National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Effect of posture on reaction time: Impact of gender

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Received: February 07, 2020; **Accepted:** July 13, 2020

ABSTRACT

Background: Reaction time (RT) is a reliable parameter of functional capacity of the central nervous system and a non-invasive method of determining coordination between sensory and motor systems and reflex activity of a person. Some studies show that males have a quick motor activity than females and therefore have a faster RT, while few other studies show variable results. **Aim and Objective:** The aim of the study was to find out the influence of gender on RT in supine, sitting, and standing postures. **Material and Methods:** An observational cross-sectional study was carried out over a period of 2 months (August-September 2018) in Medical College, Mumbai, on 60 subjects (30 males and 30 females). Visual choice RTs and auditory choice RTs of participants were measured in supine, sitting, and standing postures. **Results:** Visual RT (VRT) and auditory RT (ART) were significantly low in supine position as compared to sitting and standing position. Mean VRT and ART were fastest in standing and slowest in supine though without significance. Gender had no effect on postural effects on VRT and ART. Females had significantly higher VRT and ART in all postures as compared with that of males. **Conclusion:** No statistically significant effect of gender was found on both VRT and ART in different postures, though males had faster VRT and ART than females in all postures for all colors and frequencies with few exceptions, where difference was not significant, though mean values for males were always lower than that for females.

KEY WORDS: Visual Choice Reaction Time; Auditory Choice Reaction Time; Posture; Colors; Gender

INTRODUCTION

Reaction time (RT) or response time refers to the amount of time that is required to perceive and respond to a stimulus. It is the ability to detect, process, and respond to an incoming signal. It is a reliable parameter of functional capacity of the central nervous system[1] and a non-invasive way of determining sensorimotor coordination and reflex activity of a person.[2] RT can thus be used as a powerful tool to test the integrity of central nervous system and characteristics of the speed with which it responds to variety of stimuli. Choice RT (CRT) measures psychomotor abilities, processing velocity, alertness, reflex inhibition, and stimulus differentiation.

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2020.10.02039202013072020	

Various bodily states such as consciousness, sleep, and alertness are being controlled by the reticular activating system. In addition to this, such behaviors can also be modified during change in posture of the body, as is evident by the fact that descending reticular formation of brainstem, is the center of posture control of the body.[3]

Some of the studies have shown that a person responds better to stimuli if the posture changes from lying to a sitting to a standing and that these changes can improve reactive performances, indicating that different values of RT can be obtained with change in the posture.[4,5] However, there is not much evidence as to the extent and proportion of such an effect.

Few studies have reiterated that males have a better response time as compared to motor activity of females, thereby having faster RT.[6,7] Some other studies show that females have shorter response time as against males.[8,9] Such varied findings are entitled to be explored further to find out the effect of gender on RT.

Few studies have explored the concept of the effect of gender on cognition as far as changing postures are concerned. Thus, it is imperative to further evaluate the extent of influence of gender on RT and does the same continue with change in postures, needs to be evaluated.

The present study combines the above factors and has explored possible interactions that may occur between the variables. CRT being an important parameter of coordination of sensory and motor systems and central processing of a person and keeping in view the studies having variable results related to changes in cognition in different postures, this study was designed with the objectives to compare the effects of different postures on CRT and to find out the influence of gender on the same.

MATERIAL AND METHODS

Study Design and Study Population

An observational cross-sectional study was carried out over a period of 2 months (August-September 2018) in a Tertiary Care Medical College of Mumbai, on 60 subjects (30 males and 30 females). Ethical clearance was obtained from the Institutional Ethics Committee on April 19, 2018. Apparently, healthy medical students of age between 18 and 24 years were included on volunteer basis. Females in the follicular phase of their menstrual cycle were tested.

Subjects were ruled out for smoking, alcohol, or tobacco addiction, any drug consumption that may affect the nervous system such as opioids, anticonvulsants, barbiturates, and antidepressants or having any physical deformity or inability to stand erect.

Data Collection and Data Analysis

After explaining the procedure of study in detail, a written informed consent was taken from all subjects and their medical examination was done to rule out any underlying clinical conditions.

The tests were carried out in an isolated room in the department of Physiology so as to prevent any kind of disturbance/distraction which can affect cognitive functions. Subjects were asked to refrain from ingesting caffeinated products (i.e. coffee and tea) for at least 3 h, and alcohol for at least 15 h before testing. The study was carried out for all subjects (between 9 am to 10 am) to overcome the effect of diurnal variation and fatigue.

Auditory (Rinne's test and Weber test) and visual screening (Snellen's chart and Jaeger's chart) were carried out to rule out any hearing or visual defects. The basic data of the participants such as age, sex, handedness, and medical history were recorded.

For CRT, the RTM-608 by Bio-Tech, India was used.

