IMPACT OF NOISE EXPOSURE ON THE AUDITORY HEALTH OF BENGALEE ADOLESCENT INDIVIDUALS OF KOLKATA

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Abstract: Noise exposure is considered as most unwanted and alarming hazard. In urban environment noise emitted from various sources, creates interference in communication and contributes negative impacts on health, both auditory and non-auditory. Educational institutions are the important environment for children to develop educational and intellectual performance. In this backdrop present work has been undertaken to study the auditory status of 88 male adolescents (aged between 16 -18 years) constituting exposed Group (EG) residing and attending educational institution in and around the metropolitan area of Kolkata.77 males of comparable age, residing in less noisy rural area constituted the control group (CG). Noise survey was carried out in different parts of the institutions and rage of sound pressure level was estimated. Audiometric test was carried out and the degree of hearing impairment was calculated. It has been observed that the noise exposed group of individuals (EG) was suffered from significant hearing impairment with extended degree of severity compared to rural group of study individuals (CG).

Keywords - noise exposure, children, audiometric assessment, degree of hearing impairment

I. INTRODUCTION

Noise exposure is one the most alarming environmental hazard of present era. In urban area different source of noise emitted from different transportation and other sources makes the environment more noisy and imposing threat to citizen's wellbeing. Elevated transportation noise level in metropolitan cities is usually exceeds the recommended criteria of national noise standards and policy to ensure public health in residential areas. Noise exposure severity in busy road intersections make the pedestrian more annoyed and noise induced human error, deviation in reaction time is a significant cause of road traffic injuries and deaths (Alimohammadi *et al*, 2015). Noise induced hearing loss considered as global burden was transmitted to the masses as silent epidemic and impose a barrier in social interaction. On the other hand noise exposure contributes considerable negative effect on the psychosocial development and wellbeing of individual (Niemann *et al*, 2006).Educational institutions are the most important environment for children to develop educational and intellectual performance. Whereas, noisy classrooms were interferes in children's speech understanding and language acquisition (Byrne *et al*, 2012; Muller *et al*, 2012). In urban areas, frequent impulsive transportation noise were poses the greatest risk for significant non auditory and auditory difficulties and occasional sensation of annoyance and tinnitus was occurred after single or repeated exposure (Babish *et al*, 2012; Mahboubi *et al*, 2013). In this backdrop, the present study was undertaken to assess the auditory status and degree of hearing impairment, among male adolescents residing and attending educational institution near noisy road intersection of Kolkata.

II.METHODOLOGY

On obtaining the permission from the institutional human ethical committee and educational institution located in Kolkata, the study was conducted on 88 urban male individuals with age range 16–18 years, residing and attending schools near noisy metropolitan area of Kolkata constituting the exposed group (EG).78 males of comparable age, permanently residing in relatively calm and quiet rural area, constituting the control group (CG). Individuals with self-reported auditory complications were excluded from the study. Information about their age (years) and socioeconomic condition was recorded in predesigned schedule. Stature (cm), using anthropometric measurement kit, with an accuracy of 0.1 cm and body weight (kg), using weighing scale with an accuracy of 0.1 kg with participants in light clothing and without shoes, were measured and Body mass index (BMI) was calculated. The sound pressure level of different parts of the concerned institutions and the audiometric room was checked periodically by using sound level meter (Belojevic *et al*, 2012). Audiometric assessment was carried out [Muller *et al*, 2012; Sarfaraz *et al*, 2009) with a portable audiometer for obtaining the hearing threshold at different frequencies (0.25–8 kHz) (Rao *et al*, 2014), for each individual at a time for both ears separately using the air conduction mode in pure tone [Costa Marques et al, 2015; Reneta de Souza *et al*, 2016). The hearing impairment status was assessed and degree of hearing impairment was calculated [Kochhar *et al*, 2007: Ubuoh *et al*, 2012]. Assessment of the psychological health of participants in the study with special reference to quality' of life, level of annoyance, irritation and concentration was assessed.Obtained data were tabulated and used for further statistical analysis with the chosen level of significance being 0.05.

