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Solitary and united effects of suryanamaskara and aerobic training on physical and physiological variables of women

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Abstract

The prime purpose of the study is to find out the solitary and united effects of suryanamaskara and aerobic training on the physical and physiological variables of women. To meet the purpose, sixty (N=60) women students were selected at random, and their age ranged from 18 to 21 years. Subjects were randomly assigned into four equal groups of fifteen (n=15) each. Group I underwent solitary suryanamaskara training, Group II underwent solitary aerobic training, Group III underwent united suryanamaskara and aerobic training and Group IV controls. For the collection of data pre and post-tests were conducted on cardiorespiratory endurance, trunk flexibility, heart rate at rest and respiratory rate at rest. Criterion variables were measured by 12 minutes Coopers run/walk test, sit and reach test, bio-monitor and manual method respectively. The data was collected prior and after twelve weeks of training. The data was analyzed by applying ANCOVA. The level of confidence fixed at 0.05 level. The results of the study shows that three training groups have significantly influenced physical and physiological variables as compared to the control group.

Keywords: Solitary, United, Suryanamaskara and Aerobic training, cardiorespiratory endurance, Trunk flexibility, Heart rate at rest, Respiratory rate at rest

Introduction

Training is a methodological way of preparing oneself to achieve some pre-determined goals. Prof. M.L Kamalesh. (2022) [14]. Training is the process of preparing an athlete physically, technically, tactically, psychologically, and theoretically rapidly for the highest levels of performance. Harre. D (1982) [6] Training regimens are specially designed to incorporate and emphasize a physiological system. To enhance aerobic performance, training regimen has to be designed to improve the functionality of the musculoskeletal and cardiorespiratory systems. A physiological system needs to be exercised at a level higher than its current level for better training adaptations to take place. Kraemer. WJ *et al.* (1990) [7]

Yoga is a suitable holistic approach for supplemental, to reduce the training side effects. Among the goals of practicing a supplemental training program such as Yoga is to maintain a healthy balance in the body by compensating for the one-sided system of exercises typical in any given sport. By practicing yoga with its set of movements and exercises, an athlete can achieve this balance. The task of yoga supplemental exercises is also to develop muscle groups that are not directly used in regular practice. Not only does this increase performance, but it also helps to maintain health for the athlete. The athlete can practice yoga Asanas anytime and anywhere without the need for special equipment or workout space. Yoga also helps to decrease the negative effects of a sports training program. These negative effects include small deformations which, over a long period, can damage the body or can lead to the development of improper body posture. Prevention of injury and yoga as a supplemental sport training program go hand in hand.

Yoga is a way of life. It is a comprehensive education system for the body, mind, and inner spirit. This art of right living was perfectly practiced in India thousands of years ago since then the Yoga addresses the universal truth, and Its lessons are just as relevant now as they were in

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ancient times. Yoga is not a religion it is a practical aid. And its techniques may be practiced by Hindus, Buddhists, Jews, Christians, Muslims, and Atheists alike. Yoga is union with all Asha Vijaykumar Bengle (2005) [2].

The pranic body draws its substance from food, sunlight, and air. This latter is one of the reasons yogis pay attention to both diet and breathing. The health of the pranic body can produce health of the material body. The pranic body does indeed determine both the health and the length of life of the physical body. Prana is the very Life of God in manifestation, so we live in and by the divine life. Yoga involves breath, if breath arises from the source, it will take us to that supreme bliss if we understand how to work with it. That is why yoga is the path to life. The persevering yogi experiences keep-increasing life on all levels of his being. "The path of the just is as the shining light, that shineth more and more unto the perfect day, this is the glory of yoga and it will reveal everything in time". It must also not be overlooked that perfection in yoga brings about abundance in this world as well. Many yogis who live simply and frugally, but that is their choice—the treasure house of the world is open to them. Taittiriya Upanishad—by Swami Nirmalananda Giri.

Suryanamaskara is a series of asanas executed continuously. The series has a complete (entire body) effect. All the plexuses of the body, the circulatory, pulmonary, nervous systems, digestive organs, and big muscle groups are affected. It affects each sequence of the spine and all joints. It is most useful in stretching and warming up the muscles and joints for loading the cardiovascular system. Controlled breathing is applied. The effect of this routine called the Sun Salutation, or Surya Namaskar, is increased by the number of repetitions of the battery. Repeating the routine up to 30-50 times is excellent loading for the cardiovascular system as well as for the muscles. If you execute these movements slowly, they have a calming, deactivating effect. If you execute them fast, repeating the series 8-10 times with full inhalation, it has a stimulating, activating effect on the nervous system. Aladar Kogler (1999) [1]

