

Review Article

Psychophysiology of Suryanamaskara: A Narrative Review

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ABSTRACT

Salute to the Sun, often known as the Sun Salutation, is a sequence of twelve yoga postures that are gently linked to one another. Sun-salutation, an age-old Indian tradition is known to promote physical, mental, and spiritual wellness by regulating physiological processes moderated by the Autonomic Nervous System. This narrative review, documents the psychological changes following practice of Surya Namaskara. The online database, PubMed, PubMed central, Google scholar were searched using keywords "Suryanamaskara" from 2013 to 2022 which yielded a total of 1670 studies, of which 18 studies were clinical trials. The review conclude that sun salutation is effective in providing physiological and spiritual health by affecting different system of human body based on body system ,spiritual and psychological concept.

Keywords: Sun Salutation, Spiritual, Muscular, Psychological.

Yoga is a type of mind-body exercise that combines physical movement with a conscious interior concentration on awareness of the self, the breath, and energy [1]. A well-known and important exercise in the yogic repertoire is the surya namaskara. It is one of the most effective ways to promote a healthy, active living while also getting ready for spiritual awakening and the ensuing expansion of awareness because of its adaptability and applications. Sun is referred to as Surya, while Namaskara is a salutation. Due to the sun's potent symbolism of spiritual consciousness, it was formerly a daily routine to worship the sun [2].

Procedure of Suryanamaskara

- Pranamasana (prayer pose):** Standing upright with feet together, slowly place the palm together in front of the chest in namaskara mudra, mentally. Relax the whole body.
- Hasta uttanasana (raised arms pose):** Raised and stretch both arms above the head keeping them shoulder width apart, bend the head, arms and upper trunk slightly backward.
- Padahasthasana (hand to foot pose):** Bend forward from the hips until the fingers or palms of the hands touch the floor on beside of the feet. Bring the forehead and try to touch the forehead to the knees as is comfortable.

- Ashwa Sanchalanasana (equestrian pose):** Place the hands down next to the feet on the ground. With your right leg extended as far as it is comfortable, place your toes on the ground. While maintaining the same posture of the left foot on the floor, simultaneously bend the left knee. The back should be arched, the head should be cocked back, and the inner glance should be raised to the middle of the eyebrow.
- Parvatasana (mountain pose):** Keep the hands and right foot still, and take the left foot back beside the right foot. Simultaneously, raise the buttocks and lower the head between the arms so that the back and legs form two sides of a triangle. The legs and arms straighten in the final position and the heels come down towards the floor in the final pose. Bring the head and shoulders towards the knees.
- Ashtanga Namaskara (salute with eight parts or points):** Keep still with your hands and feet. The feet will come up on the toes as you lower your knees, torso, and chin to the floor. Only the chin, hands, knees, chest, and toes make contact with the floor in the final posture. At the same time, the chin, chest, and knees should touch the ground.

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7. **Bhujangasana (cobra pose):** Hold the hands and feet in position. Raise your head, shoulders, and back into the cobra posture by sliding your chest forward and straightening your elbows. The hips and buttocks will drop to the ground as a result. Lean back your head and look up at the middle of your eyebrows. The arms support the trunk while the thighs and hips stay on the ground.
8. **Parvatasana (mountain pose):** Maintain a straight body, use your toes to grasp the ground, and use your arm strength to lift your buttocks and bring your heels down to the ground.
9. **Ashwa Sanchalanasana (equestrian pose):** Maintain the right foot in place and your palms flat on the ground. Lean the left leg forward and place the left foot in front of the hands. Push the pelvis forward and bend the right knee till it hits the floor at the same time. Lean the head back, arch your back, and look in the middle of your eyebrows.
10. **Padahasthasana (hand to foot pose):** Place the right foot close to the left foot and step forward. Raise both of your legs straight. Avoid straining, bring the forehead as near to the knees as you can.
11. **Hasta Utthanasana (raised arms pose):** Keep the arms separated, shoulder width apart. Bend the head, arms and upper trunk backward slightly.
12. **Pranamasana (prayer pose):** Bring the palms together in front of the chest [3].