III. RESULTS AND DISCUSSION

Basic profiles of CG and EG individuals are presented in Table 1. There is no significant difference in terms socioeconomic status among CG and EG individuals

Table 1: Basic characteristics of the study participants

Demographic feature	CG	EG
Residence	Rural area of Hooghly, WB	Urban area, Kolkata,WB
Religion, caste	Hinduism, general	Hinduism, general
School being attended	Public funded	Public funded

The physical characteristics of the CG and EG individuals are presented in Table 2. All the EG and CG male individuals were of comparable in respect of age, physical activity, stature (cm), body weight (kg) and BMI

Table 2 Physical and physiological profile of CG and EG

Variables	CG	EG
Sample size	77	88
Age (years)^	16 ± 0.52	16 ± 0.55
Stature (cm)^	163.2 ± 7.82	162.1 ± 8.95
Body weight (kg)^	52 ± 11.70	52.5 ± 11.03
BMI^	19.1 ± 2.35	19.9 ± 3.51

AM± SD ^=ns

In Fig. 1, the average hearing threshold in dB (A) at different frequencies for left and right ears of the CG and EG individuals has been graphically presented. As the present study conducted on adolescent male individuals was aimed to assess the impact of noise exposure on auditory status, the assessment was started with assessing impact on average threshold shift. In the present study the audiometric assessment was conducted on all EG individuals on both ears separately.

