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Original Article

# Influence of Meditation on Visual and Auditory Reaction Time in Young Healthy Volunteers

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## Abstract

**Background**: Last few decades have witnessed meditation to be a potential alternative therapy in medicine. Many psychological and behavioural aspects of meditation help to understand the effects of meditation qualitatively. Reaction time (RT) being one such measure estimates the response of central nervous system. It serves as a simple non invasive method to measure level of alertness providing an efficiency index of central nervous system processing. **Method**: Choice reaction time was used in the present investigation to study the impact of meditation "Dialogue with the Body" on 45 young healthy volunteers who practised the technique regularly for 12 weeks. The auditory and visual RT was measured at the intervals of 45 days and 90 days using RT analyser and data analysis was done using SPSS. **Results**: Repeated ANOVA measures and least square difference comparison were used for analysis. The results obtained show significant difference ($p<0.05$) in both auditory and visual reaction time after 45 and 90 days of practising meditation. **Conclusion**: RT was reduced due to regular practice of meditation and alertness increased post meditation.

## Introduction

Certain techniques of meditation like mindfulness meditation have been found to bring about various positive psychological effects, including increased subjective well-being, reduced psychological symptoms, emotional reactivity, and improved behavioural regulation (1). Even short term meditation evokes brain activity (2). Many perceptual and cognition abilities are associated with meditation (3). Reaction time (RT) being one such measure of sensory motor association, is the elapsed time between the presentation of a stimulus of any modalities of sensory input (visual, auditory, pain, touch or temperature) and subsequent behavioural response measured typically by a button press, an eye moment, a vocal response, or some other observable behaviour (4). RT provides an indirect index of the processing capability of central nervous system, concentration and cognitive skills with well proven diagnostic validity (5). In psychometric physiology, it is considered to be an index of speed processing (6). RT has been used in certain studies to study the effect of meditation and similar such relaxation techniques like yoga and breathing. According to a study conducted by Robert Shaw et al in 1971, subjects practising the Transcendental Meditation technique had faster reactions than those not practising the technique. Practising meditation not only improved their performance but also reduced

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stress (7). In another study done by Prashant Kaul et al in 2010 meditation provided a short-term performance improvement in terms of enhanced psychomotor vigilance even in novice meditators (8). Techniques of meditation like the Dhammakaya Buddhist meditation when practised produced biochemical and physiological changes and reduced the RT (9). Regular practice of meditation is linked with increased thickness in a subset of cortical regions associated with somato-sensory, auditory, visual, and interoceptive processing (10). Meditation is associated with more efficient and flexible visual perceptual processing and also with improved visual attention processing (11). Changes linked with the active meditation state were noted in the frontal lobe. This area is involved with the focus of attention. The right anterior insula is associated with bodily attention and raised visceral awareness. Increased thickness in this region is associated with increased capacity for awareness. The right hemisphere is essential for sustaining attention, which is a centre for insight meditation (10). Long-term meditation practice is linked with modified resting electroencephalogram patterns, indicative of long-lasting alterations in brain activity (12). Meditation reflects cognitive brain functions such as sequential information processing, stimulus discrimination, and short-term memory. Not only meditation but also several other interventions like yoga, and breathing techniques cause a decrease in the reaction time of the subjects. Significant effect of Pranadharna was found on reaction time of right hand. On the other hand, significant effect of Sahaja Yoga Meditation and Pranadharna was found on reaction time of left hand (13). Study done by Malathi and Parulkar showed significant reduction in auditory reaction time (ART) values after practising yoga (14). Yoga can improve the reaction time which is helpful in surgeons, sportsmen and skilled workers (15). Thus, a combined practice of asana, breathing exercises, meditation & relaxation in a sequence is the best available resource to meet the present day needs of society for stress management and improved performance (16).

The present paper aims to understand the influence of meditation on visual reaction time (VRT) and (ART) in young healthy volunteers. The meditation technique "Dialogue with the body" was practised by the volunteers for a period of three months and the correlation between meditation and reaction time has been determined.

