

Exploring the Therapeutic Effects of Surya-Nadi Pranayama on Metabolic Fitness (Metf) and Bone Integrity

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Abstract

The primary aim of this research was to determine the therapeutic effects of Surya-Nadi Pranayama on Metabolic Fitness (MetF) and Bone Integrity. Forty Two, university level girls between the age group of 21-26 years were selected. The subjects were purposively assigned into two groups: Group-A: Experimental ($n_1=21$); Group-B: Control ($n_2=21$). The subjects from Group-A: Experimental were subjected to a 4-weeks Surya-nadi pranayama. Student t test for paired samples was utilized to compare the means of the pre-test and the post-test. Based on the analysis of the results obtained, we conclude that the significant differences were found in Metabolic Fitness (MetF) (i.e., Maximal Oxygen Consumption (V_{O_2max}) of University Level Girls. Insignificant between-group differences were noted in Blood Lipid, Blood Pressure, Blood Sugar and Bone Integrity of University Level Girls.

Keywords: Surya-Nadi Pranayama, Metabolic fitness, Bone integrity

1. Introduction

Yoga is a psycho-somatic-spiritual discipline for acquiring union and harmony between our mind, body, and soul and the ultimate union of our individual consciousness with the universal consciousness (Madanmohan et al., 2008). Pranayama is derived from two Sanskrit words, namely, prana, which means vital force or life energy, ayama means to prolong (Tandon, 2012). In an interventional research involving 98 subjects found fasting blood sugar (FBS), serum total cholesterol, low density lipoproteins (LDL), very low density lipoproteins (VLDL), the ratio of total cholesterol to HDL-C, and total triglycerides were significantly lower, and HDL-C significantly higher (Bijlani et al., 2005). Pranayama practices, stretches the lung tissue producing inhibitory signals from action of slowly adapting receptors and

hyperpolarising currents (Jerath et al., 2006). Pranayama has been researched mostly for its beneficial applications in treatment of cardiovascular diseases such as hypertension (Chodzinski, 2000; Harinath, 2004), pulmonary disease such as asthma (Cooper, 2003; Vedanthan, 1998), autonomic nervous system imbalances (Pal et al. 2004), and psychologic or stress related disorders (Harinath, 2004; Brown et al., 2005). Pranayama may also affect the immune system. Inhibition of the sympathetic nervous system has been shown to enhance function of the immune system in several forms of meditation including mindfulness meditation and Transcendental meditation (Collins & Dunn, 2005; Takahashi, 2005). The effect of different pranayamas on healthy (Subbalakshmi et al., 2005) and diseased people (Cooper et al., 2003; Dhungel et al., 2008; Ravindra & Madanmohan, 2006) 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, (Bharshankar et al., 2003) has therapeutic (Khanam et al., 1996) and rehabilitative effects (Katiyar et al., 2006). Breathing exercises have been recommended in physiotherapy to improve respiratory and bowel function, in occupational therapy to facilitate spiritual emergence. It has been assumed single nostril breathing can be used to therapeutically influence autonomic function and may significantly affect other hemisphere- specific functions (Chanavirut, 2008). It is thought that practicing yoga over a period of time leads to a decrease in respiratory rate, muscular relaxation along with calming of the mind, which might be interpreted at least partly as a decreased state of arousal (Maharishi, 1969; Nagendra, 1977).

2. Methods

2.1 Participants

Forty Two, university level girls between the age group of 21-26 years were selected. The subjects were purposively assigned into two groups: Group-A: Experimental ($n_1=21$); Group-B: Control ($n_2=21$).

Table 1. Distribution and demographics of subjects

Sample Size (N=42)			
Variables	Total (N=42)	Experimental group ($n_1=21$)	Control group ($n_2=21$)
Age	21.714±1.851	21.714±2.003	21.714±1.736
Body Height	5.430±1.584	5.428±1.677	5.433±1.527
Body Mass	54.659±2.617	54.085±2.830	55.233±2.311

2.2 Procedure

This study is designed as a retrospective cross-sectional study. The subjects from Group-A: Experimental were subjected to a 4-weeks training of Surya-nadi Pranayama. This lasted 4 weeks and consisted of daily sessions.