METHODOLOGY

The terms "Suryanamaskara" were used to search the web databases PubMed, PubMed central, Google scholar, and books for relevant citations. A total of 1670 references from the databases' since inception to 2022 were found. The review comprised experimental papers, case studies, and case series in English that illustrated the impact of sun salutation. Studies that combined sun salutation with other yoga techniques were disregarded. The review did not include studies whose abstracts were unavailable or in languages other than English. A total of 18 studies were chosen from the final review after applying the inclusion and exclusion criteria, deleting the duplicates, and doing the search. Physiological and clinical investigations were divided into two main groups for the review's studies. According to their sub classification. The physiological alterations in respiratory, cardiac, metabolic, digestive, reproductive, and psychological factors are the physiological measurements measured with sun salutation procedures. Studies have also been done to determine how sun salutation

affects those who have diabetes, musculoskeletal issues, and dysmenorrhea.

RESULT

Changes on Cardiorespiratory

According to Ananda Balayogi Bhavanani et al Suryanamaskara cause a considerable rise in HR, which is indicative of a generalized sympathetic arousal, and a significant shortening of RT in female participants. We propose that SN may be utilized as a useful training tools enhance neuromuscular capabilities [3]. According to Bishwajit Sinha et al. By performing Suryanamaskara there is considerable declined in physiological variables such as VO₂, HR, V CO₂, V E, and VT. When compared to the first phase .In the third phase of the training compared to the first phase, O₂P, a measure of myocardial oxygen carrying, showed a considerable decline. Due to different V O₂ and HR reductions during exercise, this may have occurred. In the 3rd phase compared to the 1st phase, the respiratory parameters fR did not demonstrate any discernible decline. Ventilatory parameters like EQO₂ and EQCO₂ demonstrated a considerable rise in the third phase from the first phase, which is consistent with a disproportionate reduction of VO₂ and V [4]. Another study suggested by Evelyn Synthiaet al Suryanamaskara practice showed a substantial improvement in cardiorespiratory and other variables after 12 weeks of use on 20 subjects [5]. Yuvaraj KB et al. have been taken 350 subjects and given Suryanamaskara for the period of 5 days in a week for 12 week and there is significantly higher in experimental group as compared to control group on abdominal muscular strength and endurance, flexibility, cardio-respiratory [6]. E. Dr Deepthi et al shows that slow suryanamaskar might be that stance to stretches muscles. As a result, the intercoastal muscles become less rigid and their respiratory muscular endurance rises.enhancing lung compliance as a result.who showed that simple exercise improves the kinetics, kinematics, and breathing patterns of the chest wall. On the basis of decreased sympathetic activity and increased vagal tone, the decline in diastolic pressure can be explained. And also it causes the autonomic balance to change, resulting in parasympatho dominance and a decrease in sympathetic activity [7]. Satyanath Reddy et al According to studies, 85 people who practiced Suryanamaskara for 3 months saw significant improvements in their circulatory and respiratory systems measured by variable PEFr and maximum oxygen consumption [8].

Table 2: Cardiorespiratory changes

Author	Year	Sample size	Variable Studied	Findings
Ananda Balayogi Bhavanani, Meena Ramanathan, R. Balaji, D. Pushpa Biswajit Sinha, Tulika Dasgupta Sinha	Nov 2012	21	RT,HR, simple ART, simple VRT	In this study it shows that immediate practice of Suryanamaskara for 3 rounds there is decrease in RT,VRT,ART and increased in HR
	Jan 2015	9	Oxygen consumption ([VO ₂] in L/min), carbon dioxide output ([V CO ₂] in L/min), minute ventilation ([V. E] in L/min), volume tidal ([VT] in L/ breath), breathing rate (fR in breaths/min). HR (HR in beats/min)	By practicing suryanamaskar there is deseased in O ₂ consumption,CO ₂ output, minute ventilation, tidal volume and heart rate ,and breathing rate does not show any changes

Evelyn Synthiya, P Anbalagan	2018	40	Body Mass Index (BMI), Flexibility, Muscular Strength and Endurance, Cardio Respiratory Endurance, Stress and Anxiety	There is significantly improvement in BMI, Muscular Strength and endurance, cardio respiratory endurance, stress and anxiety by practicing Suryanamaskara
Yuvraj KB, SK Manjunatha, T Viswanatha	2020	350	Abdominal muscular strength and endurance, cardio-respiratory endurance,	There is significantly higher in experimental group as compared to control group on abdominal muscular strength and endurance, flexibility, cardio-respiratory endurance body weight.
Deepti wadhwa, Amit Kaur, Naman Shah, Amruta Dhande	Jul 2022	80	PEFR, DBP and physical fitness by Modified Harvard step test	By performing SSN there is more significantly reduce in PEFR and DBP as compared to FSN, but in physical fitness FSN is more significant than SSN
Satyanath Reddy Kodidala, Priyaka Singh Raj Hans, Jitender Sorout, Harsha Soni	Feb 2022	85	Resting BP, PR, vital capacity, MVV, Maximum oxygen consumption, PEFR, body weight, Addenbrooke's Cognitive Examination- Revised for cognitive function test	In this research it concluded that by performing Suryanamaskara for 12 weeks there is decreased in resting BP and PR, and increased in vital capacity, MVV, PEFR and cognitive functions

