Sharma Rekha
Assistant Professor, Department of Physical Education and Sports Sciences, Institute of Home Economics, University of Delhi, New Delhi, India

Shaw Dhananjoy
Associate Professor, Indira Gandhi Institute of Physical Education and Sports Sciences, University of Delhi, New Delhi, India

A study on the effect of selected yogic practices on parasympathetic reactivity variables of autonomic functions

Sharma Rekha and Shaw Dhananjoy

Abstract
The purposes of the study were (i) to study the effect of Kapalbhati, Anulom Vilom, Agnisar, and Bhramari Practice on Deep Breathing Test Score (change in heart rate) (ii) to study the effect of Kapalbhati, Anulom Vilom, Agnisar, and Bhramari Practice on Expiratory Inspiratory Ratio (iii) to study the effect of Kapalbhati, Anulom Vilom, Agnisar, and Bhramari Practice on Valsalva Manoeuvre Ratio (iv) to study the effect of Kapalbhati, Anulom Vilom, Agnisar, and Bhramari Practice on 30:15 Ratio. The age of the subjects ranged from 35 to 45 yrs sedentary females. There were four experimental groups and four control group. The number of samples at pre test in experimental groups were (anulom vilom n1= 35, kapalbhati n2=35, bhramari n3=35, agnisar n4=35) consisting of 140 samples. The number of samples at pre test in control groups were (anulom vilom n1= 26, kapalbhati n2=26, bhramari n3=26, agnisar n4=26) consisting of 104 samples. The number of samples at post test in experimental groups were (anulom vilom n1= 30, kapalbhati n2=30, bhramari n3=32, agnisar n4=30) consisting of 122 samples. The number of samples at post test in control groups were (anulom vilom n1 = 23, kapalbhati n2=23, bhramari n3=26, agnisar n4=25) consisting of 97 samples. The experimental groups were treated with selected yogic practices namely Kapalbhati, Anuloma Viloma, Agnisar, Bhramari, (tailored programme) independently to independent group for 20 minutes, five days a week, for six weeks whereas the control group were not given any treatment. Deep Breathing Test Score (change in heart rate), Expiratory Inspiratory Ratio, Valsalva Manoeuvre Ratio, 30:15 Ratio were done at pretest and after six weeks of treatment the post test was taken. Simultaneously the control group was tested. It was hypothesized that there will be positive effect of anulom vilom, kapalbhati, bhramari and agnisar on the autonomic functions of sedentary females age ranging from 35 years to 45 years. Mean, Standard Deviation, and t- test were used as statistics and hypothesis was tested at .05 level of significance. The findings exhibited significant differences between pretest and post test scores of experimental groups in regard to the variables namely Deep Breathing Test Score (change in heart rate), Expiratory Inspiratory Ratio, Valsalva Manoeuvre Ratio, 30:15 Ratio.

Keywords: Kapalbhati, Anuloma Viloma, Agnisar, Bhramari, Deep Breathing Test Score (change in heart rate), Expiratory Inspiratory Ratio, Valsalva Manoeuvre Ratio, 30:15 Ratio

Introduction
Yoga is an effective method for improving health in addition to the prevention and management of diseases (Sengupta P. Health Impacts of Yoga and Pranayama, 2012) [14]. Yoga plays an important role in reducing stress, reducing sympathetic activity (Dvivedi J, Dvivedi S, Mahajan KK, Mittal S, Singhal, 2008, Vempati RP, Telles S, 2002) [8, 16] increasing parasympathetic activity (Udupa K, Madanmohan, Bhavanani AB, Vijayalakshmi P, Krishnamurthy N., 2003) [15], decreasing blood pressure (Parshad O, Richards A, 2011) [12], improving sense of well-being (Malathi A, Damodaran A. 1999) [11], and decreasing anxiety levels (Rocha KK, Ribeiro AM, Rocha KC, Sousa MB, Albuquerque FS, Ribeiro S, *et al.*, 2012) [13].
Yoga modules have, for instance, been found to be effective in the management of hypertension, diabetes and IR. (Telles 1999, Damodaran 2002, Monro 1992 and Raub 2002) [2]. These may be related to reductions in stress and arousal, since the basal metabolic rate (BMR) has been found to be reduced in practitioners of yoga, (Chaya 2006) [3] as have diurnal metabolic rates; (Chaya 2008) [4] the reduced metabolic rate of transcendental meditation (TM)

