Original Article

A Comparative Study of the Differential Effects of Short Term Asana and Pranayama Training on Reaction Time

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Abstract

Background: Numerous studies have reported long and short term effects of Yoga training on reaction time (RT), but few have evaluated differential effects of training in asana and pranayama. Hence the present study was done to elucidate effects of such differential training on RT in health professions students attending Yoga training. **Materials:** 134 healthy young adults studying BSc Nursing at KGNC were recruited for the study and informed consent obtained from them. 89 from 1st year were randomly divided into two groups and 44 of them received one week of training in asana while 45 received parallel training in pranayama. 45 control subjects were recruited from 2nd year that didn't receive Yoga training but were coming to CYTER for clinical posting. Auditory and visual RT (ART and VRT) were measured before and after the one week study period and appropriate statistical methods applied for intra and inter group comparisons. **Results:** Both asana and pranayama training resulted in significant ($p<0.001$) shortening of ART and VRT, while ART was significantly ($p<0.05$) prolonged in controls with no significant change in VRT. Intergroup comparisons revealed that these changes were more pronounced following pranayama training especially with regard to VRT. **Discussion:** The present study provides evidence that even a short term, one week training in asana and pranayama can shorten RT in novices and that this is more pronounced in case of pranayama training. These changes may be attributed to enhanced central processing ability resulting from better sense of perception, sensitivity, alertness and awareness occurring as a result of Yoga practice. As pranayama practice tends to be more introspectional (with eyes closed), this may have more pronounced effects than asana where awareness is more externalized in novices. It is also plausible that the conscious alterations of respiratory patterns may influence ascending pathways resulting in more pronounced changes after pranayama. It is suggested that Yoga training of even a short duration can enhance central processing ability and that such training especially in pranayama may be utilized to enhance learning capabilities in students of health professions education.

Keywords: Asana; Pranayama; Yoga; Training

Introduction

Reaction time (RT) is described as the interval between onset of a signal (stimulus) and the resultant motor response. [1] It is an indirect index of central neuronal processing and provides objective evidence of sensory-motor association, performance, and cortical arousal. [2] It depends on the state of alertness of an individual and is vital in professions such as drivers, military personnel, sportspeople, medical and nursing staff, etc., as they require quicker, and more efficient responses to deal with emergencies. [3] While it is independent of socio-cultural influences, prolonged RT denotes a decreased performance that may be due to physical, mental, emotional, social or other environmental factors. [4]

Numerous studies have reported effects of Yoga training on shortening of RT and these have included those evaluating immediate effects of techniques, as well as those reporting on Yoga training for durations varying from a few weeks to a few months. [5-8]

Most of these previous studies have only looked at generalized Yoga training consisting of different techniques and their combinations and few have compared effects of differential training in asana and pranayama. Trakroo and colleagues [9] reported on differential effects in police trainees following 6 months of training while Biswas reported effects of 4 weeks training in asana, pranayama and raja yoga meditation in medical students [10]

Studies by Bhavanani and colleagues have reported on pranayama with significant and immediate decrease of RT, both auditory (ART) and visual (VRT), following nine rounds of mukha bhastrika, in normal school children [11] and mentally challenged adolescents [12] as also following suryanamaskar. [2] Others have evaluated differential effects of slow and fast pranayamas [7,13] or right and left uni-nostril breathing. [14]

Regular training in Yoga is being imparted for students of

How to Cite this Article: Bhavanani AB, et al. A Comparative Study of the Differential Effects of Short Term Asana and Pranayama Training on Reaction Time. Ann Med Health Sci Res. 2017; 7: 80-83

Kasturba Gandhi Nursing College (KGNC) since 2012, initially as an optional extracurricular activity and later as a co-curricular activity. Based on positive changes experienced and expressed by students, [15] teachers and administrators, Yoga was officially included as part of nursing curriculum in 2016. [16] This inclusion was done through a specialized course of 90 hours namely "Foundation in Yoga Therapy" having lectures and practical training of 45 hours during 1st year BSc (N), followed by 30 and 15 hours under Medical Surgical Nursing during 2nd and 3rd year respectively. The training for the first batch of students commenced in August 2016 and 45 hours were completed over a period of 3 months via bi-weekly classes at CYTER.

