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A Comparative Study of Mean Auditory Reaction Time for Low Pitch and High Pitch in School Bus Drivers with Normal Population (Controls)

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Abstract

The present study was carried out in the Department of Physiology, Mahatma Gandhi Memorial Medical College, Indore (M.P.). It is a type of cross-sectional study. Study was performed after taking permission from the Ethics and Scientific Review Committee M.G.M. Medical College M.Y. Hospital, Indore and permission letter from the Head of Department of Physiology MGM Medical College, Indore and from respective school authorities. The period of study was from March 2015 to February 2016. We had selected 100 school bus drivers of age group 20-50 years.

Study Design: Cross-sectional Study.

Keywords: Auditory Reaction Time; High & Low Pitch; BMI & Normal Population.

Introduction

Reaction time (RT) is defined as elapsed time between the presentation of a sensory stimulus and its behavioral response. Simple reaction time is usually defined as the time required for an observer to detect the presence of a stimulus. Reaction time is the time interval between the application of a stimulus and the appearance of appropriate voluntary response by a subject. It involves stimulus processing, decision making, and response programming. Reaction time has been widely studied as its practical implications may be of great consequence e.g., a slower than normal reaction time while driving can have grave results [1]. It is a measure of function of sensory-motor association[2] and performance of an individual [3]. It involves stimulus processing, decision making, and response programming. Reaction time studies have been documented in both sexes for visual and auditory stimuli. It has physiological significance and is a simple and non-invasive test for peripheral as well as central neural structures [4]. Reaction time provides an indirect index of the processing capability of CNS and it is a simple means to determine sensory motor performance, therefore, it represents the level of neuromuscular coordination via different physical, chemical, and mechanical processes decodes visual or auditory stimuli which travel via afferent pathways and reach the brain as sensory stimuli [5,6]. There are various factors that affect the reaction time to a stimulus. Factors like intensity and duration of the stimulus, age and gender of the participant, effect of practice can affect the reaction time of an individual to a particular stimulus. For example, there are relative differences between the reaction time to visual and auditory stimuli between genders.

Material & Method

The present study was carried out in the Department of Physiology, Mahatma Gandhi Memorial Medical College, Indore (M.P.). It is a type of cross-sectional study. The study was performed after taking permission from the Ethics and Scientific Review Committee M.G.M. Medical College M.Y. Hospital, Indore and permission letter from the Head of Department of Physiology MGM

Medical College, Indore and from respective school authorities. The period of study was from March 2015 to February 2016. We had selected 100 school bus drivers of age group 20-50 years and 100 controls (non-bus drivers) from normal population of same age group.

An informed written consent had been taken from these subjects after explaining the study procedure and a self-made questionnaire had been administered to every participant regarding their personal, present, past, family, socioeconomic and medical history in detail. Special information about the duration of bus driving, shift, duty hours, history of any addiction and history of any medicine which can affect central nervous regulation was obtained. Then after the assessment of related hearing tests we had done auditory reaction time test by audio-visual analyzer. Only those participants were taken into the study that fulfilled our inclusion criteria.

Inclusion and Exclusion Criteria

Inclusion

1. School bus drivers of age group 20-50 years (cases) and non-bus drivers (controls) of same age group.
2. School bus drivers driving the vehicle for more than one year.
3. All subjects included were healthy males.
4. All subjects with no auditory or visual disturbances.
5. Individuals giving consent for test participation in the study.
6. Those who are not taking any sedative or hypnotic or anti-allergic medicine.
7. Individuals with history of addiction (only smoking or tobacco chewing).

Exclusion

1. Individuals of age group <20 and >50 years.
2. School bus drivers driving the vehicle for less than one year.
3. Individuals with auditory or visual disturbances.
4. Individuals taking any sedative or hypnotic or anti-allergic medicine.
5. Individuals not giving consent for test participation in the study. These subjects were assessed for various physiological parameters mentioned below and a standardized protocol was followed while taking the measurements: height, weight, pulse, blood pressure, clinical examination (general & systemic), hearing tests (Rinnie's test, and weber's test) followed by auditory reaction time for high and low pitch [6].

Procedure

Before doing the reaction time test, subjects were assessed for various physiological parameters as mentioned above.

