Original Article

DOI: 10.7860/JCDR/2016/17361.7199

Hearing Impairment and High Blood Pressure among Bus Drivers in Puducherry

Physiology Section

RAJESHWAR BALAJI[1], RAJALAKSHMI RAJASEGARAN[2], NITIN ASHOK JOHN[3], UMADEVI SAJJA VENKATAPPA[4]

ABSTRACT

Introduction: Noise Induced Hearing Loss (NIHL), a major heath concern due to constant exposure to loud noise is on the rising trend in today's world. The bus drivers are more vulnerable to the auditory and non-auditory ill effects of noise pollution.

Aim: The aim of this study was to assess and compare the hearing level, blood pressure and peak expiratory flow rate of bus drivers and individuals employed in office jobs.

Materials and Methods: Fifty male bus drivers aged 30-50 years and fifty males of the same group employed in office jobs were recruited as the test and control groups respectively. The hearing level of the individuals in both the groups was assessed using the Hearing Deterioration Index (HDI). The lung function and cardiovascular status of the study participants were assessed by measuring their Peak Expiratory Flow Rate (PEFR) and Blood Pressure (BP) respectively. The mean HDI, PEFR and BP values of both the groups were compared using the unpaired t-test and the extent of correlation between HDI, service years, exposure level, systolic blood pressure (SBP) and diastolic blood pressure (DBP) was determined using Pearson correlation coefficient test.

Results: HDI, SBP and DBP were significantly higher among the bus drivers when compared to the controls. However, there was no significant difference in the PEFR values between the test and the control groups. There was a highly significant positive correlation between HDI and service years and exposure level. Similarly, there was a significant positive correlation between exposure level and systolic and diastolic blood pressure.

Conclusion: Prolonged exposure to high intensity of sound results in deterioration of hearing capacity and increase in blood pressure among the bus drivers.

Keywords: Hearing deterioration index, Hearing loss, Noise, Service years

INTRODUCTION

Noise pollution is emerging as a major environmental threat to the developed and developing countries. Nearly 10% of the world population is known to be suffering from hearing loss and exposure to very loud noise has been identified as the cause for most of these cases [1]. In major cities, road traffic noise is considered as the most important source for noise pollution. The professional bus drivers who drive the buses at the busy traffic lanes are always at a risk of exposure to high levels of noise due to traffic congestion along roadside [2,3]. Studies have shown that long term exposure to loud noise affects the hearing capacity of drivers eventually resulting in hearing loss and a decrease in their work performance [4-6].

Recently, there is also growing evidence on the non-auditory effects of environmental noise on public health [7,8]. Studies have proved that long term exposure to high environmental noise affects the cardiovascular system leading to hypertension, ischemic heart disease and myocardial infarction [9,10]. The bus drivers who are on the constant mental stress due to nature of their duties which includes working in odd shifts, compliance for timely reaching the destination and conscious safe driving practices are more susceptible to various cardiovascular and other health disorders [11].

Due to the increasing automobile transports, the major cities in our country are exposed to several air pollutants from the automobile exhaust such as oxides of nitrogen, sulphur, carbon and aromatic hydrocarbons [12,13]. These compounds are known to be involved in the pathogenesis of various respiratory and cardiovascular disorders [14,15]. Exposure to high concentrations of carbon monoxide is known to be associated with dizziness, headache and impaired judgment while exposure to oxides of nitrogen and sulphur is known to be associated with lung irritation, asthma and chronic obstructive pulmonary disorders [16]. Study by Arden Pope III et al., has described the association between fine particulate matter due to air pollution and cardiopulmonary mortality [17]. Similarly, a study by Ye F et al., has also shown that the concentration of nitrogen dioxide in the atmosphere was associated with the daily hospital emergency transports for asthma, myocardial infarction and angina in individuals more than 65 years of age [18]. The bus drivers are major victims to such air pollutants and their subsequent ill effects on health [11,19].

Puducherry, a small Union territory in Southern India is currently facing the problem of increasing noise and air pollution due to the growing population and industrialization [16]. Hence, this study was conducted on bus drivers in Puducherry as they are more vulnerable to the health hazards of noise and air pollution. Hearing Deterioration Index (HDI), Peak Expiratory Flow Rate (PEFR) and blood pressure (systolic and diastolic) was assessed among the bus drivers and were compared with those assessed among the individuals employed in office jobs.

