CHAPTER IV

RESULTS AND DISCUSSIONS

4.1 OVERVIEW

This chapter deals with the analysis of data collected from the samples under study. This research was to out the effects of physical exercises and suryanamaskar practices on selected health related physical fitness, physiological and biochemical variables among college women students. To facilitate the study sixty college women students were randomly selected from different colleges in Chennai. Their age was between 19 and 23 years. They were assigned into three groups of which one group served as physical exercises group (PEG), second group served as suryanamaskar group (SNG) and the third one as control group (CG). Taking into consideration of feasibility criteria, availability of instruments and the relevance of the variables of the present study, the following variables were selected.

Health Related Physical Fitness Variables

1. Cardiorespiratory Endurance
2. Muscular Endurance
3. Muscular Strength
4. Flexibility
5. Body Composition

Physiological Variables

1. VO_2 max
2. Mean Arterial Blood Pressure
3. Resting Pulse Rate
4. Forced Vital Capacity

Biochemical Variables

1. Triglycerides
2. Total Cholesterol
3. High Density Lipoprotein
4. Low Density Lipoprotein

The study was formulated as a true random group design, consisting of a pre test and post test. The subjects (N=60) were randomly assigned to three equal groups of twenty students each. The groups were assigned as Experimental Groups I, II and control group respectively. Pre tests were conducted for all the subjects on selected health related physical fitness, physiological and biochemical variables such as cardiorespiratory endurance, muscular strength, muscular endurance, flexibility and body composition, forced vital capacity, mean arterial blood pressure, VO_2 max and resting pulse rate and biochemical variables, triglycerides, total cholesterol, High Density Lipoprotein and Low Density Lipoprotein. The experimental groups participated in their respective physical exercises (PEG) and suryanamaskar (SNG) for a period of

twelve weeks. The post tests were conducted on the above said dependent variables after a period of twelve weeks experimental treatments in the respective training protocols. The mean differences between the initial and final means on selected criterion variables were considered as the effect of the respective experimental treatment.

4.2 TEST OF SIGNIFICANCE

As Clarke and Clarke (1970) say, “these data must be analysed in ways appropriate to the research design. Such analysis can only be appropriate to the research design. And such analysis can only be accomplished through the application of pertinent statistics”.

This is the vital portion of thesis achieving the conclusion by examining the hypotheses. The procedure of testing the hypotheses was either by accepting the hypotheses or rejecting the same in accordance with the results obtained in relation to the level of confidence.

The test was usually called the test of significance since we test whether the differences between three groups or within many groups scores were significant or not. In this study, if the obtained F-value were greater than the table value, the null hypotheses were rejected to the effect that there existed significant difference among the means of the groups compared and if the obtained values were lesser than the required values, then the null hypotheses were accepted to the effect that there existed no significant differences among the means of the groups under study.

4.2.1 LEVEL OF SIGNIFICANCE

The subjects were compared on the effect of Physical Exercises and Suryanamaskar practices on selected criterion variables among college women students. The selected criterion variables were, cardiorespiratory endurance, muscular endurance, muscular strength, flexibility, body composition, forced vital capacity, VO_2 max, mean arterial blood pressure, resting pulse rate, triglycerides, total cholesterol, High Density Lipoprotein and Low Density Lipoprotein. The analysis of covariance (ANCOVA) was used to find out the significant difference if any, between the groups on selected criterion variables separately. In all the cases, 0.05 level of confidence was fixed to test the significance, which was considered as appropriate.

In this study, if the obtained F value were greater than the table value, the null hypotheses were rejected to the effect that there existed significant difference among the means of the groups compared and if the obtained values were lesser than the required values at 0.05 level, then the null hypotheses were accepted to the effect that there existed no significant differences among the means of the groups under study.

4.3 COMPUTATION OF ANALYSIS OF COVARIANCE AND SCHEFFE'S POST HOC TEST

4.3.1 RESULTS ON CARDIORESPIRATORY ENDURANCE

The statistical analysis comparing the initial and final means of Cardiorespiratory Endurance due to Physical exercises and Suryanamaskar practices among college women students is presented in Table VIII.

Table VIII

COMPUTATION OF ANALYSIS OF COVARIANCE OF CARDIORESPIRATORY ENDURANCE

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	74.60	76.30	77.35	B	77.03	2.00	38.52	1.35
				W	1631.55	57.00	28.62	
Post Test Mean	81.00	82.85	78.15	B	224.23	2.00	112.12	**3.25***
				W	1965.10	57.00	34.48	
Adjusted Post Test Mean	82.49	82.63	76.88	B	419.34	2.00	209.67	**37.05***
				W	316.91	56.00	5.66	
Mean Diff	-6.40	-6.55	-0.80					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table VIII, the obtained pre test means on Cardiorespiratory Endurance on Physical exercises group was 74.60, Suryanamaskar practices group was 76.30 was and control group was 77.35. The obtained pre test F value was 1.35 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Cardiorespiratory Endurance on Physical exercises group was 81.00, Suryanamaskar practices group was 82.85

was and control group was 78.15. The obtained post test F value was 3.25 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 37.05 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table IX.

Table IX

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON CARDIORESPIRATORY ENDURANCE

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
76.88	82.49		**5.61***	2.20
76.88		82.63	**5.76***	2.20
	82.49	82.63	0.14	2.20

***** Significant

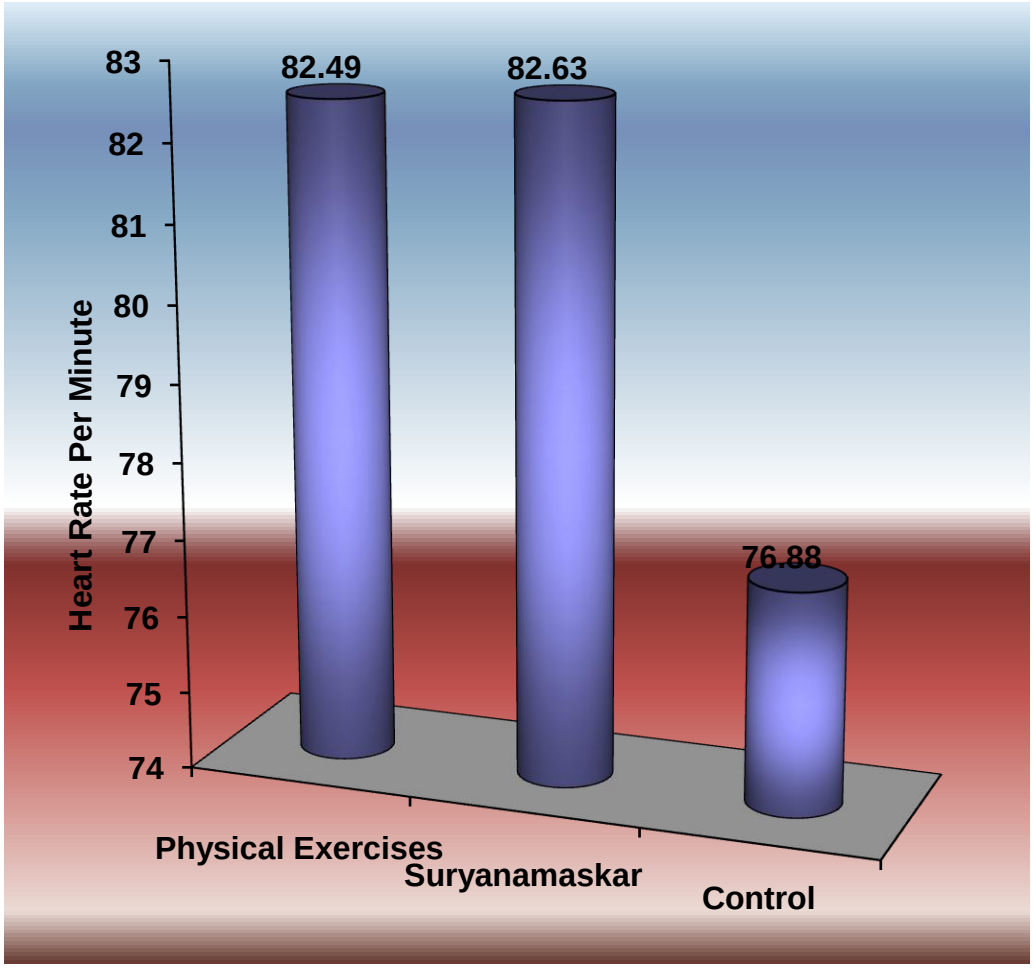
The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 5.61). There was significant difference between

Suryanamaskar practices group and control group (MD: 5.76). There was no significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 0.14).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 14.

Figure 14

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON CARDIORESPIRATORY ENDURANCE



4.3.1.2 DISCUSSIONS ON FINDINGS ON CARDIORESPIRATORY ENDURANCE

The effect of Physical exercises and Suryanamaskar practices on Cardiorespiratory Endurance is presented in Table VIII. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 37.05 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table IX proved that there was significant difference between Physical exercises group and control group (MD: 5.61) and Suryanamaskar practices group and control group (MD: 5.76). Comparing between the treatment groups, it was found that there was no significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Physical Exercise group and Suryanamaskar group were significantly better than control group in improving Cardiorespiratory Endurance of the college women students.

Loprinzi and Kane, (2015) examined the effects of acute exercise intensity and free-living physical activity and found acute moderate-intensity exercise, improve cardiorespiratory fitness among young and healthy adults. **Padmanathan, (2011)** founded that the low impact aerobic exercises significantly improved cardio respiratory endurance of male adolescents. **Jakhotia, et al., (2015)** compared the effect of circuit training (CT), treadmill (TM) walking and suryanamaskar (SN) and found all three

methods in improving cardio-respiratory fitness. **Bhutkar, et al., (2008)** found regular practice of ‘suryanamaskar’ in improving the cardio-respiratory fitness.

The findings of this study that Physical Exercise group and Suryanamaskar group were significantly better than control group in improving Cardiorespiratory Endurance of the college women students was in agreement with the previous findings of **Loprinzi and Kane (2015), Padmanathan, (2011), Jakhotia, et al., (2015)** and **Bhutkar, et al., (2008)**.

