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Hearing impairment in military personnel in Eastern Saudi Arabia

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Abstract:

BACKGROUND: Noise exposure is one of the most common occupational hazards worldwide. Studies have shown that the prevalence of hearing loss and tinnitus is higher in military personnel than in other occupations. This study aimed to estimate the prevalence of hearing impairment in military personnel in Eastern Saudi Arabia.

MATERIALS AND METHODS: A cross-sectional study was conducted among 409 military personnel. A self-administered questionnaire collected data on level of awareness, hearing impairment, and protection of hearing. Pure-tone audiometry (PTA) was conducted on 141 participants to determine the prevalence and pattern of hearing impairment. Multivariate analysis was used to determine the predictors of hearing loss in military personnel.

RESULTS: More than half of the participants (54.3%) were unaware of the consequences of noise exposure and none used proper hearing protection. A small percentage (5.9%) complied with the annual hearing examination, and only 23% had had a previous hearing evaluation. More than half of the participants (58.4%) had one or more abnormal hearing-related symptoms, with tinnitus as the most common symptom (43.8%). PTA showed hearing impairment in 71.6% of the participants. Multivariate analysis showed older age as only significant factor associated with hearing impairment in military personnel.

CONCLUSION: Noise-induced hearing loss and tinnitus are common occupational disabilities in military personnel. Hearing conservation programs have to be initiated to ensure the application of hearing protection measures and control the effects of exposure to noise.

Keywords:

Hearing loss, military, noise-induced hearing loss, noise, occupational, tinnitus

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Introduction

Noise-induced hearing loss (NIHL) is the most common preventable cause of hearing loss and the second most common cause of hearing loss overall after presbycusis.^[1] It is estimated that the world prevalence of hearing loss in the adult population is more than 15%, and almost half of this is due to exposure to noise.^[2] Occupational NIHL is a subset of NIHL that develops gradually or suddenly

as a result of the exposure to continuous or impulse noises in the workplace. It is common among workers in noisy work environments and represents a public health concern worldwide owing to its high prevalence and significant impact on the quality of life.^[3-5] Data from the United States of America (USA) showed that approximately 30 million employees are at risk of developing hearing loss owing to daily noise exposure in the workplace.^[3] In Saudi Arabia, the prevalence of hearing loss of employees in noisy work environments ranges from 15.8% to 57%.^[6-8]

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Published studies have demonstrated that the prevalence of hearing loss and tinnitus is higher in military personnel than in the general public and industrial workers.^[9] The prevalence of occupational NIHL in the military has been estimated to range between 12% and 68% in studies from multiple countries.^[10-13] The incidence and impact of NIHL are influenced by several factors other than the level of noise exposure. These include noise-related factors (e.g., frequency, intensity, and type of noise) and patient-related factors such as age and gender.^[14] Military personnel are subject to exposure to impulse and steady noises concurrently. The use of hearing protection devices in the workplace has been shown to decrease the incidence of occupational NIHL.^[15] However, studies have shown that the majority of employees who are exposed to high noise levels in their workplace are not compliant with the use of hearing protection. Some reasons behind this noncompliance include discomfort and little awareness of NIHL and its consequences.^[16]

Occupational NIHL and hearing-related symptoms are considered some of the most common occupational disabilities.^[17] Studies on the prevalence of hearing impairment in military personnel in Saudi Arabia are limited. Therefore, the aim of this study was to estimate the prevalence, pattern, and predictors of hearing loss and other hearing-related symptoms in military personnel at a military institution in the eastern region of Saudi Arabia. Examining hearing impairment and its predictors in military personnel can contribute to the recognition and control of noise exposure and its harmful consequences.

