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Surya Namaskar: Build and raise physique power, common stamina, health and body work how helpful is?

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Introduction of research paper:

The demand of the 21st century is not simply to achieve medical excellence in healing the patients but also and maybe more importantly to prevent people from getting ill. At present, a major cause of morbidity and mortality is modern lifestyle which includes stress, physical inactivity and high fat diet leading to obesity. These factors manifest themselves as lifestyle diseases such as hypertension, diabetes mellitus and coronary artery disease [1,2].

In Indian culture, yoga has traditionally been a function of the daily routine which is meant for attaining healthy life. Ashtang yoga, as described by Maharishi Patañjali, comprises of 8 stages viz. *yam* (code of conduct, self-restraint), *niyam* (religious observances, commitments to practice, such as study and devotion), *asana*(integration of mind and body through physical postures), *pranayam* (regulation of breath leading to integration of mind and body i.e. controlled breathing), *pratyahar* (abstraction of the senses, withdrawal of the senses of perception from their objects), *dharana* (concentration, one-pointedness of mind), *dhyan*(meditation) and *Samadhi* (the quiet state of blissful awareness, superconscious state). Sun salutation, also called as Suryanamaskar, sun adoration for health, efficiency and longevity is a share of Indian traditional yogic practices [3]. It involves pranayam, asana and upasana i.e. rituals. The sun salutation is perWorked as a cyclical event synchronized with a specific breathing pattern. Each round consists of 10 steps performed consecutively, one after the other. The round begins with Stithi or Pranamasana; the prayer position. It is then pursued by the following steps in a succession. Footfall 1- Hasta Uttanasana, step 2- Padahastasana, Step 3-Dakashinpad Prasarnasan, Step 4- Dwipad Prasarnasan, Step 5- Saashtang Namasakarasan, Step 6-Bhujangasan, Step 7- Parvatasan Step 8- again Dakashinpad Prasarnasan, Step 9- Padahastasana and Step 10- coming back to Stithi. These individual asanas have their own physical benefits [3] e.g. Step 0 and 10 in Fig. 1 induces a state of

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introversion; Step 1 stretches thoracic, abdominal and intestinal musc1 induces a state of introversion; Step 1 Stretches thoracic, abdominal and intestinal muscles and lifts Prana upwards in the torso. her body parts. Measure 4 and 5 tone abdomen, muscles of thighs and legs. Step 6 exercises the spine and strengthens muscles of arms and legs.

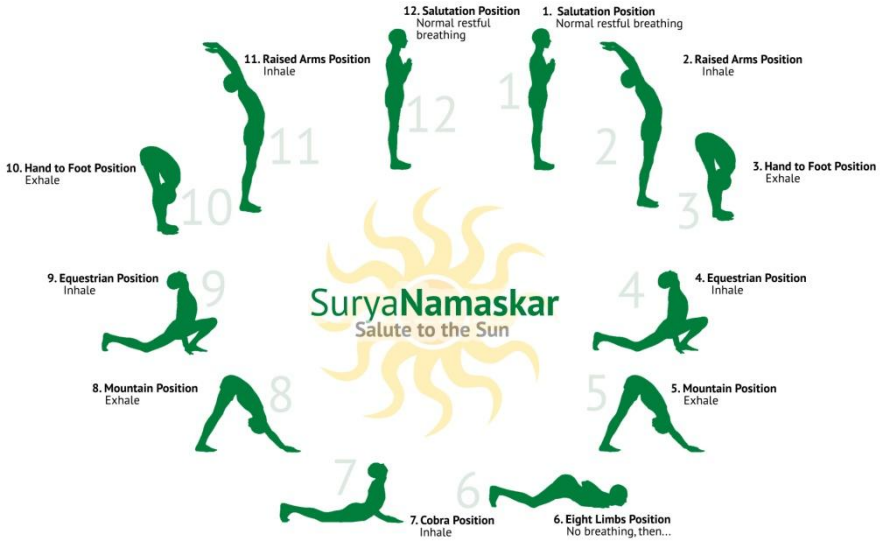

Fig. 1

Steps involved in sun salutation. 0/10: Stithi/ Pranamasana, 1: Hasta Uttanasana 2 and 9: Padhastasan, 3 and 8: Dakashinpad Prasarnasan, 4: Dwipad Prasarnasan, 5: Saashtang Namasakarasan, 6: Bhujangasan, 7: Parvatasan

Step 7 strengthens the muscles of shoulders, arms and chest. All these posters are ordered in such a manner that each step is complimentary to the other. As an example, backward bending alternates with forward bending. This sun salutation becomes a form of action which requires virtually every function of the body and is regarded as a perfect practice. Many of sun salutation practitioners also consider that regular practice of few cycles, when done the right way leads to evolution and toning up of almost every region of the body [4]. Hence, the present study was designed to evaluate changes in muscle strength, gGeneral body endurance and body makeup with regular practice of sun salutation.

