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A Comprehensive Narrative Review of Surya Namaskar and Associated Health Benefits

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ABSTRACT:

BACKGROUND: *Suryanamaskar* or Sun Salutation, is an ancient yoga sequence of twelve postures that provides a full-body workout, stretching the spine and stimulating vital organs. Originating from the Indus Valley civilization, it has recently attracted scientific interest for its numerous health benefits, such as improved heart and metabolic health, increased flexibility, and stress relief. The advent of tele-yoga, offering online yoga sessions, has shown to be effective and convenient. This review highlights the wide-ranging health advantages of *Suryanamaskar* underlining its importance in enhancing overall well-being and fitness.

AIMS: This review aims to assess the qualitative and quantitative health benefits of *Suryanamaskar* evaluate its impact on reducing health issues through clinical trials, and raise awareness of its health advantages among the general population.

METHODS: An electronic, online search was conducted of the literature published between 2001 and 2024 from Google Scholar, PubMed, ResearchGate, Semantic Scholar, Cochrane, Medline, ScienceDirect, BASE, EBSCO, DOAJ and related health resources websites to address the aims of this study.

RESULTS: Thirty-nine primary research articles were selected based on the aims and inclusion criteria of this study. The studies revealed that improved hip and trunk flexibility, stabilized thyroid and cortisol levels, sharpened attention and memory, and enhanced cardiovascular and pulmonary functions was seen in individuals who performed Surya namaskar. Additionally, *Suryanamaskar* reduces stress, anxiety, and depressive states, and is effective in promoting weight loss and cardiovascular endurance.

CONCLUSION: *Suryanamaskar* offers numerous health benefits, including improved flexibility, hormone balance, cognitive functions, and physiological health, while reducing stress and aiding in weight loss. This comprehensive practice enhances both physical and mental well-being, making it a highly effective exercise regimen.

KEYWORDS: *Surya namaskar*, sun salutations, review, flexibility, weight loss, physiological benefits, psychological benefits, hormone levels, *yoga.*

INTRODUCTION:

'*Suryanamaskar'* also 'sun salutation' a series of active poses, is considered neither an *Asana* nor a part of traditional Yoga. [1] India has an ancient and rich tradition of yoga practice. In recent times, Yoga is gaining attention and increasing scientific interest from healthcare professionals. [11] Yoga is believed to be 4000 to 8000 years old with its origins in the Indus Valley civilization in the northwestern part of India.

[12] *Suryanamaskar* is a complete physical exercise that is believed to be Conceived and propagated by the King of *Aundh*, Late *Shrimant Balasaheb Pant Pratinidhi* in the 1920s [1] *Suryanamaskar i*s a series of 12 physical postures made up of a variety of forward and backward bends [2]. '*Surya*' signifies the sun and *'namaskar'* implies bending down in with Appropriate structures. *Suryanamaskar* is an ancient method of practice or a type of yogic exercise [3]. *Surya Namaskar* is typically performed early in the morning, facing the rising sun. It consists of twelve steps, each with a specific posture, breathing pattern (inhalation or exhalation), and *mantra.* [5]

The series gives such a profound stretch to the body that it is considered a complete yoga practice [3] The following asanas are done in a sequential manner step by step as follows: 1. *Pranamasana* (prayer pose), 2. *Hasta Utthanasana* (raised arms pose), 3. *Padahastasana* (hand to foot pose), 4. *Ashwa Sanchalanasana* (equestrian pose), 5. *Parvatasan* (mountain pose), 6. *Ashtanga Namaskara* (salute with eight parts or points), 7. *Bhujangasana* (cobra pose), *Parvatasana (*mountain pose), 8. *Ashwa Sanchalanasana* (equestrian pose), 9. *Padahastasana* (hand to foot pose), 10. *Hasta Utthanasana* (raised arms pose), 11. *Pranamasana* (prayer pose)[1]. There are twelve names of Lord Sun (*Surya*) which are recited with or without *beeja mantra*, one by one before each round of *Surya Namaskar*. Those mantras are: 1. *Om Mitraya namah 2. Om Ravaye namah 3. Om Suryaya namah 4. Om Bhanve namah 5. Om khagaya namah 6. Om pushnaye namah 7. Om hiranyagarbhaya namah 8. Om marichaye namah 9. Om Adityaya namah 10. Om Savitre namah 11. Om Arkaya namah 12. Om Bhashkaraya namah [8]*

There are various disciplines of *Suryanamaskar* namely, The twelve-step way to health (BSY tradition), *Krishnamacharya Vinyasa* Yoga tradition, *Sivananda* Yoga *Vedanta Centre tradition, Swami Vivekananda Kendra tradition [1].*

