



THE EFFECTS OF DYNAMIC SURYA NAMASKAR ON DIFFERENTIAL CHEST CIRCUMFERENCE OF PHYSICAL EDUCATION STUDENTS

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ABSTRACT

Purpose. The objective of the study was to determine the effects of dynamic Surya Namaskar (sun salutations) on the differential chest circumference of selected physical education students at Banaras Hindu University, Varanasi. **Basic procedures.** The subjects for this study were selected from the Department of Physical Education at Banaras Hindu University. A total of 20 male subjects were selected and used as one practicing group. Dynamic Surya Namaskar was considered the independent variable and differential chest circumference was considered the dependent variable. The test was for differential chest circumference. The Repeated Measures Design was used for this study. Only one group of 20 participants was created. Tests were administered at regular intervals of two weeks. The tests started four weeks prior to the dynamic Surya Namaskar (DSN) treatment and took place every two weeks, three times. Thereafter, tests took place every two weeks during the treatment and after the completion of the treatment, they were continued for the following four-week period. **Main findings.** To determine the effect of dynamic Surya Namaskar on physiological and anthropometric variables of selected physical education students at Banaras Hindu University, Varanasi, one way ANOVA was used at .05 level of significance. **Conclusions.** In relation to differential chest circumference, a significant ($p < 0.05$) effect of dynamic Surya Namaskar was found.

Key words: dynamic Surya Namaskar, differential chest circumference, physical education

Introduction

Surya Namaskar practice is a very powerful practice and affects the whole body. It especially remains the preferred cardiovascular exercise [1, 2]. This makes it open to people of all ages and levels. The number of rounds should be decided on the basis of physical condition, whereas maximum benefit is obtained by performing a sequence of yoga-poses regularly [3–5]. After the session, the practitioners usually rest in the yoga resting posture – Shavasana.

The practice of Surya Namaskar as a complete and perfect compound blend of body movement, breathing and concentration is used in many Indian schools and ashrams since it was considered by the ancients of India to be a form of *kriya* (purification), or body oblation, which would give an abundance of health, vitality and spiritual upliftment [6–10]. The fact that some authors call it *kriya* indicates its strong purification qualities. Historically, it is widely believed that in the state of Maharashtra, the national freedom fighter of the 17th century, King Shivaji Maharaj, sage Samarth

Ramdas and the Marathas performed Surya Namaskar as a physical exercise to develop strong and able bodies. This is not surprising since *vyayama* (physical exercise) traditionally has been influenced by spirituality. Many physical practices have an ingrained spiritual value in them [11–13]. In addition, spiritual training has been considered a part of physical training in India since ancient times [14, 15]. The routine differs greatly with regards to the recommended pace of movement, number of repetitions, sequence of asanas and the emotional approach (whether ritual or physical exercise). In ritual form, the movements are accomplished very slowly with devotion and mantra repetition and the central pose is the Ashtanga Namaskar. The exercise version requires a high number of repetitions, often more than 200, to be performed quickly, i.e. less than 20 seconds per round.

Some sources mention as many as forty various Surya Namaskar-like routines. Over the years, especially when they were performed as a part of ritual, these routines were renamed and now one can find such names as Chandra Namaskar, Guru Namaskar, Hanuman Namaskar, etc. There are some differences with regard to the body movements, yet the main idea of the original Surya Namaskar remains intact.

Surya Namaskar (SN) is a yogic practice generally

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done at sunrise and usually consists of twelve *asanas* (postures) which are performed in a pre-established sequence. Each and every movement of the body should be coordinated with respiration [4, 16, 17]. The mind should be focused on the breathing process. The sequence of postures used for the experiment was the traditional style popularly called the Rishikesh series which is based on the work of the Kaivalyadhama Institute (Lonavla) [7] and the Bihar School of Yoga (Munger) [3].

In addition to the above definition, dynamic Surya Namaskar (DSN) requires that the speed of one round of Surya Namaskar is performed in 7.5 to 8 seconds, making approximately 40 rounds of Surya Namaskar per five minutes. Usually during one session, several hundred rounds are performed.

