

Impact of short-term Bhastrika Pranayama on respiratory parameters: an ancient practice with contemporary significance

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Abstract:

Purpose: The study was conducted to determine the impact of short-term bhastrika pranayama on respiratory parameters. **Material:** The research was carried out on a sample of 30 university level girls. Experimental group was subjected to 4-week training of bhastrika pranayama. **Statistical Analysis:** Student t test was utilized for analysis of data. **Results:** The Mean and Standard Deviation values of Tidal Volume (VT) of pre-test and post-test of experimental group was 389.60 ± 10.25 and 408.40 ± 27.44 respectively. However, the Mean and Standard Deviation values of Tidal Volume of pre-test and post-test of control group were 352.93 ± 8.80 and 351.40 ± 9.83 . The t-value in case of experimental group was 2.8976 and for control group it was 1.3580. **Conclusions:** The significant differences were noted in Tidal Volume, Expiratory Reserve Volume, Inspiratory Reserve Volume, Vital Capacity and Inspiratory Capacity in the experimental group. However, insignificant changes over that 4-week period were noted in the control group.

Keywords:

tidal volume, expiratory reserve volume, inspiratory reserve volume, vital capacity, inspiratory capacity.

Балджндер Сингх Бал. Влияние краткосрочных занятий Бхастрика Пранаяма на респираторные параметры: Древняя практика и ее современное значение. Цель: исследование было проведено для определения влияния краткосрочных занятий Бхастрика Пранаяма на параметры дыхания. **Материал:** Исследование проводилось на выборке из 30 девушек университета. В экспериментальной группе проводилось 4-недельное обучение Бхастрика Пранаяма. **Статистический анализ:** для анализа данных использовали t-критерий Стьюдента. **Результаты:** в экспериментальной группе средние значения и стандартные отклонения дыхательного объема до и после эксперимента находились на уровне $389,60 \pm 10,25$ и $408,40 \pm 27,44$, соответственно. Средние значения и стандартные отклонения дыхательного объема до и после эксперимента в контрольной группе составили $352,93 \pm 8,80$ и $351,40 \pm 9,83$. Т-критерий в экспериментальной группе был 2,8976 и в контрольной группе 1,3580. **Выводы:** в экспериментальной группе были отмечены существенные различия в дыхательном объеме, резервном объеме выдоха, резервном объеме вдоха, жизненной емкости и емкости вдоха. Тем не менее, незначительные изменения в течение этого 4-недельного периода было отмечено в контрольной группе.

Балджндер Сингх Бал. Вплив короткострокових занять Бхастрика Пранаяма на респіраторні параметри: Стародавня практика та її сучасне значення. Мета: дослідження було проведено для визначення впливу короткострокових занять Бхастрика Пранаяма на параметри дихання. **Матеріал:** Дослідження проводилося на вибірці з 30 дівчат університету. В експериментальній групі проводилося 4-тижневе навчання Бхастрика Пранаяма. **Статистичний аналіз:** для аналізу даних використовували t-критерій Стьюдента. **Результати:** в експериментальній групі середні значення і стандартні відхилення дихального об'єму до і після експерименту знаходилися на рівні $389,60 \pm 10,25$ і $408,40 \pm 27,44$, відповідно. Середні значення та стандартні відхилення дихального об'єму до і після експерименту в контрольній групі склали $352,93 \pm 8,80$ і $351,40 \pm 9,83$. Т-критерій в експериментальній групі був 2,8976 і в контрольній групі 1,3580. **Висновки:** в експериментальній групі були відзначені істотні відмінності в дихальному обсязі, резервному обсязі видиху, резервному обсязі вдиху, життєвої ємності і ємності вдиху. Тим не менш, незначні зміни протягом цього 4-тижневого періоду було відзначено в контрольній групі.

дыхательный объем, резервный объем выдоха, резервный объем вдоха, жизненная емкость, емкость вдоха.

дихальний обсяг, резервний обсяг видиху, резервний обсяг вдиху, життєва ємність, ємність вдиху.

