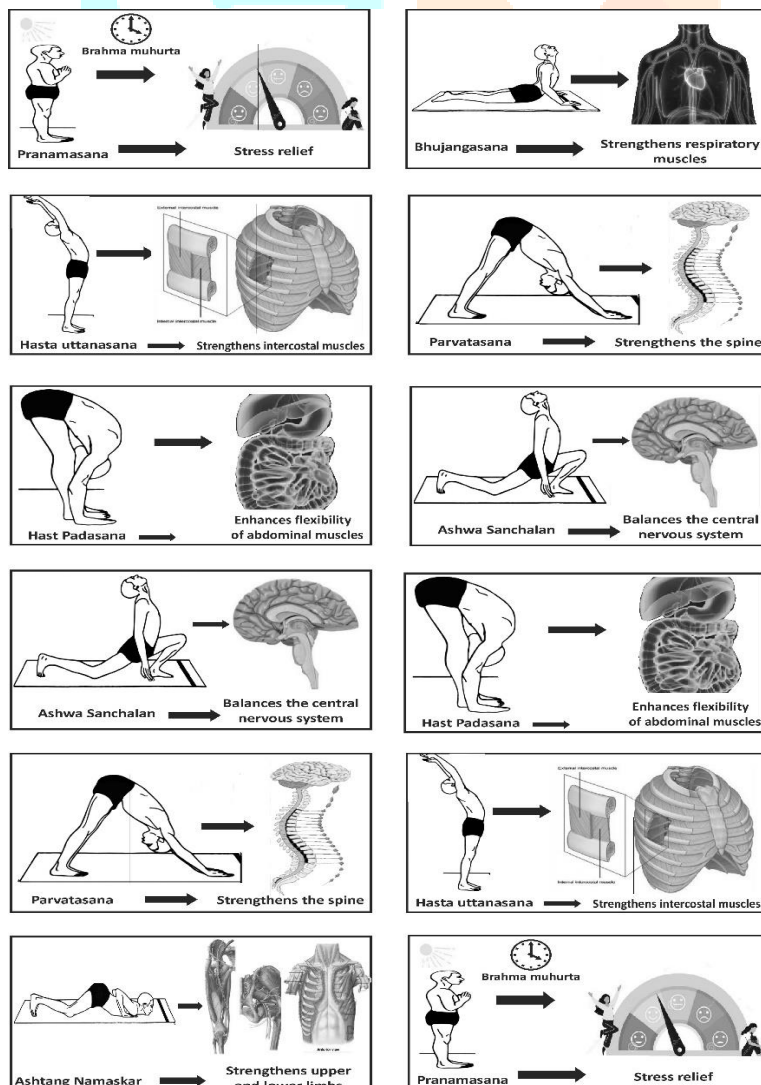
The influence of *Surya namaskar* in various organs, specifically in regard to the mechanistic role it plays, is thought to be the subject of no published reviews to date. Thus, this study examines the role of *Surya namaskar* in promoting diseases of several body systems. Review's objective was to present scientific evidence supporting *Surya namaskar's* management of life's diseases. The current review will contribute to a better knowledge of how *Surya namaskar* affects specific organs.

## 1. Methodology

MEDLINE, EMBASE, Scopus, Science Direct Databases Directory of Open Access Journals (DOAJ), PubMed, and Google Scholar were utilised as search engines to find published articles. *Surya Namaskar*, yoga, sickness, treatment, and mechanism were used as key terms along with the conjunctions OR/AND. The language of searches was limited to English. Research studies describing the management of life disorders using *Surya namaskar*. Conference proceedings, letters to the editor, grey literature, previously unpublished data, news items, abstracts and full texts that couldn't be retrieved, research published in languages other than English, and studies that weren't pertinent to the current review weren't included.

## 2. Discussion

**Figure 1: Effects of Surya namaskar on various systems**



Schematic diagram showing in 12 steps of Suryanamaskar with their therapeutic benefits

## A) Effect of Surya namaskar on flexibility

Reduced flexibility can be caused by a number of things, including a desk job, a sedentary lifestyle, or fat buildup around joints, which limits full range of motion. Various factors are involved for reduced or altered functioning of skeletal muscles[19]. Various biomechanical alterations in joints and changed postures can result from changes in flexibility. So, in order to carry out daily tasks with ease, flexibility is required. Maintaining flexibility may aid in reducing stress and stiffness, which can result in physical issues that are persistent and frequently crippling[20]. The series mimicked push-up movement and weight-bearing positions for the upper body may aid in building pectoral, triceps, and trunk muscles with greater strength and endurance[21]. The sequence offers such a significant physical stretch that it is regarded as constituting a whole yoga practise in and of itself[8].

Muscle flexibility is defined as the ability to move a single joint or series of joints smoothly and easily through an unrestricted, pain-free range of motion[22] Hamstring is a two joint muscle which contracts eccentrically to maintain a proper posture in standing hence are prone to be tight. Hamstrings are an example of muscle groups that tend to shorten (Turner et al., 1988). A tight hamstring causes increased patellofemoral compressive force, which may eventually lead to patellofemoral syndrome [23] Hamstring tightness can also lead to altered gait patterns that are inadequate knee extension at initial contact and overuse injuries. Donald E Hartig (1999) reported that increasing hamstring flexibility decreases lower extremity overuse injuries in basic military trainees[24].

The superficial back line includes the hamstrings. The entire posterior surface of the body, from the bottom of the foot to the top of the head, is connected and shielded by the superficial back line. The superficial back line performs as an uninterrupted line of integrated myofascial when the knees are extended, such as during standing. As a result, when *Suryanamaskar* is performed, the hamstrings are stretched via the visible back line[25].

Additionally, a study by Deshmukh et al.[20] comparing the effects of Pilates and Surya Namaskar on flexibility in sedentary women using the sit-and-reach test and the shoulder and wrist test found that Surya Namaskar is more effective at improving flexibility in sedentary women than Pilates and can be added to a daily fitness routine. In a different investigation, Anagha Mangaonkar et al. [21] examined the impact of Surya Namaskar vs. dynamic stretching on hamstring flexibility in physiotherapy students and came to the conclusion that Surya Namaskar is more efficient in enhancing hamstring flexibility than dynamic stretching. Prof. (Dr.) Kanwaljeet Singh et al study 's[26]on the impact of *Surya Namaskar yogasana* on yogini intercollege athletes' concludes to increase flexibility and muscular stamina.

