Original Article

The effect of traffic noise on the hearing level of people on Karachi streets

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Abstract

Objective: To study the effects of traffic noise on hearing ability of subjects prone to traffic noise exposure.

Method: A hospital based prospective study was performed comprising of 200 selected subjects significantly exposed to traffic noise. These included rickshaw drivers, traffic constables and shopkeepers in central business area. All subjects were questioned according to a Performa after which ENT examination was carried out followed by Pure Tone Audiometery.

Results: Hearing impairment showed correlation with the duration of job when analyzed by linear regression analysis with correlation coefficient r=0.36 ($p<0.001$), Hearing impairment was 33.81+0.42 dB according to the duration of job (in years).

Conclusion: Subjects are perceptually exposed to potentially damaging sound pressure level in the metropolis of Karachi. It was observed that audiologically consistent noise induced hearing loss was found to be 0.42 dB per octave from 500Hz to2000Hz per year of duration of job (JPMA 60:813; 2010).

Introduction

Noise induced hearing loss is the fourth most frequently self-reported and work related illness in UK.[1,2] Human hearing and hair cells of the inner ear are sensitive over a wide range of sound pressures from the quietest whisper to a jet air craft take-off. In the latter situation ear protectors are advised because at the top end of noise range, hair cells can be damaged.

The hearing loss can be represented by a temporary (TTS) or permanent threshold shift (PTS).[3] One mechanism of

noise induce hearing loss (NIHL) involves structural damage ranging from disturbance of delicate stereocilia to tearing of organ of corti and eventually permanent hair cells loss.[3] Cochlear dysfunction and consequent hearing loss also cost change in the organization of the central auditory pathway especially within the primary auditory cortex.[4] The damage to the inner ear results in permanent deafness of varying degrees.

Karachi is the metropolitan city of Pakistan with a population of around 20 million people and more than 8 million vehicles plying[5] on its roads. Residents of Karachi are under a constant threat of traffic noise pollution. Numerous studies have been conducted on the subject of noise pollution in Karachi. The leq of Karachi is 80 dB[6] (A). The noise pollution level (NPL) is 99 dB (A) +5 and general noise index is 460.[7]

The fact that traffic is the most significant source of noise in this city has also been established.[8] A large percentage of the noise is contributed by Auto Rickshaws that produce noise level up to 100 to 110 dB. It directly affects the hearing of drivers. In Karachi, the public remains unaware of this disability until irreversible damage has occurred. This will lead the nation to overall high incidence of hearing loss unless drastic measures are taken.

The objective of this research was to study the hearing loss of subjects who are attached to high risk occupations.

Subject and Methods

A hospital based prospective study, statistically designed to evaluate the effects of traffic noise on hearing was conducted in 2001 on a sample collected from Karachi. Four categories of subjects, considered to be most significant among those exposed to traffic noise were selected. The sample included, Rickshaw Drivers, Traffic Constables and Shopkeepers (in central business areas). Controls were randomly taken from Outpatients department and who were not attached occupationally with a noisy atmosphere e.g. office workers and medical students. All subjects matched in age and gender. Those who had a positive history of ear diseases were excluded A questionnaire was used to record the demographic details of subjects which included age, duration of job in years and working hours. Consent was taken from each subject and audiometery was carried out at ENT Department, Jinnah Postgraduate Medical Centre. The biased were eliminated to significant degree during the study; however, a margin of error was set at 5% in a sample.