"Tele-yoga" is an online yoga teaching method approved by the Ministry of AYUSH as an alternative to in-person yoga during the COVID-19 pandemic, and it will remain useful afterward. Telehealth is an emerging concept to provide healthcare globally. Moderate yoga therapy delivered through tele-yoga has proven to be feasible, effective, cost-effective, and suitable for adults. [9] *Chandranamaskar* is a late 20th-century invention with 14 positions corresponding to the fourteen lunar phases. The lunar energy flows through *Ida nadi*, known for its cool, relaxing, and creative qualities. *Ida* represents the negative, feminine, or mental force responsible for consciousness. [17]

It is suggested that performing *Surya Namaskar* (SN) at varying speeds offers different benefits: if done quickly, it warms up the body and acts as a cardio tonic, while done slowly, it strengthens and tones muscles. [5] Hagins et al. reported that yoga practice incorporating SN for more than 10 min may constitute some portion of sufficient intense physical activity and can improve Cardiorespiratory fitness in unhealthy or sedentary individuals. [6] For most people, nowadays lifestyle accentuates mental tensions and there are many difficult problems, including personal relationships, economic issues, and threats of war and destruction. [7]. Memory and selective attention are important skills for academic and professional performance. [10] Yoga exercises gently tone and shape the body, improve posture, flexibility and contribute to feeling of well-being [2] The movements in the series stretch the spine and entire body, stimulating vital organs with forward and backward bends, benefiting older adults' range of motion. [3] Yoga practices induce relaxation in the mind-body system, counteracting the influence of stress conditions that may lead to excessive cortisol secretion and alter thyroid axis function, thereby affecting sympathetic activity and immune response. [9] Obese female individuals showed a significant reduction in anthropometric measures suggesting *Suryanamaskar* can be a useful method for weight control and physical fitness and cardiorespiratory fitness management. [14]

This narrative review is particularly important in context of *Suryanamaskar* because there is a lack of presence of all the health benefits provided by *Suryanamaskar* under one single heading. With this background, the present review has been done to assess the qualitative and quantitative health benefits of *Suryanamaskar*.

AIMS AND OBJECTIVES:

1. To assess the qualitative and quantitative health benefits of performing *Suryanamaskar*.
2. To review the decrease in health issues caused by performing *Suryanamaskar* through clinical trials.
3. To increase the awareness about the health benefits of *Suryanamaskar* among general population.

MATERIALS AND METHODS:

STUDY TYPE: The present article is a narrative review of various research papers published on *Suryanamaskar* and its health benefits.

STUDY DESIGN: An Electronic and Online Search of the literature published from 2001 to 2024 was made to address aims 1 and 2 from various online research resources.

STUDY DURATION: 15 days

METHODOLOGY:

Data sources and search strategy

An electronic and online search was made to retrieve articles from PubMed, Medline, Cochrane, Research Gate, Science Direct, etc. on clinical trials of *Suryanamaskar* that highlighted its various health benefits. The following terms were searched: *Suryanamaskar* Health benefits, Dynamics of *Suryanamaskar* etc. with appropriate Boolean operators. In the beginning, there were no limitations or restrictions on research concerning journal type, articles' themes, year, region, nationality of author, etc. Initially, it was started searching the pertinent articles on the search engine, namely Google search or Google. Further, it was continued by searching in various scientific databases like Google Scholar, PubMed, ResearchGate, Semantic Scholar, Cochrane, Medline, ScienceDirect, BASE, EBSCO, DOAJ, etc. The author even went through all the reference lists collected from each article to get more additional studies. The study was further delimited with the year of publications from 2001 to 2024.

The search yielded a total of 315 articles for screening. Articles were included if they met the following inclusion criteria: published, peer-reviewed, experimental, interventional studies of human subjects that addressed both *Suryanamaskar* and its qualitative and quantitative health benefits. We excluded editorials, commentaries, letters to the editor, and studies focusing on infants and children below 10 years of age. The most common reason for these exclusions was that the studies did not meet the given interest. After a review of the 123 remaining articles, abstracts and their reference lists from the search, we excluded 71 articles that were not related to our objectives. After retrieving the full-length articles, we assessed 52 full-text journal-based articles to assess for quality of evidence and further evaluation was done by peers.

REVIEW OF LITERATURE:

Table 1: *Suryanamaskar* and associated Flexibility gains:

Sr. No	*AUTHOR*	PARTICIPANTS	INTERVENTIONS	OUTCOME MEASURES	RESULTS
	Krisitine Fondran [18] (2008)	30 male and female subjects aged 20-55 years having minimal exposure to mind-body and yoga related classes	• 2 SN= morning and evening • Each routine= 8 rounds (15 minutes) • 5 times/ week • 6 weeks	• Hamstring Flexibility • Upper body Muscular endurance • Perceived well-being	• Significant change in hamstring flexibility and Upper body muscle endurance (both increased significantly)
	Gauri Shankar and Bhavita Pancholi [12] (2011)	80 male and female subjects aged 18-40 years	• 2 SN /day, Morning and evening • 10 minutes /day • 10 rounds /day • 7 days /week • 2 weeks	• Flexibility	• Flexibility increased than control group.
	Arpana Regmi and Diker Dev Joshi [2] (2020)	10 male and female subjects aged 18-25 years tested positive for limited flexibility with normal BMI	• 4 SN in 1 session • Each pose= 5 seconds • One cycle= 60 seconds • Cool down= 2 minutes • 3 times/week 4 weeks	• Hip Adductor Flexibilty	• An improvement in hip adductor flexibility was seen in the test subjects after intervention of *Suryanamaskar*
	S Chidambara Raja [3]	30 male subjects aged 50-60 years	Group 1 = SN • 2 times /day	• Trunk Flexibility	• Trunk flexibility was

	(2023)		• 6 days /week • 12 weeks • Group 2 = Control		seen increased significantly.
Abbreviations: *SN: Suryanamaskar*					

Table 2: *Suryanamaskar* and Hormone Levels balance:

Sr. No	***AUTHOR***	**PARTICIPANTS**	**INTERVENTIONS**	**OUTCOME MEASURES**	**RESULTS**
	Meagan Henneken s [47] (2018)	9 subjects aged 21-30 years	• SN • 70 minutes /day • 48 hours gap between 1st and 2nd day • 2 weeks gap between 2nd and 3rd day • 2 weeks gap between 3rd and 4th day	• Acute Salivary Cortisol Levels in response to yoga speed (SSY, HSY, SLSY)	• Yoga effectively provided an acute way to mitigate cortisol within female nursing student.
	Sunitha M. et. al. [46] (2023)	50 females aged 35-50 years	• SN as a part of warmup • 1 hour /day • 4 days/ week • 24 weeks	• T_3 • T_4 • TSH	• Increase in T_3, T_4 and TSH is seen • Good balance and improvement in thyroid hormone
	Savithri Nilkantham et. al. [9] (2023)	120 primary hypothyroid subjects aged 18-60 years with controlled co-morbidity (DM, HTN, BMI≤40)	• SN • 60 minutes/day • 6 days /week • 6 months	• SF-36(HRQOL) • T_3, T_4 and TSH • BMI • BP	• Yoga intervention could be effective in dose reduction in levothyroxi

				• Fatigue level • Perceived stress • Sattva, Rajas, Tamas	ne administration to maintain euthyroidism • Hence, drug related side effects.
	Pushpa Lamba et. al. [13] (2023)	30 male medical students aged 18-21 years	• SN • 3 rounds (12 poses in 1 round) • 30 minutes /day • 6 weeks	• Serum cortisol level • Pulse rate • Blood pressure • Heart rate variability (HRV)	• Decreased Serum cortisol level (indicating reduces stress) • Mean pulse rate and mean heart rate decreased.
Abbreviations: SN*: Suryanamaskar SSY:* standard speed yoga, HSY: high speed yoga, SLSY: slow speed yoga, T_3: Triiodothyronine, T_4: Tetraiodothyronine, TSH: thyroid stimulating hormone, SF-36(HRQOL): Short Form Health Survey-36 (health-related quality of life), BMI: body mass index, BP: blood pressure, HRV: Heart rate variability					

Table 3: *Suryanamaskar a*nd associated cognitive functions gains:

Sr. No	***AUTHOR***	**PARTICIPANTS**	• **INTERVENTIONS**	• **OUTCOME MEASURES**	• **RESULTS**
1.	*Vineet Kumar Sharma and Jayshree Acharya [10] (2016)*	36 adolescent males aged 13-15 years	• SN • 45-50 minutes/ day • 5 days /week • 6 weeks	• Memory • Selective attention	• Significant difference found in DLST performance of adjusted mean of mantras

					and control • No significant difference between the adjusted means of mantras and breathing and breathing and control group.
2.	*Satyanath Reddy Kondidala et. al. [11] (2022)*	85 students aged 18-25 years	• SN • 60 minutes/ day • 6 days /week • 3 months (12 weeks)	• Cognitive function: -Memory -attention and orientation -fluency -visuospatial function	• Significant improvement in cognitive functions.
Abbreviations: *SN: Suryanamaskar DLST: digit-letter substitution test*					

Table 4: *Suryanamaskar* and Physiological advantages

Sr. No	***AUTHOR***	**PARTICIPANTS**	**INTERVENTIONS**	**OUTCOME MEASURES**	**RESULTS**
1.	*B. Sinha et. al. [19] (2004)*	21 male volunteers aged (21.7±1.4 years)	• SN • 3 minutes 40 seconds	• VCO_2 • f_R • V_T	• SN is a special set of yogic

