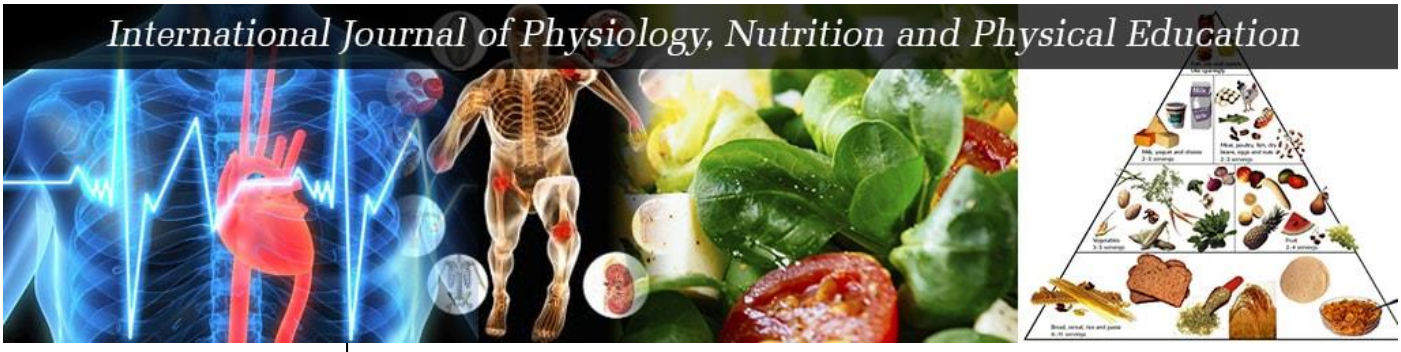

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Baljinder Singh Bal
Guru Nanak Dev University, Amritsar, Punjab, India

Gurjit Singh
Guru Nanak Dev University, Amritsar, Punjab, India

Correspondence
Baljinder Singh Bal
Guru Nanak Dev University, Amritsar, Punjab, India

The effects of Surya Nadi pranayama on hematological parameters

Baljinder Singh Bal and Gurjit Singh

Abstract
Study aim: To assess the effects of Surya nadi pranayama on hematological parameters.
Design and Methodology: Forty, university level girls of Department of Physical Education (T), Guru Nanak Dev University, Amritsar between the age group of 21-26 years volunteered to participate in the study. The subjects from Group-A: Experimental were subjected to a 3-week surya nadi pranayama.
Statistical Analysis: Student t-test for paired samples was utilized to compare the means of the pre-test and the post-test.
Results: To conclude, it is significant to mention in relation to Hemoglobin (Hb), Total Cholesterol (TC), Low Density Lipoprotein Cholesterol (LDL-Cholesterol) and High Density Lipoprotein Cholesterol (HDL-Cholesterol) of university level girls were found statistically insignificant ($P > .05$) in group (Experimental) and (Control) whereas in relation to Triglycerides (TG) results were found statistically significant ($P < .05$) in group (Experimental).

Keywords: Surya Nadi pranayama, hemoglobin, total cholesterol, low density lipoprotein cholesterol, high density lipoprotein cholesterol, triglycerides

Introduction
Motor Breathing is conventionally defined in medical transcripts as the progression of taking air into and expelling it from lungs. The process – the passage of air into and out of the lungs – is movement; specifically, it is movement in the body's cavities. This simplified illustration of the human body in Figure-1 shows that the torso consists of two cavities, thoracic and abdominal.

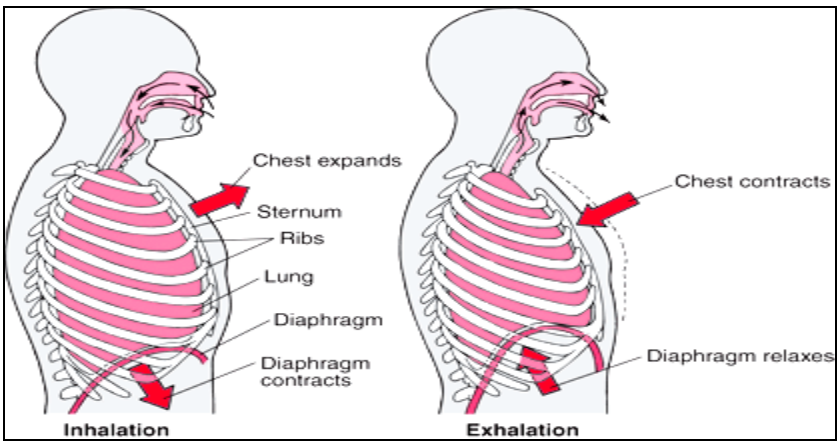


Fig 1: Breathing is thoracoabdominal shape changes between (a) inhalation and (b) exhalation