1. Hearing Tests

For the assessment of related auditory function we have used Rinnie's and Weber's test. Before testing for auditory reaction time we must be assured that all the subjects should have normal hearing capacity. For this Rinnie's and Weber's test were done. Rinnie's test: This test compares the ability of hearing through the medium of bone and that of air; that means there is comparison of bone conduction with air conduction of the same ear.

Procedure

1. After giving proper instructions to the subject we have asked them to raise the finger when they stop hearing the sound of the vibrating tuning fork (of 512 hz frequency).
2. The stem of the tuning fork was hold between the thumb and the index finger in such a way that the fingers do not touch the blades of the tuning fork.
3. For Rinnie's test - the tuning fork was made to vibrate by suddenly stroking the blades of the fork against the hypothenar eminence or the thigh. Immediately the base of the vibrating tuning fork was placed on the mastoid process of one side and the subject was asked to raise the his finger when he ceases to hear the sounds.
4. Once he stopped hearing, we have hold the tuning fork very close to his ear and asked him whether he hears the sound or not. If the hearing is normal, the subject will hear the vibrating fork by air conduction even after he ceased hearing by bone conduction i. e. in healthy subject's air conduction is better than bone conduction.
5. Weber's test- Weber's test compares bone conduction of both the ears. Base of the vibrating tuning fork is placed on the forehead and the

subject was asked to indicate whether the sound is heard equally in both the ears or is better heard in one of the ears. In healthy subjects, both the ears hear the sound equally. But in abnormal conduction sound is lateralized to the affected ear.

2. Reaction Time Test

Each subject was made familiar with the apparatus and procedure is explained before doing the test. In our study we had used choice reaction time test.

Apparatus

The "608 Audiovisual reaction timer" was used in this study. Display has 3 different types of light and sound on either side. Three visual stimuli red, green and yellow color light and three auditory stimuli low, moderate and high pitch sound system with independent operation are provided. The operating channel on the "experimenter's side" consisted of red, green and yellow lights. Digital time display in middle, below which a press button "reset to zero" button and low moderate and high pitch sound buttons are provided. The subject's side has the same buttons as in experimenter's side i.e. three buttons for red, green and yellow lights and three buttons for low pitch, medium pitch and high pitch sound. buttons. A power on and off button is present on the side of the instrument. A ready signal in the form of red light is present on the subject's side.

Test procedure: For auditory reaction time: Three practical trials were given each time before taking the observation. Before presenting a stimulus a ready signal or warning in the form of a verbal instruction READY was given. For auditory reaction time, the stimulus given was a continuous beep of three different frequency sounds i.e. High, medium and low pitch sound stimuli. The subjects sat to one side and examiner sat to other side of instrument. Subject has to react to three different frequencies of sound stimuli i.e. high, medium and low by pressing the respective key for the sound as soon as that respective frequency sound was produced which may be high, medium or low pitch sound. When subject pressed the key as a response to auditory stimuli, instrument stops counting the time. This time was directly taken as auditory reaction time. Three practical trials of auditory stimuli were given to each subject and the best (i.e. the lowest) was taken as the auditory reaction time of that subject.

Results & Observation

Data thus collected were compiled, tabulated, and analyzed statistically by using unpaired 't' test. p value < 0.05 was taken as statistically significant. The table 1 shows the comparison of auditory reaction time between the two groups – non-drivers and drivers for three pitches – low, medium and high.

The auditory reaction time for low pitch in non-drivers group was 1.29±0.44 and in drivers group it was 1.21±0.38. The auditory reaction time to low pitch was comparable between the two groups ($p > 0.05$).

The auditory reaction time for medium pitch in non-drivers group was 1.16±0.45 and in drivers group it was 1.18±0.52. The auditory reaction time to medium pitch was comparable between the two groups ($p > 0.05$).

The auditory reaction time for high pitch in non-drivers group was 1.16±0.45 and in drivers group it was 1.07±0.43. The auditory reaction time to high pitch was comparable between the two groups ($p > 0.05$).