Materials and Methods

This was a cross-sectional study of 409 military personnel conducted from June to August of 2018 at King Abdulaziz Hospital (KAH) in Al Ahsa, Saudi Arabia. KAH is a secondary care center that belongs to the Ministry of National Guard Health Affairs. A self-administered questionnaire was distributed to all the military members in the institution (800 subjects). Personnel who completed the self-administered questionnaire and did not have a recent history of noise exposure or trauma (within 72 h) were included in the study (409 participants). Moreover, personnel with known conductive hearing loss (e.g., chronic suppurative otitis media and tympanic membrane perforation) were excluded from the pure-tone audiometry (PTA) testing (18 participants). All those who met the inclusion criteria were enrolled in PTA testing (391 participants), but only 141 participants completed the examination.

A self-administered questionnaire on hearing impairment and noise exposure awareness was developed based on published validated questionnaires and translated into Arabic.^[18-20] Questions relating

to baseline clinical and demographic characteristics, chronic diseases (including diabetes, hypertension, and cardiovascular diseases), hearing-related symptoms, history of noise exposure, and awareness on NIHL and hearing protection were included in the distributed questionnaire. PTA was done on 141 participants by an experienced audiologist in KAH in fulfillment of the ISO 8253-1 (2010) requirements to determine the prevalence and pattern of hearing impairment.^[21] Hearing thresholds were measured in 5-dB steps until there was a response. Subjects with an average hearing threshold between 26 and 40 dB were considered as having mild hearing impairment, those with a threshold from 41 to 60 dB were considered moderate, 61–80 dB were severe, and 81 dB or greater were profound at frequencies of 0.5, 1, 2, and 4 kHz based on the WHO classification for hearing impairment.^[22]

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 25 (IBM Corp, Armonk, NY). All categorical variables were summarized and reported as proportions, and all continuous variables were summarized and reported as means and standard deviations. Categorical and continuous variables were compared in all study groups using Chi-square tests and Independent *t*-test, respectively. A multinomial logistic regression model was used by the relationship between hearing impairment and other variables to determine the predictors of hearing loss in military service. All results were reported in terms of odds ratio (OR) and the corresponding 95% confidence interval (CI). A $P < 0.05$ was considered statistically significant.

Ethical approval was obtained from the Institutional Review Board (IRB) of King Abdullah International Medical Research Center vide Letter No. IRBC/111/14 dated 07/03/2014 and informed written consent was taken from all participants. Patient confidentiality was protected. Only data relevant to the study objectives were collected with limited access to the research team only.

Results

The majority of the military personnel included in the study were soldiers (91.2%) while the remaining were officers (8.8%). The study including only male participants belonged the age group 20–34 years, the most common (55%). More than half of the participants had a service duration of 1–14 years (57%). The prevalence of chronic diseases in our sample was 16.6%, and only 18 participants (4.4%) had a history of known hearing impairment [Table 1].

The study showed that more than half of the participants (54.3%) were unaware of the impact and consequences of noise exposure. Only a small proportion

of the participants (31.5%) used any form of hearing protection. None used the proper hearing method during their service. A small percentage (5.9%) were compliant with the annual hearing exam and only 23% had a previous hearing evaluation [Table 2].

More than half of the participants (58.4%) had one or more abnormal hearing-related symptoms. Several symptoms were identified in the participants, tinnitus being the most common, affecting 179 participants (43.8%). Difficulty in word recognition was next in 177 participants (43.3%),

Table 1: Demographic and baseline clinical characteristic of military personnel in Al Ahsa, Saudi Arabia (n=409)

Variables	N (%)
Age	
20-34	225 (55.0)
35-44	134 (32.8)
45-60	50 (12.2)
Chronic diseases	
Yes	68 (16.6)
No	341 (83.4)
Known hearing impairment	
Yes	18 (4.4)
No	391 (95.6)
Military ranking	
Soldier	373 (91.2)
Officer	36 (8.8)
Military unit	
Artillery	176 (43.0)
Nonartillery	233 (57.0)
Service duration (years)	
1-14	233 (57.0)
15-24	124 (0.3)
25-35	52 (12.7)

Table 2: Awareness about noise-induced hearing loss and hearing protection among military personnel in Al Ahsa, Saudi Arabia (n=409)

