

Research Article

Comparison of brake reaction time in younger and older drivers

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ABSTRACT

Background: Reaction time (RT) is the time taken for an individual to respond to a stimulus. Brake reaction time is the time taken for the driver to visualize an object and to press the brake pedal. BRT should be assessed in drivers for analysing their speed of mental processing and physical response. Objective of the study is to assess the BRT in male drivers and compare BRT between younger and older drivers.

Methods: Male drivers between age groups of 18-65 years were included. Study is conducted in a stationary car. An in-house built; vehicle braking reaction timer is fixed to the electric circuit of the braking system in the car. The device is connected with laptop. The subject is instructed to press the brake pedal when the light changed.

Results: The correlation between BRT and age was found to be negative in less than 55 years age group, the R value is found to be -0.094. Above the age group of 55 years there was a positive correlation, the R value was found to be +0.458.

Conclusions: The decrease in BRT in <55 years age group could be due to the experience/training, which has increased the driving skills and speed of processing.

Keywords: Brake reaction time, Older drivers, Younger drivers, Reaction timer, Stationery car

INTRODUCTION

Reaction time (RT) is the time taken for a person to respond to an event/stimulus. It gives an idea about how quickly a person reacts to a change in the environment and measures the time taken for mental operations (requiring cognitive process), following presentation of a stimulus and the motor response. The measure of RT is very important for certain tasks which require rapid responses to stimuli as in driving a car. Slower braking reaction while driving a car can result in dangerous consequences. Therefore brake reaction time (BRT) in drivers should be assessed to check their ability of mental processing and motor performance.¹

BRT is the amount of time taken from the point of visualization of an object on the road and the application

of brake.² It includes various components like, visual perception time, mental processing time, movement of leg on the brake pedal & the device response time.³

BRT is affected by many factors like age, gender, fatigue, sleep deprivation, muscular diseases, neurological disabilities, distractions, alcohol etc.,¹ along with, environmental conditions and the properties of the distracting objects like its size, color etc.

In view of increase in the aging population throughout the world, the number of older persons driving the automobile has increased enormously. Aging has its own toll over the human body resulting in physical disabilities and slowing down of mental processing. Driving being a multitasking event requires the ability to identify advancing vehicles, obeying traffic signals, controlling

vehicle speed and reacting to sudden distractions on road.⁴ Therefore driving relies on higher functions of brain like working memory, selective attention etc. But as age declines these abilities are decreased.⁵

Therefore, research involving age-related changes affecting driving performance is important, to find out, the role of age as a risk factor. BRT is used to measure the mental attention and the driving performance in the drivers.

No such study has been conducted among the Indian drivers. So this study has been undertaken to assess the Brake reaction time (BRT) of male drivers and to compare it among drivers of different age groups and to assess the effect of aging on BRT.

METHODS

This study was conducted in & around the Veerapandi village in Salem district, Tamilnadu. 120 Male subjects were selected between the age groups of 18-65 years. All the subjects were ensured to have a driving license. Subjects with illnesses likely to disable them from driving like muscular disorders or neurological illnesses were excluded from the study. Subjects with visual impairment were also excluded.

About instrument

The entire study was conducted in a stationary car. An in-house built, vehicle braking timer is fixed to the electric circuit of the braking system in the car. This device is wirelessly connected to the reaction time software installed in the laptop computer.

Methodology

The driver is seated in the driver’s seat of the car with his right leg on the accelerator pedal. Laptop is placed in front of the driver (Figure 1). The software displays a change in the color of spot light from red to green on activation by the examiner. The subject is instructed to move his foot from the accelerator pedal and to press the brake pedal each time the stoplight changed from red to green. The test allowed for five RT trials to be taken consecutively over the course of approximately one minute with random rest intervals as determined by the test. The test then automatically calculates mean RT in seconds. These recordings were preceded by two to five practice sequences for the subject to get familiar with the test.

The software recorded the time at which the participant releases the accelerator pedal and when the brake pedal began to be depressed fully for each of the sequences. The times were relative to the traffic light changing from red to green.

RESULTS

The analysis was done with Excel 7.0 software. Pearson correlation was used to analyze the data and the R value was derived.

Table 1 shows correlation between BRT and age, it was found to be negative in less than 55 years age group, the R value is -0.094. This shows that as age advances in the 18 to 55 years group, the BRT reduces. Above the age group of 55 years there is a positive correlation between the BRT and age, the R value was found to be +0.458.