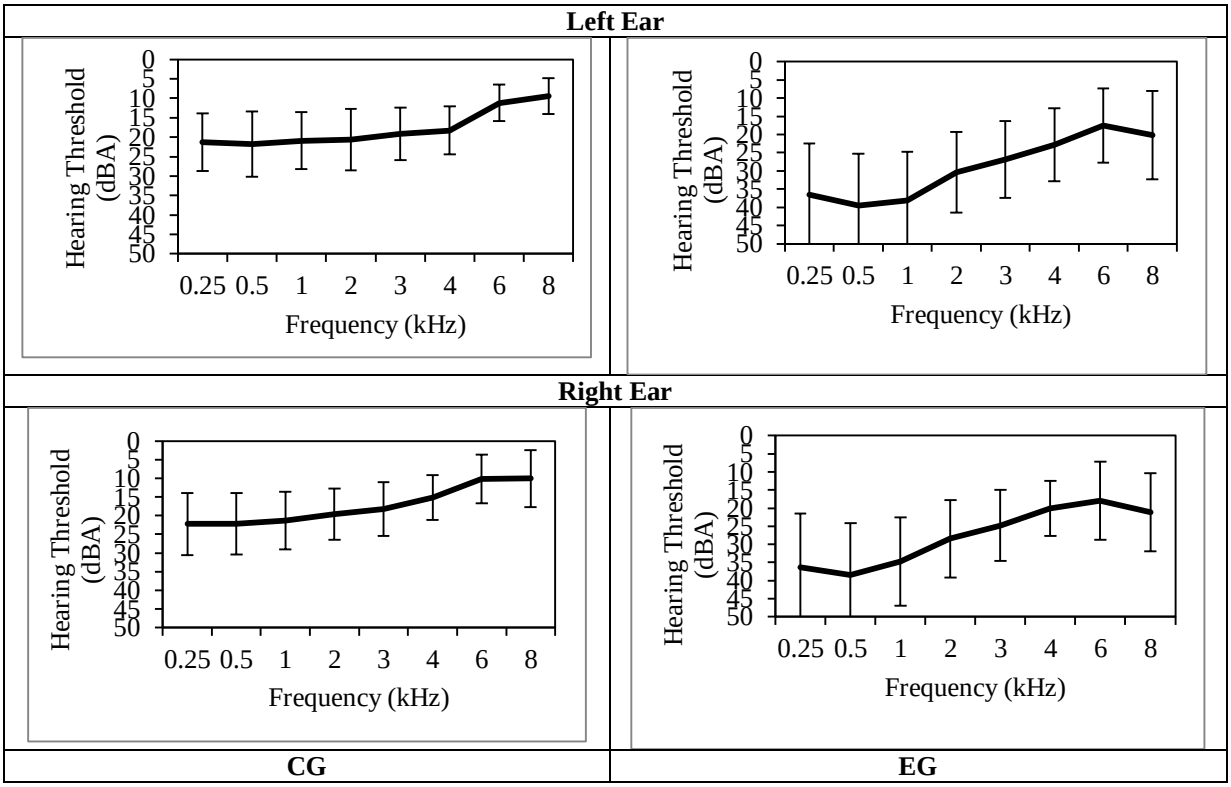

Figure 1: Average hearing threshold in dB (A) at different frequencies (0.25–8 kHz) for left and right ears, of the CG and EG individuals

It was observed from the audiogram that average threshold shift in both left and right ear was present at speech frequencies among EG individuals. On the other hand no threshold shift was observed among their respective CG counterparts (fig. 1). The present findings are in consonance with other studies carried out on schools close to the road-side, and reported that loud noise levels affected the students adversely in terms of auditory status (Mondal *et al*, 2014).The similar trend of result also observed earlier study conducted of students exposed to railway transportation noise(Chatterjee *et al*, 2015a) and individuals involuntarily exposed elevated noise levels (Chatterjee *et al*, 2014a; Chatterjee *et al*, 2014b; Chatterjee *et al*, 2015b; Chatterjee *et al*, 2015c).

The bilateral hearing impairment status of the study participants as per WHO hearing impairment classification has been presented in fig. 2.

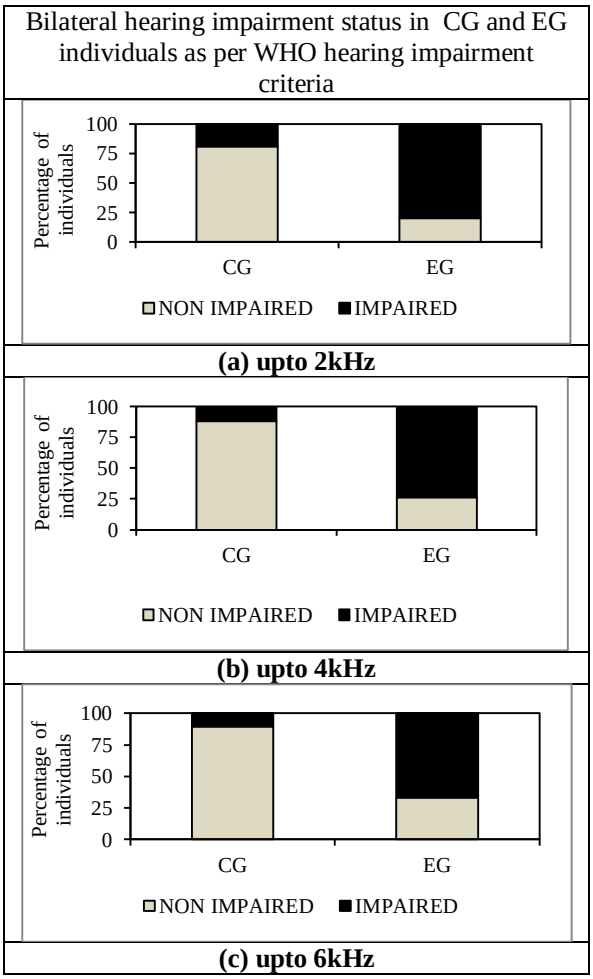

Figure 2: Comparison between CG and EG individuals in respect of Bilateral Hearing Impairment status as per WHO hearing impairment classification (a) upto 2kHz, (b) upto 4kHz and (c) upto 6 kHz

The degree that is extent of bilateral hearing impairment status, computed as per the WHO impairment status calculation criteria, has been presented in fig.3.