Variables	N (%)
Awareness about impact and consequences of NIHL	
Aware	187 (45.7)
Not aware	222 (54.3)
Use of hearing protection (any)	
Yes	129 (31.5)
No	280 (68.5)
Use of proper hearing protection	
Yes	0
No	409 (100)
Annual hearing exam	
Yes	24 (5.9)
No	385 (94.1)
Previous hearing exam	
Yes	96 (23.5)
No	313 (76.5)

NIHL=Noise-induced hearing loss

176 (43.0%) participants requested repetition of speech, 131 participants (32.0%) had a feeling of gradual hearing loss, in 128 participants (31.3%) other people had noticed the hearing impairment. Figure 1 demonstrates the prevalence of abnormal hearing-related symptoms in military personnel.

Audiometry hearing test was carried on 141 out of the 409 included in the study. It showed that 51.8% of the participants had a bilateral hearing impairment and 19.9% had a unilateral hearing loss [Figure 2]. The prevalence of hearing loss in the right and left ears was reported as follows, mild (23.4% and 29.1%),

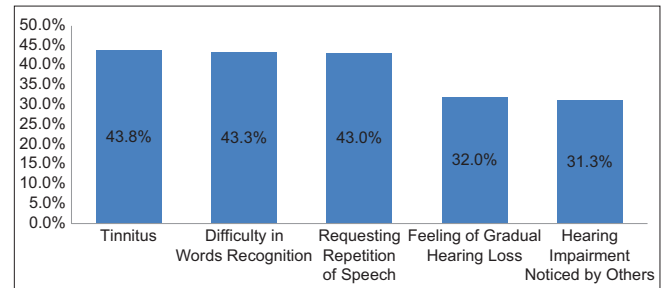


Figure 1: Distribution of abnormal hearing-related symptoms among military personnel (n = 409)

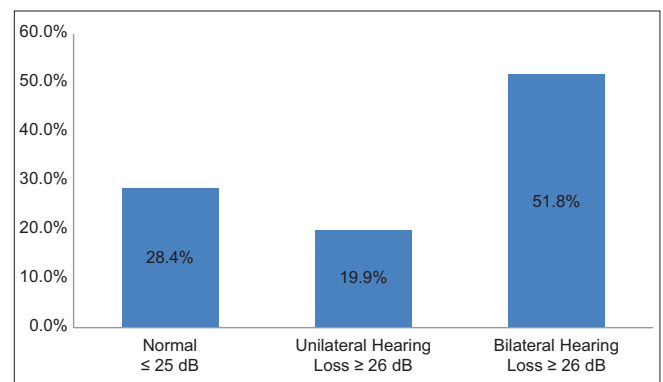


Figure 2: Prevalence of hearing loss among military personnel on pure-tone audiometry (n = 141)

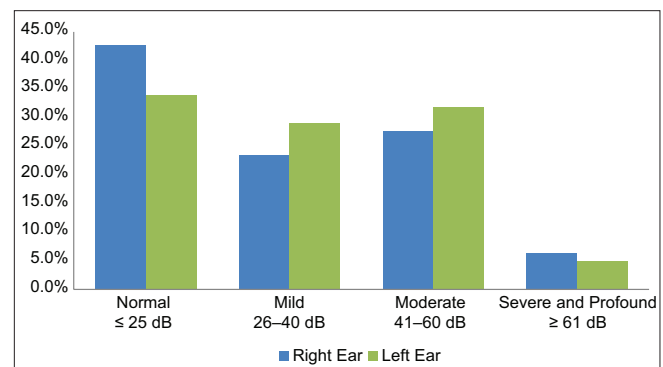


Figure 3: Prevalence of hearing loss among military personnel according to the side and degree of impairment in pure-tone audiometry (n = 141)

moderate (27.7% and 31.9%), severe as well as profound (6.4% and 5.0%), respectively [Figure 3].

