

## Study of Effects of Traffic Noise Pollution on Hearing

**Mala Agarwal**

Department of Botany, B.B.D. Government P.G. College, Chimanpura (Shahpura), Jaipur, Rajasthan, India.

\*E-mail: agarwal.mala@yahoo.co.in

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**ABSTRACT**

Effects of traffic noise on hearing were consisted of collection of data of 150 persons related to noise pollution. Ten persons belonging to age group of 20-50 yrs from fifteen locations were selected. Most of the subjects were Shopkeepers (31) and were working for 9hrs/day for all 7 days in a week in the same locality for 5-10 yrs. Total 96 persons had no complaint. Tinnitus was the most common symptom present in 31 subjects followed by Tinnitus with hearing loss. Our study shows that noise induced loss was present in 36% of subjects. This study was conducted to draw immediate attention towards this serious but much preventable cause of hearing loss. There is an urgent need to do more evidence based studies with positive results to fight with this modern day problem.

Keywords: noise, frequency, hearing threshold, tinnitus

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### INTRODUCTION

Jaipur is one of the metropolitan cities of India with population growth 49% per decade. The city has developed in imbalanced form. Most of the economic activities are located in walled city area; the residential colonies are growing in southern and western parts, which are far away from the walled city. Due to imbalanced growth and inadequacy of public transport system, huge volume of intermediate and personnel traffic has generated, especially on arterial road of the city, with growth rate of traffic volume ranging between 6-12% per annum. The present study was conducted to find out noise pollution due to road traffic in Jaipur city and its impact on hearing of general population.

### MATERIALS AND METHODS

The study consisted of collection of data related to noise pollution which was the study of sound pressure level and its effect on the people residing in the different localities of the city with the help of Rajasthan State Pollution control Board, Jaipur. Ten persons belonging to age group of 20-50 years from fifteen different locations were selected (Table-2).

Patients having known cause of deafness were excluded from the study. Subjects were asked about any hearing loss, tinnitus, otalgia, vertigo or any previous history of ear discharge. Informed consent was taken. Subjects were selected by simple random sampling from the traffic police personnel posted in the locality, shopkeepers and resident of the community. Only those participants were taken who were residing in the area for more than last five years. Data regarding age, sex and working hours were collected.

Noise levels at the selected areas were recorded with the help of sound level meter. Sound pressure level recording was done at different time of day at the same place; more than five measurements were done at a time for a period of 20-30 seconds.

Pure tone audiometry was performed after complete ENT examination, proper explanation of the nature of examination was given and informed consent was taken. An otoscopic examination was performed to exclude wax or any discharge in the ear canal or tympanic membrane perforation.

Hearing acuity was measured at 5dB intervals over a range of 500 to 8000Hz for air conduction and 500 to 6000 for bone conduction. Hearing was considered normal if threshold for hearing was less than or equal to 25dB. Hearing threshold is measured by taking mean value of threshold at 500,1000,1500,2000 Hz is frequencies. Threshold for bone conduction at 4000 Hz is taken into consideration as noise induced hearing loss is maximum at this frequency. Mean threshold at different frequencies for right and left ear was measured. It was found that that means threshold for air conduction at all frequencies is more than 20dB with peak threshold at 4000Hz frequency and mean threshold for bone conduction is maximum for 4000Hz frequency, which is 15.8 and 15.6 respectively (Table-7).

## RESULTS AND DISCUSSION

In hearing test, the chart that shows hearing levels known as audiogram. If hearing loss is caused by exposure to noise, test will produce a characteristic pattern. The typical pattern usually consists of a 'dip' in the high frequencies (at around 3-4 KHz). Which means inability to hear these pitches as well as others. If the noise exposure is continuous, the dip will spread to lower and higher frequencies. In beginning hearing loss is not noticeable. As it gets worse and affects wider frequency range, it becomes difficult to follow conversations if there is background noise. Later it becomes difficult to follow the very quiet sound also.

The Noise Pollution (Regulation and Control) Rule 2000 has published ambient noise standards for India (Table- 1). The present study consisted of effects of noise .Total 150 persons were selected randomly. Ten persons each from fifteen locations were selected, which belonged to age group 20-50 yrs and working or living in the locality for 5 years or more (Table- 2). Informed consent was taken from study population .Patients having known cause of deafness was excluded from the studies.