According to the Goodman Classification,[8] communicative effects of hearing impairment are based on the average impairment at the speech frequencies (500, 1000, 2000 Hz), except in cases (with sharply falling configuration), where it is appropriate to use the best two of three frequencies as recognized by WHO.[10,11]

Hearing impairment was classified in terms of degree of loss:

Hearing Loss (dB)	Degree of Hearing Loss
< 26	Normal Hearing
26-40	Mild
41-55	Moderate
56-70	Moderately severe
71-90	Severe
> 90	Profound

(WHO International Classification of Impairment, Disabilities and Handicaps.[11]

Statistical analysis:

The quantitative values of the subject were calculated as MEAN ± S.D. In most cases where extreme values existed, the median of observation was taken as average. The distribution of cases among various criteria was represented by their percentage. The results were considered to be statistically significant if P value was less than or equal to 0.05. All the analysis and computation including the data based development was done in the package of EPI INFO 6 Ver. 3.02, a word processing database and statistical programme for public health centers for disease control and prevention (CDC,USA) and World Health Organization, Geneva- Switzerland. To know the interrelation between two quantitative variables, the linear regression analysis was done and the correlation coefficient was computed and tested by t-test.

Results

In this hospital based study of 200 subjects, 27 (13.5%) were Rickshaw Drivers, 35 (17.5%) were Traffic Constables, 79 (39.5%) were shopkeepers and 59 (29.5%) were controls. The results were obtained by testing the subjects by Pure Tone Audiometery.

The age of all 200 subjects varied from 15 to 80 years; therefore the subjects were classified in eight decades. The mean age was 37.72 ± 12.82 and median age 35 years. The duration of the job varied from 1 to 50 years with median duration 11 years. Hence, the subjects were classified in five decades as shown in Table-1. Almost 72 (40 %) out of 179 subjects were in 10 to 19 years job duration.

Table-1: Duration of Job. (179 out of 200 subjects were employed).

Duration of job in years	Number of Subjects
0-9	61(34.1%)
10-19	72(40.2%)
20-29	29(16.2%)
30-39	12(6.7%)
40-49	4(2.2%)
50-59	1(0.6%

Median = 11 years.

Table-2: Noise induced hearing loss in Subject in various professions. (Sample size of 200 persons).

Subject	Normal <26 (dB)	Mild 26-40 (dB)	Moderate 41-55 (dB)	Moderately severe 50-70 (dB)	Severe 71-90 (dB)	Profound > 90 (dB)
Right Ear						
Control	44	10	4	1	0	0
Rickshaw Drivers	20	4	2	1	0	0
Shopkeepers	45	23	8	3	0	0
Traffic Constables	6	13	13	1	2	0
Left Ear						
Control	40	13	2	2	2	0
Rickshaw Drivers	21	4	2	0	0	0
Shopkeepers	43	27	5	2	2	0
Traffic Constables	10	15	6	3	0	1

Table-3: Noise induced hearing loss in relation to duration of job. (Sample size of 200 persons).

Duration of job (years)	Normal <26 (dB)	Mild 26-40 (dB)	Moderate 41-55 (dB)	Moderately severe 50-70 (dB)	Severe 71-90 (dB)	Profound > 90 (dB)
Right Ear						
0-10	46	24	8	1	0	0
11-20	35	17	9	2	1	0
21-30	14	4	4	1	1	0
31-40	5	1	3	1	0	0
>41	0	1	0	1	0	0
Left Ear						
0-10	49	27	1	0	2	0
11-20	33	21	7	1	1	1
21-30	14	3	3	3	1	0
31-40	3	3	3	1	0	0
>41	1	0	0	0	1	0

The results were recorded in computerized tabular spreadsheets and are shown in Tables 2 and 3. Hearing impairment showed correlation with the duration of job when analyzed by linear regression analysis with a correlation coefficient $r = 0.36$ ($p < 0.001$) and hearing impairment = 33.81 ± 0.42 per year of job duration. The study showed correlation between hearing impairment and subjects with NIHL, when tested by Chi-Square, 24.38 test of proportion with $p<0.001$ (excluding controls). These are distributed as 15(17.5%) in control group, 7(8.2%) Rickshaw Drivers, 34(40%) Shopkeepers and 29(34.1%) Traffic Police Constables. Hearing impairment showed correlation with age when analyzed by linear regression analysis with correlation coefficient $r = 0.42$ ($p < 0.001$), hearing impairment = 25.78 + 0.3507 age in years. Hearing impairment showed correlation with age more than 50 years when analyzed by linear regression analysis with correlation coefficient $r = 0.43$ ($p < 0.05$), hearing impairment = 4.55 + 0.72 age. Hearing impairment showed correlation with age less than 50 years when analyzed by linear regression analysis with correlation coefficient $r = - 0.04$ (Non-significant), hearing impairment = 38.83 - 0.05 age.

