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# Effect of Gender and Physical activity on Visual and Auditory reaction time in young Adults

**Ovais Karnain Wadoo*[1], Sheikh Imran Sayeed[2], Mariya Rouf[3]**
[1]Senior Resident, Department of Physiology, GMC Srinagar
[2]Associate Professor and HOD, Department of Physiology, GMC Srinagar
3 Resident, Department of Microbiology, GMC Srinagar

***Corresponding Author:**

**Dr Ovais Karnain Wadoo**
Department of physiology, GMC Srinagar

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**ABSTRACT**

**Background**: Reaction time is defined as the interval of time between the presentation of the stimulus and appearance of appropriate voluntary response in the subject. It indicates time taken by an individual to react to external stimulus. Various factors influencing human reaction time are age, sex, left or right hand, central versus peripheral vision, practice, fatigue, fasting, breathing cycle, personality types, exercise, and intelligence of the subject.

Aim: This study seeks to determine (i) whether RT varies with the receptor system involved, (ii) the difference if any to RTs between the two sexes (iii) difference in RT in young adults with sedentary lifestyle and regularly exercising.

**Materials and Methods**: The present study was conducted on 100 healthy medical students in age group of 18–22 years. RT for target stimulus that is, for the beep tone for measuring ART, and red circle for measuring VRT was determined using Reaction time v4.03 computer software released by Delphi Software. The task was to press the spacebar as soon as the stimulus is presented. Five readings of each stimulus were taken, and their respective fastest RT's for each stimuli were recorded. Statistical analysis was done.

Results: In both the sexes' RT to the auditory stimulus was significantly less ($P < 0.0001$) as compared to the visual stimulus. Significant difference was found between RT of males and females ($P < 0.0001$) as well as between sedentary and regularly exercising healthy young adults.

**Conclusion**: The ART is faster than the VRT in young adults. Furthermore, males have faster RTs as compared to females for both auditory as well as visual stimuli. Regularly exercising young adults have faster RTs when compared with young adults with sedentary lifestyles.

**Keywords:** Auditory reaction time, physical exercise, visual reaction time.

## INTRODUCTION

Reaction time (RT) is a measure of the quickness with which an organism responds to some sort of stimulus. RT is defined as the interval of time between the presentation of the stimulus and appearance of appropriate voluntary response in the subject (1). It indicates time taken by an individual to react to external stimulus. It involves reception of the stimulus by the sense organ, conduction of the information through the nerve to the brain and from brain to muscle contraction and movement of muscle (2). Luce (3) and Welford (4) described three types of RT. (i) Simple RT: Here there is one stimulus and one response. (ii) Recognition RT: Here there is some stimulus that should be responded to and other that should not get a response. (iii) Choice RT: Here there are multiple stimulus and multiple responses. It provides an indirect index of the integrity and processing ability of the central nervous system and a simple, non-invasive means of determining sensory motor coordination and performance of an individual. Visual RT is time taken by an individual to react to a visual stimulus while as Auditory RT is time taken by an individual to react to a auditory stimulus. RT determines the alertness of a person because how

quickly a person responds to a stimulus depends on his reaction time.

Various factors influencing human reaction time are age, sex, left or right hand, central versus peripheral vision, practice, fatigue, fasting, breathing cycle, personality types, exercise, and intelligence of the subject (5).

In the literature very few studies (6,7) can be found determining RTs in medical students. Considering reaction time as a good indicator of sensorimotor co-ordination and performance of an individual and keeping in view the lacunae present in literature in respect of determination of reaction time in medical students, present study is undertaken. This study seeks to determine (i) whether RT varies with the receptor system involved, (ii) the difference if any to RTs between the two sexes (iii) difference in RT in young adults with sedentary lifestyle and regularly exercising.

## MATERIAL AND METHOD:

The study was conducted in the Department of Physiology, Government Medical College, Srinagar. 100 first year medical students consisting of equal number of males and females formed the subjects of the study. Participation in the test was voluntary and informed written consent was taken from every participant. Detailed history and physical examination of each subject was done and those with any history of hearing or visual disorder, smoking, alcoholism, cardiovascular and respiratory disease, on any medication affecting cognitive performance were excluded.