Table-1: Ambient Noise standards in India (Ministry of Environment and Forest(MOEF)Guidelines vide Environment (Protection) Act, 1986 third amendment rules, dated 26 th December 1989.)

Area code	Area	LAeq (A), Day time*	LAeq (A), Night time#
A	Silence zone <sup>^</sup>	50	45
B	Residential area	55	45
C	Commercial area	65	55
D	Industrial area	75	65

<sup>^</sup>Silence zone: up to 100m around hospitals, educational institutions and courts. The zones are to be declared by competent authority. Use of vehicle horns, loud speakers and bursting of crackers shall be banned in these zones.

\*Day time from (600 hrs to 2100hrs, IST)

#Night time from (2100hrs to 600hrs, IST)

Table-2: Noise level at selected area

Commercial/Residential /Silence area	Noise level in Day (dB)	Noise level in Night (dB)	Peak Noise level (dB)
Tonk Phatak	60.4	50.1	80.2
Sanganeri Gate	72.2	63.2	99.1
Badi Chopad	78.1	68.1	95.3
Raja Park	79.3	72.7	98.4
Sanganer	74.2	70.2	64.3
Gandhi Nagar	62.3	52.1	62.1
Shastri Nagar	60.1	53.1	90.1
Vaishali Nagar	65.2	52.2	68.7
Jai Jawan Colony	58.8	51.7	61.5
SDMH Hospital	64.1	60.2	64.2
Fortis Hospital	56.1	50.2	72.6
SMS Hospital	74.3	62.2	78
Secretariat	60.4	52.3	66.5
University of Rajasthan	72.1	64.2	74.4
High Court	65.2	58	69.1

In our study 140 subjects were male and only 10 female. This could be because mostly males are engaged in outdoor earning activities and exposed to noise at their work place.

On complete ENT examination it was found that out of the 150 persons selected , 96 persons had no ear complaints, and 54 had some ear complaints, among which tinnitus was common . Total 31 people had complaint for tinnitus alone whereas 12 had tinnitus with hearing loss. Complain with hearing loss was in 11 cases out of which 9 was bilateral and 2 unilateral (Table- 3; Fig.-1).

Maximum number of subjects was shopkeeper (31); followed by Bus/auto drivers (20).All the persons were exposed to noise due to road traffic (Table- 4; Fig.-2). All the applicable acts are against the working for more than 8 hrs. But in our studies most of the people are working for more than 8 hrs .Only six subjects was working for 8 hrs in a day,

84 were working for 11-12 hrs and 7 subjects were working for more than 12 hrs in a day. Total 132 persons were working for all 7 days in a week, which was against the applicable law (Table- 5). Most of the subjects in our study (78) were working in the same locality for 5-10 yrs.

