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EFFECT OF YOGIC PRACTICES WITH RESISTANCE TRAINING ON PHYSIOLOGICAL PARAMETERS OF WOMEN STUDENTS OF INFORMATION TECHNOLOGY

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ABSTRACT

Work related disorder is common in computer professions. Work style may be one of the risk factor in the development of musculoskeletal and discomfort. The objective of the study was to find out the effect of combination of yogic practices (vinyasa yoga) and resistance training on physiological parameters of information technology women students of Coimbatore Institute of Technology (CIT), Coimbatore. 60 untrained volunteers from CIT were taken to participate in the study. Their age ranged from 18 to 25 years. They were randomly assigned into two group of twenty each such as experimental group 1(n=30) and control group 2(n=30). The experimental group underwent yogic practices (vinyasa) with resistance exercise training and control group did not undergo any special training except their leisure time pursuit as college students. The data were collected before and after the training period of 12 weeks and the data collected were statically analyzed by paired't' test, which was used to find out the significant improvement on selected parameters and analysis of covariance (ANCOVA) was used to find out the significant difference if any among the adjusted post test means of experimental and control group on each parameters separately. The result shows that there was a significant improvement in the Peak flow rate, Pulse rate, Breath holding time and Vo2 Max.

Key words: *Peak flow rate, Pulse rate, Breath holding time and Maximum Volume of oxygen.*

INTRODUCTION

In day today lifestyle every individual is scared of diseased metabolic syndrome and health hazards. This is because of lack of physical activity. Even a household woman is not prone to do the normal household activity like washing, cleaning, grinding and wiping instead they use the machine or depend upon the maid. If the body is not able to do the minimum physical work the muscle get atrophy, it loses its elasticity and that leads to muscular pain due to the sudden activity or movement. Studies proved that to maintain the good health everyone have to make minimum of 20 minutes of muscular movement. (1) Same way due to the development of industries and factory's the atmospheric pollution is hazardous to pulmonary diseases. The diseases like bronchitis, Asthma, chronic abstractive pulmonary diseases, difficulty in breath, Emphysema (lung damage) tuberculosis, lung cancer, pulmonary oedema etc. Now as days this diseases are very common for children and for teenagers. The percentage rises day by day due to lack of awareness about the purification of lungs. This can be done by practicing yoga in regular intervals. Yoga is an ancient practice. This is done to purify/cleans the internal organs like intestine and lungs which are more vital and prone to diseases. Yoga one of the many forms or paths of yoga, focuses on overall fitness through Pranayama (breath control exercises asanas (yoga postures) and Chandra (meditative).In recent years there has been considerable interest in scientific research on yoga in India and in the west. The goal of yoga is to develop the state of mental and physical health, well-being, inner harmony and ultimately a union of the human individual with the universal and transcendent existence. Yoga techniques middle the practice of number of physical exercises and postures, regulation of respiration with a variety of breathing exercises and practice of meditation.

Ashtanga vinyasa yoga founded and popularized by K. Pattabi Jois, and which is often promoted as a modern day form of classical Indian yoga. The yoga practiced in the present study is a

form of vinyasa. Vinyasa is a tool used in many styles of yoga beyond vinyasa yoga blue, Ashtanga yoga, Power yoga, Jivamukti, Viniyoga and Iyengar yoga each incorporate vinyasa into their practice. Yoga is not just about working out; it's about a healthy lifestyle. The practice of yoga allows students to be still in a world consumed with chaos. Peace and tranquility achieved through focused training appeals to everyone. Yoga's deep breathing and meditation practices help foster an inner shift from to-do lists, kids and spouse's needs, financial concerns and relational struggles to something a little bit bigger than the issues faced. Yoga helps relieve stress and uncluttered the mind, and helps you get more focused. The benefits of Yoga by Ashley. (2)As yoga has become an increasingly integral part of 21st-century life, scientists, armed with new tools that allow them to look ever deeper into the body, have been turning their attention to what happens physiologically when we practice yoga not just asana but also pranayama and meditation**.** (3)Yoga's heritage is comprehensive enough so that anyone can find just the right techniques that will not conflict with his or her personal benefits. (4). A survey among Bangalore IT professionals revealed 36% respondents were found to be "probable psychiatric case"10% were diagnosed with mental distress , one of 20% were regular considered to sucide,28% were constantly under strain and 300 of the 900 employees battle in fertility problems.(5) Information Technology, banking are the top sector with unhealthy employees. Computers have became an epitome of modern life, being used in every aspect of life from calculating grocery bills, telecommunications, banking operations, name any sphere and one will find computer. With use of Internet technology distances carry little meaning and information anywhere in the world is accessible just with a click of mouse. India has been in the forefront in cyber world with IT industry developing into a major service provider. It was estimated in the 1990's that 40-80 million Visual Display Terminals (VDTs) were there in the workplace. There are approximately six-computers/1000 population with an installation of 18 million Personal Computers (PCs) and their number increasing all the time**.** (6) This has also ushered in a new genre of occupational health problem i.e. of computer related health problems. India being the forerunner in the cyber world, there is an urgent need to understand the dynamics of these problems and prevent it from assuming epidemic proportions**.** This training was designed to cure such problems for Information Technologies students and prevent the future professionals from the health hazards.