- Maximal oxygen uptake (VO_{2max}) was used as a measure of cardiopulmonary fitness and was assessed by a maximal running test on a treadmill. Maximal oxygen uptake was scaled relative to body weight ($mL \cdot min^{-1} \cdot kg^{-2/3}$).

- Blood samples (10 ml) for the determination of lipid profiles were obtained. All of biochemical tests have been done with serum samples.
- Blood pressure was measured in supine posture by Sphygmomanometer. Two reading were taken 5 minutes apart and the mean of two was taken as the basal blood pressure.
- The blood sugar levels were measured by Digital Glucometer (ACCU-CHEK, Sr no-GN20606850 manufactured by Roche Diagnostics India Pvt. Ltd, Mumbai).
- Bone mineral density (BMD) of lumbar spine (L2-L4) in anteroposterior view was measured by dual-energy X-ray absorptiometry (DXA) using a Hologic QDR 1500W (Bedford, MA, USA).

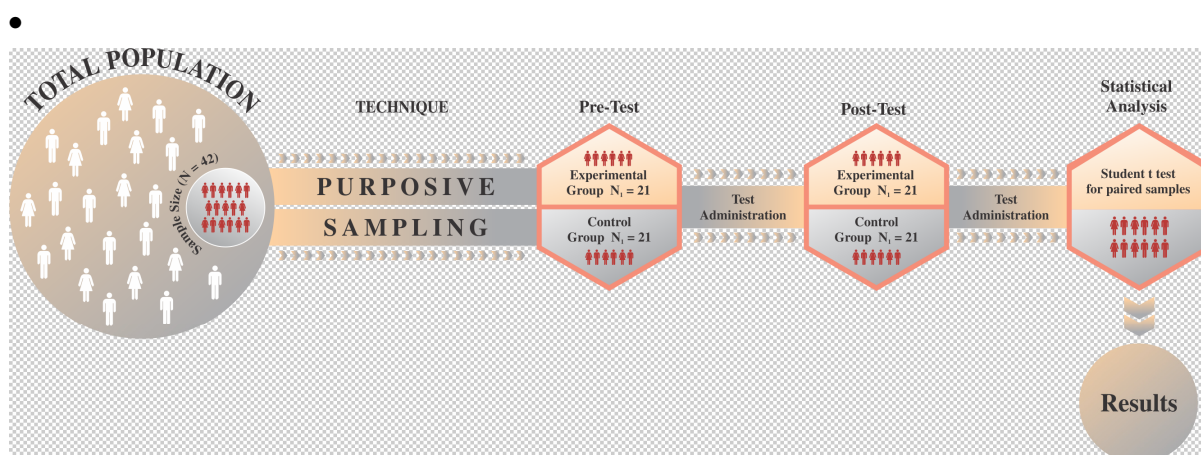


Figure 1. Study design

Table 2. Experimental treatment

4-Weeks Surya-Nadi Pranayama Training Programme			
Weeks	Schedule	Time	Duration
1 st Week	Preliminary Yogic Exercises	5 Minute	20 Minute
	Practice of Surya-Nadi Pranayama (9 Rounds X 1 Set)	10 Minute	
	Relaxation Posture	5 Minute	
2 nd Week	Preliminary Yogic Exercises	5 Minute	25 Minute
	Practice of Surya-Nadi Pranayama (9 Rounds X 2 Set)	15 Minute	
	Relaxation Posture	5 Minute	
3 rd Week	Preliminary Yogic Exercises	5 Minute	30 Minute
	Practice of Surya-Nadi Pranayama (9 Rounds X 3 Set)	20 Minute	
	Relaxation Posture	5 Minute	
4 th Week	Preliminary Yogic Exercises	5 Minute	35 Minute
	Practice of Surya-Nadi Pranayama (9 Rounds X 4 Set)	25 Minute	
	Relaxation Posture	5 Minute	