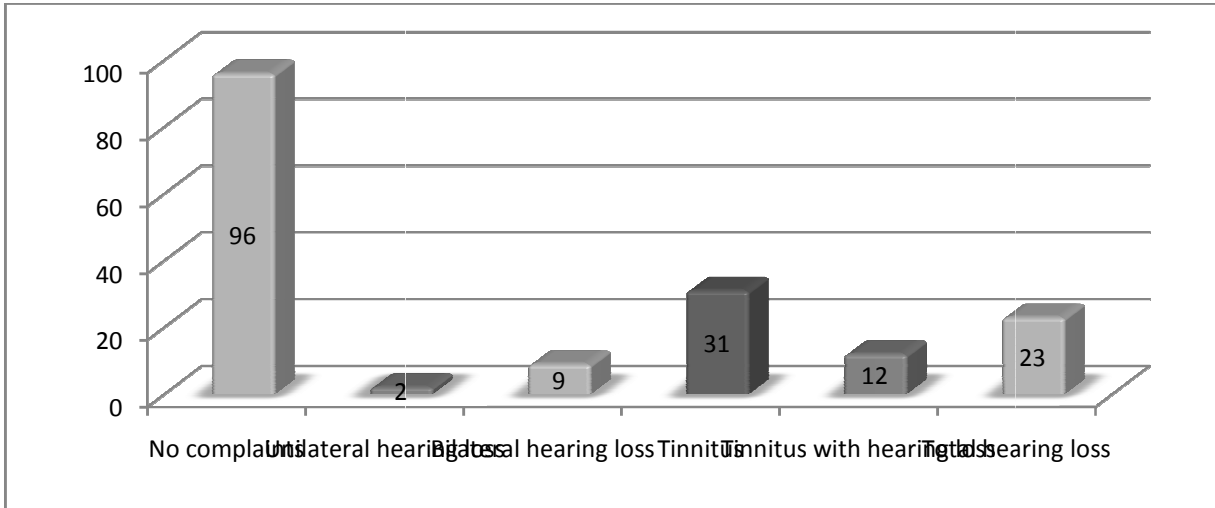


Fig. - 1: Hearing Problems due to Noise exposure

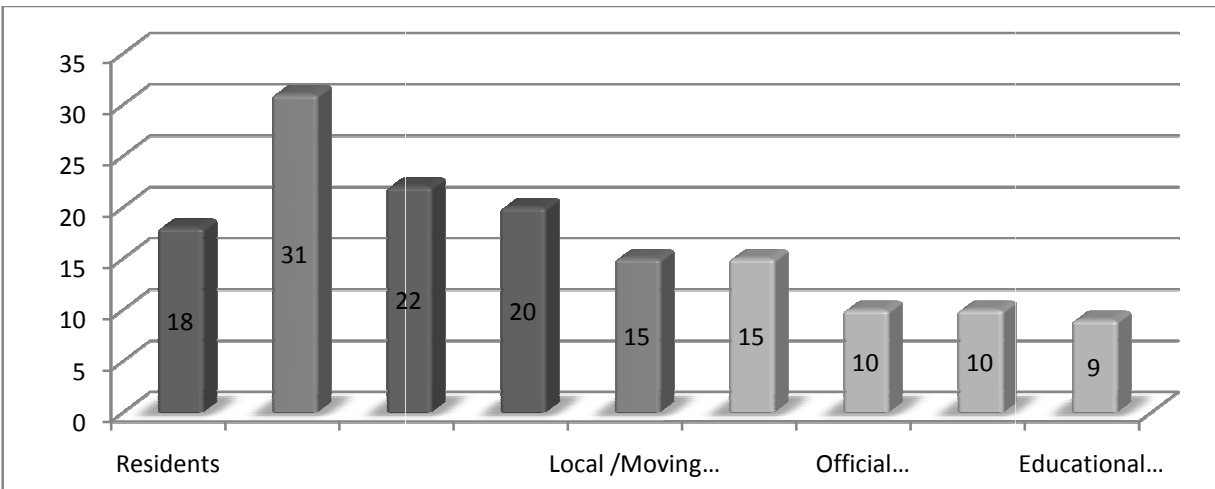


Fig.-2: Occupation of the persons

Table- 3: Complaints of subjects

Complaints	No. of subjects
No complaint	96
Unilateral hearing loss	2
Bilateral hearing loss	9
Tinnitus	31
Tinnitus with hearing loss	12
Total	150

The 15% individual had threshold for bone conduction more than 25 dB in right ear and 13% in left ear. Threshold for bone conduction ranges from 0 to 32.5 in right ear and 0 to 31.3 dB in left ear, 17% subjects had threshold for air conduction more than 25dB in right ear and 18% in left ear (Table- 6; Fig.-3).

Table- 4: Occupation of subjects

S. No.	Occupation	No. of persons
1	Shopkeeper/Merchants	31
2	Traffic/Local Police	12
3	Bus/Auto Drivers	20
4	Local/Moving Vendors	15
5	Stall Owners	15
6	Official staff in Locality	10
7	Hospital staff	10
8	School Staff	09
9.	Residents	18
10.	Watchmen	10