The Sun salutation in Sivananda School of yoga is a following repetition of postures that follows the traditional Hata yoga method. Originally performed at dawn as prostrations to the Sun god, it evolved to represent the all-encompassing and powerful full divinity of the Sun. It is quite literally a ritual that awakens and salute each and every part of the body, mind and spirit Sharma *et al.* (2017) [18]. Salute the Sun/ Sun salutation is practiced in yoga as exercise in cooperating a flow sequence of some twelve graceful linked asanas. The asana sequence originated in the Hata yoga tradition in the 9th century in India. Hatha yoga is the most widely practiced type of yoga. To develop peaceful mind and healthy body (Patanjali). The Sun salutation is a graceful sequence of twelve positions performed as one continuous exercise. Each position counteracts the one before stretching the body in a different way and alternately expanding and contracting the chest to regulate the breathing. Sivanandha Yoga Institute the Sivananda School of suryanamaskara is different from traditional Patanjali suryanamaskara in the fifth pose can change parvatasana to plank pose. This pose can concentrate Manipura Chakra and improve core strength, flexibility and body alignment. It is a key factor to choose Sivananda School of yoga practice in Suryanamaskara.

Aerobics produce beneficial changes in the body, especially the action of the lungs, heart and blood circulation. Mitchell Baura and Daka Barbara (1980) [11] Aerobic training is widely acknowledged that success in aerobic sports is largely

contingent on a good early season training regimen in which athletes train at a substantially higher volume than is required for physical fitness. This intentional elevating of training volume for the particular intent of enhancing the athlete performance. Raglan. J.S and Wilson G.S (2000) [15]. The regular aerobic exercise program will result in a decrease in blood fats such as cholesterol and triglycerides. Aerobic exercises builds stamina and enhance the efficiency of the physiological systems. Aerobic activity involves an exercise routine that uses large muscle groups, is maintained for a long period and is rhythmic in nature. Regular aerobic exercise improves fitness, as heart becomes stronger and begins to work better. The result is that the heart can pump more blood and increase oxygen delivery to the tissues with each heartbeat. As the aerobic fitness increases, we can work out longer with greater intensity and quick recover at the end of the session.

Cardiovascular Responses and adaptations to endurance training:

The principal function of the cardiovascular system during high-volume exercise is to deliver oxygen and other nutrients to the working muscles and to eliminate metabolites waste products. Aerobic training causes for several shifts in cardiovascular function, including increased maximal cardiac output, increased stroke volume, and reduced heart rate at rest further, the muscle fiber capillary density also increases as a result of aerobic training. One of the primary mechanisms for increasing maximal oxygen uptake is the enhancement of central cardiovascular function. The normal discharge rate of the sinoatrial (SA) node ranges from 60 to 80 Bpm. Aerobic training results in a significantly delay in the discharging rate due to an increase in parasympathetic tone. The heart rate at rest is also impacted by increased stroke volume, resulting in a reduced heart rate required to achieve the same cardiac output. Highly conditioned aerobic athletes, whose resting heart rates typically range from 40 to 60 Bpm, may have considerable bradycardia. This is because aerobic exercise can enhance the heart's capacity to expel blood per contraction during rest. The most significant change in cardiovascular function with macrocycle aerobic training resulted primarily from improved stroke volume. A significantly lower heart rate in response to a standardized submaximal level of work is another hallmark of aerobic training. Furthermore, heart rate increases more slowly in trained athletes than in normal and healthy people McArdle WD *et al.* (2014) [9].

Heart rate

Heart rate is probably the most frequently used method for determining aerobic training intensity. The reason for this is the strong relationship between heart rate and oxygen consumption. There is a positive high correlation between resting heart and fitness of an individual. The key method for improvement of resting heart rate is aerobic training. Trgular practice of asnaas with moderate pace, benifited as an aerobic activity. Suryanamaskara is itself comination of asanas. Shankar G and Pancholi B (2011) [17]. The change in the pace of suryanamaskara will effect on resting heart rate Bhavani *et al.* (2011) [3].

Just before and at the commencement of an exercise regimen, a reflex or expectant stimulation of the sympathetic nervous system increases heart rate. Heart rate increases linearly with an enhancement in intensity during aerobic training. Franklin. BA (1998) The rate of increasing heart rate, the actual heart rate response, and the peak heart rate achieved relate to a variety of particular characteristics of the human system,

including fitness and age, in addition to training workload.

Respiratory responses

Aerobic training provides the greatest impact on both O₂ uptake and CO₂ production as compared to anaerobic training. Significant increases in O₂ delivered to the tissue, CO₂ returned to the lungs, and minute ventilation (the volume of air breathed per minute) provide for appropriate levels of alveolar gas concentrations during aerobic training McArdle WD *et al.* (2014) ^[9].

Flexibility is the ability of joint or series of joints, to move through a full range of motion (ROM) without injury. Static flexibility is a measure of the total ROM at the joint and is limited by the extensibility of the musculotendinous unit. Dynamic flexibility is a measure of the rate of torque or resistance developed during stretching throughout the ROM Vivian H Heyward (2006) ^[19].

