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Tinnitus and its Relationship with Noise Induced Hearing Loss

Sehrish Khan[1], Ghulam Saqulain[2], Muhammad Naveed Babur[3], Fariha Ambreen[4]

[1] Audiology Technologist Mayo Hospital Lahore, Pakistan
[2] Professor Capital Hospital PGMI, Islamabad, Pakistan
[3] Dean Faculty Allied Health Sciences Superior University Lahore, Pakistan
[4] Senior Lecturer /In Charge Speech Language Therapy Program, Faculty Allied Health Sciences, Superior University Lahore, Pakistan

Author`s Contribution

[1-4]Conception and design, Collection and assembly of data, [2-4]Analysis and interpretation of the data, [3-4]Critical revision of the article for important intellectual content, Statistical expertise [1-4]Final approval and guarantor of the article.

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Address of Correspondence

Ghulam Saqulain
ghulam_saqulain@yahoo.com
ORCID: 0000-0002-6452-9339

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A B S T R A C T

Background: Hearing loss is common with a high prevalence reported for noise induced hearing loss.. Cases with tinnitus also reveal high prevalence of hearing loss. With deficient legislation and hearing protection measures, developing countries face the brunt of noise. Hence literature gap prompted current study.

Objectives: To determine the correlation of tinnitus with noise induced hearing loss.

Methodology: This cross sectional study recruited N=377 factory workers with history of tinnitus and/ or hearing loss, of both genders, aged 18-50 years, using convenient sampling from Punjab Social Security Hospital Manga Mandi, Lahore from January to April 2020. Demographic sheet, self-structured questionnaire, Otoscopy, Pure Tone Audiometry were used for data collection and analysis done using SPSS version 20.0 version.

Results: Study revealed a prevalence of Noise Induced Hearing Loss of 39(10.3%) with predominance of moderate hearing loss. Noise induced hearing loss revealed significant association with age (P=0.012), gender (P=0.000), duration and site of tinnitus (p<0.001) & number of tinnitus sounds (p=0.04). However there was no association with type of tinnitus (p=0.25).

Conclusion: Noise Induced hearing loss with a prevalence of 39(10.3%) has significant association with tinnitus

Key Words: Sensorineural hearing Loss, Noise induced hearing loss, Tinnitus.

Introduction

Noise induced hearing loss (NIHL) is classified as Sensorineural hearing loss (SNHL) caused by exposure to intense sound or a loud sound for prolonged period, commonly seen in communities exposed to noise.[1] NIHL is characterized by a notch at 4 kHz (range of 3-6 kHz), which can become deeper and wider involving lower frequency.[2] Hearing loss (HL) is a common occurrence and World Health Organization (WHO) estimates a population of 360 million having disabling HL with neglect resulting in around 750 billion dollars annual cost globally.[3] The frequency of NIHL reported in United States accounts to 24% in one study.[4] In Asia, with most countries being developing economies with lack of awareness and limited prevention programs and access to health, NIHL is prevalent and a serious issue even in China. [5]

Tinnitus on the other hand is a sensation of sound inside the ears in the absence of external sound i.e., phantom sound sensation [6]. It may or may not be associated with HL. It may be unilateral or bilateral and it may occur as a phantom noise with ringing, buzzing, hissing, chirping, clicking, humming, pulsatile or non-pulsatile character.[7] Reduced intra-cortical inhibition as a result of hearing loss due to cochlear or auditory pathway damage is suggested to result in tinnitus sensation.[6]

McCormack A et al. noted a prevalence of tinnitus varying from 5.1% to 42.7% with a higher prevalence in males[8] and in those exposed to prolonged work and/ or loud recreational noise.[9] There is increasing incidence of tinnitus over time, contributing to increasing health burden.[10]

Mazurek B et al. reported that 83% of their tinnitus cases suffered high frequency SNHL corresponding to NIHL.[11] Hence, NIHL is one of the most common place occupational pathology. It is commonly characterized by irreversible, permanent, sensorineural, bilateral, and symmetrical HL, initially affecting frequencies from 4000 to 6000 Hz, with preservation of 8000 Hz in most cases. [12]

Tinnitus is a field open to research with no significant evidence of any morphologic changes in such patients [13]. The exact value of association of tinnitus with noise induced hearing loss is unknown.

With deficiencies in legislation and hearing protection measures in underdeveloped and developing countries like Pakistan face the brunt of noise especially in industrial sector. In addition there is dearth of local literature on the subject which prompted this study designed to determine the correlation of tinnitus with NIHL.

The study is important since tinnitus as a result of acoustic exposure is also important but receiving less attention compared to NIHL[14], hence the study is very important and carries a broad scope for both students and professionals and its findings might be helpful for researchers to conduct more research in the field and clinicians including otolaryngologists and audiologists for clinical management of these cases.