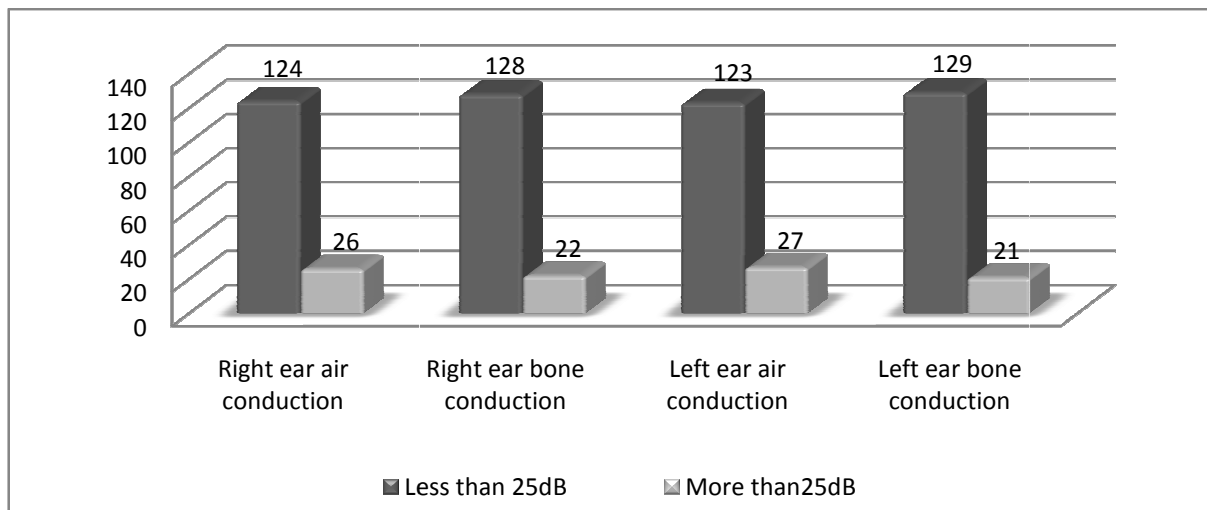


Fig.-3: Hearing threshold of Persons

Tinnitus is most common symptom of noise induced hearing loss [8]. Our study is consistent with Mc combe et al, as the tinnitus was most common symptom which was present in about 42.3% of symptomatic subjects, followed by tinnitus with hearing loss in 30.7% subjects. A study on 100 traffic police, showed high incidence of noise induced hearing loss. Total 21% of the study subjects have noise induced hearing loss [6].

Mean threshold for hearing for both air conduction and bone conduction showed that hearing threshold was maximum at 4000 Hz frequency (Table-7). This was consistent with other studies and literatures. The 4 KHz area of basilar membrane is usually affected by noise because of para-ossicular conduction of sound [7].

Noise induced hearing loss occurs at higher frequencies range of 3000-6000 Hz, with largest effect observed at 4000 Hz[9] . Criteria for the diagnosis of occupation noise induced hearing loss (ONIHL) has been listed [3].Noise induced hearing loss effects higher frequencies with a peak at 4000Hz [1].Hearing threshold for air conduction at 4000Hz was 23.55 and 25.75 dB in right and left ear respectively, whereas for bone conduction 15.8 and 15.4 respectively(Table-7).

Table- 5: No. of Working hours/day and days in week of subjects

Working hours/ day	No. of subjects
<8hours	1
9-10 hours	34
11-12 hours	62
>12 hours	3
<6days	8
7days	92

In man the muscle contraction subsides very quickly after the onset of sounds for frequencies above 3,000 Hz, whereas for lower frequencies, the contraction can last for a considerable time [5]. Impulsive sounds or sounds with a sudden onset can penetrate the ear without stimulating the protective mechanism, because of a time lag in the muscle contraction. Furthermore, the reflex action weakens with time and thus provides little protection against prolonged steady sounds.

In our study 22 subjects had threshold for bone conduction more than 25 dB in right ear 21 in left ear. Threshold for bone conduction was ranging from 0 to 32.5dB in right ear and 0 to 31.3 in left ear. Total 26 subjects had threshold for air conduction more than 25 dB in right ear 27 in left ear. Threshold for air conduction was ranging from 7.5 to 42.5 dB in right ear and 10 to 42.5dB in left ear. A conductive hearing loss is not due to noise exposure and can even provide some protection to the cochlea by virtue of sound attenuation (Table- 6).