Correspondence
Sharma Rekha
Assistant Professor, Department of Physical Education and Sports Sciences, Institute of Home Economics, University of Delhi, New Delhi, India

has been called 'alert rest'. (Wallace 1971) The reduction in arousal has been attributed to a diminished cardiac sympathetic tone and enhanced vagal activity. (Vempati 2000, 2002) [16] Further, an increase in baroreflex sensitivity has been documented with the practice of yoga including meditation or prayers. (Bernardi 2001) [2] Plasma norepinephrine levels have been shown to be reduced in patients with cardiac failure after yoga training and urinary catecholamines have been shown to be significantly reduced in long term practitioners of yogic asanas. (Schmidt 1997) Finally, yoga has been found to be useful in reducing IR-related risk factors. (Innes KE 2005)

The integrated teaching and learning methodology where assessment forms important signpost, inclusion of stress relaxation techniques in modern education system is the need of hour. (Finkelstein 2007)Vastness of the medical curriculum poses young medical student under stress, mental fatigue and performance deficits (Doren Kshetrimayu). Nadishodhan Pranayama, Bhramari and Omkar recitation are important yogic practices. (Mandlik 2009) Nadidhodhana Pranayama causes modulation of sympathetic and parasympathetic activity thereby improving autonomic functions of body (Geetha 2008 and Jain 2009) [10]. The vibrations produced due to Bhramari, Omkar recitation increases the receptive capacity of individual. The study was intended to evaluate the collective effect of Nadishodhana Pranayma, Bhramari and Omkar chanting on autonomic functions and performance output amongst preclinical medical students (Basavareddy 2008) [1].

The review of research suggest that some studies are of combined effect i.e. general yogic treatment (Schmidt 1997, Telles 1999, Damodaran 2002, Monro 1992 and Raub 2002) [6] and some studies are of independent treatment Geetha 2008 [10] and Jain 2009 effect. In some studies there was specified treatmemt (Mandlik 2009) were given where as in some studies there was non-specified treatment. Considering the research gap the researcher was interested to study the independent effect of selected yogic kriyas and pranayamas namely Kapalbhati, Anuloma Viloma, Agnisar, Bhramari, on selected Autonomic Functions.

Methodology

There were four experimental groups and four control group. The number of samples at pre test in experimental groups were (anulom vilom n1= 35, kapalbhati n2=35, bhramari n3=35, agnisar n4=35) consisting of 140 samples. The number of samples at pre test in control groups were (anulom vilom n1= 26, kapalbhati n2=26, bhramari n3=26, agnisar n4=26) consisting of 104 samples. The number of samples at post test in experimental groups were (anulom vilom n1= 30, kapalbhati n2=30, bhramari n3=32, agnisar n4=30) consisting of 122 samples. The number of samples at post test in control groups were (anulom vilom n1 = 23, kapalbhati n2=23, bhramari n3=26, agnisar n4=25) consisting of 97 samples. The experimental groups were treated with selected yogic practices namely Kapalbhati, Anuloma Viloma, Agnisar, Bhramari, (tailored programme) independently to independent group for 20 minutes, five days a week, for six weeks whereas the control group were not given any treatment. Deep Breathing Test Score (change in heart rate), Expiratory Inspiratory Ratio, Valsalva Manoeuvre Ratio, 30:15 Ratio were done at pretest and after six weeks of treatment the post test was taken. Simultaneously the control group was tested. It was hypothesized that there will be positive effect of anulom vilom, kapalbhati, bhramari and agnisar on the autonomic functions of sedentary females age ranging from 35 years to 45 years. Mean, Standard Deviation, and t test were used as statistics and hypothesis was tested at.05 level of significance.

Findings

Table 1: Effect of Selected Yogic Kriyas and Pranayamas on Deep Breathing Test Score (Change in Heart Rate)