TRAINING PROCEDURE

Yogic practice classes were offered three times per week, from 7.30 – 9.00 a.m. for 12 weeks. Ashtanga Vinyasa yoga is different from many yoga classes in that the order of asanas is completely predefined. A practice was comprised of four main series. Each series had the same structure. The practice was started with the sun salutations (suryanamaskara) followed by a set of standing postures (primary series). Then practitioners moved on a set of seated postures (primary series) and finishing sequences. Resistance training from 4 pm to 6 pm (Two days a week).

Sequence of training:

The **opening sequence** began with sun salutation (suryanamaskara). Sun salutation is a consisted of the following sequence of movements. 1. Inhale, hands up, Look up to the thumbs, 2. Exhale, bend forward to uttanasana gage at tip of nose. 3. Inhale, head up, straighten spine, gage at third eye. 4. Exhale, bend knees, jump back (or) step back to chaturaga dandasana. 5.Inhale roll up to urdhva mukha savasana,upward dog, gaze toward to sky back and up. 6.Exhale lift hip back to adhomukha savasanasa ,downward dog ,gaze toward navel,hold for 5 breaths. 7. Inhale,up (or) step feet up between hands, gaze between eyebrows. 8. Exhale,fold at waist to uttanasana,gaze tip of the nose. 9. Inhale,come all the way up looking between eyebrows with spine straight hands up gaze at thumbs. 10. Exhale on to sides samasthiti .**Standing posture** (primary sequence) the standing asanas:- 1.(Triangle posture) Utthitatrikonasana 2. Parivaritta Trikonasana (Revolving triangle) 3. Utthita Prsvakonasana (Extended side angle pose) 4. Parivritta parasvakonasana (Revolving side angle pose) 5. Padamgusthasana (Big toe posture) 6. Padahasthasana (Hand under foot posture). Then the practitioner's made on to a set of seated postures. **Primary series-sitting posture**.1 Paschimottanasana 2. Janusirasana 3. Triangmukhai pada paschimottanasana 4. Gomukasana 5.Vakrasana 6.Vajrasana. **Finishing sequences** ended with 1.Matsysana 2. Yoga Mudra 3.Uttana Padasana 4.Sarvagasana 5.Ardha Sirasana 6.Savasana.

Following Vinyasa practices, all participated in the progressive resistance training programme on weekly twice. In the first phase of each resistance training session all subjects performed one sets of 10 to 12 repetitions on the following Isometric resistance exercises: Plank Bridge, Isometric wall squat, full leg contraction, hamstring curl, isometric pushup,

shoulder extension, hip adduction, squat hold and Ankle press for first four weeks. In the second phase the subjects performed one sets of 10 to 12 repetitions on the following barbell exercises: Squat, Bench press, Standing calf raise, Biceps curl, Shoulder press, Calf full down, Triceps extension and upright row in the second four week. In the third phase of training subjects performed one sets of 10 to 12 repetitions on the following Dumbells exercises: Dumbell bench press, Biceps curl, Shoulder press, Lateral raise, Stationary lunge, Toe raise, Abdominal crunch and Dumbell side bend in the third four week. The last repetition of the set on each exercise represented momentary muscular fatigue whereby participants were unable to perform additional repetitions. Following every resistance training session subjects performed 10 to 15 repetitions of abdominal curl.

TESTING PROCEDURE

The pre and post testing measurements were conducted on two different ways separately by minimum 24 hours. The variables tested on day 1 of the pre and post testing sessions included a peak expiratory flow rate was tested by peak expiratory flow rate monitor measured litter per minute, resting pulse rate is tested by pulse measurement measured by heart beats per minutes, Breath holding was tested by breath holding test measured in seconds and on day two Vo2 max was measured by conducting Queen's college step test and measured in ml.kg-1.min-1 , subject completed a stranded warm-up before testing sessions of aerobic capacity.

