KNOWLEDGE, ATTITUDE AND PRACTICE SURVEY REGARDING NOISE-INDUCED HEARING LOSS IN AIR AND GROUND CREW OF PAKISTAN AIR FORCE BASE MASROOR

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ABSTRACT

Objectives: To assess the pattern of knowledge, attitude and practice regarding occupational noise-induced hearing loss, amongst the air and ground crew of Pakistan Air Force Base Masroor, Karachi.
Study Design: KAP survey.
Place and Duration of Study: Department of ENT, PAF Hospital Masroor, Karachi; and Flight Surgeon's Inspection Room, PAF Base Masroor, Karachi. The study was conducted from January 2016 till October 2016.
Patients and Methods: 137 aviation personnel who worked for 6 to 8 hours on a weekday; 5 days a week, in an ambient noise greater than 95dB SPL were requested to respond to constructs of a specially modified valid questionnaire.
Results: Only weak areas in knowledge section were awareness about appearance of early indication of noise induced hearing loss and a misunderstanding regarding medical cure of the disorder. Precise comprehension, attitude and practices were attributed to literate background and high standard of professional training of individuals in the organization.
Conclusion: Realization of understanding the risks and setting up correct practical approach by following technical guidelines and adopting counteractive measures ensure wellness of individuals and their outright efficacy at workplace.

Keywords: Hearing loss, Noise-induced disorder, Occupational noise.

INTRODUCTION

Insidious exposure to industrial noise is a major avoidable cause of a permanent physical and social disability. Aviation personnel are constantly exposed to a wide range of noise. Global prevalence of occupational hearing loss is 16%[1,2]. The burden of occupational hearing impairment influenced 10 million in the US; and, 250 million people have been affected worldwide in year 2004[1]. More than 30 million workers (1 out of 10) are at risk of emergent disability from occupational noise exposure in developing countries[2]. A surge in hearing loss, particularly in young age group is alarming[3]. Besides having a physical and psychosocial impact, the brunt of economic burden resulting from noise-induced hearing loss in developed countries ranges from 0.2 to 2% of the gross domestic product (GDP), the European Union spends €40 billion annually on controlling traffic noise[4,5]. Only in 2009, the United States Veterans Affairs Department had to spend $1.2 billion to compensate those who suffered from hearing impaired and tinnitus. Canadian Forces had to spend $33 million annually in 2000-2001 to compensate the claims of veterans with noise-induced hearing loss[6].

Occupational noise exposure is an established risk for aviation personnel[7]. The source of noise may be from the ground maintenance and engineering equipment, auxiliary power unit of a parked aircraft, generators, actuators, propellers, running rotors, hydraulics, after-burners, pressurization and communication equipment. A cascade of mechanical and biochemical events is known to occur in the most delicate parts of the sense organ in response to high intensity sound. These may consist of a perforated tympanic membrane, ossicular chain disruption, necrotic

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and apoptotic hair cell death due to surge in reactive oxygen species in the cochlea[8]. Cochlear inflammation recruits circulating leukocytes in the inner ear. It follows metabolic exhaustion in basal turn outer hair cells. Further chronic exposure to noise progresses to Wallerian degeneration of the auditory nerve[9,10]. 80% of such hearing impaired individuals would contract high pitch pure tone subjective tinnitus; which is, many a time, a set off to persistent distress, insomnia and failure to concentrate[11].

Regional literature stresses considerably on the subject and attributes illiteracy, unawareness, lack of willingness, personal dislike and non availability of personal protection equipment to the enormity of noise-induced hearing impairment[12]. Unfortunately the problem has not very often been brought in public eye in our country[13]. Very little work has been performed in our country on hearing conservation programs at community level[14]. This study objective was underscore the extent of prevalence of this rather irreversible disability and to bring up an understanding in the masses and need for legislation and implementation at organizational echelon.

PATIENTS AND METHODS

Pakistan Air Force Base Masroor is a busy workplace with day and night flying and engineering operations. On an average 16 to 25 landings and take-offs of propeller-driven wide-bodied aircrafts, supersonic fighter jets and helicopters take place in a day. Almost 1160 personnel are employed in this setup. Estimated population that is exposed to noise above 90dB SPL is 880. Keeping the prevalence at 16%, confidence-level of 95%, and margin of error of 5; minimum sample size was 129 subjects. Individuals having a family history of hearing loss, those suffering from diabetes mellitus, chronic otitis media and audiometric air-bone gap of ≥15dB HL in 0.5, 1 and 2kHz, those receiving anti hypertensive or other ototoxic drugs, were excluded.