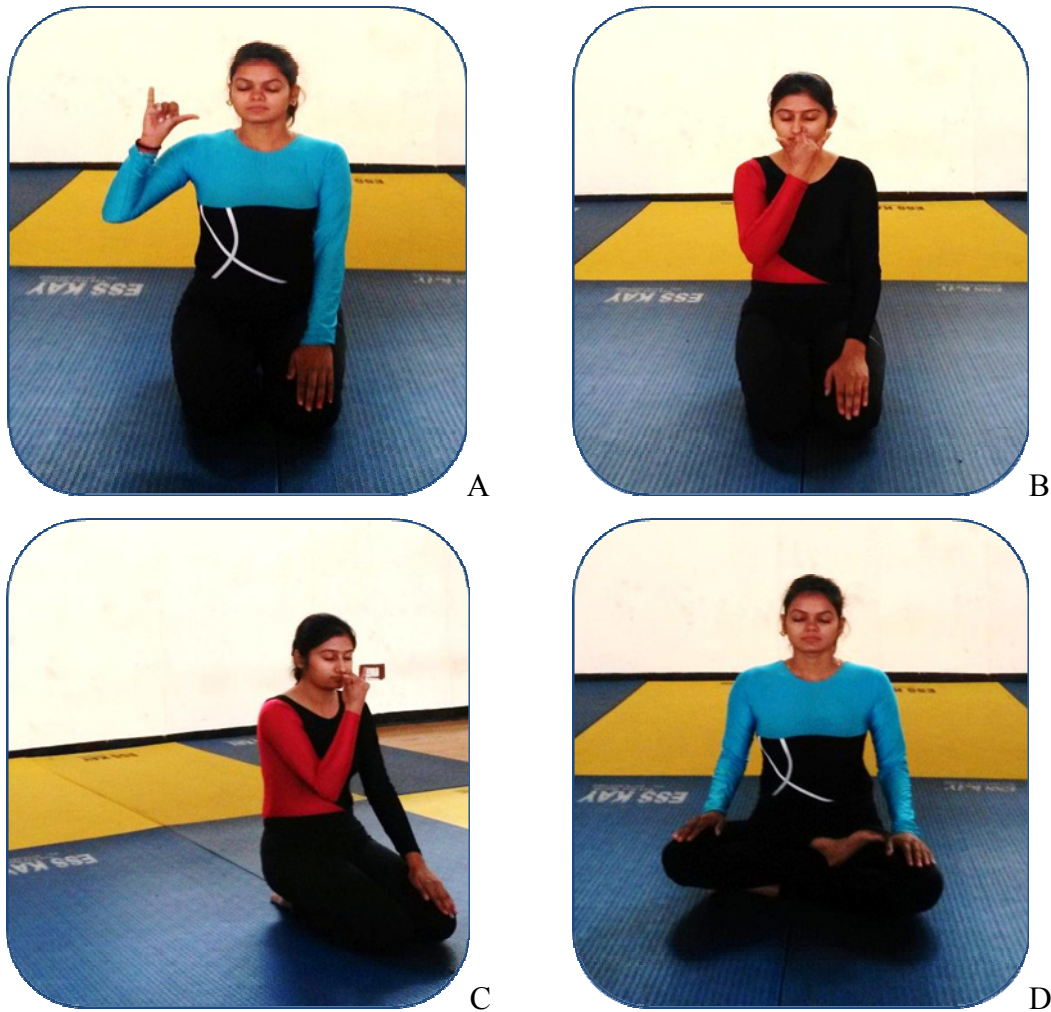


Figure 2. Subjects performing Surya Nadi Pranayama

3. Statistical Analysis

One Way Analysis of Variance (ANOVA) was employed to compare the three groups of basketball. For testing the hypotheses, the level of significance was set at 0.05.

