

NEURO- ANATOMICAL AND PHYSIOLOGICAL CORRELATES OF YOGIC EXERCISES ON REACTION TIME TASK

M.R. Shende, N.A. John Parekh*

Professor and Head, Department of Anatomy, NKP Salve Institute of Medical Sciences, Digdoh, Nagpur, India.

Professor and Head, Department of Physiology, Indira Gandhi Medical College and Research Institute, Government of Puducherry

ABSTRACT

Assess the neurological function in relation to the auditory and visual reaction time in yogic exercisers and to compare it with healthy controls. Auditory and visual reaction time was measured by Response Analyzer manufactured by Yantrashilpa system, Pune in sixty normal healthy control and sixty yogic exercisers in age group of thirty to sixty years. The observations revealed faster reaction time for auditory and visual stimuli in yogic exercisers as compared to controls. The faster reaction time in healthy yogic exercisers as compared to control is attributed to improved concentration, alertness, finger tapping task, muscular co-ordination and improved performance in speed and accuracy task.

Key words: Reaction time, Auditory, Visual, Yoga.

INTRODUCTION

Yoga's primary emphasis is upon general well-being. The benefit of yoga is its application in relieving stress, fatigue, invigoration and vitality and its anti-aging properties and its application for relaxation therapy. Anatomy of yoga for posture and health focuses on the benefits of yoga for improving posture and general health. Its premise is the fact that good posture and spine strength lie at the core of the body's health. The anatomical overview of postural exercises in yoga suggests that these exercises are centered towards stretching and strengthening of muscles. Stretching helps increase circulation to the muscles and joints, and increases flexibility and range of motion. Strengthening puts a small amount of strain on the muscle in a way it is not used to receiving (which isn't harmful to muscles). As a result, muscle strength and mass are built. Also, bone strength and the body's metabolism are increased. Core strength is derived from the muscles in the following areas of the body: back, abdomen, pelvis and hips. The pelvic muscles actually stabilize your spine. These core muscles work together as a unit. In yoga, there is emphasis placed on the core muscle groups because strong core muscles will keep our back and spine healthy and so also strengthen our muscles for

performing various muscular activities.^{1,2}

Madanmohan et al and Malathi et al have reported that yoga training produces a significant reduction in Visual Reaction time (VRT) and Audio Reaction Time (ART). This alertness may be related to reaction time. Reaction Time is an indirect index of the processing ability of central nervous system and a simple and inexpensive means for determining sensorimotor performance. Shortening of VRT as well as ART after pranayam training signifies greater arousal, improved concentration and faster responsiveness.^{1,3,4}

Madanmohan et al in their study designed to test whether yoga training of six weeks duration modulates sweating response to dynamic exercise and improves respiratory pressures, handgrip strength and handgrip endurance concluded that yoga training for a short period of six weeks can produce significant improvements in respiratory muscle strength and endurance. Thus Yoga improves perceptual-motor skills, improves hand steadiness and flexibility, muscular stability, and improves tone in muscle in adults as well as children.^{1,2,5}

These facts gave us impetus to conduct and study of the beneficial effect of yoga on reaction time task. As we being from Medical faculty we wanted to investigate the neuro anatomical and physiological basis of these exercises on human health. In present study we found out the auditory and visual reaction time in healthy controls and compared it

Correspondence

Dr. M.R. Shende.

Professor and Head, Department of Anatomy,
NKP Salve Institute of Medical Sciences,

Digdoh, Nagpur, 440022.

Phone No. (M) 9850390330.

E-mail: shende_dr@yahoo.com

with those doing yogic exercises. We choose wider parameters for analysis of reaction time task which included auditory low and high frequency sound stimuli and visual reaction time for red, green, and indigo light stimuli which were not done in earlier studies by researchers. Our objective was to find out any difference and if present its statistical significance and to further analyze the reasons for the observed facts.

MATERIAL AND METHODS

The study was carried out in the Department of Physiology at Indira Gandhi Government Medical College, Nagpur. The present study included one hundred and twenty male subjects (sixty yogic exercisers and sixty controls). The Controls and aerobic exercisers selected for study were age matched from same socio-economic group and were non-smokers, non-alcoholic, having normal vision and hearing and had no clinical evidence of any illness and had perfect sense of physical, mental, and psychological well being. All the Controls and aerobic exercisers studied were in age group of 30 to 60 years. The mean age of control was 42((± 7.7) and 43 (± 6.5). They were not on any medication, therapy, or placebo treatment. All the subjects who were selected as yogic exercisers had been practicing yoga regularly for more than a year at yoga centre. The various exercises carried out by these were Asana for meditational posture such as Padmasana and Siddhasana, Asana for physical relaxation such as Shavasana and Makarasana, Asana for correcting the proprioceptive awareness of the musculo skeletal system, such as Dhanurasana, Vakrasana and Mayurasana. These Yogic Exercisers were regularly performing yogic exercises for one hour daily through out the year. The standard protocol of all above mentioned exercises were performed daily by these exercisers.