Table- 6: Hearing threshold of subjects

Hearing threshold	Right ear air conduction	Right ear bone conduction	Left ear air conduction	Left ear bone conduction
<25dB	124	128	123	129
>25dB	26	22	27	21

Table- 7: Thresholds at different frequencies for right and left ear

Frequency	Air Conduction Hearing threshold		Bone Conduction Hearing threshold	
	Right ear	Left ear	Right ear	Left ear
500	20.9	21.2	10.4	10.55
1000	22.35	21.35	10.75	10.7
1500	20.9	22.6	10.65	10.6
2000	22.65	22.65	10.8	10.2
3000	22.55	22.6	10.7	10.2
4000	23.55	24.70	15.8	15.6
6000	22.55	22.15	10.95	10.25
8000	20.75	20.85		

In our studies the average noise level in all selected commercial area were more than permitted noise levels for the area. Sanganeri Gate was the noisiest area among all selected commercial areas. There maximum noise level was more than 99dB. The average noise level in all selected residential area was more than permitted noise levels for that area. Noise level was more than the permitted limit in the day time and in night hours. Shastri Nagar was noisiest. The average noise level in all selected silence area was more than permitted noise level for the area for both day and night time (Table- 2; Fig.-4-6).

Hearing loss may occur following exposure to loud sound which is usually temporary and associated with tinnitus called temporary threshold shift, normal hearing comes back within a few hrs at most [2]. A TTS may be experienced after firing a gun or after a long drive in the car with the windows open. It may not be considered that if exposure to this type of loud noise at a rate of 8hrs a day, 5 days a week is a threat to develop permanent hearing loss. This type of exposure to noise does not have to be loud as a gun being fired; it can be as simple as a person shouting across the room. The type of hearing loss is any degree from partial to complete hearing loss. The loss, usually, is permanent and is not satisfactorily corrected by any devices such as, hearing aids. The loss is caused by the destruction of the delicate hair cells and their auditory nerve connections in the Organ of Corti, which is contained in the cochlea. Every exposure to loud noise destroys some cells, but prolonged exposure damages a larger amount of cells, and ultimately collapses the organ of Corti, which causes deafness.

The prolonged exposure to noise with intensity more than 85dB will produce irreversible noise induced hearing loss [4]. Noise induced hearing loss manifests irreversible subtle change in organ of corti in the cochlea. Consequently, the hair cells and supporting cells disintegrate and ultimately the nerve fibers that innervate the hair cells disappear resulting in permanent threshold shift and irreversible hearing loss at the higher frequencies occurs. When the hearing impairment exceed 30dB (averaging over 2000-4000Hz) in both ear a social hearing handicap is noticeable.

