Prevalence of Noise Induced Hearing Loss in Indian Air Force Personnel

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Abstract

Background: Noise exposure is an inherent part of duty of the aircrew and maintenance staff in the Indian Air Force (IAF). An audiometric survey of IAF personnel was carried out to analyze the prevalence and severity of noise induced hearing loss (NIHL). **Methods:** An audiometric study of 1000 IAF personnel of various trades, age and exposure groups were carried out at an operational base. Age related correction of 5 dB per decade was applied for personnel above 50 years of age. Personal factors like smoking, blood group and use of ear defenders were analysed for their effect on the prevalence of NIHL.

Result: The study revealed an overall incidence of NIHL of 22.9 % in the personnel with a higher prevalence among the technical trades (26.18 %) as compared to non technical trades (12.5 %). There was a significant increase in prevalence of hearing loss with duration of exposure with 50.8% of personnel above 30 years of exposure having hearing loss. A higher incidence of hearing loss was observed in personnel of blood group O and smokers whereas use of ear defenders was protective.

Conclusion: The study reveals a significantly increased prevalence of NIHL among the technical trades of the IAF personnel. The deleterious effects of smoking and protective effect of regular use of ear defenders are emphasized.

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Key Words : Noise induced hearing loss ; Smoking; Ear defenders

Introduction

Noise is a common occupational hazard and the awareness that loud sound produces hearing loss has been recognized for thousands of years. The sound pressure levels required to produce hearing loss are much less than what is required to cause discomfort to the exposed individual. This makes noise induced hearing loss (NIHL) a sinister problem as the affected person is unaware that his hearing is being damaged. Noise is also the cause of annoyance, interference with speech and communication, ultimately producing psychological effects as well as reducing efficiency at work.

Noise has been recognized as a problem, both environmentally and operationally, since the earlier days of aviation. The incidence of NIHL in the Indian Air Force (IAF) has been analysed in the past with various conservation measures applied to reduce the effects of noise. A realistic knowledge of prevalence of hearing loss is essential for planning as well as monitoring of the various hearing conservation programmes in vogue.

We present a wide assessment of NIHL in a large group of IAF personnel at an operational base. The study aimed at determining the incidence and severity of NIHL in the study group. The data was also analysed for personal factors like blood group, use of ear defenders and smoking.

Material and Methods

A study of the prevalence and severity of NIHL in IAF personnel at an operational IAF base was carried out from Jan 2001 to Jan 2003. 1000 personnel of varying lengths of service from all branches of IAF were audiometrically surveyed.

Prior to pure tone audiometry, a detailed history was taken to exclude the individuals with previous history of ENT diseases, head injury and medication with ototoxic drugs. The hearing examination included an otoscopic evaluation and pure-tone audiometry. Audiometric testing was conducted in a sound treated room at the base using digital audiometer. Hearing thresholds were obtained for each ear at 250, 500, 1000, 2000, 4000, 6000, and 8000 Hz. A threshold of above 25 dB was considered to be a hearing loss in any of the above frequencies. The hearing loss was graded in severity as normal (<25 dB), mild (26-40 dB), moderate (41-55 dB), severe (56-90 dB) and profound (> 90 dB). Age related correction of 5 dB per decade was applied for personnel above 50 years to nullify effects of age induced hearing loss [1]. The audiometric data was analysed and examined for their relation with trade, age and duration of exposure.

The personal history and lifestyle factors interview was conducted during the hearing examination. Participants were asked about their smoking status and blood group for evaluation of the effects of smoking and the incidence of hearing loss in various blood groups. Preventive measures like use of ear defenders were also evaluated. The data was

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tabulated in an excel spreadsheet which was then exported to SPSS Ver 10.0 for analysis. The statistical significance was set to $p < 0.05$.

Results

A total of 1000 IAF personnel of various trades were analysed audiometrically, of which 760 personnel belonged to the technical group which included pilots, aircrew, fitters (engine, electrical, airframe, radar and radio), crash bay personnel and drivers etc who were exposed to loud noise due to their nature of work near jet aircrafts, heavy machinery and transport. 240 personnel were of the non-technical trades like clerks, equipment assistants, sweeper, medical assistants, defence civilians etc. The personnel were in the age group of 18 to 58 years with a mean of 37.3 years in technical and 31.6 years in non-technical trades. The demographic profile of the same is shown in Table 1.