The Rus *et al* (2008) questionnaire was translated into Urdu language. It was a close ended questionnaire. It was reviewed by a panel of officers from the Pakistan Air Force Hospital Masroor. This questionnaire comprised of four main domains:

1. Demographic
2. Knowledge
3. Attitude
   - Belief
   - Feeling
   - Judgment
4. Practice

We communicated the purpose of our study to the participants and sought a written informed consent from every participant. All participants were air and ground crew of Pakistan Air Force Base Masroor who worked on 6 to 8 hours shift in a day; 5 days in a week, either in the Engineering Wing or on flight lines. The participants were requested to answer each construct on a 1-4 Likert scale, where 1 would mean 'strongly agree'; 2, 'agree'; 3, 'disagree' and 4 would mean 'strongly disagreed'.

Each participant would be requested to undergo a thorough Otorhinolaryngology, general physical and systemic clinical examination. We conducted pure tone audiometry at the Department of ENT with Madsen Voyager-522 dual-channel portable digital audiometer.

Ambient noise at workplace was measured through a calibrated android-based 'Sound Meter PRO version 2.993[34]' application. We acquired ambient sound pressure levels at Engineering Wing, aircraft engine test bed, GE shop, take off mobile, landing mobile, taxi area and flight lines.

The participants were briefed through verbal communication, and we acquired a written informed consent from all. They were requested to respond to all constructs of Urdu translated version of Rus *et al* (2008) questionnaire.

Database was maintained and analyzed in IBM-SPSS version-24. Chi-square test was used to determine the association between categorical variables like audiometric threshold, individual's

age, duration of service, intensity of ambient noise and duration of noise exposure. *p*-value ≤0.05 considered significant.

RESULTS

Total 137 adult male participants of our study responded to the constructs of our questionnaire. Mean age was 30.35 ± 5.317 yrs. The youngest respondent was 19 years of age, while the oldest being 42 years old. Mean tenure of active service was 11.15 ± 3.52 yrs. Minimum service was recorded to be 3 years, and longest duration of service was 19.5 years. Intensity of ambient noise did not appear to influence the hearing of the employees (*p*-value 0.991) (table-I). On the contrary, duration of exposure to ambient noise impose a statistically significant deleterious impact on hearing (*p*-value 0.000) (table-II). Age was observed to have a strong association with hearing loss (*p*-value 0.000) (table-III). Duration of service did not bring about a significant impact on audiometric threshold (*p*-value 0.081) (table-IV).

In knowledge domain majority of the respondents answered correctly to constructs K1 through K5, 126 (92%), 135 (98.5%), 133 (97.1%), 132 (96.4%), 107 (78.1%) and K8 and K9, 115 (83.9%), 99 (72.2%), respec-tively. Constructs K6 and K7 were wrongly answered by majority, only 43 (31.4%) and 41 (29.9%) replied correctly. This database confirms that majority of the subjects are well aware of the etiology and possible contributory factors of noise induced hearing loss, but are not clear regarding its early symptoms and the manage-ment aspects (table-V).

In attitude (beliefs) domain majority answered correctly to both questions, 121 (88.3%) and 127 (92.7%) respectively. In attitude (feelings) domain, all participants truly felt their responsibilities and of their employer to preempt noise hazard, and the need to detect any imminent risk of hearing impairment early; 129 (94.1%), 126 (92%), 125 (91.2%) and 129 (94.2%), respectively. Greater part of respondents correctly judged the risk of hearing impairment and decided to adopt protective measures; 133 (97%), 122 (89%), 123 (89.8%) and 122 (89.1%), respectively. Most of the participants pledged to assume favorable practices in day to day life to avert noise induced hearing loss; 82 (59.9%), 70 (51%), 133 (97.1%), 123 (89.8%) and 111 (81.1%), respectively (table-V).

Table-I: Audiometric hearing standard x Work-area noise intensity (dBSPL) Chi-Square Test.

	Value	df	*p*-value
Chi-Square	10.738a	24	0.991
Likelihood Ratio	11.654	24	0.984
Linear-by-Linear Association	1.194	1	0.274
No. of Valid Cases	137		

a. 29 cells (74.4%) had expected count less than 5. The minimum expected count was 0.01.

