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Effect of various slow, deep breathing techniques on Cardiac and Respiratory parameters.

Dr.Aman Kumar | Dr. Lakshmi S Menon

Introduction

Breathing exercises are a group of exercise involving taking control over timing and/or volume aspect of respiration actively and consciously. Breathing exercises are among common complementary health approaches, Slow and Deep breathing exercise (SDB) is performed at slower breathing frequencies of around ~0.1 Hz (~6 breaths per minute).

Use of Deep breathing exercises as add on intervention technique with other pharmacological and non-pharmacological treatments is not uncommon. Various techniques are available to practice deep breathing such as relaxation, hypnosis, meditation, yoga [1]

Deep breathing exercises are commonly used for several health conditions including Relaxation, improving muscle function during exercises, preventing strain, increasing blood Oxygen levels, reducing blood pressure, Managing heart rate and Hypertension.[2] [3]

Different SDB techniques may have different effects on the cardiovascular and autonomic systems, and therefore, may produce different outcomes hypertension management.

Several studies have shown that practicing SDB reduces blood pressure and heart rate in the long-term [3]

The baroreflex mechanisms functional in aortic arch and carotid sinus seems to be the key player for the rapid control of arterial blood pressure. They act by sensing the arterial wall stretch changes in blood pressure and convert the mechanical signals into an action potential the aortic depressor and carotid sinus nerves to the nucleus of the solitary tract in the brain
stem. This leads to decreased sympathetic and increased cardiovagal outputs and ultimately a decrease in heart rate, cardiac output, vascular tone, and blood pressure [4]

We have compared 3 deep breathing techniques and examined outcomes in Respiratory rate, Blood oxygen saturation, Blood pressure changes and Pulse rate changes. Healthy adult volunteers performed pursed-lips breathing, left and right unilateral nostril type of deep breathing, all at a frequency of 0.1 Hz (i.e., controlled breathing) and for 3 minutes each.

- **Keywords:** SDB: Slow Deep Breathing; PLB : Pursed Lip Breathing ; LUNB Left unilateral nostril breathing ; RUNB Right unilateral nostril breathing.

Aims

Estimating effects of different breathing conditions on cardiovascular system in terms of Blood pressure and Heart rate changes and Respiratory system in terms of Pulse Oximetry and Respiratory rate.

- PLB- Pursed Lip Breathing.
- LUNB Left unilateral nostril breathing.
- RUNB Right unilateral nostril breathing.

Methodology

This experimental study will be conducted in the Human physiology laboratory of the GMC (Bambolim,Goa). Healthy 1st year medical students will be selected from the age group of 18 to 24 years.

Study Duration – 3months.

Inclusion criteria: 1st year M.B.B.S students.

Exclusion criteria: Those who report any of the following conditions will not be included in the study- cardiovascular, respiratory, or neurological diseases, acute or chronic pain conditions, psychiatric disorders, regular medication use other than contraceptives, pregnancy, current smoking, or any other nicotine consumption, and regular practice of a breathing exercise.

Participants will be instructed to avoid strenuous exercise as well as intake of caffeine and alcohol for at least 12 hr before conducting the study.

TRAINING

First, participants were trained to perform controlled breathing at different breathing frequencies. Using a visual cue (Solid Circle) was continuously presented on a computer screen along with an auditory cue.

Participants practiced breathing at a frequency of 0.1 Hz (6 breaths per minute). The inspiration to expiration ratio was 1:2. These parameters were selected based on several other studies.[15]

Participants practiced each breathing frequency for 3 min. At the beginning of each breathing condition, participants were given adequate instructions.

For the PLB technique, participants were instructed to breathe in through the nose and breathe out through the mouth while pursing the lips.[10]

For the UNB technique, participants were instructed to use the thumb of their right hand to close the right and left nostrils for LUNB and RUNB, respectively.

In all conditions, and to prevent hyperventilation, participants were instructed to always breathe comfortably, without extra effort. The instructor demonstrated how to perform each of the breathing conditions. Participants practiced each condition for 1 min, before they went for the Specific breathing technique.

After each practice run, they were enquired about any difficulties they experienced.

Baseline measures

Participants were seated in a comfortable chair with the upper body and arms being supported. After the equipment were placed, participants rested for 5 min then Arm blood pressure, Heart rate, Respiratory rate, Blood Oxygenation was measured.

