

A Survey of Noise Induced Hearing Loss in Indian Air Force Personnel by Extra High Frequency Audiometry

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Abstract

Noise is an inherent problem in the Indian Air Force (IAF) as exposure to high intensity noise is part of duty of the aircrew and maintenance staff. A conventional and extra high frequency audiometric survey of IAF personnel was carried out at an operational base to analyze the prevalence of noise induced hearing loss (NIHL). Extra high frequency audiometry (8-20 KHz) is a useful tool for detecting early changes of hearing impairment in individuals at risk of developing NIHL. This early knowledge of deterioration of hearing can be effectively used to prevent further progression of NIHL. An audiometric study of 1164 IAF personnel of various trades was carried out at an operational base using a GSI 61 clinical audiometer. Pure tone thresholds for air conduction were determined at the frequencies of 500 Hz to 8 KHz using TDH 50 P headphones and 10 KHz, 11.25 KHz, 12.5 KHz, 14 KHz and 16 KHz using Sennheiser high frequency headphones. The results were analysed as per the various trades of IAF personnel. The use of ear defenders and their protective effects was also analysed. The study revealed an overall incidence of NIHL of 12.1% in the personnel with a higher prevalence among the technical trades (13.1%) as compared to non technical trades (6.6%). On extra high frequency audiometry 440 (37.8%) had prevalence of NIHL. As compared to earlier studies, the present study shows a lower prevalence of NIHL among the IAF personnel which may be attributed to higher awareness among personnel and administration, better noise environment in the IAF bases as well as use of protective devices by the personnel. The high frequency audiometry reveals a significantly high prevalence of NIHL which can be considered as an indicator of latent NIHL. Identifying personnel at risk especially technical personnel and evaluating them periodically can lead to early detection of personnel at risk and with early hearing loss and institute measures to protect them.

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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.

The evaluation of NIHL is conventionally done with an audiometric evaluation of the frequencies

from 250 Hz to 8 KHz. In addition to conventional audiometry, extra high frequency audiometry (HFA) (8-20 KHz) may represent a useful tool for detecting early changes of hearing impairment. This early knowledge of deterioration of hearing can be effectively used to prevent further progression of NIHL.

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Noise has been recognized as a problem, both environmentally and operationally, since the earlier days of aviation. We present a wide assessment of NIHL in Indian Air Force (IAF) personnel at an operational base. A realistic knowledge of prevalence of hearing loss is essential for planning as well as monitoring of the various hearing conservation programmes in vogue.

Material and Methods

A study of the prevalence of NIHL in IAF personnel at an operational IAF base was carried out. 1164 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.

Audiometry was conducted using GSI 61 Clinical audiometer. Conventional audiometry was carried out using TDH 50P headphones and High frequency audiometry was done using Sennheiser headphones. Audiometry was carried out in a sound controlled room. Each subject underwent pure tone audiometry in the frequencies 500, 1000, 2000, 4000, 6000, 8000, 10000, 11200, 12500, 14000 and 16000 Hz. The technique of audiometry was as per the American Speech and Hearing Association (ASHA) method. The personnel initially underwent sweep audiometry at 25 dB at 500,1000, 2000, 4000 and 8000 Hz, 30 dB on 10000 Hz, 40 dB at 11200 Hz, 12500 Hz, 14000Hz and 60 dB 16000 Hz. Normative data for HFA thresholds were obtained from previous studies [1]. The frequency, at which hearing loss was observed, was noted for each individual and the prevalence of NIHL using conventional and HFA was calculated.

Preventive measures like use of ear defenders were also evaluated. The data was collected as per proforma and evaluated statistically by SPSS (Ver18). The results were analysed to determine the significance and p value of less than 0.05 was considered significant.

Results

1164 IAF personnel of various trades were analysed audiometrically. 969 (83.2%) personnel belonged to the technical group which included pilots, aircrew, fitters (engine, electrical, airframe, radar and radio), drivers etc who were exposed to loud noise due to their nature of work near jet aircrafts, heavy machinery and heavy vehicles. 195 (16.8%) personnel were of the non-technical trades like clerks, equipment assistants, sweeper, medical assistants, defence civilians etc. The personnel were of the age range 20 to 58 years with a mean age of 31.2 years in technical and 36.6 years in non-technical trades. The demographic of the IAF personnel studied is listed in Table 1.