MATERIAL AND METHOD

Sixty female subjects from Coimbatore Institute of Technology volunteered to participate in the study. Participants were not involved in any organized sports activity, but were required to perform an average of 3 hours per week of yoga practice. The mean (SD) age, height, mass and BMI of the group were 21.84 ±1.4 years, 178.4 ± 4.6cm, 62.4 ±6.47kg and 24.2 ±2.4kg /m^2 respectively all subject after having been informed about the objective and protocol of the study, gave their return consent to participate in the study the randomized pre- post test control group design was adopted for the study. The subjects were randomly assigned into two groups experimental group (YPRT N=30) and control group (CGN N=30). Experimental group was subjected to 12 weeks of yogic (Vinyasa) practice training for 45 minute a day and resistance training for 30 minutes.

STATISTICAL TECHNIQUE

Statistical analysis of the data was performed for each group using the mean and standard deviations. Students paired test was used to compare the pre- and post training values of both the groups. The differences between the two groups for the physiological variables were determined using analysis of co-variance (ANCOVA). The $P \leq 0.05$ criteria was used for establishing significances P value of lesser than 0.05 was accepted as indicating significant difference between the compared values. The derived results are discussed as follows Table-1 to Table-8.

RESULTS

Table -1
Significance of mean gains/losses between pre and post test of experimental and control groups on Pulse Rate

Groups	Pre-Test Mean ± Standard Deviation	Post-Test Mean ± Standard Deviation	Mean. Difference	SEM	't'-ratio	P.Value
Control Group	**84.87 ±10.63**	**84.77 ±9.66**	**0.10**	**0.42**	**0.24**	**0.82**
Experimental Group	**83.23 ±8.92**	**79.50 ±8.63**	**3.73**	**0.28**	**13.57***	**0.00**

*significant at 0.05 level of confidence

Table I reveals the descriptive aspects and differential analysis on pulse rate of Information technology women students. The mean and standard deviation on pulse rate among the students of Information technology pertain to control group and experimental group for pre-test 84.87 ± 10.63, 83.23 ±8.92, and for post test 84.77 ± 9.66, 79.50 ± 8.63 respectively.

Table-II

Analysis of covariance of adjusted post-test means of experimental and control groups on Pulse Rate

Test	Source of variance	Sum of square	Degree's of Freedom	Mean square	F-ratio	P.Value
Pre-test	B / G	40.017	1	40.02	0.41	0.52
	W / G	5586.83	58	96.32		
Post-test	B / G	416.07	1	416.07	4.95	0.03
	W / G	4866.87	58	83.91		
Adjusted post test	B / G	211.80	1	211.80	66.04*	0.00
	W / G	182.81	57	3.21		

*significant at 0.05 level of confidence

Table II reveals that the F-ratio on pulse rate are: 0.41(pre-test) and 4.95 (post test). The obtained F-ratio for pre and post test was found to be statistically significant at 0.05 level (3.155). Further when testing the adjusted post test means between the control group (84.77) and experimental group (79.50), on pulse rate, the obtained F-ratio was 66.04 and found to be significant at 0.05 levels (3.155). From the observed F-ratio, it was inferred that the specific training comprised vinyasa yoga practice with resistance training has significant impact on pulse rate.

Table –III

Significance of mean gains/losses between pre and post test of experimental and control groups on Breath Holding

Groups	Pre-Test Mean ± Standard Deviation	Post-Test Mean ± Standard Deviation	Mean Difference	SEM	't'-ratio	P.Value
Control Group	0.41 ±0.15	0.41 ±0.15	0.01	0.003	1.89	0.068
Experimental Group	0.45 ±0.18	0.52 ±0.24	0.07	0.02	3.46*	.002

*significant at 0.05 level of confidence

Table III reveals the descriptive aspects and differential analysis on Breath Holding of Information technology women students. The mean and standard deviation of breath holding among the students of Information technology pertain to control group and experimental group for pre-test 0.41± 0.15, 0.45 ±0.18, and for post test 0.41 ± 0.15, 0.52 ± 0.24 respectively

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Table-IV

Analysis of covariance of adjusted post-test means of experimental and control groups on Breath Holding