## Methods

The study was carried out on 45 young healthy subjects (43 males and 2 females) in the age group 16-24 years for a period of 12 weeks daily for 20 minutes. (Ethic approval was obtained from ethical committee and institutional review board of Haffkines Institute for Training, Research & Testing, and Ref. No. HITRT/IEC/01/2015) Informed, written, witnessed consent was taken from all the subjects. Prior to the study volunteers were examined for general physical, mental health and the clinical history details were taken through a standard Performa and questionnaire by a medical professional. These subjects were chosen on the basis of inclusion criteria of subjects with normal hearing & sighted vision, no medical or surgical illness. The study was conducted at Manashakti Research Centre, Lonavla, Maharashtra, India. All the subjects were students resided at Manashakti Research Centre under various schemes of earn and learn. These volunteers belonged to the average socio-economic group. The volunteers were trained to practise meditation (Dialogue with the body) regularly for a period of 12 weeks daily for 20 minutes. "Dialogue with the body" is a focused attention technique proposed by Swami Vijnananand in 1982 (17). It involves continuous sustained attention on a guided meditation audio "Dialogue with the body." In this meditation, one has to focus on the six chakras (plexus) of the body while listening to the audio which is a form of Kundalini meditation (18, 19). This audio compact disc (CD) has to be listened in the language which is understood by the subject. Subject has to sit in a comfortable position on a chair or on floor with closed eyes and listen to the audio by the means of a head phone.

RT was measured using the choice reaction time at baseline, 45 day and 90 day interval. It was measured by multi-choice reaction apparatus with different type of sound (sound of a click, sound of buzzer) &

different type of light (green bulb, red bulb), that were given to the participants and in form of response, they had to press the button related to it. Multi-choice reaction apparatus displays time of response in milliseconds on its screen digitally which were recorded as per the response of the subject. An average of the 10 readings of each left and right visual and auditory reaction time was recorded. The testing procedures were quite simple, non-invasive and harmless from subject's point of view. Measurements were taken - 2 h after a light breakfast and 10 min rest and instructions in the laboratory. All the tests were performed while the subject was sitting comfortably in a chair.

**Data analysis:**

Data analysis was done using Statistical Package for Social Sciences (SPSS 15.0) in which One-way repeated measure analysis of variance (ANOVA) was performed for comparing 3 intervals when the readings were taken i.e. day 1, day 45 and day 90. Repeated measure ANOVA was used as same group of participants were assessed at different intervals. ANOVA was interpreted using the multivariate test typically reporting values for Wilks Lambda to test whether there are any significant differences between the different intervals. One way repeated ANOVA is thereby used when each subject is exposed to two or more different conditions or measured on same continuous scale on three or more occasions. (SPSS Survival manual)

Paired-sample t-test was used for comparing scores before and after the meditation intervention for the same participants. Paired sample t test is used when only one group of subjects is present and data is collected under different occasions. This test is used specifically for the pre-test / post-test experimental designs.

## Results

The audio and visual RT of 45 young and healthy volunteers who were mentally and physically fit as certified by medical professional was measured; all the subjects were students who resided at Manashakti Research Centre. The ART and VRT recordings of the subjects practising the meditation technique "Dialogue with the Body" were taken at various intervals of 45 day and 90 day. Table I depicts the results of one way repeated ANOVA (Multivariate Wilk's lambda test) done using SPSS.

Present study was performed for comparison between the intervals of Day 1 with Day 45 and Day 90 using the LSD – Least Square Difference test and it was observed that day 1 significantly differs from day 45 and day 90 (Table I).

The left visual RT was found to be significantly decreased at day 45 by 19% and day 90 by 20% while the right reaction time was found to be significantly decreased at day 45 by 14% and day 90 by 19% (Table II, Fig. 1)

The left auditory RT was found to be significantly

TABLE I: Multivariate tests Wilks' lambda.

| | *Value* | *F* | *Hypothesis df* | *Error df* | *Sig.* |
|---|---|---|---|---|---|
| Visual Left | .734 | 7.807 | 2.000 | 43.000 | 0.001* |
| Visual Right | .585 | 15.232 | 2.000 | 43.000 | <0.001* |
| Audio Left | .626 | 12.826 | 2.000 | 43.000 | <0.001* |
| Audio Right | .464 | 24.856 | 2.000 | 43.000 | <0.001* |

(*) p value significane <0.05

One way repeated ANNOVA measures of the visual and auditory reaction time.