Because the lungs occupy a three-dimensional space in the thoracic cavity, when this space changes to cause air movement, it changes shape three-dimensionally. Specifically, an inhalation involves the chest cavity increasing its volume from top to bottom, from side to side, and from front to back, and an exhalation involves a reduction of volumes in those three dimensions (see Figure-2).

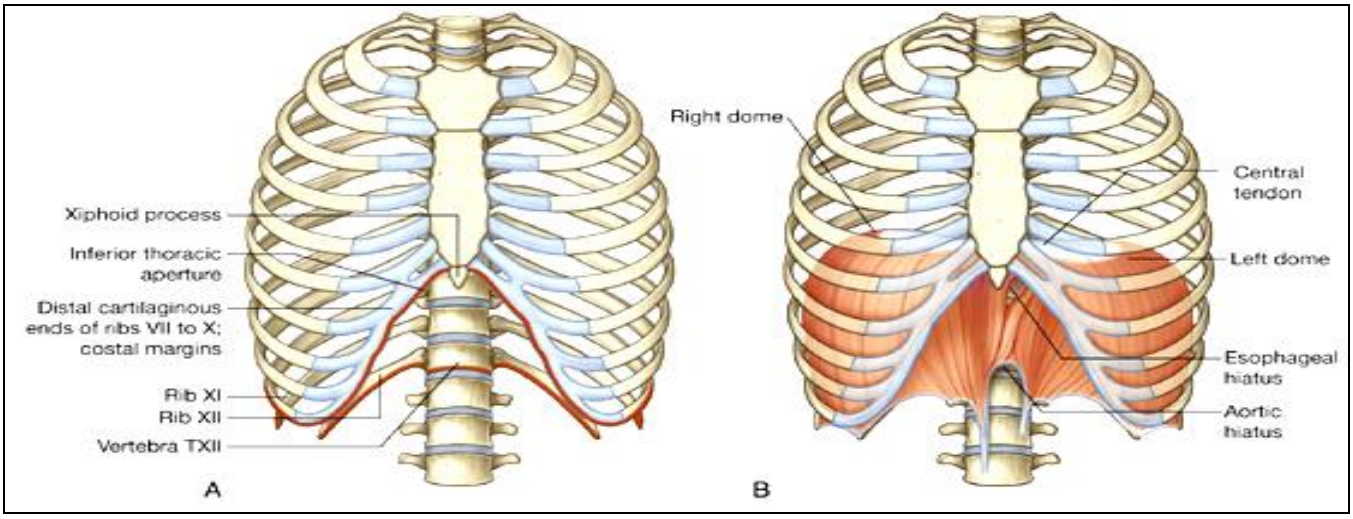


Fig 2: Three – dimensional thoracic shape changes of (a) inhalation and (b) exhalation

Pranayama is the cognizant and deliberate control and regulation of the breath, this means controlling the motion of inhalation & exhalation. The effect of different pranayamas on healthy [1] and diseased people [2-4] has been well studied and they are known to affect the cardiopulmonary activities and autonomic functions. Growing number of evidences have claimed that yoga practices increases longevity, [5] has therapeutic [6] and rehabilitative effects [7].

Design and Methodology

Subjects

Forty, university level girls of Department of Physical Education (T), Guru Nanak Dev University, Amritsar between the age group of 21-26 years volunteered to participate in the study. The subjects were purposively assigned into two groups: Group-A: Experimental (N_1=20); Group-B: Control (N_2=20).

Methodology

This study is designed as a retrospective cross-sectional study. The subjects from Group-A: Experimental were subjected to a 3-week surya nadi pranayama. This lasted 3 weeks and consisted of daily sessions. Hemoglobin was determined in the blood samples of all the subjects with the use of a hematology analyzer (Celldyne model 3500). Blood samples (10 ml) for the determination of lipid profiles were obtained. All of biochemical tests have been done with serum samples. Lipid parameters (Triglyceride; Cholesterol; Low-density lipoprotein; High-density lipoprotein) were measured using Boehringer Mannheim kits and Clinilab, BioMerieux analyser as used by Jastrzebska *et al*.

