Original Article

Auditory effect of noise exposures among commercial and non-commercial light motor vehicle drivers: A comparative cross-sectional study in Lucknow city

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Abstract

Context: Noise-induced hearing loss, one of the most common and preventable occupational hazard, occurs due to repeated and continuous exposure of loud noise, A single exposure of an impulse of noise at the level of 130--140 dB or long and repeated exposures to loud sounds to an average level of 85 dB or higher for an 8-h period can cause permanent loss of hearing. **Aims:** To study and compare hearing loss over different audiometric frequencies among autorickshaw and non-commercial institutional personal car drivers. **Settings and Design:** This was a cross-sectional comparative study conducted at a tertiary medical college, located in Lucknow during October 2017–November 2018. **Methods and Materials:** The sample size was calculated using EpiInfo7. We took a sample size of 300 drivers, out of which 150 three-wheeler autorickshaw drivers (Tempo), that is, group I and 150 non-commercial car drivers, that is, group II were selected. **Statistical Analysis Used:** For statistical analysis, "Chi-square test of independence" and student's t-tests were used. **Results:** The mean age at which drivers in group I and group II started work was 23.91 ± 7.63 years an d 23.60 ± 5.58 years, respectively. The mean hearing loss in Group I was 21.15 ± 8.65 dB and in group II it was 13.34 ± 5.79 dB. **Conclusions:** Autorickshaw drivers who were exposed to louder noise, that is, autorickshaw drivers in group I had more sensory neural hearing loss than the non-commercial car drivers, that is, group II.

Keywords: Decibels, light motor vehicle drivers, noise-induced hearing loss

Introduction

Hearing loss is reduced hearing or understanding ability of speech and sounds. Loud sound damages particularly to the inner ear or auditory nervous system. It could be temporary or may be permanent in one or both ears. Progressive hearing loss occurs due to continuous exposure of loud noise.[1] Single exposure of an impulse of noise at the level of 130--140 dB or long and repeated exposures to loud sounds to an average level of 85 dB or higher for an 8-h period can cause permanent loss of hearing.[2] In the United States, about 24% of adults have features of some hearing loss in one or both ears due to exposure of loud sound.[3]

In urban areas and cities of north India, the autorickshaws are the primary mode of passengers transport and they are a major source of noise for the drivers and also for the passengers. The situation further worsens due to traffic congestion and honking as it causes increased noise exposure level. A study conducted in India showed that 89% of drivers had abnormal audiograms whereas in the control group the abnormal audiograms were only 19%.[4] There are few studies regarding noise-induced

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Received: 13-03-2019 **Revised:** 15-03-2019 **Accepted:** 29-03-2019

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_220_19

How to cite this article: Manar MK, Verma V, Mohan U, Shukla SP, Singh SK. Auditory effect of noise exposures among commercial and non-commercial light motor vehicle drivers: A comparative cross-sectional study in Lucknow city. J Family Med Prim Care 2019;8:2023-8.

hearing loss among three wheeler autorickshaw (tempo) drivers and non-commercial institutional personal drives, the present study was done with objectives of: (1) To study hearing loss over different audiometric frequencies among autorickshaw and non-commercial institutional personal drives car drivers. (2) To find and compare the prevalence of noise-induced hearing impairment/loss among three-wheeler autorickshaw (tempo) drivers and non-commercial institutional personal drives car drivers.

Subjects and Methods

The present study was conducted at a tertiary medical college, located at north India during October 2017–November 2018. It was a cross-sectional comparative study conducted among three-wheeler autorickshaw (tempo) drivers (noise-exposed group) and non-commercial car drivers (noise-unexposed group). Tempo drivers were selected from three busy routes of the Lucknow city. These routes were (1) Chowk, Charbagh; (2) Chowk, Dubagga; (3) Madiyaon, Kaisarbagh. The personnel car drivers of academicians and researchers were selected from Academic and Research Institutions as noise-unexposed group. The participants were selected by using a random sampling technique.

Sample size calculation

It was calculated by taking two-sided confidence level of 95%, the power of the study 90%, the ratio of 1 among unexposed to exposed with prevalence taken from a study done by Patwardhan *et al*. using Epi Info7 (available at http://www.cdc.gov/epiinfo).[4,5] The sample size came out to be 135 in each group. So we took 150 in each group as round off.