Methodology

To achieve this purpose sixty (N=60) degree college women students in the age group 18-21 years were randomly divided into four groups fifteen (n=15) each. Group I underwent solitary suryanamaskara, Group II underwent solitary aerobic, Group III underwent united suryanamaskara & aerobic training groups and Group IV acted controls.

Load Dynamics for Solitary Suryanamaskara Training

Weeks	Duration	Suryanamaskara training
1-4	60 minutes Loosening exercises 15 min Suryanamaskara 30 min Relaxation 15 min	16 rounds
5-8	60 minutes Loosening exercises 15 min Suryanamaskara 30 min Relaxation 15 min	20 rounds
9-12	60 minutes Loosening exercises 15 min Suryanamaskara 35 min Relaxation 10 min	24 rounds

Load Dynamics for Solitary Aerobic Training

Weeks	Duration	Aerobic training
1-4	60 minutes Warm-up 15 min Aerobic training 30 min Cool-down 15 min	Heart rate @ 120 Bpm
5-8	60 minutes Warm-up 15 min Aerobic training 30 min Cool-down 15 min	Heart rate @ 125 Bpm
9-12	60 minutes Warm-up 15 min Aerobic training 35 min Cool-down 10 min	Heart rate @ 130 Bpm

Load Dynamics for United Suryanamaskara and Aerobic Training

Weeks	Duration	Aerobic training	Suryanamaskara training
1-4	90 minutes Loosening exerciss15 mins Suryanamaskara training 30 min Aerobic training 30 min Cool-down 15 min	Heart rate @ 120 Bpm	16 rounds
5-8	90 minutes	Heart rate @ 125 Bpm	20 rounds

These four groups attended their regular college schedule. Cardiorespiratory endurance, flexibility, heart rate at rest and respiratory rate at rest were measured by 12 minutes Coopers run/walk test, sit and reach test, bio-monitor and manual respectively.

Statistical analysis

The data were collected from the four groups prior to and after the experiment period of 12 weeks cardiorespiratory endurance, flexibility, heart rate at rest and respiratory rate at rest were statistically examined by employing analysis of covariance (ANCOVA). To find out the significance difference the level of confidence was fixed at 0.05 level.

Training programme

During the training period, solitary suryanamaskara and solitary aerobic training groups underwent their respective training program, three sessions per week, each last for about 60 minutes including warm-up and warm-down for twelve weeks. United suryanamaskara & aerobic training underwent the respective training program sessions per week each last about 90 minutes including warm-up and warm-down for twelve weeks. Whereas control group did not participate in any training program apart from their regular college schedule.

	Loosening exercises 15 min Suryanamaskara training 30 min Aerobic training 30 min Cool-down 15 min		
9-12	90 minutes Loosening exercises 10 min Suryanamaskara training 35 min Aerobic training 35 min Cool-down 10 min	Heart rate @ 130 Bpm	24 rounds

Result and Discussion

The influence of independent parameters on each dependent

parameters were analyzed and illustrated below.

Table 1: ANCOVA for the pre, post and adjusted post-test data on cardiorespiratory endurance of solitary and united suryanamaskara & aerobic training group and control groups

Tests		Solitary Surya namaskara Training Group	Solitary Aerobic Training Group	United Surya namaskara & Aerobic Training Group	Control Group	Source of Variance	DF	Sum of Squares	Mean Squares	F Value
Pre-test	\bar{x}	1674.80	1650.33	1648.93	1657.60	B	3	6350.32	2116.77	0.30
	σ	84.84	89.26	83.40	78.22	W	56	395356.27	7059.93	
Post-test	\bar{x}	2194.20	2427.93	3284.73	1665.73	B	3	20472702.45	6824234.15	390.15*
	σ	95.64	196.88	123.93	81.81	W	56	979517.20	17491.38	
Adjusted Post-test	\bar{x}	2194.29	2428.02	3284.90	1665.39	B	3	20460573.83	6820191.28	383.50*
	σ					W	55	978118.67	17783.98	

* Implication at 0.05 level of assurance.

The table value for implication at 0.05 level with degrees of freedom 3 and 56 and 3 and 55 are 2.776 and 2.78 consequently.

The table I exhibits that the pre-test means of solitary and united suryanamaskara & aerobic training group and control groups are 1674.80, 1650.33, 1648.93 and 1657.60 meters consequently. The achieved 'F' ratio of 0.30 for pre- test means is less than that of the table value of 2.776 for the degrees of freedom 3 and 56 for implication at 0.05 level. The post-test means of solitary and united suryanamaskara & aerobic training group and control groups are 2194.20, 2427.93, 3284.73 and 1665.73 meters consequently. The achieved 'F' ratio of 390.15 for post-test means is greater than that of the table value of 2.776 for the degrees of freedom 3

and 56 for implication at 0.05 level. The Adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups are 2194.29, 2428.02, 3284.90 and 1665.39 meters consequently. The achieved 'F' ratio of 383.50 is greater than that of the table value of 2.78 for the degrees of freedom 3 and 55 for implication at 0.05 level. The results of the study stipulate that there is an implication difference among adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups on cardiorespiratory endurance. Scheffe's test was applied as a post-hoc test to determine the implication difference between the four paired means. The findings are illustrated in Table 2.