- a) Hearing loss : 229 (22.9 %) personnel were detected to have audiometric evidence of hearing loss. These included 199 (26.18%) personnel of technical trades and 30 (12.50%) personnel of non-technical trades ($p=0.0002$).
Of the 199 personnel of the technical trades, the hearing loss was higher in the personnel working in crash bay (61.53%), aircrew (44.23%) and mechanical transport drivers (43.33%). On statistical analysis there was a definite risk among the technical trades to develop hearing loss as compared to others ($p=0.0064$). In the 30 personnel of non technical trades incidence of hearing loss was similar and there were no specific trades with increased loss ($p= 0.78$) (Table 2).
- b) Severity of hearing loss: Among the 229 personnel with hearing loss, 99 (43.23%) had mild loss, 65 (28.38%) had moderate loss and 65 (28.38%) had severe loss. No individual had profound loss (Table 3).
- c) Symptoms: Out of the study group, the common symptoms were discomfort and fullness in the ear in 48 (20.96%) personnel, hearing loss in 37 (16.15%) personnel and tinnitus in 13 (5.67%) personnel.

Table 1
Demographics of the IAF personnel studied

(1) Total IAF personnel studied	1000
(a) Technical trades	760 (76%)
(b) Non technical trades	240 (24%)
(2) Number of personnel as per length of service	
(a) 0 – 9 years	259 (25.9%)
(b) 10 – 19 years	364 (36.4%)
(c) 20 – 29 years	287 (28.7%)
(d) 30 years and above	90 (9%)
(3) Number of personnel who are smokers	268
(a) Technical trades	189 (70.5%)
(b) Non technical trades	79 (29.5%)
(4) Number of personnel with blood group	
(a) A	262 (26.2%)
(b) B	170 (17%)
(c) O	427 (42.7%)
(d) AB	141 (14.1%)

- d) Age and exposure variability: The overall incidence of hearing loss as expected increased with age and duration of exposure or length of service. In the technical trades the incidence increased from 11.5% in 0-9 years, 23.9% in 10-19 years, 35.8% in 20-29 years to 50.8% in 30 years and above service group ($p = 0.0001$). There was no significant relation in the non-technical group ($p=0.0601$) (Table 4).
- e) Smoking: In the study group, 268 (26.8%) personnel gave history of smoking. The incidence of hearing loss was 130 (48.5%) in smokers as compared to 99 (13.5%) in non-smokers ($p= 0.0001$).
Among the personnel with hearing loss in technical trades smokers 112 (59.2%) had a higher incidence than non smokers 87(15.2%). Similar findings were observed in the non technical personnel also. The data suggested a higher incidence of hearing loss among smokers in both the technical and non technical personnel which was found to be statistically significant ($p=0.006$) (Table 5).
- f) Blood group: Out of the 229 personnel with hearing loss, 40 (15.2%) were of blood group A, 25 (14.7%) of blood group B, 146 (34.2%) of blood group O and 18 (12.7%) had blood group AB. The personnel of blood group O had higher percentage of hearing loss both in the technical and non technical group which was found to be statistically significant ($p=0.0001$) (Table 6).
- g) Unilateral / Bilateral involvement : 185 (80.78%) personnel had bilateral involvement as compared to 44 (19.21%) with unilateral. Among the personnel with unilateral involvement right ear was more involved than the left. In the non-technical trades the unilateral involvement (36.66%) was significantly higher than technical trades (16.58%) ($p=0.0091$) (Table 7).
- h) Ear defenders (ED): 414 (41.4%) of personnel gave history of using ED regularly which included 390 (51.31%) of technical trades and 24 (10%) of non technical trades. 15.21 % of personnel who used ED regularly had hearing

Table 2
Distribution of hearing loss as per trade

Trade	Number of personnel	Loss (%)
Technical	760	199 (26.18)
Pilot	32	7 (21.88)
Air Crew	52	23 (44.23)
Crashbay	26	16 (61.54)
Eng/Fit	143	38 (26.57)
Elect/Fit	134	29 (21.64)
AF/Fit	112	31 (27.68)
Rad/Fit	127	20 (15.75)
Rdo/Fit	104	22 (21.15)
MTD	30	13 (43.33)
Non Tech	240	30 (12.50)
Clerk	67	7 (10.45)
Eqpt/ Asst	128	16 (12.50)
Others	45	7 (15.56)
Total	1000	229 (22.9)