The tests were done using Reaction time v4.03 computer software released Delphi Software. During the visual RT (VRT) task, in the centre of the white screen background, the participants got presented after a variable time interval by a target stimulus that is, red circle. The participants were asked to concentrate on the screen and press the trigger (left mouse button) as soon as possible once the red circle (target stimulus) appears on the screen. In a simple auditory RT (ART) task after variable time intervals, a click sound was played to the participant through the headphone. The task was to press the trigger (left mouse button) as soon as the sound is presented. All the subjects were thoroughly acquainted with the procedure and practice trial was given to every student before taking the test.

By default, the time intervals were randomly chosen from1000 ms, 2000 ms, 3000 ms, 4000 ms, 5000 ms, 6000 ms. Five readings of each stimulus was taken, and their respective fastest RT's for each stimulus was recorded (8).

A comparison was made between a. VRT and ART; b. VRT and ART between males and females; and c. VRT and ART between sedentary and regularly exercising healthy students.

Both male and female medical students who participated in at least 30 min of moderate physical activity which made them sweat or breathe hard, such as fast walking, slow bicycling, skating, pushing a lawn mower, etc., on 5 or more days/week or in at least 20 min of vigorous physical activity that made them sweat or breathe hard, such as basketball, soccer, running, swimming, fast bicycling, fast dancing etc., on 3 days or more/week for a minimum duration of 6 weeks were considered to be regularly exercising healthy adult students, whereas those students who did not participate in these activities were considered to have a sedentary lifestyle (9).

The statistical analysis was carried out with Statistical Package for Social Sciences version 24.0 manufactured by SPSS Inc. (Chicago). $P < 0.05$ was considered to be statistically significant.

## RESULTS:

The present study was undertaken on 100 students. Table 1 shows comparison between VRT and ART of all 100 subjects.

Paired T-test was done to know the significance. The statistical analysis of the results show that there is highly significant difference between the two and the ART is faster than the VRT.

Table 2 show comparison of ART and VRT between male (n = 50) and female (n = 50) subjects.

Unpaired t-test was used to know the significance. P value of <0.0001 was obtained, which is highly significant indicating that males have faster RTs when compared to females for both auditory, as well as visual stimuli.

In our study 35 subject where found to be physical active. For comparison of ART and VRT between



Volume 2, Issue 2; March-April 2019; Page No. 462-467

sedentary and regularly exercising subjects 35 sedentary subjects were chosen which closely matched physically active subjects in anthropometric data. Table 3 show comparison of anthropometric data between sedentary (n = 35) and regularly exercising (n = 35) subjects.

Table 4 show comparison of ART and VRT between sedentary (n = 35) and regularly exercising (n = 35) subjects.

Unpaired t-test was used to know the significance. P value of 0.0495 was obtained for VRT which is significant. For ART P value of 0.1759 was obtained which is not significant.

## DISCUSSION:

The study was conducted on 100 healthy medical students to study whether RT varies with the receptor system involved; the difference if any to RTs between the two sexes and difference in RT in medical students with sedentary lifestyle in comparison to regularly exercising.

### Comparison between auditory reaction time and visual reaction time

On comparing auditory reaction time and visual reaction time in all subjects (n = 100) our study shows that the ART is faster than the VRT. The results obtained are in agreement with the studies existing in the literature. Pain and Hibbs (10) in their study have shown that simple ART has the fastest RT for any given stimulus. Jain et al (11) in their study have also demonstrated that ART is faster than VRT which is in agreement with our study. Research done by Kemp (12) shows that an auditory stimulus takes only 8–10 ms to reach the brain while as, a visual stimulus takes 20–40 ms. Therefore, since the auditory stimulus reaches the cortex faster than the visual stimulus, the ART is faster than the VRT. Shelton and Kumar (13) in their study have shown 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. Studies done by Shelton et al (14) and Ghuntal et al (15) are also in agreement with our study. Thus, our study further supports the evidence that ART is faster than the VRT.

### Effect of gender on reaction time

In our study we found that males have faster ART and VRT in comparison to females and is highly significant. Researches done by Misra et al. (16) also showed that males responded faster than females. Study done by Shelton and Kumar (14), Nikam and Gadkari[17] also reported similar findings to support females have longer RTs than males. Study done by Devi and Mudhuri (18) is also in agreement with our study.