Changes in psychological function

Tripthi, et al and kuntal et al. Surya Namaskara aid in the development of self-concept and attitude, two complex behavioral components that are improved by Surya Namaskara. . Surya Namaskara exercises also improve fitness, encourage relaxation, develop self-concept, self-confidence, and attitude, and reduce stress and anxiety [9,14]. Dr. Manoj kumar Sharma Suryanamaskar gives the person new experiences, helps them effectively manage their stress, and helps them stop using psychoactive and mood-lifting medicines [10]. According to Ananda Sarad Godse et al Study on physical relaxation and mental levels, the effects of suryanamaskar are seen to be multifaceted. Therefore proven to be helpful for all three stress disposition subscales.

Table 3: Psychological function

Author	Year	Sample size	Variable selected	Findings
Tripthi, Manish Kumar Bharadwaj, Bijendra Kumar	2013	60	Beena Shah's Self-concept Inventory Scale and Gopal Rao's School Attitude Inventory Scale were employed	Improvement of self-concept was observed by administering three months treatment of Sun Salutation among school going boys. Attitude was improved.
Manoj Kumar Sharma	Jan 2014	30	Stress scale	Suryanamaskara give the person rejuvenating sensations and effectively control their stress.
Anand Sharad Godse, Bhaskar R Shejwal, Amruta Anand Godse	2015	419	SSSI, Smith relaxation disposition inventory, SRDI-stress subscale	Study shows that Suryanamaskara is a powerful way that it promotes R-Dispositions like strength, alertness, and joy as well as physical relaxation, mental peace and quiet, and ease.
Manju Deorari Mrignayani Agarwal, Pratima Shukla	Nov 2017	30	Emotional Maturity Scale (EMS), PGI General Well-Being Measure (PGI GWBM; and Manuals of the Emotional Maturity Scale and PGI General Well Being Measure.	Study shows that there is significant effect by performing. Surya Namaskara in improving the levels of Emotional Maturity and Psychological Well-Being
Niranjan Parajuli Muttu raj Shinde Balram Pradhan.	Oct 2021	63	Brief Self-control Scale (BSCS), Mindfulness, Attention and Awareness Scale for Adolescents (MAAS-A), and General Health Questionnaire 12 (GHQ-12) questionnaire	This study proved that by practicing SN there is an improvement of mental health, self-control and mindfulness.
Kuntal Thakur	2013	60	Beena shah's Self-concept Inventory scale and Gopal Rao's school attitude inventory scale	After practicing Surya Namaskara for three months as a form of therapy, schoolboys' attitudes and self-concept greatly improved.

Changes in Musculoskeletal

According to Ranjini P et al. A mathematical model to forecast loads on the wrist, elbow, shoulder, hip, knee, and ankle joints is given together with the biomechanics of Suryanamaskar, the

This study advances the information from earlier investigations into suryanamaskar and its physiological effects [11]. Manju Deorari et al yoga can enhance well-being and physical and mental health and yoga exercises can be employed as psychophysiological stimuli to boost endogenous melatonin release, which may be the reason for an enhanced sense of wellbeing [12]. Niranjan Parajuli et al additionally, it increases the volume of the frontal cortex, which is linked to impulse control and self-control. According to studies, self-control is a high-level function that includes willpower, executive function, self-regulation, delay of desire, and impulsive control all of which are primarily controlled by the frontal brain. Therefore, one potential explanation for the improvement in self-control following SN intervention could be an increase in the frontal lobes volume [13].

