ORIGINAL ARTICLE

SIMPLE REACTION TIME IN RESPONSE TO AUDITORY STIMULI IN A SAMPLE POPULATION OF RICKSHAW DRIVERS RECRUITED AT CMH LAHORE MEDICAL COLLEGE

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ABSTRACT

Background and Objectives: Simple reaction time is used as an indicator of the ability of the central nervous system to receive information and to synchronize movement which is then executed through the peripheral nervous system. Abnormalities in reaction time in response to auditory stimuli may have profound effects on a driver's performance. This study was conducted with an objective to compare the simple reaction time in a sample population of noise exposed rickshaw drivers and to compare it with non-exposed controls.

Methods: Fourteen rickshaw drivers were enrolled in this comparatives study after informed consent. Ear examination and Pure Tone Audiometry was performed to rule out any profound hearing impairment. Simple reaction time was calculated by BioPac Student Data acquisition system. A group of 15 non-exposed subjects were also enrolled for the purpose of comparison.

Results: Comparison of simple reaction time in response to random interval and fixed interval auditory clicks revealed that noise exposed rickshaw drivers had a much higher reaction time as compared to controls which was statistically significant (p-value = 0.001 and 0.029 respectively).

Conclusions: The noise exposed rickshaw divers take more time to respond to auditory stimuli than age matched controls. There is a dire need to educate these drivers through public health awareness programs to prevent development of noise induced hearing loss and thus avoid frequent accidents.

Key words: PTA, simple reaction time, hearing loss.

INTRODUCTION

Reaction time is defined as the interval of time between the application of a stimulus and initiation of a muscle response.[1] Various researches in the past have shown that it is a valid parameter which indicates the ability of the nervous system to receive sensory information and synchronize movement in response to this sensory information which is then executed through the peripheral nervous system.[2] In addition to the type of stimulus and the intensity of stimulus, other factors such as age, gender, fatigue, arousal and alcohol consumption are known to affect the reaction time. One consistent finding in literature is that responses decrease with age and males have faster reaction times than females.[3] Reaction time may be assessed by various methods and has three different types based on these methods: simple, choice and recognition reaction times.[1] A set of one stimulus and one response are used for determining simple reaction time. For determining recognition reaction time, there are some stimuli that should get a response (these are called the 'memory set'), and some stimuli that should not be responded to (these are called the 'distractor set'). In the last type, the choice reaction time, the experiments are more complex. The subject is required to respond to a stimulus, for example pressing a key in response to an alphabet only if that alphabet appears on the monitor.[4] Reaction time has been widely studied in the past by physiologists as its real life applications may be of great importance, e.g., a slower than normal reaction time while driving can have serious and critical consequences.[5]

Noise is an unavoidable hazard of the industrial world. It originates from a variety of sources and traffic is one of them. Traffic noise plays a major role in noise pollution. Published literature suggests that this is a global crisis owing to a huge number of motorcycles, cars, wagons, trucks, and in our case, rickshaws.[6] Rickshaw drivers are constantly exposed to an environment which is polluted, dirty and noisy.[7] Noise induced hearing loss is the most common type of hearing loss found in these drivers.[8] In addition, these drivers who have been driving rickshaws without a proper silencer are reported to have complaints of

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tinnitus and difficulty in following telephonic conversations.[9] According to published research, the highest acceptable noise level according to WHO criteria is 60 – 65 decibels (dB) and people exposed to excessive traffic noise are more vulnerable to develop headaches, annoyance and irritability.[10]

Thus, a study question was developed to evaluate the simple reaction time in response to auditory stimuli in the rickshaw drivers. The objective of the study was to compare simple reaction time in the dominant and non-dominant hand between rickshaw drivers and healthy subjects.

METHODS

The study was performed at the Department of Physiology, CMH Lahore Medical College and Institute of Dentistry from January to July 2015. The study was approved by the Institutional Ethical Review Committee. It was a comparative study. Fourteen rickshaw drivers were inducted in the study. A written informed consent was given to all participants both in English and in Urdu. The duration for driving rickshaw was asked from the drivers and classified as being less than 5 years, between 6 to 10 years and between 11 to 15 years. The daily hours for driving were also identified as being less than 10 hours or more than 10 hours. An ear examination was performed to rule out the presence of any impacted wax or any perforation of the tympanic membrane. Pure Tone Audiometry was performed in the Department of ENT, CMH Lahore in a sound proof room by using the Interacoustics Clinical Audiometer AC33. It was ensured that none of the drivers was falling into the category of moderate, severe or profound hearing impairment according to the WHO classification of hearing impairment and hearing loss (≥ 41dB in the better ear). The participants were then explained the process of simple reaction time in the Physiology Laboratory. Simple reaction time was calculated by using BioPac Head Phones and Push Button Switch (SS10L). Reaction time was recorded by giving an auditory stimulus in the form of an auditory click at random intervals and then at fixed intervals by BioPac Student Lab System Data Acquisition unit MP36 (Fig. 1). A group of 15 age and gender matched individuals were also enrolled in the study for the purpose of comparison. These were office workers whose mode of transportation was cars and they were not accustomed to travel in rickshaws. Data was computed by using the BIOPAC Student Lab Software (BSL version 4.0.0). All data was recorded on predesigned proformas and was later analyzed by SPSS version 20 (IBM SPSS Inc., Chicago, USA). A *p*-value of < 0.05 was considered statistically significant.