Material and methods

Objective of the study

The objective of the study was to determine the effects of dynamic Surya Namaskar (sun salutations) on differential chest circumference of selected physical education students at Banaras Hindu University, Varanasi.

Hypothesis

It was hypothesized that there shall be a significant effect of dynamic Surya Namaskar on differential chest circumference on the group following the regime of the daily dynamic Surya Namaskar practice in comparison to the period when such regular practice was not followed.

Flexibility is an important characteristic of physical fitness. Most sports and exercise systems are rarely applied directly to maintain the rib cage flexibility and its range of motion, while Surya Namaskar uniquely addresses such shortcoming.

Participants

The subjects for this study were selected from the Department of Physical Education at Banaras Hindu University. A total of 20 male subjects were selected and used as one practicing group.

Variables

Dynamic Surya Namaskar (sun salutations) was considered the independent variable and differential chest circumference was considered the dependent variable.

Test for differential chest circumference

Chest circumference was measured with the help of a meter tape during the maximum inhalation and maximum exhalation and was recorded in centimeters. The measurement was taken as soon as the subject took inhalation or exhalation holding it steady for a few seconds and the tape was adjusted at the subject’s back to the horizontal level marked *mesosternale*.

The differential chest circumference was calculated by using the following formula:

$$\text{Differential Chest Circumference (cm)} = \text{Chest Circumference after Inhalation (cm)} - \text{Chest Circumference after Exhalation (cm)}.$$

Experimental design

The Repeated Measures Design was used for this study. Only one group of 20 participants was created. Tests were administered at regular equal intervals of two weeks. The tests started four weeks prior to the dynamic Surya Namaskar (DSN) treatment and took place every two weeks, three times. Thereafter, tests took place every two weeks during the treatment and after the completion of the treatment, they were continued for the following four-week period.

Data set	1	2	3	4	5	6	7	8
	Pre-treatment		Treatment starts	Treatment period			Post-treatment	
Time (weeks)	-4	-2	0	+2	+4	+6	+8	+10

Experimental treatment – dynamic Surya Namaskar (sun salutations) practice

All the subjects were assembled at Shivaji Hall (gymnasium and a weight training hall) at Banaras Hindu University, Varanasi and were briefed on the general objectives and requirements of Surya Namaskar practice (SN), as well as on the specific objectives and requirements of the dynamic Surya Namaskar practice (DSN).

Subjects were administered the dynamic Surya Namaskar practice in addition to regular participation in all other activities as scheduled by the Department of Physical Education at Banaras Hindu University, Varanasi.

Dynamic Surya Namaskar training was carried out for a period of six weeks, six times per week (excluding university holidays) between December 15, 2008 and January 24, 2009. The scheduled time of the practice lasted for 45 minutes between 6:30 a.m. and 7:15 a.m.

and was conducted instead of the students' regular conditioning period. Each and every practice period was concluded with five minutes of Shavasana (relaxation posture).

Each day of the first week, Surya Namaskar practice was demonstrated to the group by the research scholar and the most important points were reviewed several times. Afterwards, a review of the most important points and common mistakes was conducted once per week. Individual correction of Surya Namaskar practice was conducted every day on an ongoing basis. Additionally, a number of stretching exercises were taught in order to facilitate better and more accurate execution of the individual asanas which are a part of the Surya Namaskar cycle.

Results

Statistical analysis

To determine the effect of dynamic Surya Namaskar on differential chest circumference variable of selected physical education students at Banaras Hindu University, Varanasi, one way ANOVA was used at .05 level of significance (Table 1, Table 2).

It appears from Table 2 that the computed value of F in relation to the differential chest circumference is greater than the required F (7,152) to be significant at the 0.05 level of significance. Since the F-value was found to be significant, the least significant difference (L.S.D.) post hoc test was applied for inter-group comparison.

