National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Immediate effect of slow right and left nostril deep breathing exercises on reaction time, pain sensitivity, and temperature of elderly population in Madurai

Mathava Kumar V[1], Anu S[2]

[1]MBBS Student, Velammal Medical College and Hospital, Madurai, Tamil Nadu, India, [2]Department of Physiology, Velammal Medical College and Hospital, Madurai, Tamil Nadu, India

Correspondence to: Anu S, E-mail: anu.sengottaiyan@gmail.com

Received: July 27, 2018; **Accepted:** August 29, 2018

ABSTRACT

Background: Falls and fractures are very common in the elderly due to reduced swiftness of the response, decreased attention, and concentration. Normal reference point of temperature and pain threshold also varies in old age adding to their chronic illness. Important factor contributing to this is an imbalance in the autonomic nervous system (ANS). As nostril breathing exercises were known to modulate the ANS, the present study was done to find out the immediate effect of slow right nostril breathing (RNB) and left nostril breathing (LNB) exercises on reaction time, pain sensitivity, and temperature in the elderly population. **Aims and Objectives:** The objectives of the study were to measure the effect of 30 min of RNB and LNB exercises on auditory and visual reaction time, pain sensitivity, and temperature in elderly individuals. **Materials and Methods:** The study was done in the Department of Physiology of a Private Medical College in Madurai, on 30 healthy subjects aged 50–70 years. Reaction time was measured with discriminatory and choice time reaction apparatus, pain with digital algometer, and temperature with clinical thermometer. **Results:** A significant decrease in reaction time and pain threshold ($P < 0.001$ and <0.001) was observed with RNB exercises without change in temperature (0.909). A significant increase in reaction time, pain threshold, and decrease in body temperature ($P < 0.001$, <0.001, and <0.001) was observed with LNB exercises. **Conclusion:** RNB decreases reaction time and increases pain sensitivity without affecting body temperature. LNB increases reaction time but decreases pain sensitivity, and body temperature.

KEY WORDS: Breathing; Reaction Time; Pain; Temperature

INTRODUCTION

WHO global report states that there is an increasing incidence of falls in the elderly population all over the world and preventive measures have to be initiated. 70% of injuries are due to falls with multifactorial etiology.[1] An intact nervous system is essential for mobility and gait. With aging, there is a loss of neurons, especially in frontal and parietal lobes and alterations in the secretion of neurotransmitters.[2] Degenerative changes are seen in both myelinated and unmyelinated neurons and because of that speed of conduction in both sensory and motor nerves along with coordination decreases.[3,4] Due to this, the time taken to react to a stimulus increases (reaction time) and is unable to respond immediately to auditory and visual cues. There is synaptic delay in conduction of impulses from receptors to the brain and from brain to the effector organs. This

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2018.8.0724329082018	

increases the vulnerability of elderly population for falls and fractures.

Reaction time reflects sensory-motor coordination. A faster reaction time is essential for certain day to day activities such as crossing the road, catching a bus, and immediately responding to a call. A slower reaction time indicates damage in central and peripheral nervous system. Both auditory and visual reaction time (VRT) was found to increase with age.[5]

A balanced autonomic system activity is essential for the functioning of all vital organs in the body. There is also an age dependent decline in activity of both the parasympathetic and sympathetic components of the autonomic nervous system (ANS).[6] This imbalance in the ANS activity is associated with postural instability, hypertension, myocardial infarction, constipation, and insomnia, etc., in old age. Exercise does improve the vagal tone but only at specific intensity and duration.[7]

Deep breathing exercises alter autonomic function and that right nostril breathing (RNB) technique had shown to increase the sympathetic nervous system activity and left nostril breathing (LNB) technique to increase the parasympathetic nervous system activity. Literature shows that RNB practice increased basal oxygen consumption, increased basal metabolic rate, increased blood glucose levels, increased systolic, diastolic, and mean blood pressure LNB practice decreased basal oxygen consumption and metabolic rate, and decreased blood glucose levels, decreased systolic, diastolic, and mean blood pressure. RNB by activating the left hemisphere increases sympathetic activity and by activating right hemisphere increases parasympathetic activity. These evidence suggests the influence of RNB on sympathetic nervous system and LNB on parasympathetic nervous system.[8-10]

Sensitivity for hearing, vision and touch decrease with aging due to decrease in the number of specific sensory receptors and degeneration of afferent nerves.[11] In a study conducted on police trainees, 6 months training of breathing exercises along with yogasanas had shown improvement in the conduction in both sensory and motor nerves.[12] This could be confirmed with the help of the reaction time which is an index of central processing of the nervous system.