TABLE II: Pairwise comparison.

| | | *Mean difference* | *Standard error* | *Significance* |
|---|---|---|---|---|
| Visual Left | Day 1–Day 45 | .107 | .028 | <0.001* |
| | Day 1–Day 90 | .114 | .029 | <0.001* |
| Visual Right | Day 1–Day 45 | .084 | .022 | <0.001* |
| | Day 1–Day 90 | .112 | .020 | <0.001* |
| Audio Left | Day 1–Day 45 | .181 | .042 | <0.001* |
| | Day 1–Day 90 | .207 | .041 | <0.001* |
| Audio Right | Day 1–Day 45 | .189 | .033 | <0.001* |
| | Day 1–Day 90 | .234 | .034 | <0.001* |

(*) p value significane <0.05

Least square difference test for comparison between day 1 with day 45 and day 90 readings.

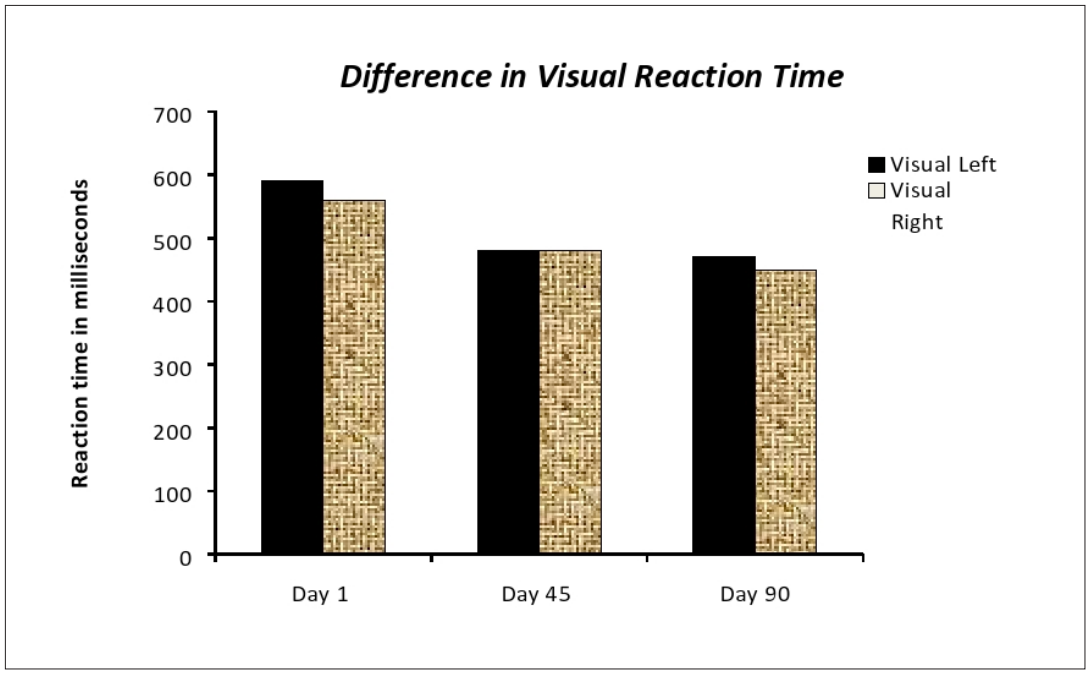


Fig. 1 : Depicts the change in visual reaction time at various intervals of practising meditation.