Methodology

Current cross sectional study was conducted using non-probability convenient sampling over a period of 4 months from 1st January, 2020 to 30th April, 2020. Study recruited 377 noise exposed factory workers with history of tinnitus from ENT out patients of Punjab Social Security Hospital Manga Mandi, Lahore, Pakistan, of both genders aged 18 to 50 years. Cases with tinnitus or HL before joining factory, and cases with obstructive and inflammatory diseases of outer and middle ears were excluded. Sample size of N=377 was calculated using raosoft online calculator taking confidence level of 95%, and margin of error of 5%.

Study was conducted following ethical approval of Institutional Research Board of Isra Institute of Rehabilitation sciences, Isra University vide registration number 1609-M.Phil HS-006 dated 31st December 2019 and informed consent of the participant and maintaining confidentiality of participants.

Basic Demographic sheet; a questionnaire developed with experts' opinion and literature review with queries regarding work duration, tinnitus duration, site of tinnitus, number of tinnitus sounds, and type of tinnitus; Otoscopy, and pure tone audiometry (PTA) were used for data collection. Questionnaire were filled by the researcher as per patient responses and patient subjected to Otoscopy and pure tone audiometry in a sound treated room. A calibrated Pure Tone Audiometer GSI-16 made in USA was used and both air conduction and bone conduction was performed. Air conduction was checked at frequencies of 250 to 8000 Hz

Data collected was subjected to analysis using SPSS version 20.0 version. Descriptive statistics were utilized. Demographic and clinical variables were presented by frequency and percentage. Variables specially studied included work duration, hearing status including NIHL, degree of HL; and tinnitus including duration, site, number of sounds and type of sounds. Effect modifiers were controlled through stratification and post-stratification Chi-square was used to see their effects on NIHL and p-value of <0.05 was considered significant. Pearson correlation matrix was used to see correlation between variables.

Results

The present study with a sample of N=377 cases with mean age of 35.14±8.14 with a males to female ratio of 2.69:1, revealed a prevalence of NIHL of 39(10.3%) (Figure 1). As regards severity of HL (figure 1), NIHL in cases with tinnitus was mostly moderate followed by severe variety.

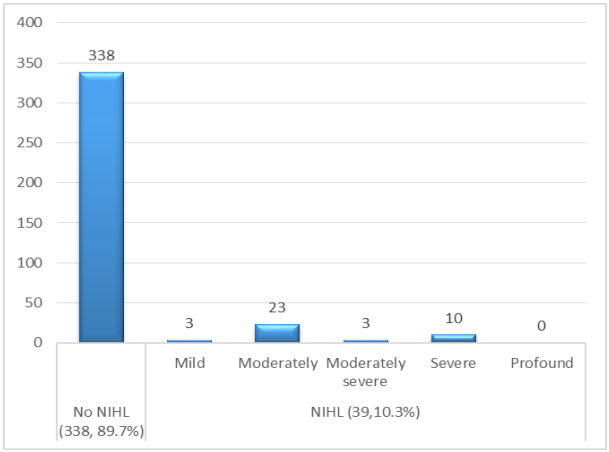

Figure 1: Prevalence of Noise Induced Hearing Loss (N=377)

In the current study majority (n=135) of the population was age group of 31-40 years and most (n=159) worked for >12 hours a day (figure 2).

Most (n=270) had tinnitus for <1 year duration, with bilateral tinnitus heard in majority (n=191). Also most had tonal tinnitus (n=212) with variety of tinnitus sounds (table I).

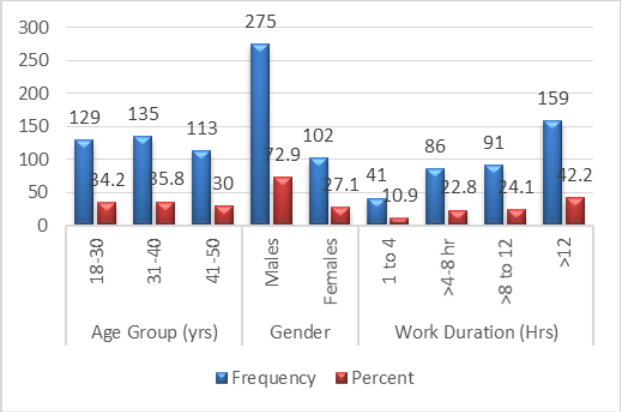

Figure 2: Demographic Characteristics (N=377)

Table I: Characteristics of Tinnitus Versus Noise Induced Hearing Loss. Cross Tabulation with Chi-Square Association (N=377)

