A pilot study to compare auditory and visual reaction time in male and female young adults

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ABSTRACT

Background: It was explained that there are very few studies that exist in the literature that assessed the reaction time in young adults. Aims and Objectives: The primary objective of the present study was to assess and compare the auditory and visual reaction time among male and female young adults. The secondary objective was to compare auditory and visual reaction time’s right- and left-hand responses. Materials and Methods: A total of 120 male and female young adults were part of the study after obtaining informed consent. Auditory and visual reaction time was assessed using the RT apparatus manufactured by Anand Agencies, Pune. The instrument can assess visual reaction time for the green and red light and auditory reaction time for tone and click sounds of both right- and left-hand responses. Results: Age and weight were significantly different between males and females, whereas height was not significant. The auditory and visual reaction times were not significantly different between the male and female participants. Conclusion: The present study reveals that there is no significant difference between the auditory and visual reaction time among male and female young adults. There is a need for more detailed studies to testify to the results. Key words: Reaction time; Young adults; Sensory system; Motor system

INTRODUCTION

The speed with which an individual responds to a stimulus is called reaction time.¹ Reaction time is an excellent test to observe individuals’ cognitive functions, because it involves the sensory and motor systems. It is a measure of processing speed. Hence, the assessment is for both sensory and motor systems.² There are various methods of reaction time assessments like simple reaction time, choice reaction time, and recognition reaction time.³ Reaction time is a complex mechanism. When the stimulus is applied, it has to be perceived by the corresponding receptors and then transmit the information to the sensory system. Now, the sensory system sends impulses to the motor system and from the motor system, impulses pass through the spinal cord to the corresponding muscles, and there will be a response. Although this much-complicated mechanism is involved, there are only a few milliseconds to complete the process. However, conditions like Parkinson’s disease damage the brain and causes prolonged reaction time. Hence, assessment of reaction time helps for the early diagnosis of neuronal diseases. It was explained that there are very few studies exist in the literature that assessed the reaction time in young adults.⁴⁵ Hence, the present study was designed to assess the reaction time in males and females.

Aims and objectives

The primary objective of the present study was to assess and compare the auditory and visual reaction time among male and female young adults. The secondary objective was
MATERIALS AND METHODS

Study design
The study was observational study.

Study setting
The present study was conducted at KVG Medical College and Hospital and R.D.Gardi Medical College, Ujjain, Madhya Pradesh, India.

Study participants
A total of 120 male and female young adults were part of the study after obtaining informed consent.

Inclusion criteria
Healthy and willing participants of both genders within the age group of 18–24 years were included in the study.

Sample size and sampling method
The sample size was calculated based on the study published earlier.21 The confidence level was 95%, the margin of error was 10%, the population proportion was 50%, and the required sample size was 97. A total of 100- and 51-year medical students were screened and out of 150, 100, and 20 were willing to participate in the study and meet the inclusion and exclusion criteria. A convenient sampling method was used to select the samples for the study.

Assessment of reaction time
Reaction time was assessed in all the participants at 10 AM in the morning to overcome diurnal variations. Auditory and visual reaction time was assessed using the RT apparatus. This is called the research RT apparatus and is equipped to measure the reaction time of the right and left hands separately. It consists of two sides one is the examiner side other is the participant side. On the participant side, there are two keys for corresponding hands to respond. Furthermore, green and red lights and speakers to deliver a high pitch and low pitch sounds are present. There is a main switch to the machine on the examiner’s side. Once the machine on the chronoscope shows to display. This can reset to zero using the reset switch. There is a switch to select which hand response, we need to assess. There are four switches for two auditorys: High pitch and low pitch sounds and two visual that is a red and green light to deliver. For delivering, a stimulus initially resets the chronoscope to zero, and then, the subject is instructed on which hand to respond to and what is the stimuli. Then, the stimulus is delivered and once the subject responds, the reading on the chronoscope will be recorded (Figure 1).

Ethical considerations
The Institutional Human Ethical Committee approved the study protocol.

Statistical analysis
Data were analyzed using SPSS 20.0 version. A student t-test was applied to assess the significance of the difference between the groups. The probability value of <0.05 was considered significant.