4.3.2 RESULTS ON MUSCULAR ENDURANCE

The statistical analysis comparing the initial and final means of Muscular Endurance due to Physical exercises and Suryanamaskar practices among college women students is presented in Table X

Table X

COMPUTATION OF ANALYSIS OF COVARIANCE OF MUSCULAR ENDURANCE

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	33.20	30.60	32.25	B	69.23	2	34.62	0.85
				W	2327.75	57	40.84	
Post Test Mean	36.75	33.20	32.75	B	192.03	2	96.02	3.39*
				W	1616.70	57	28.36	
Adjusted Post Test Mean	35.89	34.23	32.58	B	108.96	2	54.48	8.06*
				W	378.30	56	6.76	
Mean Diff	3.55	2.60	0.50					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table X, the obtained pre test means on Muscular Endurance on Physical exercises group was 33.20, Suryanamaskar practices group was 30.60 was and control group was 32.25. The obtained pre test F value was 0.85 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Muscular Endurance on Physical exercises group was 36.75, Suryanamaskar practices group was 33.20 was and control group was 32.75. The obtained post test F value was 3.39 and the

required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 8.06 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XI

Table XI

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON MUSCULAR ENDURANCE

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
35.89	34.23		1.65	2.07
35.89		32.58	**3.31***	2.07
	34.23	32.58	1.65	2.07

***** Significant

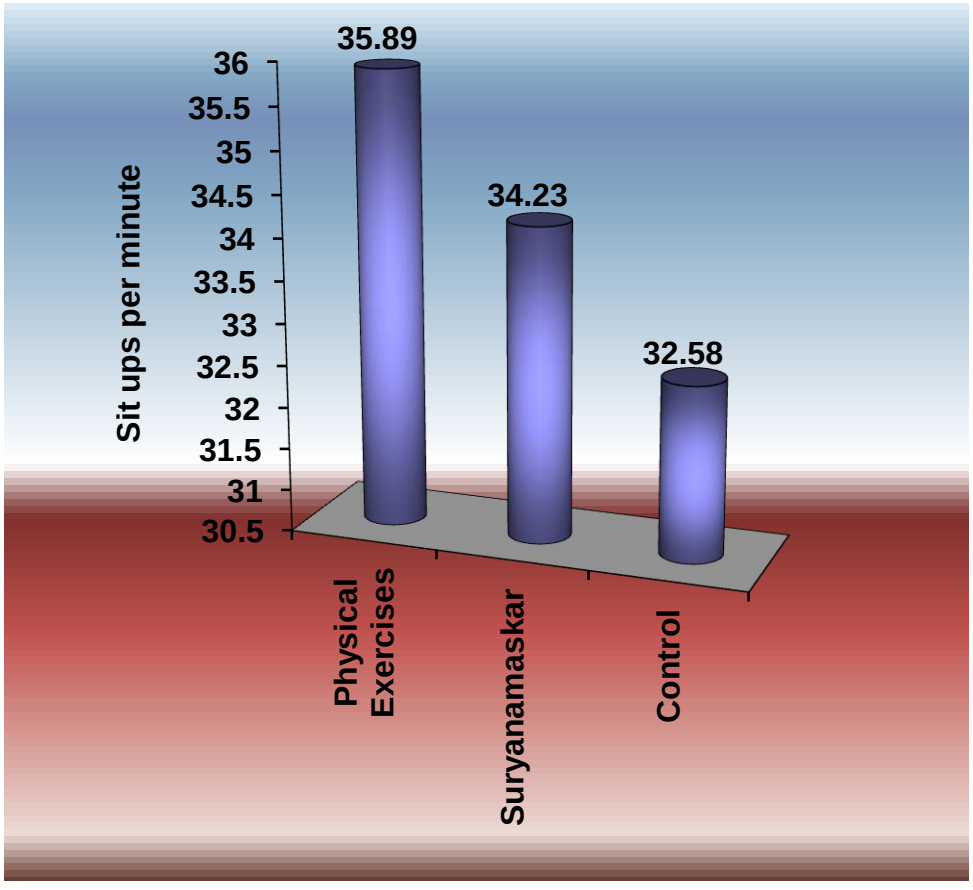
The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 3.31). There was no significant difference between

Suryanamaskar practices group and control group (MD: 1.65). There was no significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 1.65).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 15.

Figure 15

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON MUSCULAR ENDURANCE



4.3.2.2 DISCUSSIONS ON FINDINGS ON MUSCULAR ENDURANCE

The effect of Physical exercises and Suryanamaskar practices on Muscular Endurance is presented in Table X. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 8.06 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XI proved that there was significant difference between Physical exercises group and control group (MD: 3.31) and there is no significant difference between Suryanamaskar practices group and control group (MD: 1.65). Comparing between the treatment groups, it was found that there was no significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that physical exercise group was significantly better than control group in improving Muscular Endurance of the college women students.

Vilela, et al., (2015) found a structured program of physical exercise was effective in improving body composition, abdominal strength, upper limb strength, and flexibility in workers. **Telles, et al., (2013)** found yoga and physical exercise increased BMI, and number of sit-ups. **Lohan and Rajesh (2002)** found asanas and pranayamas physical fitness variables abdominal strength, speed, agility, power and endurance and physiological variables blood pressure, heart rate, vital capacity and pulse rate. Jakhotia, et al., (2015) compared the effect of circuit training (CT), treadmill (TM) walking

and suryanamaskar (SN) and found all three methods in improving cardio-respiratory fitness and upper limb muscle endurance. **Bhutkar, et al., (2011)** experimented with suryanamaskar and found significant decrease in body fat percent was observed only in female and improvement in Muscle Strength, body endurance among men. **Bhavanani, et al., (2011)** found Suryanamaskar has positive physiological benefits as evidenced by improvement of pulmonary function, respiratory pressures, hand grip strength and endurance, and resting cardiorespiratory parameters.

The previous research findings proved that muscular endurance was significantly improved due to physical exercises and suryanamaskar. The findings of this study that muscular endurance was significantly improved due to physical exercises were in agreement with these previous researches.

4.3.3 RESULTS ON MUSCULAR STRENGTH

The statistical analysis comparing the initial and final means of Muscular Strength due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XII.

Table XII

COMPUTATION OF ANALYSIS OF COVARIANCE OF MUSCULAR STRENGTH

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	12.55	11.75	12.25	B	6.53	2	3.27	0.66
				W	282.45	57	4.96	
Post Test Mean	14.80	14.45	13.20	B	28.30	2	14.15	2.75
				W	293.35	57	5.15	
Adjusted Post Test Mean	14.50	14.81	13.14	B	31.24	2	15.62	**8.86***
				W	98.74	56	1.76	
Mean Diff	2.25	2.70	0.95					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XII, the obtained pre test means on Muscular Strength on Physical exercises group was 12.55, Suryanamaskar practices group was 11.75 was and control group was 12.25. The obtained pre test F value was 0.66 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Muscular Strength on Physical exercises group was 14.80, Suryanamaskar practices group was 14.45 was and control group was 13.20. The obtained post test F value was 2.75 and the required table F value was 3.16, which proved that there was no significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 8.86 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XIII.

Table XIII

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON MUSCULAR STRENGTH

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
14.50	14.81		0.31	1.06
14.50		13.14	**1.35***	1.06
	14.81	13.14	**1.67***	1.06

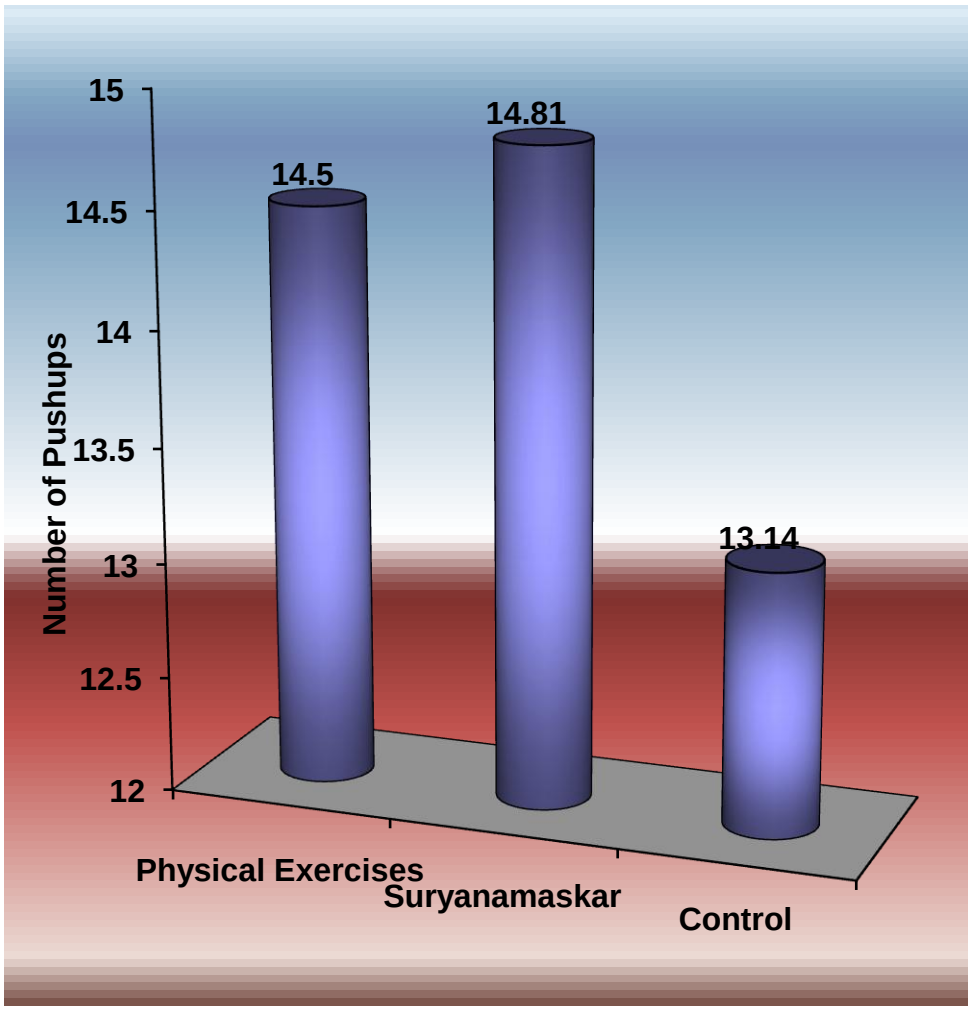
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 1.35). There was significant difference between Suryanamaskar practices group and control group (MD: 1.67). There was no significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 0.31).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 16.

Figure 16

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON MUSCULAR STRENGTH



4.3.3.2 DISCUSSIONS ON FINDINGS ON MUSCULAR STRENGTH

The effect of Physical exercises and Suryanamaskar practices on Muscular Strength is presented in Table XII. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 8.86 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XIII proved that there was significant difference between Physical exercises group and control group (MD: 1.35) and Suryanamaskar practices group and control group (MD: 1.67). Comparing between the treatment groups, it was found that there was no significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Physical Exercise group and Suryanamaskar group were significantly better than Physical Exercises group and control group in improving Muscular Strength of the college women students.

D'souza and Avadhany (2014) studied effect of yoga training and detraining on physical performance measures. The results suggest that the improvement in the physical performance is largely by the increase in the respiratory muscle strength in the yoga group. In conclusion, the study presents the efficacy of yoga to improve strength, endurance, whole body endurance and aerobic capacity**. Vilela, et al., (2015)** found a structured program of physical exercise was effective in improving body composition, abdominal strength, upper limb strength, and flexibility in workers. **Telles, et al., (2013)** found yoga

and physical exercise increased BMI, and number of sit-ups. **Lohan and Rajesh (2002)** found asanas and pranayamas physical fitness variables abdominal strength, speed, agility, power and endurance and physiological variables blood pressure, heart rate, vital capacity and pulse rate. **Bhutkar, et al., (2011)** experimented with suryanamaskar and found significant decrease in body fat percent was observed only in female and improvement in Muscle Strength, body endurance among men. **Bhavanani, et al., (2011)** found Suryanamaskar has positive physiological benefits as evidenced by improvement of pulmonary function, respiratory pressures, hand grip strength and endurance, and resting cardiorespiratory parameters.