Introduction

Yoga techniques yield incredible physiological variations and have comprehensive methodical basis [6, 11]. Yoga & pranayam is an antique practice practiced by mentors and yogis as an enviable and vivacious way of life. Pranayam, the fourth step of ashtang yoga is an important component of yoga training [6]. The precise significance of yoga is to attain stability within the inner and peripheral atmosphere, thus looking for intellectual, divine and bodily health. This is probable through the exercise of "Pranayama", [10]. The exercise of yoga leads to a decrease in respiratory rate and calming of the mind, which leads to reduced arousal condition [7, 8]. But various studies show that respiratory parameters improve after yoga & pranayama. Significant increase in the VC V_T increase in ERV & IC and breath holding time is observed [2, 9]. Growing number of evidences have claimed that yoga practices increases longevity, [1] has therapeutic [4] and rehabilitative effects [3]. Consequently, a yoga practitioner, through the technique of pranayama, can at some stage control other physiological functions and finally control manifestation of prana even outside the body [12]. The effect of different pranayamas on healthy [13] and diseased people [14, 15 and 16] has been well

studied and they are known to affect the cardiopulmonary activities and autonomic functions. Growing number of evidences have claimed that yoga practices increases longevity, [17] has therapeutic [18] and rehabilitative effects [19, 20].

Methods

Subjects

For the purpose of the current investigation, thirty, university level girls of 21-26 years were selected. Subjects were purposively divided into 2 groups: Group-A: Experimental ($n_1=15$); Group-B: Control ($n_2=15$).

Methodology

This study is designed as a retrospective cross-sectional study. The experimental group was subjected to 4-week training of bhastrika pranayama. The following indices were measured:

- Tidal volume (V_T)
- Expiratory Reserve Volume (ERV)
- Inspiratory Reserve Volume (IRV)
- Vital Capacity (VC)
- Inspiratory Capacity (IC)

The details of training program are brought forth in table-1.

Statistical Analyses

Student t test was utilized for analysis of data. The level of significance was set at 0.05.

Table 1

Distribution and Demographics of Subjects

Sample Size (N=30)			
Variables	Total (N=30)	Experimental group (n ₁ =15)	Control group (n ₂ =15)
Age	22.00±1.93	21.67±1.95	22.33±1.91
Body Height	5.49±0.19	5.533±0.19	5.46±0.18
Body Mass	61.14±3.85	61.00±3.38	59.29±4.21

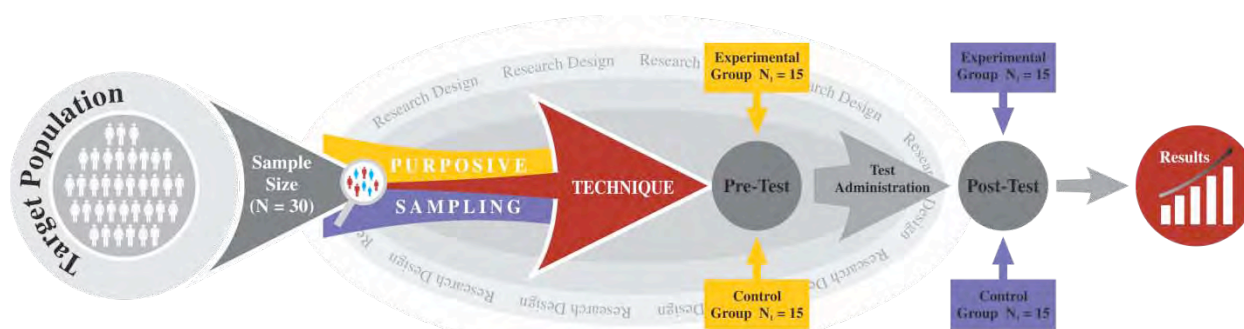


Fig. 1. Study Design



Fig. 2. Subjects Performing Tidal Volume (V_t)



Fig. 3. Subjects Performing Expiratory Reserve Volume (ERV)



Fig. 4. Subjects Performing Inspiratory Reserve Volume (IRV)



Fig. 5. Subjects Performing Vital Capacity (VC)



Fig. 6. Subjects Performing Inspiratory Capacity (IC)

Table 2

Experimental Treatment

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

Results

The results of Respiratory Parameters are brought forth in table-3-7.