MATERIALS AND METHODS

The study was accepted by the Indian Council of Medical Research for the Short-term Studentship project and was carried out in July-August 2014. It was conducted in the Department of Physiology, Indira Gandhi Medical College and Research Institute, Puducherry, after being approved by the Institute Ethical Committee. A written informed consent was obtained from all the study participants before recruiting them in the study.

The study involved two groups: a) Test group; and b) Control group

A. Test Group: Fifty male bus drivers in the age group of 30-50 years working under the Pondicherry Road Transport Corporation (PRTC), Puducherry, were included in the test group after receiving prior permission from the Managing Director, Pondicherry Road Transport Corporation.

B. Control Group: Fifty males in the age group of 30-50 years working as staffs, clerks or office assistants within the college premises were included in the control group.

Subjects with previous history of ear, nose and throat disease or those suffering from auditory impairment due to any cause (family history of hearing defects, ototoxic drugs etc) and those who were using hearing protective equipments were excluded from the study. Similarly, smokers, alcoholics and subjects with Diabetes mellitus, chronic respiratory disorders, cardiovascular diseases and psychiatric illnesses were also excluded from the study.

Estimation of Hearing Deterioration Index (HDI): HDI is considered as an indirect and simple method of measuring Noise Induced Hearing Loss [20]. It is often used as a screening tool during mass screening for NIHL in different subgroups of individuals. Hearing deterioration index was calculated using the standard formula:

$$HDI = 10\log_{10}\left[\int_0^t 10^{L/20}\,dt\right]$$

where 'L' is the average sound level in dBA to which the individual is exposed and 't' is the time in years during which the individual was exposed to the sound 'L'

Mean sound exposure level was measured following "International Electrotechnical Commission (IEC) guidelines" [21] using the Sound Level Meter approved and assisted by Puducherry Pollution Control Committee, Department of Science, Technology and Environment, Puducherry. For the test group, the average sound levels were assessed in busy areas of Puducherry where the bus drivers were frequently plying and for the control group the average sound levels were assessed within the college premises.

The total exposure time't' for the study participants was calculated based on their daily working hours and total service years. This information was collected using a simple pretested questionnaire which was used to collect information regarding the demographic data, occupational and medical history of the study participants.

Measurement of Peak Expiratory Flow Rate (PEFR): PEFR was measured in standing position in all the subjects following standardized procedures using the Mini Wright Peak Flow Meter. The subjects were asked to take a deep breath following which the peak flow meter was placed in their mouth. They were asked not to obstruct the mouth piece with their tongue and to close their lips tightly around the mouthpiece. After this, the subjects were asked to blow out as hard and fast as possible and the PEFR reading (litre/min) on the flow meter was noted down. The above procedure was repeated thrice giving an interval of one minute in between the recordings. The highest PEFR value among three readings was taken as the PEFR of the subject.

Recording of Blood pressure: Blood pressure was recorded in all subjects after 5 minutes of rest in sitting position using a manual sphygmomanometer and stethoscope. Two blood pressure readings were taken at an interval of 5 minute in each arm and the average of all the four readings was taken as the blood pressure of the individual.

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS version 16. The study variables namely HDI, PEFR, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) of the control and test groups were compared using unpaired t-test. The extent of correlation between the study parameters was determined by Pearson's correlation coefficient test. A p-value less than 0.05 were considered to be statistically significant.

RESULTS

Hearing Deterioration index, PEFR, systolic and diastolic blood pressure of 15 male bus drivers (43.4±7.1 years, mean age±SD) were compared with those of 15 age matched controls (43.3±9.6 years, mean age±SD). The mean sound exposure level for the test and control group was 83.30 dBA and 59.00 dBA respectively. HDI, SBP and DBP were significantly higher in drivers when compared to the controls. However, there was no significant difference in the PEFR values between the test and control group [Table/Fig-1].

Pearson correlation coefficient test was done to see the extent of correlation between HDI, service years, exposure level, systolic blood pressure and diastolic blood pressure [Table/Fig-2]. There was a highly significant positive correlation between HDI and service years and exposure level. Similarly, there was a significant correlation between exposure level and systolic and diastolic blood pressure.