TableII: Audiometric hearing standard x Work-area noise intensity (dBSPL) Chi-Square Test

	Value	df	*p*-value
Chi-Square	52.688*	20	0.001
Likelihood Ratio	41.392	20	0.003
Linear-by-Linear Association	31.915	1	<0.001
No. of Valid Cases	137		

*28 cells (84.8%) had expected count less than 5. The minimum expected count was 0.01.

Table-III: Audiometric hearing standard x Age of participants Chi-Square Test.

	Value	df	*p*-value
Chi-Square	109.678*	44	0.001
Likelihood Ratio	60.555	44	0.049
Linear-by-Linear Association	28.733	1	<0.001
No. of Valid Cases	137	-	

* 58 cells (84.1%) had expected count less than 5. The minimum expected count was 0.01.

Table-IV: Service in years x Audiometric hearing standard Chi-Square Test.

	Value	df	*p*-value
Chi-Square	91.593*	74	0.081
Likelihood Ratio	59.208	74	0.895
Linear-by-Linear Association	13.911	1	<0.001
No. of Valid Cases	137		

*105 cells (92.1%) had expected count less than 5. The minimum expected count was 0.01.

DISCUSSION

Modernization of west began in early 17th century. The transition from pre-modernity to civilization was gradual. Many a time, it carried

along primitive ways of thinking that lasted even till today. Advances in technology has brought comfort and convenience to man. Concurrently this expansion has also been a constant source of nuisance. The consequence of a regular human exposure to a persistently elevated ambient noise may have delirious effects on the human auditory mechanism. Occupational noise puts forth the worker prone to develop a rather irreversible hearing impairment, annoyance, sleep disturbance, feeling of isolation, depression, anger, frustration, anxiety and hypertension. Individuals exposed to ambient noise for long have a strong tendency to develop ischemic heart disease[15-19]. A Pakistani worker in a polyester fiber plant is exposed to an average noise of 93-99.5dBA for 48 hours in a week[1]. Just like transport, manufacturing, music, building and construction, textile, sawmill, mining, printing, ship-breaking and stone-crushing industries; personnel involved in military conflicts are too at a high risk of developing noise-induced hearing loss.

Risk perception varies amongst persons. It involves how a person understands and experiences the consequences. Need for mitigation depends on risk perception, beliefs, and judgment[20]. Over recent years, a decline in incidence of occupational noise-induced hearing loss in the developed world has probably been attributed to mass awareness and general compliance to workplace protective measures[7]. However, the same study points out an alarmingly rising incidence in the developing nations.

Recent data from Asian countries also highlights annoyance caused to communities residing near airports. Guoqing *et al* and Lim *et al* mathematically investigated the subjective

Table-V: Participants' response to the questionnaire.

Domain		Strongly Agree	Agree	Disagree	Strongly disagree	Correct answer
		n (%)	n (%)	n (%)	n (%)	n (%)
Knowledge	K1	5 (3.6)	6 (4.4)	43 (31.4)	83 (60.6)	126 (92.0)
	K2	0 (0)	2 (1.5)	37 (27)	98 (71.5)	135 (98.5)
	K3	1 (0.7)	3 (2.2)	37 (27)	96 (70.1)	133 (97.1)
	K4	79 (57.7)	53 (38.7)	5 (3.6)	0 (0)	132 ()96.4
	K5	68 (49.6)	39 (28.5)	28 (20.4)	2 (1.5)	107 (78.1)
	K6	30 (21.9)	64 (46.7)	26 (19.0)	17 (12.4)	43 (31.4)
	K7	46 (33.6)	50 (36.5)	37 (27)	4 (2.9)	41 (29.9)
	K8	7 (5.1)	15 (10.9)	60 (43.8)	55 (40.1)	115 (83.9)
	K9	54 (39.4)	45 (32.8)	24 (17.5)	14 (10.2)	99 (72.2)
Attitude (Belief)	AB1	4 (2.9)	12 (8.8)	41 (29.9)	80 (58.4)	121 (88.3)
	AB2	2 (1.5)	8 (5.8)	28 (20.4)	99 (72.3)	127 (92.7)
Attitude (Feeling)	AF1	85 (62.0)	44 (32.1)	6 (4.4)	2 (1.5)	129 (94.1)
	AF2	80 (58.4)	46 (33.6)	3 (2.2)	8 (5.8)	126 (92.0)
	AF3	4 (2.9)	8 (5.8)	47 (34.3)	78 (56.9)	125 (91.2)
	AF4	3 (2.2)	53 (3.6)	62 (45.3)	67 (48.9)	129 (94.2)
Attitude (Judgment)	AJ1	4 (2.9)	0 (0)	58 (42.3)	75 (54.7)	133 (97.0)
	AJ2	3 (2.2)	12 (8.8)	35 (25.5)	87 (63.5)	122 (89.0)
	AJ3	92 (67.2)	31 (22.6)	9 (6.6)	5 (3.6)	123 (89.8)
	AJ4	83 (60.6)	39 (28.5)	13 (9.5)	2 (1.5)	122 (89.1)
Practices	P1	59 (43.1)	23 (16.8)	51 (37.2)	4 (2.9)	82 (59.9)
	P2	45 (32.8)	25 (18.2)	58 (42.3)	9 (6.6)	70 (51)
	P3	84 (61.3)	49 (35.8)	3 (2.2)	1 (0.7)	133 (97.1)
	P4	69 (50.4)	54 (39.4)	12 (8.8)	2 (1.5)	123 (89.8)
	P5	62 (45.3)	49 (35.8)	21 (15.3)	5 (3.6)	111 (81.1)