Tidal Volume (V_T)

The Mean and Standard Deviation values of Tidal Volume (V_T) of pre-test and post-test of experimental

group was 389.60 ± 10.25 and 408.40 ± 27.44 respectively. However, the Mean and Standard Deviation values of Tidal Volume (V_T) of pre-test and post-test of control group were 352.93 ± 8.80 and 351.40 ± 9.83 . The t-value in case of experimental group was 2.8976^* and for control group it was 1.3580 .

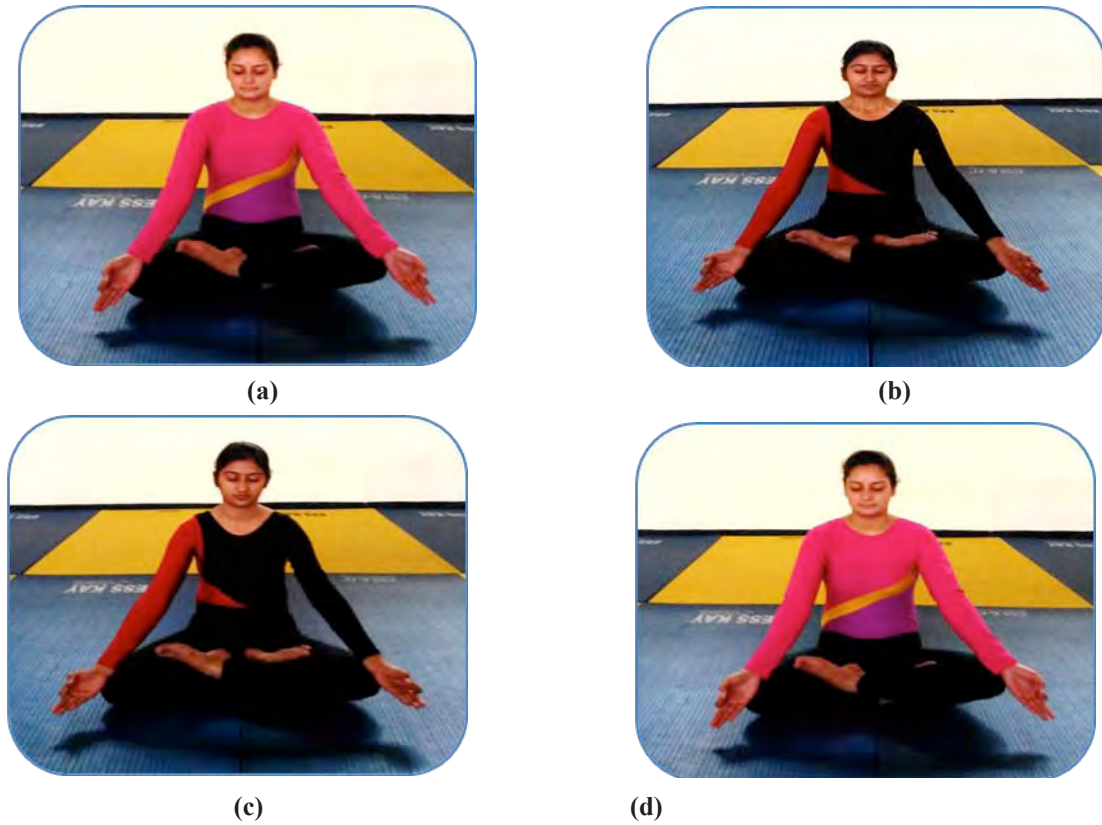
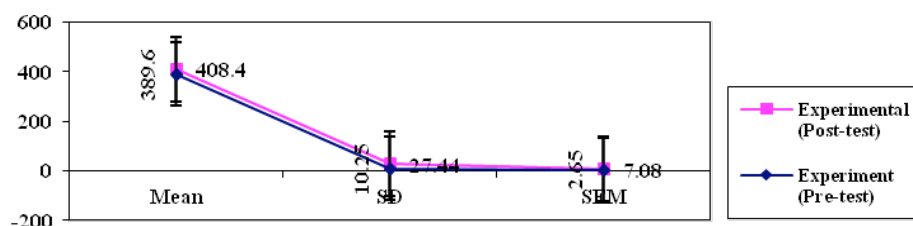