The previous research findings proved that muscular strength was significantly improved due to physical exercises and suryanamaskar. The findings of this study that muscular strength was significantly improved due to physical exercises were in agreement with the findings **of D'souza and Avadhany (2014), Vilela, et al., (2015), Telles et al., (2013), Bhutkar, et al., (2011)** and **Bhavanani, et al., (2011)**.

4.3.4 RESULTS ON FLEXIBILITY

The statistical analysis comparing the initial and final means of Flexibility due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XIV

Table XIV

COMPUTATION OF ANALYSIS OF COVARIANCE OF FLEXIBILITY

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	10.10	9.25	9.75	B	7.30	2	3.65	1.38
				W	151.30	57	2.65	
Post Test Mean	12.00	13.55	10.50	B	93.03	2	46.52	**12.51***
				W	211.95	57	3.72	
Adjusted Post Test Mean	11.83	13.74	10.48	B	104.95	2	52.48	**15.81***
				W	185.93	56	3.32	
Mean Diff	1.90	4.30	0.75					

*Significantat 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XIV, the obtained pre test means on Flexibility on Physical exercises group was 10.10, Suryanamaskar practices group was 9.25 was and control group was 9.75. The obtained pre test F value was 1.38 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Flexibility on Physical exercises group was 12.00, Suryanamaskar practices group was 13.55 was and control group was 10.50. The obtained post test F value was 12.51 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 15.81 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XV.

Table XV

Scheffe's Confidence Interval Test Scores on Flexibility

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
11.83	13.74		**1.90***	1.45
11.83		10.48	**1.35***	1.45
	13.74	10.48	**3.26***	1.45

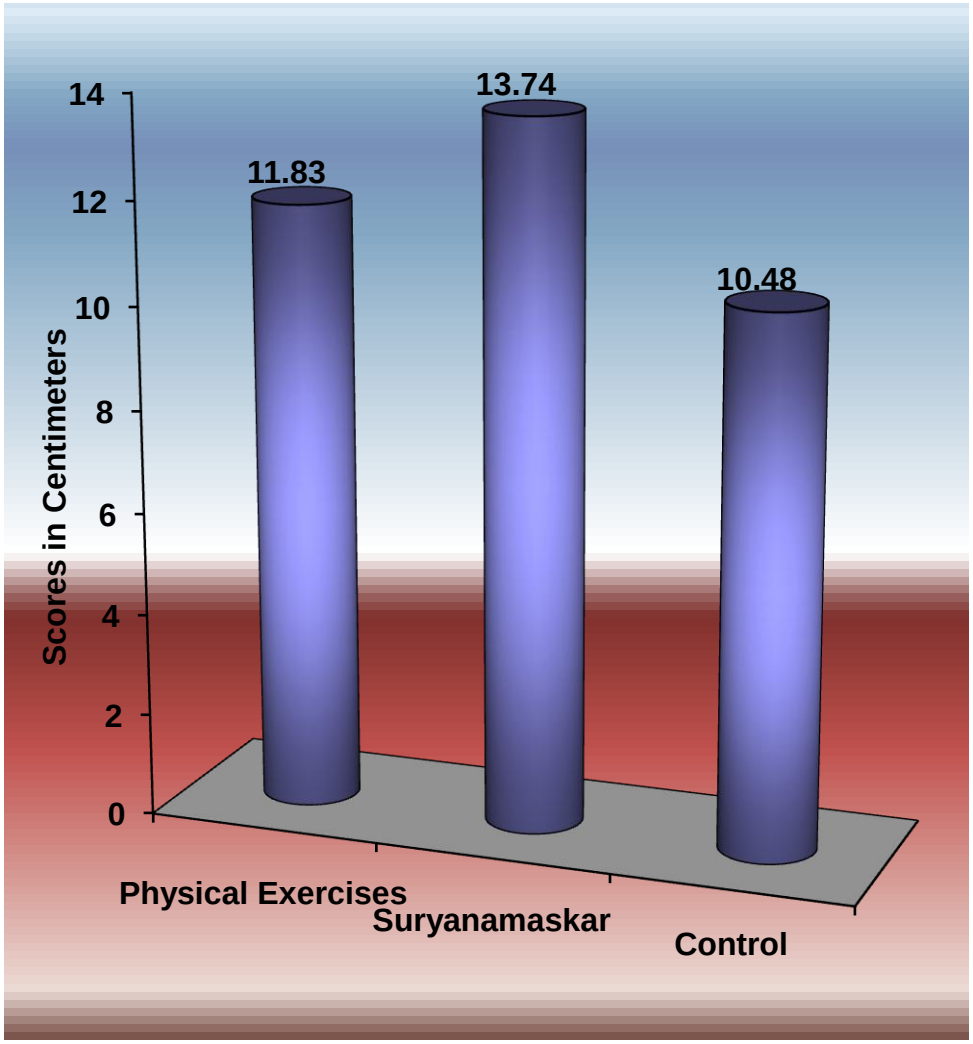
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 1.35). There was significant difference between Suryanamaskar practices group and control group (MD: 3.26). There was significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 1.90).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 17.

Figure 17

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON FLEXIBILITY



4.3.4.2 DISCUSSIONS ON FINDINGS ON FLEXIBILITY

The effect of Physical exercises and Suryanamaskar practices on Flexibility is presented in Table XIV. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 15.81 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XV proved that there was significant difference between Physical exercises group and control group (MD: 1.35) and Suryanamaskar practices group and control group (MD: 3.26). Comparing between the treatment groups, it was found that there was significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Suryanamaskar group was significantly better than Physical Exercises group and control group in improving Flexibility of the college women students.

Vilela, et al., (2015) found a structured program of physical exercise was effective in improving body composition, abdominal strength, upper limb strength, and flexibility in workers. **Jakhotia, et al., (2015)** compared the effect of circuit training (CT), treadmill (TM) walking and suryanamaskar (SN) and found all three methods in improving cardio-respiratory fitness and upper limb muscle endurance while only SN was effective in improving body flexibility. **Amin and Goodman (2014)** evaluated the effects of a six week Iyengar yoga intervention on flexibility and found significant increase in flexibility due to Iyengar Yoga. **Giannaki, et al., (2015)** found high intensity training on

physical fitness and found effective in reducing total body fat and visceral adiposity ($p < 0.05$) and improving handgrip strength, sprint time, jumping ability and flexibility ($p < 0.05$).

The findings of this study proved that both physical exercises and Suryanamaskar groups significantly improved flexibility and comparing between the treatment groups it was found that Suryanamaskar group was significantly better than Physical Exercises group and control group in improving Flexibility of the college women students. The findings of this study are in agreement with the previous findings of **Vilela, et al., (2015), Jakhotia, et al., (2015), Amin, and Goodman (2014)** and **Giannaki, et al., (2015).**

4.3.5 RESULTS ON PERCENT BODY FAT

The statistical analysis comparing the initial and final means of Percent Body Fat due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XVI.

Table XVI

COMPUTATION OF ANALYSIS OF COVARIANCE OF PERCENT BODY FAT

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	26.48	26.92	27.14	B	4.48	2	2.24	1.53
				W	83.79	57	1.47	
Post Test Mean	24.45	23.92	26.65	B	83.86	2	41.93	**33.65***
				W	71.02	57	1.25	
Adjusted Post Test Mean	24.74	23.86	26.41	B	66.47	2	33.23	**116.97***
				W	15.91	56	0.28	
Mean Diff	-2.03	-3.00	-0.49					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XVI, the obtained pre test means on Percent Body Fat on Physical exercises group was 26.48, Suryanamaskar practices group was 26.92 was and control group was 27.14. The obtained pre test F value was 1.53 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Percent Body Fat on Physical exercises group was 24.45, Suryanamaskar practices group was 23.92 was and control group was 26.65. The obtained post test F value was 33.65 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 116.97 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XVII.

Table XVII

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON PERCENT BODY FAT

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
24.74	23.86		**0.88***	0.42
24.74		26.41	**1.67***	0.42
	23.86	26.41	**2.55***	0.42

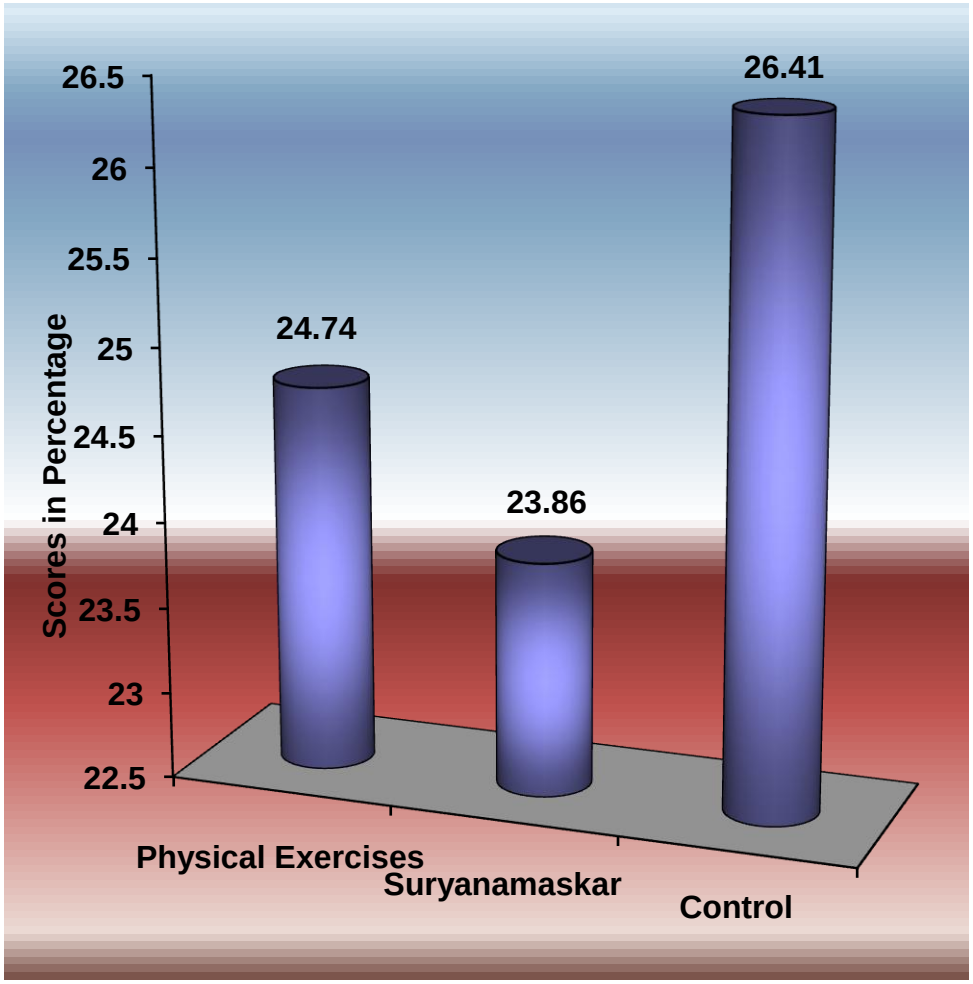
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 1.67). There was significant difference between Suryanamaskar practices group and control group (MD: 2.55). There was significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 0.88).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 18.