Table 1: IAF personnel were divided into Technical and Non-technical groups as per their trades.

Trade	Categories (No of Personnel)
Technical (969)(83.2%)	Pilot (69)
	Air Crew (21)
	Fitter (815)
	MT Driver (64)
Non Technical (195)(16.8%)	Clerk (59)
	Eqpt Asst (60)
	NCE(31)
	Med Asst (45)

Out of the study group, the common symptoms were discomfort and fullness in the ear in 103 (8.8 %) personnel, hearing loss in 75 (3.8 %) personnel and tinnitus in 24 (2.1 %) personnel. (Table 2).

Table 2: Showing the various major complaints of IAF personnel studied.

TRADE	NO OF PERSONNEL	HL	HL (%)	TINNITUS	LOSS (%)	DISCOMFORT INEAR	LOSS (%)
TECHNICAL	969	68	7.01	21	2.1	95	9.8
PILOT	69	3	4.3	1	1.4	9	13.1
AIRCREW	21	6	28.57	4	19	7	33.3
FITTER	815	56	6.87	13	1.5	70	8.5
MTD	64	4	6.2	3	4.6	9	14.1
NONTECH	195	7	3.5	3	1.5	8	4.1
CLERK	59	1	1.6	1	1.6	2	3.3
EQPTASST	60	2	3.3	0	0	1	1.6
NCE	31	3	9.6	2	0	3	9.6
MEDASST	45	1	2.2	0	0	2	4.4
TOTAL	1164	75	3.8	24	2.1	103	8.8

140 (12.1%) personnel were detected to have NIHL by conventional audiometry. These included 127 (13.1%) personnel of technical trades and 13 (6.6%) personnel of non-technical trades. Of the 127 personnel of the technical trades, the hearing loss was higher in aircrew (19.1%) and mechanical transport drivers (17.1%). On statistical analysis there was a definite risk among the technical trades to develop NIHL as compared to others ($p < 0.05$). (Table 3).

440 (37.8%) IAF personnel had NIHL in HFA. Of the 969 Technical personnel studied 404 (41.6%) showed NIHL whereas in 195 Non-technical personnel, 36 (18.5%) showed NIHL. The Technical trades had a statistically significant higher incidence of personnel having HFA NIHL as compared to Non-technical personnel ($p < 0.5$). (Table 4).

Table 3: Distribution of the IAF personnel showing hearing loss in conventional audiometry as per their trade.

Trade	No of Personnel	Hearing Loss	Percentage
TECHNICAL	969	127	13.1
PILOT	69	3	4.3
AIRCREW	21	4	19.1
FITTER	815	109	13.3
MTD	64	11	17.1
NONTECH	195	13	6.6
CLERK	59	3	5.1
EQPTASST	60	4	6.6
NCE	31	4	12.9
MEDASST	45	2	4.4

Table 4: Distribution of the IAF personnel showing hearing loss in extra high frequency audiometry as per their trade.

Trade	No of Personnel	Hearing Loss	Percentage
TECHNICAL	969	404	41.6
PILOT	69	21	30.4
AIR CREW	21	7	33.3
FITTER	815	349	42.8
MTD	64	27	42.1
NONTECH	195	36	18.5
CLERK	59	16	27.1
EQPTASST	60	7	11.7
NCE	31	10	32.2
MEDASST	45	3	6.6

Discussion

NIHL is currently one of the most common occupational diseases and the second most frequently self-reported occupational injury. Although NIHL is permanent, irreversible, and prevalent, it is preventable. 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. As per published literature the noise exposure and the incidence of NIHL in the IAF has been high. [2,3] Suitable hearing conservation measures to reduce as well as prevent NIHL are in vogue. We conducted this survey at an operational IAF base. On survey of the noise environment of the base, the main cause of high levels of noise was seen due to ground running of aircraft, aircraft flying overhead, heavy machinery and equipment, workshop hangars and heavy vehicles. The noise environment at the operational areas of the base revealed that the personnel especially the technical groups were exposed to high intensity of continuous as well as impulse noise.