Persistent pain is a distressing factor more common in old age which could be due to loss of dorsal horn neurons and altered endogenous pain inhibition. According to the WHO report, 1 in 5 older individuals suffers from some kind of pain. Depression, anxiety, and sleep disturbance all add to increased pain sensitivity. Pain perception increases with aging and this is due to age-related increase in inflammation.[13] Pain also alters the autonomic function. As breathing exercises were reported to reduce stress, inflammation, and alter autonomic function, and few studies were done to identify the effect of slow deep breathing on pain perception but only in young subjects. The results showed increased pain tolerance, due to modulation in ANS.[14]

So far, no study was done on the role of breathing practices on pain sensitivity specifically in elderly population.

Mean body temperature decreases with age in healthy individuals.[15] Undiagnosed clinical illness might be reflected by the higher mean body temperature in the elderly. Previous studies had shown that decreased body temperature is associated with increased longevity.[16] The immediate effect of uninostril breathing exercises on body temperature was also not studied until now in older population. Hence, the purpose of the present study was to find out the immediate effect of 30 min of right and LNB practices on auditory and VRT, pain sensitivity, and temperature in older individuals.

Aim and Objectives

Among healthy elderly, aged 50–70 years in Madurai city, India, the objectives of the study are as follows:

1. To measure the immediate effect of RNB on VRT and auditory reaction time (ART), pain sensitivity, and temperature
2. To measure the immediate effect of LNB on VRT and ART, pain sensitivity, and temperature.

MATERIALS AND METHODS

A total of 30 healthy subjects in the age group of 50–70 years were chosen by simple random sampling. Healthy elderly people in the Private Medical College campus who were either working in the hospital or acquaintances of the patients were recruited for this study after obtaining their informed written consent. This study was done after obtaining clearance from Institutional Ethical Committee.

On the same subject, the effects of both right and LNB were assessed in a single day. This interventional study was carried out in the Department of Physiology, Velammal Medical College, Madurai, for a period of 2 months from June 2017 to August 2017.

Old individuals who had never practiced pranayama and without clinical evidence of any physical illness such as diabetes, hypertension, and lung diseases were included in the study. Subjects with ophthalmologic and hearing disorders, with musculoskeletal deformities, suffering from any psychiatric disorder affecting their psychomotor abilities and on medication were excluded from the study.

Description of Intervention

Baseline data on VRT and ART, pain threshold, and temperature were measured initially. RNB group participants were then taught RNB exercises, and LNB group were

taught. LNB exercises to familiarize them with the technique by a certified yoga instructor. RNB involves inhaling through right nostril for count of 5 while the left nostril is occluded and then exhaling through the same nostril for a count of 5 with no pause in between. LNB involves inhaling through the left nostril for a count of 5 while the right nostril is occluded and then exhaling through the same nostril for a count of 5 with no pause in between. Hence, for 1 min, there will be 6 breathing cycles. Once the skill is acquired, in the same individual VRT and ART, pain threshold, and temperature was measured after 30 min of RNB and LNB exercises in the same subject.

Data Collection Method and Tools

Baseline data on all participants were collected using a structured questionnaire. VRT and ART were measured with the help of discriminatory and choice reaction time apparatus (Anand Agencies, Pune) between 10 am and 12 pm every day. VRT was measured for green and red light stimuli and ART was measured for low- and high-frequency sound stimuli in the sitting posture at around 80 cm distance. For recording the baseline VRT, initially, the subject was instructed to keep pressing the finger on the response button, and once he visualizes the stimulus, immediately he has to remove his finger. The response button terminated the clock counter and the value of VRT was displayed on the screen in milliseconds. This process has to be repeated for 3 times, and the lowest value was taken as the final reaction time. Baseline ART is also recorded in the same way for both for tone and click sound. After 30 min of RNB and LNB, again VRT and ART were recorded.