Figure 18

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON PERCENT BODY FAT



4.3.5.2 DISCUSSIONS ON FINDINGS ON PERCENT BODY FAT

The effect of Physical exercises and Suryanamaskar practices on Percent Body Fat is presented in Table XVI. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 116.97 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XVII proved that there was significant difference between Physical exercises group and control group (MD: 1.67) and Suryanamaskar practices group and control group (MD: 2.55). Comparing between the treatment groups, it was found that there was significant difference between Physical exercises and Suryanamaskar practices group among college women students (MD: 0 .88).

Thus, it was found that Suryanamaskar group was significantly better than Physical Exercises group and control group in reducing Percent Body Fat of the college women students.

The findings of this study proved that both physical exercises and Suryanamaskar groups significantly reduced Percent Body Fat and comparing between the treatment groups it was found that Suryanamaskar group was significantly better than Physical Exercises group and control group in improving Percent Body Fat of the college women students. **Gutin et al., (2002*)*** founded that the physical training intensity enhancing body composition. **Bhutkar, et al., (2011)** founded effects of regular practice of sun salutation significant decrease in body fat percent was observed only in female but not in male subjects.

Jakhotia, et al., (2015) compared the effect of circuit training (CT), treadmill (TM) walking and suryanamaskar (SN) and found Reduction in mean total body fat % in the CT (5%) and SN (3.7%). **Vilela, et al., (2015)** found the effects of a workplace fitness and education program intervention showed a significant decrease in body fat.

The findings of this study proved that Physical Exercise group and Suryanamaskar group were significantly better than control group in reducing Percent Body Fat of the college women students and these findings were in agreement with the previous researches cited.

4.3.6 RESULTS ON VO_2 MAX

The statistical analysis comparing the initial and final means of VO_2 Max due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XVIII.

Table XVIII

COMPUTATION OF ANALYSIS OF COVARIANCE OF VO_2 MAX

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	37.00	36.23	36.87	B	6.78	2	3.39	0.17
				W	1152.61	57	20.22	
Post Test Mean	40.50	40.90	37.01	B	183.01	2	91.50	**5.79***
				W	901.43	57	15.81	
Adjusted Post Test Mean	40.29	41.23	36.89	B	207.58	2	103.79	**17.15***
				W	338.83	56	6.05	
Mean Diff	3.50	4.67	0.14					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XVIII, the obtained pre test means on VO_2 Max on Physical exercises group was 37.00, Suryanamaskar practices group was 36.23 was and control group was 36.87. The obtained pre test F value was 0.17 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on VO_2 Max on Physical exercises group was 40.50, Suryanamaskar practices group was 40.90 was and control group was 37.01. The obtained post test F value was 5.79 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 17.15 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XIX.

Table XIX

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON VO_2 MAX

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
40.29	41.23		0.94	1.96
40.29		36.89	**3.40***	1.96
	41.23	36.89	**4.33***	1.96

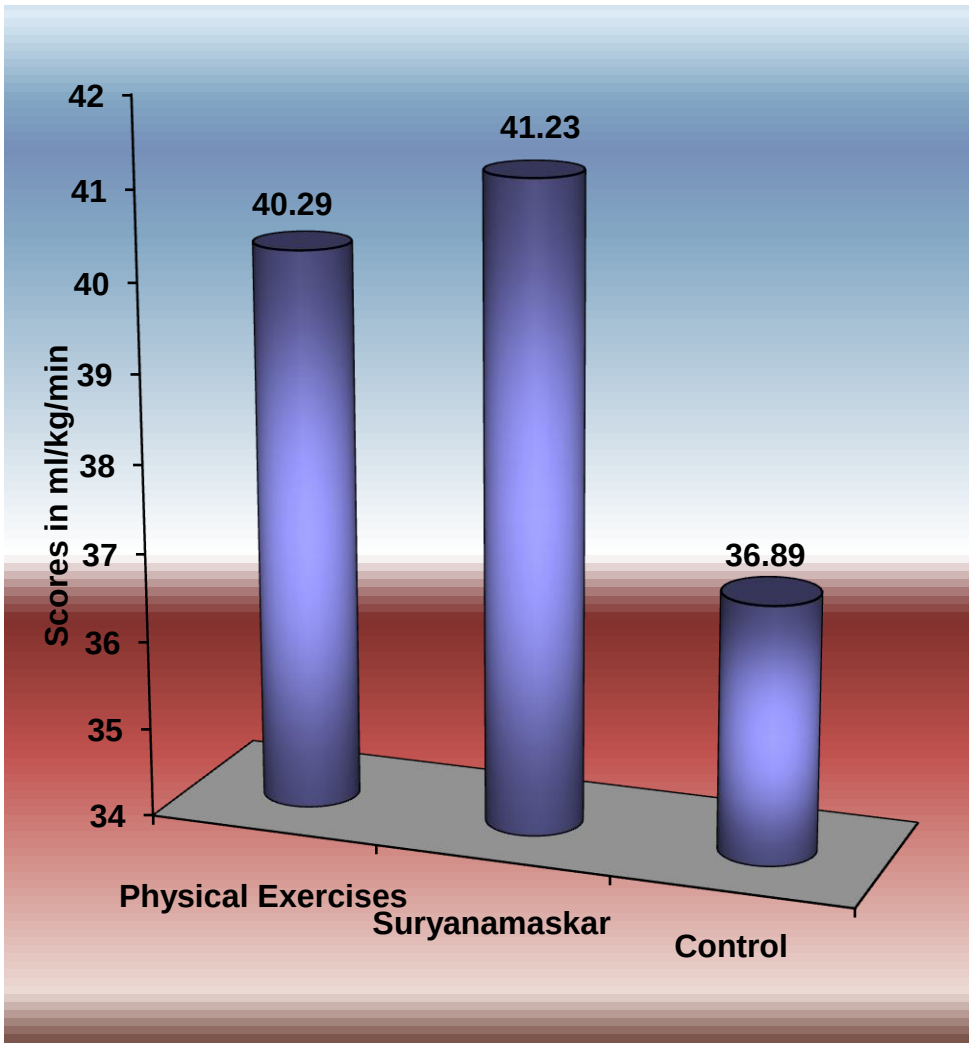
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 3.40). There was significant difference between Suryanamaskar practices group and control group (MD: 4.33). There was no significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 0.94).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 19.

Figure 19

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON VO_2 MAX



4.3.6.2 DISCUSSIONS ON FINDINGS ON VO_2 MAX

The effect of Physical exercises and Suryanamaskar practices on VO_2 Max is presented in Table XVIII. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 17.15 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XIX proved that there was significant difference between Physical exercises group and control group (MD: 3.40) and Suryanamaskar practices group and control group (MD: 4.33). Comparing between the treatment groups, it was found that there was no significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Physical Exercise group and Suryanamaskar group were significantly better than control group in improving VO_2 Max of the college women students.

Kahlin, et al., (2014) found Maximal oxygen consumption was improved in the intervention group compared with the controls ($P < .001$) due to physical exercise intervention. **Sinha and Sinha (2014)** found Suryhanamaskar improved cardiorespiratory parameters oxygen consumption and heart rate. **Cho, et al., (2014)** found long term combined exercise including aerobic and resistance exercise contributed for significant increased in VO2max. **Jimenez (2010)** found the effect of an intensive HY intervention on cardiorespiratory risk

factors in middle-aged and older women. The proposed IHY program increased VO 2max. **Mark, et al., (2001)** determined the effects of hatha yoga practice on the health-related aspects of physical fitness. Absolute and relative maximal oxygen uptake increased by 7% and 6%, respectively ($p<0.01$).

The findings of this study proved that Physical Exercise group and Suryanamaskar group were significantly better than control group in improving VO_2 Max of the college women students and these findings were in agreement with the previous researches cited.

4.3.7 RESULTS ON MEAN ARTERIAL BLOOD PRESSURE

The statistical analysis comparing the initial and final means of Mean Arterial Blood Pressure due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XX.

Table XX

COMPUTATION OF ANALYSIS OF COVARIANCE OF MEAN ARTERIAL BLOOD PRESSURE

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	97.93	98.18	97.05	B	13.96	2	6.98	0.52
				W	764.22	57	13.41	
Post Test Mean	96.76	97.88	98.46	B	29.84	2	14.92	1.38
				W	616.63	57	10.82	
Adjusted Post Test Mean	96.72	97.78	98.60	B	35.45	2	17.72	1.70
				W	582.18	56	10.40	
Mean Diff	-1.16	-0.30	1.41					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XX, the obtained pre test means on Mean Arterial Blood Pressure on Physical exercises group was 97.93, Suryanamaskar practices group was 98.18 was and control group was 97.05. The obtained pre test F value was 0.52 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

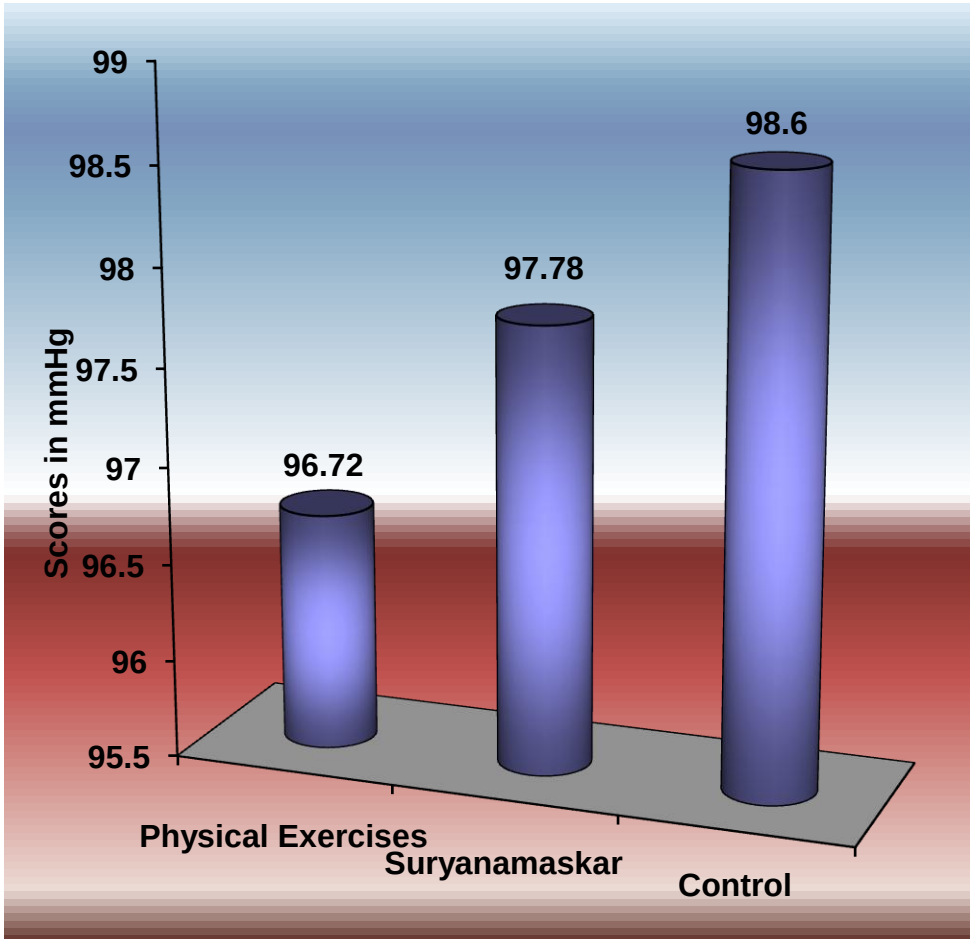
The obtained post test means on Mean Arterial Blood Pressure on Physical exercises group was 96.76, Suryanamaskar practices group was 97.88 was and control group was 98.46. The obtained post test F value was 1.38 and the required table F value was 3.16, which proved that there was no significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 1.70 was lesser than the required value of 3.16 and hence it was accepted that there was no significant differences among the treated groups.

