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Hearing Loss Due to Occupational Exposure: An Analysis of Cases at Lahore

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ABSTRACT

Objective: To study the severity of noise-induced hearing loss and noise levels in the environment in occupationally exposed individuals.

Study Design: Prospective longitiginal study.

Place and Duration of Study: Tertiary care hospital, Lahore Pakistan, from Dec 2019 to Jun 2020.

Methodology: The noise levels and duration of exposure to loud noise were measured at various exposure points to define ways and means for future prevention.

Results: Out of 3000 patients reporting to the ENT outpatient department for various problems, 33.3% had ear problems. Out of 1000, 750 had hearing loss with normal tympanic membranes. Among 750, 200 (26.6%) had conductive hearing loss, while 550 (73.3%) had sensorineural hearing loss. Out of 550, 70 (12.72%) were related to occupational exposure in service and 480 (87.2%) were due to various causes. Most patients reported from the security wing (40, 57.14%) being exposed to the loud noise as a pulsed exposure, followed by patients in the telecommunication field (20, 28.57%) being exposed to persistent noise.

Conclusion: Occupational exposure to loud noise in the workplace poses significant health issues, including an economic burden on an individual. NIHL related to occupational exposure to loud sounds is frequently reported worldwide. Education and prevention are two vital steps which can reduce the number of such cases significantly, thus preventing this lifelong disability, ensuring health and reducing the economic burden.

Keywords: Audiometry, Hearing loss, Noise, Occupational hazard.

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INTRODUCTION

Hearing loss can occur for a variety of reasons, but loss due to exposure to loud noise at the work-place, otherwise called "occupational hearing loss", makes one important cause.[1,2] We are exposed to various sounds at different intensity levels in our surroundings daily. Some levels are harmful and some not, but one must consider that sounds at lower intensity levels, when heard for a longer period, can cause damage. So either a short burst of high sound intensity level or at low-intensity level but the longer period can cause a detrimental effect on health.[3]

All ages are vulnerable to damage, as was seen in one centre for disease control and prevention, a CDC study conducted in 2011/2012 which showed that at least 10 million (6%) of US adults below the age of 70 yrs were having hearing loss in one or both ears after exposure to loud noise. It also showed that almost 17% of teens aged 12 to 19 years had features of hearing loss in one or both ears, and the cause in many cases was related to noise exposure, which was very much preventable.[4]

Exposure to loud sounds can affect hearing in a variety of ways. It can cause temporary changes (temporary threshold shift), which later on recover or permanent (permanent threshold shift). Loss can be unilateral or bilateral. Sometimes the damage has started but is not noticeable to the individual, and when picked up by an audiologist, it is too late to recover. Whatever the cause, simple lifestyle modifications can prevent this damage which has devastating effects on health and finances, too.[5,6]

Noise-induced hearing loss can occur suddenly like when exposed to loud pulsed sounds such as recreational activities with music or especially the use of Hand free where the ear is exposed to sound being generated very close to the tympanic membrane. There are professions where the duration of work exceeds the safe permissible limit of exposure to sound, and unfortunately, governing rules for the safety of employees are either missing or not followed, especially in Asia.[3,7,8]

Another important factor is the distance from the source of origin of the sound; if it is increased, the chances of damage to the vital organ decreases. So as

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prevention is better than cure, less intense sound with less duration of exposure and a long distance from the source of sound will be less detrimental for ear damage. Figure-1 showed a normal audiogram and one with sensorineural hearing loss.[5] The objective of this study was to see the noise-induced hearing loss in various occupational setups so that preventative measures could be taken to avoid such loss.

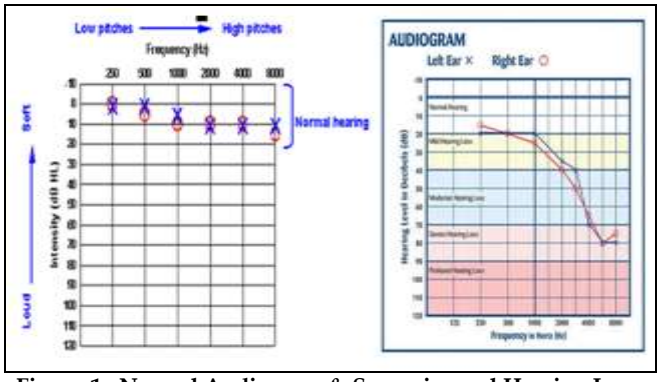

Figure-1: Normal Audiogram & Sensorineural Hearing Loss

METHODOLOGY

It was a prospective longitiginal study carried Tertiary care hospital Lahore Pakistan, from December 2019 to June 2020. The consent to carry out the study was taken from the ethics review committee (ERC/21-18058). The sampling technique was non-probability consecutive sampling. Amplivox 116 pure tone audiometer calibrated on 9th June 2019 was used for the study.

