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Effect of Body Mass Index (BMI) on Mean Auditory Reaction Time for Low Pitch and High Pitch in School Bus Drivers

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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. *Conclusion:* With increase in BMI auditory reaction time also increases but the data obtained were statistically not significant ($p>0.05$). So from above findings we can conclude that shorter auditory reaction time in drivers makes important sense for safe driving and it can prevent road traffic accidents as well. *Study Design:* Cross-sectional Study.

Keywords: Auditory Reaction Time; High & Low Pitch; BMI & Bus Drivers.

Introduction

Reaction time is defined as an interval of time between the application of stimulus and the initiation of appropriate voluntary response under the condition that the subject has been instructed to respond as rapidly as possible [1]. Thus it indicates the time taken by an individual to react to external stimulus [2]. In everyday life one has to respond almost instantaneously to many diverse situations. Many simple situations of reaction time are usually at our home itself e.g. response to a door bell, telephone ring or whistle of pressure cooker.

One measure of information processing is reaction time and is used to judge the ability of the person to concentrate and coordinate. It provides an indirect index of the integrity and processing ability of the central nervous system [3] and a simple, non invasive means of determining sensorimotor co-ordination and performance of an individual [4]. With improving health care and services, the entire world has seen a spurt of growth in geriatric population. Some factors like nutrition, exercise, personal habits, environmental influences, substances like antioxidants in heroic doses can slow down the process of aging to some degree, still it has proved to be almost an inevitable process.

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. 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.

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. Then after the assessment of related hearing tests we had done choice 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 and systemic), hearing tests (Rinnie's and Weber's). The BMI of all the participants was measured by taking height and weight into consideration and categorized into three groups - normal weight, over weight, and obese groups.

Procedure

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.

2. 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 him to raise the finger when he stops hearing the sound of the vibrating tuning fork (of 512 hz frequency).
2. The stem of the tuning fork was held between the thumb and the index finger in such a way that the fingers do not touch the blades of the tuning fork.
3. The tuning fork was made to vibrate 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 ask the subject to raise 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 subjects, the air conduction is better than bone conduction.

   Weber's test: Weber's test compares bone conduction of both the ears. Base of the vibrating tuning fork was 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.

3. Reaction Time Test

Each subject was made familiar with the apparatus and procedure was 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, medium, 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, medium, 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. low, medium, and high pitch sound stimuli. The subjects sat to one side and examiner sat to other side of instrument. Subject has to react to two different frequencies of sound stimuli i.e. high and low by pressing the respective key for the sound as soon as that respective frequency sound was produced which may be high 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.