Since insignificant differences were recorded, the results were not subjected to post hoc analysis. The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 20.

Figure 20

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON MEAN ARTERIAL BLOOD PRESSURE



4.3.7.2 DISCUSSIONS ON FINDINGS ON MEAN ARTERIAL BLOOD PRESSURE

The effect of Physical exercises and Suryanamaskar practices on Mean Arterial Blood Pressure is presented in Table XX. Due to physical exercise, mean arterial pressure was reduced 1.16 and due to suryanamaskar it was 0.30 and in control group there increased to the tune of 1.41. To test the statistical significance of the differences, the analysis of covariance proved that though there were mean differences in favour of Suryanamaskar group, these differences were not significant as the obtained F value 1.70 was lesser than the required table F value to be significant at 0.05 level.

Thus, it was found that Physical Exercise group and Suryanamaskar group were failed to significantly alter Mean Arterial Blood Pressure of the college women students comparing to control group.

Raub (2002) found Hatha Yoga can control such physiological variables as blood pressure, respiration and heart rate, and metabolic rate to improve overall exercise capacity. **Lohan and Rajesh (2002**) found asanas and pranayamas contributed for physical fitness variables abdominal strength, speed, agility, power and endurance and physiological variables blood pressure, heart rate, vital capacity and pulse rate. **Swift, et.al (2012)** suggested for a high dose of aerobic exercise is recommended to successfully reduce both exercise systolic and diastolic blood pressure. The findings of this study proved that physical exercises and suryanamaskar though reduced mean arterial blood pressure, it was not significant. And the findings were not in agreement with the previous findings cited, as the exercise protocols experimented in that studies were different from the one experimented in this study.

4.3.8 RESULTS ON RESTING PULSE RATE

The statistical analysis comparing the initial and final means of Resting Pulse Rate due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XXI.

Table XXI

COMPUTATION OF ANALYSIS OF COVARIANCE OF RESTING PULSE RATE

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	73.70	73.30	72.25	B	22.43	2	11.22	0.29
				W	2170.15	57	38.07	
Post Test Mean	69.75	68.35	72.75	B	202.13	2	101.07	**4.10***
				W	1406.05	57	24.67	
Adjusted Post Test Mean	69.59	68.29	72.96	B	230.35	2	115.17	**5.10***
				W	1265.82	56	22.60	
Mean Diff	-3.95	-4.95	0.50					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XXI, the obtained pre test means on Resting Pulse Rate on Physical exercises group was 73.70, Suryanamaskar practices group was 73.30 was and control group was 72.25. The obtained pre test F value was 0.29 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Resting Pulse Rate on Physical exercises group was 69.75, Suryanamaskar practices group was 68.35 was and control group was 72.75. The obtained post test F value was 4.10 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 5.10 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XXII.

Table XXII

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON RESTING PULSE RATE

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
69.59	68.29		1.30	3.78
69.59		72.96	**3.37***	3.78
	68.29	72.96	**4.67***	3.78

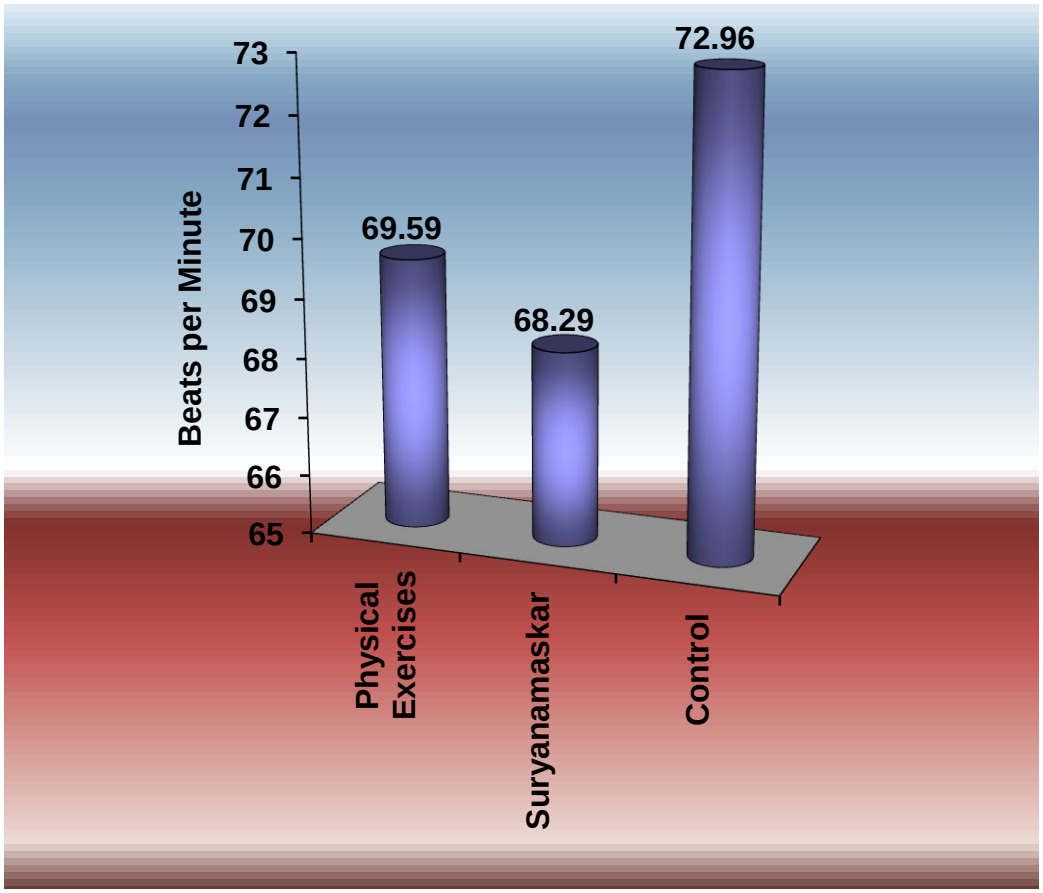
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 3.37). There was significant difference between Suryanamaskar practices group and control group (MD: 4.67). There was no significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 1.30).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 21.

Figure 21

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON RESTING PULSE RATE



4.3.8.2 DISCUSSIONS ON FINDINGS ON RESTING PULSE RATE

The effect of Physical exercises and Suryanamaskar practices on Resting Pulse Rate is presented in Table XXI. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 5.10 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XXII proved that there was significant difference between Physical exercises group and control group (MD: 3.37) and Suryanamaskar practices group and control group (MD: 4.67). Comparing between the treatment groups, it was found that there was no significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Physical Exercises group and Suryanamaskar group were significantly better than control group in reducing Resting Pulse Rate of the college women students.

Lohan and Rajesh (2002) found asanas and pranayamas contributed for physical fitness variables abdominal strength, speed, agility, power and endurance and physiological variables blood pressure, heart rate, vital capacity and pulse rate. **Bhavanani et al., (2011)** found Suryanamaskar has positive physiological benefits as evidenced by improvement of pulmonary function, respiratory pressures, hand grip strength and endurance, and resting cardiorespiratory parameters. **Sinha and Sinha (2014)** found Suryanamaskar

improved cardiorespiratory parameters oxygen consumption and heart rate**. Bhavanani, et al., (2013)** found SN can be used to regulate heart rate.

The findings of this study that Physical Exercises group and Suryanamaskar group were significantly better than control group in reducing Resting Pulse Rate of the college women students are in agreement with the findings of **Lohan and Rajesh (2002), Bhavanani , et al., (2011). Bhavanani et al., (2013)** and **Sinha and Sinha (2014)**.

4.3.9 RESULTS ON FORCED VITAL CAPACITY

The statistical analysis comparing the initial and final means of Forced Vital Capacity due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XXIII.

Table XXIII

COMPUTATION OF ANALYSIS OF COVARIANCE OF FORCED VITAL CAPACITY

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	3165.00	3157.50	3255.00	B	117750.00	2	58875.00	**0.41**
				W	8211375.00	57	144059.21	
Post Test Mean	3425.00	3602.50	3330.00	B	765250.00	2	382625.00	**2.60**
				W	8396875.00	57	147313.60	
Adjusted Post Test Mean	3448.15	3631.96	3277.39	B	1243694.50	2	621847.25	**13.50***
				W	2579267.09	56	46058.34	
Mean Diff	260.00	445.00	75.00					

*Significantat 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XXIII, the obtained pre test means on Forced Vital Capacity on Physical exercises group was 3165.00, Suryanamaskar practices group was 3157.50 was and control group was 3255.00. The obtained pre test F value was 0.41 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Forced Vital Capacity on Physical exercises group was 3425.00, Suryanamaskar practices group was 3602.50 was and control group was 3330.00. The obtained post test F value was 2.60 and the required table F value was 3.16, which proved that there was no significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 13.50 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XXIV.