Table 2: Scheffe's post-hoc test for the difference between the adjusted post-tests paired means of cardiorespiratory endurance

Adjusted Post-Test Means				Mean Differences	CI
Solitary Suryanamaskara Training group	Solitary Aerobic Training group	United Suryanamaskara & Aerobic Training group	Control group		
2194.28	2428.02	-	-	233.73*	200.26
2194.28	-	3284.90	-	1090.62*	
2194.28	-	-	1665.39	528.89*	
-	2428.02	3284.90	-	856.88*	
-	2428.02	-	1665.39	762.63*	
-	-	3284.90	1665.39	1619.51*	

*Implication at 0.05 level of assurance.

Table VII-A exhibits that the adjusted post-test mean difference on cardiorespiratory endurance between solitary suryanamaskara and solitary aerobic training group is 233.73, solitary suryanamaskara and united suryanamaskara & aerobic training group is 1090.62, solitary suryanamaskara training group and control group is 528.89, solitary aerobic and united suryanamaskara & aerobic training group is 856.88, solitary aerobic training group and control group is 762.63, united suryanamaskara & aerobic training group and control group is 1619.51 are greater than that of CI value 200.26. From the results it was concluded that, all the

experimental groups have significantly improved the cardiorespiratory endurance as compared to control group. Based on mean difference it is also concluded that the implication difference also exists among the training groups. Among the training groups united suryanamaskara & aerobic training has significantly improves the criterion variable cardiorespiratory endurance than that of two training groups. The adjusted post-test mean values on cardiorespiratory endurance of four groups are graphically illustrated in Figure 1.

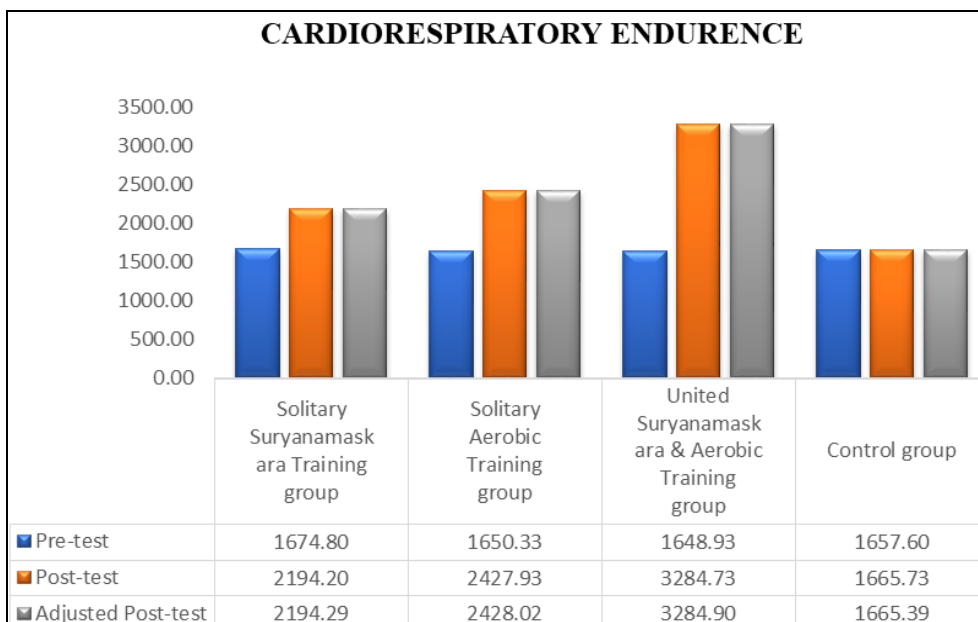


Fig 1: Bar diagram on cardiorespiratory endurance of pre, post and adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups

Table 3: ANCOVA for the pre, post and adjusted post test data on trunk flexibility of solitary and united suryanamaskara & aerobic training group and control groups

Tests		Solitary Suryanamaskara Training group	Solitary Aerobic Training group	United Suryanamaskara & Aerobic Training group	Control Group	Source of Variance	DF	Sum of Squares	Mean Squares	F Value
Pre-test	\bar{x}	38.77	38.77	38.53	38.43	B	3	1.30	0.43	0.079
	σ	2.26	2.26	2.26	2.48	W	56	301.03	5.38	
Post-test	\bar{x}	63.77	44.27	58.77	38.83	B	3	6240.11	2080.04	611.03*
	σ	1.22	1.45	2.39	2.08	W	56	190.63	3.40	
Adjusted Post-test	\bar{x}	63.69	44.19	58.52	38.94	B	3	6194.32	2064.77	1193.89*
	σ					W	55	95.12	1.73	

*Implication at 0.05 level of assurance.