The male-female difference can be explained due to the lag between the presentation of the stimulus and the beginning of muscle contraction. It is documented in the literature that the muscle contraction time is the same for males and females (19) and motor responses in males are comparatively stronger than females (20) this explains why males have faster simple RTs for both auditory as well as visual stimuli.

Structural changes (such as myelination, synaptogenesis, or synaptic pruning) occur in the brain through adolescence and even into adulthood (21). Differential effects of sex hormones on these processes could lead to RT differences between the sexes. There is evidence of sex differences in developmental cerebral white and grey matter volume changes through adolescence (22,23) and these are thought to reflect myelination and changes in synaptic density. Therefore, brain dimorphism is another mechanism that may underlie sex differences in RT variability.

### Effect of Physical activity on reaction time

In our study we found that regularly exercising healthy medical students have faster RT than medical students with sedentary lifestyles. These findings confirm that physical activity and doing sports improve RT which is supported by various studies. Nougier et al. (24) suggest that athletes have better RT as compared to control subjects. Nakamoto and Mori (25) found that college students who played basketball and baseball had faster RTs than sedentary students. Kaur et al. (26) found that athletes performed better than controls for auditory as well as VRT tasks. Spirduso (27) in his study proposed that less RT of athletes as compared to non-athletes was attributed to faster central nervous system processing times producing faster muscular movements in athletes. Gavkare et al. (28) in their study proposed that shorter RT in athletes could be due to improved concentration and alertness, better muscular



Volume 2, Issue 2; March-April 2019; Page No. 462-467

coordination, improved performance in the speed and accuracy task. Also, motor response execution is a physical task and people trained in physically reactive sports may have superior motor response ability. (29)

It is also thought that individuals who exercise at moderate to intense levels have higher rates of cerebral blood flow. This increased amount of blood flow in the brain results in improvements in cognitive functioning due to increased supply of necessary nutrients, such as oxygen and glucose. (30,31)

**CONCLUSION:**

From our study we concluded that the ART is faster than the VRT. Males have faster RTs as compared to female for both auditory, as well as visual stimuli. Regularly exercising young adults have faster RTs as compared to young adults with sedentary life styles. Thus, it is strongly recommended that regular exercising must be encouraged in both males and females to improve their efficiency levels.

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Volume 2, Issue 2; March-April 2019; Page No. 462-467

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## TABLES

**Table 1: Comparison between VRT and ART**

| Reaction time | n | Mean±SD | P |
|---|---|---|---|
| **VRT** | 100 | 252.99±17.53 | <0.0001 |
| **ART** | 100 | 230.03±15.32 | |

**Table 2: comparison between male and female**

| Reaction time | Males (n=50) mean±SD | Females (n=50) mean±SD | P |
|---|---|---|---|
| **VRT** | 242.86±12.71 | 260.28 ±17.21 | <0.0001 |
| **ART** | 221.08 ±10.26 | 234.98 ±16.89 | |



Volume 2, Issue 2; March-April 2019; Page No. 462-467

**Table 3: comparison of anthropometric data between sedentary and physically active**

| | N | AGE (Mean±SD) (Years) | WEIGHT(Mean±SD) (KG) | HEIGHT(Mean±SD) (M) | BMI(Mean±SD) |
|---|---|---|---|---|---|
| **SEDENTARY** | 35 | 19.3±0.8 | 59.3±9.8 | 1.6±0.1 | 21.2±4.6 |
| **PHYSICALLY ACTIVE** | 35 | 19.6±0.6 | 61.1±9.8 | 1.6±0.1 | 22.2±2.9 |
| **P** | | 0.0804 | 0.4449 | 1.0000 | 0.2805 |

**Table 4: Comparison between sedentary and regularly exercising**

| Reaction time | Sedentary (n=35) mean±SD | Regularly exercising (n=35) mean±SD | P |
|---|---|---|---|
| **VRT** | 258.51 ±18.19 | 250.17 ±16.67 | 0.0495 |
| **ART** | 231.46 ±15.40 | 226.80 ±12.98 | 0.1759 |



Volume 2, Issue 2; March-April 2019; Page No. 462-467