			• 6 days /week • 3 months	• V_E • HR • O_2 pulse • RER • EQO_2 • $EQCO_2$	asanas having both static and stretching and dynamic muscular exercise
2.	*Kristine Fondran [18] (2008)*	30 male and female subjects aged 20-55 years having minimal exposure to mind-body and yoga related classes	• 2 SN= morning and evening • Each routine= 8 rounds (15 minutes) • 5 times/ week • 6 weeks	• HR • Blood Pressure (Systolic and Diastolic)	• No significant change in SBP, DBP.
3.	*Anand Balayogi Bhavnani et. al. [4] (2011)*	42 students studying in 8th standard (14 years)	Group 1 FSN -each pose=2 minutes -15 rounds=30-40 minutes -After 2 weeks, perform the same for 6 months Group 2 FSN -each pose=30 seconds -1 round= 6 minutes -15 rounds=30-40 minutes -After 2 weeks, perform same for 6 months.	• Pulmonary Functions • Respiratory pressure • Handgrip strength • Endurance • Resting Cardiovascular parameters	Group 1 FSN -increased IHG, HGE, MIP, PEFR, FVC. FEV_1 and DP, MP, PP, RPP, DOP Group 2 SSN -increased IHG, HE, MIP, MEP, PEFR, FVC, FEV_1 and PP. -decreased DP, HR, MP, RPP, DOP.
4.	*Gauri Shankar and Bhavita Pancholi [12] (2011)*	80 male and female subjects aged 18-40 years	• 2 SN /day, Morning and evening • 10 minutes /day	• Endurance • SBP • DBP	• Endurance increased than control group

			• 10 rounds /day • 7 days /week • 2 weeks	• Heart Rate	• SBP decreased than control group • DBP decreased than control group • HR decreased than control group.
5.	*Dr. Vikas C. kothane et. al. [5] (2013)*	Healthy male aged 18-25 years	Initially SN: -1 round=6 minutes -5 rounds=30-40 minutes Finally, SN -15-20 rounds=45 minutes -1 month	• Pulmonary and Cardiovascular functions	• A few weeks of disciplined yoga practice can lead to improvement in physiological and psychological functions.
6.	*Anand Balayogi Bhavanani et. al. [20] (2013)*	• 21 female volunteers with yoga background • 19 female volunteers withou	• Aruna SN • 3 rounds /day	• HR • ART (Auditory reflex time) • VRT (Visual reflex time)	• HR increased significantly • Decreased ART and VRT significantly

		t any previous background			• RT is based significantly.
7.	*P. Shyam Karthik et. al. [15] (2014)*	50 students aged 17-19 years	• SN • 30 minutes /day • 2 months	• VC • TV • FRV • Breath Holding Test (BHT) • 40 mm endurance • PEFR	• VC, TV, FRV, BHT, 40 mm endurance, PEFR increased significantly • SN improves pulmonary functions.
8.	*Biswajit Sinha, Tulika Dasgupta Sinha [6] (2014)*	9 male army soldiers with mean age (22.3±1.31 years)	• SN • 3 minutes 40 seconds • 5 days /week • 11 months	• VO_2 • HR • O_2P • VCO_2 • V_E • f_R • V_T • EQO_2 • $EQCO_2$	• VO_2 decreased in 3rd phase • HR decreased in 3rd phase • O_2P decreased in 3rd phase • VCO_2 decreased in 2nd phase also in 3rd phase

					• V_E decreased in 3rd phase • f_R did not reduce significant • V_T decreased in 3rd phase • EQO_2 increased in 3rd phase • $EQCO_2$ increased in 2nd and 3rd phase
9.	*Rajak Chanda et. al. [22] (2016)*	60 male students aged 18-22 years	• SN along with Nadishodhana and Pranayam with omkar chanting and meditation • Each session= 60 minutes • 2 times/day • 3 months	• Basal Mean Tidal Volume • Mean Vital Capacity • Mean Forced Expiratory Volume in 1 second (FEV_1) • Mean Respiratory rate /min	• BMTV, MVC, $MFEV_1$, Rate of Respiration were increased significantly.

10.	*Priyanka Singh et. al. [23] (2017)*	40 medical students aged 18-30 years	Group 1 = 20 individuals -SN=5 minutes/day -6 weeks Group 2 = 20 individuals -Spot Jogging = 5 minutes/ day • -6 weeks	• SBP • DBP • HR • Heart rate variability (HRV) • LF	• SBP decreased • DBP decreased • HR increased • No significant change in VLF and HF • LF decreased a little bit
11.	*Dr. Deepti Wadhwa et. al. [16] (2022)*	• 80 students aged 17-25 years	Group A= SSN -1 round=6 minutes -5 rounds=30 minutes Group B=FSN -1 round=2 minutes -5 rounds=10 minutes • 5 days /week • 4 weeks	• PEFR • BP • Physical Fitness • MHST	**SSN** -PEFR increased -SBP no significant change -DBP decreased significant -MHST increased significant **FSN** -PEFR increased significantly -SBP no significant change -DBP no significant change -MHST increased