Additionally, Ananda Balayogi Bhavnani et al. [16] 2013 investigated the immediate effects of Surya Namaskar on reaction time and heart rate in female volunteers and came to the conclusion that Surya Namaskar may be used as an efficient training method to enhance neuromuscular abilities.

Additionally, a research by Mastrengeolo et al. found that *Surya namaskar* significantly increased menopausal women's hamstring flexibility[27]. Kanwaljeet Singh, Dr. Baljinder Singh Bal, and Dr. Wilfred Vaz conducted a similar study on the impact of *Suryanamaskar* on the muscular endurance and flexibility of intercollegiate yoginis.

It was established that Suryanamaskar yogasana significantly increased muscular endurance and hamstring flexibility[26]. Suryanamaskar has also been demonstrated to enhance hamstring flexibility, upper body strength, and muscle endurance in a study by Kristine Fondran[28]. The superficial front and rear lines both extend during the suryanamaskar, which causes the superficial back line to likewise constrict. Even the smallest muscles of the spinal column and the back are strengthened when the back muscles are contracted, but dynamic stretching only affects the specific muscle and joint that is being stretched. The spinal region's blood circulation is improved by suryanamaskar, which in turn stimulates the nerves there.

It proved that Suryanamaskar yogasana has a significant effect on improving muscular endurance and hamstring flexibility[26]. A study by Kristine Fondran has also proved that Suryanamaskar improves hamstring flexibility, upper body, muscle endurance and also improves overall mental health [28]. In suryanamaskar, the superficial front line also gets stretched which causes co-contraction of the superficial back line. Owing to the contraction of the muscles of the back, even the smallest muscles of the spinal column, as well as the muscles of the back, are strengthened whereas dynamic stretching affects only the targeted muscle and joint. Suryanamaskar improves blood circulation in the vertebral region, and consequently, the nerves in this region are invigorated. In addition to the hamstrings, suryanamaskar improves and maintains spinal flexibility[29]. Suryanamaskar has been shown to have beneficial physiological effects in addition to increasing flexibility by enhancing pulmonary function, respiratory pressures, hand grip strength, endurance, and resting cardiovascular parameters[12]. These are the potential explanations for why suryanamaskar performed better than dynamic stretching in this study.

## **B) Effect of *Suryanamaskar* on Cardiovascular system**

Recent research has been done by Sinha and colleagues[15] who examined the energy costs and cardiorespiratory alterations during practise as well as Bhutkar and colleagues[30] who did a pilot study on the cardiorespiratory fitness parameters after practising *Suryanamaskar* for six months. Reduced catecholamine secretion and vasodilation brought on by decreased sympathetic activity enhance peripheral circulation. Regular yoga practise is also found to lower basal metabolic rate and oxygen consumption while at rest[31]. The drop-in resting pulse rate could be caused by all of these. These variables also lessen the strain on the heart, which in turn lowers cardiac output and, ultimately, systolic blood pressure[31].

The best kind of aerobic exercise, according to Sinha and colleagues, is *Suryanamaskar*, which involves all major joints in static, stretching, and dynamic muscular movements[9]. The *Suryanamaskar* technique varies among many schools of yoga. Some schools promote slow performance in sync with slow breathing, while others promote a speedy style of performing numerous rounds quickly, much like physical training. It has been said that performing *Suryanamaskar* at various speeds has various advantages that when it is done rapidly it warms up the body and acts as a cardio tonic, whereas when done slowly it strengthens and tones the musculature and enhances functioning of internal organs[12]. During *Suryanamaskar*, muscles of the entire body experience stretch and pressure alternately and therefore it is said to give more benefits with less expenditure of time[30].

Additionally, *Surya namaskar* was found to significantly lower blood pressure in studies by McCaffrey et al. [32] and Blank[33] that looked at the effectiveness of an 8-week yoga programme in a group of hypertensive patients in Thailand and the physiological responses to Iyengar Yoga practised by trained practitioners respectively.

Also, McCaffrey et al. [32]who examined the effectiveness of an 8 week yoga program in a group of hypertensive patients in Thailand, as well as Blank8 [33]who studied the physiological responses to Iyengar Yoga, as performed by trained practitioners, found a significant decrease in blood pressure with intervention of *Surya namaskar*.

### C) *Suryanamaskar* effect on stress

Homeostasis requires stress to be maintained, but when stress overwhelms a person or disrupts homeostasis, it can be dangerous[34]. The neurological system is stimulated by stress, which also overworks the adrenal glands and reduces immunity[35]. The parasympathetic and sympathetic nervous systems become unbalanced during stress, which affects the body's equilibrium and, ultimately, quality of life[34]. The need to create solutions that can lower stress levels among young people is quite high due to the increase in the number of young people suffering from mental health issues and the difficult lives they lead[35]. One such tool may be considered to be yoga[36]. You may confront overwhelming anxieties, frustrations, and problems in daily life by using the inner strength that yoga teaches you to access[37].Yoga has been shown to be an effective intervention for college students in enhancing psychological factors including sense of wellbeing and feeling relaxed, to mention a few[38].Yoga and relaxation techniques have been shown to lower stress and competitive anxiety while boosting mental toughness, according to a study[[39].

It has also been suggested that one can drive away depression through fast rounds or cool down hyperactivity with slow rounds [40]It is an ideal way to relax the mind as it uses the whole body and produces sweating. This can lead to great burn off anger and allow to calmly dealing the situation with full of awareness.

Additionally, it increases the volume of the frontal cortex, which is linked to impulse control and self-regulation[41][42]. Studies have shown that willpower, executive function, delay of gratification, self-regulation, and executive controlall of which are primarily under the direction of the frontal cortexmake up the high-level function of self-control [36][38]. Therefore, a proposed reason for the improvement in self-control following *Suryanamaskar* intervention could be an increase in the frontal lobe of the brain's volume.

Yoga intervention greatly promotes mindfulness, according to earlier research by Gaiswinkler & Unterrainer, Erkin & Senuzun Aykar, and Brisbon & Lowery[43][44][41]. *Suryanamaskar* is a component of yoga, which is a mindfulness-based practise. In order to properly practise yoga, one must pay close attention to their breathing, mental activity, and bodily sensations over time [41].