4. Results

Table 3. Mean values (\pm SD) and Paired Sample t-test of Metabolic Fitness (MetF) (i.e., Maximal Oxygen Consumption (V_{O_2max}), Blood Lipid, Blood Pressure and Blood Sugar) in Experimental and Control group (n=21 each) before (Pre) and after (Post) 4-weeks Surya Nadi Pranayama Training Programme (Experimental group only)

Parameters	Group	Pre-Test	Post-Test	t-value	p-value
Maximal Oxygen Consumption (V_{O_2max})	Experimental	33.69 \pm 2.21	34.78 \pm 1.52	5.931*	0.0001
	Control	22.66 \pm 0.45	22.48 \pm 0.28	1.806	0.0859
Blood Cholesterol	Experimental	153.02 \pm 11.46	153.32 \pm 11.24	1.468	0.1574
	Control	157.81 \pm 9.98	157.86 \pm 10.01	1.105	0.2821
Lipid Triglycerides	Experimental	146.64 \pm 1.87	146.72 \pm 1.72	0.782	0.4430
	Control	135.16 \pm 8.65	135.18 \pm 8.64	0.721	0.4787
Blood Pressure	Experimental	111.33 \pm 3.55	111.67 \pm 3.35	1.581	0.1295
	Control	125.90 \pm 3.39	126.29 \pm 2.33	0.477	0.6379
Blood Pressure	Experimental	83.62 \pm 2.58	84.29 \pm 1.71	1.071	0.2968
	Control	76.10 \pm 2.14	76.24 \pm 1.87	0.568	0.5764
Blood Sugar	Experimental	85.62 \pm 2.82	86.86 \pm 3.29	1.618	0.1212
	Control	95.38 \pm 2.64	96.29 \pm 3.24	0.948	0.3540
Blood Sugar	Experimental	124.33 \pm 3.12	125.67 \pm 2.82	1.122	0.2750
	Control	133.90 \pm 3.90	134.86 \pm 2.94	0.779	0.4448

*Significantly ($p < 0.001$) different from the respective 'Pre' value.

4.1 Maximal Oxygen Consumption (V_{O_2max})

The results of Metabolic Fitness (MetF) in group (Experimental) and group (Control) are shown in Table-3. The Mean and Standard Deviation (\pm SD) values of Maximal Oxygen Consumption (V_{O_2max}) of pre-test and post-test of experimental group were 33.69 \pm 2.21 & 34.78 \pm 1.52 respectively. However, the Mean and Standard Deviation (\pm SD) values of Maximal Oxygen Consumption (V_{O_2max}) of pre-test and post-test of control group were 22.66 \pm 0.45 & 22.48 \pm 0.28. The t-value in case of experimental group was 5.931* and for control group it was 1.806.

Significant between-group differences were noted in Maximal Oxygen Consumption (V_{O_2max}) in the experimental group before (Pre) and after (Post) subjected to 4-weeks Surya Nadi Pranayama Training Programme since, the calculated value of ($t=5.931^*$) is greater than tabulated value of $t_{.05}(20) = 2.09$ for the selected degree of freedom and level of significance. However, no significant changes over that 4-week period were noted in the control group.

4.2 Cholesterol

The Mean and Standard Deviation values (\pm SD) of Cholesterol of pre-test and post-test of experimental group were 153.02 \pm 11.46 and 153.32 \pm 11.24 respectively. However, the Mean and Standard Deviation (\pm SD) values of Cholesterol of pre-test and post-test of control group were 157.81 \pm 9.98 and 157.86 \pm 10.01. The t-value in case of experimental group was 1.468 and for control group it was 1.105.

Insignificant between-group differences were noted in Cholesterol in the experimental group before (Pre) and after (Post) subjected to 4-weeks Surya Nadi Pranayama Training Programme since, the calculated value of ($t=1.468$) is less than tabulated value of $t_{.05}(20) = 2.09$ for the selected degree of freedom and level of significance. However, no significant changes over that 4- week period were noted in the control group.