Test	Source of variance	Sum of square	Degree's of Freedom	Mean square	F-ratio	P.Value
Pre-test	B / G	0.25	1	0.025	0.89	0.349
	W / G	1.604	58	0.03		
Post-test	B / G	0.19	1	0.19	4.92	0.030
	W / G	2.27	58	0.04		
Adjusted post test	B / G	0.069	1	0.07	12.65*	0.001
	W / G	0.31	57	0.005		

*significant at 0.05 level of confidence

Table IV reveals that the F-ratio on Breath holding are: 0.89 (pre-test) and 4.92 (post test). The obtained F-ratio for pre and post test was found to be statistically significant at 0.05 level (3.155). Further when testing the adjusted post test means between the control group (0.41) and experimental group (0.52),

on breath holding, the obtained F-ratio was 12.65 and found to be significant at 0.05 levels (3.155). From the observed F-ratio, it was inferred that the specific training comprised vinyasa yoga practice with resistance training has significant impact on breath holding.

Table -V

Significance of mean gains/losses between pre and post test of experimental and control groups on Peak Flow Rate

Groups	Pre-Test Mean ± Standard Deviation	Post-Test Mean ± Standard Deviation	Mean. Difference	SEM	't'-ratio	P.Value
Control Group	358 ±62.11	355 ±60.96	3.00	2.09	1.43	0.163
Experimental Group	376.33 ±55.55	392 ±53.33	15.67	2.13	7.37*	0.00

*significant at 0.05 level of confidence

Table V reveals the descriptive aspects and differential analysis on Peak flow rate of Information technology women students. The mean and standard deviation of peak flow rate among the students of Information technology pertain to control group and experimental group for pre-test 358 ± 62.11, 376.33 ±55.55, and for post test 355 ± 60.96, 392± 53.33 respectively

Table-VI

Analysis of covariance of adjusted post-test means of experimental and control groups on peak flow rate

Test	Source of variance	Sum of square	Degree's of Freedom	Mean square	F-ratio	P.Value
Pre-test	B / G	5041.67	1	5041.67	1.45	0.233
	W / G	201376.67	58	3472.011		
Post-test	B / G	20535	1	20535	6.26	0.015
	W / G	190230	58	3279.83		
Adjusted post test	B / G	5580.202	1	5580.202	43.44*	0.00
	W / G	7322.581	57	128.466		

*significant at 0.05 level of confidence

Table VI reveals that the F-ratio on peak flow rate are: 1.45 (pre-test) and 6.26 (post test). The obtained F-ratio for pre and post test was found to be statistically significant at 0.05 level (3.155). Further when testing the adjusted post test means between the control group (355) and experimental group (392), on peak flow rate, the obtained F-ratio was 43.44 and found to be significant at 0.05 levels (3.155). From the observed F-ratio, it was inferred that the specific training comprised vinyasa yoga practice with resistance training has significant impact on peak flow rate.

Table -VII

Significance of mean gains/losses between pre and post test of experimental and control groups on Vo2 Max

Groups	Pre-Test Mean ± Standard Deviation	Post-Test Mean ± Standard Deviation	Mean. Difference	SEM	't'-ratio	P.Value
Control Group	45.87 ±4.27	45.67 ±3.79	1.09	0.20	1.00	0.326
Experimental Group	45.83 ±4.33	50.97 ±2.92	2.01	0.37	13.97*	0.00

*significant at 0.05 level of confidence

Table VII reveals the descriptive aspects and differential analysis on Vo2Max of Information technology women students. The mean and standard deviation of Vo2 Max among the students of Information technology pertain to control group and experimental group for pre-test 45.87± 4.27, 45.83±4.33, and for post test 45.67± 3.79, 50.97± 2.92respectively.

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Table-VIII
Analysis of covariance of adjusted post-test means of experimental and control groups on Vo2 Max

Test	Source of variance	Sum of square	Degree's of Freedom	Mean square	F-ratio	P.Value
Pre-test	B / G	0.017	1	0.017	0.001	0.975
	W / G	947.63	58	16.34		
Post-test	B / G	421.35	1	421.35	30.95	0.00
	W / G	789.63	58	13.61		
Adjusted post test	B / G	425.79	1	425.79	191.29*	0.00
	W / G	126.87	57	2.23		

*significant at 0.05 level of confidence

Table VIII reveals that the F-ratio on Vo2 Max are 0.001 (pre-test) and 30.95 (post test). The obtained F-ratio for pre and post test was found to be statistically significant at 0.05 level (3.155). Further when testing the adjusted post test means between the control group (45.67) and experimental group (50.97), on Vo2 max, the obtained F-ratio was 191.29 and found to be significant at 0.05 levels (3.155). From the observed F-ratio, it was inferred that the specific training comprised vinyasa yoga practice with resistance training has significant impact on Vo2 Max.