Table XXIV

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON FORCED VITAL CAPACITY

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
3448.15	3631.96		**183.81***	170.61
3448.15		3277.39	**170.75***	170.61
	3631.96	3277.39	**354.57***	170.61

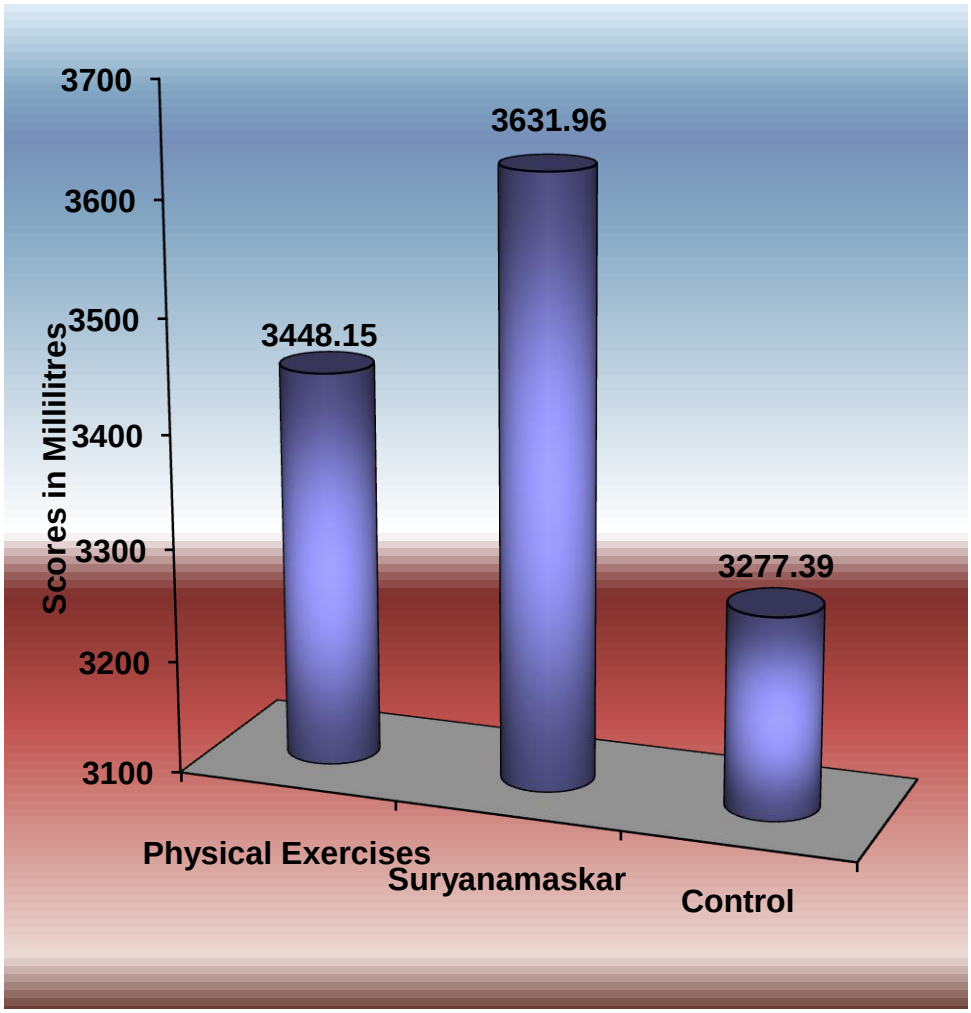
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 170.75). There was significant difference between Suryanamaskar practices group and control group (MD: 354.57). There was significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 183.81).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 22.

Figure 22

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON FORCED VITAL CAPACITY



4.3.9.2 DISCUSSIONS ON FINDINGS ON FORCED VITAL CAPACITY

The effect of Physical exercises and Suryanamaskar practices on Forced Vital Capacity is presented in Table XXIII. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 13.50 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XXIV proved that there was significant difference between Physical exercises group and control group (MD: 170.75) and Suryanamaskar practices group and control group (MD: 354.57). Comparing between the treatment groups, it was found that there was significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Suryanamaskar group was significantly better than Physical Exercises group and control group in reducing Forced Vital Capacity of the college women students.

Lohan and Rajesh (2002) found asanas and pranayamas contributed for physical fitness variables abdominal strength, speed, agility, power and endurance and physiological variables blood pressure, heart rate, vital capacity and pulse rate**. Vedala, et al., (2014)** found Yoga exercise significantly increased chest wall expansion as observed by higher values of pulmonary functions compared with sedentary controls vital capacity, timed vital capacity, maximum voluntary ventilation, breath holding time and maximal inspiratory and expiratory pressures. **Sasi Kumar, Sivapriya and Shyamala Thirumeni, (2011)**

studied the effects of suryanamaskar and yogic techniques. The results showed that the Systolic blood pressure, PEFR and FVC increased significantly and RR, HR and diastolic blood pressure decreased significantly after the practice of suryanamaskar.

The findings of this study proved that Suryanamaskar group was significantly better than Physical Exercises group and control group in reducing Forced Vital Capacity of the college women students and the findings of this study are in agreement with the findings of **Lohan and Rajesh (2002), Vedala, et al., (2014)** and **Sasi Kumar, Sivapriya and Shyamala Thirumeni, (2011)**

4.3.10 RESULTS ON TRIGLYCERIDES

The statistical analysis comparing the initial and final means of Triglycerides due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XXV.

Table XXV

COMPUTATION OF ANALYSIS OF COVARIANCE OF TRIGLYCERIDES

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	Df	MS	Obtained F
Pre Test Mean	146.84	149.59	144.38	B	271.21	2	135.61	1.18
				W	6544.82	57	114.82	
Post Test Mean	138.86	141.44	146.60	B	621.26	2	310.63	**3.49***
				W	5079.32	57	89.11	
Adjusted Post Test Mean	138.94	139.26	148.70	B	1194.85	2	597.43	**50.45***
				W	663.20	56	11.84	
Mean Diff	7.98	8.15	-2.22					

*Significantat 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XXV, the obtained pre test means on Triglycerides on Physical exercises group was 146.84, Suryanamaskar practices group was 149.59 was and control group was 144.38. The obtained pre test F value was 1.18 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Triglycerides on Physical exercises group was 138.86, Suryanamaskar practices group was 141.44 was and control group was 146.60. The obtained post test F value was 3.49 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 50.45 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XXVI.

Table XXVI

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON TRIGLYCERIDES

MEANS				**Required . C I**
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
148.70	138.94		**9.76***	3.19
148.70		139.26	**9.44***	3.19
	138.94	139.26	0.32	3.19

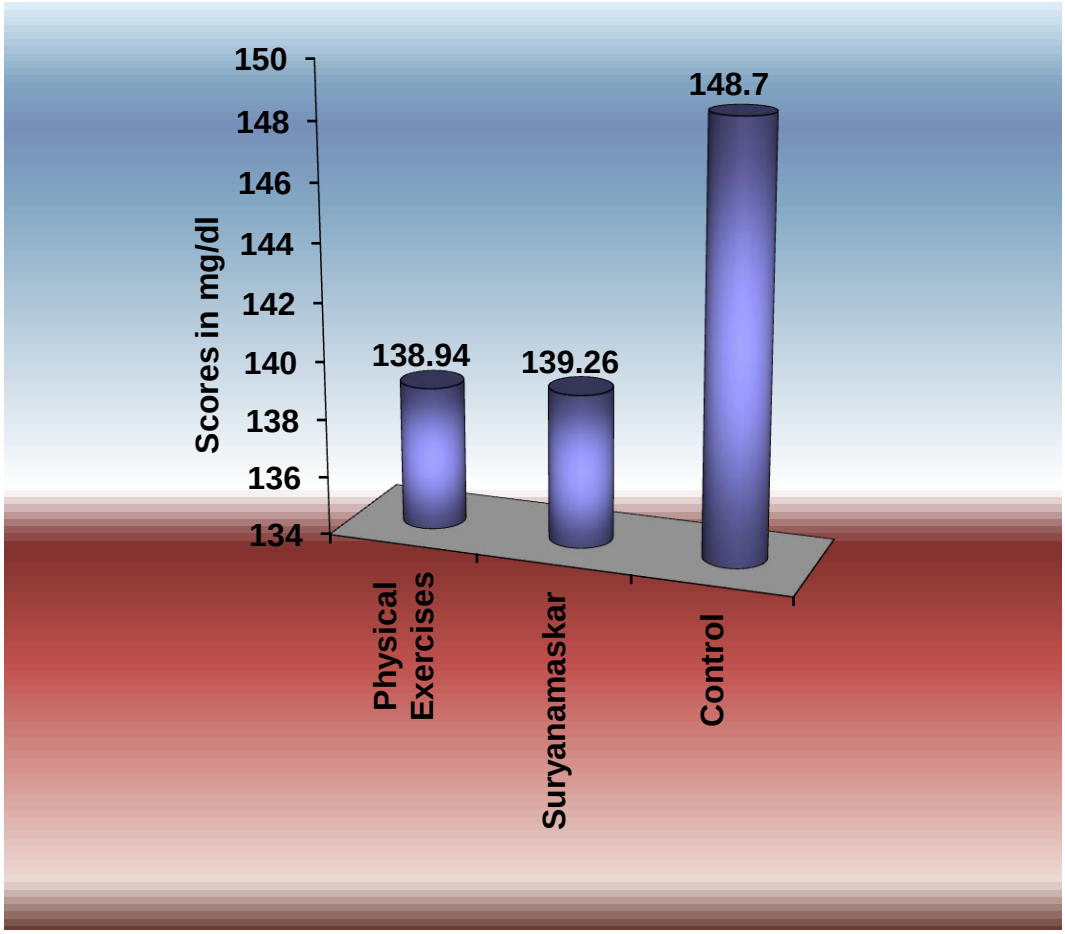
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 9.76). There was significant difference between Suryanamaskar practices group and control group (MD: 9.44). There was no significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 0.32).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 23.

Figure 23

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON TRIGLYCERIDES



4.3.10.2 DISCUSSIONS ON FINDINGS ON TRIGLYCERIDES

The effect of Physical exercises and Suryanamaskar practices on Triglycerides is presented in Table XXV. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 50.45 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XXVI proved that there was significant difference between Physical exercises group and control group (MD: 9.76) and Suryanamaskar practices group and control group (MD: 9.44). Comparing between the treatment groups, it was found that there was no significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Physical Exercises group and Suryanamaskar and Physical Exercise group were significantly better than and control group in reducing Triglycerides of the college women students.

Bijlani, et al., (2005) found short-term impact of a brief lifestyle intervention based on yoga Fasting plasma glucose, serum total cholesterol, low-density lipoprotein (LDL) cholesterol, very- LDL cholesterol, the ratio of total cholesterol to high density lipoprotein (HDL) cholesterol, and total triglycerides were significantly lower, and HDL cholesterol significantly higher, on the last day of the course compared to the first day of the course. **Cho et al., (2014)** found long term combined exercise including aerobic and resistance exercise VO2max and high-density lipoprotein cholesterol (HDL-C) were significantly

increased. Further significant decrease in triglyceride (TG) total cholesterol (TC)/HDL-C (p=0.013)**. Leela, et al., (2013)** founded the effects of Pranayama and Yoga on Triglycerides was decreased. **Santwana Mondal, Brajanath Kundu and Sukanta Saha, (2014)** assessed the effect of 12 weeks of yogatherapy intervention significantly ($p \leq 0.05$) decrease in triglycerides.

The findings of this study that Physical Exercises group and Suryanamaskar group were significantly better than Physical Exercises group and control group in reducing Triglycerides of the college women students are in agreement with the findings of **Bijlani, et al., (2005), Leela, et al., (2013), Santwana Mondal, Brajanath Kundu and Sukanta Saha, (2014)** and **Cho et al., (2014).**

4.3.11 RESULTS ON TOTAL CHOLESTEROL

The statistical analysis comparing the initial and final means of Total Cholesterol due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XXVII

Table XXVII

COMPUTATION OF ANALYSIS OF COVARIANCE OF TOTAL CHOLESTEROL

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	Df	MS	Obtained F
Pre Test Mean	168.15	174.00	167.00	B	563.09	2.00	281.55	1.63
				W	9829.20	57.00	172.44	
Post Test Mean	158.79	164.10	168.60	B	964.49	2.00	482.25	**3.30***
				W	8337.81	57.00	146.28	
Adjusted Post Test Mean	160.17	160.33	170.99	B	1506.51	2.00	753.26	**58.37***
				W	722.67	56.00	12.90	
Mean Diff	9.36	9.90	-1.60					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XXVII, the obtained pre test means on Total Cholesterol on Physical exercises group was 168.15, Suryanamaskar practices group was 174.00 was and control group was 167.00. The obtained pre test F value was 1.63 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Total Cholesterol on Physical exercises group was 158.79, Suryanamaskar practices group was 164.10 was and control group was 168.60. The obtained post test F value was 3.30 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 58.37 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XXVIII.