Additionally, practising yoga improves both sustained and focused attention [45]. Similarly, mindfulness is positively correlated with improved academic achievement, life satisfaction, and self-esteem while adversely correlated with sadness, anxiety, exhaustion, substance misuse, and bewilderment[46][47][41].

#### **D) Surya namaskar effect on GIT**

During this stage of life, *Vatavriddhi Vataj* diseases of the gastrointestinal tract, such as indigestion, stomach distention, flatulence, diarrhoea, joint pain, backache, tremors in the limbs, and insomnia are typical issues. Every second elderly person often complains about constipation (*Vibandha*) among these. Therefore, a wonderful option to treating constipation all-naturally is to use numerous Yogic treatments, which are practically free. By hereditary variables, dietary habits, socioeconomic conditions, way of life, occurrence of diseases, etc., it tends to vary in different age groups. Yoga can be used to treat geriatric G.I.T. issues, particularly constipation. According to *Acharya Charaka*, there are two methods: yogic *Ahara*(diet) and *yogic Vihar*(practice). *Yogic Vihara* refers to a variety of yogic asanas and *kriyas*, such as *Surya-namaskar, Vajrasana, Pashchimothasana, Dhanurasana, Pranayama, Pratyahara*, and various *Agnisara Kriyas*, by which one can successfully correct *Jatharagni* and gain mastery over *Apana Vayu*[48]. *Surya namaskara* promotes the peristaltic action of the gut, which aids in removing extra gas and relieving constipation[49].

#### **E) Surya namaskar effect on skin**

The practitioners of Yoga beautiful, clean complexion is a sign of healthy skin since these asanas cause the perspiration to cleanse all the skin pores[50]. *Suryanamaskar* also enhances the function of the intestines' peristalsis, promotes blood flow throughout the body, tones up the kidneys, massages them, and helps the body discharge wastes more effectively through increased sweating. Elimination of toxins is a crucial function for keeping the skin healthy and preventing skin problems[6].

#### **F) Surya namaskar effect on obesity**

One of the most prevalent metabolic disorders in the modern era is obesity. With the constant change in lifestyle, environment, and dietary practises in the modern period, man has fallen prey to various ailments, including obesity, which is one of them. Obesity is essentially a lifestyle disorder in today's rapidly globalising society, where health is a major concern. The lifespan and life expectancy decline when BMI rises. One of the most prevalent nutritional issues is it. Numerous ailments, including Diabetes Mellitus and hypertension, are caused by obesity[51].

Asanas can benefit the body in different ways depending on whether they are performed individually or in a continuous sequence like the sun salutation. *Suryanamaskar*, however, unquestionably promotes improved calorie burning[52].

A study on the impact of Surya namaskar in the treatment of *Sthaulya* that measured variables including chest, abdominal, and buttock circumferences clearly suggests that *Suryanamaskar* has a significant impact on the treatment of *Sthaulya*. These study's scientific parameters supported this discovery, which indicated correspondingly significant and highly significant improvement[53].

According to a study, Surya namaskar practised regularly for one month caused obese people to lose weight[54]. Surya namaskar is a gentle physical workout that involves breathing. It uses calories moderately and is not overly worn out or exhausted. Since this sort of exercise is isotonic, it raises metabolic rate rather than stress. Different vicerceptors are stimulated by dynamic stretching in both the forward and backward directions as well as rhythmic positive and negative pressure changes in the viscera.



Because of this, all systems function at their best. Adding one or two rounds to routine practise increases the exercise's difficulty. Stamina and cardiovascular endurance are boosted by this. By boosting blood flow, it mobilises the fat that has been deposited or collected. Even if the practitioner is barely perspiring, they feel rejuvenated. It has been observed that even low-intensity activities like *kapalabhati* and 10 minutes of Om recitation can cause the body to undergo psycho-physiological changes[54]. According to a study, obese people who lost almost 4 kg in a month did it in a medically healthy way. These individuals' diets were not under strict monitoring, yet the weight loss effect persisted. This suggests that obese people will need to continue doing Surya namaskar for longer than a month in order to attain their weight loss goals. Regular yoga practise under qualified instruction has a different, more long-lasting impact on obesity than other methods[55]. The *Surya Namaskara* dynamic sequence is crucial for managing obesity[54].

### **G) Surya namaskar effect on respiratory system**

Each movement in Surya Namaskar is linked with a deep rhythmic breathing procedure that forces the lungs to vigorously empty and then fill with oxygenated, clean air. All of the lungs' alveoli are stimulated, enlarged, and then cleaned. The blood's oxygen content rises, improving the health and oxygenation of the entire body, notably the heart and brain. Additionally strengthened are the heart muscles. The likelihood of heart attack, blood vessel problems, and overall weariness can all be reduced by increasing microcirculation to the heart. Lethargy and sluggishness are thereby considerably diminished.

The hypothalamic discharges are altered by yoga techniques[56], which decrease sympathetic tone, peripheral resistance, and ultimately diastolic blood pressure. Regular yoga practice increases thoracic compliance, lung and diaphragm excursions, and strengthens the respiratory muscles [57]. Yoga poses also lessen resistance in the airways[58]. All these traits contribute to improve the outcomes of various lung function tests after regular *Suryanamaskar* practice. Yoga practises help strengthen the endurance of the respiratory muscles[59]. According to a 40mm endurance test that also showed statistically significant improvement, people's respiratory endurance appeared to have improved following frequent *Suryanamaskar* practise. Recent studies show that practising yoga raises VO2 max[60][61].

This is brought about by a decrease in resting oxygen consumption and an improvement in oxygen use at the cellular level. Raised VO2 max following frequent *Suryanamaskar* practise can be explained by both improvements in cellular machinery and improved lung functioning. Regular *Suryanamaskar* practise is excellent exercise for both men and women and, according to studies, enhances cardiopulmonary efficiency in healthy teens. These yogic techniques can be suggested to people who want to increase their cardiovascular fitness but are unable to engage in severe exercise[60][61].

Dr. Tim Noakes while writing "The Lore of Running" state that efficiency of the body's circulatory and respiratory systems can be increased by aerobic activities, which enhances aerobic metabolism. Similarly, *Suryanamaskar* exercises performed regularly for 30 to 35 minutes at a medium intensity assist to enhance aerobic metabolism, *Suryanamaskar* exercises increase the efficiency of the pulmonary system or, to put it another way, increase vital capacity.

