Global Journal of Otolaryngology
ISSN 2474-7556

Research Article
Volume 13 Issue 2 - January 2018
DOI: 10.19080/GJO.2018.13.555860

Glob J Otolaryngol

Prevalence of Hearing Loss and Tinnitus with Correlation to the Usage of Protective Hearing Equipment among Airport Workers

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Submission: January 17, 2018; **Published:** January 30, 2018

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Abstract

Objectives: Epidemiological studies have shown that tinnitus and occupational hearing loss are common symptoms in the working population. Only few studies have assessed the aforementioned symptoms in this population, none of which have assessed airport field workers, thus the need for our study.

Methodology: A cross-sectional study was conducted among airport field workers at King Khaled International Airport in Riyadh. The sample size was calculated to be 380. Each was asked to fill a self-administered questionnaire and undergo pure tone audiometry to assess hearing level. The questionnaire assessed the participants' demographics, usage of protective hearing equipment (PHE) as well as prevalence and characteristics of tinnitus if present.

Results: Of all field workers, 300 (78%) have agreed to participate in the study. A number of 180 (60%) participants believe that PHE prevents noise-related hearing loss. Of all participants, 114 (38%) of workers use PHE. No association was found between the participants' believe regarding PHE benefits and their usage of the equipment (P=0.473). Tinnitus was reported by 81 (27%) of the whole sample. Most of the participants 171 (57%) were found to have hearing impairment (>25dB HL) at low frequencies (0.5, 1, 2kHz), in comparison to 144 (48%) at high frequencies (4 and 8kHz).

Conclusion: Even with relatively good knowledge about the importance of PHE, only few workers actually use them. Thus, frequent audiometric screening tests as well as enforcement of PHE usage by airport field workers needs to be introduced by the airport administrations.

Keywords: Tinnitus; Occupational; Hearing loss; Airport workers; Protective hearing equipment

Introduction

Sound and noise are part of the same auditory continuum. Noise has been defined by the National Institute for Occupational Safety and Health as «any unwarranted disturbance within a useful frequency band» [1]. As a result of industrialization, noise exposure in different occupations is almost inevitable. Noise has been identified as a risk factor for multiple medical conditions including hypertension, anxiety, hearing loss and tinnitus [2,3] In fact, noise is responsible for 16% of hearing loss worldwide [4] In the United stated, approximately twenty-two million individuals are exposed to dangerous levels of noise each year [5]. Approximately 10 million individuals in the U.S suffer from occupational hearing loss [6] In Saudi Arabia (KSA), Ahmed et al. has shown that the prevalence of hearing impairment in industrial workers exposed to noise is 39.3% in comparison to only 4.5% of non-noise exposed worker [7]. These levels are comparable to China where 42% of airport maintenance workers are estimated to suffer from occupational hearing loss [8].

Tinnitus is defined as noise, regardless of its nature, perceived in absence of external stimulus, [9] This noise may take multiple forms such as whistling, buzzing or hissing and may be perceived as emanating from within the head or outside the body. The sound perceived may be subjective in nature, audible only by the patient, or objective, audible by both the patient and the examiner. Objective tinnitus is quite rare with a defined muscular or vascular pathology whereas subjective tinnitus is due to neurophysiological aberrations in the auditory pathway [9]. The prevalence of tinnitus differs globally. In Japan, 11.9% of adults (45-79) are reported to have tinnitus [10]. Similarly, 10% of Industrial workers in KSA were found to have tinnitus [7]. In the most recent survey, Kim et al. [11] surveyed approximately

twenty thousand adults aged between 20 and 98 and identified a prevalence of 20.7%, of which 31% reported that they were annoyed by the noise during their daily life [11].

The study results showed that females were at a higher risk of developing tinnitus and that patients with depression are twice as likely to develop tinnitus when compared to the rest of the population. Other defined risk factors included, smoking, dyslipidemia, age and different systemic chronic diseases such as Rheumatoid arthritis and thyroid diseases [11]. In Saudi Arabia, only few studies have assessed the prevalence of hearing loss and tinnitus in the working population, none of which have assessed airport workers. We hope that our study can shed light on this topic in our community and provide feedback regarding possible educational programs or screening strategies, if needed, directed towards this population.

Methods

Ethical statement

The study protocol was approved by the institutional review board of King Saud University. The study was conducted in accordance with the Declaration of Helsinki. Informed consent was attained from all participants prior to their inclusion in this study.

Study design

A quantitative observational cross-sectional study

Subjects

King Khalid International Airport is the largest airport in the kingdom of Saudi Arabia with a total of 900 Airport Field Workers (AFWs) distributed across 3 departments: maintenance, transportation and cargo and is located in the capital city, Riyadh. In this cross-sectional study, we targeted all AFW working at King Khalid International Airport in the year 2016 to assess the prevalence of hearing Loss and tinnitus, and to correlate them with the use of protective hearing equipment. All AFWs included in this study have underwent a pre-employment baseline audiometry screening. Inclusion criteria included all AFWsat King Khalid International Airport. Exclusion criteria included refusal to participate.