In group I, 150 three-wheeler autorickshaw drivers (tempo) were selected, they were exposed to a sound level of more than 85 dB and group II in which 150 non-commercial car drivers were selected and they were exposed to a sound level less than 75 dB. After doing audiometry of both ears of the subjects, hearing loss of right and left ears on frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, and 8000 Hz was noted.

Inclusion criteria for autorickshaw (tempo) drivers (noise-exposed group)

1. Age between 18 and 50 years.
2. At least working as a driver for a year.

Exclusion criteria for autorickshaw (tempo) drivers (noise-exposed group)

1. Drivers with any obvious ear disease/CSOM or ear/head injury in past.
2. Consumed or consuming ototoxic drugs.
3. Having a history of diabetes mellitus illness.
4. Drivers who were previously exposed to non-traffic occupational noise.
5. Drivers who are not willing to participate in the study.

Inclusion and exclusion criteria for car drivers (noise-unexposed group)

Inclusion and exclusion criteria for selection of car drivers were kept same as autorickshaw drivers except one additional exclusion criteria was added, that is, the drivers who worked as a driver of any commercial vehicle or heavy vehicle were also excluded.

Data collection and analysis

Data were collected through audiometry and individual interview using pretested questionnaire. Data were entered in Microsoft Excel and exported and analyzed using SPSS V.24 (IBM Inc. Chicago, USA). "Chi-square test of independence" and student's t-tests were used.

Ethical clearance was obtained from the institutional ethical committee, King George's Medical University, UP, Lucknow, India. Informed consent was obtained from all participants in this study. All the participants were informed about the nature of the study.

Audiometry

Audiometry was done using the Medical Grade MAICO (Model: MA42) Audiometer. Pure tone air conduction audiometry was done for both the ears of the subjects at 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, and 8000 Hz. Audiometry was done using the method recommended by the American Speech and Hearing Association. An audiometric loss of more than 25 dB in the better ear was taken as hearing impairment.

Results

Table 1 shows that most of the drivers in both groups, that is, in group I and in group II belong to Hindu by religion (66.0% and 79.3%), married (74.7% and 76.7%), living in joint family (62.7% and 63.3%), and residing in urban areas (82.2% and 82.7%).

Table 2 shows that mean age at which drivers in group I and group II started work was 23.91 ± 7.63 years and 23.60 ± 5.58 years, respectively, and this showed a significant difference between two groups (*P* value 0.026). The mean systolic blood pressure was 119.41 ± 16.79 mm Hg in group I and 115.98 ± 8.32 mm Hg in group II. The mean diastolic blood pressure was 80.52 ± 12.80 mm Hg in group I and 79.24 ± 6.30 mm Hg in group II and this showed a statistically significant difference between two groups (*P*-value 0.027).

Table 3 shows that a statistically significant difference in the hearing threshold levels in the right ear of group I drivers and group II drivers at frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, and 8000 Hz. The same was also true for the left ear.

Table 4 shows that the average hearing loss in age group less than 30 years in group I was 15.44 ± 5.46 dB and in group II it

was 11.28 ± 4.07 dB. Drivers belonging to age group 31-40 years showed an average loss of 19.74 ± 5.83 dB and 12.55 ± 3.75 dB among group I and group II, respectively. Also, the drivers in the age group of 41--50 years showed mean hearing loss of 28.27 ± 8.96 dB and 16.17 ± 7.74 dB among group I and group II, respectively. The difference in the hearing loss of group I and group II was statistically significant across all the three age groups. There was a statistically significant difference among group I drivers and group II drivers in whom average hearing loss was more than 25 dB (at combined frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz) in the better ear across all the three age groups.