S. No.	Group	Test	Treatment/Training (Pranayama/Kriya)	N	Mean (bpm)	Standard Deviation (bpm)	"t"	Mean Difference (bpm)	Standard Error Difference (bpm)	Probability
1	Exp	Pre	Anulom Vilom	30	29.948167	4.8977305	2.025*	5.0591667	2.4988149	.048
		Post		30	24.889000	4.5793911				
2	Cont	Pre	Nil	23	22.008261	2.8574093	-1.226(N.S)	-1.2691304	1.0350597	.227
		Post		23	23.277391	4.0590922				
3	Exp	Pre	Kapalbhati	30	25.991500	6.7522496	.469(N.S)	.7165000	1.5291937	.641
		Post		30	25.275000	4.9558170				
4	Cont	Pre	Nil	23	21.691304	2.0383467	.027(N.S)	.0300000	1.1052894	.978
		Post		23	21.661304	4.8932024				
5	Exp	Pre	Bhramari	32	27.381719	8.2636053	2.582*	4.3070313	1.6680063	.012
		Post		32	23.074688	4.5546318				
6	Cont	Pre	Nil	26	22.197308	2.7406796	-.761(N.S)	-.6969231	.9159838	.450
		Post		26	22.894231	3.7819785				
7	Exp	Pre	Agnisar	30	25.742000	2.2839262	3.283*	3.9126667	1.1917137	.002
		Post		30	21.829333	1.7657062				
8	Cont	Pre	Nil	25	21.686400	2.4748937	-.871(N.S)	-.5876000	.6743275	.388
		Post		25	22.274000	2.2897252				

Note: Exp = Experimental Group

Cont = Control Group

N = Number of Sample

"t" = t test

* = Significant at 0.05 level

N.S = Not Significant at 0.05 level

According to table-1 effect of selected yogic kriyas and pranayamas on deep breathing test score (change in heart rate) have been documented, which reveals that there were significant experimental effect of anulom vilom (t=2.025), bhramari (t=2.582) and agnisar (t = 3.283), whereas there was insignificant experimental effect of kapalbhati (t=.469) at 0.05 level of significance. The control group demonstrated insignificant difference between the pre test and post test of anulom vilom (t= -1.226), kapalbhati (t=.027), bhramari (t=-.761) and agnisar (t=-.871) at 0.05 level significance.

Table 2: Effect of Selected Yogic Kriyas and Pranayamas on Expiratory Inspiratory Ratio

S. No.	Group	Test	Treatment/Training (Pranayama/Kriya)	N	Mean (Ratio)	Standard Deviation (Ratio)	"t"	Mean Difference (Ratio)	Standard Error Difference (Ratio)	Probability
1	Exp	Pre	Anulom Vilom	30	1.798250	.7741094	2.038*	.3055833	.1499730	.046
		Post		30	1.492667	.2747938				
2	Cont	Pre	Nil	23	1.337609	.1762737	-.075(N.S)	-.0034783	-0463636	.941
		Post		23	1.345870	.1355289				
3	Exp	Pre	Kapalbhati	30	1.557333	.4071489	.385(N.S)	.0355000	.0922525	.702
		Post		30	1.521833	.2992418				
4	Cont	Pre	Nil	23	1.315652	.1277720	-.716(N.S)	-.0286957	.0400723	.478
		Post		23	1.344348	.1435532				
5	Exp	Pre	Bhramari	32	1.626719	.4999655	2.311*	.2334375	.1009964	.024
		Post		32	1.393281	.2764831				
6	Cont	Pre	Nil	26	1.336731	.1701467	-.076(N.S)	-.0035993	.-.0453736	.945
		Post		26	1.346923	.1355289				
7	Exp	Pre	Agnisar	30	1.547667	.3809827	3.268*	.2360000	.0722062	.002
		Post		30	1.311667	.1061337				
8	Cont	Pre	Nil	25	1.304400	.1509437	-.857(N.S)	-.0346000	.0403839	.396
		Post		25	1.339000	.1341175				

Note: Exp = Experimental Group
Cont = Control Group
N = Number of Sample
"t" = t test
* = Significant at 0.05 level
N.S = Not Significant at 0.05 level

According to table-2 effect of selected yogic kriyas and pranayamas on expiratory inspiratory ratio have been documented, which reveals that there were significant experimental effect of anulom vilom (t=2.038), bhramari (t=2.311) and agnisar (t=3.268), whereas there was insignificant experimental effect of kapalbhati (t=.385) at 0.05 level of significance. The control group demonstrated insignificant difference between the pre test and post test of anulom vilom (t=-.075), kapalbhati (t=.716), bhramari (t=.076) and agnisar (t=-.857) at 0.05 level of significance.