Fig. 7. Subjects Performing Bhastrika Pranayama

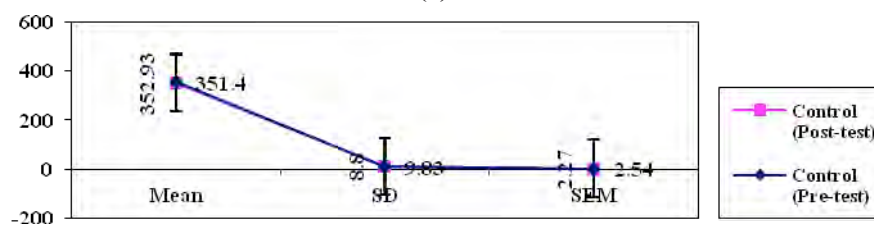
Table 3

Descriptive Statistics and Paired Sample t-test of Tidal Volume (V_T) of University Level Girls

Tidal Volume (V_T)						
Group	Number	Mean	SD	SEM	t-value	p-value
Experiment (Pre-test)	15	389.60	10.25	2.65	2.8976*	0.011
Experimental (Post-test)	15	408.40	27.44	7.08		
Control (Pre-test)	15	352.93	8.80	2.27	1.3580	0.195
Control (Post-test)	15	351.40	9.83	2.54		



(a)



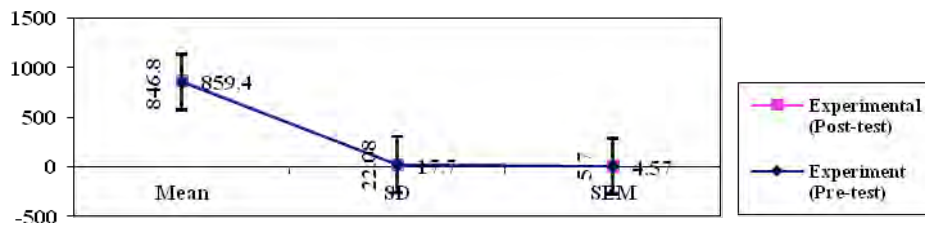
(b)

Fig. 8. Descriptive Statistics of Tidal Volume (V_T) of (a) Experimental (Pre & Post) and (b) Control (Pre & Post) group of University Level Girls.

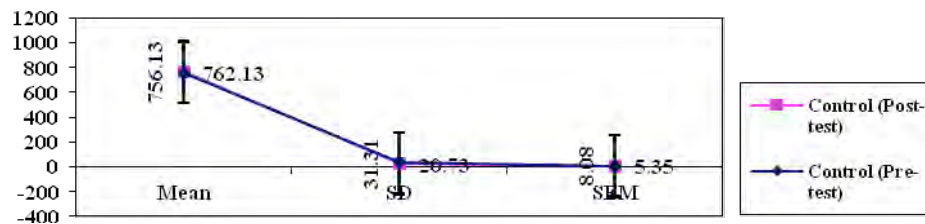
Table 4

Descriptive Statistics and Paired Sample t-test of Expiratory Reserve Volume (ERV) of University Level Girls