fluid rhythmic kinematic transition from one posture to another. It is suggested that none of the joints are overloaded when doing Suryanamaskar by the low loading strains imposed in distinctive distribution patterns. Clinical measurements also show increases in sleep quality, balance, gait speed, and stride

length [15]. Aparna Regmi et al. Suryanamaskara series helps by alternately flexing the body forward and backward, the series of movements lengthens the spinal column, as well as the upper and lower bodies, through their full range of motion. This stimulates, tones, and massages the essential organs. The intrinsic weight-bearing poses used throughout the sequence, particularly with the arms and shoulders, help to increase upper body strength. The sequence provides the body with such a deep stretch that it is regarded as a whole yoga practice in and of itself [16]. According to Meng ni et al By practicing suryanamaskar there will helps to prevent from the dorsiflexor

and elderly people'. It is a key muscle addressed during rehabilitation of the ankle after injury, and it is frequently strengthened in programs intended to lessen ankle sprains and other injuries caused by unstable ankles. The dominant hip and knee flex as the toes are raised. The TA is strengthened as a result, and the pressure on the metatarsals is decreased. Uniform weight distribution throughout the hallux during weight bearing is made possible by strengthening the TA and expanding dynamic range during dorsiflexion. To lessen discomfort and tissue damage, it is now therapeutic to reduce plantar pressure [17].

Table 4: Musculoskeletal changes

Author	Year	Sample size	Variable studied	Findings
Rajani P Mullerpatan, Bela M Agarwal, Triveni Shetty, Girish R Nehete, Omkar Subbaramajois Narasipura ArpanaRegmi, dikerjoshi	2019	10	12-camera Vicon System (Oxford Metrics Group, UK) at a sampling frequency of 100 Hz using 39 retro-reflective markers. Data were processed using plug-in-gait model. Analog data were filtered at 10Hz. Vicon Nexus. Passive Hip Abduction (PHA) test, Goniometer.	This study shows that Suryanamaskar likely increase mobility of almost all body joints by stretching.
Meng Nia, Kiersten Mooneyb, Anoop Balachandrana, Luca Richardsb, Kysha Harriella, Joseph F. Signorile	2014	36	Suryanamaskara A and B	By practicing Suryanamaskara there is highly improve in hip adductor flexibility and also improve flexibility component of physical fitness. Different postures might result in particular muscle activation patterns, which can vary depending on the practitioners' level of proficiency.

Changes in Metabolic function

Surya namaskar gives us energy and vitality and maintains us fit and healthy. This series helps our muscles and joints get stronger and more flexible. In accordance with the movement and posture, the respiration is likewise modified. Consequently, Suryanamaskar promotes blood circulation. The endocrine system is affected by this. It sharpens our intelligence and increases our vigilance and energy [18]. Komal et al. an improvement in metabolic state, more effective musculoskeletal and cardiorespiratory systems, and decreased fat mass can all occur simultaneously. It seems that low to moderate level endurance exercise is likely to produce

equivalent positive metabolic effects as high intensity exercise, if the increase in energy expenditure is substantial [19].

Changes in Reproductive

According to Dr SD Archana By practicing Suryanamaskara it give effective to both the male and female reproductive systems. The uterus and vaginal walls' supporting muscles are strained. This facilitates labor without pain .The pelvic area's blood flow is boosted, which has the effect of toning the ovaries. Menstrual pain and irregular menstruation are reduced as a result [20].

Table 5: Metabolic function.

Author	Year	Sample size	Variables selected	Findings
Rajni Nautiyal	Mar 2016	30	Digital weighing machine	The study shows that by practicing of Suryanamaskara for the duration of one month helps to reduce their weight in obese persons.
Komal A Jakhotia et al	2015	119	Circuit training (CT), Treadmill (TM) walking and Suryanamaskar (SN) training	CT and SN were effective in enhancing upper limb muscle endurance and cardio-respiratory fitness. But for managing fitness and weight, three strategies worked well. Only SN was helpful in increasing body flexibility,

Table 6: Reproductive changes.

Author	Year	Sample size	Variables Selected	Findings
SD Archana	Feb 2018	30	Numeric pain intensity scale (NPI), BMI (Body Mass Index).	Practice of Sun salutation alone helps reduce the intensity of pain and improve the symptoms in primary dysmenorrhea.

CONCLUSION

This narrative review conclude that sun salutation is an ancient knowledge of India which provides physiological and spiritual health by affecting different activities of human body based on body, mind and breath concept. Sunsalutation helps on all the

five dimensions of our body strengthens body, improves vital capacity, lung functions and contractility of the lungs. It creates awareness of mind, tones the muscles and improves hand grip and endurance, reduces the pulse rate and decreases the sympathetic activity causes vasodilatation. Improves memory and activates the brain, correct the menstrual irregularities and

helps in painless labour, stimulate the endocrine glands there by correcting hormonal imbalances, improving the digestive fire and relieving gastric problems, helps in strengthening bones and joints, increase the mental focus and concentration, reduce depression, anxiety, stress and helps in transformation spiritually by working on so many energy centres. Thus sun salutation can be used as one of the effective method for preventive and curative benefits on health.

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