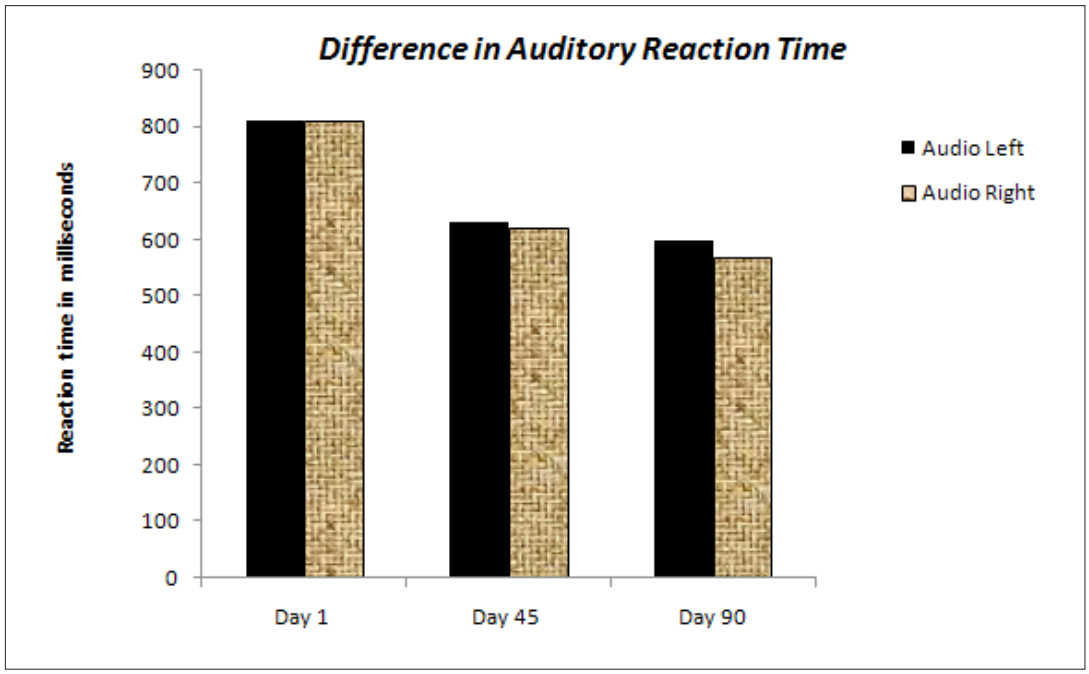


Fig. 2 : Depicts the change in auditory reaction time at various intervals of practising meditation.

decreased at day 45 by 22% and day 90 by 25% while the right auditory reaction time was found to be significantly decreased at day 45 by 24% and day 90 by 30% (Table II, Fig. 2).

## Discussion

In the present study we have used the meditation technique “Dialogue with the body” as an intervention

to study the effects of meditation on physiology. This technique was put forth by Swami Vijnananand. Swami Vijnananand has used the technique known as Kundalini (chakra) meditation (20) to induce a relaxed but awake state of mind. References to Kundalini in the literature can be traced back to the Upanishads (Hindu sacred treatises), the commentaries on the Vedas (the sacred scriptures of the Hindus), written more than 2000 years ago (21). Kundalini yoga meditation techniques were found to be specific for treating anxiety, fatigue, stimulating the immune system for treating solid tumours, expanding and integrating the mind, developing a comprehensive, comparative and intuitive mind, and one for regenerating the central nervous system (18). The audio consists of Kundalini mediation in the form of Chakra meditation (22) in which a journey of meditation starts from the Muladhar Chakra up to the Ajna Chakra inducing a thought of relaxation in every chakra, plexus innervating the entire human body. The changes are measured in terms of the reaction time.

Reaction time is found to be altered by a number of factors both physiological and pharmacological (23, 24). In our study we measured the visual and audio RT at intervals 45 day and 90 day. It revealed that there is a gradual decrease in the reaction time. This decrease was found to be more at 45 day interval than 90 day interval. RT determines alertness of the person (25) whereas prolonged reaction time denotes decreased performance (26). In our study a significant decrease in reaction time was found with the regular practice of meditation. These results are consistent with the results of Mark Hardesty 1972 which showed transcendental meditation decreased the reaction time (27), also R. Sudsuang 1991 showed practising Buddhist meditation reduced the reaction time of the subjects suggesting increased alertness (9). ART and VRT are thereby good indicators of sensory motor coordination and performance of an individual (28). Brown et al (29, 30) conducted experiments on visual sensitivity reported significant improvement in visual sensitivity post meditation. Moreover, studies also reported that practising meditation increased visual imagery abilities (31), enhanced attentive ability (32) and reduction of perceptual noise (33), increased reaction time (34), and enhanced perceptual motor speed (35). Our study also shows that ART is faster than VRT. The results obtained are in parallel with the research done by Pain and Hibbs, (36) shows that simple ART has the fastest RT for any given stimulus. Also study done by Kemp (37) show that an auditory stimulus reaches the cortex faster than the visual stimulus; the ART is faster than the VRT. Shelton and Kumar (38) also stated that simple RT is faster for auditory stimuli compared with visual stimuli and auditory stimuli has the fastest conduction time to the motor cortex along with fast processing time in the auditory cortex. Hence our study further supports the evidence that ART is faster than VRT in young healthy volunteers who practise meditation.