Discussion

Everyday noise exposure, over prolonged time has an impact on the hearing ability. The mechanism of excessive noise inducing hearing loss includes direct mechanical damage of cochlear structure and metabolic overload due to over stimulation.[12,13] In the United States, the Occupational Safety and Health Administration (OSHA) has set standards and guide lines for noise exposure in order to protect workers. All employees who are exposed to greater than 85 dB time weighted average must be enrolled in Hearing Conservation Programme and provided with hearing protection. OHSA's Standards limit employees exposure to noise as follows: if time weighted average is 90 dB (which is equivalent to the noise made by a power lawn mower) the exposure allowed is 8-hours; at 95 dB 4-hours of exposure is allowed and at 100 dB 2-hours are permitted.[14] This study confirmed that the continuous to high level of noise can cause hearing impairment in individuals. It is clear that African and African-American are less prone to acquired hearing loss than Caucasians.[15] It has also been established that most people will not experience hearing loss if the noise level does not exceed 85 to 90 dB.[16] The present study showed a drop of 0.42 dB per octave from 500 Hz to 2000 Hz after one year of duration of job. This fact is supported by epidemiological studies that compare the prevalence of the hearing loss in different categories of the noisy occupations.[17-19]

Noise is the commonest cause of preventable sensorineural loss in the world.[19] The problem needs to be addressed as there is no medical therapy for hearing loss caused by noise. Once established, the hearing loss is irreversible because loud noise wears off the delicate hair cells in the inner ear which translate sound into nerve impulses.[20] The main social consequence of the hearing impairment is the inability to understand speech in normal conditions, which is considered as a severe handicap. Therefore public education is important and the population must be persuaded that good health is a right and no employer should neglect the health and welfare, including the hearing of his employees. The citizens of Karachi, particularly those living or working in commercial areas are constantly exposed to harmful noise levels.[21] Legislation is required to reduce dangerous noise levels and to protect people at risk. Legislation should be enacted in industries and cities. No legislation works unless the legislator, citizen and authorities all believe in its validity. The government concerns have been expressed particularly in relation to traffic. The general public is largely unaware of the dangers of exposure to high noise levels. Globally it is estimated, that in the age range between 40 to 59 years about 3.4% of population have a hearing loss exceeding 40 dB (1/2, 1,2,4 kHz). In the better ear in the age above 60 years, the figure rises to 14%.[22] This study showed that hearing impairment started after every one year of age advancement i.e. a drop of 0.35 dB per octave from 5090 Hz to 2000 Hz. It was also observed that before 50 years of age hearing impairment was insignificant. After crossing 50 years, when presbyacusis interacts with noise, a more severe hearing impairment was produced. The noise standard ISO 1999 (1990) addresses the issue of age and noise. It suggests that the two are additive except in high level of noise where there is slightly less additional effect from presbyacusis than predicted. If all hearing is lost from noise than aging cannot have an effect and vice versa.[23] Noise and aging are only totally additive with moderate amount of noise in young and middle aged people.[24] Excessive noise can damage hearing. The Otologist helps people working with excessive noise to preserve hearing so that wanted sound can be heard.

Conclusions

This study concluded that the subjects studied were perceptually exposed to potentially damaging sound pressure levels within the metropolis of Karachi. It showed a strong direct association between noise induced hearing loss and the duration of exposure time. A drop of 0.42 dB per octave from 500 Hz to 2000 Hz per year of job duration was ascertained.

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