Parameters	Control group (n=50) Mean ± SD	Test group (n=50) Mean ± SD	p-value
HDI	33.0738 ± 1.59307	53.4881± 1.93936	<0.001*
SBP (mm Hg)	118.00 ± 14.657	132.34 ± 18.073	<0.001*
DBP (mm Hg)	76.80 ± 10.453	85.94 ± 12.512	<0.001*
PEFR (litres/min)	365.20 ± 77.308	375.60 ± 87.904	.531

[Table/Fig-1]: Comparison of absolute values of the study parameters between the control and test Group.
Values are expressed as Mean (Standard deviation), *- highly significant
HDI- hearing deterioration index, SBP-systolic blood pressure, DBP-diastolic blood pressure, PEFR- peak expiratory flow rate

Parameters	Pearson Correlation Coefficient 'r' values
Hearing deterioration index and service years	0.892**
Hearing deterioration index and exposure level	0.986**
Exposure level and systolic blood pressure	0.403**
Exposure level and diastolic blood pressure	0.372**

[Table/Fig-2]: Extent of correlation between the various study parameters.
** p< 0.001

DISCUSSION

Worldwide, occupational noise is emerging as one of the most common cause for hearing loss among the individuals exposed to high intensity of noise [22-24]. The bus drivers are extremely vulnerable to the noise induced hearing loss as they are constantly exposed to high levels of traffic noise during their working hours [4,25]. Audiometry, an investigation which is done to assess the hearing capacity of the individuals may not be easily available in all centres. Hence, in this study we used the Hearing Deterioration Index, a very simple and an easy tool to measure the level of hearing loss among the study subjects. It was observed that the bus drivers had a significantly high NIHL when compared to their age matched controls. This is similar to that observed in previous studies [4,25-27] which have reported abnormal audiograms suggestive of hearing impairment among bus drivers using Pure tone Audiometry. In addition, a highly significant positive correlation was observed between the HDI and service years and exposure level. This finding is also in agreement with the results of previous studies [4,6,27,28] which have also shown that the prevalence of noise induced hearing loss was more among drivers with more number of service years.

Peak expiratory flow rate, an objective measure of airflow obstruction was done for the drivers and the control subjects. However, there was no significant difference in the PEFR values of these subjects. This is in contrast to the observations of previous studies [29-31] which have reported a decreased PEFR among the drivers. The absence of significant difference in PEFR between the bus drivers and the controls subjects in this study could be due to the small sample size.

Stress, a major issue faced by the bus drivers can make them more vulnerable to various cardiovascular morbidities [11]. It is known that constant exposure to high levels of sound can lead to increased sympathetic activity [32-34] and permanent changes in blood vessels resulting in increased blood pressure, heart rate

and increased risk of ischemic heart disease. Blood pressure, a simple index of cardiovascular status was assessed and compared among the test and control group subjects. Significantly high blood pressure values were observed among the bus drivers when compared to the control group. This is in line with the results of previous studies [6,27,35-40] which have also reported high blood pressure among the bus drivers. Furthermore, a strong positive correlation was seen between sound exposure level and systolic and diastolic blood pressures which is consistent with the results reported by Ndrepepa et al., [41]. Studies have also shown the link between prolonged exposure to various environmental air pollutants and cardiovascular morbidities [42-44]. Thus, the combined effect of noise and air pollution does seem to have a significant effect on the health of bus drivers.

Hence, special awareness and preventive programmes need to be conducted for the bus drivers to enlighten them about the harmful effects of noise pollution on their health and to stress the importance and need for the usage of protective ear devices. Enhanced bus designs and better implementation of noise control programmes will also aid in improving their overall health profile.

LIMITATION

The limitation of our study would be the relatively small sample size

CONCLUSION

Noise induced hearing loss and high blood pressure is very significant among the bus drivers. Hence, periodical medical examination in these individuals would help in initiating various curative and preventive measures at an early stage.