The subjects and control were examined and detail personal history, family history and general medical examination was conducted. The pulse, height, weight and blood pressure was recorded. The Body Mass Index was calculated and those having BMI above 25 were excluded. The auditory and visual reaction time was measured by, 'Response Analyzer' by "Yantra Shilpa " System, Pune, which had a display accuracy of 0.001 second.^{1,3} The instrument is specially designed to measure response time in millisecond. It has four modes of providing stimulus audio, visual, cutaneous, and electrical. The reaction

time was recorded for auditory low and high frequency sound stimuli and visual reaction time for red, green, and indigo light stimuli. As soon as the stimuli was perceived by the subject, they responded by pressing the response switch. The display indicated the response time in milliseconds. After familiarizing the subject with the instrument and after repeated practice, three readings for each parameter were noted. The average of these three readings was taken as the value for reaction time task and was noted in the subject record profile. The standard't' test was applied to determine the statistical significance. The present study was carried out as per guidelines of Helsinki Declaration of 1975 as revised in 2000.

RESULTS

The results of auditory reaction time for low and high frequency sound and visual reaction time for red, green, and indigo light is shown in Table I and Table II.

The statistical significance was determined using students't' test. All the observed values for auditory reaction time for low and high frequency sound and visual reaction time for red, green, and indigo light after comparison between controls and aerobic exercisers were proved to be statistically significant.

Study Group	N	Auditory Reaction Time	Reaction Time in Milli-seconds(Mean ±SD)
Control	60	Low frequency sound	0.1684 (±0.0153)
Yogic Exercisers	60	Low frequency sound	0.1362 (±0.0135)*
Control	60	High frequency sound	0.1660 (±0.0173)
Yogic Exercisers	60	High frequency sound	0.1365 (±0.0118)*

Table I: Auditory reaction time for low and high frequency sound in controls and aerobic exercisers

Parameter	N	Visual Reaction Time For Colour	Reaction Time in Milli-seconds (Mean ±SD)
Control	60	Red	0.1711 (±0.0077)
Yogic Exercisers	60	Red	0.1580 (±0.0127)*
Control	60	Green	0.1785(±0.003)
Yogic Exercisers	60	Green	0.1613 (±0.0144)*
Control	60	Indigo	0.1764(±0.0069)
Yogic Exercisers	60	Indigo	0.1580 (±0.0127)*

Table II: Visual reaction time for red, green and indigo color in controls and aerobic exercisers

Note: N denotes sample size in each group.
 * denotes significance (p < 0.05), Reaction time values are recorded in milliseconds.

DISCUSSION

In our study the mean age of control was 42((± 7.7) and 43 (± 6.5). The age difference in control and yogic exercisers was statistically non significant. The reaction time in healthy yogic exercisers was less in yogic exercisers as compared to controls for auditory and visual reaction time. Our finding was consistent with findings of Madan Mohan et al who in their study found that the practice of yoga improves physical and mental performance Twenty seven student volunteers were given yoga training for 12 weeks. There was a significant (P < 0.001) decrease in visual RT (from 270.0 +/- 6.20 (SE) to 224.81 +/- 5.76 ms) as well as auditory RT (from 194.18 +/- 6.00 to 157.33 +/- 4.85 ms). Their results show that yoga practice for 12 weeks results in significant reduction in visual and auditory RTs and significant increase in respiratory pressures and breath holding times.^{1,2} Similarly Malthi et al studied Visual and auditory reaction time (VRT, ART) in 83 healthy male subjects of 30-40 years of age who had never practiced yogasanas before. These subjects were divided into two group's viz. Group A in whom VRT and ART was determined after 1 hr. yogasanas and Group B ART

and VRT was determined after 6 weeks yogasanas training programme. VRT and ART the result showed a significant reduction in Group A (P less than .05) and Group B (P less than .001) in their study.³ The visual reaction time for red color is significantly decreased in healthy yogic exercisers in our study which are consistent with the finding of Malathi, et al (1989).³

The normal reaction time per study of Pathak et al and Shenvi et al for visual stimuli is 0.150 to 0.222 seconds and 0.130 to 0.180 for auditory stimuli.^{6,7} The visual reaction time for green color and indigo color is found to be decreased in healthy yogic exercisers as compared to controls and this decrease is statistically significant.

The observed faster reaction time of yoga of practitioners can be explained in terms of the effect of yoga on certain aspects of human personality and performance that can help to improve reaction time. Jansi Rani.N⁸ and Sridevi.K⁹ documented that practice of yoga reduces anxiety and increases alertness and attention which can improve the subjects' performance in the reaction time experiment. Manjunath et al¹⁰ and Telles S¹¹ found enhanced spatial and temporal characteristics which likely improves visual reaction time.

The decrease in reaction time for auditory (low and high frequency) and visual reaction time (red, green and indigo colors) in our study is attributed to the followings :- Our study shows significant effect of practicing yoga on auditory and visual reaction time with significantly faster reaction time of yoga group as compared to those not practicing yoga.