## H) *Surya namaskar* effect on reproductive system

Health problems like menstruation irregularities primarily impact women. In order to have a wealthy country, they have an additional obligation to have a healthier populace. Premenstrual syndrome, for example, has an impact on women's daily lives, particularly those of college ladies. College females' sedentary lifestyles alter their Body Mass Index ratio, one of which becomes a contributing factor to premenstrual syndrome. For one to be in excellent health, both the body and the mind should be active. Exercise of the body and the breath will improve everyone's overall health[62]. Studies suggest that simple labour can be ensured as well as erratic menstruation periods in women can be controlled by regularly practising the *Surya Namaskar*. It assists in restoring the sheen throughout, delaying the appearance of wrinkles, and enhancing its durability and brilliance[63][42].

Regular yoga practise helps reduce a variety of menopause symptoms[64]. All age groups can benefit from its practise because it can boost physical performance before puberty[65]. According to the research, premenstrual syndrome is influenced by abnormal BMI. Walking and *Surya Namaskar* together offer a way to lose the weight gained from a sedentary lifestyle and offer relief from menstrual issues. According to the study's findings, regular exercise can help teenage females avoid premenstrual syndrome symptoms permanently[62].

Every female goes through a crucial phase that gets her body ready for reproduction throughout puberty, which is followed by menarche. Menarche and puberty are accelerated to an early age because of environmental circumstances and dietary practises, when the body is not well-prepared to go through those processes. This increases the risk of cardiovascular disease, lowers life expectancy, dysmenorrhea, infertility, and a variety of menstrual cycle-related issues[6]. *Suryanamaskar* is essential for preventing puberty in girls and preparing the body for the required changes to take place. Therefore, it's crucial to start teaching *surya namaskar* at a young age—even as early as 7 years old. 12 weeks of one-hour yoga sessions that include *Suryanamaskar, asanas, pranayama, and meditation*. *Surya namaskar* results for teenage girls with polycystic ovarian syndrome (PCOS) revealed significant changes in blood sugar, insulin, and cholesterol levels [6].

Also in a study of a group of 42 men, *Suryanamaskar* yoga sessions reduced seminal oxidative stress and oxidative DNA damage and improved sperm motility, which in turn has a good impact on the dynamics of the sperm[6]. Studies emphasise the value of prenatal yoga in reducing the stress, hormone changes, and labour pain that are related to pregnancy[6]. Asanas are nevertheless suggested with care and taking into account the contraindications during pregnancy. Prenatal yoga is said to help high-risk pregnant patients who are hospitalised relieve stress and have favourable benefits on their musculoskeletal activities[6].

## I) *Surya namaskar* effect on physical strength

The increased muscle endurance would be a strong justification for doing the exercise programme frequently for people who don't have much time for strength training or who avoid it altogether. Additionally, since the simulated push-up element of the exercise targets the triceps and serratus anterior muscles especially, regular *Suryanamaskar* practise may increase muscle strength and stamina. Given that strength declines with age, *Suryanamaskar* may be especially helpful for old age people.

In contrast to Telles et al. [66] who discovered a decrease in resting heart rate following the implementation of a yoga training programme and instruction on how to specifically lower resting heart rate, few study did not detect any differences in resting heart rate following the yoga intervention. Significant drops in heart rate from baseline readings were also discovered by [67], who examined the effects of a six-week yoga intervention on participants with coronary artery disease. This finding of the study Telles et al.'s [66] as it stimulated the protocol for voluntarily lowering heart rate since multiple journal comments on the difficulty of lying still for 5 minutes, it might be deduced that the mindset of true relaxation following the rigours of the *Suryanamaskar* routine was difficult.

### **J) Surya namaskar effect on Diabetes**

Yoga activities are said to lessen life stress and even lower postprandial blood glucose levels [37],[68] It has been demonstrated that Surya Namaskar increases the dynamic flexibility of the chest wall [69]. The second and third poses involve backwards and forward bending, targeting the hip flexors, anterior trunk, hamstrings, and upper back for flexibility; the fourth and sixth poses target the gastrocnemius for flexibility. The cobra stance, which is excellent for this purpose, is included in the final elements [8][70]. Surya Namaskar, which is a self-controlled spinal adjustment, can result in better spinal adjustments in cases of low back pain [71]. In the case of asymptomatic persons, the Surya Namaskar's 12 exercises, which cover both extension and flexion postures for the spine, might be employed as a promotive exercise intervention [72].

Surya Namaskar improves the body's ability to digest glucose, and the endocrinal surge typically results in improved circulation and sustained high levels of energy [73]. A randomised controlled experiment has demonstrated the value of yoga as a diabetic intervention [73][74]. Additionally, it reduced the cardiometabolic risk [75].

### **3. Conclusion, Limitation and future perspective**

The results show that Surya namaskar improves body flexibility, lowers blood sugar levels, stress, flatulence, body weight constipation, and high blood pressure, increases physical strength, promotes healthy skin and respiratory muscles, treats premenstrual symptoms, lowers the likelihood of high-risk pregnancy, lowers seminal oxidative stress and oxidative DNA damage, and improves sperm motility in men. We consequently come to the conclusion that Surya Namaskar should be performed daily by everyone to reap these advantages. Because the full benefits of yoga have not yet been fully understood, more can yet be learned about the advantages of *Suryanamaskar*. *Suryanamaskar* can be advised in future disease management strategies to enjoy its beneficial effects after more research to understand its influence at the molecular level. Future studies with a solid research design, a sizable sample size, and sophisticated methods should, nevertheless, validate the findings of the current study.

### **4. Acknowledgment**

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### **5. Conflict of interest**

Authors declare no conflicts of interest.