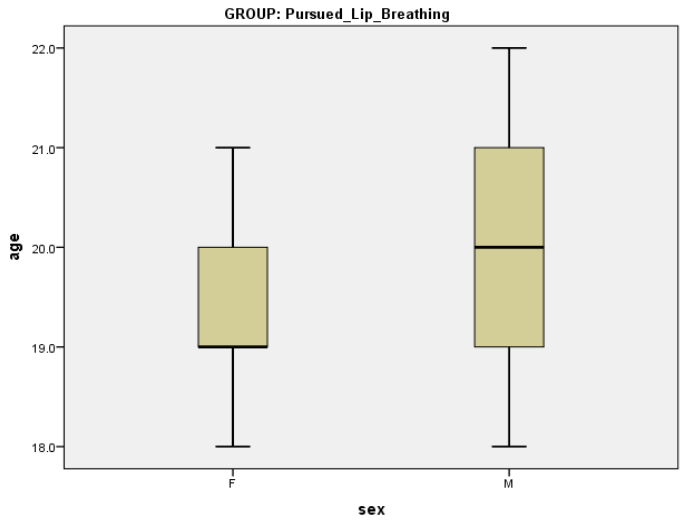
Participants

Healthy volunteers i.e.1st year medical students aged 18 to 24 years were invited. Out of 50 participants required for each type of breathing group, for PLB only 40 students matched the inclusion criteria, for LUNB and RUNB 28 and 35 respectively.

Results

All results are expressed as Mean ± SD. A total of 40 patients with PLB, 28 for LUNB and 35 for RUNB.

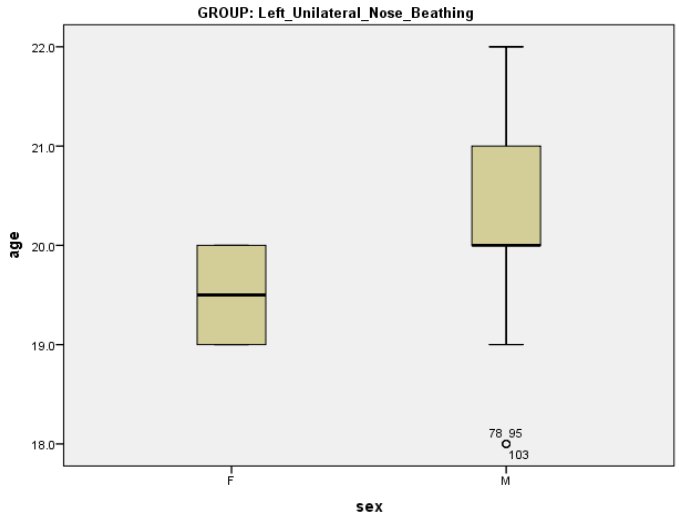
1. PLB: Total 10 females and 30 males participated in PLB group. Mean age for female participants was 19.400 ± 0.8433 and Mean age for male participants was 19.767 ± 1.1043.



Pursed lip breathing

	Mean	Standard deviation	t	df	Significance
SBP	6.4250	7.4623	5.445	39	0.000 Highly significant
DBP	-0.0500	5.4770	-.058	39.000	0.954 Not significant
HR	-6.6250	6.0667	-6.907	39.000	0.000 Highly significant
RR	6.1250	2.9716	13.036	39.000	0.000 Highly Significant
sPO2	-2.6500	5.9120	-2.835	39.000	0.000 Highly Significant.