The table value for implication at 0.05 level with degrees of freedom 3 and 56 and 3 and 55 are 2.776 and 2.78 consequently

The table 3 exhibits that the pre-test means solitary and united suryanamaskara & aerobic training group and control groups are 38.77, 38.77, 38.53 and 38.43 cm consequently. The achieved 'F' ratio of 0.079 for pre- test means is less than that of the table value of 2.776 for the degrees of freedom 3 and 56 for implication at 0.05 level. The post-test means of solitary and united suryanamaskara & aerobic training group and control groups are 63.77, 44.27, 58.77 and 38.83 cm consequently. The achieved 'F' ratio of 611.03 for post-test means is greater than that of the table value of 2.776 for the

degrees of freedom 3 and 56 for implication at 0.05 level. The Adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups are 63.69, 44.19, 58.52, and 38.94 cm consequently. The achieved 'F' ratio of 1193.89 is greater than that of the table value of 2.78 for the degrees of freedom 3 and 55 for implication at 0.05 level. The results of the study indicated that the implication difference exist among Adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups on Trunk flexibility. Scheffe's test was applied as a post-hoc test to determine the implication difference between the four paired means. The findings are illustrated in Table 4.

Table 4: Scheffe's post-hoc test for the difference between the adjusted post-tests paired means of trunk flexibility

Adjusted Post-Test Means				Mean Differences	CI
Solitary Suryanamaskara Training group	Solitary Aerobic Training group	United Suryanamaskara & Aerobic Training group	Control group		
63.69	44.19			19.50*	1.98
63.69		58.82		4.87*	
63.69			38.94	24.75*	
	44.19	58.82		14.63*	
	44.19		38.94	5.25*	
		58.82	38.94	19.88*	

*Implication at 0.05 level of assurance.

Table 4 exhibits that the adjusted post-test mean difference on Trunk flexibility between solitary suryanamaskara and solitary aerobic training group is 19.50, solitary

suryanamaskara and united suryanamaskara & aerobic training group is 4.87, solitary suryanamaskara training group and control group is 24.75, solitary aerobic and united

suryanamaskara & aerobic training group is 14.63, solitary aerobic training group and control group is 5.25, and united suryanamaskara & aerobic training group and control group is 19.88 are greater than that of CI value 1.98. From the results it is deduced that, all the experimental groups have significantly improved the trunk flexibility as compared to control group. Based on mean difference it is also concluded

that the implication difference also exists among the training groups. Among the training groups solitary suryanamaskara training has significantly improves the criterion variable trunk flexibility than that of two training groups. The adjusted post-test mean values on Trunk flexibility of four groups are graphically portrayed in Figure 5.

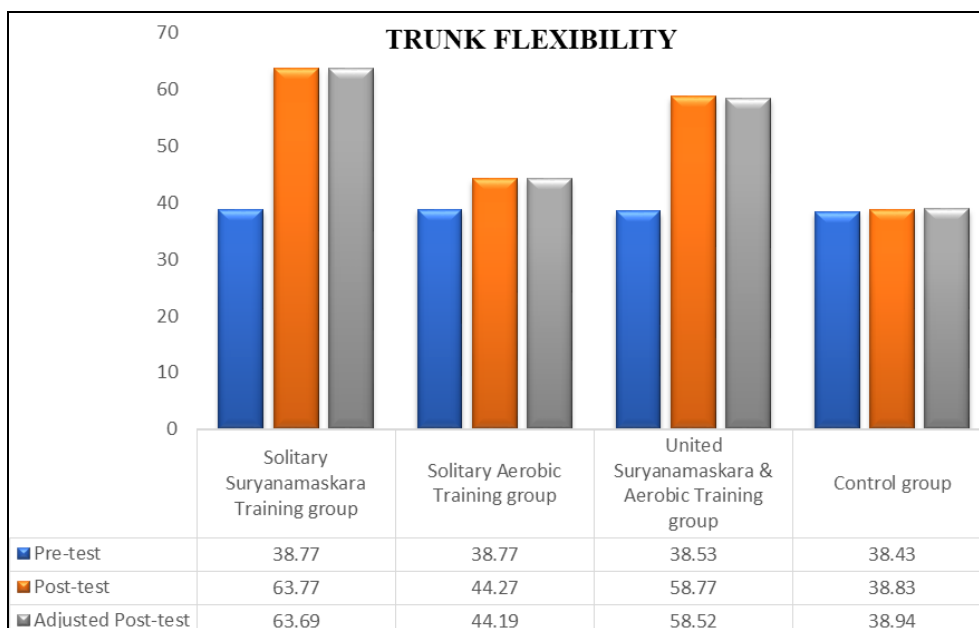


Fig 2: Bar diagram on trunk flexibility of pre, post and adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups

Table 5: ANCOVA for the pre, post and adjusted post test data on heart rate at rest of solitary and united suryanamaskara and aerobic training group and control groups

Tests		Solitary Suryana maskara Training group	Solitary Aerobic Training group	United Suryanamaskara & Aerobic Training group	Control group	Source of Variance	DF	Sum of Squares	Mean Squares	F Value
Pre-test	\bar{x}	72.00	72.067	72.067	72.20	B	3	0.32	0.106	0.109
	σ	1.00	0.96	0.96	1.014	W	56	54.27	0.97	
Post-test	\bar{x}	67.80	65.87	63.87	72.27	B	3	580.05	193.35	231.36*
	σ	1.014	1.13	0.74	0.70	W	56	46.80	0.84	
Adjusted Post-test	\bar{x}	67.86	65.88	63.88	72.18	B	3	565.21	188.40	572.59*
						W	55	18.097	0.33	

*Implication at 0.05 level of assurance.

The table value for implication at 0.05 level with degrees of freedom 3 and 56 and 3 and 55 are 2.776 and 2.78 consequently

The table 4 exhibits that the pre-test means of solitary and united suryanamaskara & aerobic training group and control groups are 72, 72.067, 72.067 and 72.20 beats/min consequently. The achieved 'F' ratio of 0.109 for pre- test means is less than that of the table value of 2.776 for the degrees of freedom 3 and 56 for implication at 0.05 level. The post-test means of solitary and united suryanamaskara & aerobic training group and control groups are 67.80, 65.87, 63.87 and 72.27 beats/min consequently. The achieved 'F' ratio of 231.36 for post-test means is greater than that of the table value of 2.776 for the degrees of freedom 3 and 56 for

implication at 0.05 level. The Adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups are 67.86, 65.88, 63.88 and 72.18 beats/min consequently. The achieved 'F' ratio of 572.595 is much greater than that of the table value of 2.78 for the degrees of freedom 3 and 55 required for implication at 0.05 level. The results of the study exhibit that there is an implication difference among adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups on heart rate at rest. Scheffe's test was applied as a post-hoc test to determine the implication difference between the four paired means. The findings are illustrated in Table 5.

Table 6: Scheffe's post-hoc test for the difference between the adjusted post-tests paired means of heart rate at rest

Adjusted Post-Test Means				Mean Differences	CI
Solitary Suryanamaskara Training group	Solitary Aerobic Training group	United Suryanamaskara & Aerobic Training group	Control group		
67.86	65.88	-	-	1.98*	0.86
67.86	-	63.88	-	3.98*	

67.86	-	-	72.18	4.32*
-	65.88	63.88	-	2.00*
-	65.88	-	72.18	6.30*
-	-	63.88	72.18	8.30*

*Implication at 0.05 level of assurance.

Table 6 exhibits that the adjusted post-test mean difference on heart rate at rest between solitary suryanamaskara and solitary aerobic training group is 1.98, solitary suryanamaskara and united suryanamaskara & aerobic training group is 3.98, solitary suryanamaskara training group and control group is 4.32, solitary aerobic training and united suryanamaskara & aerobic training group is 2.00, solitary aerobic training group and control group is 6.30, and united suryanamaskara & aerobic training group and control group is 8.30 are greater than the CI value 0.86. From the results it exhibits that, all the

experimental groups have significantly lowered the heart rate at rest as compared to control group. Based on mean difference it is also concluded that the implication difference also exists among the training groups. Among the training groups united suryanamaskara & aerobic training has significantly lowered the criterion variable heart rate at rest than that of two training groups. The adjusted post-test mean values on heart rate at rest of four groups are graphically illustrated in Figure 3