The need of the hour is holistic health. Health as defined by WHO encompasses not only physical but also mental & social well being. The paradigm has now shifted from curative to preventive measures. Anand has stated that “The ultimate aim of medical sciences is the attainment of optimum physical & mental health for the individual. The ultimate aim of meditation techniques is also to achieve holistic health beginning with a peaceful mind (39). The study was conducted on 45 young healthy volunteers on testing with ANOVA revealed that significant reduction in auditory reaction time (ART) & visual reaction time (VRT) after practising the meditation “Dialogue with the Body” for 3 months. It thus serves as a mental activity which increases the alertness of a volunteer by affecting the physiology.

**Conclusions**

The current study investigated the effect of meditation on the VRT and ART in young volunteers. Practising meditation technique “Dialogue with the body” for a given period of time generates significantly shorter reaction time thereby enhancing the efficiency of the central nervous system to a certain extent. ART obtained was shorter than the VRT. Reduction in reaction time indicates an increase in the alertness of the volunteers practising meditation.

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**Disclosure**

No conflicts of interest, financial or otherwise are declared by the authors.

## References

1. Shian-Ling Keng, Moria J. Smoskib and Clive J. Robins, Effects of Mindfulness on Psychological Health: A review of Empirical Studies. *Clin Psychol Rev,* 2011; 31: 1041–1056.
2. Xiaoqian Ding,Yi-Yuan Tang, Chen Cao, Yuqin Deng, Yan Wang, Xiu Xin and Michael I. Posner, Short-term meditation modulates brain activity of insight evoked with solution cue. *Soc Cogn Affect Neurosci*, 2015; 10: 43–49.
3. Dilwar Hussain and Braj Bhushan, Psychology of Meditation and Health: Present Status and Future Directions. *International Journal of Psychology and Psychological Therapy*, 2010; 3: 439–451.
4. R. Niruba and K.N. Maruthy, Assessment of Auditory and Visual Reaction Time in Type 2 Diabetics –A Case Control Study. *AJMS Al Ameen J Med Sci*, 2011; 4: 274–279.
5. Kamini Ilamkar, The neurobehavioural evaluation in schizophrenics: a comparative study. *Journal of Clinical and Diagnostic Research*, 2013; 7: 26–29.
6. Madiha Mehvish, Anupriya Deshpande, A comparative study of hand dominance and assessment of cognitive function by reaction time in non smokers and chronic smokers. *Journal of Evolution of Research in Human Physiology*, 2016; 2: 18–20.
7. Robert Shaw and David Kolb, Reaction Time following the Transcendental Meditation Technique. *Scientific Research on the Transcendental Meditation Program: collected papers*. 1971; I: 309–311.
8. Prashant Kaul, Jason Passafiume, Craig R Sargent, Bruce F O'Hara, Meditation acutely improves psychomotor vigilance and may decrease sleep need. *Behavioral and Brain Functions*, 2010; 6: 47, 1–9.
9. Ratree Sudsuang, Vilai Chentanez and Kongdej Veluvan, Effect of Buddhist meditation on serum cortisol and Total protein levels, blood pressure, pulse rate, lung volume and reaction time. *Physiology & Behaviour,* 1991; 50: 543–548.
10. Sara W. Lazar, Catherine E. Kerr, Rachel H. Wasserman et al, Meditation experience is associated with increased cortical thickness. *Neuroreport*, 2005; 28, 16: 1893–1897.
11. Holley S. Hodgins, Kathryn C. Adair, Attentional processes and meditation. *Consciousness and Cognition*, 2010; 19: 872–878.
12. Katya Rubia, The neurobiology of Meditation and its clinical effectiveness in psychiatric disorders. *Biological Psychology* 2009; 82: 1–11.
13. Bharati Rajak, Dr. Rajeev Choudhary, Effect of Sahaja Yog meditation and pranadharna on reaction time of university female students. *International Journal of Applied Research*, 2016; 2: 1025–1028.
14. A. Malathi, Vidya G. Parulkar, Effect of yogasanas on the visual and auditory reaction time. *Physiol. Pharmac*, 1989; 33: 110–112.
15. Chandrashekar V Hanji1, G Venkatesh, Short communication To study the effect of Yoga Training on auditory and visual reaction time. *Journal of International Medicine and Dentistry,* 2014; 1: 90–92.
16. Debbie L. Cohen, Nancy Wintering, Victoria Tolles et al, Cerebral Blood Flow Effects of Yoga Training: Preliminary Evaluation of 4 Cases. *The Journal of Alternative And Complementary Medicine*, 2009; 15: 9–14.
17. Swami Vijnanand, Bhagyayoga, 1982; 1: 153–158.
18. David Shannahoff, An introduction to Kundalini yoga meditation techniques that are specific for the treatment of psychiatric disorders. *Journal of Alternative and Complementary Medicine*, 2004; 10: 91–101.
19. C.K Peng, Joseph E. Mietus, Yanhui Liu et al, Exaggerated heart rate oscillations during two meditation techniques. *International Journal of Cardiology*, 1999; 70:101-107.
20. Venkatesh S, Raju TR, Shivani Y, Tompkins G, Meti BL, A study of phenomenology of consciousness in meditative and non-meditative states. *Indian Journal of Physiology and Pharmacology* 1997; 41: 149–153.
21. Laura Sanches and Michael Daniels, Kundalini and transpersonal development: Development of a Kundalini Awakening Scale and a comparison between groups. *Transpersonal Psychology Review* 2008; 12: 73–83.
22. Lota Frenros, Furhoff AK, Wandell PE, Improving quality of life using compound mind-body therapies: evaluation of a course intervention with body movement and breath therapy, guided imagery, chakra experiencing and mindfulness meditation. *Quality of Life Research*, 2008; 17: 367–376.
23. Mohan M, Thombre DP, Das AK & Subramanian N, Reaction time in clinical diabetes mellitus. *Indian Journal of Physiology and Pharmacology*, 1984; 28: 311–314.
24. A. Malati, Vidya G. Parulkar, H. S. Dhavale and C. Pinto, 56 short communication a preliminary study of reaction time in schizophrenics. *Ind J Physiot Pharmac* 1990; 34: 54–56.
25. Grrishma Balakrishnan, Gurunandan Uppinakudru, Gaur Girwar Singh, Shobith Bangera, Aswini Dutt Raghavendra, and Dinesh Thangavel, A Comparative Study on Visual Choice Reaction Time for Different Colors in Females. *Neurology Research International*, 2014; Volume 2014, 5 pages.
26. Chinmay Shah, P A Gokhale, H.B. Mehta , Effect of Mobile Use on Reaction Time, short communication. *Al Ameen J Med Sci* 2010; 3: 160–164.