1. The long term effect of yogic asana aids in improvement in flexibility of joints and over all improvement is an indicator of physical fitness. The significant improvement in co-ordination of hand movements and hand steadiness is also noted in other scientific studies^{1,2,4} thus improvement in flexibility of joints and improvement in co-ordination of hand movements and hand steadiness is responsible for faster reaction time in Yogic Exercises in our study.
2. Yoga Asana brings equipoise between psychic and somatic aspects of body functions and improved motor performance, nerve conduction, speed motor action, increased level of consciousness and calmness in those performing Yogic Exercises. It lowers neuro-humoral activity, lowers rate of mental fatigability, increase performance quotient and

improves memory quotient. ^{2,8,9,12} Better equipose between psychic and somatic aspects of body functions is responsible for faster reaction time in our Yogic Exercises. ¹²

3. Yoga quickens the neuronal transmissions, provide calmness of the mind and increase the concentration of predetermined thoughts or action play and thus improve the performance. Thus calm mind and increased concentration can be contributed to faster reaction time in our study in the Yogic Exercising group. ^{1,3}

The link between mind and the body has been scientifically related. The role of limbic system of the brain in regulating the homeostatic condition in the body by influencing the visceral mechanism through the autonomic nervous outflow and endocrine secretions are now well known. The proper conditioning of the nervous system can maintain the normal homeostasis. The process of mental relaxation may thus be expected to produce such conditioning. ^{12,13} Thus proper conditioning in those performing regular Yogic exercises as in our study is responsible for better motor performance, faster finger tapping task and reaction time for auditory (low and high frequency) and visual reaction time (red, green and indigo colors) in our Yogic Exercisers.

CONCLUSION

The reaction time for auditory and visual stimuli was less in yogic exercisers than controls. It appears that the broad spectrum of physiological and bio-energetic events is triggered by Yoga and that these mechanisms can be modified and refined by conscious and concentrated practice. There is, however, substantial research from numerous disciplines of western science, (exercise physiology, behavioral medicine, psycho neuro immunology, neurology hematology, immunology and lymphology) that explores states or responses that are similar to states or responses initiated by Yoga practice. Hence like other postural and aerobic exercises yoga also aids in enhanced muscular performance, better muscular mobility, strengthening of muscles, stretching exercises helps increasing blood circulation to the muscles and joints, and increases flexibility and range of motion. Hence practicing Yoga as exercise for health benefits can be done though spiritual aspects and beliefs in scientific world is unacceptable but scientist researchers should explore the exercise physiology behind the health benefits.

Studies regarding beneficial effect of yoga in diseases involving the central neural axis may be carried out to find if any beneficial effect which can be derived for improvement of motor function as it in evidence from our study that the reaction time of healthy yogic was decreased after regular exercises in comparison to control.

REFERENCES

- 1) Madanmohan, Thombre D.P, Balakumar B. et al. Effect of yoga training on reaction time, respiratory endurance and muscle strength. *Indian J Physiology and Pharmacology* 1992; 36(4): 229-33.
- 2) Madanmohan, Mahdevan S.K, Balkrishnan S. Effect of six weeks yoga training on weight loss following step test, respiratory pressures, handgrip strength and handgrip endurance in young healthy subjects. *Indian J Physiology and Pharmacology* 2008; 52(2): 164-70.
- 3) Malathi A. Parulkar, Vidya G. Effect of Yogasanas on the visual and auditory reaction time. *Indian Journal of Physiology and Pharmacology.* 1989;33:110-112.
- 4) Gopal K.S., Ananthraman, Nishith S.D et al. Effect of Yogasnas on muscle tone and cardio respiratory adjustments. *Indian Journal of Medical Sciences* 1974;28:438-443.
- 5) Telles S, Hanumanthaiah B, Nagarathna R et al. Improvement in static motor performance following yogic training of school children. *Perception Motor Skills* 1993;76(3):1264-6.
- 6) Pathak J.D, Dixit V.B, Rao M.S. Normal visual reaction time and effect of missing a meal on it. *Journal of Indian Medical Association* 1962;38(10):530-532.
- 7) Shenvi D, Balasubramanian. A comparative study of visual and auditory reaction times in males and females. *Indian Journal of Physiology and Pharmacology* 1994;38:229231.
- 8) Jansi R.N. Effect of enhancement of oxygen supply through yogic procedure on cognitive task performance. *Journal of Indian Psychology* 2006;24:1-6.
- 9) Sridevi K, Sitamma M.,Krishnarao P.V. Yoga training and cognitive task performance. *Journal of Indian Psychology.* 1998;16:34-39.

- 10) Manjunath N.K., Telles S. Improvement in visual perceptual sensitivity in children following yoga training. *Journal of Indian Psychology* 1999;1741-45.
- 11) Telles S. Progressive increase in critical flicker fusion frequency following yoga training. *Indian journal of physiology & pharmacology.* 1997; 41: 71-74.
- 12) Saeed S.A., Antonacci D.J., Bloch R.M. Exercise, yoga and meditation for depressive and anxiety disorder. *American Family Physician* 2010;81(8):981-6.
- 13) Hascelik Z, Basgoze O, Turker K et al. The effects of physical training on physical fitness tests and auditory and visual reaction times of volleyball players. *Journal of Sports Medical Physical Fitness* 1989; 29: 234239.