Expiratory Reserve Volume (ERV)						
Group	Number	Mean	SD	SEM	t-value	p-value
Experiment (Pre-test)	15	846.80	22.08	5.70	6.8739*	0.0001
Experimental (Post-test)	15	859.40	17.70	4.57		
Control (Pre-test)	15	756.13	31.31	8.08	1.0473	0.3127
Control (Post-test)	15	762.13	20.73	5.35		



(a)



(b)

Fig. 9. Descriptive Statistics of Expiratory Reserve Volume (ERV) of (a) Experimental (Pre & Post) and (b) Control (Pre & Post) group of University Level Girls

Table 5

Descriptive Statistics and Paired Sample t-test of Inspiratory Reserve Volume (IRV) of University Level Girls

Inspiratory Reserve Volume (IRV)						
Group	Number	Mean	SD	SEM	t-value	p-value
Experiment (Pre-test)	15	2345.47	23.86	6.16	6.0502*	0.0001
Experimental (Post-test)	15	2360.00	18.35	4.74		
Control (Pre-test)	15	2223.07	29.12	7.52	0.666	0.516
Control (Post-test)	15	2228.67	12.26	3.17		

Significant between-group differences were noted in Tidal Volume (V_T) since the calculated value of ($t=2.8976^*$) is greater than tabulated value of $t_{.05}$ (14) = 2.14 for the selected degree of freedom and level of significance.

Expiratory Reserve Volume (ERV)

The Mean and Standard Deviation values of Expiratory Reserve Volume (ERV) of pre-test and post-test of experimental group was 846.80 ± 22.08 and 859.40 ± 17.70 respectively. However, the Mean and Standard

Deviation values of Expiratory Reserve Volume (ERV) of pre-test and post-test of control group were 756.13 ± 31.31 and 762.13 ± 20.73 . The t-value in case of experimental group was 6.8739^* and for control group it was 1.0473 .

Significant between-group differences were noted in Expiratory Reserve Volume (ERV) since the calculated value of ($t=6.8739^*$) is greater than tabulated value of $t_{.05}$ (14) = 2.14 for the selected degree of freedom and level of significance.

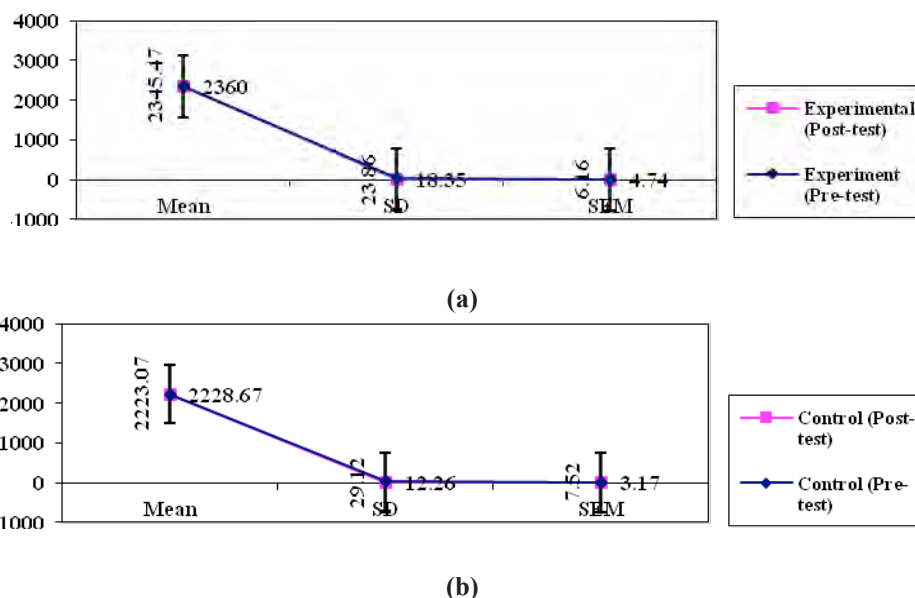


Fig. 10. Descriptive Statistics of Inspiratory Reserve Volume (IRV) of (a) Experimental (Pre & Post) and (b) Control (Pre & Post) group of University Level Girls