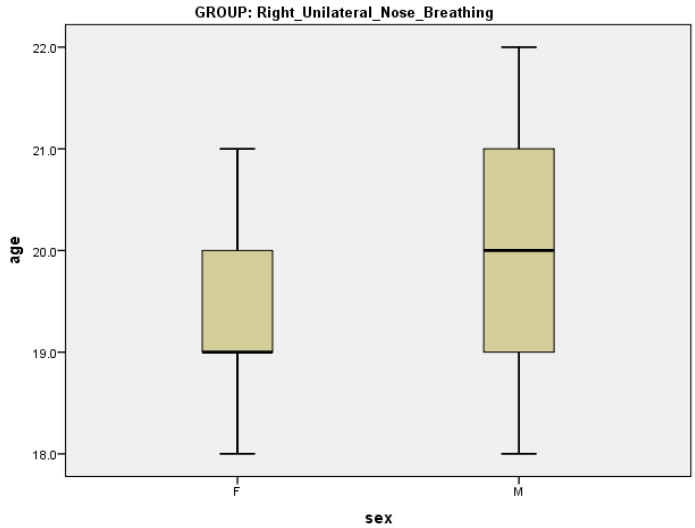
2. LUNB: Total 6 females and 22 males participated in PLB group. Mean age for female participants was 19.500 ± 0.5477 and Mean age for male participants was 20.045 ± 1.1329.



LUNB

	Mean	Standard deviation	t	df	Significance
SBP	9.1786	4.6908	10.354	27.000	0.000 Highly significant
DBP	4.4286	5.1599	4.542	27.000	0.020 Highly Significant
HR	-4.8214	4.2344	-6.025	27.000	0.000 Highly significant
RR	5.3571	2.2806	12.430	27.000	0.000 Highly Significant
sPO2	-1.5714	4.9697	-1.673	27.000	0.106 Not Significant.

3. RUNB: Total 10 females and 25 males participated in RUNB group. Mean age for female participants was 19.400 ± .8433 and Mean age for male participants was 20.000 ± 1.2247.



RUNB

	Mean	Standard deviation	t	df	Significance
SBP	6.5429	6.6037	5.862	34.000	0.000 Highly significant
DBP	2.1143	5.1092	2.448	34.000	0.020 Highly Significant
HR	-5.8857	5.7383	-6.068	34.000	0.000 Highly significant
RR	5.4286	2.6266	12.227	34.000	0.000 Highly Significant
sPO2	-3.4706	6.2389	-3.244	33.000	0.03 Highly Significant.

According to the studies done previously RUNB increases while LUNB decreases heart rate and blood pressure suggesting sympathetic and parasympathetic stimulation, respectively [16].

The mechanism is not clear, LUNB and RUNB may differentially influence autonomic activity at the central level.

In contrast to previous studies, we found no differential effect between LUNB and RUNB on cardiac autonomic activity. This may be due to a shorter duration of the breathing exercise in our study (3 min) compared with the previous studies (15 to 30 min).

Slow, deep breathing has been shown by several studies to reduce blood pressure and heart rate in hypertension patients, and improvement in the baroreflex function and cardiac autonomic regulation are proposed as the main possible mechanisms. Whether such an effect is via improvement in baroreflex function remains to be investigated. Applying an inspiratory threshold load during SDB increases blood pressure variation, enhances the stimulation of the arterial baroreceptors, and leads to increased cardiac vagal modulation.

Discussion

The arterial baroreceptors' reflex, the baroreflex, seems to be a mediating neural mechanism in this regard.
The baroreflex is responsible for the rapid control of arterial blood pressure. Arterial (high-pressure) baroreceptors are mechanoreceptors mainly located in the aortic arch and carotid sinus. These receptors sense the changes in blood pressure and convert the mechanical signals (the degree of the arterial walls stretch) into an action potential frequency. An increase in blood pressure leads to increased baroreceptors afferent signalling via the aortic depressor and carotid sinus nerves to the nucleus of the solitary tract in the brain stem. This leads to decreased sympathetic and increased cardiovagal outputs and ultimately a decrease in heart rate, cardiac output, vascular tone, and blood pressure.[4]
Long-term practice of SDB is associated with an increased baroreflex sensitivity and cardiac parasympathetic activity and a decreased sympathetic activity which are suggested as the mechanisms for the effects of SDB on blood pressure and heart rate in hypertensive patients.[5]

REFERENCES

1. Jackson, C. (2015). Trends in the use of complementary health approaches among adults in the United States: New Data. Holistic Nursing Practice, 29(3), 178–179. https://doi.org/10.1097/
HNP.0000000000000088

2. Brook, R. D., Appel, L. J., Rubenfire, M., Ogedegbe, G., Bisognano, J.
D., Elliott, W. J., & Rajagopalan, S. (2013). Beyond medications and
diet: Alternative approaches to lowering blood pressure: A scientific statement from the American heart association. Hypertension, 61(6), 1360–1383. https://doi.org/10.1161/HYP.0b013e318293645f