reaction to background noise by calculating the weighted equivalent continuous perceived noise level (WECPNL), which essentially defines a relation between the aircraft noise and annoyance[21,22].

In another study, Ismail *et al* observed a rather suboptimal response of quarry workers in knowledge and practice domains for protection against noise-induced hearing loss[23]. Another regional data reported a lack of awareness, familiarity and practice regarding use of personal protective equipment by traffic policemen[24]. Many had low literacy. Only 2.3% could feel they had below average hearing acuity. 62.8% of the subjects experienced tinnitus. Only 4.7% wore ear plugs, that too, less often. 65.1% of the subjects believed non-availability of personal protection equipment was the reason, followed by discomfort and personal dislike, in decreasing order. Sayapathi, Su and Koh concluded by emphasizing on long-term awareness programs and constant practical demonstrations about personal protection at workplace[25]. Siddiqui pointed out the prevalence of noise-induced hearing loss in workers at a large metropolitan airport in Pakistan however, he also highlighted non availability of personal protection equipment and inadequate compliance to legislation in accordance with ICAO chapter-3, annexure-16[14].

A multicenter European study concluded significant impairment in comprehension and learning in school children exposed to aircraft noise[26].

Rus *et al* developed a knowledge, attitude and practice based questionnaire and studied the response of sawmill workers[25]. We applied the Rus *et al* (2008) questionnaire to carry out our research. Here the respondent is adequately assessed for recall, comprehension and evaluation components in the 'cognitive' domain; beliefs, feelings and judgment in the 'attitude' domain; and, it tests the respondents' perception, guided response, adaptation and origination in the 'psychomotor/practice' domain. All of the constructs can be conveniently translated into explicit Urdu language and are validated. Educational backdrop and high-quality training of our subjects is the key basis of correct understanding and forestalling against the potential and rather irreparable hearing loss caused by workplace noise.

This study reflected the results of a database from one airport. We urged on the need to conduct similar surveys nationwide in order to generate a consensus to collectively formulate a national legislation, based on scientific reasoning to overcome this occupational health hazard.

CONCLUSION

Deterrence at workplace was the only time-tested management modality for occupational noise-induced hearing loss. Awareness, protection, legislation and compensation are the key strategies to minimize the risk and address the cumulative irrevocable outcome of this occupational menace.

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CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

REFERENCES

1. Cantley LF, Galusha D, Cullen MR, Dixon-Ernst C, Rabinowitz PM, Neitzel RL. Association between ambient noise exposure, hearing acuity, and risk of acute occupational injury. Scandinavian journal of work, environment & health 2015; 41(1): 75-83.
2. Butkus R, Šarlauskas A, Vasiliauskas G. Prognostication of noise exposure risk on workers' safety and health in Lithuania. J Environ Eng Landsc 2015; 23(2): 155-62.
3. Bainbridge KE, Wallhagen MI. Hearing loss in an aging American population: extent, impact, and management. Annual review of public health 2014; 35(1): 139-52.
4. Balaji R, Rajalakshmi Rajasegaran NAJ, Venkatappa US. Hearing impairment and high blood pressure among bus drivers in Puducherry. J Clin Diag Res 2016; 10(2): 139-52.
5. Forsséna J, Hornikx M, Van Der Aa B, Nilsson M, Rådsten-Ekmanc M, Defrance J, et al. Toolbox from the EC FP7