Among the IAF personnel very few had complaints. The complaints were mainly of hearing loss, tinnitus and discomfort or fullness in the ear. Most of the complaints were transient and lasted for 10-30 mins after exposure to aircraft noise. Hearing loss and tinnitus was seen to be higher in Technical trades especially Air Crew, Fitter, MTD as compared to Non Technical Trades

On review of existing data on NIHL in the IAF, it was seen that various studies have variable results. Rao et al in their study in IAF fighter bases have recorded an incidence of 22% among technical airmen [2]. Soodan et al have described the overall prevalence of NIHL to be 44.4 % for IAF aircrew (25.7 % among fighter aircraft aircrew and 74.3 % among transport / helicopter aircrew). [3] Similar high prevalence of hearing loss has been described among the Air Traffic Controller, crash bay personnel and aircrew [4,5]. These studies are more than three decades old and their relevance in the present context is limited due to the change in noise environment, type of noise (earlier piston engines to jet aircrafts now) and improved noise protective mechanisms.

The most recent study on this subject is the analysis of 1000 IAF personnel by conventional audiometry in the IAF in 2000 [6]. The study detected a prevalence of 22.9% among the IAF personnel. Our study has a prevalence of NIHL of 12.1% which is definitely lower than that detected among IAF personnel in the earlier studies [2,3,6]. The differences can partly be attributed to different operational demands of the two bases studied, type of aircraft in the base, better noise environment in aircraft, newer sophisticated machinery with lower levels of noise etc. But it is also known that most of the personnel are not static at a base and do have exposure at various centres. In view of that, the significant decrease in prevalence of NIHL in IAF should also be attributed to the knowledge of NIHL

among the personnel and administration as well as effective hearing conservation measures like the use of protective gear during exposure to loud noise.

The technical trades had a higher prevalence of NIHL (13.1 %) as compared to non-technical trades (6.6%). Earlier studies have also shown a higher prevalence of NIHL among the Technical trades (26.18%), as compared to the Non-technical trades (12.5%) [6]. Among the various technical trades in our study, the aircrew (19.1%) and mechanical transport drivers (17.1%) showed significantly higher NIHL than the pilots (4.3%). This significant difference in prevalence of NIHL, among the technical trades is attributed to the fact that the aircrew and the various personnel involved in the maintenance of the aircraft are exposed to continuous noise of aircraft maintenance and workshop machinery in addition to exposure to intermittent very high intensity noise during aircraft take off and landing as compared to a pilot.

Although HFA is in clinical practice since 1960, its use has been limited due to the conflicting reports of its importance. In recent times various studies have proved the importance and rationale of use of HFA as a screening tool in detecting NIHL in high risk noise environment. There are no data of HFA of IAF personnel to date and this study provides the first data on this aspect. The IAF personnel showed a significant difference in prevalence of NIHL between conventional audiometry (12.1%) and HFA (37.8%) with a significant difference between technical (41.6%) and non technical trades (18.5%). The rationale of HFA is that frequencies higher than 8 KHz may be more sensitive than lower frequencies (250Hz-8KHz) to noise, acoustic trauma or ototoxic substances, thus hearing loss in these frequencies after exposure to noise may precede NIHL in lower and especially speech frequencies. Extension of the frequency range allows detecting the earliest function shifts in the

inner ear, which cannot be detected in the usual frequency range (125Hz–8 KHz). In a study measuring serial conventional (0.25-8 kHz) and high frequency (10-20 kHz) hearing thresholds in a group of noise exposed workers and non exposed controls, hearing loss was detected in the high-frequency range in 62% of patients with history of noise exposure [7]. A study by Somma G et al found that use of the extended high frequency test may represent a useful tool for detecting early changes of hearing impairment and that it could be used in addition to the conventional test to better prevent the progression of noise hearing loss [8]. Sulaiman AH et al also described the utility of HFA in identifying latent NIHL which cannot be identified by conventional audiometry [9]. Ahmed et al found 14KHz and 16 KHz as specific frequencies, which were sensitive to exposure to noise [10]. These data indicate that HFA is more sensitive than conventional audiometry in detecting early NIHL.

Conclusion

The IAF personnel are exposed to high intensity noise which is inherent in their daily routine work causing NIHL. As compared to earlier studies, the present study shows a lower prevalence of NIHL among the personnel which may be attributed to higher awareness among personnel and administration, better noise environment in the IAF bases as well as use of protective devices by the personnel. The high frequency audiometry reveals a significantly high prevalence of NIHL which can be considered as an indicator of latent NIHL. Identifying personnel at risk especially technical personnel and evaluating them periodically can lead to early detection of personnel at risk, with early hearing loss and institute measures to protect them.

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