

# Prevalence of Noise Induced Hearing Loss among Traffic Police Personnel of Kathmandu Metropolitan City

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## ABSTRACT

### Background

Noise induced hearing loss (NIHL) is a major preventable occupational health hazard.

### Objective

To measure permanent threshold shift in traffic police personnel due to noise exposure and to examine whether it was associated with duration of noise exposure, years of work and risk factors.

### Methods

Cross sectional, descriptive study conducted at Dhulikhel hospital, Kathmandu University Hospital in 110 responding traffic police personnel. Detailed history and clinical examination of ear, impedance audiometry and pure tone audiometry was performed.

### Results

Mean age group was 29.82 years; 82(74.5%) were males and 28 (25.5%) were females. Mean duration of service is 11.86 years. Twenty six (23.6%) had tinnitus and 39(35.5%) had blocked sensation in ear. Sixty five (59.1%) worked between 10-19 years. Alcohol and smoking shows positive impact on NIHL ( $p$  value =0.00). Odds ratio with 95% confidence interval were 4.481 (1.925-10.432) and 6.578 (2.306-18.764) respectively. Among 73(66.4%) noise induced hearing loss positive cases, bilateral involvement was seen in 45 (40.9%) and unilateral in 28(25.4 %) cases. Among unilateral cases most were left sided. Hearing threshold at 4 kHz increased according to age and duration of service.

### Conclusion

Traffic police personnel are in constant risk of noise induced hearing loss. Screening for hearing loss is recommended for people exposed to noise.

## KEY WORDS

*noise induced hearing loss, traffic police personnel, occupational hazard*

## INTRODUCTION

Noise-induced hearing loss (NIHL) is caused by sustained, repeated exposure to excessive sound levels. It accrues progressively and often remains unnoticed until it has reached a certain degree. Any form of sound exposure can lead to NIHL provided there is sufficient intensity and exposure time.<sup>1-4</sup> The main site of impairment is the outer hair cells of the cochlea, where the damage is irreversible. Very high levels of noise exposure can lead to acute mechanical damage to inner and outer hair cells, but this form of damage is rare.<sup>3-6</sup>

An average traffic sound in the city is about 60-100 dB by a close observer.<sup>5</sup> When there is exposure to sound level approximately 85dB, initially it causes temporary dullness of hearing (temporary threshold shift) which usually

recovers within 24 hours of exposure; whereas if there is repeated sustained exposure, the threshold shift becomes permanent (permanent threshold shift) due to nerve fiber degeneration.<sup>3,7</sup>

Occupational Safety and Health Association (OSHA) has set 90 dBA as the time-weighted average (TWA) for an 8-hour work day exposure to noise.<sup>8</sup> This limit according to National Institute of Occupational Safety and Health (NIOSH) is 85 dBA.<sup>9</sup> After the import of first vehicle in Kathmandu in BS 1958, there has been a steady rise in the number of vehicles and hence with this modernization came the noise pollution.

Objective of the study is to measure permanent threshold

shift in traffic personnel and to examine whether it was associated with age, duration of service or any risk factors.

## METHODS

This is a cross sectional, descriptive study conducted at Dhulikhel Hospital, Kathmandu University Hospital in June 2009. The protocol was approved in advance by the Institutional Review Committee for medical research ethics. Written informed consent was acquired before the study was carried out.

Audiometric survey was carried out on 110 Traffic police personnel from Kathmandu Metropolitan city. Prior to audiometric assessment, a detailed medical, personal and occupational history was taken. Questionnaires elicited more detailed information on risk factors like smoking, alcohol consumption, acute noise trauma, ototoxic drugs and prior ear diseases. Hearing was measured in a sound treated room by pure tone audiometry (PTA) (air and bone conduction) in the frequencies 0.25, 0.5, 1, 2, 4 and 6 kHz for both ears using Midimate 602 Clinical Audiometer. Measurements were taken using 5 dB increments. Middle ear pathology was assessed by otomicroscopy, impedance audiometry and air-bone gap. A threshold of >25dB was considered to be hearing loss in any of the above frequencies.