					significant change
12.	*Satyanath Reddy Kondidala et. al. [11] (2022)*	85 students aged 18-25 years	• SN • 60 minutes/ day • 6 days /week • 3 months (12 weeks)	• Resting Pulse Rate • BP • Increase in Vital Capacity • MVV • PEFR	• Decreased Pulse rate, SBP, DBP. • Increased VC, MVV, PEFR, VO_{2max}
13.	*Abhishek Bandyopadhyay et. al. [24] (2022)*	7 men with mean age (32.6±1.97) years	• SN • 3 round = 1 minutes • For 5 minutes • For over 2 years	• HR • V_E • Q • SV • % $V0_{2max}$	• SN boosts arteriovenous oxygen difference at high $VO_{2\ max}$ and keeps a low respiratory exchange ratio during exercise.
14.	*Pushpa Lamba et. al. [13] (2023)*	30 male medical students aged 18-21 years	• SN • 3 rounds (12 poses in 1 round) • 30 minutes /day • 6 weeks	• Pulse rate • Blood pressure • Heart rate variability (HRV)	• Mean pulse rate and mean heart rate decreased.
15.	*Rameswar Pal et. al. [21] (2024)*	30 subjects	NYPS and YPS • SN= 12 rounds	• Height and Weight • BMI	• HR, SBP, Pulse Pressure, Double

			• 24 minutes/ day • 5 days/week • 6 weeks	• HR • SBP and DBP • BHT (Breath holding time) • RHGS (Right Hand Grip Strength) • LHGS (Left Hand Grip Strength) • Flexibility • Muscle Mass • Body Fat percentage • Total Body Fat • Bone mass • Waist to hip ratio • BMR	product, Rate pressure product decreased in NYPS. • SBP, DBP, MBP decreased in YPS.

Abbreviations: SN: *Suryanamaskar* VCO_2: carbon dioxide output, f_R : respiratory rate , V_T : tidal volume , V_E : pulmonary ventilation , HR: Heart rate , RER: respiratory exchange ratio, IHG: isometric hand grip , HGE: hand grip endurance , MIP: Maximum inspiratory pressure, MEP: maximum expiratory pressure, PEFR: peak expiratory flow rate, FVC: Forced vital capacity, FEV_1: forced expiratory volume in 1st second, BP: blood pressure, DP: diastolic pressure, SP: systolic pressure, MP: mean pressure, PP: pulse pressure, RPP: rate pressure product, Do P: double product, VC: vital capacity, TV: tidal volume, FRV: functional residual volume, SSN: slow *Suryanamaskar* FSN: fast *Suryanamaskar* MVV: maximum ventilatory volume, Q: cardiac output, SV: stroke volume, % $V0_{2max}$: maximal oxygen uptake percentage, BMI: body mass index, NYPS: Non Yoga Professional Surya Namaskar group, YPS: Yoga Professional Surya Namaskar group

Table 5: *Suryanamaskar* and Psychological advantages:

Sr. No	*AUTHOR*	PARTICIPANTS	INTERVENTIONS	• OUTCOME MEASURES	• RESULTS
1.	*Kuntal Thakur [29] (2013)*	60 male subjects aged 10-12 years	Gr. S • SN • 90 minutes /day • 4 days /week • 3 months Gr. C • Act as control group	• Self-concept • Attitude	• Improvement in self-concept was seen • Improvement in attitude was seen.
2.	*Anand Sharad Godse et. al. [30] (2015)*	80 students aged 17-22 years	Group 1 = 40 subjects • 13 rounds • 20 minutes /day • 14 days Group 2 = 40 subjects Acted as Control group	• R-dispositions -Mental quiet -At ease /pace -Rested and refreshed -Strength -Awareness -Joy • Stress dispositions -somatic stress -worry -negative emotions	• *Suryanamaskar* is seen being effective in leading to R-dispositions like mental quiet, at ease/peace, rested and refreshed, strength and awareness and joy. • *Suryanamaskar* group was seen being lower compared with the control group on the stress dispositions–somatic stress, worry, and

					negative emotion
3.	*Dr. V. Parthiban [27] (2019)*	90 female subjects aged 20-25 years	• Group I =Yogasana. • Group II = surya namaskar • Group III = control group • 6 days /week • 8 weeks	• Anxiety • Study skills	• Significant improvement in study skill and reduction in Anxiety due to Yogasana and Surya Namaskar as compared with control group.
4.	*Niranjan Parajuli et. al. [25] (2021)*	63 (24 male and 39 female) with mean age (14.24±0.42) years. Finally, 56 participants were able to complete the study.	• SN = 1 hour • 6 days /week • 2 weeks	• Self-control • Mindfulness	• SN improved self-control and mindfulness in adolescent school children.
5.	*Sharayu Agre et. al. [33] (2021)*	120 adolescent subjects aged 16-18 years	• SN • 13 rounds • 14 days	• Stress S dispositions - Sleepiness - Disengagement -Mystery -Timeless -Somatic Stress -Worry -negative emotions	• The SN intervention has made a significant difference in reducing Stress disposition • The SN intervention has made significant difference in improving R dispositions. • Altogether Stress is seen