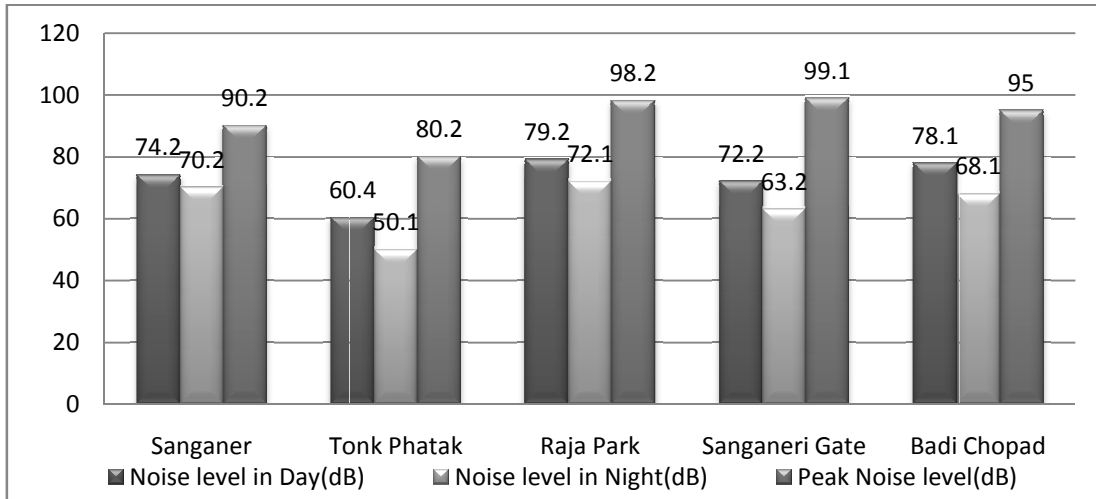


Fig.-4: Noise Levels in Commercial areas

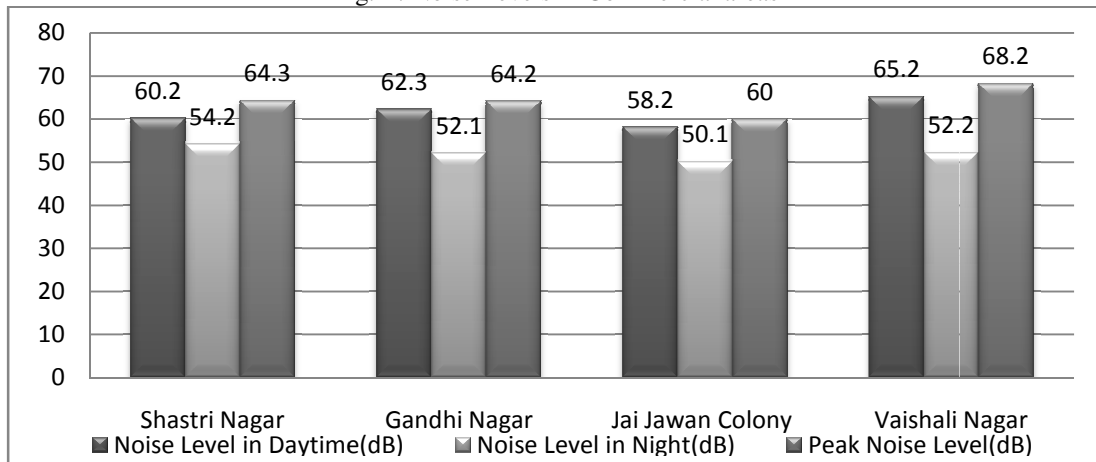


Fig.-5: Noise Level in Residential Areas

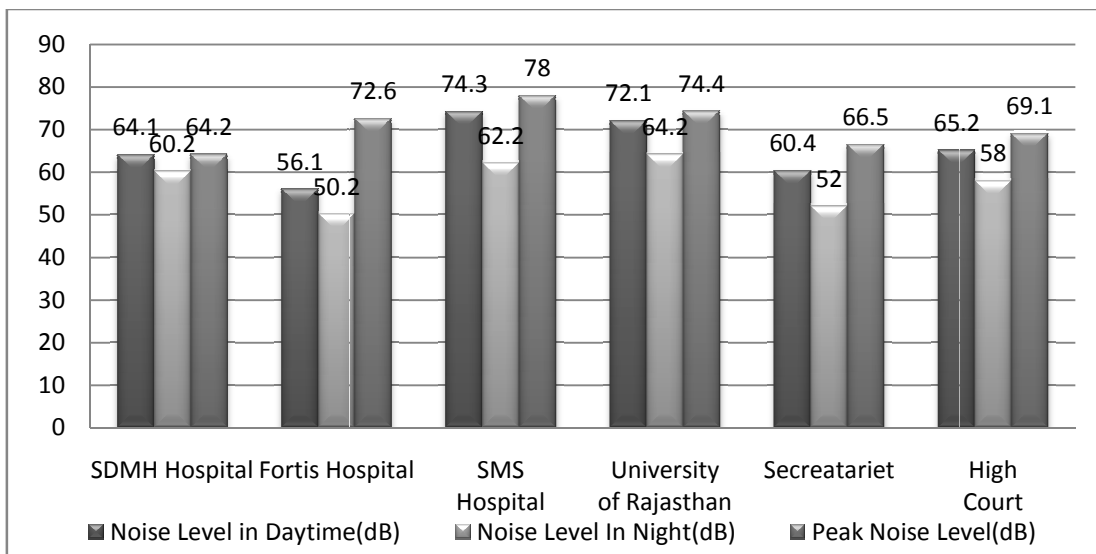


Fig.-6: Noise Level in silence Zone

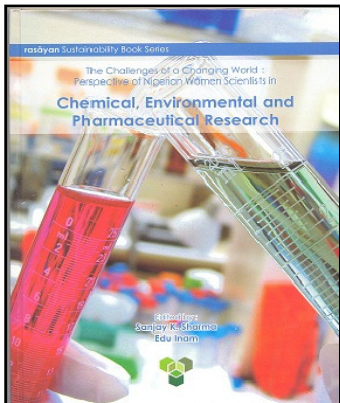
## CONCLUSION

This study shows that noise induced loss was present in 36% of subjects. This study was conducted to draw immediate attention towards this serious but much preventable- cause of hearing loss. There is an urgent need to do more evidence based studies with positive results to Fight with this modern day problem.

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