4.3 Triglycerides

The Mean and Standard Deviation values (\pm SD) of Triglycerides of pre-test and post-test of experimental group were 146.64 ± 1.87 and 146.72 ± 1.72 respectively. However, the Mean and Standard Deviation (\pm SD) values of Triglycerides of pre-test and post-test of control group were 135.16 ± 8.65 and 135.18 ± 8.64 . The t-value in case of experimental group was 0.782 and for control group it was 0.721.

Insignificant between-group differences were noted in Triglycerides in the experimental group before (Pre) and after (Post) subjected to 4-weeks Surya Nadi Pranayama Training Programme since, the calculated value of ($t=0.782$) is less than tabulated value of $t_{.05}(20) = 2.09$ for the selected degree of freedom and level of significance. However, no significant changes over that 4- week period were noted in the control group.

4.4 Systolic Blood Pressure

The Mean and Standard Deviation (\pm SD) values of Systolic Blood Pressure of pre-test and post-test of experimental group were 111.33 ± 3.55 & 111.67 ± 3.35 respectively. However, the Mean and Standard Deviation (\pm SD) values of Systolic Blood Pressure of pre-test and post-test of control group were 125.90 ± 3.39 & 126.29 ± 2.33 . The t-value in case of experimental group was 1.581 and for control group it was 0.477.

Insignificant between-group differences were noted in Systolic Blood Pressure in the experimental group before (Pre) and after (Post) subjected to 4-weeks Surya Nadi Pranayama Training Programme since, the calculated value of ($t=1.581$) is greater than tabulated value of $t_{.05}(20) = 2.09$ for the selected degree of freedom and level of significance. However, no significant changes over that 4- week period were noted in the control group.

4.5 Diastolic Blood Pressure

The Mean and Standard Deviation (\pm SD) values of Diastolic Blood Pressure of pre-test and post-test of experimental group were 83.62 ± 2.58 & 84.29 ± 1.71 respectively. However, the Mean and Standard Deviation (\pm SD) values of Diastolic Blood Pressure of pre-test and post-test of control group were 76.10 ± 2.14 & 76.24 ± 1.87 . The t-value in case of experimental group was 1.071 and for control group it was 0.568.

Insignificant between-group differences were noted in Diastolic Blood Pressure in the experimental group before (Pre) and after (Post) subjected to 4-weeks Surya Nadi Pranayama Training Programme since, the calculated value of ($t=1.071$) is greater than tabulated value of $t_{.05}(20) = 2.09$ for the selected degree of freedom and level of significance. However, no significant changes over that 4- week period were noted in the control group.

4.6 Fasting Blood Sugar

The Mean and Standard Deviation (\pm SD) values of Fasting Blood Sugar of pre-test and post-test of experimental group were 85.62 ± 2.82 & 86.86 ± 3.29 respectively. However, the Mean and Standard Deviation (\pm SD) values of Fasting Blood Sugar of pre-test and post-test

of control group were 95.38 ± 2.64 & 96.29 ± 3.24 . The t-value in case of experimental group was 1.618 and for control group it was 0.948.

Insignificant between-group differences were noted in Fasting Blood Sugar in the experimental group before (Pre) and after (Post) subjected to 4-weeks Surya Nadi Pranayama Training Programme since, the calculated value of ($t=1.618$) is less than tabulated value of $t_{0.05}(20) = 2.09$ for the selected degree of freedom and level of significance. However, no significant changes over that 4- week period were noted in the control group.

4.7 Post Prandial Blood Sugar

The Mean and Standard Deviation (\pm SD) values of Post Prandial Blood Sugar of pre-test and post-test of experimental group were 124.33 ± 3.12 & 125.67 ± 2.82 respectively. However, the Mean and Standard Deviation (\pm SD) values of Post Prandial Blood Sugar of pre-test and post-test of control group were 133.90 ± 3.90 & 134.86 ± 2.94 . The t-value in case of experimental group was 1.122 and for control group it was 0.779.