Table 3: Effect of Selected Yogic Kriyas and Pranayamas on Valsalva Manoeuvre Ratio

S. No.	Group	Test	Treatment/Training (Pranayama/Kriya)	N	Mean (Ratio)	Standard Deviation (Ratio)	"t"	Mean Difference (Ratio)	Standard Error Difference (Ratio)	Probability
1	Exp	Pre	Anulom Vilom	30	1.951833	.6435254	1.835(N.S)	.2738333	.1492533	.072
		Post		30	1.678000	.5041545				
2	Cont	Pre	Nil	23	1.404130	.2927637	-.410(N.S)	-.0347826	.0849242	.684
		Post		23	1.438913	.2831397				
3	Exp	Pre	Kapalbhati	30	1.975000	.5450616	2.969*	.5428333	.1828329	.004
		Post		30	1.572167	.3312013				
4	Cont	Pre	Nil	23	1.352174	.2116162	-.227(N.S)	-.0134783	.0594400	.822
		Post		23	1.365652	.1909980				
5	Exp	Pre	Bhramari	32	1.762656	.7891114	1.066(N.S)	.1646875	.1545222	.291
		Post		32	1.597969	.3759930				
6	Cont	Pre	Nil	26	1.365192	.2910755	-.815(N.S)	-.0621154	.0761783	.419
		Post		26	1.427308	.2572090				
7	Exp	Pre	Agnisar	30	1.698667	.5562481	3.263*	.3421667	.1048467	.002
		Post		30	1.356500	.1427329				
8	Cont	Pre	Nil	25	1.476200	.3897149	-.899(N.S)	-.1042000	.1159250	.373
		Post		25	1.580400	.4290540				

Note: Exp = Experimental Group
Cont = Control Group
N = Number of Sample
"t" = t test
* = Significant at 0.05 level
N.S = Not Significant at 0.05 level

The analysis in regard to effect of selected yogic kriyas and pranayamas on valsalva Manoeuvre ratio in table-3 reveals that there were significant difference at 0.05 level between the pre test and post test of kapalbhati experimental group (t=2.969) and agnisar experimental group (t=3.263), whereas there were insignificant difference at 0.05 level between the pre test and post test of anulom vilom experimental group (t=1.835), anulom vilom control group (t=-.410), kapalbhati control group (t=-227), bhramari experimental group (t=1.066), bhramari control group (t=-.815), and agnisar control group (t=-.899).

Table 4: Effect of Selected Yogic Kriyas and Pranayamas on 30:15 Ratio

S. No.	Group	Test	Treatment/Training (Pranayama/Kriya)	N	Mean (Ratio)	Standard Deviation (Ratio)	"t"	Mean Difference (Ratio)	Standard Error Difference (Ratio)	Probability
1	Exp	Pre	Anulom Vilom	30	1.378667	.3575538	.618(N.S)	.0573333	.0928340	.539
		Post		30	1.321333	.3615244				
2	Cont	Pre	Nil	23	1.287826	.2501446	-.313(N.S)	-.0226087	.0721506	.775
		Post		23	1.310435	.2390793				
3	Exp	Pre	Kapalbhati	30	1.232500	.2726490	-1.884(N.S)	-.1373333	.0729128	.065
		Post		30	1.369833	.2918062				
4	Cont	Pre	Nil	23	1.213478	.1860745	.314(N.S)	.0152174	.0485044	.755
		Post		23	1.198261	.1395985				
5	Exp	Pre	Bhramari	32	1.630469	.5771696	3.972*	.4192188	.1055359	.000
		Post		32	1.211250	.1525958				
6	Cont	Pre	Nil	26	1.272115	.2558053	-.282(N.S)	-.0190385	.0674317	.799
		Post		26	1.291154	.2297534				
7	Exp	Pre	Agnisar	30	1.501833	.4848702	1.784(N.S)	.1721667	.0965156	.080
		Post		30	1.329667	.2106146				
8	Cont	Pre	Nil	25	1.289200	.3187073	-.434(N.S)	-.0374000	.0861928	.666
		Post		25	1.326600	.2900960				

Note: Exp= Experimental Group
Cont= Control Group
N= Number of Sample
"t"= t test
*= Significant at 0.05 level
N.S= Not Significant at 0.05 level

The analysis in regard to effect of selected yogic kriyas and pranayamas on 30:15 ratio in table-4 reveals that there was significant difference at 0.05 level between the pre test and post of bhramari experimental group (t=3.972), whereas there were insignificant difference at 0.05 level between pre test and post test of anulom vilom experimental group (t=.618), anulom vilom control group (t=-.313), kapalbhati experimental group (t=-1.884), kapalbhati control group (t=.314), bhramari control group (t=-.282), agnisar experimental group (t=1.784) and agnisar control group (t=-.434).