The prevalence of hearing loss was significantly ($P=0.006$) higher in patients aged 35–44 and 45–60 years (80.4% and 85.3%, respectively) compared to younger patients (aged 20–34 years) with a prevalence of 58.2%. Moreover, participants with longer service durations (15–24 and 25–35 years) had significantly higher rates of hearing loss (85.1% and 75.0%, respectively) in comparison to 61.4% of participants with shorter service duration (1–14 years) as demonstrated in Table 3. However, only older age continued to be a significant predictor ($P=0.007$) of hearing loss in the multivariate logistic regression analysis with OR of 4.76, and 95% CI: 1.53–14.84 [Table 4].

Discussion

Exposure to noise can lead to various hearing-related disabilities such as hearing loss and tinnitus.^[1] Hearing loss from noise exposure ranges from temporary threshold shifts (TTS) to permanent threshold shift (PTS). TTS is a transient attenuation of hearing acuity which usually recovers within 48 h postexposure but increases the likelihood of the development of permanent hearing loss later in life.^[23] PTS, on the other hand, occurs as a result of the destruction of cochlear hair cells, or damage

to their mechanosensory hair bundles, resulting in permanent hearing loss.^[24] Hearing loss in our study refers to the permanent form of hearing loss.

Our study showed that the prevalence of hearing loss among military personnel is high (71.6%). The finding of high hearing loss is expected since military personnel are one of the occupational categories that are exposed to hazardous levels of noise each day in their line of work.^[10,25] Data from military services in the USA showed that hearing loss is the most prevalent occupational health disability.^[25] Moreover, published annual benefits report in military service of the USA showed that tinnitus and hearing loss are the number one and number two disabilities for which compensations are given in the military, with an estimated cost of \$242.4 million per year.^[11,26] The prevalence of hearing loss in our study exceeded the reported prevalence of hearing loss among military personnel reported in the literature, at a variable range of 12.5%–68%.^[10-13] One important factor that might have led to such high prevalence in our study is the lack of awareness and education about NIHL and the possible preventive measures.

The present study demonstrated that the level of awareness of NIHL is low in military personnel (45.7%). Moreover, nearly two-thirds of our sample (68.5%) were not compliant with the use of hearing protection.

Table 3: Correlates of hearing loss in military personnel in Al Ahsa, Saudi Arabia (n=141)

Variables	Total	Have hearing loss N (%)	P-value
Number of samples	141	101 (71.6)	
Age			
20-34	55	32 (58.2)	0.006
35-44	51	41 (80.4)	
45-60	34	29 (85.3)	
Chronic diseases			
Yes	45	37 (82.2)	0.063
No	95	65 (68.4)	
Military ranking			
Soldier	126	91 (72.2)	0.441
Officer	14	11 (78.6)	
Military unit			
Artillery	61	43 (70.5)	0.358
Nonartillery	79	59 (74.7)	
Service duration (years)			
1-14	57	35 (61.4)	0.024
15-24	47	40 (85.1)	
25-35	36	27 (75.0)	
Number of firearm drills (times/year)			
1-2	96	67 (69.8)	0.176
3	20	18 (90.0)	
>3	24	17 (70.8)	
Use of hearing protection			
Yes	45	34 (75.6)	0.390
No	95	68 (71.6)	

Table 4: Logistic regression analysis: Correlates of hearing loss among military personnel

Variables	Odds ratio	95% CI	P-value
Older age	4.760	1.527-14.839	0.007
Longer service duration	0.389	0.131-1.154	0.089
Presence of chronic disease	1.835	0.516-2.608	0.379
Military unit	1.160	0.474-7.099	0.720
Medication use	0.995	0.233-4.246	0.994
Previous hearing test done	1.161	0.454-2.968	0.756