Table 1: Mean and standard deviation of age and brake reaction time.

	Mean BRT	S deviation	R value
Age <55	0.5282	±0.1196	-0.094
Age >55	0.7306	±0.1036	+0.458



Figure 1: Vehicle with brake reaction timer.

DISCUSSION

The findings of this study points out to the increase in BRT in the older age group of drivers. The BRT was definitely prolonged when compared between the <55 years age group and >55 age groups of drivers. But in the 18-55 age group the BRT decreased as age advanced. This could be attributed to the effect of experience gained by driving over the years. In the older drivers, of >55 years of age, there was a definite increase in BRT with increasing age and points to the increased risk of unsafe driving associated with aging.

Studies have been conducted on older drivers, affected by skeletal diseases like osteoarthritis,³ post-surgery conditions like after total knee replacement⁶ and hip replacement,⁷ Neurological diseases affecting cognition as in Parkinson's diseases⁸ and it has been identified that drivers with above complications, driving ability is highly compromised. The effects of physiological ageing on driving abilities has to be analyzed. Components of the cognitive and physical factors affecting driving has to be identified and has to be taken into consideration while permitting the older drivers to drive.

A recent report identified 5 main deficiencies in older drivers. These include, sensory (visual), perceptual, physical, cognitive and general deficiencies in knowledge of driving.⁹

Lei Zhang et al have analyzed the BRT among older drivers, where they have assessed the components of BRT, the Initial reaction time (IRT), the time taken for the perception of stimulus and the Physical reaction time (PRT), the brake movement time. They have identified a positive correlation between IRT & PRT. IRT predicts cognitive processes and PRT relates to motor activities.¹⁰

Warszawsky et al have also identified that with advancing age the BRT has increased and the initial component of BRT, the Perception time, time taken to visualize the stimulus and to move the leg from accelerator to the brake pedal, was increased with age and the brake movement time, time taken to fully press on the brake pedal, was not affected.¹¹

Jeffrey et al have assessed the neuropsychological predictors of driving errors in older drivers and have pointed that there was a strong association of worse driving to visuospatial and visuo-motor disabilities rather than memory defects. Especially the decline in accuracy and speed of visuo-motor processing leads to unsafe driving.¹²

David et al have identified that older adults have well preserved driving skills than the younger drivers.¹³ There are evidences to show that age related attention deficits and task switching can be improved by practice, experience or training. Though there is a general view of age affecting cognition there can be inter-individual variability. Some older people >70 – 80 years of age have well preserved cognitive functions, even better than younger individuals. But most of them show a decline in cognition by age of 60 years.¹⁴ So this may be the reason that in our study that in the <55 years group there was a negative correlation between BRT and age.

Steven et al have used a battery of tests to assess the various cognitive functions relating to safe driving in older drivers. Along with the visual screening tests it was identified that the tests analyzing the speed of processing, visuospatial processing and memory were good

predictors of safe driving. Such tests can be employed along with the other tests to give driving fitness.¹⁵

As age advances, various physical disabilities like Osteoarthritis, muscular and joint pains affect the Physical component of BRT.¹⁰ Visual defects like loss of visual acuity, visual field defects etc. and the defects in cognitive parameters like Visuospatial & Visuomotor analysis, Speed of processing affect the the initial reaction time or the Perception reaction time.¹⁵ Since aging by itself has a direct effect on Perception reaction time, tests used to assess this component of BRT have to be employed for giving the driving fitness.

Limitations of the study

We have analyzed BRT as a single component rather than identifying the Perception and motor components individually. Also the health aspects of the subjects were not taken into account and they were not correlated with BRT in older drivers. More number of subjects could have been included in the study for better results.

This study could be extended to include distractions for the drivers like usage of cell phones, listening to music etc. while driving and to compare the BRTs for the distractions. Also BRT can be assessed for various types of physical illnesses and to predict who can and who cannot drive.

CONCLUSION

Our study is a first of its kind to be conducted in India. It compares the BRT among various age groups to assess the effect of aging on the BRT. It has been proved that as age advances the BRT increases and that older drivers (>55 years) are at higher risks for unexpected situations on the road. This test can be employed to assess the Physical & cognitive fitness of the drivers along with other fitness tests before issuing of a driving license/renewal of license.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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