Conclusions
1. Deep breathing test score registered significant difference in regard to Anulom Vilom, Bhramari experimental group as well as agnisar experimental group, whereas insignificant difference between the pre test and post test were recorded for rest of the comparisons.
2. Expiratory Inspiratory Ratio registered significant difference in regard to Anulom Vilom, Bhramari experimental group as well as agnisar experimental group, whereas insignificant difference between the pre test and post test were recorded for rest of the comparisons.
3. Valsalva Manoeuvre Ratio registered significant difference in regard to Kapalbhati experimental group as well as agnisar experimental group, whereas insignificant difference between the pre test and post test were recorded for rest of the comparisons.
4. 30:15 Ratio registered significant difference in regard to Bhramari experimental group whereas insignificant difference between the pre test and post test were recorded for rest of the comparisons.

References
1. Basavareddy IV. Yogic Management of Cardiovascular Diseases, Published by National Institute of Science Communication and Information Resources; First edition, 2008, 19-40.
2. Bernardi L, Sleight P, Bandinelli G, Cencetti S, Fattorini L, Wdowczyc-Szulc J, *et al*. Effect of Rosary Prayer and Yoga mantras on Autonomic Cardiovascular Rhythms: Comparative study. BMJ. 2001;323:1446-9.
3. Chaya MS, Kurpad AV, Nagendra HR, Nagarathna R. The Effect of Long Term Combined Yoga Practice on the Basal Metabolic Rate of Healthy Adults. BMC Complement Altern Med. 2006;6:28.
4. Chaya MS, Nagendra HR. Long-term Effect of Yogic Practices on Diurnal Metabolic Rates of Healthy Subjects. Int J Yoga. 2008;1:1-4. Available at www.ijoy.org.in
5. Curiati JA, Bocchi E, Freire JO, Arantes AC, Braga M, Garcia Y, *et al*. Meditation Reduces Sympathetic Activation and Improves the Quality of Life in Elderly Patients with Optimally Treated Heart Failure: A prospective randomized study. J Altern Complement Med. 2005;11:465-72.
6. Damodaran A, Malathi A, Patil N, Shah N, Suryavansihi, Marathe S. Therapeutic Potential of Yoga Practices in Modifying Cardiovascular Risk Profile in Middle Aged Men and Women. J Assoc Physicians India. 2002;50:633-40.
7. Doren Kshetrimayu. Yoga and youth-an Overview-downloaded from www.yogamdniy.com/article (accessed on 12/08/09)
8. Dvivedi J, Dvivedi S, Mahajan KK, Mittal S, Singhal A. Effect of '61-points relaxation technique' on stress parameters in premenstrual syndrome. Indian J Physiol Pharmacol. 2008 Jan;52(1):69-76.
9. Finkelstein C, Brownstein A, Scott C, Lan YL. Anxiety and Stress Reduction in Medical Education: an Intervention. Med Educ. 2007 Mar;41(3):258-64.
10. Geetha N, Textbook of Medical Physiology, 2nd edition, Paras Medical Publishers, 2008, 601-602.
11. Malathi A, Damodaran A. Stress due to exams in medical students--role of yoga. Indian J Physiol Pharmacol. 1999 Apr;43(2):218-24.
12. Parshad O, Richards A, Asnani M. Impact of yoga on haemodynamic function in healthy medical students. West Indian Med J. 2011 Mar;60(2):148-52.
13. Rocha KK, Ribeiro AM, Rocha KC, Sousa MB, Albuquerque FS, Ribeiro S, *et al*. Improvement in

physiological and psychological parameters after 6 months of yoga practice. Conscious Cogn. 2012 Jun;21(2):843-50.

14. Sengupta P. Health Impacts of Yoga and Pranayama: A State-of-the-Art Review. Int J Prev Med. 2012 Jul;3(7):444-58.

15. Udupa K, Madanmohan, Bhavanani AB, Vijayalakshmi P, Krishnamurthy N. Effect of pranayam training on cardiac function in normal young volunteers. Indian J Physiol Pharmacol. 2003 Jan;47(1):27-33.

16. Vempati RP, Telles S. Yoga-based guided relaxation reduces sympathetic activity judged from baseline levels. Psychol Rep. 2002 Apr;90(2):487-94.