Table 1. Mean and standard deviation of eight different trials in differential chest circumference

Trials	Mean	Standard deviation
1	5.2500	2.07428
2	5.6500	2.10950
3	5.3500	1.89945
4	7.0000	2.49209
5	7.7450	2.25843
6	8.3750	2.42180
7	6.8500	2.05900
8	6.4500	2.32775

Table 2. Analysis of variance of differential chest circumference in eight different trials

	Sum of squares	df	Mean square	F	Sig.
Between groups	179.841	7	25.692	5.244	.000
Within groups	744.697	152	4.899		

Table 3. Least significant difference (L.S.D.) post hoc test for comparison of the means of the trials of the effect of dynamic Surya Namaskar on differential chest circumference

Paired means (I) (J)	Mean difference (I-J)	Sig.			
Trial 1	Trial 2	-.40000	.569		
	Trial 3	-.10000	.887		
	Trial 4	-1.75000(*)	.013		
	Trial 5	-2.49500(*)	.000		
	Trial 6	-3.12500(*)	.000		
	Trial 7	-1.60000(*)	.024		
	Trial 8	-1.20000	.088		
	Trial 2	Trial 3	.30000	.669	
Trial 4		-1.35000	.056		
Trial 5		-2.09500(*)	.003		
Trial 6		-2.72500(*)	.000		
Trial 7		-1.20000	.088		
Trial 8		-.80000	.255		
Trial 3		Trial 4	-1.65000(*)	.020	
		Trial 5	-2.39500(*)	.001	
	Trial 6	-3.02500(*)	.000		
	Trial 7	-1.50000(*)	.034		
	Trial 8	-1.10000	.118		
	Trial 4	Trial 5	-.74500	.289	
		Trial 6	-1.37500	.051	
		Trial 7	.15000	.831	
Trial 8		.55000	.433		
Trial 5		Trial 6	-.63000	.370	
		Trial 7	.89500	.203	
		Trial 8	1.29500	.066	
		Trial 6	Trial 7	1.52500(*)	.031
	Trial 8		1.92500(*)	.007	
	Trial 7		Trial 8	.40000	.569

* The mean difference is significant at the .05 level

1. There is no significant difference between Trial 1 & Trial 2, Trial 1 & Trial 3, and Trial 2 & Trial 3. (Table 3) This shows that no improvement took place in differential chest circumference before the start of the treatment.
2. There is significant difference between Trial 3 & Trial 4, Trial 3 & Trial 5 and Trial 3 & Trial 6. (Table 3). This shows that the treatment proved to be effective in the improvement of differential chest circumference especially in the early phase of its application.
3. There is no significant difference between Trial 4 & Trial 5 and Trial 5 & Trial 6. (Table 3). This indicates that the treatment does not result in any differential

chest circumference effect in the later phase of its application.

- There is no significant difference between Trial 7 & Trial 8. On the other hand, there is significant difference between Trial 6 & Trial 7 and Trial 6 & Trial 8. (Table 3). This shows that the effect of dynamic Surya Namaskar remains for two weeks even after a pause in treatment but the achieved performance decreases significantly after four weeks of rest (Fig. 1).

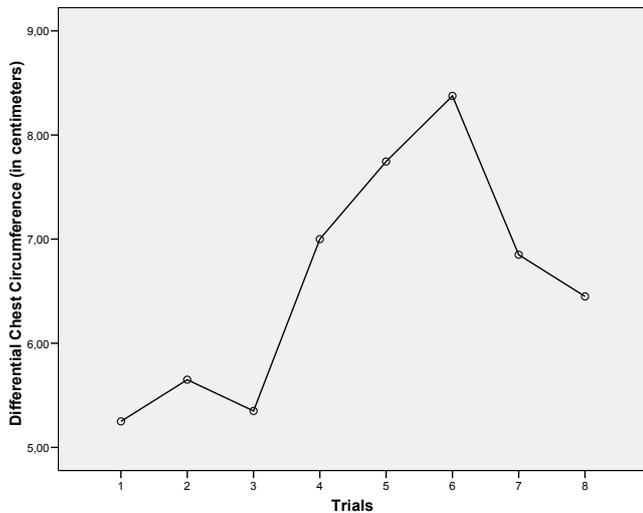


Figure 1. Graphical representation of the comparison of the means of the trials of the effect of dynamic Surya Namaskar on differential chest circumference