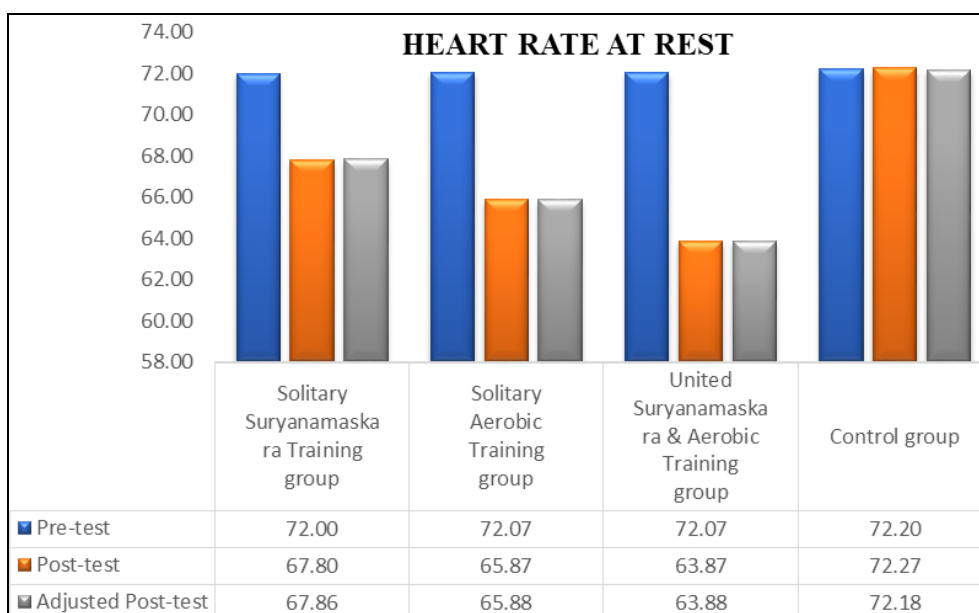


Fig 3: Bar diagram on heart rate at rest of pre, post and adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups

Table 7: ANCOVA for the pre, post and adjusted post test data on respiratory rate at rest of solitary and united suryanamaskara & aerobic training group and control groups

Tests		Solitary Suryanamaskara Training group	Solitary Aerobic Training group	United Suryanamaskara & Aerobic Training group	Control Group	Source of Variance	DF	Sum of Squares	Mean Squares	F Value
Pre-test	\bar{x}	18.87	18.87	19.00	18.87	B	3	0.20	0.07	0.10
	σ	0.83	0.83	0.85	0.74	W	56	37.20	0.66	
Post-test	\bar{x}	17.60	16.47	15.50	18.80	B	3	89.93	29.98	96.11*
	σ	0.51	0.52	0.52	0.68	W	56	17.47	0.31	
Adjusted Post-test	\bar{x}	17.61	16.48	15.50	18.81	B	3	91.83	30.61	128.43*
	σ					W	55	13.11	0.24	

*Implication at 0.05 level of assurance.

The table value for implication at 0.05 level with degrees of freedom 3 and 56 and 3 and 55 are 2.776 and 2.78 consequently: The table IV exhibits that the pre-test means of solitary and united suryanamaskara & aerobic training group and control groups are 18.87, 18.87, 19.00 and 18.87 breaths/min consequently. The achieved 'F' ratio of 0.10 for pre- test means is less than that of the table value of 2.776 for the degrees of freedom 3 and 56 for implication at 0.05 level. The post-test means of solitary and united suryanamaskara & aerobic training group and control groups are 17.60, 16.47, 15.50 and 18.80 breaths/min consequently. The achieved 'F' ratio of 96.11 for post-test means is much greater than that of the table value of 2.776 for the degrees of freedom 3 and 56

for implication at 0.05 level. The Adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups are 17.61, 16.48, 15.50 and 18.81 breaths/min consequently. The achieved 'F' ratio of 128.43 is much greater than that of the table value of 2.78 for the degrees of freedom 3 and 55 for implication at 0.05 level. The results of the study designated that there is an implication difference among adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups on respiratory rate at rest. Scheffe's test was applied as a post-hoc test to determine the implication difference between the four paired means. The findings are illustrated in Table 8.

Table 8: Scheffe’s post-hoc test for the difference between the adjusted post-tests paired means of respiratory rate at rest

Adjusted Post-Test Means				Mean Differences	CI
Solitary Suryanamaskara Training group	Solitary Aerobic Training group	United Suryanamaskara & Aerobic Training group	Control group		
17.61	16.48	-	-	1.13*	0.74
17.61	-	15.50	-	2.11*	
17.61	-	-	18.81	1.20*	
-	16.48	15.50	-	0.98*	
-	16.48	-	18.81	2.33*	
-	-	15.50	18.81	3.31*	

*Implication at 0.05 level of assurance.

Table 8 exhibits that the adjusted post-test mean difference on Respiratory rate at rest between solitary suryanamaskara and solitary aerobic training group is 1.13, solitary suryanamaskara and united suryanamaskara & aerobic training group is 2.11, solitary suryanamaskara training group and control group is 1.20, solitary aerobic training group and united suryanamaskara & aerobic training group is 0.98, solitary aerobic training group and control group is 2.33, and united suryanamaskara & aerobic group and control group is 3.31 are greater than that of CI value 0.74. From the results it

was designated that, all the experimental groups have significantly decreased the respiratory rate at rest as compared to control group. Based on mean difference it is also concluded that the implication difference also exists among the training groups. Among the training groups united suryanamaskara & aerobic training has significantly decreased the criterion variable respiratory rate at rest than that of two training groups. The adjusted post-test mean values on Respiratory rate at rest of four groups are graphically portrayed in Figure 4.