3.Prasad, K., Sharma, V., Lackore, K., Jenkins, S. M., Prasad, A., &
Sood, A. (2013). Use of complementary therapies in cardiovascular disease. The American Journal of Cardiology, 111(3), 339–345. https://doi.org/10.1016/j.amjcard.2012.10.010

4. Mohrman, D. E., & Lois, J. H. (2018). Cardiovascular physiology (9th
ed). : McGraw-Hill Education LLC

5.Fonkoue, I., Marvar, P. J., Norrholm, S. D., Kankam, M. L., Li, Y., DaCosta, D., & Park, J. (2018). Acute effects of device-guided slow breathing on sympathetic nerve activity and baroreflex sensitivity in posttraumatic stress disorder. American Journal of Physiology. 14 of 16 | GHOLAMREZAEI et al.Heart and Circulatory Physiology, 29(6), 386–391. https://doi.org/10.1152/ajpheart.00098.2018

6.Harada, D., Asanoi, H., Takagawa, J., Ishise, H., Ueno, H., Oda, Y., & Inoue, H. (2014). Slow and deep respiration suppresses steady-state sympathetic nerve activity in patients with chronic heart failure: From modeling to clinical application. AJP: Heart and Circulatory Physiology, 307(8), H1159–H1168. https://doi.org/10.1152/ajpheart.00109.2014

7.Bernardi, L., Sleight, P., Bandinelli, G., Cencetti, S., Fattorini, L., Wdowczyc-Szulc, J., & Lagi, A. (2001). Effect of rosary prayer and yoga mantras on autonomic cardiovascularrhythms: Comparative study. BMJ: British Medical Journal, 323(7327), 1446–1449. https://doi.org/10.1136/bmj.323.7327.1446

8.Joseph, C. N., Porta, C., Casucci, G., Casiraghi, N., Maffeis, M., Rossi,
M., & Bernardi, L. (2005). Slow breathing improves arterial baroreflex sensitivity and decreases blood pressure in essential hypertension. Hypertension, 46(4), 714–718. https://doi.org/10.1161/01.

9.Modesti, P. A., Ferrari, A., Bazzini, C., & Boddi, M. (2015). Time sequence of autonomic changes induced by daily slow-breathing sessions. Clinical Autonomic Research: Official Journal of the Clinical Autonomic Research Society, 25(2), 95–104. https://doi.org/10.1007/s10286-014-0255-9

10. Spahija, J. A., & Grassino, A. (1996). Effects of pursed-lips breathing and expiratory resistive loading in healthy subjects. Journal of Applied Physiology, 80(5), 1772–1784. https://doi.org/10.1152/ jappl.1996.80.5.1772

11.Holland, A. E., Hill, C. J., Jones, A. Y., & McDonald, C. F. (2012). Breathing exercises for chronic obstructive pulmonary disease. The Cochrane Database of Systematic Reviews, 10, CD008250. https://doi.org/10.1002/14651858.CD008250.pub2

12. Brown, R. P., & Gerbarg, P. L. (2009). Yoga breathing, meditation, and longevity. Annals of the New York Academy of Sciences, 1172, 54–62. https://doi.org/10.1111/j.1749-6632.2009.04394.x

13. Brandani, J. Z., Mizuno, J., Ciolac, E. G., & Monteiro, H. L. (2017). The hypotensive effect of Yoga's breathing exercises: A systematic review. Complementary Therapies in Clinical Practice, 28, 38–46. https://doi.org/10.1016/j.ctcp.2017.05.002

14. Pal, G. K., Agarwal, A., Karthik, S., Pal, P., & Nanda, N. (2014).

15.Russo MA, Santarelli DM, O'Rourke D. The physiological effects of slow breathing in the healthy human. Breathe (Sheff). 2017;13(4):298-309 yogic breathing through right and left nostril influences sympathovagal balance, heart rate variability, and cardiovascular risks in young adults. North American Journal of Medical Sciences, 6(3), 145–151. https://doi.org/10.4103/1947-2714.128477

16. Raghuraj, P., & Telles, S. (2008). Immediate effect of specific nostril manipulating yoga breathing practices on autonomic and respiratory variables.