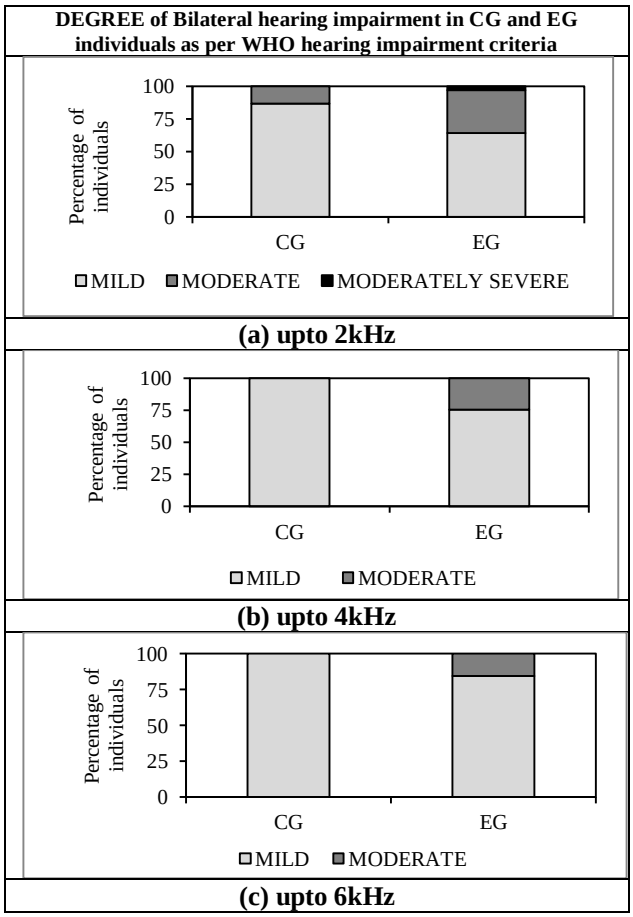

Figure 3: Degree of Hearing Impairment status of CG and EG impaired individuals

From the present finding, it has been observed that, ,among 70 impaired EG individuals, 63.9 % suffer from 'mild' hearing impairment, about 32.9% from 'moderate' hearing impairment and even 3.2% suffer from 'moderately severe' hearing impairment considering up to 2 kHz; in case of CG, among 15 impaired individuals, it has been observed that there was also 86.6 % of these 15, i.e., 13 individuals suffered from 'mild' type of hearing impairment and 13.4 % of these 15, i.e. 2 individuals suffer from 'moderate' type of hearing impairment. When the analysis has been carried out considering up to 4 kHz level, it has been observed that, among 65 impaired EG individuals, 75.3% and 24.7% EG individuals suffered from 'mild' and 'moderate' degree of hearing impairment respectively, compared to their rural CG counterparts where all 9 impaired individuals are only having 'mild' type of hearing impairment. Further when analysis was carried out considering up to 6 kHz level, it has been observed that among 59 impaired individuals, 84.7 % EU1 individuals suffered from 'mild' and 15.3% from 'moderate' degree of hearing impairment and in case of CG, the trend was similar like 4 kHz level i.e. all the impaired individuals i.e. all 8 individuals were only having 'mild' type of impairment. In case of degree of impairment status depicted in fig 3, the trend of result is reflecting that EG individuals in lower frequency are seriously suffering from even moderately severe degree of hearing impairment whereas the CG individuals are in significantly better condition. The results of the present study are in agreement with the findings of other studies carried out on school going children in Cairo, Egypt, wherein the significant hearing impairment has been observed among school children residing in busy metropolitan area (Ahmed *et al*, 2010).The similar trend of was observed among school children exposed to community noise including railway transportation noise (Chatterjee *et al*, 2016; Chatterjee *et al*, 2018a; Chatterjee *et al*, 2018b)

In the present study, Quality of life (QOL), an important indicator of individual psychosocial wellbeing, has been considered and the comparisons between CG and EG individuals, have been presented in fig 4.