Table 6. Descriptive Statistics and Paired Sample t-test of Vital Capacity (VC) of University Level Girls

Vital Capacity (VC)						
Group	Number	Mean	SD	SEM	t-value	p-value
Experiment (Pre-test)	15	3581.80	26.24	6.78	7.0889*	0.0001
Experimental (Post-test)	15	3626.47	42.63	11.01		
Control (Pre-test)	15	3334.80	40.08	10.35	0.717	0.4851
Control (Post-test)	15	3342.33	26.23	6.77		

Table 7. Descriptive Statistics of Inspiratory Capacity (IC) of University Level Girls

Inspiratory Capacity (IC)						
Group	Number	Mean	SD	SEM	t-value	p-value
Experiment (Pre-test)	15	3971.40	30.64	7.91	3.4908*	0.003
Experimental (Post-test)	15	4057.60	98.08	25.33		
Control (Pre-test)	15	3687.73	42.65	11.01	0.605	0.554
Control (Post-test)	15	3693.80	32.34	8.35		

Inspiratory Reserve Volume (IRV)

The Mean and Standard Deviation values of Inspiratory Reserve Volume (IRV) of pre-test and post-test of experimental group was 2345.47 ± 23.86 and 2360.00 ± 18.35 respectively. However, the Mean and Standard Deviation values of Inspiratory Reserve Volume (IRV) of pre-test and post-test of control group were 2223.07 ± 29.12 and 2228.67 ± 12.26 . The t-value in case of experimental group was 6.0502^* and for control group

it was 0.666.

Significant between-group differences were noted in Inspiratory Reserve Volume (IRV) since the calculated value of $(t=6.0502^*)$ is greater than tabulated value of $t_{0.05}(14) = 2.14$ for the selected degree of freedom and level of significance.

Vital Capacity (VC)

Mean and Standard Deviation values of Vital Capacity (VC) of pre-test and post-test of experimental group

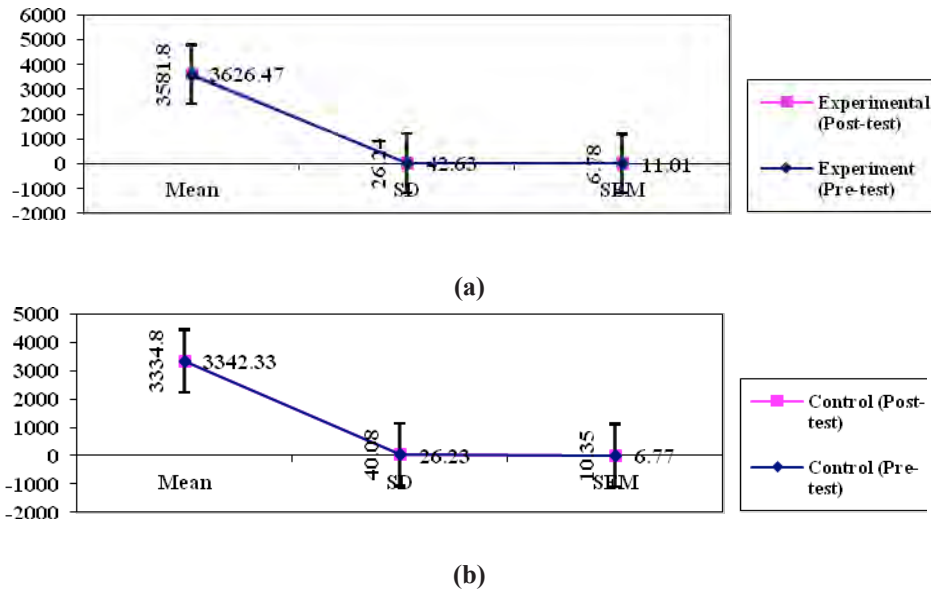


Fig. 11. Descriptive Statistics of Vital Capacity (VC) of (a) Experimental (Pre & Post) and (b) Control (Pre & Post) group of University Level Girls