Table 1: Sociodemographic characteristics of auto rickshaw and non-commercial institutional car drivers

Variables	Group I		Group II		Total	
	No.	%	No.	%	No.	%
Religion						
Hindu	99	66.0	119	79.3	218	72.7
Muslim	48	32.0	31	20.7	79	26.3
Sikh	03	2.0	0	0	03	1.0
Social Group						
Unreserved	39	26.0	55	36.7	94	31.3
SC	15	10.0	18	12.0	33	11.0
ST	0	0	02	1.3	02	0.7
OBC	96	64.0	75	50.0	171	57.0
Marital status						
Single	35	23.3	35	23.3	70	23.3
Married	112	74.7	115	76.7	227	75.7
Divorcee/separated	02	1.3	0	0	01	0.3
Widowed	01	0.7	0	0	01	0.3
Type of family						
Nuclear	53	35.3	48	32.0	101	33.7
Joint	94	62.7	95	63.3	189	63.0
Three-generation	03	2.0	07	4.7	10	3.3
Residence						
Urban	123	82.2	124	82.7	247	82.3
Rural	23	15.3	23	15.3	46	15.3
Urban slum	03	20.	03	2.0	06	2.0
Peri-urban	01	0.7	0	0	01	0.3
Education						
Illiterate	46	30.7	12	8.0	58	19.3
Primary school	61	40.7	40	26.7	101	33.7
Secondary school	36	24.0	76	50.7	112	37.3
Graduate & above	07	4.6	22	14.7	29	9.7
Total	150	100	150	100	300	100

Table 5 shows that in group I, about 10.4% drivers had mean hearing loss more than 25 dB in the age group of "less than 30 years," 28.3% drivers in the age group of 31-40 years showed mean hearing loss more than 25 dB, about 65.3% drivers in age group 41--50 years showed hearing loss more than 25 dBs, while in group II, no driver had hearing loss of more than 25 dBs in age group of "less than 30 years" and age group of 31--40 years; however, 8.16% drivers in the age group of 41--50 years had hearing loss of more than 25 dB. The difference in prevalence of hearing loss among the group I and group II was statistically highly significant in the age group of 31--40 years and 41--50 years.

Discussion

Continuous exposures to the loud sound can produce hearing loss. Drivers of autorickshaw face louder sound levels than the car drivers. This hearing loss can affect their personal life or even socially. This could also affect their professional life.

A study conducted by Balaji *et al.* (2016) among male bus drivers and office workers at Puducherry showed mean systolic blood pressure of 132.34 ± 18.07 mmHg and 118.00 ± 14.65 mmHg

Table 2: Baseline characteristics of auto rickshaw and non-commercial institutional car drivers

Variables	Group I (Mean±SD)	Group II (Mean±SD)	Total	*P*
Age (in completed years)	35.09±9.24	35.47±8.41	35.28±8.82	0.710
Age at start of work (in completed years)	23.91±7.63	23.60±5.58	23.75±6.68	0.026
Systolic Blood Pressure (mmHg)	119.41±16.79	115.98±8.32	117.70±13.34	0.270
Diastolic Blood Pressure (mmHg)	80.52±12.80	79.24±6.30	79.88±10.09	0.027
Pulse rate (per minute)	74.13±8.03	76.32±9.01	75.22±8.59	0.100
Respiratory rate (per minute)	17.63±2.22	18.00±1.55	17.81±1.92	0.685

Table 3: Hearing threshold level (in dB) detected by audiometric test at different frequencies

Freq. (in KHz)	Right Ear			Left Ear		
	Group I (Mean±SD)	Group II (Mean±SD)	*P*	Group I (Mean±SD)	Group II (Mean±SD)	*P*
0.25	16.23±11.94	7.76±8.68	<0.01	17.83±13.75	11.86±10.40	<0.01
0.5	20.70±12.19	12.73±9.72	<0.01	15.33±12.44	11.30±8.74	<0.01
1	18.20±12.45	10.63±6.93	<0.01	18.40±12.78	13.20±8.36	<0.01
2	25.73±12.24	14.45±6.43	<0.01	23.53±11.24	17.17±6.96	<0.01
3	31.07±14.78	16.40±7.39	<0.01	30.20±14.35	18.90±8.17	<0.01
4	34.97±15.23	18.40±7.63	<0.01	34.87±15.34	22.03±8.59	<0.01
6	30.37±17.38	14.80±8.78	<0.01	30.23±17.87	16.83±10.14	<0.01
8	30.87±19.97	13.67±10.67	<0.01	32.50±22.51	16.63±13.54	<0.01