Audiogram of noise induced hearing loss showed air and bone conduction losses both reduced unilaterally or bilaterally with notch at 4 kHz. Air conduction with average hearing loss of >25 dB at 1, 2, 3 KHz. Typical audiogram of NIHL along with exclusion of all other associated causes of hearing loss confirmed diagnosis of NIHL.

As per World Health Organization (WHO, 1986), hearing loss was then assessed: less than 25 dB (normal), 25–40 dB (slight), 41–60 dB (moderate), 61–80 dB (severe), and above 80 dB (extreme). According to American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS)'s definition in 1997 asymmetric hearing loss is defined as HTL (hearing threshold level) difference of greater than 15 dB at 0.5, 1, or 2 kHz or 30 dB at 3, 4, or 6 kHz between two ears.

The audiometric data was analyzed for their sex, age, duration of exposure in hours each day, years of service, hearing loss, symmetrical or asymmetrical hearing loss, risk factors etc.

All the responding traffic police personnel working in Kathmandu metropolitan city with normal looking tympanic membrane and no diseases of the external ear during the time of examination were included in the study. Patient of hypertension, diabetes, history of meningitis, ear surgery (apart from myringoplasty), hereditary loss, usage of ototoxic drugs, any history of head injury or mechanical hearing loss (air-bone gap > 10 dB) were excluded.

Four subjects were excluded from the study, one for

chronic suppurative otitis media, two for retracted tympanic membrane and one for impacted cerumen which when removal caused trauma to external auditory canal. Remaining 110 were included in the study.

The data was calculated in an excel spreadsheet which was then exported SPSS (15.0) for analysis. The statistical significance was set to  $p < 0.05$ . Demographic characteristics and study variables were analyzed using descriptive statistics. Means, standard deviations and ranges were reported for continuous variables. Frequencies and percentages were reported for categorical variables.

## RESULTS

Demographic characteristics of the study participants are summarized in Table 1.

**Table 1. Socio- demographic characteristics (n=110).**

Variable	Frequency (%)
Age	
20-29	55 (50%)
30-39	51 (46.4%)
40-49	4 (3.6%)
Sex	
Males	82 (74.5%)
Females	28 (25.5%)
Years of service	
0-9	38 (34.5%)
10-19	65 (59.1%)
20-29	7 (6.4%)
Duration of work per day	
< 8 hrs	30 (27.3%)
>8hrs	80 (72.7%)
Symptoms	
Fullness in ears / Hearing impairment	39 (35.5%)
Tinnitus	26 (23.6%)
None	45 (40.9%)

Among 110 traffic police personnel, mean age group was 29 years (range 23-41). with standard deviation 4.54. Eighty two (74.5%) were males and 28 (25.5%) were females. Mean duration of service in years is 11.86 years with standard deviation of 4.51. Among 110 subjects, 38(34.5%) of participants worked for < 9 years, 65 (59.1%) between 10-19 years and 7 (6.4%) for 20-29 years. Eighty (72.7%) traffic personnel reported that they worked > eight hours per day; whereas 30(27.2%) reported to work < 8 hours per day. Forty five (40.9%) participants perceived their hearing as good. Among the participants; 26(23.6%) had tinnitus and 39(35.5%) say that they feel some blocked sensation in ear and have difficulty hearing in noisy environment.

History of tobacco smoking was present 42(38.2%) respondents. Positive history of alcohol consumption either as binge drinking, weekly or more often was seen

**Table 2. Effects of risk factors on NIHL.**

	NIHL		Total	Pearsons p value	Odds ratio (95% Confidence Interval)
	Yes	No			
<b>Alcohol</b>					
Yes	55	15	70		4.481 (1.925- 10.432)
No	18	22	40		
<b>Tobacoo smoking</b>					
Yes	37	5	42	0.000	6.578 (2.306-18.764)
No	36	32	68		
<b>Acute Noise Trauma</b>					
Yes	1	1	8	0.621	-
No	72	36	108		
<b>Family History</b>					
Yes	29	9	38	0.108	-
No	44	28	72		
<b>History of ototoxic drugs</b>					
Yes	1	0	1	0.474	1.514 (1.323-1.732)
No	7	37	109		
<b>Total</b>	<b>73</b>	<b>37</b>	<b>110</b>		

Significant Pearsons P value < 0.000

in 70(63.6%) participants. Thirty eight (34.5%) participants had at least one parent or grandparent with hearing loss and two (1.8%) had history of acute noise trauma (e.g.-firearm) and one had history of taking ototoxic drug (ATT for Pulmonary tuberculosis).