Pain sensitivity was assessed with the help of a digital algometer. After switching on the instrument, electrode attached with the algometer is placed on forearm of the subject, and the baseline value is kept at 0. After that, the knob will be adjusted until the patient perceives pain sensation, and then the final displayed reading at which pain is felt is noted. Temperature was measured with the help of oral clinical thermometer before and after all these types of breathing exercises.

Statistics

The data were entered into MS Excel and analyzed using SPSS v16.0. VRT, ART, pain threshold, and temperature values before and after RNB and LNB were compared using paired *t*-test. An arbitrary cutoff of 0.05 was used to interpret significance of *P* value.

RESULTS

A significant difference is observed for all the parameters except temperature. There is no change in temperature. VRT, ART, and pain threshold had decreased from the basal value. Reaction time for green light is reduced more than that for red light after RNB. Reaction time for tone is reduced more than that for click after RNB [Table 1].

In Table 2, a significant difference is observed before and after 30 min of LNB for all the parameters. There is an increase in both VRT and ART and pain threshold. There is no much difference in the reaction time of red and green light. Increased reaction time is observed for click sound than for tone. Temperature had decreased from the baseline value.

DISCUSSION

In the present study, according to Table 1, a significant reduction in ART and VRT (<0.001 and <0.001) was seen after RNB exercises. There was also an increase in pain sensitivity. Although mean temperature increased, significant change was not observed. According to Table 2, a significant increase in ART and VRT (<0.001 and <0.001) was seen after LNB exercises. Pain sensitivity and body temperature had decreased significantly (<0.001).

This shows that practicing RNB increases conduction in both afferent and efferent nerve fibers. This could be attributed to increased stimulation of sympathetic nervous system and

Table 1: Comparison of parameters before and after 30 min of RNB among elderly (*n*=30)

Parameter	Baseline	RNB	*t*	*P*
	Mean±SD	Mean±SD		
Heart rate/min	83.5±5.3	85.9±4.7	−8.389	<0.001
VRT-green light (ms)	0.233±0.041	0.206±0.040	14.975	<0.001
VRT-red light (ms)	0.247±0.047	0.220±0.044	10.281	<0.001
ART-tone (ms)	0.234±0.041	0.205±0.041	14.779	<0.001
ART-click (ms)	0.255±0.039	0.229±0.044	10.889	<0.001
Pain threshold	65.8±15.0	49.5±16.3	12.213	<0.001
Temperature° F	97.4±0.8	97.5±1.6	−0.115	0.909

RNB: Right nostril breathing, SD: Standard deviation

Table 2: Comparison of parameters before and after 30 min of LNB among elderly (*n*=30)

Parameter	Baseline	LNB	*t*	*p*
	Mean±SD	Mean±SD		
Heart rate/min	83.5±5.3	80.3±5.0	10.116	<0.001
VRT-green light (ms)	0.233±0.041	0.265±0.042	-13.453	<0.001
VRT-red light (ms)	0.247±0.047	0.276±0.042	-11.005	<0.001
ART-tone (ms)	0.234±0.041	0.262±0.041	-14.211	<0.001
ART-click (ms)	0.255±0.039	0.280±0.042	-12.915	<0.001
Pain threshold	65.8±15.0	80.9±16.1	-13.394	<0.001
Temperature°F	97.4±0.8	97.0±0.9	4.072	<0.001

LNB: Left nostril breathing, SD: Standard deviation

increased catecholamine levels resulting in improved attention and concentration. This is supported by increased heart rate noted after RNB. This coincides with the results of the previous studies done on RNB techniques.[8-10] Sympathetic effects observed after 3 months of yogic breathing techniques could be elicited even after 30 min of RNB.