## 6. Reference

- [1] L. H. L. L. Sparrowe, *Yoga*. 2004. [Online]. Available: <https://www.goodreads.com/book/show/137516.Yoga>
- [2] S. S. Saraswati, *Asana Pranayama Mudra Bandha*, First digi. Bihar, India.: Yoga Publications Trust, Ganga Darshan, Munger, Bihar, India. [Online]. Available: [https://ia804508.us.archive.org/31/items/aaa\\_20210704/aaa.pdf](https://ia804508.us.archive.org/31/items/aaa_20210704/aaa.pdf)
- [3] R. Sharma *et al.*, “Mucormycosis in the COVID-19 Environment: A Multifaceted Complication,” *Front. Cell. Infect. Microbiol.*, vol. 12, Jul. 2022, doi: 10.3389/FCIMB.2022.937481.
- [4] R. Sharma and N. Martins, “Telomeres, DNA Damage and Ageing: Potential Leads from Ayurvedic Rasayana (Anti-Ageing) Drugs,” *J. Clin. Med.*, vol. 9, no. 8, pp. 1–7, 2020, doi: 10.3390/JCM9082544.
- [5] R. Sharma, P. Kakodkar, A. Kabra, and P. K. Prajapati, “Human Clinical Trials,” 2022, doi: 10.1155/2022/9106415.
- [6] I. on S. namaskar from its origin to application towards Health, “Insights on Surya namaskar from its origin to application towards health,” *Insights Surya namaskar from its Orig. to Appl. Towar. Heal.*, vol. v.13(2);, [Online]. Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8814407/>
- [7] N. E. Sjomani, *No Title*, Second Edi. Shakti Malik Abhinav Publications E-37 Hauz Kha. [Online]. Available: <https://tereless.hu/english/Yoga-Tradition-of-the-Mysore-Palace.pdf>
- [8] A. Vaibhav, S. Shukla, and O. P. Singh, “Surya Namaskar (Sun Salutation): A Path to Good Health,” *Int. J. Pharmacol. Res.*, vol. 6, no. 7, pp. 224–230, Jul. 2016, doi: 10.7439/IJPR.V6I7.3349.
- [9] V. M. Nikam, “A Role Of ‘Surya Namaskara’ For Good Health,” *A Role ‘Surya Namaskara’ Good Heal.*, vol. VOL-VII, no. ISSUE-II, [Online]. Available: [https://www.aiirjournal.com/uploads/Articles/2020/03/4434\\_25.Vd.Manisha Nikam.pdf](https://www.aiirjournal.com/uploads/Articles/2020/03/4434_25.Vd.Manisha Nikam.pdf)
- [10] “Measuring Immediate Effects of Surya Namaskar on Trunk and Hip Flexibility among Young College Going Students.” [https://www.ijhsr.org/IJHSR\\_Vol.9\\_Issue.10\\_Oct2019/IJHSR\\_Abstract.011.html](https://www.ijhsr.org/IJHSR_Vol.9_Issue.10_Oct2019/IJHSR_Abstract.011.html) (accessed Jun. 30, 2022).
- [11] R. Sharma and P. K. Prajapati, “Predictive, Preventive and Personalized Medicine: Leads From Ayurvedic Concept of Prakriti (Human Constitution),” *Curr. Pharmacol. Reports 2020 66*, vol. 6, no. 6, pp. 441–450, Oct. 2020, doi: 10.1007/S40495-020-00244-3.
- [12] P. R. Ananda Balayogi Bhavanani 1, Kaviraja Udupa, Madanmohan, “A comparative study of slow and fast suryanamaskar on physiological function,” *A Comp. study slow fast suryanamaskar Physiol. Funct.*, vol. 2):71-6., doi: 10.4103/0973-6131.85489.

- [13] 1 and O. P. Tandon<sup>1</sup> Savita Singh, corresponding author<sup>1</sup> Varun Malhotra, <sup>1</sup> K. P. Singh, <sup>1</sup> S. B. Sharma, <sup>2</sup> S. V. Madhu, “No Title,” *A Prelim. Rep. role yoga asanas oxidative Stress non-insulin Depend. diabetes Mellit.*, vol. 16(2): 216, doi: doi: 10.1007/BF02864866.
- [14] P. K. S. Komal A Jakhotal<sup>1</sup>, Apurv P Shimpil<sup>1</sup>, Savita A Rairikar<sup>1</sup>, Priyanka Mhendale<sup>1</sup>, Renuka Hatekar<sup>1</sup>, Ashok Shyam<sup>2</sup>, “Suryanamaskar: An equivalent approach towards management of physical fitness in obese females,” *Suryanamaskar An Equiv. approach Towar. Manag. Phys. Fit. obese females*, vol. 8, no. 1, pp. 27–36, 2015, [Online]. Available: <https://www.ijoy.org.in/article.asp?issn=0973-6131;year=2015;volume=8;issue=1;spage=27;epage=36;aurlast=Jakhotia>
- [15] W. S. B Sinha <sup>1</sup>, U S Ray, A Pathak, “Energy cost and cardiorespiratory changes during the practice of Surya Namaskar,” *Energy cost Cardiorespir. Chang. Dur. Pract. Surya Namaskar*, vol. 48(2):184-, [Online]. Available: <https://pubmed.ncbi.nlm.nih.gov/15521557/>
- [16] G. J. S. Sean S-Y Yu <sup>1</sup>, Man-Ying Wang, Sachithra Samarawickrame, Rami Hashish, Leslie Kazadi, Gail A Greendale, “The physical demands of the tree (vriksasana) and one-leg balance (utthita hasta padangusthasana) poses performed by seniors: a biomechanical examination,” *Phys. demands tree one-leg Balanc. (utthita Hast. padangusthasana) Poses performed by seniors a Biomech. Exam.*, vol. Volume 201, p. 11, 2012, doi: 10.1155/2012/971896.
- [17] and D. Das SN Omkar, Meenakshi Mour, “Motion analysis of sun salutation using magnetometer and accelerometer,” *Motion Anal. sun Salut. using Magnetom. Accelerom.*, vol. 2(2), pp. 62–68., doi: 10.4103/0973-6131.60046.
- [18] D. W. J O Judge <sup>1</sup>, C Lindsey, M Underwood, “Balance improvements in older women: effects of exercise training,” *Balanc. Improv. older women Eff. Exerc. Train.*, vol. 4, doi: 10.1093/ptj/73.4.254.
- [19] D. Karati, R. Varghese, K. R. Mahadik, R. Sharma, and D. Kumar, “Plant Bioactives in the Treatment of Inflammation of Skeletal Muscles: A Molecular Perspective,” *Evidence-Based Complement. Altern. Med.*, vol. 2022, pp. 1–18, Jul. 2022, doi: 10.1155/2022/4295802.
- [20] “A comparative study between Pilates and Suryanamaskar on flexibility in women having sedentary lifestyle using sit and reach test and shoulder and wrist test.” <http://www.sportsjournal.in/archives/2018/vol3/issue2/3-2-51> (accessed Jun. 29, 2022).
- [21] A. Mangaonkar and A. Puntambekar, “EFFECT OF SURYANAMASKAR VS DYNAMIC STRETCHING ON HAMSTRING FLEXIBILITY AMONG PHYSIOTHERAPY STUDENTS: A PILOT STUDY,” *Int. J. Physiother.*, vol. 5, no. 6, pp. 202–206, Dec. 2018, doi: 10.15621/IJPHY/2018/V5I6/178058.
- [22] M. Carolyn Kisner, PT, M. Lynn Colby, PT, and P. John D. Borstad, PT, *Carolyn Kisner, Lynn Allen Colby. Therapeutic exer\_cise. 6th edition.2012*, 6 th. United States of America: F. A. Davis Company, 2012. [Online]. Available: <file:///C:/Users/dell/Desktop/Therapeutic-exercise->