				• Relaxations R dispositions -Physical Relaxation -Mental Quiet -At Ease/peace -Rested and Refreshed -Strength and Awe -Joy -Love and thankfulness -Playfulness -Childlike behaviour -Awe and wonder	reduced in these students.
6.	*Dr. K. Jaiganesh et. al. [28] (2022)*	45 high school students aged 12-15 years	Group 1=SN with yognidra • 1 hour /day • 5 days /week • 6 weeks Group 2=SN without yognidra • 1 hour /day • 5 days /week • 6 weeks	• Stress	• Stress can be better managed in students when yoga nidra is practiced along with *Suryanamaskar* rather than *Suryanamaskar* alone.

			Group 3=control group • Did not participate in any such activities, only performed day-to-day activities.		
7.	*Pratiksha Karwa [26] (2022)*	40 girls diagnosed with PCOS aged 18-25 years	SN (group 1): • 12 postures of SN • Each posture =30 secs • Each round = 6 mins. • 5 rounds • 5 rounds = approx. 30-40 minutes. • Started the SN postures with breathing awareness (each posture =	• Perceived Stress	• SN is more effective than resistance training in stressed subjects in PCOS.

			30 seconds) • Ended with cool down exercise- Pranayama, Meditation • 4 weeks Resistance Training (group 2): • Multi joint resistance exercises with TheraBand. • Exercises performed- leg curl, bicep curl, triceps extension, hip flexion, hip extension, leg extension, Lat. Shoulder raises, shoulder press,		

			chest press. • 8 repetitions of each exercise • 2 sets /day • 4 weeks		
8.	*Sharvari Joshi et. al. [34] (2022)*	30 study subjects	Group A • Aerobic exercises • 30 minutes/ day • 5 days/week • 4 weeks Group B • SN • 30 minutes/ day • 5 days/week • 4 weeks	• Stress • Resting Heart Rate • SBP • DBP	• SN is found more beneficial in reducing stress levels as compared to Aerobic Exercises.
9.	*S Chidambara Raja [3] (2023)*	30 male subjects aged 50-60 years	Group 1 = SN • 2 times /day • 6 days /week • 12 weeks • Group 2 = Control	• Depression	• Depression was seen decreased significantly.
10.	*Boonsita Suwannakul et. al. [31]*	44 female subjects aged 19-22 years	Group 1 = Exercise group • SN	• Perceived Stress • Trunk Flexibility	• Perceived Stress was seen in the Exercise group.

	(2023)		• 50 minutes /day • 8 weeks Group 2 = Control group • Did not perform any exercise		• Trunk Flexibility was seen improved in exercise group.
11.	*Krzysztof Stec et. al. [32] (2023)*	105 subjects with median age (17.15±1.42) years	4 groups Group I and III • DSN • 50 minutes • 6 times /week • 12 weeks Group II and IV • Acted as control group	• Perceived Stress • Emotional Intelligence	• Perceived Stress was seen lowered in DSN • The level of Emotional intelligence was seen raised.
• **Abbreviations:** SN: *Suryanamaskar* R: relaxation, DSN: dynamic *Suryanamaskar* SBP: systolic blood pressure, DBP: diastolic blood pressure, PCOS: polycystic ovarian syndrome					

Table 6: *Suryanamaskar* and Weight Loss efficacy:

Sr. No	***AUTHOR***	**PARTICIPANTS**	**INTERVENTIONS**	• **OUTCOME MEASURES**	• **RESULTS**
1.	*Rajni Nautiyal [8] (2016)*	30 subjects aged 25-30 years	Group 1 = 15 subjects • Exercise group • SN • 60 minutes/ day • 30 days Group 2 = 15 subjects	• Weight	• Reduction in weight was seen in study subjects after the intervention.

			• Acted as Control group		
2.	*Komal Jakhotia et. al. [35] (2015)*	119 female subjects aged 20-40 years	Group 1 • Circuit Training (CT) Group 2 • Treadmill (TM) walking Group 3 • Modified SN • 1 step/second Group 4 • Acted as Control Groups -8 weeks	• Body composition, • cardio-respiratory • muscle endurance • flexibility	• SN, CT and TM training were found to be more effective in weight management. • SN was particularly more effective in increasing Flexibility • SN and CT were more effective in improving upper body muscle endurance and cardiorespiratory fitness.
3.	*Geetarani Devi et. al. [14] (2024)*	60 subjects aged 18-30 years	Group 1 = 30 individuals • SN and heating Pranayama • 45 minutes/day • 5 days/week • 4 weeks Group 2 = 30 individuals	• BMI • WC • SKF	• Significant decrease in BMI, WC, SKF was seen in Group 1.