DISCUSSION

As shown in the results all the parameters in the yoga training group shows statistically significant with regular vinyasa practices. Statistically significant reduction in Pulse rate after regular practice of vinyasa practice is attributed to increased vagal tone and decreased sympathetic activity. (7, 8). Decreased sympathetic activity in turn reduces catecholamine secretion and also leads to vasodilatation leading to improvement in peripheral circulation. It is also observed that regular yogic practices reduce basal metabolic rate and resting oxygen consumption. (9)All these may be responsible for redactor in resting pulse rate. Regular vinyasa practices with resistance decrease airway resistance.

As for as Breath Holding is concerned Vinyasa practices have better strengthening of respiratory muscles. Repeated inspiration and expiration to improve total lung capacity and breath holding as done during Pranayama can lead to maximal shortening of the inspiratory muscles which have been shown to improve the lung functions and many authors were in agreement with this. (11). During yoga practice, one consciously and consistently overrides the stimuli to the respiratory centers, thus acquiring some degree of control over the respiration. This is responsible for prolongation of Breath holding Time in yoga trained subjects. It is also possible that yoga training might alter the responsiveness of medullar and systemic arterial chemoreceptor's with consequent prolongation of Breath holding Time.(10)

As Peak expiratory flow rate (PEFR) is concerned the increase in PEFR might be due to significant increase in vital capacity. The other possible mechanism for PEFT may: (a) Increased power of respiratory muscle that is due to the work hypertrophy of the muscle during vinyasa yogic practice. (b) Breathing along with vinyasa practice training practitioners use the diaphragmatic and abdominal muscles more efficiently thereby emptying and filling the respiratory apparatus more efficiently and completely. (12). Compared to control group, basal oxygen consumption is reported to have a training effect with oxygen consumption, during sub maximal exercise decreasing by 36% after 3 month**.**(13) Many studies emphasized the need of PEFR as one of the important indicator of pulmonary function. In the present study, the mean % PEPR among vinyasa yoga practitioners was increased when compared to control group. PEFR is determined mainly by airway caliber, alveolar elastic recoil and respiratory muscle effort. Vinyasa yoga practice which emphasized on Pranayama along with the asana practice may be characterized by slow and deep inhalation and exhalation. It is said to be the main breathing exercise causing an increase in breath holding time, and also trains the respiratory centers to suspend the breath for quite a long time. The stress is more on prolonged expiration and efficient use of abdominal and diaphragmatic muscles. This act trains respiratory apparatus to get emptied and filled more completely and efficiently which is recorded in terms of vital capacity.

All these factors contribute to improvement in various lung functions, which also improve in respiratory muscle endurance. Recent studies confirm increase in Vo2 max by yoga training (11, 12) due to reduction in resting oxygen consumption at the same time it better utilization at cellular level which raise

vo2 max after regular vinyasa yoga with resistance training.Vo2 max was higher for subjects due to the practice of vinyasa training with resistance exercise at low to moderate intensity (40-70% of HR max). This is caused by the stronger effort performed during the vinyasa practice with resistance training. These effects can be explained on the following basis. (I) Increase in Oxygen Consumption by the muscles (16), which in turn suggest increase in muscle blood flow. This may be due to a generalized decrease in vascular tone resulting from stimulation of parasympathetic activity during Yogic Training. (17).(II) Conversion of some of the Fast Twitch muscle fibers into Slow Twitch muscle fibers during yogic training. Slow twitch fibers have high aerobic power. (18). (III) Yoga postures (asanas) involve isometric contraction which is known to increase skeletal muscle strength. (19) (IV) Greater involvement of active muscle mass from different parts of the body. (20). (V) Increase in muscular endurance and delay in onset of fatigue (21). (VI) Improvement in lung functions and better utilization of oxygen at cellular level. Improvements in both lung functions as well as cellular machinery explain raised VO2 max after regular practice of yoga. (22).Thus, practice of vinyasa yogic practices with resistance training seems to be beneficial for respiratory efficiency and numbers of studies have been done to show and support the present study.

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