Ways and area under discussion

Contributor

The experimental design was sequential self-control study which was conducted between January 2009 and September 2009. Eighty eight medical undergraduate students voluntarily enrolled in the present survey. Those experiencing a story of active sports training, yoga practice, and medical illness such as hypertension, diabetes mellitus, bronchial asthma,

tuberculosis or major surgery in the recent past were kept out from the survey. Informed written consent was obtained from the participants after explaining them the design of the written report, testing procedures and sun salutation training schedule. The survey protocol was approved by the institutional research council and ethics committee.

Seventy nine subjects (49 males and 30 females) completed the survey protocol. Reasons for dropout included transfer to other institutes (n=4), medical problems (n=2), and irregular participation in the training schedule (n=3).

Process

Sun salutation training: Sun salutation training was imparted to the subjects by a trained yoga instructor as per the guidelines of Yoga Vidya Dham, Nashik Maharashtra, India. Exercise sessions were taken between 5.00 p.m. and 6.00 p.m., Monday through Saturday, for a duration of 24 weeks. Each school term started with a prayer followed by Omkar chanting with the appropriate ‘ Bija mantra’ for each sun salutation and the session ended with prayer and shavasana. Subjects performed 6 cycles of sun salutation on the 1st day and the number gradually increased to 24 over the following 15 days. This daily practice of 24 cycles of sun salutation was then performed for 6 days a week and continued for 24 weeks. Disciplines in the study group were asked to go to at least 80% of the sessions to be deliberated in the study analysis.

Experimental protocol: All the tests were performed under standard laboratory conditions after familiarising the subjects with the testing process. Vital information including name, age (17.5-20 years), sex, height and weight of the themes were put down. Height was assessed to the nearest 0.1 cm by using a standard speedometer. In all cases, the parameters described below were measured before the origin of sun salutation practice and after the 24 weeks of regular practice of sun salutation.

Upper body muscle strength: It was valuated by the one repetition maximum (1RM) technique for bench press and shoulder press exercises [5,6]. The 1-RM is defined as the maximum resistance a subject can overcome, using correct form, through a full range of motion, for no more than one repetition. All the nationals were required to lift lighter weights to learn proper technique and minimize muscle soreness for 1 week. Subsequently the 1 week of familiarization, the tester took a light weight and asked the subject to do the facelift. A sleep period of 4 minutes was applied and the procedure was duplicated with a greater weight. With adequate rest periods, the process was continued till 1RM was obtained. The

maximum weight in kg that could be come up perfectly through only one repetition was noted as the intensity. The bench press technique was applied to assess pectoralis strength, whereas shoulder press technique was employed to measure the effectiveness of the triceps and deltoids.

Lower body muscle strength: This was evaluated by using a spinal column and leg dynamometer (Anand Agencies Pvt. Ltd. Pune) [5].

The subject was asked to stick out on the platform of the instrument with knees flexed at 45 points and was instructed to preserve the back square. The view of the rod to be pulled was adjusted so that it could be taken with extended arms at the tier of the thigh. And so the study was required to get out the rod upwards just by knee extension with his entire strength. The interpretation on the dial to the nearest 1 kg was recorded as the lower body muscle strength. (Fig. 2)

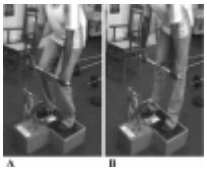

Fig. 2

Leg dynamometry A) Starting position B) Final position

With the back and leg dynamometer strength of the back muscles was found out as follows: Subject was asked to stand with his knees extended and hip flexed at 45 degrees. The view of the rod was adjusted at knee level and he was required to pull the rod by extending his back. The measure of power generated in kg was observed. (Fig. 3)

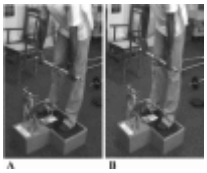

Fig. 3

Back dynamometry A) Starting position B) Final position

General body endurance: It was evaluated by push-up and sit-up tests [5]. Maximum number of pushups and sit-ups which could be performed with the rate of 20/min was recorded.