In order to scientifically validate effects of such training in young health professions students, we planned various studies evaluating anthropometric, cardiovascular, musculoskeletal and neurological parameters. In this paper we are reporting the short term effects of differential training in asana and pranayama on auditory (ART) and visual (VRT) reaction time.

Materials and Methods

The present study was conducted at the Centre for Yoga Therapy, Education and Research (CYTER) of Sri Balaji Vidyapeeth in Pondicherry, India. It was done between August and October 2016 as part of a larger study on the effects of yoga training in nursing students for which ethical clearance had been obtained from Institutional Human Ethics Committee.

134 healthy young adults (99 F and 35 M) studying BSc Nursing at KGNC were recruited for the study and informed consent obtained from them. 89 of them studying in 1st year were randomly divided into two groups and 44 of them (age 18.48 ± 0.66 yrs and BMI 22.45 ± 5.19 Kg/m^2) received one week of training in asana while 45 (age 18.33 ± 0.72 yrs and BMI of 20.83 ± 4.52 Kg/m^2) received parallel training in pranayama. 45 control subjects (age 18.69 ± 0.73yrs and BMI 23.50 ± 6.23 Kg/m^2) were recruited from 2nd year batch that didn't receive Yoga training but were coming to CYTER for clinical postings.

Anthropometric data was taken at the beginning of the training in the Yoga Hall of CYTER. Individual height was measured to the nearest mm by a wall mounted stadiometer and weight measured with a weighing scale (Krups scale). BMI was calculated by Quetelet's index that is weight (in kg)/(height in m^2).

ART and VRT were recorded in all subjects before and after the study period of one week. Seminar cum Lecture Hall of CYTER between 11am and 1 pm in a quiet environment with temperature between 22°C and 25°C. The subjects were advised to come at least two hours after breakfast with empty bowel and bladder.

RT apparatus having built in 4 digit chronoscope with display accuracy of 1 ms manufactured by Anand Agencies, Pune was used for the present study. Auditory click sound stimulus was used to evaluate simple ART while red light stimulus was used for simple VRT. Each subject was evaluated separately and instructed to release the response key as soon as respective stimulus was perceived by them. The subjects used their dominant hand while responding to the click sound or red light signals that were given only from their front to avoid any confounding effect of lateralized stimulus.

On two days prior to the actual testing all subjects were familiarized with the procedure and equipment as RT is found to be more consistent when subjects have had adequate practice. [17] Eight to ten trials were recorded for both auditory and visual signals and average of the lowest three similar observations was taken as a single value as per established norms. [6,7,11,12,14] Yoga techniques utilized in the present study were based on the Gitananda Yoga tradition [18-20] are given in Table 1. Group A and Group B received training (5 sessions of 60 min each) exclusively in asana and pranayama respectively during the week while control subjects (Group C) didn't receive training but participated in routine activities at CYTER. Data was recorded from subjects in all groups on 1st and 7th day of the week-long study.

Table 1: Asana and pranayama techniques performed in the study.

Group A: Asanas (postures done and held with awareness)	Group B: Pranayamas (breathing techniques to enhance vitality)
Tala (palmyra), ardhakati chakra (lateral stretch), trikona (triangle), pashchimottana (posterior stretch), purvottana (anterior stretch), chatushpada (four footed), baddhakona (bound angle/cobbler), vakra (twist), makara (crocodile), bhujanga (cobra), ardha shalabha (half locust), eka and dwi pada uttana (single and double leg lifting), viparitakarani (inverted) and shava (corpse) asana.	Vyagraha (tiger), surya nadi (sun channel), chandra nadi (moon channel), pranava (AUM chanting), nadi shuddhi (alternate nostril), brahma mudra (gesture of creation) and bhramari (bee) pranayama. All were done in sitting posture with spine erect and well aligned.