Insignificant between-group differences were noted in Post Prandial Blood Sugar in the experimental group before (Pre) and after (Post) subjected to 4-weeks Surya Nadi Pranayama Training Programme since, the calculated value of ($t=1.122$) is less than tabulated value of $t_{0.05}(20) = 2.09$ for the selected degree of freedom and level of significance. However, no significant changes over that 4- week period were noted in the control group.

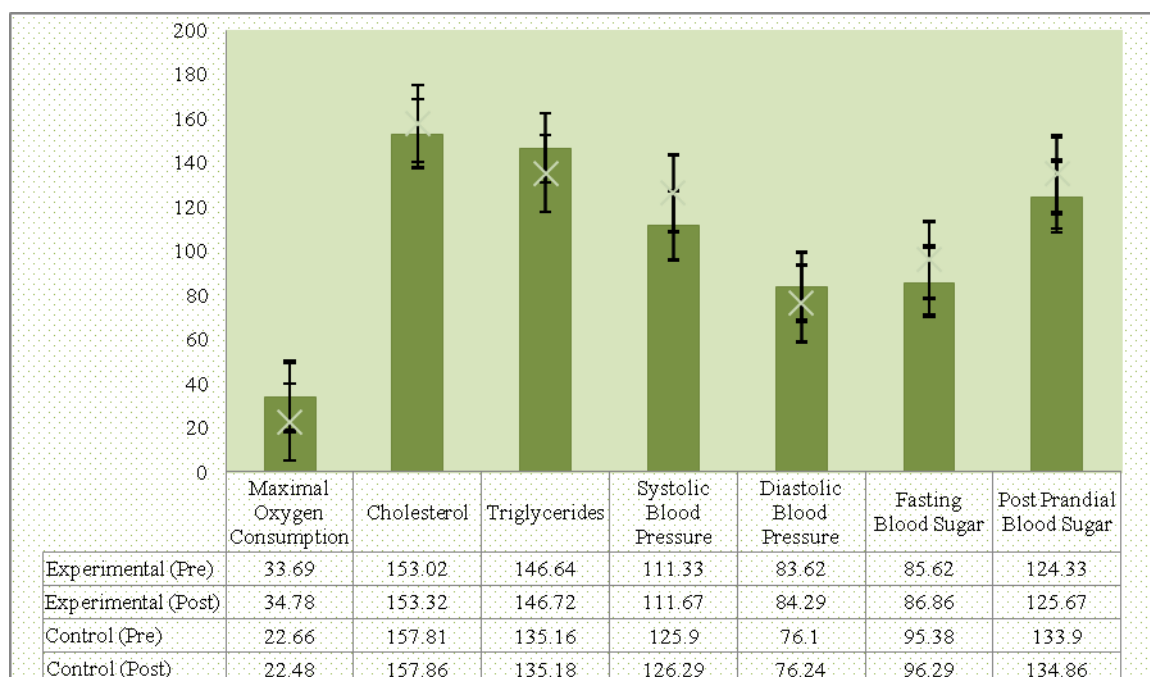


Figure 3. Mean values of Metabolic Fitness (MetF) (i.e., Maximal Oxygen Consumption (V_{O_2max}), Blood Lipid, Blood Pressure and Blood Sugar) in Experimental and Control group ($n=21$ each) before (Pre) and after (Post) 4-weeks Surya Nadi Pranayama Training Programme (Experimental group only)

Table 4. Mean values (\pm SD) and Paired Sample t-test of Bone Integrity in Experimental and Control group (n=21 each) before (Pre) and after (Post) 4-weeks Surya Nadi Pranayama Training Programme (Experimental group only)

Parameters	Group	Pre-Test	Post-Test	t-value	p-value
Bone Integrity	Experimental	1.13 \pm 0.021	1.12 \pm 0.008	1.700	0.1046
	Control	1.13 \pm 0.016	1.13 \pm 0.014	0.256	0.8000

*Significantly ($p < 0.001$) different from the respective 'Pre' value.

