BRAKE REACTION TIME IN SOUTH INDIAN DRIVERS

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ABSTRACT

Background: Driving is a skill involving multitasking by the brain. The drivers are issued license for driving following the assessment of their motor skills and knowledge about road instructions. Since driving involves multitasking and it is a cognitive function therefore it has to be assessed prior to issuing the license. Reaction time is a good test to assess cognitive functions and therefore brake reaction time (BRT) is assessed in drivers of different age groups and gender to standardize the BRT.

Materials and Methods: 130 subjects from Veerapandi village in Salem district, Tamilnadu were included in the study. They were divided into different age groups of both genders and their BRT was assessed. The study was conducted in a stationary car. An in house built vehicle braking timer is fixed to the electric circuit of the braking system of the car and is wirelessly connected to the reaction time software in the laptop. Whenever the stimulus is given the driver presses on the brake pedal and the time taken to react is recorded by software.

Statistical analysis and Result: Postmenopausal women had a lower VO₂max than premenopausal women, which may be associated with a higher total and visceral fat mass in postmenopausal women.

Conclusion: The BRT assessed using a stationary vehicle with single stimulus gives an approximate value of < 1 second in the different age groups of both the genders. But the values vary with different methods and real life situations. This could be taken as an approximate value for this group of drivers.

Keywords: Brake reaction time, Stationary vehicle, Cognitive function, Drivers.

INTRODUCTION:

Driving is a skill involving multitasking by the brain. It includes physical skills, mental processing and motor actions. Drivers are evaluated for eligibility for driving before issuing of driving license. The evaluation is usually done for motor skills and knowledge about road instructions. Driving is a safety-critical-real world multitasking action which involves cognitive functioning of the brain. Therefore cognitive function of the drivers should also be tested before issuing the driving license.¹ ²

Reaction time is a simple test for cognitive function and is a sensitive test for sustained attention which is very essential for safe driving. ³ ⁴ Brake reaction time (BRT) of drivers can be estimated in various age groups and genders and can be used to compare it with the drivers while issuing the driving license.

Brake reaction time is the time taken from the time of recognition of an object or hazard in the road and the application of brakes. It varies among drivers and it depends on various factors like, driver

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characteristics, properties of the object and environmental conditions. Studies have shown that BRT also varies with the different methods of study done to assess BRT.

The BRTs for younger and older drivers in both genders for the western population is given as 0.70 – 0.75 seconds for drivers when they are fully aware of the situation and 1.2 to 1.5 seconds was the BRT in surprise conditions. There are no such values identified for the Indian population. This study has been undertaken to find out the BRT in drivers of less than 45 years' age group and above 45 years age in both the genders.

MATERIALS & METHODS:
The study was conducted in the Veerapandi village in Salem district, Tamilnadu. 130 Male & female subjects were selected from 18 years of age onwards. Subjects were divided into 4 groups – Group 1 – 18 to 35 years of age, Group 2 – 36 to 55 years of age, Group 3 – 56 -65 years of age and Group 4 - >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.

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. 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 when the stoplight changed from red to green. Five trials were given consecutively over approximately one minute with random rest intervals. The test then automatically calculates mean RT in second (s), which constituted each subject's BRT. Two to five practice sequences were given before the actual test, 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 is being depressed fully for each of the sequences.

RESULTS:
The statistical analysis of the data for BRT of drivers of the different age groups in male and female was done using the excel 7.0 and the mean values for each age group have been taken.

Table 1 shows that the BRT increased with the age and it was longer for females than males in all the age group. We were not able to identify female drivers in >55 years age group and therefore the comparison of BRT in male and female drivers are done only for groups 1 & 2.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean BRT (in seconds)</th>
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<tbody>
<tr>
<td></td>
<td>Males</td>
</tr>
<tr>
<td>Group 1 (18 – 35 years)</td>
<td>0.5007</td>
</tr>
<tr>
<td>Group 2 (36 – 55 years)</td>
<td>0.5340</td>
</tr>
<tr>
<td>Group 3 (56 – 65 years)</td>
<td>0.6704</td>
</tr>
<tr>
<td>Group 4 (&gt;65 years)</td>
<td>0.7990</td>
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DISCUSSION:
The BRT of younger drivers are found to be shorter than the older subjects. At all age groups the BRT in females were longer than that of the males.
BRT includes the following components - Mental processing time - the time taken from the time of appearance of the object on the road and its perception & decision making, the mental processing time, Movement time - time taken for the muscles to perform the action, like movement of foot from accelerator to brake pedal and fully depressing it and the Device response time - time taken for the device to respond and to stop the vehicle. Many studies were able differentiate the various components of BRT and specifically identify which time was altered with the different variables affecting BRT. But in our study we have measured BRT as a whole, from the time of appearance of change in colour of light to the application of brake.

The BRT in most of the drivers of younger age group was shorter than the drivers of older age group. As age advances many physiological changes affecting the body like the, joint problems, muscle pain etc which could be responsible for prolongation of movement time and therefore increase in BRT. Other problems like the visual defects and defects in neural processing & cognitive abilities can prolong the mental processing time. But some older drivers could have shorter BRTs inspite of age related changes and this has been attributed by the repeated training and experience in driving. The disabilities and prolongation of RT varies between individuals and therefore some older drivers have shorter BRT.

BRT was found to be longer in females than the males in both the age groups. In the studies where they were able to differentiate the actual components of BRT, it was identified that in females there was increase in the movement time which was attributed to lesser muscle mass which could have caused the delay in fully pressing on the brake pedal and therefore the longer BRT.

Also some studies mention that female sex hormones retain salt & water which increases the time for impulse transmission and therefore a delay in sensorimotor co-ordination which prolongs their reaction times.

Greene has proposed that not only the characteristics of the driver, the hazard on road, & environmental conditions but also BRT varied with the different methodologies used for its evaluation. Simulation studies done in the lab or in stationary vehicles gave a shorter BRT in comparison to on road studies/Naturalistic driving studies. The awareness of the driver about the appearance of stimulus also gave a shorter BRT.

Our study was conducted in a stationary vehicle with a test for a simple reaction of the driver to the change in light presented on the laptop. Also the driver was aware that there will be a stimulus and reaction times following expectations were shorter in other studies. Therefore this may be a very simple test which could not be compared to real road situations and the BRT could be a lower estimate than the original BRT of the drivers as when they are exposed to real road conditions.

So taking into consideration of all the above situations/variables which affect the BRT of the drivers, it is better to identify the original BRT of drivers of different age groups of both the genders by using naturalistic driving studies and to use it as a standard to compare it with that of the drivers before issuing/renewal of the driving license.

CONCLUSION:
The study was conducted on the drivers to assess the BRT of drivers of both genders and to create a standard BRT for different age groups. We were able to give an approximate BRT for younger and older drivers of both genders. But we know that it cannot be generalised for all situations and all individuals. We should consider that the BRT differs with different methodologies. So in our method which is an estimate of simple brake reaction time test for a single stimulus with expectancy the BRT was less than 1 second.
LIMITATIONS OF THE STUDY:
We had used a stationary vehicle with a simple stimulus of change in light colour for which the driver had to respond. The time recorded was an overall timing from the appearance of change in colour of light to application of brake. We were not able isolate the different components of BRT and to identify the individual time durations. It would have been better if we could have been able to find the individual timings so that we could have known which component was affected in different conditions. Also the sample size was very less, studies done previously have employed 500 – 700 samples to estimate the BRT.

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