Statistical Analysis

Study data obtained was analyzed using Graph Pad In Stat version 3.06 for Windows 95, (Graph Pad Software, San Diego California USA, www.graphpad.com). Nonparametric tests were utilized for analysis as data failed normality testing by Kolmogorov-Smirnov Test. Wilcoxon Matched pairs Signed ranks Test was used for intra-group pre-post training comparison while intergroup comparison was done by Kruskal-Wallis Test (Nonparametric ANOVA). Post hoc testing was done by Dunn's Multiple Comparisons Test. P values of less than 0.05 were taken to be indicating statistically significant differences between data.

Results

The results are given in Table 2. At baseline ART and VRT values were comparable for all three groups. ART decreased from a median 204 to 189.50 after asana and from 201 to 179 after pranayama.

In both cases the changes were statistically significant ($p< 0.001$). On the contrary ART significantly increased ($p<0.05$) from a median of 206 to 209 in control group. In case of VRT, there was a decrease from a median of 206 to 198.5 in asana group ($p<0.01$) and from 204 to 187 in pranayama group

(p<0.001). Changes in control group were not significant. Intergroup comparisons of post values showed highly significant (p<0.0001) differences between groups for both ART and VRT.

Table 2: Comparison of auditory (ART) and visual (VRT) reaction time in normal, healthy volunteers before and after one week exclusive training in asana, pranayama or control period.

Parameter		Asana (n=44)	Pranayama (n=45)	Control (n=45)	P value
ART	Pre	204 (160,260)	201 (158,345)	206 (158,271)	0.9994
	Post	189.50 (158,237) *** ♦♦♦	179 (148,216) *** ●●● Ψ	209 (165,261) *	<0.0001
	Δ%	-8.24 (-24.90, 26.88) ♦♦♦	-10.87 (-42.03, 15.70) ●●●	1.59 (-16.87, 27.14)	<0.0001
VRT	Pre	206 (176,269)	204 (173,299)	201 (161,384)	0.6440
	Post	198.50 (163,255) **	187 (152,279) *** ●●● ΨΨ	200 (174,406)	<0.0001
	Δ%	-4.66 (-22.78, 12.20) ♦	-10.10 (-35.12, 31.60) ●●●	0.00 (-14.84, 25.12)	<0.0001

Values are given as median (range).
*p<0.05, ** p<0.01,***p<0.001 by Wilcoxon Matched-pairs Signed-ranks Test for intra-group pre-post comparison.
Actual p values are given for intergroup comparison by Kruskal-Wallis Test (Nonparametric ANOVA) in the last column.
♦ p<0.05 and ♦♦♦p<0.001 for asana vs. control by Dunn's Multiple Comparisons Test.
●●●p<0.001 for pranayama vs. control by Dunn's Multiple Comparisons Test.
Ψ p<0.05 and ΨΨ p<0.01 for pranayama vs. asana by Dunn's Multiple Comparisons Test.

Post hoc analysis by Dunn's multiple comparisons test showed changes to be significantly more significant in asana and pranayama versus control and such changes were significantly more in pranayama group when compared to asana group.

Discussion

The practice of yoga has been reported to enhance an individuals' ability to react faster and more efficiently to stimuli and numerous studies have evidenced enhanced central processing and sensory-motor functioning effected by such training. [2,5-7, 14, 21,22] The present study was planned to evaluate any potential differential effects between short term (one week) exclusive training in either asana or pranayama as such work has only been done in two earlier studies.

The earlier study by Trakroo et al. was done in police trainees and for a duration of 6 months with RT as one of many parameters. [9] It reported a post-training decrease in RT in all the yoga groups that was significant for VRT in asan group, ART in pranayama group, and VRT as well as ART in the asan-pranayama group. They attributed the faster reactivity following yoga training to an "intermediate level of arousal brought about by a conscious synchronization of dynamic muscular movements with slow, regular, and deep breathing". They had also recommended that RT be used as a simple, quantitative, objective, and non-invasive method for monitoring beneficial effects of yoga training. However, unlike our present study there was no significant difference between groups on ANOVA testing. The major difference between that study and the present one is that all subjects in that study were undergoing regular and intensive police training. As exercise is known to influence RT, this may be considered a confounding factor that may have diluted/enhanced the actual effect of yoga on RT itself.