Foundations-and-techniques-by-Colby-Lynn-Allen-Kisner-Carolyn-z-lib.org\_.pdf

- [23] N. A. Odunaiya, Hamzat T K, and Ajayi O F, “The Effects of Static Stretch Duration on the Flexibility of Hamstring Muscles,” *African J. Biomed. Res.*, vol. 8, pp. 79–82, 2005, Accessed: Jun. 30, 2022. [Online]. Available: <http://www.bioline.org.br/md>
- [24] J. M. H. D E Hartig 1, “Increasing hamstring flexibility decreases lower extremity overuse injuries in military basic trainees,” *Increasing hamstring Flex. decreases Low. Extrem. overuse Inj. Mil. basic trainees*, doi: 10.1177/03635465990270021001.
- [25] T. W. Myers, “Anatomy trains : myofascial meridians for manual and movement therapists,” p. 280, 2001.
- [26] K. Singh, B. Singh Bal, and W. Vaz, “THE EFFECT OF SURYANAMASKAR YOGASANA ON MUSCULAR ENDURANCE AND FLEXIBILITY AMONG INTERCOLLEGE YOGINIS,” *JPES J. Phys. Educ. Sport*, vol. 27, no. 2, 2010, Accessed: Jun. 29, 2022. [Online]. Available: [www.efsupit.ro](http://www.efsupit.ro)
- [27] M. A. Mastrangelo, M. Lou Galantino, and L. House, “Effects of Yoga on Quality of Life and Flexibility in Menopausal Women: A Case Series,” *Explor. J. Sci. Heal.*, vol. 3, no. 1, pp. 42–45, Jan. 2007, doi: 10.1016/J.EXPLORE.2006.10.007.
- [28] K. Fondran, “The Effect of Surya Namaskara Yoga Practice on Resting Heart Rate and Blood Pressure, Flexibility, Upper Body Muscle Endurance, and Perceived Well-Being in Healthy Adults,” *ETD Arch.*, Jan. 2008, Accessed: Jun. 30, 2022. [Online]. Available: <https://engagedscholarship.csuohio.edu/etdarchive/550>
- [29] “Yoga for Health and Peace by Sadashiv Nimbalkar.” <https://www.goodreads.com/book/show/15790307-yoga-for-health-and-peace> (accessed Jun. 30, 2022).
- [30] “(PDF) Effect of Suryanamaskar Practice on Cardio-respiratory Fitness Parameters: A Pilot Study | pratima bhadane - Academia.edu.” [https://www.academia.edu/34037178/Effect\\_of\\_Suryanamaskar\\_Practice\\_on\\_Cardio\\_respiratory\\_Fitness\\_Parameters\\_A\\_Pilot\\_Study](https://www.academia.edu/34037178/Effect_of_Suryanamaskar_Practice_on_Cardio_respiratory_Fitness_Parameters_A_Pilot_Study) (accessed Jun. 30, 2022).
- [31] “(PDF) Effect of Suryanamaskar Practice on Cardio-respiratory Fitness Parameters: A Pilot Study.” [https://www.researchgate.net/publication/26597674\\_Effect\\_of\\_Suryanamaskar\\_Practice\\_on\\_Cardio-respiratory\\_Fitness\\_Parameters\\_A\\_Pilot\\_Study](https://www.researchgate.net/publication/26597674_Effect_of_Suryanamaskar_Practice_on_Cardio-respiratory_Fitness_Parameters_A_Pilot_Study) (accessed Jun. 30, 2022).
- [32] R. McCaffrey, P. Ruknui, U. Hatthakit, and P. Kasetsoomboon, “The effects of yoga on hypertensive persons in Thailand,” *Holist. Nurs. Pract.*, vol. 19, no. 4, pp. 173–180, Jul. 2005, doi: 10.1097/00004650-200507000-00009.
- [33] R. Robergs *et al.*, “Physiological Responses to Yoga,” *J. Exerc. Physiol. (JEPonline)*, vol. 9, no. 1,

2006.