Table 3
Severity of hearing loss among the various trades

Trade	Mild loss (%)	Moderate loss (%)	Severe loss (%)	Total
Technical	76 (38.19)	75 (37.68)	48 (24.12)	199
Pilot	5 (71.42)	2 (28.57)	0	7
Air Crew	8 (34.78)	8 (34.78)	7 (30.43)	23
Crashbay	5 (31.25)	6 (37.5)	5 (31.25)	16
Eng/Fit	14 (36.84)	14 (36.84)	10 (26.31)	38
Elect/Fit	12 (41.37)	9 (31.03)	8 (27.58)	29
AF/Fit	12 (38.7)	13 (41.93)	6 (19.35)	31
Rad/Fit	8 (40)	9 (45)	3 (15)	20
Rdo/Fit	9 (40.9)	9 (40.90)	4 (18.18)	22
MTD	3 (23.07)	5 (38.46)	5 (38.46)	13
Non Tech	23 (76.66)	7 (23.33)	0	30
Clerk	6 (85.71)	1 (14.28)	0	7
Eqpt/Asst	11 (68.75)	5 (31.25)	0	16
Others	6 (85.71)	1 (14.28)	0	7
Total	99 (43.23)	82 (35.8)	48 (20.96)	229

Table 4
Hearing loss as per trade and length of service

Trade	0-9 years	10-19 years	20-29 years	30 years and above	Total
Technical					
No of personnel	209	272	210	69	760
Hearing loss	24 (11.5%)	65 (23.9%)	75 (35.8%)	35 (50.8%)	199 (26.2%)
Non Tech					
No of personnel	50	92	77	21	240
Hearing loss	1 (2%)	17 (18.5%)	8 (10.4%)	4 (19.1%)	30 (12.5%)

Table 5
Hearing loss as per trade and smoking

	Number of personnel		Hearing loss	
	Smokers	Non smokers	Smokers	Non smokers
Technical	189	571	112 (59.2%)	87 (15.2%)
Non Tech	79	161	18 (22.7%)	12 (7.5%)

loss as compared to 28.32 % of personnel who used ED irregularly. There was a significantly higher prevalence of hearing loss in the personnel who used ED irregularly ($p=0.006$) (Table 8).

Discussion

Occupational noise induced cochlear damage is usually caused by long-term work-related exposure to noise. The development of NIHL is affected by many factors, such as individual sensitivity, noise level, noise characteristics, duration of exposure and the effectiveness of noise protection. We conducted this survey at an operational IAF base to study the effects of noise among the personnel of various trades and exposure groups as well as to analyze the various personal compounding factors affecting the prevalence of NIHL.

On survey of the noise environment at the base it was seen that the high levels of noise was mainly due to

ground running of aircraft, aircraft flying overhead, heavy machinery, workshop hangars and vehicular traffic. The noise environment of the base revealed that the technical personnel were exposed to high intensity of continuous as well as impulse noise.

As per studies in the past, the prevalence of NIHL in the IAF personnel has been variable. Rao et al [2], have recorded an incidence of 22% among technical airmen. Soodan et al [3] have described the overall prevalence of NIHL to be 44.4 % for IAF aircrews (25.7 % among fighter aircraft aircrew and 74.3 % among transport / helicopter aircrew). In our study we had an overall prevalence of NIHL of 22.9%. The technical trades had a higher prevalence of hearing loss (26.18 %) as compared to non technical trades (12.50%). Among the various technical trades, the crash bay personnel (61.53%), aircrew (44.23%) and mechanical transport drivers (43.33%) showed significantly higher loss as compared to engine (26.31%), electrical (27.58%) and airframe fitters (19.35%). This significant difference in prevalence of NIHL among the technical trades is attributed to the fact that the aircrew as well as personnel working in the crash bay in addition to exposure to the continuous noise due to aircraft maintenance and workshop machinery were also

Table 6**Hearing loss as per trade and blood groups**

Blood Group	Number of personnel				Hearing loss			
	A	B	O	AB	A	B	O	AB
Tech	212	114	321	113	36 (16.9%)	19 (16.6%)	121 (37.6%)	15 (13.2%)
Non Tech	50	56	106	28	4 (8%)	6 (10.7%)	25 (23.5%)	3 (10.7%)

Table 7**Unilateral or bilateral involvement**

Trade	Bilateral (%)	Unilateral (%)	Right Ear (%)	Left Ear (%)
Technical (N = 199)	166 (83.41)	33 (16.58)	20 (60.6)	13 (39.39)
Non Tech (n = 30)	19 (63.33)	11 (36.66)	7 (63.63)	4 (36.36)
Total (N= 229)	185 (80.78)	44 (19.21)	27 (61.36)	17 (38.63)

Table 8**Ear Defender use and hearing loss**

Trade	Regular	Loss (%)	Irregular	Loss (%)
Technical	390	61 (15.64)	370	138 (37.29)
Non Tech	24	2 (08.33)	216	28 (12.96)
Total	414	63 (15.21)	586	166 (28.32)

exposed to intermittent very high intensity noise during aircraft take off and landing. Similar high prevalence of hearing loss has been described among the air traffic control (ATC), crashbay and aircrew personnel [4,5].