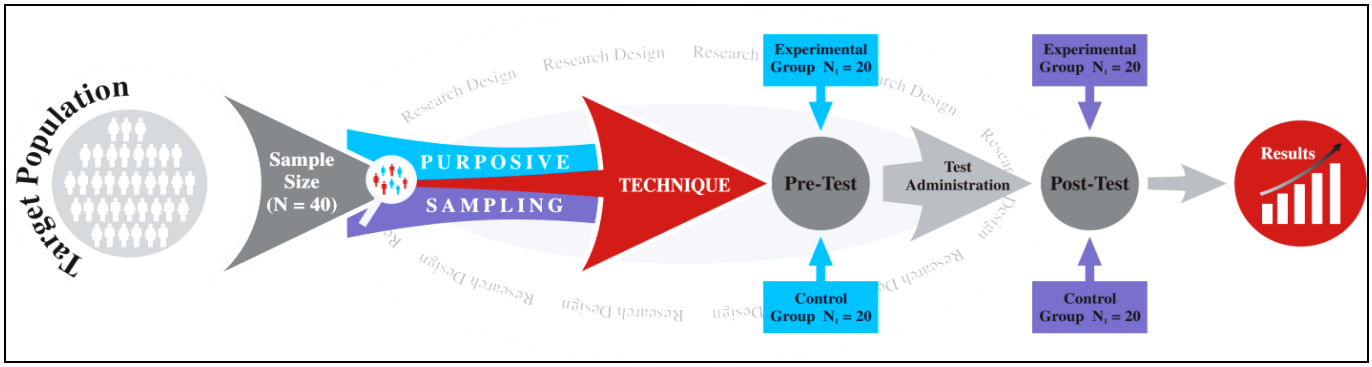
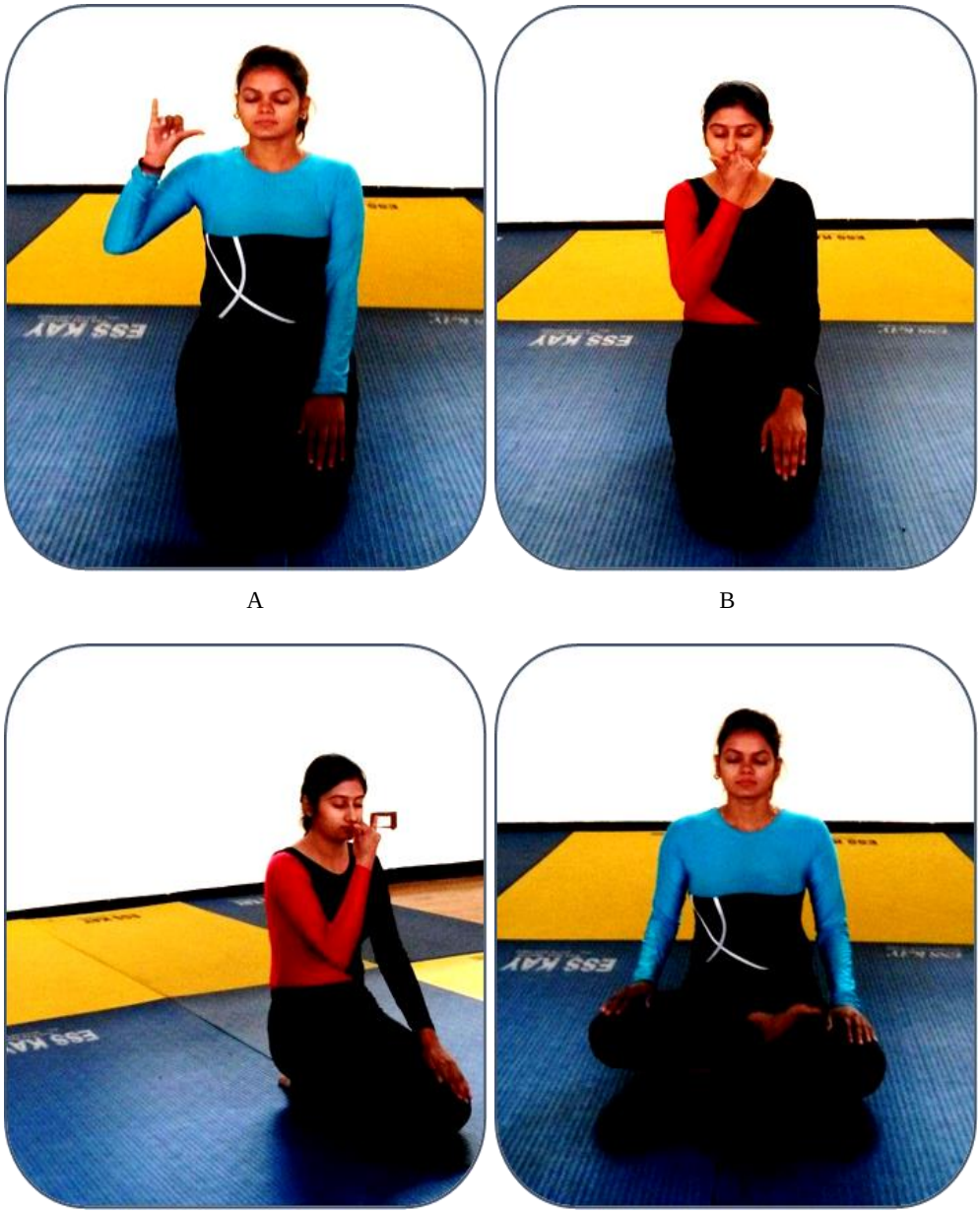