Inclusion Criteria: All patients in their age up to 50 years reporting to ENT OPD with hearing loss were included in the study.

Exclusion Criteria: Patients with systemic illnesses like diabetes or altered thyroid functions; chronic suppurative otitis media (all types); recurrent acute otitis media; patients with altered Eustachian tube functions; Nasal pathologies; patients of presbyacusis; age more than 50 yrs were excluded from the study.

All patients with sensorineural hearing loss, especially in high frequencies, with a history of occupational noise exposure, were to undergo baseline lab investigations along with blood sugar levels and thyroid profiles, followed by a detailed medical examination by a medical specialist to rule out syste-mic illnesses. In addition, routine ENT examinations and pure tone audiograms were carried out. On the ground, at the site of duty, noise levels were monitored with a commercially available sound meter and counter-checked with an android application to minimize chances of error and the duration of noise exposure.

Statistical Package for Social Sciences (SPSS) version 20.0 was used for the data analysis. Frequencies and percentages for the type of hearing loss were calculated. Severity, i.e., mild, moderate and severe, was also calculated in percentage and frequencies.

RESULTS

A total of 3000 patients reported to ENT OPD for various problems, out of which 1000 had ear problems. Out of those 1000 patients, 75% had hearing loss with normal-looking tympanic membranes. Among those 750, 200 (26.6%) had conductive hearing loss, while 550 (73.3%) were sensorineural hearing loss. Out of 550, 70 (12.72%) were related to occupational exposure in service (after excluding all other probabilities of loss as mentioned in the exclusion criterion), and 480 (87.2%) were due to various causes (Figure-2).

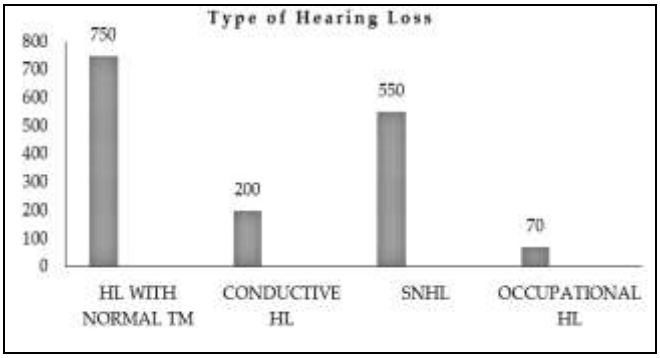

Figure-2: Types of hearing loss (n=1000)

As far as the severity of hearing loss was concerned, mild hearing loss cases were 30 (42.8%), moderate hearing loss cases were 27 (38.5%), and severe hearing loss cases were 13 (18.5%).

DISCUSSION

There are multiple definitions of noise-induced hearing loss. Various frequencies are considered in defining the loss, which includes 0.5-2 kHz, 0.5-4 kHz and 3-6kHz. Some definitions consider the loss in both ears; some focus on the better ear only, while in some cases, the worse ear is considered.[9] The laws in various countries vary as far as occupational hearing loss is considered, thus making it difficult to standardize criteria for loss and thus comparing results of various studies from different countries may be difficult. One very simple definition of noise-induced hearing loss is a permanent hearing impairment resulting from prolonged exposure to a high noise level.