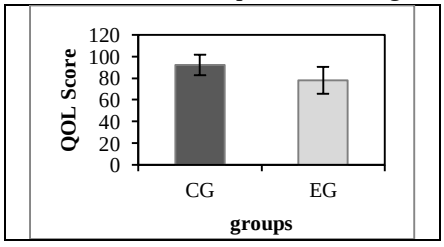

Figure 4: Comparison between CG and EG individuals in respect of QOL

In the present study it has been observed that both male and female individuals CG participants performed with significantly ($P<0.05$) better QOL score compared to their EG individuals. The results of the present study are in tune with previous studies that suggested in children, that transportation noise exposure is unlikely to be associated with serious psychological illness. However, there may be effects on wellbeing and quality of life (Clark *et al*, 2018)

IV. CONCLUSION

On the basis of the study conducted, it can be concluded that adolescents residing and attending schools in noisy metropolitan area, are having significantly (P<0.05) adverse hearing impairment status compared to the individuals residing and attending the schools located in calm and quiet rural area. The quality of life status of the adolescent individuals exposed in noisy environment is found to be poor compared to rural group of individuals.

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REFERENCES

1) Alimohammadi, I., Zokaei, M., Sandrock, S. 2015.The Effect of Road Traffic Noise on Reaction Time. Health Promotion Perspectives, 5(3): 207-214.
2) Ahmed, S. F., Maha, H. A. E., Rahman, M. Y. A.,Fathy,S.I.2010.Hearing Impairment and Middle Ear Disease in Primary School Children in Cairo. Med. J. Cairo Univ, 78:219-224.
3) Byrne, D.C., Themann, C.L., Meinke, D.K., Morata, T.C., Stephenson, M.R. 2012.Promoting Hearing Loss Prevention in Audiology Practice. Perspect Public Health Issues Relat Hear Balance, 13:3-19.
4) Belojevic, G., Evans, G.W., Paunovic, K., Jakovljevic, B.2012.Traffic Noise and Executive Functioning in Urban Primary School Children: The Moderating Role of Gender. J Environ Psychol, 32: 337–341.
5) Babisch, W., Schulz, C., Seiwert, M. C.2012. A Noise Annoyance as Reported by 8- To14-Year-Old Children. Environ Behav, 44(1):68–86.
6) Costa Marques, A. P., Miranda Filho, A. L., Rego Monteiro, G. T., 2015. Prevalence of Hearing Loss in Adolescents and Young Adults as a Result of Social Noise Exposure: Meta-Analysis, Rev. CEFAC, 17(6):2056-2064.
7) Chatterjee, S., Chatterjee, A., Santra, T., Mitra, S., Mukherjee, S. 2014a: Relationship between Audiometric Configuration and BMI in Organized Sector Human Resources. In: User Centred Design and Occupational Wellbeing, McGraw Hill Education, 674 – 677.
8) Chatterjee, A., Chatterjee, S., Banerjee, N., Mukherjee, S. 2014b. Impact of Noise in Human Resources Occupationally Engaged. Impact of Pollution: assessment and awareness (ISBN 978-81-921083-8-4), 137-141.
9) Chatterjee, S., Chatterjee, A., Chatterjee, S., Santra, T., Bhattacharjee, S., Mukherjee, S. 2015 a. A study on The Auditory Status of Adolescent Students Attending School near Railway Tracks. Quad Scientific Reporter (ISBN 978-81-925784-4-6) 30-36.
10) Chatterjee, S., Chatterjee, A., Chatterjee, S., Banerjee, N., Santra, T., Mukherjee, S. 2015b: A Study to Evaluate The Effects of Occupational Noise on Hearing Threshold in Human Resources Occupationally Engaged in Organized Sector. International Physiology (ISSN-2347-1506), 3(1): 29-34.
11) Chatterjee, S., Banerjee, N., Mukherjee, S.2015.Impact of Occupational Noise in Transportation Sector HR, Ergonomics for rural development (ISBN 978-93-5174-905-9), 161–166.
12) Chatterjee, A., Chatterjee, S., Banerjee, N., Mukherjee, S.2014a. Impact of Noise In Human Resources Occupationally Engaged. Impact of Pollution: Assessment and Awareness (ISBN 978-81-921083-8-4), 137-141.