Fig 3: Study Design

Table 1: Experimental Treatment

3-Weeks Surya Nadi Pranayama Training			
Weeks	**Schedule**	**Time**	**Duration**
1St Week	Preliminary Yogic Exercises	5 Minute	20 Minute
	Practice of Surya Nadi Pranayama (9 Rounds X 1 Set)	10 Minute	
	Relaxation Posture	5 Minute	
2nd Week	Preliminary Yogic Exercises	5 Minute	30 Minute
	Practice of Surya Nadi Pranayama (9 Rounds X 2 Set)	20 Minute	
	Relaxation Posture	5 Minute	
3rd Week	Preliminary Yogic Exercises	5 Minute	40 Minute
	Practice of Surya Nadi Pranayama (9 Rounds X 3 Set)	30 Minute	
	Relaxation Posture	5 Minute	



A B

C D

Fig 4: Subject Performing Surya Nadi Pranayama

A B

Fig 5: Biochemical tests with Serum Samples

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences for Windows version 10.0 software (SPSS Inc., Chicago, IL). Data is expressed as the mean ± SD. Student t test for paired samples was utilized to compare the means of the pre-test and the post-test. To test the hypothesis, the level of significance was set at 0.05.

Results

Table 2: Descriptive Statistics (Mean & Standard Deviation) and Paired Sample t-test of Hematological Parameter (i.e., Hemoglobin (Hb), Total Cholesterol (TC), Low Density Lipoprotein Cholesterol (LDL-Cholesterol), High Density Lipoprotein Cholesterol (HDL-Cholesterol) and Triglycerides (TG) of University Level Girls

Hemoglobin (Hb)				
Group	**Number**	**Mean**	**Standard Deviation**	**t-value**
Experiment (Pre-test)	20	11.765	0.595	0.5846
Experimental (Post-test)	20	11.865	0.6595	
Control (Pre-test)	20	12.36	0.8406	0.1959
Control (Post-test)	20	12.31	0.8699	
Total Cholesterol (TC)				
Experiment (Pre-test)	20	155.07	2.3835	0.4981
Experimental (Post-test)	20	154.68	2.484	
Control (Pre-test)	20	139.39	12.1786	0.2077
Control (Post-test)	20	138.56	12.6064	
Low Density Lipoprotein Cholesterol (LDL-Cholesterol)				
Experiment (Pre-test)	20	118.88	5.7074	0.3881
Experimental (Post-test)	20	117.785	11.292	
Control (Pre-test)	20	121.3	5.935	0.5564
Control (Post-test)	20	121.585	6.2782	
High Density Lipoprotein Cholesterol (HDL-Cholesterol)				
Experiment (Pre-test)	20	89.363	5.6866	0.4041
Experimental (Post-test)	20	90.077	3.5449	
Control (Pre-test)	20	86.594	4.5003	1.8252
Control (Post-test)	20	89.777	4.3822	
Triglycerides (TG)				
Experiment (Pre-test)	20	117.24	8.6284	2.2624*
Experimental (Post-test)	20	123.955	10.7606	
Control (Pre-test)	20	116.51	10.919	0.5209
Control (Post-test)	20	114.575	10.2104	

Hemoglobin (Hb)

- The absolute value of the calculated *t* is smaller than critical value (0.5846<2.093), so the means are not significantly different in group (Experimental).
- The calculated *t* value is smaller than critical value (0.1959<2.093), so the means are not significantly different in group (Control).