REFERENCES

[1] Daniel E. Noise and hearing loss: a review. *J Sch Health.* 2007;77(5):225–31.
[2] Bluhm G, Nordling E, Berglind N. Road traffic noise and annoyance--an increasing environmental health problem. *Noise Health*. 2004;6(24):43–49.
[3] Karimi A, Nasiri S, Kazerooni FK, Oliaei M. Noise induced hearing loss risk assessment in truck drivers. *Noise Health*. 2010;12:49–55.
[4] Pushpa K, Girija B, Veeraiah S. Effect of Traffic Noise on Hearing in City Bus Drivers of Bangalore. *Indian J Public Health Res Dev*. 2013;4(3):227–30.
[5] Janghorbani M, Sheikhi A, Pourabdian S. The prevalence and correlates of hearing loss in drivers in isfahan, iran. *Arch Iran Med*. 2009;12(2):128–34.
[6] Corrêa Filho HR, Costa LS, Hoehne EL, Pérez MAG, Nascimento LCR, de Moura EC. Noise-induced hearing loss and high blood pressure among city bus drivers. *Rev Saúde Pública*. 2002;36(6):693–701.
[7] Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, et al. Auditory and non-auditory effects of noise on health. *The Lancet.* 2014;383(9925):1325–32.
[8] Stansfeld SA, Matheson MP. Noise pollution: non-auditory effects on health. *Br Med Bull*. 2003;68(1):243–57.
[9] Münzel T, Gori T, Babisch W, Basner M. Cardiovascular effects of environmental noise exposure. *Eur Heart J*. 2014;35(13):829–36.
[10] Babisch W. Road traffic noise and cardiovascular risk. *Noise Health*. 2008; 10(38):27-33.
[11] Tse JLM, Flin R, Mearns K. Bus driver well-being review: 50 years of research. *Transp Res Part F Traffic Psychol Behav*. 2006;9(2):89–114.
[12] Rizwan S, Nongkynrih B, Gupta SK. Air pollution in Delhi: Its Magnitude and Effects on Health. *Indian J Community Med Off Publ Indian Assoc Prev Soc Med*. 2013;38(1):4–8.
[13] Subramani T. Study of air pollution due to vehicle emission in tourism centre. *Int J Eng Res Appl*. 2012;2(3):1753–63.
[14] Del Donno M, Verduri A, Olivieri D. Air pollution and reversible chronic respiratory diseases. *Monaldi Arch Chest Dis*. 2002;57(3-4):164–66.
[15] Uzoigwe JC, Prum T, Bresnahan E, Garelnabi M. The Emerging Role of Outdoor and Indoor Air Pollution in Cardiovascular Disease. *North Am J Med Sci*. 2013;5(8):445–53.
[16] Balashanmugam P, Ramanathan AR, Nehrukumar V. Ambient Air Quality Monitoring in Puducherry. *Int J Eng Res Appl.* 2012;2(2):300–07.
[17] Pope III C, Burnett RT, Thun MJ, et al. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA.* 2002;287(9):1132–41.
[18] Ye F, Piver WT, Ando M, Portier CJ. Effects of temperature and air pollutants on cardiovascular and respiratory diseases for males and females older than 65 years of age in Tokyo, July and August 1980-1995. *Environ Health Perspect.* 2001;109(4):355–59.
[19] Zuskin E, Mustajbegovic J, Schachter EN. Respiratory symptoms and lung function in bus drivers and mechanics. *Am J Ind Med*. 1994;26(6):771–83.
[20] Bies D A, Hansen C H. Engineering Noise Control. Third edition. London: Spon Press, UK; 2003.
[21] IEC Standard for Sound Level Meters. Electroacoustics - Sound level meters - Part 1: Specifications. *International Electrotechnical Commission (IEC)* 2002.
[22] Azizi MH. Occupational noise-induced hearing loss. *Int J Occup Environ Med*. 2010;1(3):116–23.
[23] Nandi SS, Dhatrak SV. Occupational noise-induced hearing loss in India. *Indian J Occup Environ Med*. 2008;12(2):53–56.
[24] Nelson DI, Nelson RY, Concha-Barrientos M, Fingerhut M. The global burden of occupational noise-induced hearing loss. *Am J Ind Med.* 2005;48(6):446–58.
[25] Lopes A, Otowiz V, Lopes P, Lauris J, Santos C. Prevalence of noise-induced hearing loss in drivers. *Int Arch Otorhinolaryngol*. 2013;16(04):509–14.
[26] Majumder J, Mehta CR, Sen D. Excess risk estimates of hearing impairment of Indian professional drivers. *Int J Ind Ergon*. 2009;39(1):234–38.
[27] Abdelmoneim I. Hearing impairment and hypertension among long distance bus drivers. *J Fam Community Med*. 2003;10(3):25–29.