			• Acted as control groups		

- **Abbreviations:** SN: *Suryanamaskar* BMI: body mass index, WC: waist circumference, SKF: Skin Fold Thickness, CT: Circuit Training, TM:Treadmill walking

RESULTS:

The final selection altogether consists of 39 research articles out of 52 that met our inclusion criteria for summary of literature review. Table 1 include summaries of the articles synthesized for this paper. Four articles were related to *Suryanamaskar* and Flexibility [2,3,12,18], Four articles were related to *Suryanamaskar* and Hormone level [9,13,46-47], Two articles were related to *Suryanamaskar* and Memory [10-11], Fifteen articles were related to *Suryanamaskar* and Physiological Benefits [4-6,11-13,15-16,18-24], Eleven articles were related to *Suryanamaskar* and Psychological Benefits [3,25-34], Three articles were related to *Suryanamaskar* and either Weight loss or Obesity [8,14,35]. Six articles were review of *Suryanamaskar* and its various health benefits [1,36-40].

***Suryanamaskar* and associated Flexibility gains**:

The finding from clinical and interventional studies have revealed strong association between performance of *Suryanamaskar* and Hip Adductor Flexibility [2], Trunk Flexibility [3] and Upper Body Muscle Endurance [18] (Table 1-A). Researchers have investigated how *Suryanamaskar* and Flexibility are related. In cross sectional studies using a small population data, an increase in Hip Adductor Flexibility is seen in adults, comparing pre- and post-test mean scores of the Bilateral PHA test showed a significant improvement with *Suryanamaskar* practice ($p<0.05$). [2]. For instance, study conducted by S Chidambara Raja found that trunk flexibility was seen increased in the group performing *Suryanamaskar* than the control group ($p<0.05$). Similar results were found in other studies also. [48-52]

***Suryanamaskar* and Hormone Levels balance:**

There is a strong relationship between *Suryanamaskar* and Hormone Levels. Table 1-B presents summary of the articles that examined the relationship between *Suryanamaskar* and Hormone Levels. The findings revealed that the stability of Hormone levels in groups performing *Suryanamaskar* is higher [46], and individuals who perform *Suryanamaskar* have stable Thyroid hormone, as seen in one clinical trial, one famous RCT on Tele-yoga by Savithri Nilkantham et. al. found that Yoga intervention could be effective in dose reduction in levothyroxine administration to maintain euthyroidism [9]. For instance, clinical studies provide evidence that *Suryanamaskar* intervention [13,47] can lower the stress by mediating the levels of cortisol hormone.

***Suryanamaskar* and associated cognitive functions gains:**

Individuals with issues of cognitive performance can show improvement in the same. For instance, significant improvement in Selective attention was seen in group which performed *Suryanamaskar* accompanied by Mantras in a study conducted by Sharma and Acharya [10]. Similarly, significant improvement in Attention, memory and visuospatial functions was seen in a study performed by Satyanath Reddy Kondidala et. al. [11]

***Suryanamaskar* and Physiological advantages**:

The findings from the studies demonstrated a connection between performance of *Suryanamaskar* and physiological factors including Pulmonary and Cardiovascular functions. Decrease in Heart Rate [4,6,21], increased Heart Rate [20-23], significant change in Systolic and Diastolic Blood Pressure [11,12,16,21,23] and increased PEFR [4,16] was also found in some of the interventional studies. Also, no significant change in SBP and DBP was also reported in one study [18]. Increase in pulmonary functions like increased FVC and FEV_1 is also seen in some studies. [4,22] Additionally investigators have also found significant association between performance of *Suryanamaskar* and various Cardiovascular and Pulmonary functions.

***Suryanamaskar* and Psychological advantages:**

We summarized the interventional studies examining the relationship between *Suryanamaskar* and Psychological Benefits in Table 1-E. The findings suggest that decrease in stress levels can be achieved by performing *Suryanamaskar*. [26,28,30,31-34] Similarly, decrease in depressive state [3] and improved study skills and reduced anxiety [27] is also seen in those who perform *Suryanamaskar*.

One interesting result was seen in a study performed by Krzysztof Stec et. al. in which the level of emotional intelligence was seen elevated. The levels of perceived stress were lowered significantly in others. [32]

***Suryanamaskar* and Weight Loss efficacy:**

Studies show that performance of *Suryanamaskar* for more than 2 weeks can depict surprising results in case of obese individuals. The effectiveness of *Suryanamaskar* (either accompanied by mantras or performed individually) has been tested in some obese individuals but not all. Table 1-F shows the results of interventional studies investigating the same. One study [35] that compared the effectiveness of *Suryanamaskar* in comparison with Treadmill walking and Circuit Training found out that *Suryanamaskar* was more effective in increasing both Flexibility and Cardiovascular endurance and equivalent to Circuit Training in increasing Cardiorespiratory fitness.