Examiner sat on one side to operate the signals and subject sat on the other side. An opaque partition was placed in the slot provided on the unit so as to prevent subject from seeing which switch the examiner was pressing. There was a digital time display on the side of examiner. Below the digital time display, there was a press switch for resetting the machine to zero timing. Power "on" and "off" switch was present at the side of the apparatus. Headphone was provided to the subject for auditory RT.

Subject was allowed to rest for 5 min. Subject was instructed to press the appropriate switch as fast as possible using the index finger of the dominant hand. The CRT was recorded in supine, sitting, and standing postures. For each posture, average of three readings was taken. All the three postures (supine, sitting, and standing) were studied at same time, consecutively.

The RT in supine position was assessed by giving 30 degree reclining position on a head tilt table and placing the RT apparatus on a table of adjustable height across the bed as per the convenience for the subject to operate the apparatus.

For visual CRT, any one of the signal (red, green, or yellow lights) were given randomly. The timer started instantly and the colored bulb glowed on both sides. After seeing the colored light, the correct switch was pressed by the subject as fast as possible. As soon as the switch was pressed, timer stopped instantly and the RT for the subject was displayed. The lowest possible time that could be measured was 0.0001 s. If incorrect switch was pressed, the timer continued to run and stopped after the appropriate switch was pressed.

Auditory CRT was also measured in same way, where the switches for high, medium, and low frequencies were used by the investigator and appropriate sound through headphone was heard.

Before taking readings, several practice sessions were given to each subject. Before giving signal, verbal instruction "Ready" was given. Fixed fore-period of 2 s was used. Fore-period is time interval between the warning signal and the actual presentation of the stimulus. Mean of the three readings was taken.

After data collection, the data was entered in the Microsoft Excel sheet and checked for errors. Data was imported to Statistical Package for the Social Sciences version 25.0

software and analysis were done. Quantitative data were presented with the help of mean and SD.

For the analysis, multivariate analysis of variance was used to compare among visual RT (VRT) and auditory RT (ART) with reference to posture to compare among VRT and ART among males and females with reference to posture.

Two independent sample *t*-test were used to compare each color and frequency of VRT and ART, respectively, in each posture among genders. $P < 0.05$ was considered statistically significant.

RESULTS

CRT was carried out on males (n = 30) and females (n = 30). The VRT and ART were recorded in supine, sitting, and standing postures. For each posture, three readings each of VRT and ART were taken and the mean of the three was considered [Tables 1 and 2].

Tables 3-5 shows comparison of response of males and females to green red and yellow color in different postures, respectively.

Table 1: Comparison between 3 colors of VRT with respect to posture

Colors	*P*					
	Sitting		Standing		Supine	
	Mean	SD	Mean	SD	Mean	SD
Green	0.3495	0.0561	0.3346	0.0587	0.4151	0.0639
Red	0.3094	0.0593	0.3092	0.0656	0.3962	0.0684
Yellow	0.2791	0.0602	0.2771	0.0558	0.3493	0.0785

VRT: Visual reaction time, SD: Standard deviation

Table 2: Comparison between frequencies of ART with respect to posture

Frequency	Posture					
	Sitting		Standing		Supine	
	Mean	SD	Mean	SD	Mean	SD
High	0.4554	0.0921	0.4461	0.0956	0.5225	0.0996
Medium	0.4633	0.0914	0.4664	0.0901	0.5247	0.0900
Low	0.5136	0.0842	0.5044	0.0970	0.5584	0.0875

ART: Auditory reaction time, SD: Standard deviation

Table 3: Comparison of CRT to green color in each posture in males and females

Green	Male (n=30)		Female (n=30)		*P*-value
	Mean	SD	Mean	SD	
Sitting	0.326	0.045	0.375	0.056	0.001*
Supine	0.396	0.060	0.439	0.060	0.007*
Standing	0.310	0.055	0.357	0.053	0.001*

CRT: Choice reaction time, SD: Standard deviation

There is no significant effect of gender on visual RT using green, red, and yellow color in sitting, supine, and standing posture.

Tables 6-8 shows comparison of response of males and females to high, medium, and low frequency of sound in

Table 4: Comparison of CRT to red color in each posture in males and females

Red	Male (n=30)		Female (n=30)		*P*-value
	Mean	SD	Mean	SD	
Sitting	0.286	0.061	0.333	0.048	0.001*
Supine	0.378	0.076	0.416	0.054	0.033*
Standing	0.284	0.058	0.334	0.064	0.002*

CRT: Choice reaction time, SD: Standard deviation

Table 5: Comparison of CRT to yellow color in each posture in males and females

Yellow	Male (n=30)		Female (n=30)		*P*-value
	Mean	SD	Mean	SD	
Sitting	0.268	0.064	0.290	0.055	0.154
Supine	0.341	0.075	0.362	0.081	0.294
Standing	0.265	0.056	0.292	0.052	0.059