Descriptive statistics of the subjects

Table 4. Descriptive statistics of the subjects in relation to calendar age

N	Valid	20
	Missing	0
Mean		22.09
Std. error of mean		.36417
Median		21.78
Mode		21.28
Std. deviation		1.63
Variance		2.65
Range		6.16
Minimum		19.21
Maximum		25.37
Sum		441.80

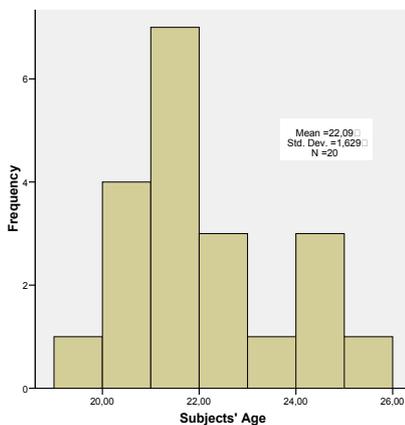


Figure 1. Graphical representation of the subjects' age

Table 5. Descriptive statistics of the subjects in relation to active participation in various sports

N	Valid	20
	Missing	0
Mean		7.10
Std. error of mean		.721
Median		7.50
Mode		10.00
Std. deviation		3.23
Variance		10.41
Range		11.00
Minimum		1.00
Maximum		12.00
Sum		142.00

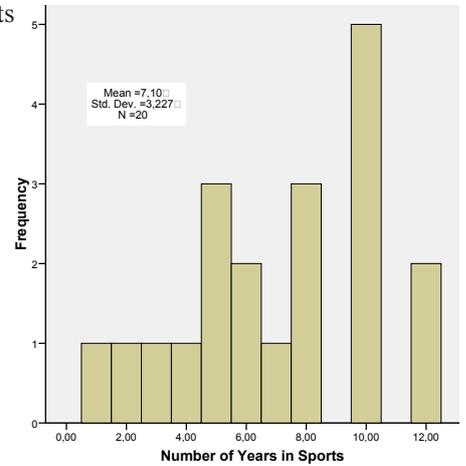


Figure 2. Graphical representation of the frequency of the subjects' active participation in various sports

Discussion

Findings in the light of the literature

Bhattacharya et al. [18] have confirmed that yoga practice improved oxidative status. Vaze et al. [19] have confirmed that yogasanas and pranayamas followed by 20 minutes of relaxation techniques considerably improved chest flexibility. However, no statistics were used in their report. In this study, it was found that the differential between the in-breath and the out-breath chest circumference increased in a statistically significant manner. Therefore, this earlier study has been confirmed by statistics here which show that yoga, and in particular dynamic Surya Namaskar, increases chest flexibility. The post hoc least significant difference test in relation to differential of chest circumference shows that the duration of the first two weeks of the treatment was sufficient to bring about significant difference (mean difference = -1.65). The following two intervals were not effective enough to bring about any significant difference though there was an observable small improvement. According to Sinha et al. [2] after three months of yoga training dynamic Surya Namaskar as aerobic exercise seemed to be ideal as it involves static stretching and slow dynamic component of exercise with optimal stress on the cardiorespiratory system. Ray et al. [1] tested 28 of yoga trainees who were administered yogic practices for ten months (Table 4, Table 5, Fig. 2, Fig.3). There was improvement in body flexibility and at submaximal level of exercise and in anaerobic

threshold. Also Christensen [20], Ornish [21], Cowen and Adams [22] and Sanjay [23] have mentioned the influence of heart rate in yoga practice.

Limitations

Moreover, the present study of dynamic Surya Namaskar practice does not allow determining whether the level of skills of the students, their personality profile or some kind of external motivation influence the final result. Questions such as these need to be addressed in future research.

Conclusions

To conclude, the study shows that the effect of dynamic Surya Namaskar remains for two weeks even after a pause in treatment but the achieved performance decreases significantly after four weeks of rest (mean difference = 1.525).

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