In the early stages of NIHL the speech frequencies are less affected and the patients have very few symptoms and hence are usually unaware of the deleterious effects of sound. In our study 20.9% of personnel complained of discomfort or fullness in the ear, 16.2% had transient hearing loss and 5.7% had tinnitus. The personnel described these symptoms as transient which lasted for 10-30 minutes after exposure to loud sounds. On analysis of the severity of hearing loss most of the personnel had mild or moderate loss with only 24.12% of technical personnel with severe loss. There were no personnel with profound loss in the study. These results are comparable with a study on aircrew of IAF where 27.9 % had hearing loss of severe degree [3]. Probably as most of the personnel had mild or moderate hearing loss and also due to the transient nature of the symptoms, very few personnel reported to the medical attendant and they were detected with hearing loss during this audiometric survey.

In the process of calculating the exposure profile we found that the number of hours of daily exposure to noise by the personnel was variable depending on the operational tasks of the base. Also these personnel had postings at different types of units with varied noise environment during their service. So for the purpose of calculating the duration of exposure to noise we

considered exposure periods as proportional to the duration of service and age of the personnel. Murty et al [6] in their study among jet maintenance personnel of IAF reported a prevalence of 45.6 %, 49.1% and 68.1% in the service group of 0-9 years, 10-19 years and above 30 years respectively. Rao et al [2] reported 6% prevalence in IAF personnel below 10 years of service with an increase to almost 50% in personnel above 30 years service range. We found a statistically significant increase in hearing loss in the technical group with increase in duration of service / exposure. The technical personnel in the exposure group 20–29 years and above 30 years had three and five times higher prevalence of hearing loss than that seen in the 0-9 year's group. The exposure group of above 30 years (age above 50 years) had a high prevalence of 50.8%. Other studies among the various international Air Forces have also shown an increase in prevalence of NIHL with age especially after 40 years of age [7-9].

Smoking and NIHL are known to have a synergistic relation [10, 11]. Although the mechanism is not clear, it is hypothesized that smoking may damage hair cells by ischemia due to reduced blood flow to the cochlea by increasing the blood viscosity [12] or by increasing carboxyhaemoglobin and reducing available oxygen. We found the prevalence of NIHL among the smokers to be a higher among the technical and non technical trades. The present study confirms the deleterious effects on smokers exposed to high noise levels. In our study personnel with O blood group had a higher prevalence of NIHL among the technical and non technical trades as compared to other blood groups which is in consonance to published literature [13].

Bilateral hearing loss was commonly seen in our study. Among the personnel with unilateral hearing loss, right ear was involved more than left ear. As per various studies, NIHL is found to be more common in the left ear [14,15]. Our findings of higher right ear involvement

is contrary to literature and can be due to fact that the personnel of IAF are exposed to range firing in addition to the noise at the base where a right handed person usually holds the weapon on the right shoulder close to the right ear. Another interesting reason which was found on interview with the personnel was the habit of conversing with each other in noisy surroundings by removal of the ear muff usually of the right ear exposing it to deleterious effects of high intensity noise. The author hypothesizes the above factors to be contributory to higher right ear involvement as these are specific conditions seen in armed forces personnel as compared to other occupational hearing loss.

The use of ear defenders (ED) is considered a must in high noise environment with a positive effect in reduction of the prevalence of NIHL. 51.31% of technical trades gave history of regular use of ED with a statistically significant reduction in the prevalence of NIHL among them.

Published literature on actual noise exposure, protection levels, acute and long-term effects of aviation noise on IAF personnel have been in the 1970's and 1980's. Since then there have been changes in noise environment in the IAF with advanced aircrafts and machinery and also improved noise reduction measures. The results of this study suggest that in spite of the various hearing conservation measures in vogue the prevalence of NIHL especially among the technical trades is significant. The IAF personnel need to be periodically indoctrinated on the various deleterious effects of noise as well as emphasis on compulsory usage of personal protective devices. The synergistic effect of smoking and noise exposure on the hearing loss needs to be highlighted.

Conflicts of Interest

None identified

Intellectual Contribution of Authors

Study Concept : Lt Col S Nair, Air Vice Mshl RC Kashyap
Drafting & Manuscript Revision : Lt Col S Nair
Statistical Analysis : Lt Col S Nair
Study Supervision : Air Vice Mshl RC Kashyap

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