Table XXVIII

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON TOTAL CHOLESTEROL

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
170.99	160.17		**10.82***	3.33
170.99		160.33	**10.66***	3.33
	160.17	160.33	0.16	3.33

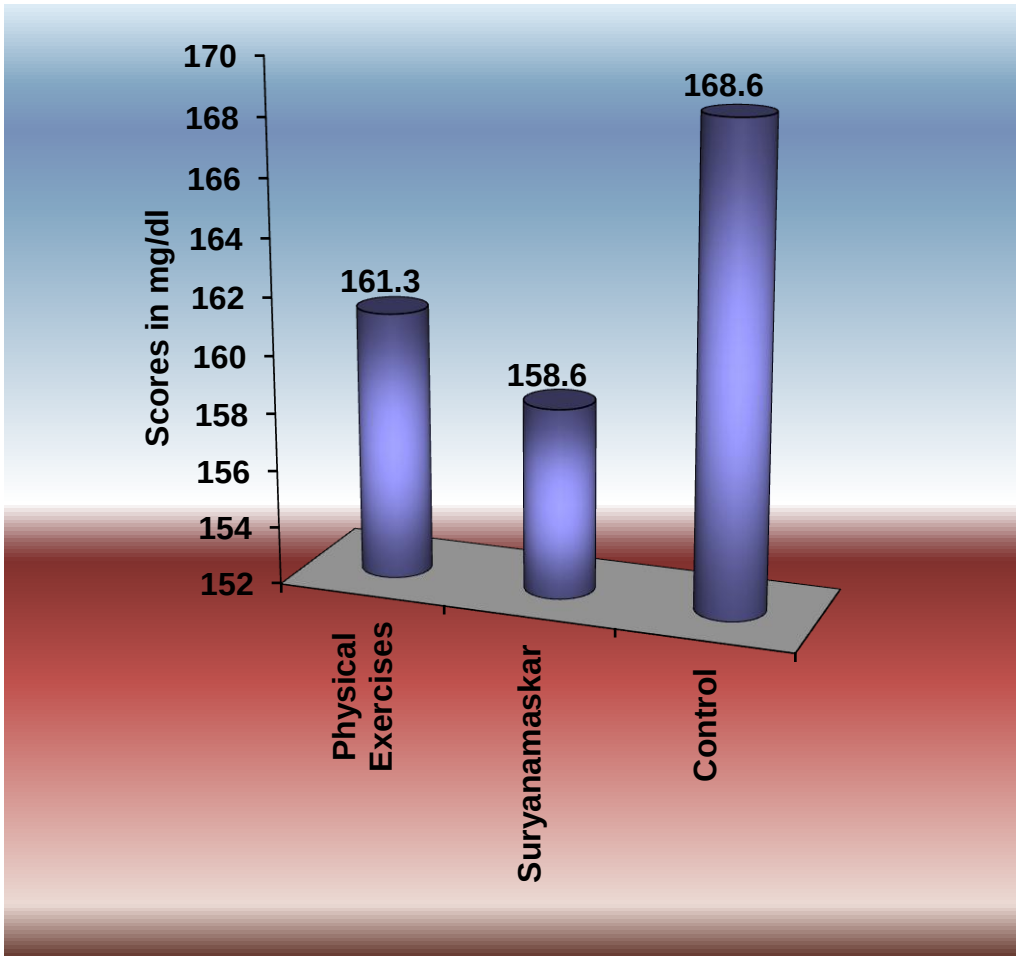
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 10.82). There was significant difference between Suryanamaskar practices group and control group (MD: 10.66). There was significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 0.16).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 24.

Figure 24

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON TOTAL CHOLESTEROL



4.3.11.2 DISCUSSIONS ON FINDINGS ON TOTAL CHOLESTEROL

The effect of Physical exercises and Suryanamaskar practices on Total Cholesterol is presented in Table XXVII. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 58.37 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XXVIII proved that there was significant difference between Physical exercises group and control group (MD: 10.82) and Suryanamaskar practices group and control group (MD: 10.66). Comparing between the treatment groups, it was found that there was significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Suryanamaskar group was significantly better than Physical Exercises group and control group in reducing Total Cholesterol of the college women students.

Bijlani, et al., (2005) found short-term impact of a brief lifestyle intervention based on yoga Fasting plasma glucose, serum total cholesterol, low-density lipoprotein (LDL) cholesterol, very- LDL cholesterol, the ratio of total cholesterol to high density lipoprotein (HDL) cholesterol, and total triglycerides were significantly lower, and HDL cholesterol significantly higher, on the last day of the course compared to the first day of the course. **Cho et al., (2014)** found long term combined exercise including aerobic and resistance exercise VO2max and high-density lipoprotein cholesterol (HDL-C) were significantly

increased. Significant increase in muscular strength and decrease in triglyceride (TG) total cholesterol (TC)/HDL-C (p=0.013)**. Santwana Mondal, Brajanath Kundu and Sukanta Saha, (2014)** founded 12 weeks of yogic intervention significantly ($p \leq 0.05$) decrease in total cholesterol. **Anjum Sayyed, et al., (2010)** observed Sudarshan Kriya Yoga may play vital role in reducing Total Cholesterol ($P<0.05$).

The findings of this study that Physical Exercises group and Suryanamaskar group were significantly better than Physical Exercises group and control group in reducing Total cholesterol of the college women students are in agreement with the findings of **Bijlani, et al., (2005), Santwana Mondal, Brajanath Kundu and Sukanta Saha, (2014), Anjum Sayyed, et al., (2010)** and **Cho et al., (2014).**

4.3.12 RESULTS ON HIGH DENSITY LIPOPROTEIN (HDL)

The statistical analysis comparing the initial and final means of HDL due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XXIX

Table XXIX

COMPUTATION OF ANALYSIS OF COVARIANCE OF HIGH DENSITY LIPOPROTEIN (HDL)

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	55.65	54.55	55.00	B	12.23	2	6.12	1.70
				W	205.50	57	3.61	
Post Test Mean	56.70	57.40	55.75	B	27.43	2	13.72	**3.39***
				W	230.75	57	4.05	
Adjusted Post Test Mean	56.20	57.84	55.81	B	45.46	2	22.73	**16.08***
				W	79.16	56	1.41	
Mean Diff	1.05	2.85	0.75					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XXIX, the obtained pre test means on HDL on Physical exercises group was 55.65, Suryanamaskar practices group was 54.55 was and control group was 55.00. The obtained pre test F value was 1.70 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on HDL on Physical exercises group was 56.70, Suryanamaskar practices group was 57.40 was and control group was 55.75. The obtained post test F value was 3.39 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 16.08 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XXX.

Table XXX

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON HIGH DENSITY LIPOPROTEIN

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
56.20	57.84		1.64*	0.95
56.20		55.81	0.39	0.95
	57.84	55.81	2.04*	0.95

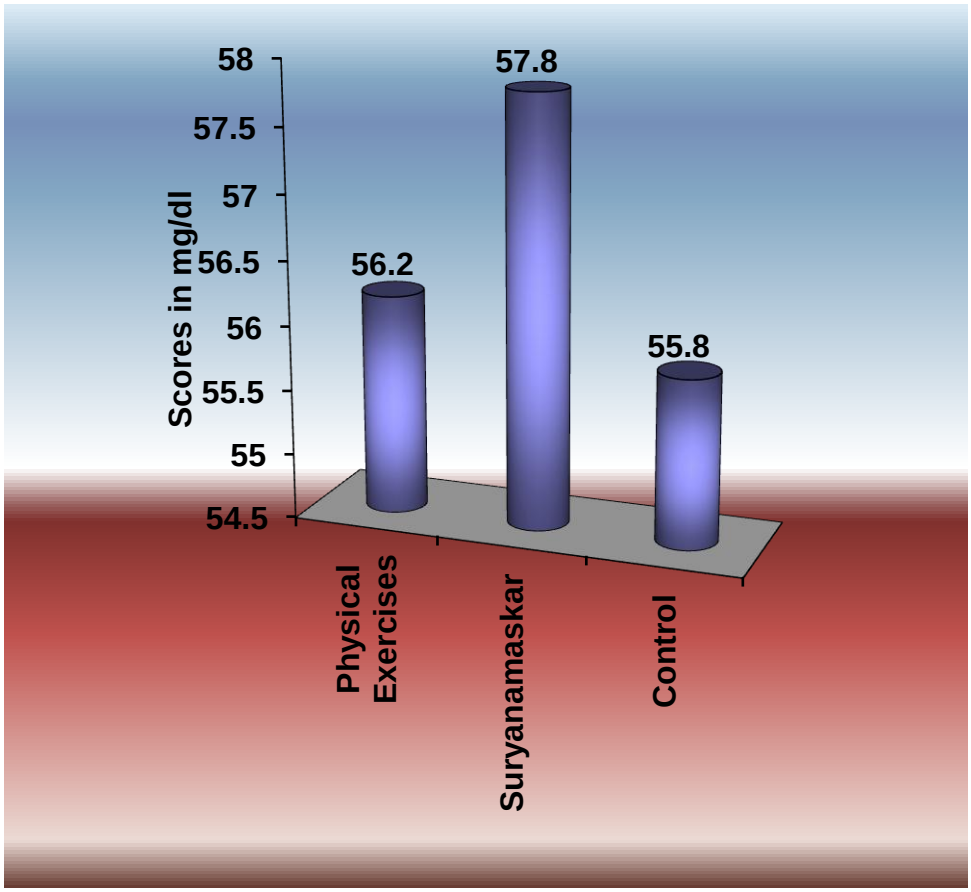
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was no significant differences existed between Physical exercises group and control group (MD: 0.39). There was significant difference between Suryanamaskar practices group and control group (MD: 2.04). There was significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD: 1.64).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 25.

Figure 25

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON HIGH DENSITY LIPOPROTEIN



4.3.12.2 DISCUSSIONS ON FINDINGS ON HDL

The effect of Physical exercises and Suryanamaskar practices on HDL is presented in Table XXIX. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 16.08 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XXX proved that there was no significant difference between Physical exercises group and control group (MD: 0.39) and there was significant difference between Suryanamaskar practices group and control group (MD: 2.04). Comparing between the treatment groups, it was found that there was significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Suryanamaskar group was significantly better than Physical Exercises group and control group in improving HDL of the college women students.