Total Cholesterol (TC)

- The calculated *t* value is smaller than critical value (0.4981<2.093), so the means are not significantly different in group (Experimental).
- The calculated *t* value is smaller than critical value (0.2077<2.093), so the means are not significantly different in group (Control).

Low Density Lipoprotein Cholesterol (LDL-Cholesterol)

- The calculated *t* value is smaller than critical value (0.3881<2.093), so the means are not significantly different in group (Experimental).
- The absolute value of the calculated *t* is smaller than critical value (0.5564<2.093), so the means are not significantly different in group (Control).

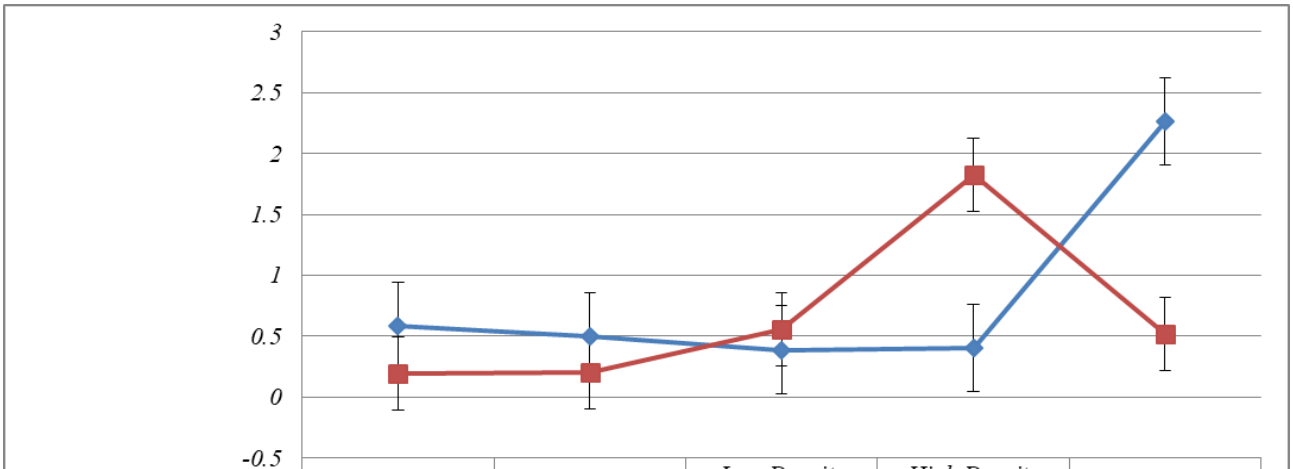
High Density Lipoprotein Cholesterol (HDL-Cholesterol)

- The absolute value of the calculated t is smaller than critical value (0.4041<2.093), so the means are not significantly different in group (Experimental).
- The absolute value of the calculated *t* is smaller than critical value (1.8252<2.093), so the means are not significantly different in group (Control).

Triglycerides (TG)

- The absolute value of the calculated *t* exceeds the critical value (2.2624>2.093), so the means are significantly different in group (Experimental).

The calculated *t* value is smaller than critical value (0.5209<2.093), so the means are not significantly different in group (Control).



	Hemoglobin (Hb)	Total Cholesterol (TC)	Low Density Lipoprotein Cholesterol (LDL-Cholesterol)	High Density Lipoprotein Cholesterol (HDL-Cholesterol)	Triglycerides (TG)
Experiment t-value	0.5846	0.4981	0.3881	0.4041	2.2624
Control t-value	0.1959	0.2077	0.5564	1.8252	0.5209

Fig 6: t-value for the Experimental (Pre-Test & Post-Test) and Control (Pre-Test & Post-Test) Groups Scores of Hematological Parameter

Conclusion

To conclude, it is significant to mention in relation to Hemoglobin (Hb), Total Cholesterol (TC), Low Density Lipoprotein Cholesterol (LDL-Cholesterol) and High Density Lipoprotein Cholesterol (HDL-Cholesterol) of University Level Girls were found statistically insignificant ($P > .05$) in group (Experimental) and (Control) whereas, in relation to Triglycerides (TG) results were found statistically significant ($P < .05$) in group (Experimental).

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