- [34] R. Sharma *et al.*, “Chyawanprash: A Traditional Indian Bioactive Health Supplement,” *Biomolecules*, vol. 9, no. 5, May 2019, doi: 10.3390/BIOM9050161.
- [35] R. Sharma, K. Kuca, E. Nepovimova, A. Kabra, M. M. Rao, and P. K. Prajapati, “Traditional Ayurvedic and herbal remedies for Alzheimer’s disease: from bench to bedside,” *Expert Rev. Neurother.*, vol. 19, no. 5, pp. 359–374, May 2019, doi: 10.1080/14737175.2019.1596803.
- [36] “(No Title)”, doi: 10.4103/0973-6131.158473.
- [37] “Effect of Suryanamaskar on Occupational Stress among it Professionals Varsha SV”, doi: 10.30954/2277-9744.1.2020.1.
- [38] “[PDF] Stress due to exams in medical students--role of yoga. | Semantic Scholar.” <https://www.semanticscholar.org/paper/Stress-due-to-exams-in-medical-students--role-of-Malathi-Damodaran/6dd6308e5266e6f236f929e4e1e119404d8a5f87> (accessed Jun. 30, 2022).
- [39] “Article Details.” <http://oldpesrj.lbp.world/ArticleDetails.aspx?id=61> (accessed Jun. 30, 2022).
- [40] “The Surya Namaskar capsule | Life Positive.” <https://www.lifepositive.com/the-surya-namaskar-capsule/> (accessed Jun. 30, 2022).
- [41] B. E. Froeliger, E. L. Garland, L. A. Modlin, and F. J. McClernon, “Neurocognitive correlates of the effects of yoga meditation practice on emotion and cognition: A pilot study,” *Front. Integr. Neurosci.*, vol. 0, no. JULY 2012, p. 48, Jul. 2012, doi: 10.3389/FNINT.2012.00048/BIBTEX.
- [42] and K. R. Sergio Elías Hernández, José Suero, [...], “Increased Grey Matter Associated with Long-Term Sahaja Yoga Meditation: A Voxel-Based Morphometry Study,” *Increased Grey Matter Assoc. with Long-Term Sahaja Yoga Medit. A Voxel-Based Morphometry Study*, [Online]. Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4777419/>
- [43] L. Gaiswinkler and H. F. Unterrainer, “The relationship between yoga involvement, mindfulness and psychological well-being,” *Complement. Ther. Med.*, vol. 26, pp. 123–127, Jun. 2016, doi: 10.1016/J.CTIM.2016.03.011.
- [44] Ö. Erkin and F. Şenuzun Aykar, “The effect of the yoga course on mindfulness and self-compassion among nursing students,” *Perspect. Psychiatr. Care*, vol. 57, no. 2, pp. 875–882, Apr. 2021, doi: 10.1111/PPC.12630.
- [45] K. Gulati, S. K. Sharma, S. Telles, and A. Balkrishna, “Self-esteem and performance in attentional tasks in school children after 4½ months of yoga,” *Int. J. Yoga*, vol. 12, no. 2, p. 158, 2022, doi: 10.4103/IJOY.IJOY\_42\_18.
- [46] G. L. S. Ryan C Shorey 1, Hope Brasfield, Scott Anderson, “Differences in trait mindfulness across mental health symptoms among adults in substance use treatment,” *Differ. Trait mindfulness across*

*Ment. Heal. symptoms among adults Subst. use Treat.*, doi: 10.3109/10826084.2014.850310.

- [47] C. Caballero, E. Scherer, M. R. West, M. D. Mrazek, C. F. O. Gabrieli, and J. D. E. Gabrieli, "Greater Mindfulness is Associated With Better Academic Achievement in Middle School," *Mind, Brain, Educ.*, vol. 13, no. 3, pp. 157–166, Aug. 2019, doi: 10.1111/MBE.12200.
- [48] K. G. Satani, H. Raghvani, and K. Raghvani, "Role of Yoga in gastro-intestinal problems w.s.r. to Constipation (Vibandha) in geriatrics.," *J. Ayurveda Integr. Med. Sci.*, vol. 2, no. 2, May 2017, doi: 10.21760/JAIMS.V2I2.7711.
- [49] "PDF.MPro - Full Text Journal Article: Iyengar yoga for adolescents and young adults with irritable bowel syndrome." <https://pdf.manuscriptpro.com/search/Abstract~25025601/1/5ed22a19/Iyengar-yoga-for-adolescents-and-young-adults-with-irritable-bowel-syndrome>. (accessed Jun. 30, 2022).
- [50] "Acute effects of Surya Namaskar on the cardiovascular & metabolic system. | Semantic Scholar." <https://www.semanticscholar.org/paper/Acute-effects-of-Surya-Namaskar-on-the-%26-metabolic-Mody/779ef457edfaffbf4bfbbba9788644521bbefaf07> (accessed Jun. 30, 2022).
- [51] S. Kumar, · Kirti, R. Bhati, · Singh, and L. · Bhati, "Article Full-text available ASSESSMENT OF THE EFFICACY OF SURYA NAMASKAR IN MANAGEMENT OF STHAULYA," 2017, doi: 10.20959/WJPPS20176-9257.
- [52] R. P. Mullerpatan, B. M. Agarwal, T. Shetty, G. R. Nehete, and O. S. Narasipura, "Kinematics of suryanamaskar using three-dimensional motion capture," *Int. J. Yoga*, vol. 12, no. 2, p. 124, 2019, doi: 10.4103/IJOY.IJOY\_26\_18.
- [53] "(PDF) ASSESSMENT OF THE EFFICACY OF SURYA NAMASKAR IN MANAGEMENT OF STHAULYA." [https://www.researchgate.net/publication/317277672\\_ASSESSMENT\\_OF\\_THE\\_EFFICACY\\_OF\\_SURYA\\_NAMASKAR\\_IN\\_MANAGEMENT\\_OF\\_STHAULYA](https://www.researchgate.net/publication/317277672_ASSESSMENT_OF_THE_EFFICACY_OF_SURYA_NAMASKAR_IN_MANAGEMENT_OF_STHAULYA) (accessed Jun. 30, 2022).
- [54] "[PDF] Effect of Surya Namaskar on weight loss in obese persons | Semantic Scholar." <https://www.semanticscholar.org/paper/Effect-of-Surya-Namaskar-on-weight-loss-in-obese-Nautiyal/07a911c75224022cc0106fa11e5371646b3f88b2> (accessed Jun. 30, 2022).
- [55] P. Rani Bhardwaj, A. Kumar Bhardwaj, and P. Rani Bhardwaj Scholar, "Issue 1 | Pages 1-5 ISSN (Online): 2395-4892 Published online by Association for Indian Psychology, Rishikesh, India Quarterly, Peer-reviewed," *Int. J. Online J. Multidiscip. Res.*, vol. 1, no. 1, pp. 1–5, Accessed: Jul. 03, 2022. [Online]. Available: [www.ojmr.in](http://www.ojmr.in)
- [56] M. A. WENGER and B. K. BAGCHI, "Studies of autonomic functions in practitioners of Yoga in India.," *Behav. Sci.*, vol. 6, pp. 312–323, 1961, doi: 10.1002/BS.3830060407.
- [57] "Effects of yogic exercises on human physical efficiency. | Semantic Scholar." <https://www.semanticscholar.org/paper/Effects-of-yogic-exercises-on-human-physical-Nayar->



Mathur/b88db984545b6a893147a3bfc2968650b604b645 (accessed Jun. 30, 2022).