Sample size

According to the airport administration office there were 900AFWs (Total population). Because fewstudies have assessed the prevalence of tinnitus among aircraft workers in the Middle East, we assumed that 50% currently suffer from tinnitus to achieve the maximum sample size. We considered a margin of error of 5%, with a 95% confidence level. By using the standard sample size formula for a single proportion:

$N = Z2\alpha P (1-P)/d2$

N: Sample size

P: Proportion.

d: Margin of error.

Zα: A normal deviate reflects the type I error and is equal to 1.96 for 95% confidence level

Sample size was calculated to be 384.

Data collection tools

A self-administered questionnaire was used to assess the study's objectives. Due to the study's multiethnic population, both English and Arabic languages of the questionnaire was used. The questionnaire was composed of 3 main parts. Part 1 assesses participants' demographics in terms of age, gender, nationality, educational status, years spent at the airport and usage of protective hearing equipment (PHE). Part 2 of the questionnaire addresses the prevalence of tinnitus and its characteristics. Presence or absence of tinnitus was determined by the following question «In the past 12 months, have you noticed any buzzing, ringing or any other form of noise in the absence of any external sound?». Tinnitus severity was assessed using a subjective scale of «mild», «moderate», or «severe» as well as its impact on sleep. Part 3 included formal audiometric testing. The testing took place in a secluded room approximately 0.5km from runway to minimize interfering background noise. For the purpose of this study, hearing loss was divided into low (0.5, 1, and 2kHz) and high frequency (4 and 8kHz). A hearing loss of mild corresponded to hearing difficulties between (≥25 and ≤40dB), moderate (40-55dB) and severe (>55dB).

Statistical analysis

Pilot study was conducted on the first week on 10 employees to assess the clarity of the questionnaire, time needed for data analysis as well as data cleaning. Categorical variables were reported as percentage while continuous variable was reported for means and standard deviation. Chi-square test was used to compare the participants'belief regarding PHE benefits and their usage of the equipment. The results were considered statistically significant if P≤0.05. SPSS software version 21.0(41) was used for further analysis of data.

Results

Demographics

Three hundred airport workers responded to the survey yielding a response rate of 78%. Our population consisted of male participants exclusively, as there are no female airport field workers in Saudi Arabia. Participants were of Saudi nationality (68%), high-school graduates (38%), aged between 30-39(37%), and are current smokers (45%). The demographics are summarized in (Table 1). In regards to years spent working in the airport: 40.3% of the respondents had worked at the airport for more than 10 years, 24% of the respondents had been employed for 1 to 3 years, 17.3% of the respondents had worked at the airport for 4 to 6 years; 11.7% of the respondents

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had worked at the airport for 7 to 9 years; and only 6.7% of the respondents had worked at the airport for less than 1 year.

Table 1: Demographics.

Age	Percent
>20	1.0%
20 to 29	33.3%
30 to 39	36.7%
40 to 49	20.0%
50 to 59	8.75
60 to 69	0.3%
>70	1.0%
Education Status	Percent
High School	38.3%
Diploma	34.3%
Bachelor	24.3%
Masters	3.0%
Total	100%
Smoking Status	Percent
Current Smoker	44.6%
Former Smoker	17.7%
Never Smoked	37.7%

Usage of protective hearing equipment

Only 38% of surveyed sample reported using PHE during work, of whom: 50% use PHE for 1-3 hours/day, 27% use it for 4-6 hours, 13% use it for 7-9 hours and only 10% reported using PHE all throughout their work shift. Furthermore, our survey shows that only 58% of our sample believe that PHE preventhearing loss. Only 45% believe that PHE prevent tinnitus.

Prevalence and characteristic tinnitus

Tinnitus was reported by 27% of population. In most cases, tinnitus was bilateral (61%) and did not cause any difficulties in sleep (67%). Tinnitus reportedly affected right ear in 19%, left ear in 22% and was bilaterally in 59%. Only 20% of those affected by tinnitus sought medical attention.

Pure tone audiometry

In the low frequency group (0.5, 1.2kHz), a total of 43 participants were found to have some degree of hearing loss, most of whom (79%) was measured at mild. In regards to high frequency hearing loss(4 and 8kHz), 36 participants were found to have some degree of hearing loss, most of whom (50%) was measured also at mild. Across all frequencies, 32 participants were found to have variable degree of hearing loss most of whom (69%) was measured also at mild. These results are summarized in (Table 2). Possible risk factors for hearing loss were also assessed. The results of which are summarized in (Table 3).