RESULTS

Demographic data of the participants are presented in Table 1. Age and weight were significantly different between males and females, whereas height was not significant. The auditory and visual reaction times were not significantly different between the male and female participants (Tables 2 and 3). There was no significant difference in the right- and left-hand responses of reaction time among the males and females (Tables 2 and 3).

DISCUSSION

Reaction time is a measure of how fast the nervous system works. It needs the coordination of both sensory and motor systems. It assesses the central and peripheral neuronal structures. Measurement of reaction time accounts for the estimation of cognitive functions in healthy individuals as well as bedside patients. However, the studies related to the assessment of reaction time among male and female young adults were sparse. Hence, this is a present study that observed the comparison of auditory and visual reaction times between males and females. The study also compared both right- and left-hand responses. It was found that there was no significant difference present between the right
and left-hand responses of auditory and visual reaction times among male and female participants. Earlier studies reported that there is a significant difference between male and female participants.\(^1\) It was reported that ART is faster than VRT.\(^3\) Our study agrees with this study as the same results were observed in our study as well. The reason was explained as faster processing in the auditory cortex compared to the visual cortex.\(^8\) In contrast, another study reported that visual reaction time was faster than auditory reaction time.\(^3\)

Earlier studies reported that males’ reaction time was faster than females.\(^9\) The faster response in males is explained due to the faster motor response. However, the muscle contraction time is the same for males and females.\(^13,14\) Earlier studies removed the confounding factor, especially the sedentary lifestyle, and compared males and females\(^15\). The present study does not remove the confounding factor. This may be one reason why we have not observed the difference between the auditory and visual reaction times of the male and female participants. Another study compared the reaction time of hands and feet and reported a significantly faster reaction time on the dominant side. The present study does not observe a significant difference between the right- and left-hand responses. Another reason explained for the gender-based difference in the reaction time is that the gray matter volume of a male’s right anterior hippocampus, which acquires or encodes new visuospatial information, is larger than that of a female.\(^16\) In contrast, some studies showed no difference in the reaction time between males and females.\(^17,18\) Another study reported that females tend to choose incorrect responses during the task.\(^19\) Interestingly, another study explained that the visual reaction time does not change with the time of the day.\(^20,21\) Another study reported that the reaction time was not significantly different in the age groups of 15–18 years and 20–30 years.\(^22\) Lalitha et al., reported that females have higher body mass index and longer reaction times than females.\(^23\) These contrasting findings explain that the reaction time among males and females is not well-understood to date. Further, variations are possible due to different factors affecting age, gender, individual intelligence, fatigue, exercise, training, etc.\(^24\) There is a strong need for studies in this area with higher sample size.

### Limitations of the study
The sample size of the study was small; hence, results cannot be generalized.

### CONCLUSION
The current study reveals that there is no significant difference between the auditory and visual reaction time for the right- and left-hand responses. There is a need for more detailed studies to testify to the results.

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### REFERENCES
1. Duke-Elder S. Franciscus cornelis donders. Br J Ophthalmol. 1959;43(2):65-68. https://doi.org/10.1136/bjo.43.2.65
2. Jain A, Bansal R, Kumar A and Singh KD. A comparative study of visual and auditory reaction times based on gender and physical activity levels of medical first-year students. Int J Appl Basic Med Res. 2015;5(2):124-127. https://doi.org/10.4103/2229-516X.157168
3. Welford AT. Choice reaction time: Basic concepts. In: Welford AT, editor. Reaction Times. New York: Academic Press; 1980. p. 73-128.

4. Karia RM, Ghuntla TP, Mehta HB, Gokhale PA and Shah CJ. Effect of gender difference on visual and auditory reaction time: A study on medical students of Bhavnagar region. IOSR J Pharm. 2012;2(3):452-454. https://doi.org/10.9790/0313-0230452454

5. Badwe N, Patil KB, Yelam SB, Vikhe BB and Valve MS. A comparative study of hand reaction time to visual stimuli in students of 1st MBBS of a rural medical college. Pravara Med Rev. 2012;4(1):4-6.