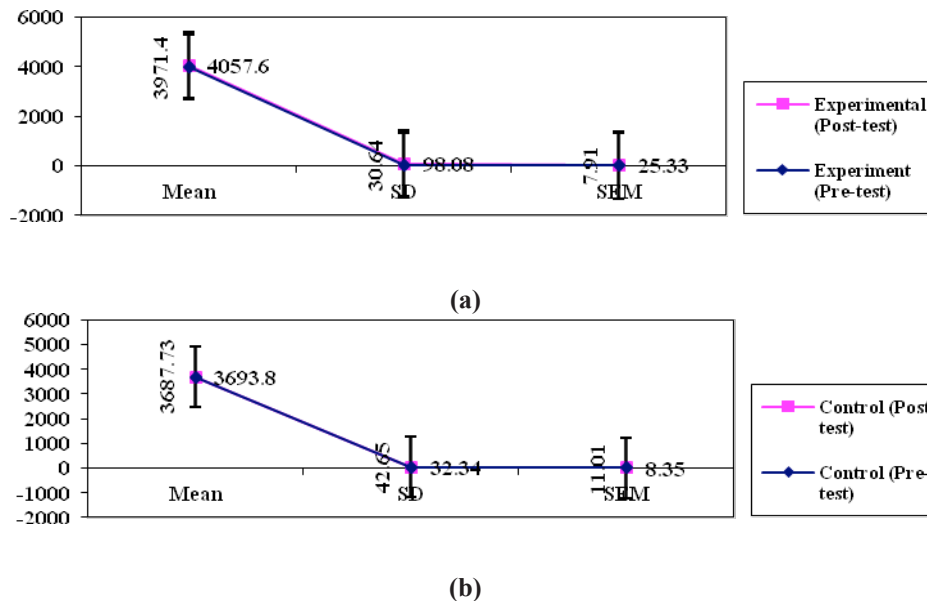


Fig. 12. Descriptive Statistics of Inspiratory Capacity (IC) of (a) Experimental (Pre & Post) and (b) Control (Pre & Post) group of University Level Girls

was 3581.80 ± 26.24 and 3626.47 ± 42.63 respectively. However, Mean and Standard Deviation values of Vital Capacity (VC) of pre-test and post-test of control group were 3334.80 ± 40.08 and 3342.33 ± 26.23 . The t-value in case of experimental group was 7.0889^* and for control group it was 0.717 .

Significant between-group differences were noted in Vital Capacity (VC) since the calculated value of ($t=7.0889^*$) is greater than tabulated value of $t_{05} (14) = 2.14$ for the selected degree of freedom and level of significance.

Inspiratory Capacity (IC)

Mean and Standard Deviation values of Inspiratory Capacity (IC) of pre-test and post-test of experimental group was 3971.40 ± 30.64 and 4057.60 ± 98.08 respectively. However, the Mean and Standard Deviation

values of Inspiratory Capacity (IC) of pre-test and post-test of control group were 3687.80 ± 32.34 . The t-value in case of experimental group was 3.4908^* and for control group it was 0.605 .

Significant between-group differences were noted in Inspiratory Capacity (IC) since the calculated value of ($t=3.4908^*$) is greater than tabulated value of $t_{05} (14) = 2.14$ for the selected degree of freedom and level of significance.

Conclusions:

Based on the analysis of the results obtained, we conclude that the significant differences were noted in (V_T), (ERV), (IRV), (VC) and (IC) in the experimental group. However, no significant changes over that 4- week period were noted in the control group.