With LNB technique, reaction time increased due to decreased conduction in sensory and motor fibers. This could be due to decreased sympathetic activity after LNB practice. The present study reports that changes in VRT and ART after RNB and LNB practices were similar to that in the young individuals except for the basal increase in mean value in old age.[10] Reaction time for the green light (0.206 ms and 0.265 ms) is faster when compared to red (0.220 ms, and 0.276 ms) after RNB and LNB practice in old age. This is in contrast to the results obtained with VRT in young individuals where the reaction to red light is faster than green light.[17] This could be explained on the basis of the corpuscular theory of light which states shorter wavelength green light carries greater energy than the same quantum of red light.[18]

In the present study, subjects practiced breathing exercises at a rate of only 6 breaths/min, as only around that rate many studies had proved changes in autonomic function.[19] Fast breathing exercises practiced for the same period of time as slow breathing exercises were not shown to alter the autonomic activity. Increased pain sensitivity in aging might be due to oxidative stress, impairment in descending analgesic pathways and change in autonomic function.[13] Chronic stress results in dysfunction of hypothalamic pituitary adrenal axis resulting in decreased secretion of glucocorticoids leading to an increase in inflammatory mediators. This increases the sensitivity of nociceptive neurons decreasing pain threshold.[20] Chronic pain also alters autonomic outflow.[21] The decrease in pain threshold with RNB exercise could be due to increased sympathetic activation, whereas an increase in pain threshold seen after LNB exercise in old individuals could be attributed to increased vagal nerve stimulation and increased antioxidants. Descending analgesic pathways are activated through nucleus tractus solitarius by increased vagal stimulation.[22]

Body temperature is kept within normal limits by hypothalamic modulation of ANS. Decrease in temperature sensation after LNB exercise could be due to increased parasympathetic stimulation. Although no significant difference was seen in temperature sensation after RNB, there is a slight increase in temperature from the mean value of 97.4–97.5°F, and this confirms the effect of sympathetic mediated increase in body temperature.

Strength of Study

The study was conducted within a short period with excellent cooperation of small group of elderly subjects. Intervention did not require much expertise and easy to practice. Effect of uninostril breathing practices on pain threshold and body temperature is documented for the 1st time in an elderly population.

Limitation

Pain threshold varies with the type of stimulus. The present study was done with electrical stimuli alone. Future studies should focus on eliciting pain sensation with other type of stimuli. The effect observed is a short-term one. Longer duration study with regular practice of these breathing exercises has to be done to show consistent results.

CONCLUSION

The present study confirms the sympathomimetic effects of RNB by showing a decrease in VRT and ART, decrease in pain threshold/increase in pain sensitivity, but with no significant change in body temperature except a mean slight increase in temperature. RNB exercises can be practiced by elderly population in situations where improved attention and swiftness is required. The parasympathomimetic effects of LNB in old age were confirmed with an increase in VRT and ART, increase in pain threshold/decrease in pain sensitivity, and decrease in body temperature. LNB exercises can be practiced to decrease the pain perception in age-related illness, maintain the normal body temperature to improve the lifespan and to have a stress free life.

ACKNOWLEDGMENT

We would like to acknowledge Dr. K. Jayashree, Assistant Professor, Department of Community Medicine, Velammal Medical College, for helping in statistical analysis and Ms. M. Dharani Devi, Technician, Department of Physiology, Velammal Medical College, for her technical support.

REFERENCES

1. Homann B, Plaschg A, Grundner M, Haubenhofer A, Griedl T, Ivanic G, *et al.* The impact of neurological disorders on the risk for falls in the community dwelling elderly: A case-controlled study. BMJ Open 2013;3:e003367.
2. Cowen T. Ageing in the autonomic nervous system: A result of nerve-target interactions? A review. Mech Ageing Dev 1993;68:163-73.
3. Drac H, Babiuch M, Wiśniewska W. Morphological and biochemical changes in peripheral nerves with aging. Neuropatol Pol 1991;29:49-67.
4. Awang MS, Abdullah JM, Abdullah MR, Tharakan J, Prasad A, Husin ZA, *et al.* Nerve conduction study among healthy Malays. The influence of age, height and body mass index on median, ulnar, common peroneal and sural nerves. Malays J Med Sci 2006;13:19-23.
5. Nikam LH, Gadkari JV. Effect of age, gender and body