Table 4: Comparison of average loss of hearing levels (in dB) in better ear

The average loss of hearing levels (in dB) in better ear*	Group I (Mean±SD)	Group II (Mean±SD)	Test	*P*
Age group <30 years	15.44±5.45	11.27±4.07	4.18	<0.01
Age group 31-40 years	19.74±5.83	12.55±3.75	7.64	<0.01
Age group 41-50 years	28.26±8.96	16.17±7.73	7.14	<0.01
Overall (in all age groups)	21.15±8.65	13.34±5.79	9.17	<0.01

*At combined frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz

Table 5: Comparison of Average Hearing Loss of More than 25 dB in Better Ear*

The average loss of more than 25 dB of hearing in better ear*		Group I No. (%)	Group II No. (%)	*P*#
Age group <30 years	Present	5 (10.4)	0 (0.0)	0.056
	Absent	43 (89.6)	46 (100.0)	
Age group 31-40 years	Present	15 (28.3)	0 (0.0)	<0.01
	Absent	38 (71.7)	55 (100.0)	
Age group 41-50 years	Present	32 (65.3)	4 (8.2)	<0.01
	Absent	17 (34.7)	45 (91.8)	

*At combined frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. #Fischer's exact test applied

among driver group and control (office workers) group and this difference in mean systolic blood pressure was statistically significant. Furthermore, this study showed that the mean diastolic blood pressure of 76.80 ± 10.45 mmHg and 85.94 ± 12.51 mmHg among control group and driver group, and this difference in the mean diastolic blood pressure was statistically significant.[6] The present study showed mean systolic blood pressure of 119.41 ± 16.79 mm Hg in group I and 115.98 ± 8.32 mm Hg in group II. The difference may be due to use of office workers in the control group. The mean diastolic blood pressure was 80.52 ± 12.80 mm Hg in group I and 79.24 ± 6.30 mm Hg in group II and this difference between the two groups was statistically significant (*P*-value 0.027). The findings in the diastolic blood pressure were similar to our study.

A study done by Ansari *et al.* (2015) in Zahedan, Iran, among 1,836 inner and intercity drivers showed that mean hearing threshold for right ear was 25.78 ± 9.11 dB, 23.51 ± 8.48 dB, 16.64 ± 7.22 dB, and 12.84 ± 7.26 dB, at lower frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, respectively.[7] The present study showed that the mean hearing threshold for right ear for group I at these lower frequencies was 16.23 ± 11.94 dB, 20.70 ± 12.19 dB, 18.20 ± 12.45 dB, and 25.73 ± 12.24 dB, respectively. The slight difference from the present study may be due to the difference in the sample size.

It was found that the mean hearing threshold for right ear was 11.61 ± 7.94 dB, 13.02 ± 9.11 dB, 13.57 ± 9.64 dB and 14.65 ± 9.58 dB at higher frequencies of 3000 Hz, 4000 Hz, 6000 Hz, and 8000 Hz, respectively.[7] The present study showed that the mean hearing threshold for right ear for group I at these higher frequencies was 31.07 ± 14.78 dB, 34.97 ± 15.23 dB, 30.37 ± 17.38 dB, and 30.87 ± 19.97 dB, respectively. Furthermore, Ansari *et al.* (2015)[7] in their study showed that mean hearing threshold for left ear was 27.74 ± 9.16 dB, 23.82 ± 9.43 dB, 17.07 ± 8.62 dB, 13.12 ± 8.17 dB at lower frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, respectively.[7] The present study showed that the mean hearing threshold at these lower frequencies was found different from this study. The mean hearing threshold for left ear was 12.10 ± 8.45 dB, 13.42 ± 9.93 dB, 13.93 ± 9.94 dB, and 15.15 ± 9.85 dB at higher frequencies of 3000 Hz, 4000 Hz, 6000 Hz, and 8000 Hz, respectively.[7] This mean hearing threshold was much lower than the result of the present study at these higher frequencies. The present study used a smaller sample size which might be the cause of difference in the findings.