Body mass index (BMI): It was counted from the stature and weight measurements by applying the formula: BMI=Body weight (kg) /Height2 (m2)

Body composition: Body fat percent was calculated with the help of bioelectrical impedance analysis (Citizen body fat Analyzer BM100, Citizen systems Japan, Co. Ltd., Tokyo). In this

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method a small alternating current is gone through the torso and the resistance offered to the current is noted. This inward turn is connected to body fat percentage based on altitude, weight, age and gender of the depicted object. This method is considered valid and reliable to measure resistance in biological tissues [7]. From percentage of body fat, percentage of lean body mass was estimated.

Perceived level of exertion: Immediately after the seance, the subjects rated the intensity of exercise by Borg scale for evaluation of perceived exertion (RPE) [8]. In this plate, the exerciser rates his perceived feelings about the exertion level on a numerical scale ranging from 6-19 i.e. from very, very light to very, very laborious.

Perform statistical analysis

The data was analysed by NCSS97 software and expressed as mean±SD. Paired t test was applied to compare the values in male and female subjects separately with α value of 0.05. The Wilcoxon Signed-Rank test was applied to the data which was not usually broadcast. Differences in means were considered statistically significant when the two-tailed *P* value was*<0.05*. Also percent changes in all the parameters in both the groups were found out. Unpaired t test and Mann-Whitney U test was applied to test the significance between the groups with α value of 0.05.

RESULTS

In the present work, we found that with regular practice of sun salutation, there was statistically significant improvement in muscle strength and general body endurance in male as well as female subjects (Table 1 and and2). 2). Upper body muscle strength as assessed by bench press method showed statistically significant improvement in male and female subjects.

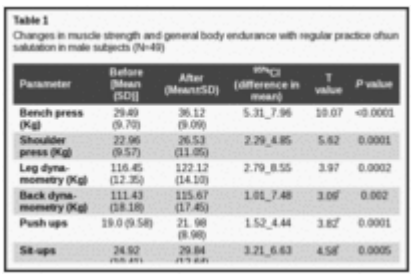

Table 1

Changes in muscle strength and general body endurance with regular practice ofsun salutation in male subjects (N=49)

Parameter	Before (Mean (SD))	After (Mean±SD)	95%CI (difference in mean)	T value	P value
Bench press (Kg)	29.49 (9.70)	36.12 (9.09)	5.31_7.96	10.07	<0.0001
Shoulder press (Kg)	22.96 (9.57)	26.53 (11.05)	2.29_4.85	5.62	0.0001
Leg dyna-mometry (Kg)	116.45 (12.35)	122.12 (14.10)	2.79_8.55	3.97	0.0002
Back dyna-mometry (Kg)	111.43 (18.18)	115.67 (17.45)	1.01_7.48	3.09	0.002
Push ups	19.0 (9.58)	21. 98 (8.98)	1.52_4.44	3.82	0.0001
Sit-ups	24.92	29.84	3.21_6.63	4.58	0.0005

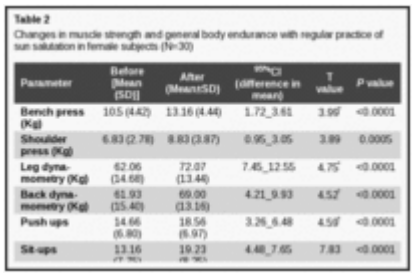

Table 2

Changes in muscle strength and general body endurance with regular practice of sun salutation in female subjects (N=30)

Parameter	Before [Mean (SD)]	After (Mean±SD)	95%CI (difference in mean)	T value	P value
Bench press (Kg)	10.5 (4.42)	13.16 (4.44)	1.72_3.61	3.95*	<0.0001
Shoulder press (Kg)	6.83 (2.78)	8.83 (3.87)	0.95_3.05	3.89	0.0005
Leg dyna-mometry (Kg)	62.06 (14.68)	72.07 (13.44)	7.45_12.55	4.75*	<0.0001
Back dyna-mometry (Kg)	61.93 (15.40)	69.00 (13.16)	4.21_9.93	4.52*	<0.0001
Push ups	14.66 (6.80)	18.56 (6.97)	3.26_6.48	4.58*	<0.0001
Sit-ups	13.16	19.23	4.48_7.65	7.83	<0.0001