mass index on visual and auditory reaction times in Indian population. Indian J Physiol Pharmacol 2012;56:94-9.
6. Parashar R, Amir M, Pakhare A, Rathi P, Chaudhary L. Age related changes in autonomic functions. J Clin Diagn Res 2016;10:CC11-5.
7. Besnier F, Labrunée M, Pathak A, Pavy-Le Traon A, Galès C, Sénard JM, *et al.* Exercise training-induced modification in autonomic nervous system: An update for cardiac patients. Ann Phys Rehabil Med 2017;60:27-35.
8. Pal GK, Velkumary S, Madanmohan T. Effect of short-term practice of breathing exercises on autonomic functions in normal human volunteers. Indian J Med Res 2004;120:115-21.
9. Telles S, Nagarathna R, Nagendra HR. Physiological measures of right nostril breathing. J Altern Complement Med 1996;2:479-84.
10. Bhavanani AB, Ramanathan M, Balaji R, Pushpa D. Differential effects of uninostril and alternate nostril pranayamas on cardiovascular parameters and reaction time. Int J Yoga 2014;7:60-5.
11. Humes LE, Busey TA, Craig JC, Kewley-Port D. The effects of age on sensory thresholds and temporal gap detection in hearing, vision, and touch. Atten Percept Psychophys 2009;71:860-71.
12. Trakroo M, Bhavanani AB, Pal GK, Udupa K, Krishnamurthy N. A comparative study of the effects of Asan, pranayama and Asan-pranayama training on neurological and neuromuscular functions of Pondicherry police trainees. Int J Yoga 2013;6:96-103.
13. Yezierski RP. The effects of age on pain sensitivity: Preclinical studies. Pain Med 2012;13 Suppl 2:S27-36.
14. Sharma P, Mavai M. Slow deep breathing increases pain tolerance and modulates cardiac autonomic nervous system. Indian J Physiol Pharmacol 2017;61:107-13.
15. Waalen J, Buxbaum JN. Is older colder or colder older? The association of age with body temperature in 18,630 individuals. J Gerontol A Biol Sci Med Sci 2011;66:487-92.
16. Güneş UY, Zaybak A. Does the body temperature change in older people? J Clin Nurs 2008;17:2284-7.
17. Batra A, Vyas S, Jeph D. Colour difference on simple reaction time in young volunteers. Int J Clin Exp Physiol 2014;1:311-3.
18. Venkatesh D, Ramachandra DL, Baboo NS, Rajan BK. Impact of psychological stress, gender and colour on visual response latency. Indian J Physiol Pharmacol 2002;46:333-7.
19. Pal GK, Agarwal A, Karthik S, Pal P, Nanda N. Slow yogic breathing through right and left nostril influences sympathovagal balance, heart rate variability, and cardiovascular risks in young adults. N Am J Med Sci 2014;6:145-51.
20. Sommer C, Häuser W, Gerhold K, Joraschky P, Petzke F, Tölle T, *et al.* Etiology and pathophysiology of fibromyalgia syndrome and chronic widespread pain. Schmerz 2008;22:267-82.
21. Roy A, Singh SK. Evaluation of cardiac autonomic control in chronic pain patients using isometric handgrip and deep breath Manaevers. Nati J Physiol Pharmacol 2016;6:420-6.
22. Millan MJ. Descending control of pain. Prog Neurobiol 2002;66:355-474.

How to cite this article: Kumar VM, Anu S. Immediate effect of slow right and left nostril deep breathing exercises on reaction time, pain sensitivity, and temperature of elderly population in Madurai. Natl J Physiol Pharm Pharmacol 2018;8(11):1543-1547.

Source of Support: Nil, **Conflict of Interest:** None declared.