References:

1. Bharshankar JR, Bharshanker RN, Deshpande VN, Kaore SB, Gosavi GB. Effect of yoga on cardiovascular system in subjects above 40 years. *Indian J Physiol Pharmacol*. 2003;47(2):202-206.
2. Gopal KS, Bhatnagar OP, Subramanian N, & Nishith SD. Effect of Yogasans and pranayama on blood pressure, pulse rate and some respiratory functions. *Indian J Physiol Pharmacol*. 1973, 17(3), 273-276.
3. Katiyar SK, & Bihari S. Role of pranayama in rehabilitation of COPD patients – a randomized controlled study. *Indian J Allergy Asthma Immunol*. 2006;20(2):98-104.
4. Khanam AA, Sachdev V, Guleria R, & Deepak KK. Study of Pulmonary and Autonomic Functions of Asthma Patients After Yoga Training. *Indian J Physiol Pharmacol*. 1996;40(4):318-324.
5. Madanmohan R, Balavittal V, Thombre DP, & Swami G. Cardiorespiratory changes during savitri pranayam and shavasan. *The Yoga Review*. 1983;3:25-34.
6. Madanmohan T, Bharathi B, Nambinarayanan TK, Thalur S, Krishnamurthy N, & Chandrabose A. Effect of Yoga Training on Reaction Time, Respiratory Endurance and Muscle Strength. *Indian J Physiol Pharmacol*, 1992;36:229-233.
7. Maharishi MY. *The science of being and art of living*. In: Rev.ed. Los Angeles, International SRM Publications; 1969.
8. Nagendra HR, & Nagarathna R. *New perspectives in stress management*. Bangalore Vivekananda Kendra Prakashana; 1977.
9. Singh V, Wisniewski A, Britton J, & Tattersfield A. Effect of yoga breathing exercises (pranayama) on airway reactivity in subjects with asthma. *The Lancet*. 1990;335:1381-1383.
10. Taimni LK. *The Science of Yoga*. Madras. The Theosophical Publishing House; 1961.
11. Wallace RK, Benson H, & Wilson AF. A wakeful hypo metabolic physiologic state. *Am J Physiol*. 1971;221:795-799.
12. Bijlani RL. *Understanding medical physiology*. 3rd Ed. New Delhi: Jaypee Brothers; 2004.
13. Subbalakshmi NK, Saxena SK, Urmimala D, & Urban JA. Immediate effect of Nadi-shodhan Pranayama on some selected parameters of cardiovascular, pulmonary and higher functions of brain. *Thai J Physiological Sciences* 2005;18:10-16.
14. Cooper S, Osborne J, Newton S, Harrison V, Thompson CJ, Lewis S, & Tattersfield A. Effect of two breathing exercises (Buteyko and pranayama) in asthma: a randomised controlled trial. *Thorax* 2003;1:64-75.
15. Dhungel KU, Malhotra V, Sarkar D, & Prajapati R. Effect of alternate nostril breathing exercise on Cardiorespiratory Functions. *Nepal Med Coll J* 2008;10:25-27.
16. Ravindra PN, & Madanmohan PP. Effect of pranayam (yogic breathing) and shavasan (relaxation training) on the frequency of benign ventricular ectopics in two patients with palpitations. *Int J Cardiol* 2006;108:124-125.
17. Bharshankar JR, Bharshanker RN, Deshpande VN, Kaore SB, & Gosavi GB. Effect of Yoga on Cardiovascular System in Subjects above 40 Years. *Indian J Physiol Pharmacol*. 2003;47(2):202-06.
18. Khanam AA, Sachdev V, Guleria R, & Deepak KK. Study of Pulmonary and Autonomic Functions of Asthma Patients After Yoga Training. *Indian J Physiol Pharmacol*. 1996;40(4):318-324.
19. Katiyar SK, & Bihari S. Role of pranayama in rehabilitation of COPD patients-a randomized controlled study. *Indian J Allergy Asthma Immunol*, 2006;20(2):98-104.
20. Jastrzębska M, Foltynska A, Torbus-Lisiecka B, Chelstowski K, Pieczul-Mróz J, Klimek K. Fibrinogen and von Wille brand factor levels in relation to lipid profile and blood pressure in children whose fathers have a history of premature myocardial infarction. *Polish Heart Journal* 2002;56(6):488-495.

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