[28] Patwardhan MS, Kolate MM, More TA. To assess effect of noise on hearing ability of bus drivers by audiometry. *Indian J Physiol Pharmacol*. 1991;35(1):35–38.
[29] Godbole SR, Godbole G, Rao A, Joshi AR. Measurement of peak flow rate in bus depot workers. *International Journal of Current Research*. 2015;7(7): 17633-35.
[30] Jain A, Singh M. Effect of occupational exposure to pollutants on peak expiratory flow rate of healthy non-smoking bus drivers in the age group of 20-55 years. *Journal of Clinical and Diagnostic Research*. 2012;6(2):176-79.
[31] Chattopadhyay BP, Alam J, Roychowdhury A. Pulmonary function abnormalities associated with exposure to automobile exhaust in a diesel bus garage and roads. *Lung*. 2003;181(5):291–302.
[32] Ising H, Kruppa B. Health effects caused by noise : Evidence in the literature from the past 25 years. *Noise Health*. 2004;6(22):5-13.
[33] Babisch W. Stress hormones in the research on cardiovascular effects of noise. *Noise Health*. 2003;5(18):1–11.
[34] Babisch W, Fromme H, Beyer A, Ising H. Increased catecholamine levels in urine in subjects exposed to road traffic noise: The role of stress hormones in noise research. *Environ Int.* 2001;26(7–8):475–81.
[35] Erhiano EE, Igbokwe VU, El-Khashab MM, Okolo RU, Awosan KJ. Prevalence of Hypertension among Commercial Bus Drivers in Sokoto, Sokoto State Nigeria. *Int Invent J Med Med Sci*. 2015;2(3):34–39.
[36] Lakshman A, Manikath N, Rahim A, Anilakumari VP. Prevalence and Risk Factors of Hypertension among Male Occupational Bus Drivers in North Kerala, South India: A Cross-Sectional Study. *ISRN Prev Med*. 2014;2014:318532.
[37] Mondal NK, Dey M, Datta JK. Vulnerability of bus and truck drivers affected from vehicle engine noise. *Int J Sustain Built Environ*. 2014;3(2):199–206.
[38] Johansson G, Evans GW, Cederström C, Rydstedt LW, Fuller-Rowell T, Ong AD. The effects of urban bus driving on blood pressure and musculoskeletal problems: a quasi-experimental study. *Psychosom Med*. 2012;74(1):89–92.
[39] Wang PD, Lin RS. Coronary heart disease risk factors in urban bus drivers. *Public Health*. 2001;115(4):261–64.
[40] Ragland DR, Winkleby MA, Schwalbe J, Holman BL, Morse L, Syme SL, et al. Prevalence of hypertension in bus drivers. *Int J Epidemiol*. 1987;16(2):208–14.
[41] Ndrepepa A, Twardella D. Relationship between noise annoyance from road traffic noise and cardiovascular diseases: a meta-analysis. *Noise Health.* 2011;13(52):251–59.
[42] Maheswaran R, Haining RP, Brindley P, Law J, Pearson T, Fryers PR, et al. Outdoor air pollution, mortality, and hospital admissions from coronary heart disease in Sheffield, UK: a small-area level ecological study. *Eur Heart J.* 2005;26(23):2543–49.
[43] Pekkanen J, Brunner E, Anderson H, Tiittanen P, Atkinson R. Daily concentrations of air pollution and plasma fibrinogen in London. *Occup Environ Med*. 2000;57(12):818–22.
[44] Peters A, Döring A, Wichmann HE, Koenig W. Increased plasma viscosity during an air pollution episode: A link to mortality? *Lancet*. 1997;349:1582–87.

PARTICULARS OF CONTRIBUTORS:
1. Student, Indira Gandhi Medical College and Research Institute, Puducherry, India.
2. Assistant Professor, Department of Physiology, Indira Gandhi Medical College and Research Institute, Puducherry, India.
3. Professor and Head, Department of Physiology, Indira Gandhi Medical College and Research Institute, Puducherry, India.
4. Associate Professor, Department of Physiology, Indira Gandhi Medical College and Research Institute, Puducherry, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Rajalakshmi Rajasegaran,
Assistant Professor, Department of Physiology, Indira Gandhi Medical College and Research Institute,
Puducherry-605009, India.
E-mail : rajalakshmimd@yahoo.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Oct 16, 2015**
Date of Peer Review: **Nov 25, 2015**
Date of Acceptance: **Dec 24, 2015**
Date of Publishing: **Feb 01, 2016**