Another study in a 60 kg individual reported the expenditure of 230 kcals of energy/30 min practice session with four rounds of *Suryanamaskar*. Total energy consumption of 13.91 kcal with an average of 3.79 kcal/min for one complete round of *Suryanamaskar* was observed in male volunteers from the Indian Army. Oxygen consumption was reported to be the highest while in *Bhujangasana [1]*.

DISCUSSION:

In this review, we found that there are various health benefits of performing *Suryanamaskar* which include increased Flexibility, balance of hormone levels, improvement in cognitive functions and memory, improvement in Physiological qualities like Cardiovascular and Pulmonary functions (which in turn include Heart rate, Systolic and Diastolic Blood Pressure, Forced vital capacity, Forced expiratory volume in the first second, Pulse Pressure, VO_2, etc.), reduction in perceived stress and depression and weight reduction (in obese individuals). A number of predominantly small trials have assessed the effect of *Suryanamaskar* on the above-mentioned factors. The studies included are heterogenous, include a variety of different study subjects and few are randomized controlled trials.

Our narrative review reveals that *Suryanamaskar* has a wide spectrum of benefits in almost every portion of body. This link could be explained by three mechanisms: 1) strengthening of respiratory muscles, 2) a

combination of forward and backward bends 3) duration of yoga training. [41] First, systematic inhalation and exhalation of air during the particular step signifies the importance of clearance of air passage and increase of Pulmonary Capacities. The increase in pulmonary capacities is facilitated by conscious increased uptake of air from the surrounding, preferably in the morning hours. Repeated deep breathing exercises, like those in pranayama, can maximize the shortening of inspiratory muscles, improving lung functions. Many authors agree with this. [41] Second, the practice of *Suryanamaskar* is known to decrease the mean arterial blood pressure by unknown mechanism, but can be hypothesized as it may decrease the sympathetic drive, and can cause neurohumoral effects by resetting the baroreceptors. [42] By calming the mind through yoga, we can live more consciously, improving our lives and reducing suffering. [43] and thus it helps in reducing the perceived stress, depression and increased selective attention and cognitive functions (including memory and decreased reflex time). Regular practice of sun salutation balances the *pingala nadi's* (right nostril) energy flow, promoting overall mental and physical harmony. [7]

The exact mechanism of hormonal balance achieved by Yoga and *Suryanamaskar* is not known, yet it can be postulated that by systematic movements in yoga and *Suryanamaskar* in addition with the massaging effect of the breathing techniques can stimulate the blood flow to the glands and/or the muscles. Studies show that yoga effectively influences the autonomic nervous system. It helps regulate the secretion of stress hormones like cortisol and catecholamines, enhances parasympathetic activity, and lowers the metabolic rate. Yoga helps to downregulate the hyperactivated HPA axis, which is triggered by stress, leading to an imbalance between the sympathetic and parasympathetic systems. This chronic state of heightened alertness can cause stress-related diseases like diabetes, depression, obesity, and cardiovascular issues. This sense of stress is reduced by yoga. [44]

A study performed by Jakicic et. al. [45] suggests that adding restorative hatha or vinyasa yoga to a weight-loss program could help treat obesity or being overweight. Hence obesity can be managed by Yoga and *Suryanamaskar*.

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IMPLICATIONS:

A comprehensive review of Surya Namaskar reveals its extensive health benefits, including improved physical and mental well-being, chronic disease management, and the preventive health measures. It promotes cultural awareness and community building, supports the integration of yoga into health systems, and identifies areas for further research. Educational programs can leverage these findings, and policymakers may promote yoga practices through public health initiatives. Moreover, widespread adoption of Surya Namaskar can potentially reduce healthcare costs, highlighting its economic significance.

RECOMMENDATIONS:

Studies on *Suryanamaskar* (SN) involving diverse populations demonstrate its multidimensional benefits. Consistent practice (30-60 minutes/day, 5-6 days/week) with a balanced diet enhances these benefits, with both morning and evening sessions showing positive outcomes. Flexibility significantly improves with routine practice, enhancing hamstring, hip adductor, and trunk flexibility. Hormone regulation benefits include reduced cortisol and balanced thyroid hormones, aiding stress management and potential medication reduction. Cognitive functions, including memory and attention, show marked improvement in adolescents and young adults. Physiologically, SN enhances pulmonary functions, cardiovascular

health, and endurance, while reducing blood pressure and heart rate variability. Psychologically, SN reduces anxiety, depression and stress, fostering improved emotional intelligence, mindfulness and self-concept. Weight management benefits include significant reductions in body mass index (BMI), waist circumference, and skinfold thickness, with SN proving more effective than traditional exercises in some cases. Hence, practicing *Suryanamaskar* nearly covers all the aspects of health benefits thereby aiding in overall health and fitness management.