Variable		Noise Induced Hearing Loss		
Characteristic	**Group n(%)**	**No (338)**	**Yes (39)**	**X^2,P-Value**
Tinnitus Duration	1 Month to < 1 years 270(71.6)	251	19	72.86, 0.000
	1 Years to <5 years 99(26.3)	87	12	
	≥5 Years 8(2.1)	0	8	
Site of Tinnitus	Right ear 76(20.2)	76	0	133.76, 0.000
	Left ear 90(23.9)]	87	3	
	Bilateral 191(50.7)	172	19	
	Somewhere in the Head 20(5.3)	3	17	
No of Tinnitus Sounds	Tonal Tinnitus (Only one type of sound) 212(56.2)	196	16	4.09, 0.04
	Non tonal tinnitus (Noise like sound) 165(43.8)	142	23	
Type of Tinnitus	Insect/ cricket Sound 38(10.1)	33	5	5.44, 0.25
	Whistling 85(22.5)	71	14	
	Machine Like 88(23.3)	81	7	
	Ocean Roaring 89(23.6)	82	7	
	Wind blowing 77(20.4)	71	6	

Significant association of NIHL was noted with age and gender, with maximum prevalence in higher age groups and lowest at 18-30 years with p=0.012 and higher prevalence in males with p=0.000 with no case of NIHL in females noted in the study. Also interestingly no association of NIHL with duration of work was noted with p=0.255.

As regards association with tinnitus was concerned (table I), NIHL showed significant association with duration of tinnitus (p=0.000) with all cases > 5 years duration having tinnitus. Also site of tinnitus was also significantly associated (p=0.000) with NIHL with higher frequency of tinnitus noted in cases with tinnitus heard somewhere in the head and bilaterally, while no case of NIHL was noted in cases with tinnitus heard in the right ear. Number of tinnitus sounds were also associated with NIHL (p=0.04) with Non tonal tinnitus having a higher frequency of NIHL compared to tonal tinnitus, while type of tinnitus had so significant association with NIHL with p=0.25

Discussion

Tinnitus and Dispersion product otoacoustic emissions (DPOAE) predict damage to the hearing mechanism in workers with normal hearing, indicating a relationship of tinnitus with HL.[15] In the present study among the cases of tinnitus with history of noise exposure, with a mean age of 35.14±8.14 years and a males to female ratio of 2.69:1 revealed a high prevalence of NIHL of 39(10.3%). However in contrast to our study Mazurek B et el. reported a very high prevalence of NIHL of 83% in tinnitus patients.[11] In the current study out of n=377, 39 (10.3%) had HL due to noise. However it is likely that cases which are not detected to have hearing loss may have hidden hearing loss.[16]

However present study revealed a significant association of NIHL was noted with gender, and higher prevalence in males with p=0.000 with no case of NIHL in females noted in the study. Similarly, in a review study by Luer & Schrode, revealed that though a gender bias was present in studies with most studies directed towards males, however males were more susceptible to NIHL.[17] Flores LS et al. reported no significant difference between gender and pitch/ loudness of tinnitus [18], while Noroozian M et al. also reported no correlation of tinnitus with gender.[19]

In the present study a significant association of NIHL with age with maximum prevalence in higher age groups and lowest at 18-30 years with p=0.012 was noted. In contrast to our study no correlation of tinnitus with age was noted in a study by Noroozian M et al. [19]

In current study, interestingly no association of NIHL with duration of work was noted (p=0.255). However in contrast, Bhumika N et al. reported significant association of NIHL with work experience.[20]

According to Noroozian M et al. tinnitus does not correlated with hearing loss.[19] However, in the current study NIHL showed significant association with duration of tinnitus (p<0.001) with all cases of tinnitus of ≥ 5 years duration having HL. Also site of tinnitus was also significantly associated (p<0.001) with NIHL with higher frequency of tinnitus noted in cases with tinnitus heard somewhere in the head and bilaterally, while no case of NIHL was noted in cases with tinnitus heard in the right ear. Number of tinnitus sounds were

also associated with NIHL (p=0.04) with Non tonal tinnitus having a higher frequency of NIHL compared to tonal tinnitus, while type of tinnitus had so significant association with NIHL with p=0.25. Flores LS et al. did not find any relationship between HL and tinnitus pitch.[18] Literature indicates relationship of HL with tinnitus loudness.[11] including negative correlation of loudness of tinnitus with intensity of HL.[18] Mazurek B et al reported that cases of decompensated chronic tinnitus having higher degree of HL than cases with compensated tinnitus.[11] In another study by Gudwani S et al, it was reported that loudness and duration of tinnitus had association with HL and vice versa.[21]

Conclusion

Noise Induced hearing loss with a prevalence of 39(10.3%) has significant association with tinnitus and its characteristics.

RECOMMENDATIONS

1. Based on the above-mentioned conclusion of this research it is recommended that.
2. All noise exposed patients with the complaint of tinnitus should be considered as baseline audiological assessment.
3. Public awareness programs and campaigns regarding the needs for hearing assessment and use of earplugs especially for patients who exposed to loud sounds

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