Study done by Izadi *et al.* (2015) in Tehran, Iran, among 1,901 professional drivers showed hearing threshold of right ear at 250 Hz was between 8.86 and 14.66, at 500 Hz was between 7.60 and 14.92, at 1,000 Hz was between 5.88 and 15.68, at 2,000 Hz was etween 5.69 and 18.31, at 3,000 Hz was between 7.04 and 25.76, at 4,000 Hz was between 9.13 and 35.42, at 6,000 Hz was between 9.32 and 36.44, and at 8000 Hz was between 9.04 and 39.07 dB. This study showed that the hearing threshold of left ear at 250 Hz was between 8.58 and 13.90, at 500 Hz was between 7.74 and 15.34, at 1,000 Hz was between 6.03 and 16.36, at 2,000 Hz was between 5.73 and 23.31, at 3,000 Hz was between 8.44 and 31.78, at 4,000 Hz was between 10.91 and 40.42, at 6,000 Hz was between 10.45 and 43.64, and at 8,000 Hz was between 9.87 and 42.88 dB.[8] These results are in accordance with the present study.

A study done by Aslam *et al.* (2008) among autorickshaw, taxi-car, wagon, and bus drivers, in Lahore, showed that 65% of the drivers had hearing loss less than 25 dB and about 10% of the drivers had hearing loss of more than 25 dB in the better ear.[9] The present study showed that in auto drivers (group I), overall about 34.67% drives had mean hearing loss more than 25 dB and while only 2.67% drivers in the group II had mean hearing loss more than 25 dB which is different from the above-mentioned study. This might be due to the difference in the mean age of drivers from the present study.

Beheshti *et al.* (2016)[10] conducted a study in northern Iran among taxi and agency which the average hearing loss in the better ear was 12.74 ± 4.64 dB and 12.53 ± 5.16 among drivers from an agency and taxi drivers, respectively. This study showed a higher prevalence of hearing loss among taxi drivers than the drivers from an agency.[10] The present study showed that the average hearing loss in the better ear was 21.15 ± 8.65 dB and 13.34 ± 5.79 dB among group I and group II, respectively. This difference in the results can be caused by the different

driving conditions and may also be due to use of smaller sample (total 95 drivers) than the present study.

We, the human beings, are born with a limited and fixed number of cochlear inner hair cells and due to exposure to noise, these hair cells attributed to metabolic exhaustion and degenerate.[11-13] Degenerated cochlear hair cells do not recover, repair, or regenerate in human beings and other mammals. There were considerable efforts made on research to regenerate the cochlear inner hair cells, either by growth of suitable hormones or genetic cell differentiation process.[14-16] But, the fact remains that once cochlear inner hair cells damaged by noise exposure, they will not recover and lost forever. Therefore, presently, early identification and prevention of noise-induced hearing loss is the only viable solution. Our present study supporting the research literature that effect of noise exposure is cumulative, results shows that the difference of hearing loss between exposed and unexposed group was found increasing with years of exposure [Table 4].

WHO estimated that 466 million persons of the world live with disabling hearing loss in 2018, which is loss unequally distributed all around the world and South Asia is the highest contributor (27%) and also projected that number of persons with disabling hearing loss grows with the years, 630 million by 2030 and 900 million by 2050.[17] It is reported that out of total prevalence of hearing loss in adults worldwide, the occupational noise contributes to 16% (range: 7--21%) of the preventable noise-induced hearing loss.[18]

Burden of deafness and hearing loss is enormous in India to tackle the hearing impairment problem, National Programme for Prevention and Control of Deafness (NPPCD), Govt. of India, emphasizes on early identification of cases of hearing impairment and their management in collaboration with NRHM at Primary Health Care Level, the detailed guidelines and facilities essentially required, have also been mentioned for all levels of healthcare.[19]

The present study demonstrates the association of noise exposure and noise-induced hearing loss, hence the study will be useful to the family physician in understanding the severity of one of the most pervasive, irreversible but preventable occupational and recreational noise hazard. Family physicians may play the primary role in managing and preventing avoidable noise-induced hearing impairment and associated risks, for example, depression, anxiety, and poor quality of life of public through early identification of hearing loss, counselling, public awareness, and medical rehabilitation.

Conclusion

It was seen in the present study that autorickshaw drivers (group I) who were exposed to louder noise had more sensory neural hearing loss than the non-commercial car drivers (group II). Preventive measures should be taken to prevent the hearing loss among autorickshaw drivers through awareness about ill effect of noise, ensuring availability of viable earplugs, and induction of low noise producing public transport vehicles.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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