HOSANNA project for the reduction of road and rail traffic noise in the outdoor environment 2014.
6. Sharif A, Khanam RA, Rahman MM, Rahman SH, Kamar-uz-zaman M, Ahmad A. Hearing Status of the Traffic Police with or without Use of Sound Protector in Dhaka Metropolitan City. J Curr Adv Med Res 2017; 4(1): 13-6.
7. Lie A, Skogstad M, Johannessen HA, Tynes T, Mehlum IS, Nordby KC, et al. Occupational noise exposure and hearing: A systematic review. International archives of occupational and environmental health 2016; 89(3): 351-72.
8. Doosti A, Lotfi Y, Moossavi A, Bakhshi E, Talasaz AH, Hoorzad A. Comparison of the effects of N-acetyl-cysteine and ginseng in prevention of noise induced hearing loss in male textile workers. Noise and Health 2014; 16(71): 223-27.
9. Morell M, Brownlow A, McGovern B, Raverty SA, Shadwick RE. Implementation of a method to visualize noise-induced hearing loss in mass stranded cetaceans. Sci Rep 2017; 7: 41848.
10. Anttonen T, Belevich I, Kirjavainen A, Laos M, Brakebusch C, Jokitalo E, et al. How to bury the dead: elimination of apoptotic hair cells from the hearing organ of the mouse. J Assoc Res Otolaryngol 2014; 15(6): 975-92.
11. Yankaskas K. Prelude: noise-induced tinnitus and hearing loss in the military. Hear Res 2013; 295: 3-8.
12. Pankaj A, Bhatia A. Otoacoustic emissions in noise-induced cochlear damage in artillery soldiers. Ind J Otol 2015; 21(2): 98-102.
13. Saxena A, Ramesh A, Mehra PR, Singh D. Short-term audiometric profile in army recruits following rifle firing: An Indian perspective. Ind J Otol 2016; 22(3): 199-202.
14. Siddiqui IA, Siddiqui RA. The effect of excessive noise exposure on the hearing thresholds of aviation workers in Karachi. Pak J Med Sci 2008; 24(4): 525-30.
15. Enshassi A, Kochendoerfer B, Rizq E. An evaluation of environmental impacts of construction projects. The Construction Engineering Magazine 2015; 29(3): 234-54.
16. Ising H, Babisch W, Kruppa B. Noise-induced endocrine effects and cardiovascular risk. Noise and health 1999; 1(4): 37.
17. Mahmood R, Khan GJ, Alam S, Safi AJ. Effect of 90 decibel noise of 4000 hertz on blood pressure in young adults. J Ayub Med Coll 2003; 16(2): 30-3.
18. Singhal S, Yadav B, Hashmi S, Muzammil M. Effects of work-place noise on blood pressure and heart rate. Biomed Res 2009; 20(2): 122-6.
19. Ibrahim D, Qamhieh Z, Abdel-Raziq I. Health effects of occupational noise exposure in the range (90 (110-dB (A) especially on blood oxygen saturation of workers in selected industrial plants. Environmental Science: Indian Journal, Accepted for publication. ESAIJ 2013; 8(11): 419-24.
20. Shaeffer NE. Models of Risk Perception and Risky Choice: Theoretical Modeling and Empirical Testing in Hypothetical and Real-life Situations: ProQuest; 2008.
21. Chun C, Yoon K, Lee S, editors. Development of combined noise annoyance model based on the partial loudness model. INTER-NOISE and NOISE-CON Congress and Conference Proceedings; 2016: Institute of Noise Control Engineering. Inter Noise 2016.
22. Guoqing D, Xiaoyi L, Xiang S, Zhengguang L, Qili L. Investigation of the relationship between aircraft noise and community annoyance in China. Noise and Health 2012; 14(57): 52.
23. Ismail AF, Daud A, Ismail Z, Abdullah B. Noise-induced hearing loss among quarry workers in a north-eastern state of Malaysia: A study on knowledge, attitude and practice. Oman Med J 2013; 28(5): 331-6.
24. Gupta S, Mittal S, Kumar A, Singh KD. Self assessment of hearing quality and noise-related attitudes among traffic policemen of Patiala, India. Int J Preven Med 2014; 5(4): 511-5.
25. Rus RM, Daud A, Musa KI, Naing L. Knowledge, attitude and practice of sawmill workers towards noise-induced hearing loss in Kota Bharu, Kelantan. Malays J Med Sci 2008; 15(4): 28–34.