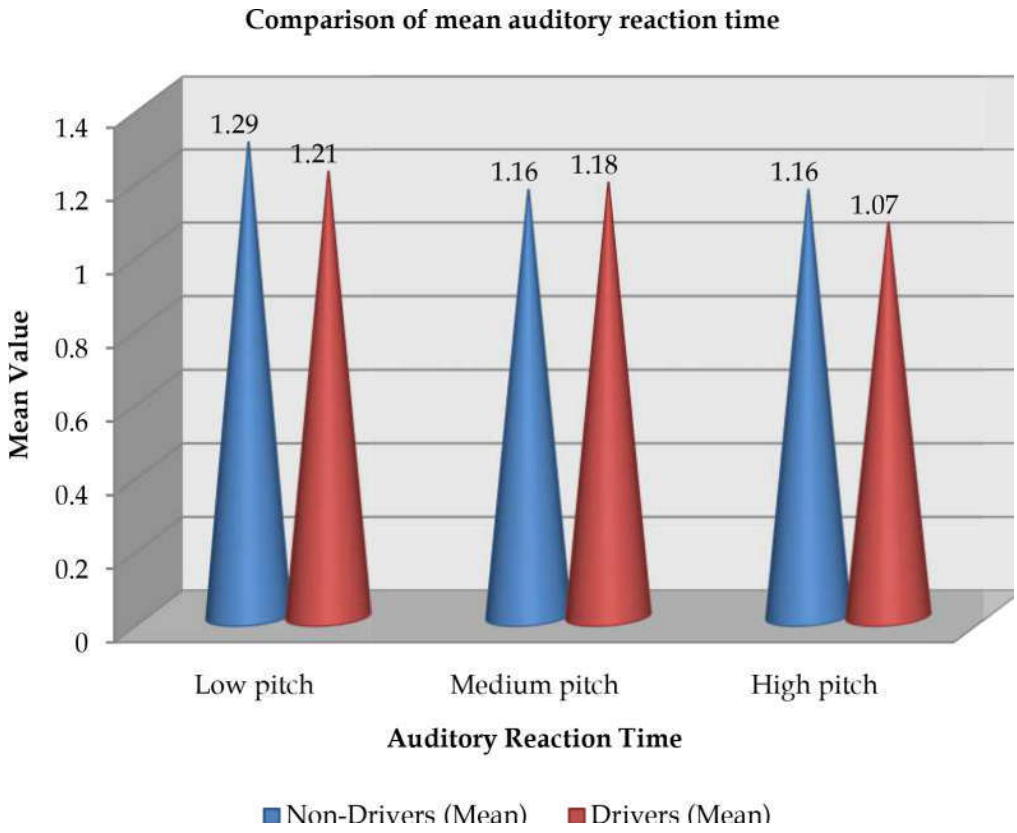
In our study we had found that auditory reaction time in drivers for low and high pitch was shorter and for medium pitch it was longer than non-drivers but the result obtained were statistically not-significant ($p>0.05$).

Following study of Herpeet et al. (2013)[7] support our study. They have included 50 drivers and 50 controls of age and sex matched. The result of their study was auditory reaction time of drivers was shorter than that of healthy controls.

Table 1: Comparison of mean auditory reaction time to three sounds Low pitch, medium pitch and high pitch between the two groups (N=200)

Auditory Reaction Time	Non-Drivers (n=100) [Mean±SD]	Drivers (n=100) [Mean±SD]	't' Value	P Value
Low pitch	1.29 ± 0.44	1.21 ± 0.38	-1.478, df=198	0.141, NS
Medium pitch	1.16 ± 0.45	1.18 ± 0.52	0.266, df=198	0.791, NS
High pitch	1.16 ± 0.45	1.07 ± 0.43	-1.460, df=198	0.146, NS

Unpaired 't' test applied. P value < 0.05 was taken as statistically significant



Graph 1: Comparison of Mean Auditory Reaction Time

Discussion

The primary aim of our study was to compare auditory reaction time of school bus drivers with normal population. The advantage of measuring auditory time reaction time in bus drivers is that we can reduce number of road traffic accidents by the assessment of audio-visual reaction time.

Most of our reactions in life are not like the simple reaction experiments. It is seldom in everyday life that we can be so sure of what is going to happen as to set ourselves to react automatically at maximum speed. Greater the complications, longer the reaction time.

Conclusion

From this we can conclude that driver's reaction time is faster which is a very important parameter for safe driving.

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