27. Mark J. Hardesty, The effect of transcendental meditation on reaction time. *Scientific Research on the Transcendental Meditation and Sidhi programme*, 1972; 2: 904–907.
28. Anupama Batra, Sangeeta Vyas, Jitendra Gupta, Kapil Gupta and Rinki Hada, A comparative study between young and elderly Indian males on audio-visual reaction time. *Ind J Sci Res and Tech* 2014; 2: 25–29.
29. Brown D, Forte M, and Dysart M, Differences in visual sensitivity among mindfulness meditators and non-meditators. *Perceptual and Motor Skills* 1984; 58: 727–733.
30. Brown D, Forte M, and Dysart M, Visual sensitivity and mindfulness meditation. *Perceptual and Motor Skills*, 1984 (b), 58, 775–784.
31. Heil JD, Visual imagery change during relaxation meditation training. *Dissertation Abstracts International*, 1983; 43: 2338.
32. Linden W, Practicing of meditation by school children and their levels of field dependence independence, test anxiety, and reading achievement. *Journal of Consulting and Clinical Psychology* 1973; 41: 139–143.
33. Walsh RN, Initial Meditative Experience: Part II. *Journal of Transpersonal Psychology* 1978; 10: 1–28.
34. Robertson DW, The Short and Long Range Effects of the Transcendental Meditation Technique on Fractionated Reaction Time. *Journal of Sports Medicine* 1983; 23: 113–120.
35. Jedrczak A, Toomey M, & Clements G, The TM-Sidhi Program, Age, and Brief Tests of Perceptual motor Speed and Nonverbal Intelligence. *Journal of Clinical Psychology*, 1986; 42: 161–164.
36. Pain MT, Hibbs A, Sprint starts and the minimum auditory reaction time. *J Sports Sci* 2007; 25: 79–86.
37. Kemp BJ, Reaction time of young and elderly subjects in relation to perceptual deprivation and signal-on versus signal-off condition. *Dev Psychol* 1973; 8: 268–272.
38. Shelton J, Kumar GP. Comparison between auditory and visual simple reaction times. *Neurosci Med* 2010; 1: 30–32.
39. BK Anand. Yoga and Medical sciences. *Indian J Physiol Pharmacol* 1991; 35: 84–87.