The other study by Biswas compared asana, pranayama and raja yoga meditation and reported significant changes in pranayama and meditation groups for both ART and VRT. [10] ART changes were only significant in the pranayama group while they were not in the asana and meditation groups. This is similar to the results of our present study where changes are more significant in pranayama than asana. Biswas had suggested that the relaxation response evoked by yoga practice, potentiated the anterior cingulate, hippocampal formation and amygdale; the brain areas related to emotions, motivation and memory. The major limitation of the study by Biswas was that intergroup comparisons by ANOVA were not done and merely paired t tests done for intra group comparison. The present study has gone further and done intergroup comparison thus providing evidence that though both asana and pranayama shorten RT, pranayama is more effective than asana.

The findings of the present study evidence that shortening of RT occurs both after training exclusively in asana or pranayama for a short period of one week. The differences between both groups were however not too apparent through pranayama seems to have an edge over asana. Such greater improvements in pranayama groups may be attributed to a few factors. All the subjects were novices to yoga and hence the asana practice may have been more externalized with them focusing on the positioning of the limbs and movements rather than internally. Such internalization is more prevalent amongst the experienced practitioners who express that asana practice becomes contemplative and meditative. However in the case of pranayama training, the internalization is possibly easier for the novice as most practices are done with eyes closed and in a sitting position. Hence the internalization through pranayama, may be favouring better central processing through an enhanced ability to ignore extraneous stimuli and detach one's self from sensory distractions in the environment. [23] Pranayama has been shown to enhance RT and this has varied between fast and slow pranayama as well as those done through right or left uninostril. [7,13,14,22] In the present study, the pranayama training was given based on a balanced set of practices that included both the right and left uninostril breathing as well as slow and fast pranayama.

Sharma et al. have suggested that pranayama enhances the participants' ability to concentrate and that the resultant changes in mental processing (e.g., focused attention and reduced stress) are then rapidly expressed in the body via the autonomic and neuro endocrine systems. [13] It has been further suggested that such changes brought about by consious regulation of the respiration, may improve bidirectional communication between the cerebral cortex (the seat of conscious activity) and the limbic/autonomic/neuro-endocrine systems (the seat of unconscious/automatic activity. [24] Telles et al. have postulated

that yogic consciously regulated breathing brings about a generalized alteration in information processing at thalamo-cortical level through modifications in neural mechanisms that regulate respiratory system activity. [21]

Conclusion

The present study provides evidence that even a short term, one week training in asana and pranayama can shorten RT in novices and that this is more pronounced in case of pranayama training. These changes may be attributed to enhanced central processing ability resulting from better sense of perception, sensitivity, alertness and awareness occurring as a result of Yoga practice. As pranayama practice tends to be more introspectional (with eyes closed), this may have more pronounced effects than asana where awareness is more externalized in novices. It is also plausible that the conscious alterations of respiratory patterns may influence ascending pathways resulting in more pronounced changes after pranayama. It is suggested that Yoga training of even a short duration can enhance central processing ability and that such training especially in pranayama may be utilized to enhance learning capabilities in students of health professions education.

Conflict of Interest

All authors disclose that there was no conflict of interest.