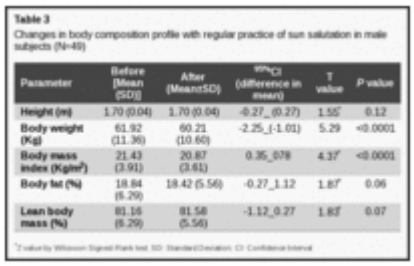

Table 3

Changes in body composition profile with regular practice of sun salutation in male subjects (N=49)

Parameter	Before [Mean (SD)]	After (Mean±SD)	95%CI (difference in mean)	T value	P value
Height (m)	1.70 (0.04)	1.70 (0.04)	-0.27_(0.27)	1.55*	0.12
Body weight (Kg)	61.92 (11.36)	60.21 (10.60)	-2.25_(-1.01)	5.29	<0.0001
Body mass index (Kg/m^2)	21.43 (3.91)	20.87 (3.61)	0.35_078	4.37*	<0.0001
Body fat (%)	18.84 (6.29)	18.42 (5.56)	-0.27_1.12	1.87*	0.06
Lean body mass (%)	81.16 (6.29)	81.58 (5.56)	-1.12_0.27	1.83*	0.07

*T value by Wilcoxon Signed Rank test. SD: Standard Deviation. CI: Confidence Interval

Table 3

Changes in body composition profile with regular practice of sun salutation in male subjects (N=49)

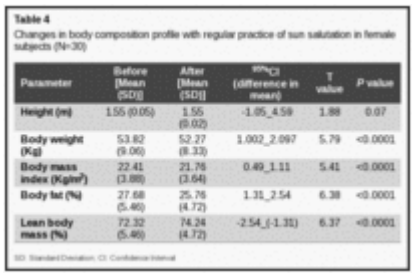

Table 4

Changes in body composition profile with regular practice of sun salutation in female subjects (N=30)

Parameter	Before [Mean (SD)]	After [Mean (SD)]	95%CI (difference in mean)	T value	P value
Height (m)	1.55 (0.05)	1.55 (0.02)	-1.05_4.59	1.88	0.07
Body weight (Kg)	53.82 (9.06)	52.27 (8.33)	1.002_2.097	5.79	<0.0001
Body mass index (Kg/m^2)	22.41 (3.88)	21.76 (3.64)	0.49_1.11	5.41	<0.0001
Body fat (%)	27.68 (5.46)	25.76 (4.72)	1.31_2.54	6.38	<0.0001
Lean body mass (%)	72.32 (5.46)	74.24 (4.72)	-2.54_(-1.31)	6.37	<0.0001

SD: Standard Deviation. CI: Confidence Interval

Table 4

Alterations in muscle strength and general body endurance with regular practice of sun salutation in female subjects (N=30)

Muscle strength by shoulder press was increased in males (t=5.62, *P*<0.001) and females (t=3.89, *P*<0.001). Lower body muscle strength and back muscle strength also showed substantial improvement in males and females. General muscle endurance as tested by pushups and sit-ups improved in males and females.

As indicated in Table 3 and and4, 4, body weight and body mass index (BMI) were cut in both male and female issues. Decrease in% body fat was significant in female subjects only but not in male subjects. Lean body mass (LBM) was increased in both the groups, but the change was important but in female subjects.

As shown in Table 5, more improvement was observed in female subjects than their male counterparts for all parameters. Mann-Whitney U test for unequal variances was used for statistical analysis. Improvement in two groups was significant ($P<0.05$) for back and branch strength, endurance by sit-ups and lean body mass. The Sun salutation session was rated 11 on the RPE (Borg) scale by male subjects which is equivalent to approximately 50% of VO2max exercise intensity, whereas for female subjects RPE was 1 which equates to 75% of VO2max.

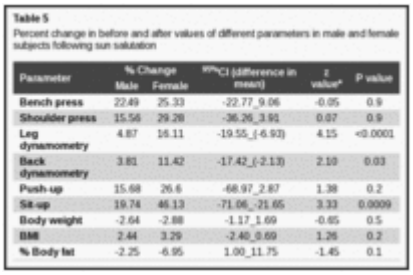

Table 5

Percent change in before and after values of different parameters in male and female subjects following sun salutation