13) Chatterjee, S., Chatterjee, A., Chatterjee, S., Mukherjee, S. 2014 c. A Study on Auditory Status of Children Residing in the Vicinity of an Airport. Impact of pollution: Assessment and Awareness,NP (ISBN 978-81-921083-8-4) 142 -146.
14) Chatterjee, A., Chatterjee, S., Banerjee, N., Santra, T., Mukherjee, S. 2015b. Study on Hearing Status of Children Residing Near an Airport. Ergonomics for rural development (ISBN 978-93-5174-905-9), 197-202.
15) Chatterjee,S., Chatterjee, A., Chatterjee, S., Banerjee, N., De, S., Mukherjee, S.2017. Study on Auditory Status and Annoyance Level of Male Adoscent Residing in the Vicinity of an Airport, 15th International Conference on Humanizing Work and Work Environment HWWE-2017, Excel Publishers, New Delhi (ISBN Number: 978-93-86724-25-0),153-156.
16) Chatterjee, S., Chatterjee, A., Chatterjee, S., Santra, T., Mukherjee, S.2016. Impact of Community Noise on Auditory Status and Cognitive Ability of Bengalee School Going Children of Kolkata, 14th International Conference on Humanizing Work and Work Environment HWWE-2016,(ISBN Number: 978-93-83006-81-6)pp.153-156.
17) Chatterjee, S., Chatterjee, A., Chatterjee, S., Santra, T., Mondal P., Banerjee, N.,Mukherjee, S. 2018a. A Study on Auditory Status of School Going Children Residing Near Railway Track. G.G. Ray et al. (eds.), Ergonomics in Caring for People,Springer Nature Singapore Pte Ltd(https://doi.org/10.1007/978-981-10-4980-4_11),83-90.
18) Chatterjee S, Chatterjee A, Chatterjee S, Bhattacharjee S, Banerjee N, Mukherjee S.2018b. A Study on Impact of Environmental Noise on Auditory Status of School Going Children of Kolkata ,16th International Conference on Humanizing Work and Work Environment HWWE-2018, Excel Publishers, New Delhi, (ISBN Number: 978-93-88237-27-7) 98.
19) Clark. C., Paunovic. K. 2018b. WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Quality of Life, Wellbeing and Mental Health. Int. J. Environ. Res. Public Health, 15:1-27.
20) Kochhar, A., Hildebrand, M.S., Smith, R.J.H.2007. Clinical Aspects of Hereditary Hearing Loss. Genetics in Med. 9: 393-408.
21) Müller, R., Fleischer, G., Schneider, J. 2012. Pure-Tone Auditory Threshold in Schoolchildren. Eur Arch Otorhinolaryngol, 269:93-100.
22)Mahboubi, H., Oliaei, S.,Karam, W., Ziai,B.k., Chang, J., Zardouz, S., Shahriari, S, Djalilian,H. R. 2013. Systematic Assessment of Noise Amplitude Generated by Toys Intended for Young Children. Otolaryngology–Head and Neck Surgery, 148(6): 1043–1047.
23) Mondal, N. K., Ghatak, B.2014.Vulnerability of School Children Exposed to Traffic Noise. International Journal of Environmental Health Engineering, 3: 45-52.

24)Muller, R.., Fleischer, G., Schneider, J.2012. Pure-Tone Auditory Threshold in School Children. Eur Arch Otorhinolaryngol 269, 93–100.
25) Niemann, H., Bonnefoy, X., Braubach, M., Hecht, K., Maschke, C., Rodrigues, C., Röbbel, N.2006. Noise-induced Annoyance and Morbidity Results from the Pan-European LARES Study. Noise Health, 8(31): 63–79.
26) Rao, V., Suraneni, V., Osuri, V.S., Uppalapati, P., Amara, A.2014. Prevalence and Etiological Factors Causing Hearing Loss in School Going Children. Int J Sci Study, 2(9): 36–40.
27)Sarafraz, M., Khashayar, A. 2009. A Practical Screening Model for Hearing Loss in Iranian School-Aged Children. World J Pediatr, 5:46.
28) Ubuoh, E.A., Akhionbare, S.M.O., Ogbuji, S.I.2012. Perception of Health-Impacts of Environmental Noise. Int J Adv Appl Sci, 1(3):101–107.