Table 2: Audiometry Results

Presence and Degree	Threshold average (dB HL) n (%)		
	Low Frequency (0.5, 1,2 kHz)	High Frequency (4 and 8 kHz)	All frequency (0.5, 1,2,4,8, kHz)
No impairment (<25 dB HL)	257 (85.7)	268 (89.4)	265 (88.3)
≥25 and ≤ 40 (mild)	34(11.3)	18 (6.0)	22(7.3)
<40 and ≤ 55 (moderate)	5(1.7)	9(3.0)	7(2.3)
>55 (severe)	4(1.3)	5(1.7)	4(1.3)
Total with impairment (≥25 dB HL)	43(14.3)	36(12.0)	32(10.9)

Table 3: Possible risk factors for hearing loss.

	Yes	No
	Percent	Percent
Ear Injury	5.0%	95.0%
Head injury	9.0%	91.0%
Exposure to explosions	2.3%	97.7%
Family history of deafness	2.0%	98.0%

Discussion

This study represents the first study to assess the prevalence of tinnitus and hearing loss among AFWs and measuring their compliance in regards to the use of PHE in Saudi Arabia and probably the Middle East. Even though in our study we did not measure the level of noise at the airport field, based on the international and global scales of noise pollution, the maximum dose of environmental noise (140db) a person can receive is by being within 25 meters distance from an airplane take-off [12]. Unfortunately, few studies have been done in Saudi Arabia and the Middle East to evaluate the burden of NIHL and tinnitus in settings with high levels of noise.

Usage of protective hearing equipment

US National Institute for Occupational Safety and Health (NIOSH 1998) noted that effective use of hearing protective devices would reduce the rate of NIHL hearing loss in noise-exposed workers [13]. Previous studies assessing the compliance to PHE among individuals working at places with high levels of noise have generally documented low usage rates [14]. Lusk et al showed that the average usage rates of PHE among 400 construction workers is ranging from 18 to 49% [15]. In the present study, although 60% of the participants believe that PHE prevent hearing loss and 45% believe that they prevent tinnitus, only 38% actually use them. Moreover, no association was found between the participants' believe regarding PHE benefits and

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their usage of the equipment (P=0.373).

Prevalence and characteristic of tinnitus

Tinnitus is an early warning symptom for NIHL [5]. In a study done at South Korea by Song JB et al. [16] on manufacturing workers (noise exposure group) and design workers (control group) at shipyard, tinnitus prevalence was 24.3% and 3.6% [17]. This study demonstrated the relationship between the high levels of noise and tinnitus.It is worth mentioning that the severity of hearing loss was found to be significantly higher in workers with tinnitus compared to workers without tinnitus in the aforementioned study. In our study, the prevalence of tinnitus was 27% with the majority of the participants (61%) reporting bilateral tinnitus. Conversely, a similar study done in eastern Saudi Arabia demonstrated that the prevalence of tinnitus among 269 industrial workers is 11% [7]. It included workers at steel pipes and the other manufactured air conditioning units. Tinnitus due to noise exposure is drawing less attention than NIHL. Nevertheless, the probability of tinnitus development ought to be taken into consideration in hearing preservation programs for the high association reported between noise exposure and tinnitus.

Pure tone audiometry

Occupational NIHL hearing lossoccurs among individuals that are exposed to excessive amounts of noise for long durations [18]. In a study done at the Republic of China by Chen TJ et al. [8] on 112 airport employees, the prevalence of high-frequency hearing loss was 41.9%. While at Jomo Kenyatta International Airport in Nairobi, the prevalence of NIHL was 15.3% [18]. Similarly, in the present study done at King Khalid international airport, the prevalence of NIHL was found to be 12%. Several factor can contribute the the disparity of the aforementioned results including duration of exposure to noise as well as the compliance to the PHE. That is concerning NIHL among airport workers. On the other hand, a fair percentage of studies have been published in the literature to assess NIHL among workers exposed to high levels of noise. One of which is a study done in Saudi Arabia by Ahmed et al involving 259 industrial workers (one manufactured steel pipes and the other is air conditioning unit) found that the prevalence of high frequency hearing loss is 65.6%. Nevertheless, the usage of PHE or the duration of exposure to noise were not documented [7]. In addition, a periodic annual audiometric examination in Taiwan done by Wu TN et al on a large number of noise exposed workers (9,535) showed that a total of 3,216 (34.0%) workers were found to have NIHL. In our target population, we found that the airport administration does encourage AFW do undergo an annual audiometric screening; although there was no official surveillance system to screen for NIHL among AFW.

Conclusion

Even with relatively good knowledge about the importance of PHE, only few workers actually use them. Thus, frequent audiometric screening tests as well as enforcement of PHE usage by airport field workers needs to be introduced by the airport administrations.

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