Yadav et al., (2014) found a comprehensive yoga life style intervention significantly increased HDL-c levels in a short duration. **Bijlani, et al., (2005)** found short-term impact of a brief lifestyle intervention based on yoga Fasting plasma glucose, serum total cholesterol, low-density lipoprotein (LDL) cholesterol, very- LDL cholesterol, the ratio of total cholesterol to high density lipoprotein (HDL) cholesterol, and total triglycerides were significantly lower, and HDL cholesterol significantly higher, on the last day of the course compared

to the first day of the course. **Cho et al., (2014)** found long term combined exercise including aerobic and resistance exercise VO2max and high-density lipoprotein cholesterol (HDL-C) were significantly increased. Significant increase in muscular strength and decrease in triglyceride (TG) total cholesterol (TC)/HDL-C (p=0.013)**.**

The findings of this study that Suryanamaskar group was significantly better than Physical Exercises group and control group in increasing HDL of the college women students are in agreement with the findings of **Bijlani, et al., (2005), Cho et al., (2014) and Yadav et al., (2014).**

4.3.13 RESULTS ON LOW DENSITY LIPOPROTEIN (LDL)

The statistical analysis comparing the initial and final means of LDL due to Physical exercises and Suryanamaskar practices among college women students is presented in Table XXXI.

Table XXXI

COMPUTATION OF ANALYSIS OF COVARIANCE OF LOW DENSITY LIPOPROTEIN

	Physical Exercises	Surya Namaskar Practices	Control Group	SV	SS	df	MS	Obtained F
Pre Test Mean	111.84	108.71	108.17	B	156.77	2.00	78.38	1.18
				W	3770.54	57.00	66.15	
Post Test Mean	103.99	101.55	108.26	B	461.53	2.00	230.76	**3.96***
				W	3318.70	57.00	58.22	
Adjusted Post Test Mean	102.02	102.30	109.47	B	702.06	2.00	351.03	**40.30***
				W	487.80	56.00	8.71	
Mean Diff	7.85	7.16	-0.09					

*Significant at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.

As shown in Table XXXI, the obtained pre test means on LDL on Physical exercises group was 111.84, Suryanamaskar practices group was 108.71 was and control group was 108.17. The obtained pre test F value was 1.18 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on LDL on Physical exercises group was 103.99, Suryanamaskar practices group was 101.55 was and control group was 108.26. The obtained post test F value was 3.96 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 40.30 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table XXXII.

Table XXXII

SCHEFFE'S CONFIDENCE INTERVAL TEST SCORES ON LOW DENSITY LIPOPROTEIN

MEANS				Required . C I
Physical Exercises Group	**Suryanamaskar Practices Group**	**Control Group**	**Mean Difference**	
109.47	102.02		**7.45***	2.73
109.47		102.30	**7.17***	2.73
	102.02	102.30	0.28	2.73

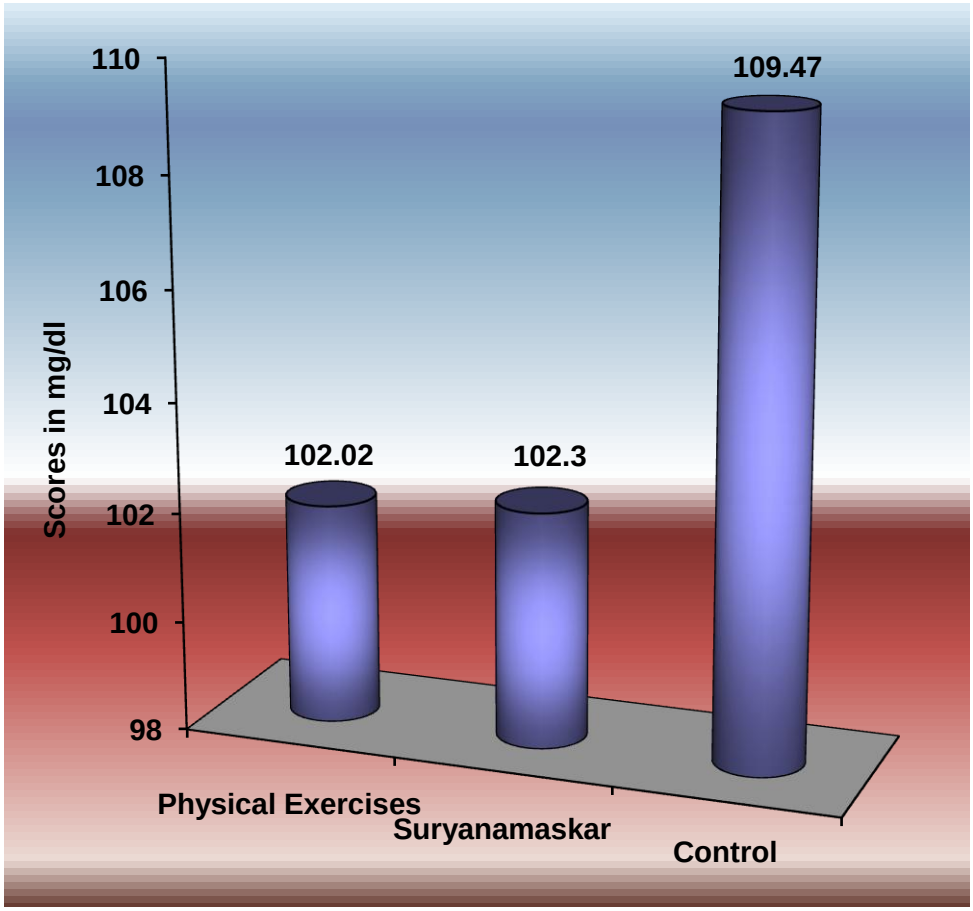
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Physical exercises group and control group (MD: 7.45). There was significant difference between Suryanamaskar practices group and control group (MD: 7.17). There was significant difference between treatment groups, namely, Physical exercises group and Suryanamaskar practices group. (MD:0.28).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure 26.

Figure 26

BAR DIAGRAM ON ORDERED ADJUSTED MEANS ON LOW DENSITY LIPOPROTEIN



4.3.13.2 DISCUSSIONS ON FINDINGS ON LOW DENSITY LIPOPROTEIN

The effect of Physical exercises and Suryanamaskar practices on LDL is presented in Table XXXI. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 40.30 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table XXXII proved that there was significant difference between Physical exercises group and control group (MD: 7.45) and Suryanamaskar practices group and control group (MD: 7.17). Comparing between the treatment groups, it was found that there was significant difference between Physical exercises and Suryanamaskar practices group among college women students.

Thus, it was found that Suryanamaskar group was significantly better than Physical Exercises group and control group in reducing LDL of the college women students.

Yadav et al., (2014) found a comprehensive yoga life style intervention significantly increased HDL-c levels in a short duration. **Bijlani, et al., (2005)** found short-term impact of a brief lifestyle intervention based on yoga Fasting plasma glucose, serum total cholesterol, low-density lipoprotein (LDL) cholesterol, very- LDL cholesterol, the ratio of total cholesterol to high density lipoprotein (HDL) cholesterol, and total triglycerides were significantly lower, and HDL cholesterol significantly higher, on the last day of the course compared to the first day of the course. **Leela, et al., (2013)** founded, Low Density

Lipoprotein were decreased after Pranayama and Yoga. **Santwana Mondal, Brajanath Kundu and Sukanta Saha, (2014)** found 12 weeks of yogic intervention significantly ($p \leq 0.05$) decrease, low density lipoprotein level. **Benounis et al., (2008)** studied effects of two month physical – endurance and diet – restriction programmes significant decrease, in triglycerides and LDL.

The findings of this study that Suryanamaskar group was significantly better than Physical Exercises group and control group in reducing LDL of the college women students were in agreement with the findings of **Yadav et al., (2014), Leela, et al., (2013), Santwana Mondal, Brajanath Kundu and Sukanta Saha, (2014), Benounis et al., (2008)** and **Bijlani, et al., (2005).**

4.4 DISCUSSIONS ON HYPOTHESIS

For the purpose of the study, the following were hypothesized:

1. It was hypothesized that physical exercises and suryanamaskar practices would significantly increase selected health related physical fitness variables, cardiorespiratory endurance, muscular strength, muscular endurance, flexibility and body composition comparing to and control group.

2. It was hypothesized that physical exercises and suryanamaskar practices would significantly alter physiological variables, forced vital capacity, VO_2 max, mean arterial blood pressure and resting pulse rate comparing to and control group.

3. It was hypothesized that physical exercises and suryanamaskar practices would significantly alter biochemical variables, triglycerides, total blood cholesterol, HDL and LDL comparing to and control group.

4. It was hypothesized that comparing between suryanamaskar and physical exercises there would be significant differences in selected health related physical fitness, physiological and biochemical variables.

The results presented in Tables VIII, X, XII, XIV, and XVI on health related physical fitness variables, cardiorespiratory endurance, muscular endurance, muscular strength, flexibility and body composition respectively proved that experimental protocols physical exercise and Suryanamaskar significantly improved selected health related physical fitness variables, as the obtained F values were greater than the required table F value to be significant

at 0.05 level. Hence, the formulated hypothesis No. 1 that, physical exercises and Suryanamaskar practices would significantly increase selected health related physical fitness variables, cardiorespiratory endurance, muscular strength, muscular endurance, flexibility and significantly decrease body composition comparing to and control group was accepted at 0.05 level.

The results presented in Tables VIII, X, XII, XIV,XVI, XVIII, XX, XXI, and XXIII on physiological variables VO_2 max, mean arterial blood pressure, resting pulse rate and, forced vital capacity respectively proved that experimental protocols significantly altered selected physiological variables, except of mean arterial blood pressure, and the formulated hypothesis No. 2 that physical exercises and Suryanamaskar practices would significantly alter physiological variables, VO_2 max, mean arterial blood pressure, resting pulse rate and forced vital capacity comparing to and control group was accepted at 0.05 level except for mean arterial blood pressure. As the obtained F value was less than the required F table value to be significant at 0.05 level, the hypothesis was rejected at 0.05 level and null hypothesis was accepted at 0.05 level.

The results presented in Tables XXV, XXVII, XXIX and XXXI on biochemical variables, Triglycerides, total cholesterol, HDL and LDL respectively proved that experimental protocols significantly altered selected biochemical variables and the formulated hypothesis No. 3 that physical exercises and Suryanamaskar practices would significantly alter selected biochemical variables comparing to control group was accepted at 0.05 level as the obtained F value was greater than the required F table value to be significant at 0.05 level.

The post hoc analysis on the results of the selected health related physical fitness, physiological and biochemical variables were presented in Tables IX, XI, XIII, XV, XVII, XIX, XXII, XXIV, XXVI, XXVIII, XXX and XXXII on cardiorespiratory endurance, muscular endurance, muscular strength, flexibility, body composition, forced vital capacity, VO_2 max, resting pulse rate, triglycerides, total cholesterol, HDL and LDL respectively. The results proved that there were significant differences between experimental treatments between physical exercises and Suryanamaskar on flexibility, percent body fat (body composition), forced vital capacity, total cholesterol, HDL and LDL and the formulated hypothesis No. 4 that comparing between Suryanamaskar and physical exercises there would be significant differences in selected health related physical fitness, physiological and biochemical variables, the formulated hypothesis was accepted for flexibility, percent body fat, forced vital capacity, total cholesterol, HDL and LDL as Suryanamaskar was found to be significantly better than physical exercise group and the formulated hypothesis was accepted at 0.05 level for these variables. As for variables, cardiorespiratory endurance, muscular endurance, muscular strength, VO_2 max, mean arterial blood pressure, resting pulse rate and triglycerides, there was no significant differences between the treatment groups and to this extent the formulated hypothesis was rejected at 0.05 level.