References

1. Balakrishnan G, Uppinakudru G, Girwar Singh G, Bangera S, Dutt Raghavendra A, Thangavel D. A comparative study on visual choice reaction time for different colors in females. Neurology Research International 2014; 2014: 301473.
2. Bhavanani AB, Ramanathan M, Balaji R, Pushpa D. Immediate effect of suryanamaskar on reaction time and heart rate in female volunteers. Indian J Physiol Pharmacol 2013; 57: 199-204.
3. Batra A, Vyas S, Gupta J, Gupta K, Hada R. A comparative study between young and elderly indian males on audio visual reaction time. Indian Journal of Scientific Research and Technology 2014; 2: 25-29.
4. Shah C, Gokhale PA, Mehta HB. Effect of mobile use on reaction time. Al-Ameen Journal of Medical Science 2010; 3: 160-164.
5. Malathi A, Parulkar VG. Effect of yogasanas on the visual and auditory reaction time. Indian J Physiol Pharmacol 1989; 33: 110-112.
6. Madanmohan P, Thombre DP, Balakumar B, Nambinarayanan TK, Thakur S, Krishnamurthy N, et al. Effect of yoga training on reaction time, respiratory endurance and muscle strength. Indian J Physiol Pharmacol 1992; 36: 229-233.
7. Madanmohan, Udupa K, Bhavanani AB, Vijayalakshmi P, Surendiran A. Effect of slow and fast pranayams on reaction time and cardiorespiratory variables. Indian J Physiol Pharmacol 2005; 49: 313-318.
8. Madanmohan, Bhavanani AB, Dayanidy G, Sanjay Z, Basavaraddi IV. Effect of yoga therapy on reaction time, biochemical parameters and wellness score of peri and post-menopausal diabetic patients. International Journal of Yoga 2012; 5: 10-15.
9. 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. International Journal of Yoga 2013; 6: 96-103.
10. Biswas DA. Effects of short term yoga training on pulmonary & reaction time in students of rural medical institution. JIMSA 2010; 23: 71-72
11. Bhavanani AB, Madanmohan, Udupa K. Acute effect of Mukh Bhastrika bellows breathing) on reaction time. Indian J Physiol Pharmacol 2003; 47: 297-300.
12. Bhavanani AB, Ramanathan M, Harichandrakumar KT. Immediate effect of mukha bhastrika (a bellows type pranayama) on reaction time in mentally challenged adolescents. Indian J Physiol Pharmacol 2012; 56: 174-180.
13. Sharma VK, Rajajeyakumar M, Velkumary S, Subramanian SK, Bhavanani AB, Sahai MA. Thangavel D. Effect of fast and slow pranayama practice on cognitive functions in healthy volunteers. Journal of Clinical and Diagnostic Research 2014; 1: 10-13.
14. 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: 60-65.
15. Bhavanani AB, Ramanathan M, Madanmohan P, Srinivasan AR. Hematological, biochemical and psychological effects of a yoga training programme in nursing students. Int Res J Pharm App Sci 2013; 3: 17-23
16. Bhavanani AB. Integrating yoga in health professional education: The SBV experience. Annals of SBV 2017; 6: 28-32.
17. Sanders AF. Elements of human performance: Reaction processes and attention in human skill. Mahwah, Lawrence Erlbaum Associates, Publishers New Jersey, USA; 1998.
18. Swami G. Pranayama: The fourth limb of Ashtanga yoga. Pondicherry, India: Satya press; 2008.
19. Bhavanani AB. Yoga for health and healing. Pondicherry, India: Dhivyananda Creations; 2008.
20. Bhavanani AB. Yoga Chikitsa: The application of yoga as a therapy. Pondicherry, India: Dhivyananda Creations; 2013.
21. Telles S, Joseph C, Venkatesh S, Desiraju T. Alterations of auditory middle latency evoked potentials during yogic consciously regulated breathing and attentive state of mind. Int J Psychophysiol 1993; 14(3): 189-98.
22. Ramanathan M, Bhavanani AB. Immediate effect of chandra and suryanadi pranayamas on cardiovascular parameters and reaction time in a geriatric population. International Journal of Physiology 2014; 2: 59-63.
23. Borker AS, Pednekar JR. Effect of pranayam on visual and auditory reaction time. Indian J Physiol Pharmacol 2003; 47: 229-230.
24. Taylor AG, Goehler LE, Galper DI, Innes KE, Bourguignon C. Top-down and bottom-up mechanisms in mind-body medicine: development of an integrative framework for psychophysiological research. Explore (NY) 2010; 6: 29-41.