4.8 Bone Integrity

The Mean and Standard Deviation (\pm SD) values of Bone Integrity of pre-test and post-test of experimental group were 1.13 \pm 0.021 & 1.12 \pm 0.008 respectively. However, the Mean and Standard Deviation (\pm SD) values of Bone Integrity of pre-test and post-test of control group were 1.13 \pm 0.016 & 1.13 \pm 0.014. The t-value in case of experimental group was 1.700 and for control group it was 0.256.

Insignificant between-group differences were noted in Bone Integrity in the experimental group before (Pre) and after (Post) subjected to 4-weeks Surya-Nadi Pranayama Training Programme since, the calculated value of ($t=1.7$) is less than tabulated value of $t_{0.05} (20) = 2.09$ for the selected degree of freedom and level of significance. However, no significant changes over that 4- week period were noted in the control group.

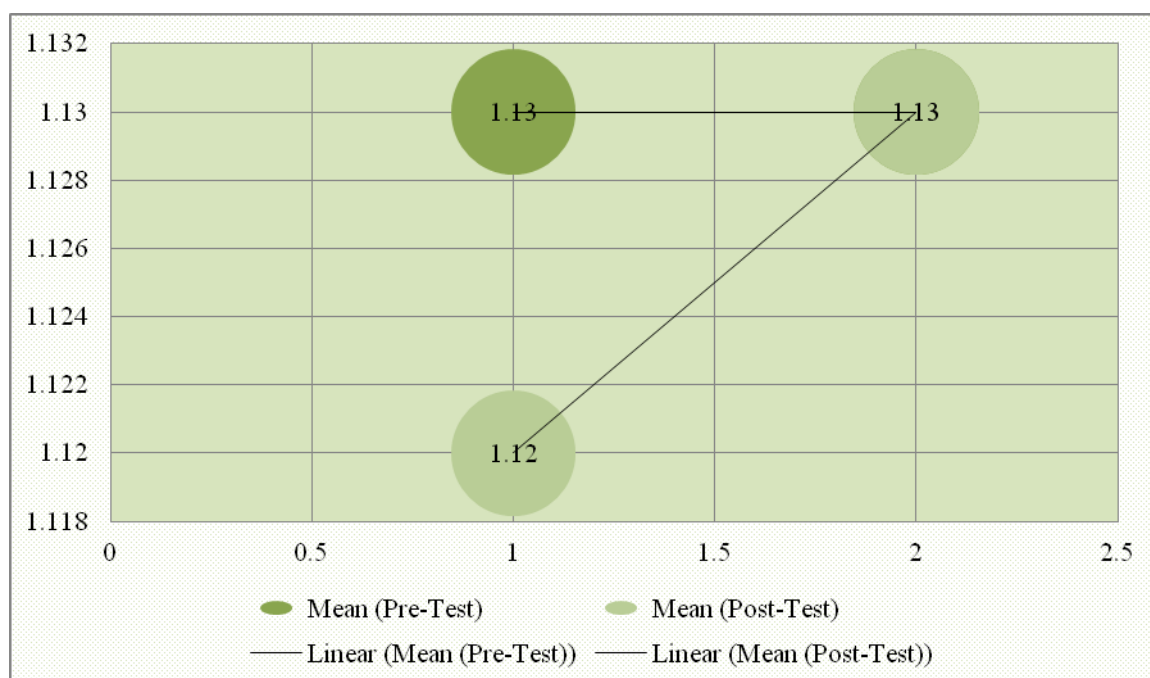


Figure 4. Mean values of Bone Integrity in Experimental and Control group (n=21 each) before (Pre) and after (Post) 4-weeks Surya Nadi Pranayama Training Programme (Experimental group only)

5. Conclusions

Based on the analysis of the results obtained, we conclude that the significant differences

were found in Metabolic Fitness (MetF) (i.e., Maximal Oxygen Consumption (V_{O_2max}) of University Level Girls. Insignificant between-group differences were noted in Blood Lipid, Blood Pressure, Blood Sugar and Bone Integrity of University Level Girls.

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