6. Pain MT and Hibbs A. Sprint starts and the minimum auditory reaction time. J Sports Sci. 2007;25(1):79-86. https://doi.org/10.1080/02640410600718004

7. Thompson PD, Colebatch JG, Brown P, Rothwell JC, Day BL, Obeso JA, et al. Voluntary stimulus-sensitive jerks and jumps mimicking myoclonus or pathological startle syndromes. Mov Disord. 1992;7(3):257-262. https://doi.org/10.1002/mds.87000312

8. Shelton J and Kumar GP. Comparison between auditory and visual simple reaction times. Neurosci Med. 2010;1(1):30-32. https://doi.org/10.4236/nm.2010.111004

9. Yagi Y, Coburn KL, Estes KM and Arruda JE. Effects of aerobic exercise and gender on visual and auditory P300, reaction time, and accuracy. Eur J Appl Physiol Occup Physiol. 1999;80(5):402-408. https://doi.org/10.1007/s004210050611

10. Noble C, Baker BL and Jones TA. Age and sex parameters in psychomotor learning. Percept Mot Skills. 1964;19:935-945. https://doi.org/10.2466/pms.1964.19.3.935

11. Adam JJ, Paas FG, Buekers MJ, Wuyts IJ, Spijkers WA and Wallmeyer P. Gender differences in choice reaction time: Evidence for differential strategies. Ergonomics. 1999;42(2):327-335. https://doi.org/10.1080/00140139950000312

12. Der G and Deary IJ. Age and sex differences in reaction time in adulthood: Results from the United Kingdom health and lifestyle survey. Psychol Aging. 2006;21(1):62-73. https://doi.org/10.1037/0882-7974.21.1.62

13. Botwinick J and Thompson LW. Components of reaction time about age and sex. J Genet Psychol. 1966;108(2d Half):175-183. https://doi.org/10.1080/00221235.1966.10532776

14. Silverman IW. Sex differences in simple visual reaction time: A historical meta-analysis. Sex Roles. 2006;54(1):57-69. https://doi.org/10.1007/s11199-006-8869-6

15. Misra N, Mahajan KK and Maini BK. Comparative study of visual and auditory reaction time of females and males. Indian J Physiol Pharmacol. 1985;29(4):213-218.

16. Wei W, Chen C, Dong Q and Zhou X. Sex differences in gray matter volume of the right anterior hippocampus explain sex differences in three-dimensional mental rotation. Front Hum Neurosci. 2016;10:580. https://doi.org/10.3389/fnhum.2016.00580

17. Seurinck R, Vingerhoets G, De Lange FP and Achten E. Does egocentric mental rotation elicit sex differences? Neuroimage. 2004;23(4):1440-1449. https://doi.org/10.1016/j.neuroimage.2004.08.010

18. Teng EL and Lee AL. Right-left discrimination: No sex difference among normals on the hand test and the route test. Percept Mot Skills. 1982;55(1):299-302. https://doi.org/10.2466/pms.1982.55.1.299

19. Karadi K, Szabo I, Szepesi T, Kallai J and Kovacs B. Sex differences on the hand mental rotation task for 9-yr.-old children and young adults. Percept Mot Skills. 1999;89(3 Pt 1):969-972. https://doi.org/10.2466/pms.1999.89.3.969

20. Hanumantha S, Kamath S and Shastry R. Diurnal variation in visual simple reaction time between and within genders in young adults: An exploratory, comparative, pilot study. Sci World J. 2021;2021:6695532. https://doi.org/10.1155/2021/6695532

21. Hodgkins J. Reaction time and speed of movement in males and females of various ages. Res Q Am Assoc Health Phys Educ Recreation. 1963;34(3):335-343. https://doi.org/10.1080/10671188.1963.10613242

22. Bucskó Z and Semela M. Case study: Reaction time of children according to age. Procedia Eng. 2017;187:408-413. https://doi.org/10.1016/j.proeng.2017.04.393

23. Nikam LH and Gadkar JV. Effect of age, gender and body mass index on visual and auditory reaction times in Indian population. Indian J Physiol Pharmacol. 2012;56(1):94-99.

24. Bamne SN, Fadia AD and Jadhav A. Effect of colour and gender on reaction time. Indian J Physiol Pharmacol. 2011;55(4):388-389.

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