All this process of noise causing hearing loss can be understood better if we know how our hearing mechanism works. It is a complex process of events that occur one after the other, and the result is perception and recognition of sound and interpretation by the brain.[10,11]

Sound waves in air are directed through our external auditory canal, which is placed so that a maximum of waves efficiently hit the tympanic membrane, thus causing it to vibrate. In turn, the vibration of a membrane makes tiny ossicles in the middle ear transmit waves of sound to the cochlea, a snail-like structure filled with fluid. Here, the wave from the air is about to travel through fluid for onward conversion to an electrical stimulus. Basilar membrane in fluid channel carrying hair cells and fine stereocilia when moves, causes opening of tiny channels thus releasing chemicals into the cells creating electrical activity which is carried by the auditory nerve to the brain for perception and translation into sound.[12,13]

These hair cells and the delicate stereocilia that, once damaged, will never regenerate, unlike birds and amphibians, leading to permanent disability. Table showed the permissible exposure limits for noise, and as shown, the limit of exposure drastically falls as the intensity of sound increases. Different studies have been conducted under different environmental conditions to evaluate the effects of noise exposure on hearing, including in the aviation industry.

Table: Safe Permissible Limit for Sound Workplace Safety and Health Advisory Committee Recommendations (WSHAC)

Sound Intensity (DB)	Max Duration/ Day
85	8 hours
86	6 hours 21 minutes
87	5 hours 2 minutes
88	4 hours
89	3 hours 11 minutes
90	2 hours 31 minutes
91	2 hours
92	1 hour 35 minutes
93	1 hour 16 min
94	1 hour
95	48 minutes
96	38 minutes
97	30 minutes

A study published by Jawed *et al*. in JPMA showed the effects of traffic noise on hearing. The study was conducted on Karachi streets. There was a correlation between hearing impairment and duration of exposure. Analysis was carried out by linear regression with a correlation coefficient of r=0.36 (p<-0.001). Hearing impairment was 33.81±0.42dB according to the job duration (in years).[5]

Another study by Shahid *et al*. was carried out on textile workers in Karachi, Pakistan and hearing loss was assessed via serial audiological examinations and otoscopic findings. The total number of candidates was 264; among these, 79% had hearing loss of more than 25dB.[6]

Siddiqui *et al*. conducted a study in 2013 in which the effect of traffic noise on hearing was studied at various places of Karachi like Gurumander, Marry weather tower and Tibet centre. He studied a total of 125 cases exposed to more than 90dB in their surroundings for more than six months. Males were more affected than females, and the vulnerable age group was between 23-27 years. Out of 36.8% of subjects were exposed to noise for more than 12 hrs per day.[7] Other studies conducted a similar study on workers in the aviation industry, and the effects of noise on hearing thresholds were measured.[8-11] In our study, patients in the security wing were affected the most because of single pulsed or multiple pulsed sounds of high intensities.

The study was conducted by Zia *et al.* at Dow international medical college in 2015, where they studied the intensity of hearing loss in young individuals using hands-free devices.[12] Audiograms were assessed in 56 individuals, mostly young and mild losses in the range of 0.5-8 kHz.[12,13]

Helfer *et al*. conducted three large studies on 87000 to over 140000 US military personnel, in which he concluded that men with ages more than 40yrs, people with active war experience and infantrymen have a higher risk of having hearing loss.[14,15] Lindgren conducted a study in which he concluded that Swedish pilots and cabin crew exposed to 75-81 dB noise levels were having normal hearing compared to normal Swedish reference population.[16,17] Smedje *et al.* in 2011, conducted a cross-sectional study in which they compared the hearing of 327 aircraft mechanics with daily noise exposure of 70-91 dB and a maximum level of 119dB with a Swedish reference population. Hearing loss of 2-3 dB in the group of 35-39 years was found. Other age groups had normal or slightly better than normal hearing.[18]

CONCLUSION

Occupational noise-induced hearing loss is one of the commonest hazards affecting not only underdeveloped and developed countries but also a significant share of such

ratios. Significant reduction in such ratios can be achieved either by adopting preventive measures in the form of ear protection or cutting down the duration of exposure to safe permissible limits. Therefore, necessary preventive measures should be taught and adapted to eliminate such irreparable loss.

Conflict of Interest: None.

Author's Contrbution

MKAK: Principal investigator responsible for conception, study design,data collection, analysis and prep of draft, AA: Validation of data and finalization of draft, MKAK: Validation of data and finalization of draft, med examination of all candidates to rule out systemic diseases, SA: Assistance in finalization of draft and validation of data, AN: Assistance in statistical data, SM: Lab analysis of study participants.

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