Parameter	% Change		95%CI (difference in mean)	z value*	P value
	Male	Female			
Bench press	22.49	25.33	-22.77_9.06	-0.05	0.9
Shoulder press	15.56	29.28	-36.26_3.91	0.07	0.9
Leg dynamometry	4.87	16.11	-19.55_(-6.93)	4.15	<0.0001
Back dynamometry	3.81	11.42	-17.42_(-2.13)	2.10	0.03
Push-up	15.68	26.6	-68.97_2.87	1.38	0.2
Sit-up	19.74	46.13	-71.06_-21.65	3.33	0.0009
Body weight	-2.64	-2.88	-1.17_1.69	-0.65	0.5
BMI	2.44	3.29	-2.40_0.69	1.26	0.2
% Body fat	-2.25	-6.95	1.00_11.75	-1.45	0.1

Table 5

Percent change in before and after values of different parameters in male and female subjects following sun salutation

Discussion

The theory of the present study was the steady practice of sun salutations improves muscle strength, endurance and body opus. In this study, we revealed a statistically significant gain in upper as well as lower body muscle strength in both male and female groups. The physiologic responses to physical training and yogic practices have been well studied [9]. Yoga training is associated with improvement of muscle strength and respiratory endurance[10]. Earlier studies also observed a statistically significant gain in lower body strength with 8 weeks of yoga practice in informal caregivers; as evaluated by chair stand test [11]. Similar results were found by the other researchers with yoga practice [12,13]. During sun salutation, muscles of the entire body experience stretch and pressure alternately and therefore it is pronounced to make more benefits in short duration of time [4,14]. Many of its poses build strength because they require sustained contractions of mAny muscle groups of the intact body, which is comparable to resistance training [15]. In the present study, more improvement is observed in strength of upper body thA lower body. This might be because of more utilization of upper torso muscles for weight bearing during the stages viz. 4, 6, and 7 of sun salutation.

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General body endurance depends on skeletal muscle characteristics, oxygen intake, its circulation and usage. Performing sun salutation is similar to aerobic exercise as it involves static stretching and slow dynamic component with an optimal stress on cardio-respiratory system [16]. Incorporating sun salutation in a yoga session contributes to the significantly intense physical activity to improve cardio-respiratory fitness in unfit or sedentary individuals [17]. Yogic practices increase muscle strength, oxygen intake, its circulation and utilization [12,18]. With increase in these parameters, sun salutation practice leads to improvement in general muscle endurance.

In the present work, sun salutation practice has passed to decrease in body weight and% body fat and increase in% lean body mass. Yoga practices lead to increase in energy expenditure resulting in statistically significant alterations in body composition [19,20]. Practice of only hatha yoga for 30 min a day increased MET to 2.5 in females. (MET is multiple of resting metabolic rate. 1 MET= oxygen uptake of 3.5 cc/kg/min) But the inclusion of sun salutation in the session increased the MET to 3.74 [21]. Thus sun salutation incorporates a significant aerobic component to the yoga activity. This fact is reflected in the change of body weight and body fat percentage. Still, the changes in% body fat and LBM were statistically significant in females but not in male cases. Body composition as well depends on the diet. In our study, no specific change was suggested in the dietary pattern and the subjects kept their routine diet. Our subjects were undergraduate students and nearly 84% of them were occupying in a lodge. But in our own unpublished study, we have noted that male students residing in hostel consume more junk food and that may be the cause of little change in their body make-up.

Besides the sun salutation training was perceived by the male subjects as ‘fairly light’ activity (RPE 11) whereas the same was perceived by female issues as ‘somewhat hard’ activity (RPE 14). Perhaps an exercise of higher intensity is needed to bring some important changes in body constitution of male cases.

In our survey we also observed that, for all parameters, females showed better improvement than males. This might be ascribable to their lower baseline physical fitness than males, which provided more scope for the advance.

The present work was limited to college students aged from 17.5 to 20 age. Future surveys can be performed on healthy but middle aged and aged populations. In gain, sun salutation

needs to be further investigated as a creature to enhance physical fitness and character of life dimensions in various pathological conditions.

Conclusion

The outcomes of the present study suggest that sun salutation has the potential to improve the muscle strength, general body endurance and body composition to the optimum level in healthy individuals. These elements in turn, enhance an individual's physical fitness. Sun salutation does not require any tools or appliances, limited space is enough to perform them and just a few minutes are necessary to do a dedicated number of rounds. Generally, resistance training which improves muscle strength and aerobic exercises which improve body endurance and body composition are considered to be the essential elements of a fitness regime. Nevertheless, from the present study, it can be concluded that sun salutation is an easier and less time consuming alternative to improve durability, body constitution and general body endurance.

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