CI=Confidence interval

In fact, none of the participants used proper hearing protection. The personal hearing protection methods, such as earplugs, which our participants used, did not provide the desired protection.^[27] The poor compliance with the use of hearing protection might be due to the little awareness of NIHL and its preventive measures, discomfort, or because these methods have noise-cancelling properties which tend to interfere with the normal communication between personnel.^[16] The use of hearing protection should be encouraged in occupations that are exposed to hazardous levels of noise since they have been proven to decrease the incidence of NIHL.^[15] Another important factor that might have contributed to the high prevalence reported in our study is the poor compliance with the annual hearing test and hearing examination in general as demonstrated in Table 2. Since NIHL is preventable, increasing the awareness of the impact and consequences of noise exposure, and the implementation of the preventive measures, may contribute to the reduction of the incidence of NIHL and tinnitus in military personnel. Moreover, our study was of male participants exclusively, as there were no female military employees in Saudi Arabia at the time of this study. This might have influenced our prevalence of hearing loss, owing to the association of male gender with higher incidence of occupational NIHL reported in the literature.^[28]

The reported prevalence of hearing loss in the present study is also high (71.6%) compared to that of other professions in Saudi Arabia such as dentists, industrial workers, and airport field workers where the prevalence ranges from 15.8% to 57%.^[6-8] This finding correlates with the findings of other published studies about NIHL, which showed that the prevalence of hearing loss and tinnitus is higher in military personnel than in industrial workers and other professions.^[9,25,29] The magnitude of the problem of hearing impairment that results from excessive noise exposure depends on several factors associated with the exposure such as sound pressure level, duration, type of noise, and frequency. In contrast to noise exposure in other work

environments, the hearing of military personnel can be disturbed as a result of exposure to both impulse noises (e.g., firearms) and steady noises (e.g., engines and communication systems), which produces more profound changes in hearing than either separately.^[11,30] Firearms can produce impulse noise levels reaching up to 150–180 dB, which can lead to extensive damage to the auditory system.^[31] Moreover, noise exposure in the military field usually continues for several days or months, as opposed exposure to noise in other professions, which is often limited to a few working hours.

Given the high prevalence of hearing loss of military personnel, it is important to identify individuals who are at higher risk of hearing impairment. In the multivariate analysis, older age was found to be significantly associated with increased prevalence of hearing loss in the military personnel. The present study demonstrated that military employees older than 35 years old were 4.7 more prone to developing hearing loss compared to younger participants. This finding correlates with the conclusion of Ribak *et al.*, that aging was the only predictor of hearing loss in pilots.^[32] The predictors of hearing loss in military personnel reported in the literature are variable and include older age, male gender, longer service duration, nonblack ethnicity, and tobacco use among others.^[33,34] However, aging was the most common of the reported predictors of hearing loss in military personnel.

Several hearing-related symptoms were detected in our study, tinnitus being the most common symptom. Published studies and reports about the prevalence of tinnitus in comparison to hearing loss are limited. However, our finding correlates with the conclusions of multiple studies in the literature that reported tinnitus as a common hearing-related symptom in noisy work settings. Ylikoski and Ylikoski reported a tinnitus prevalence of 42.5% in professional soldiers who were exposed to gunfire noise.^[12] Song showed that approximately one-fourth of manufacturing workers reported having tinnitus.^[35] Other detected symptoms were difficulty in word recognition, request for the repetition of speech, feeling of gradual hearing loss, and hearing impairment noticed by others.

There are a few limitations to this study. The first is the exclusive study of male participants since there were no female military employees in Saudi Arabia at the time of the study. Besides, PTA was conducted on only 141 out of the 409 military personnel who participated in the study. However, this is the first study of the prevalence of hearing impairment and its predictors in military personnel in Saudi Arabia.

Conclusion

NIHL and tinnitus are common occupational disabilities in military personnel. Hearing conservation programs have to be initiated to ensure that military personnel have access to hearing protection devices and hearing evaluation that their awareness of noise exposure and its consequences is raised, and that they are able to identify and control their exposure to noise as much as is practicable. Since these conditions are preventable, the application of these initiatives can help decrease the incidence of NIHL and tinnitus in military personnel.

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Conflicts of interest

There are no conflicts of interest.

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