Alcohol consumption and tobacco smoking have significant association with NIHL.(Table 2) Among the total cases, no NIHL was seen in 37 cases (33.6%) whereas 73 (66.4%) had NIHL with a clear dip at 4 kHz. Most had mild hearing loss 57(51.8%), 15 (13.6%) had moderate whereas only one(0.9%) had severe hearing loss.(Table 3)

**Table 3. Grades of Hearing loss.**

Hearing level	Frequency (n=110) (%)
normal( < 25 dB)	37 (33.6%)
Mild hearing loss (25-40 dB)	57 (51.8%)
Moderate hearing loss ( 41-60 dB)	15 (13.6%)
Severe hearing loss ( 61- 80 dB)	1 (0.9%)
<b>Total</b>	<b>110 (100%)</b>

Among the ones having hearing loss, 45 (61.6%) had bilateral loss and 28 (38.4%) had unilateral loss with 24 on left side (86%) when and four (14%) on the right side, when it was unilateral loss.

Mean threshold of hearing at four kHz on right ear is 26.31 with standard deviation 9.42(range 15-70dB). Mean threshold on left ear is 28.95 with SD 10.09 (range 10-70dB). (Table 4)

Mean threshold for left ear was more compared to right. This mean threshold increased with increasing age and more duration of service. (Table 4)

**Table 4. Hearing threshold at 4KHz in standard deviation according to age and duration of work.**

Age in years	Left (dB) (±SD)	Right (dB) (±SD)
20-29(n=55)	23.90 (7.24)	21.81 (6.26)
30-39(n=51)	33.33 (10.08)	30.68 (9.84)
40-49(n=4)	42.5 (5.00)	32.5 (12.58)
<b>Duration in years</b>		
0-9	23.81 (7.92)	21.97 (6.93)
10-19	30.76(9.96)	28.00(9.55)
10-29	40.0(7.63)	34.2 (10.96)

## DISCUSSION

Noise induced hearing loss (NIHL) is a commonly seen occupational hazard. The sound pressure levels that are required to produce hearing loss are much less compared to what is required to cause discomfort to the exposed individual so the affected person is unaware that his hearing is being damaged.<sup>10</sup> The development of NIHL is affected by many factors like, individual susceptibility, age, noise level, noise characteristic, duration of exposure, risk factors like smoking associated and use of ear protectors.

We could not find any statistically significant gender difference which was consistent with other studies.<sup>11</sup> We found prevalence of NIHL in the service group of 10-19 years is comparable to other studies.<sup>10,11</sup> Age has a cumulative effect on hearing loss. Duration of service gives an additive effect to noise in causing NIHL. So as the age and work duration advances the mean threshold for hearing also increases which is comparable to other studies.<sup>12,13</sup>

In the early stages of NIHL, the speech frequencies are less affected and the patients have a very few symptoms and

hence they are usually unaware of the deleterious effects of sound.<sup>12,13</sup> Frequency area 4-6 kHz is usually affected first with maximum at 4 kHz.<sup>14</sup> Any level of NIHL may muffle high-frequency sounds such as whistles or buzzers and may result in difficulty discriminating speech consonant sounds such as those in the words fish and fist, particularly in noisy environments with background noise, many voices, or room reverberation.<sup>13,15</sup>

Tinnitus was complained by 23.6% of the subjects. Tinnitus may accompany hearing loss in the patients who have inner ear disorders.<sup>5,16</sup> In a study among the engineers in American construction industry O Hong et al found more than 65% of participants perceived their hearing was good, about 38% indicated they had ringing or buzzing in their ears, and over 60% reported a problem understanding what people say in noisy environments.<sup>13</sup> O. Hong et al in another study on fire-fighters in the US reported that 85% of his participants had good hearing.<sup>17</sup>