RESULTS

The mean (± SD) age of the rickshaw drivers enrolled in the study was 31.93 (±5.47) years and that of the healthy controls was 31.73 (±5.05) years. Out of the study participants, 35.7% had been driving for less than 5 years, 42.85% had been driving for 6 – 10 years and 21.24% had been driving for between 11 – 15 years. The average daily hours of driving were reported as: 42.85% drove for less than 10 hours daily and 57.14 % drove for more than 10 hours daily. The mean (±SD) audiometric values of the healthy controls and rickshaw drivers are presented in tables 1 and 2. The

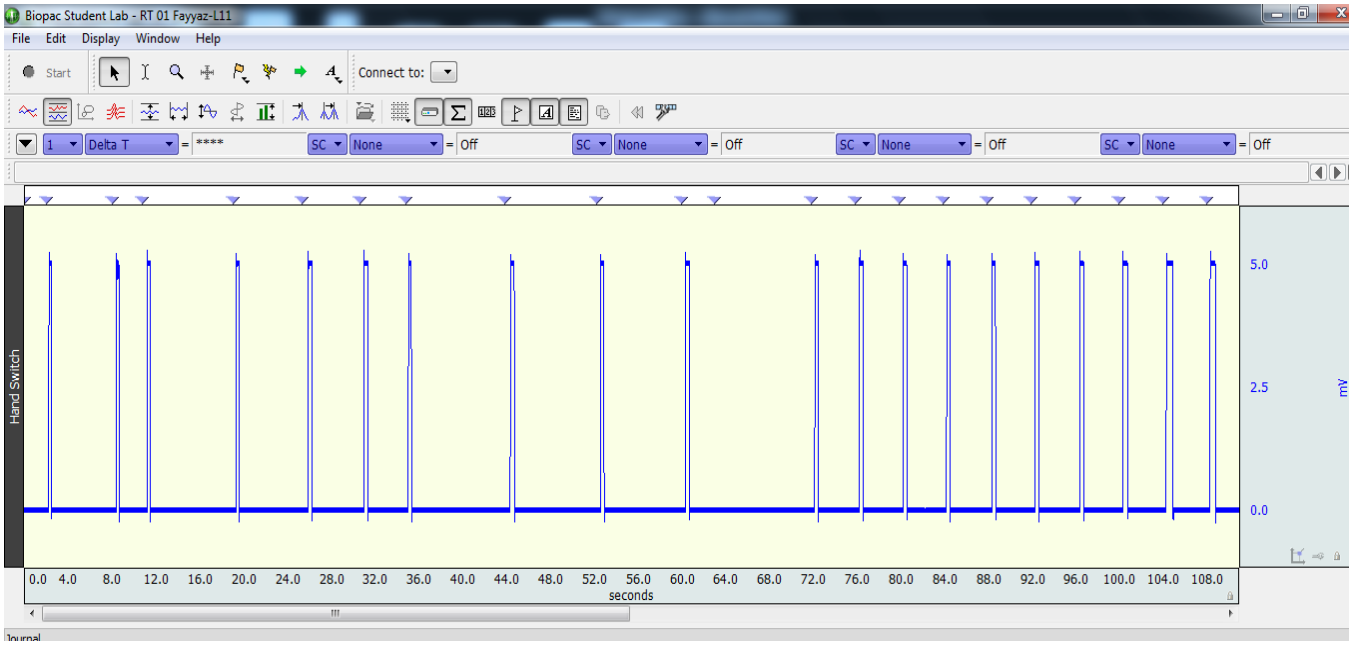

Fig. 1: *Graph demonstrating the Simple reaction time recorded by BioPac Student Lab System Data Acquisition unit MP36.*

mean (± SD) values of simple reaction time at fixed intervals and at random intervals were compared between the two groups by using Independent Sample t-Test (table 3). The simple reaction time of normal subjects was less than the rickshaw drivers when calculated both at random intervals and at fixed intervals (*p*-value 0.001 and 0.029 respectively).