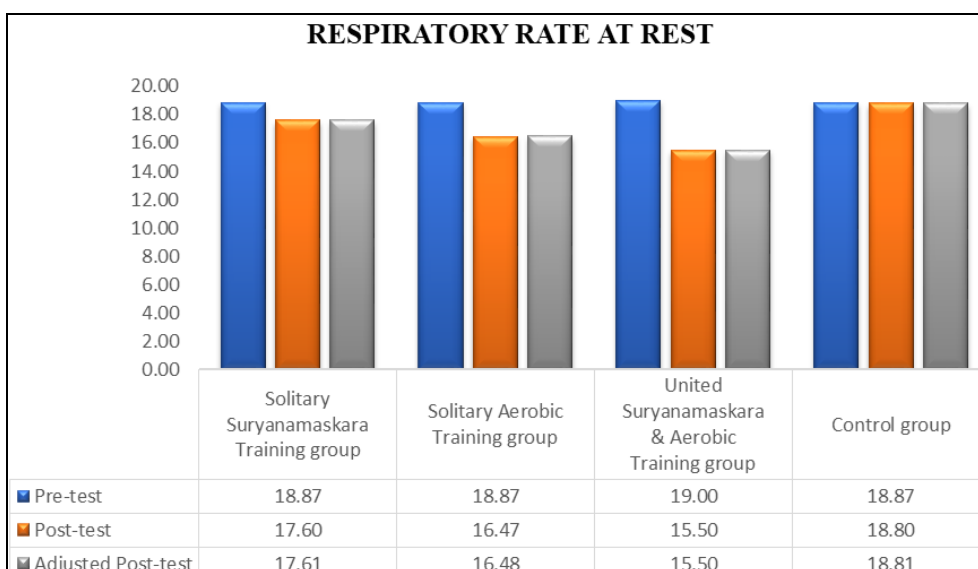


Fig 4: Bar diagram on respiratory rate at rest of pre, post and adjusted post-test means of solitary and united suryanamaskara & aerobic training group and control groups

Discussion on findings

The results of the study indicates that solitary and united suryanamaskara and aerobic training can improve the Cardiorespiratory endurance, trunk flexibility, and significantly lowered the heart rate at rest and respiratory rate at rest as compared to the control group. United suryanamaskara & aerobic training is more effective than the solitary suryanamaskara and aerobic training except on trunk flexibility. Solitary suryanamaskara has improved trunk flexibility than the two training groups.

Cardiorespiratory endurance

From the result it has been concluded that the solitary and united suryanamaskara and aerobic training can decrease the cardiorespiratory endurance as compared to the control group. Menbere Girma and Gasha Birhance (2021), stated that increasing cardiorespiratory endurance by the given 3 days/week for 3 months of aerobic exercise training. Dr. R Ashok Kumar *et al.* (2019), stated that the 6 weeks of aerobic exercise training can increase the cardiorespiratory endurance. The results of the present study fell in line with the above

research evidences.

Trunk flexibility

From the result it has been concluded that the solitary and united suryanamaskara and aerobic training can improve the trunk flexibility as compared to the control group. Menbere Girma and Gasha Birhance (2021), stated that the 3 days/week for 3 months of aerobic exercise training increase Trunk flexibility. Dr. R Ashok Kumar *et al.* (2019), noticed that the 6 weeks of aerobic exercise training can increase the flexibility. The results of the present study fell in line with the above research evidences.

Heart rate at rest

From the result it has been concluded that the solitary and united suryanamaskara and aerobic training can successfully decrease the heart rate at rest as compared to the control group. L. Ajithkumar and Dr. S. Mohanasundaram (2021) [8], stated that the 8 weeks of suryanamaskara practice can decrease the resting pulse rate. Vishan Singh Rathore and Mukesh Kumar Mishra (2015) [13], viewed that the six weeks

of aerobic exercise training can decrease resting heart rate significantly. The results of the present study fell in line with the above research evidences.

Respiratory rate at rest

From the result it has been concluded that the solitary and united suryanamaskara and aerobic training can decrease the respiratory rate at rest as compared to the control group. Mr. Santosh Toppo and Dr D Sultana (2015) ^[12], noticed that the 12 weeks of aerobic exercise training can decrease respiratory rate. Rakhi Ramakrishnan and Dr. A. Shenbagavaili (2017) ^[16], said that the 12 weeks of aerobic dance training can decrease respiratory rate. The results of the present study fell in line with the above research evidences.

Conclusion

The present study has successfully influenced the selected variables cardiorespiratory endurance, trunk flexibility, heart rate at rest and respiratory rate at rest as a results of the 12 weeks solitary and united suryanamaskara and aerobic training protocol.

Implications

Based on the above results of the study 12 weeks of solitary and united suryanamaskara and aerobic training is strongly advisable to bring the desirable modifications on Cardiorespiratory endurance, trunk flexibility, heart rate at rest and respiratory rate at rest among college sports women and it will be an effective training protocol to the clients who are with deep desire for an effective wellness and fitness.

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