**Table 5. Comparison between various studies.**

Study	Study Population	NIHL Prevalance (%)
Nair et al <sup>10</sup>	Air personnel	22.9
Md Yusuf Haider et al <sup>12</sup>	Textile mill worker	
	Generator department	46.67
Ruiker et al <sup>18</sup>	Dyeing department	37.5
	Textile mill worker	33.7
Deepak et al <sup>19</sup>	Traffic personnel	21.0
Foluwasayo et al <sup>20</sup>	Steel roll mill worker	28.2 (better ear)
		56.8 (worse ear)
Freida et al <sup>21</sup>	Dentist (Belgium)	19.6
Present study	Traffic personnel	66.4

World Health Organization estimated that at a global level occupational noise exposure was the cause of the hearing impairment in one-sixth (16%) of those people with a moderate or greater hearing loss. Internationally, contribution of occupational noise exposure to total deafness rates is approximately seven% in the most developed nations and 21% in developing regions.<sup>3</sup>

On the analysis of severity of hearing loss most of the personnel had mild hearing loss 57%, with 15% having moderate hearing loss and 1% with severe loss. This is comparable to study on Indian air force personnel where most had mild to moderate loss and only 24 % had severe loss.<sup>10</sup>

Cigarette smoking may affect cochlear blood supply because it causes peripheral vascular changes, such as increased blood viscosity and reduced oxygen availability. Therefore, smoking and noise may act synergistically.<sup>22-24</sup> We found the prevalence of NIHL among the smokers to be higher 37 out of 42 (88) which is comparable to Gholamreza et al where the percentage of workers with difference between hearing threshold levels at 4000 Hz and 1000 Hz of greater than or equal to 30 dB in both ears was 49.5% in smokers

and 11.2 % in non smokers.<sup>22</sup>

Hearing loss caused by impact noise /acute noise trauma is an important factor which corresponds well with subjective hearing loss and tinnitus. In contrast to hearing loss from occupational noise, it occurs often in only one ear and predominantly at the frequency of 4 KHz. Having increased hearing threshold due to acoustic trauma might lead people to be more susceptible to noise.<sup>25,26</sup> Systemic ototoxic drug, streptomycin was taken by one as a part of anti-tuberculosis treatment. This may act synergistically with noise to worsen hearing loss.<sup>27</sup>

Bilateral hearing loss (40.9%) was commonly seen in this study. Among some personnel with unilateral hearing loss, left ear (24%) was involved more than right (4%). This is comparable to study among operating engineers by Rop et al and Oi Saeng Hong who also show left sided predominance.<sup>12,13</sup> Nagaris et al also showed approximately half had bilaterally symmetric NIHL as in present study and 34.2% had left side predominance.<sup>28</sup> But it is contradictory to the study by Nair et al where right sided hearing loss was predominant.<sup>10</sup> The left sided asymmetry may be secondary to biological difference of a less active acoustic reflex on the left ear or may be the higher otoacoustic emission amplitude on the right side due to its more intense auditory efferent system.<sup>28,29</sup>

NIHL is permanent and cannot be cured resulting in significant monetary costs and human suffering.<sup>13</sup> Fortunately, it can be prevented. Replacing and modifying old vehicles and their horns to decrease noise level should be the priority, but it is not always possible. Using HPD (hearing protecting device) as advised by other authors is also not feasible for such a profession.<sup>30-33</sup> Restricting the duty hours to < 8 hours / day, decreasing the number of working days a week, avoiding the risk factors like alcohol, smoking, acute noise trauma, ototoxic drugs, taking good ear care and periodically getting hearing evaluated may help in some extent.

The strength of the study is the socio-demographic data collection and the number of personnel having similar job, fact that these traffic personnel were medically and audiotically fit before they joined their duty. However larger study would be desirable for more precise risk estimates.

## CONCLUSION

The study showed that NIHL was common in traffic police personnel due to the nature of their job. Study has proven that increasing age, more duration of service, alcohol intake and tobacco smoking are significant risk factors causing noise induced hearing loss. Without proper knowledge and intervention, we are all at risk of developing NIHL sooner or later. The need of the hour is to create awareness among all the city dwellers regarding the condition and prevent it as best as possible.

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