CRT: Choice reaction time, SD: Standard deviation

Table 6: Comparison of ART to high frequency in each posture in males and females

High	Male (n=30)		Female (n=30)		*P*-value
	Mean	SD	Mean	SD	
Sitting	0.433	0.103	0.479	0.072	0.049*
Supine	0.515	0.102	0.533	0.097	0.496
Standing	0.424	0.107	0.470	0.079	0.064

ART: Auditory reaction time, SD: Standard deviation

Table 7: Comparison of ART to medium frequency in each posture in males and females

Medium	Male (n=30)		Female (n=30)		*P*-value
	Mean	SD	Mean	SD	
Sitting	0.450	0.104	0.475	0.077	0.298
Supine	0.535	0.103	0.517	0.072	0.443
Standing	0.445	0.111	0.487	0.057	0.072

ART: Auditory reaction time, SD: Standard deviation

Table 8: Comparison of ART to low frequency in each posture in males and females

Low	Male (n=30)		Female (n=30)		*P*-value
	Mean	SD	Mean	SD	
Sitting	0.488	0.079	0.540	0.082	0.016*
Supine	0.537	0.082	0.582	0.088	0.042*
Standing	0.479	0.103	0.532	0.081	0.032*

ART: Auditory reaction time, SD: Standard deviation

different postures, respectively. There is no significant effect of gender on auditory RT using high, medium, and low frequency sound in sitting, supine, and standing posture.

There was no statistically significant effect of gender on postural variations of both VRT and ART though males had significantly faster VRT and ART than females in all postures for all colors and frequencies with few exceptions where difference was not significant though mean values for males were always lower than that for females.

DISCUSSION

The mean VRT was found to be highest in supine and lowest in standing posture though there was no statistical significance between standing and sitting posture but supine posture had significantly high RT as compared to both sitting and standing posture ($P < 0.05$). Exactly same pattern was found for ART.

Few studies show that, for every age group, males have faster RTs.[10-13] Study done by Mishra *et al.* showed similar results, that males were quick to respond.[8] These findings were supported by the study done by Shelton and Kumar.[14] In a study by Nikam and Gadkari, it was concluded that the muscle contraction time is the same for both genders.[15] However, Silverman in his study, stated that females have slower motor responses. This could be the reason that males have quicker ART and VRT. Additionally, because of increasing female participation in fast action sports and driving, male advantage may be reducing.[16] Study by Bruce and Russel has shown that sodium and water retaining effect associated with weight gain in females in menstrual cycle is due to difference in sex steroid levels.[17] This could change the axonal conduction leading to altered velocity of impulse transmission. This also can alter the availability of the neurotransmitter at the synapse. Thus, the sensorimotor coordination and the processing speed of the central nervous system may be affected by the increased synaptic delay and reduced speed of nerve impulse due to the effect of female sex hormones. The question that which gender is faster on tests of reactive performance has been a hotly debated topic for many years. Additionally, there is limited data available that depicts gender influence on RT in different positions. This study sought to reveal any gender differences in a young subject group performing a relatively easy RT task in different postures. Previous research shows that gender differences only occur in young subjects on tasks that load the early encoding stage of information processing such as a degraded stimulus task. The same study showed that females were quicker for tasks which are based on early stages of processing. The present study tried to investigate that does the same effect persists in supine, sitting, and standing. There was no effect of gender on postural effects on visual and auditory CRT ($P = 0.533$ and 0.336, respectively). Our study found result similar to these studies and we found that male subjects have quick RTs when compared to female subjects for both ART and VRT. It was observed that for each posture males had significantly faster RT to green color than females. This pattern was seen for all colors and sounds with significance except in yellow color and medium frequency for all positions and in high frequency for supine position where though there was same pattern but not statistically significant.

One limitation of the study is that bigger sample size was required to shed more light on the relationship between RT, posture, and gender. This does create the possibility of introducing a confounding factor of gender if males and females inherently learn differently. It is possible that this could affect the validity of the results of the study. Previous studies show that reflection may be an important part of learned material becoming applied skills. However, due to time constraints, it was not possible to give more practice sessions in the study.

CONCLUSION

There was no statistically significant effect of gender on postural variations of both VRT and ART though males had significantly faster VRT and ART than females in all postures for all colors and frequencies with few exceptions where difference was not significant though mean values for males were always lower than that for females.

Different postures with ranges of inclination will have to be studied to establish the association with RT in different postures and subsequent effect of gender on the same. Studies can be planned for comparing RTs in sitting without support and sitting with support. Future studies can also use a tilt table to compare RTs in postures other than supine, sitting, and standing.

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How to cite this article: Gaule A, Bhattad G, Pazare P. Effect of posture on reaction time: Impact of gender. Natl J Physiol Pharm Pharmacol 2020;10(09):777-781.

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