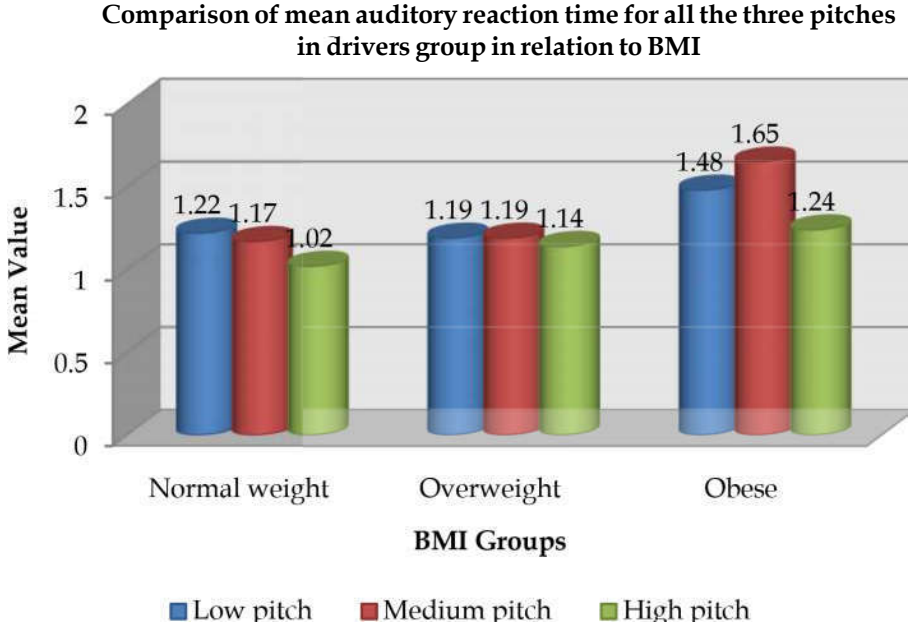
Observation and Results

Data thus collected were compiled, tabulated, and analyzed by using One-Way ANOVA test. p value < 0.05 was taken as statistically significant. The table 1 shows the comparison of auditory reaction time for different pitches in different BMI groups in the drivers group.

The mean auditory reaction time for low pitch in the normal weight group was 1.22±0.37, in the overweight group it was 1.19±0.41 and in the obese group it was 1.48±0.00. Though the mean auditory reaction time was higher for the obese person, the difference was found to be statistically not significant ($p > 0.05$), showing that the auditory reaction time for low pitch is quite comparable between all the BMI groups.

The mean auditory reaction time for medium pitch in the normal weight group was 1.17±0.59, in the over weight group was 1.19±0.39 and in the obese group was 1.65±0.00. Though the mean auditory reaction time was higher for the obese persons, the difference was found to be statistically not significant ($p>0.05$), showing that the auditory reaction time for medium pitch is quite comparable between all the BMI groups

The mean auditory reaction time for high pitch in the normal weight group was 1.02±0.43, in the overweight group it was 1.14±0.44 and in the obese group it was 1.24±0.00. Though the mean auditory reaction time was higher for the obese person, the



Graph 1: Comparison of mean auditory reaction time for all the three ptiches in the drivers group in relation to BMI

Table 1: Comparison of mean auditory reaction time for pitch in drivers group in relation to age (N=100)

Pitch	BMI	N	Mean±SD	F Value	P Value
Low pitch	Normal Weight	59	1.22 ± 0.37	0.301	0.741, NS
	Overweight	40	1.19 ± 0.41		
	Obese	1	1.48 ± 0.00		
Medium pitch	Normal Weight	59	1.17 ± 0.59	0.431	0.651, NS
	Overweight	40	1.19 ± 0.39		
	Obese	1	1.65 ± 0.00		
High pitch	Normal Weight	59	1.02 ± 0.43	0.982	0.378, NS
	Overweight	40	1.14 ± 0.44		
	Obese	1	1.24 ± 0.00		

difference was found to be statistically not significant ($p > 0.05$), showing that the auditory reaction time for high pitch is quite comparable between all the BMI groups. so our study shows that there is positive correlation between BMI and reaction time (statistically not significant $p>0.05$)

Discussion

Auditory reaction time is defined as time taken between the auditory stimulus and response obtained. The first part of auditory reaction time is sensory stimuli which may be in the form of horn in case of bus drivers, and then this sound reaches to auditory cortex via vestibulocochear nerve by auditory pathway.

Our findings match with the following study of Lalita H. Nikam and Jayshree V. Gadkari (2012)[5] who showed the effect of Age, Gender, and Body Mass Index (BMI). There was significant positive correlation between BMI and auditory reaction time. Subjects with greater BMI react slower than others (Skurvyas et al.)[7]. As shown in our study that overweight individual react slower than those individuals having normal weight. On comparing the reaction time of overweight individuals with normal weight individuals, similar findings were observed. Possible explanation for this could be obesity induced vascular disease. Other mechanisms suggested are secretions of adipose tissue like hormones, cytokines, and growth factors affecting brain health [6]. Different neurophysiological studies have shown influence of obesity and elevated body mass index on cognitive functions, memory deficits and executive dysfunction in young as well as middle aged individuals [8,9].

Conclusion

With increase in BMI auditory reaction time also increases but the data obtained were statistically not significant ($p>0.05$). So from above findings we can conclude that shorter auditory reaction time in drivers makes important sense for safe driving and it can prevent road traffic accidents as well.

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