- [58] K. Makwana, N. Khirwadkar, and H. C. Gupta, "Effect of short term yoga practice on ventilatory function tests.," *Indian J. Physiol. Pharmacol.*, vol. 32, no. 3, pp. 202–208, Jul. 1988, Accessed: Jun. 30, 2022. [Online]. Available: <https://europepmc.org/article/med/3198241>
- [59] Madanmohan *et al.*, "Effect of yoga training on reaction time, respiratory endurance and muscle strength.," *Indian J. Physiol. Pharmacol.*, vol. 36, no. 4, pp. 229–233, Oct. 1992, Accessed: Jun. 30, 2022. [Online]. Available: <https://europepmc.org/article/med/1291472>
- [60] "Is Yoga Enough to Keep You Fit? | Yoga Fitness." <https://www.yogajournal.com/poses/is-yoga-enough-to-keep-you-fit/> (accessed Jun. 30, 2022).
- [61] "Aerobic capacity & perceived exertion after practice of Hatha yogic exercises. | Semantic Scholar." <https://www.semanticscholar.org/paper/Aerobic-capacity-%26-perceived-exertion-after-of-Ray-Sinha/61e89085c267a225768594d5d12657bf9e74ab59> (accessed Jun. 30, 2022).
- [62] R. Shakeela and D. S. N. Sugumar\*, "Effect of Surya Namaskar With and Without Walking On Body Mass Index among College Girls with Premenstrual Syndrome," *Int. J. Recent Technol. Eng.*, vol. 8, no. 5, pp. 316–318, Jan. 2020, doi: 10.35940/IJRTE.E4913.018520.
- [63] "A user's guide to the General Health Questionnaire (Book, 1991) [WorldCat.org]." <https://www.worldcat.org/title/users-guide-to-the-general-health-questionnaire/oclc/26545847> (accessed Jun. 30, 2022).
- [64] R. Chattha, N. Raghuram, P. Venkatram, and N. R. Hongasandra, "Treating the climacteric symptoms in Indian women with an integrated approach to yoga therapy: A randomized control study," *Menopause*, vol. 15, no. 5, pp. 862–870, Sep. 2008, doi: 10.1097/GME.0B013E318167B902.
- [65] "Effects of yoga training and detraining on physical performance." [https://www.ijpp.com/IJPP\\_archives/2014\\_58\\_1\\_Jan - Mar/2014\\_58\\_1\\_Abstract\\_61-68.html](https://www.ijpp.com/IJPP_archives/2014_58_1_Jan - Mar/2014_58_1_Abstract_61-68.html) (accessed Jul. 01, 2022).
- [66] S. Telles, M. Joshi, M. Dash, P. Raghuraj, K. V. Naveen, and H. R. Nagendra, "An evaluation of the ability to voluntarily reduce the heart rate after a month of yoga practice," *Integr. Physiol. Behav. Sci.*, vol. 39, no. 2, pp. 119–125, 2004, doi: 10.1007/BF02734277.
- [67] G. Shankar and B. Pancholi, "The Effect of Suryanamaskar Yoga Practice on the Heart Rate, Blood Pressure, Flexibility and Upper Body Muscle Endurance in Healthy Adult," *Int. J. Heal. Sci. Res.*, vol. 1, p. 33, 2011, Accessed: Jul. 01, 2022. [Online]. Available: [www.ijhsr.org](http://www.ijhsr.org)
- [68] R. Sharma, H. Amin, and P. K. Prajapati, "Yoga: As an adjunct therapy to trim down the Ayurvedic drug requirement in non insulin-dependent diabetes mellitus," *Anc. Sci. Life*, vol. 33, no. 4, p. 229, 2014, doi: 10.4103/0257-7941.147430.
- [69] "(PDF) The Rationale for the Sit and Reach Test Revisited | Scott Martin - Academia.edu."

[https://www.academia.edu/23676504/The\\_Rationale\\_for\\_the\\_Sit\\_and\\_Reach\\_Test\\_Revisited](https://www.academia.edu/23676504/The_Rationale_for_the_Sit_and_Reach_Test_Revisited)  
(accessed Jun. 30, 2022).

- [70] M. Shukla\*, “Holistic Nature of Surya Namaskar for the Millennials, Reviewing and Investigating its Scientific Rationale,” *J. Yoga Physiother.*, vol. 7, no. 4, pp. 1–3, Jul. 2019, doi: 10.19080/JYP.2019.07.555718.
- [71] “A systematic review and meta-analysis of yoga for low back pain - Database of Abstracts of Reviews of Effects (DARE): Quality-assessed Reviews - NCBI Bookshelf.” <https://www.ncbi.nlm.nih.gov/books/NBK138467/> (accessed Jul. 01, 2022).
- [72] R. Sharma and P. K. Prajapati, “Diet and lifestyle guidelines for diabetes: Evidence based Ayurvedic perspective,” *Rom. J. Diabetes, Nutr. Metab. Dis.*, vol. 21, no. 4, pp. 335–346, 2014, doi: 10.2478/RJDND-2014-0041.
- [73] A. Pandey, P. Tripathi, R. Pandey, R. Srivatava, and S. Goswami, “Alternative therapies useful in the management of diabetes: A systematic review,” *J. Pharm. Bioallied Sci.*, vol. 3, no. 4, p. 504, Oct. 2011, doi: 10.4103/0975-7406.90103.
- [74] “EBSCOhost | 125673077 | 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.” <https://web.p.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrn1=0973709X&AN=125673077&h=j3%2FWfZfBgwkJDRhy3lkPER08jbOtSucV%2FokiazIDOylaw2PJSIW5Ly%2Brrrod%2BuRSAnRy%2B9tgp%2F58HnPEkiphz0A%3D%3D&crl=c&resultNs=AdminWebAuth&resultLocal=ErrCrlNotAuth&crlhashurl=login.aspx%3Fdirect%3Dtrue%26profile%3Dehost%26scope%3Dsite%26authtype%3Dcrawler%26jrnl%3D0973709X%26AN%3D125673077>  
(accessed Jul. 01, 2022).
- [75] R. Yadav, R. K. Yadav, R. Khadgawat, R. M. Pandey, A. D. Upadhyay, and N. Mehta, “Randomized Controlled Trial of A 12-Week Yoga-Based (Including Diet) Lifestyle vs. Dietary Intervention on Cardio-Metabolic Risk Factors and Continuous Risk Score in Indian Adults with Metabolic Syndrome,” *Behav. Med.*, vol. 46, no. 1, pp. 9–20, Jan. 2020, doi: 10.1080/08964289.2018.1538098.