Table 1: *Hearing threshold of healthy control subjects in the right and left ears (n = 15).*

Right Ear (Mean ± SD dB)		*Left Ear (Mean ± SD dB)*	
500Hz	19.29 ± 10.16	500Hz	18.21 ± 7.75
1000Hz	19.64 ± 6.64	1000Hz	15.00 ± 6.50
2000Hz	15.00 ± 5.88	2000Hz	15.00 ± 7.34
4000Hz	22.50 ± 11.39	4000Hz	19.64 ± 6.92
8000Hz	23.93 ± 15.46	8000Hz	23.57 ± 11.34

Table 2: *Hearing threshold of rickshaw drivers in the right and left ears (n = 14).*

Right Ear (Mean ± SD dB)		*Left Ear (Mean ± SD dB)*	
500Hz	30.71 ± 10.53	500Hz	32.14 ± 14.24
1000Hz	25.00 ± 7.84	1000Hz	25.36 ± 9.70
2000Hz	22.14 ± 9.75	2000Hz	27.14 ± 17.73
4000Hz	24.29 ± 11.91	4000Hz	29.64 ± 17.81
8000Hz	25.00 ± 14.01	8000Hz	32.50 ± 21.73

Table 3: *Comparison of reaction time between normal subjects and rickshaw drivers.*

Sr. No.	*Parameter*	*Normal Subjects*		*Rickshaw Drivers*		*p-value*
		N	*Mean ± SD*	*n*	*Mean ± SD*	
1.	Reaction Time - Random Interval (Seconds)	15	0.240 ± 0.129	14	0.457 ± 0.175	0.001*
2.	Reaction Time - Fixed Interval (Seconds)	15	0.219 ± (0.190 – 0.325)	14	0.444 ± 0.226	0.029*

**p*-value ≤ 0.05 is considered statistically significant
p-value is generated by *Independent Sample t-Test*

DISCUSSION

This study shows that simple reaction time in rickshaw drivers is higher as compared to control subjects. To our knowledge, this was the first study of its kind to evaluate the baseline audiometric and reaction time values together in a sample population of rickshaw drivers in Lahore.

As described in the literature, the various components of reaction time may be classified into a mental processing time and a movement time. The time required to detect a sensation, the time taken to analyze its meaning and finally the time taken to select a response are all categorized as the mental processing time. The movement time is the time required to perform the movement after the selection process is over in the brain.[11] As described by Miller and Low in 2001, the time for motor preparation and the resultant motor response is same in all kinds of reaction time test, thus suggesting that the only difference in reaction time by different techniques is due to the difference in processing time.[12]

Occupational noise induced hearing loss develops over a period of several years after continuous exposure to loud noise at the place of work.[13] In a study conducted at Sir Ganga Ram Hospital Lahore, it was concluded that 65% of the study population was suffering from Noise Induced Hearing Loss.[8] Their study comprised of drivers belonging to all types of public transport such as taxis, wagon and bus drivers and the mean age of the subjects was also higher than the subjects enrolled in the current study at 41.35 years. These findings support the findings in the current study that in this age group none of the subjects had developed moderate, severe or profound hearing loss and were recruited in the early stages of impaired hearing threshold. However, the findings from a study in Tehran conducted by Karimi et al suggest that 45% of their study population of truck drivers was suffering from hearing impairment in high frequencies for both ears[14]. In addition, noise induced hearing loss is being recognized as a global problem with 600 million workers exposed to occupational noise worldwide.[15] Usually hearing loss is equal and symmetrical, but there may be unilateral hearing impairment depending upon the side of noise exposure as described by Udaipurwala et al in 2014,[16] but in the current study, there was no study subject with profound asymmetrical hearing loss.

A study from Karachi has identified that rickshaws and motor cycles surpass all other vehicles in production of sound.[6] The exposure to such noise leads to lack of sleep, high blood pressure and irritability apart from hearing impairment. As mentioned by Kosinski in 2013, reaction time is heavily influenced by the level of arousal and state of attentiveness of the mind[4]; this may be the reason why the study subjects have a lon-

ger reaction time.

The mean reaction time in the rickshaw drivers of the current study is longer than the time reported by John and David in 2014. However, this included individuals who were under the influence of caffeine and taurine rich energy drinks. The reaction time of the placebo group in their study is comparable to the controls of the current study at 0.228 ± 0.047 seconds.[17] Our results are also comparable to the findings shown by Gandhi and Gokhale,[5] however, their study population included congenitally blind people as well.

Noise has become a global concern[18] but in Pakistan there is a lack of education and awareness about noise pollution. There is no pre employment assessment of hearing and poor usage of hearing protection devices.[19] The study by Sen and Bhattacharjee[20] suggests that the noise exposure interferes with the safety of the rickshaw driver, and it is one of the major causes for inability of the drivers to hear warning signals or horns from other vehicles on the roads.

It is therefore ***concluded*** that simple reaction time in the rickshaw drivers recruited in this study is prolonged, as compared to the control group who were not exposed to noise.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the efforts of Dr. Mohsin Ali Cheema in the statistical analysis of this study.

Authors' Contribution

HSK and MA: were involved in the conception of the idea, sampling of the study subjects (Pure tone audiometry and reaction time), data entry and scientific writing of the manuscript. HB and MA: helped in the literature review and sampling of the healthy subjects. SH: supervised the study, and was involved in the conception of idea, scientific writing and proof reading of the manuscript.

Conflict of Interests

This study was not supported by any research grant and there are no conflicts of interest.

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